
# AN ANALYSIS OF IMAGE FOLKSONOMY GENERATION

THESIS

**by**

**Jan-Erik Bråthen**

Submitted in partial fulfillment of the requirements for the degree of
“Master in information science”

The Faculty Of Social Sciences,
Department Of Information Science And Media Studies

June 2009

## Acknowledgements

First and foremost, I would like to express thankfulness to my supervisor, Associate professor Joan Nordbotten. Your guidance has been invaluable to me during this whole project, and I would not have been able to do this without your strong support and encouragement. Thank you! I would also like to thank Lars-Jacob Hove, who took the time whenever I asked. Your lessons on statistical significance have been very helpful. I would also like to mention my fellow students Bjørge Næss, Dag Skjelvik, Tomas Zijdemans and Øyvind Kristiansen. Largely because of you guys, my time as a student at the University of Bergen has been great!

Furthermore, I would like to extend my gratitude to Professor emeritus Svein Nordbotten, Christian Hartvedt, Solveig Greve and Johanne-Berit Revheim.

Finally, I would like to thank my family; mom, dad and my sister Hanne, for always supporting me and believing in me.

# Table of contents

# List of figures

# List of tables

# 1 Collaborative tagging and folksonomies

*Collaborative tagging* is a phenomenon where users assign freely chosen keywords or short sentences – called tags – to describe shared digital content, typically on the internet. Together, these keywords form a vocabulary often referred to as a *folksonomy*, which can be used for organization and retrieval of the digital content the folksonomy describes. Folksonomies are one of many buzz-words affiliated with the second generation web, coined *Web 2.0*, amongst other terms like *user-generated content* and *social networking*. Examples of highly popular web applications that enable collaborative tagging in some form include the music service *Last.fm*[1], the social bookmarking application *Delicious*[2], the social networking site *Facebook*[3] and the photo management and sharing tool *Flickr*[4]. The fact that big actors like these use collaborative tagging shows that it has become a common and likely effective way to describe various forms of digital content on the web.

Several museums and libraries have in recent years made digital image collections available to the public via internet. The content of these collections vary from actor to actor, but often include scanned images of works of art and historical images. Traditionally, such images have been textually annotated by professional curators or librarians, typically using pre-defined domain taxonomies of terms. This *metadata* has also been put on the web, making the image collections as a whole maneuverable and searchable, and the separate images in them retrievable.

In recent years, perhaps inspired by sites like Flickr, some museums and libraries have experimented with collaborative tagging of images, enabling the viewers of the images to describe the images themselves, generating a folksonomy. This has been done for several reasons. First, it has been argued that the annotations done by curators or librarians have a too professional or technical language. This could mean that their annotations are not in tune with the public interpretation of the images, making collections less accessible and possibly hard to maneuver in and search through. Secondly, it is expensive and time-consuming to annotate images which means that if the public can contribute, that is welcome. Third, museum and library annotations are often the work of one or a few persons, possibly making them

[1] http://www.last.fm/
[2] http://delicious.com/
[3] http://www.facebook.com/
[4] http://www.flickr.com/

subjective; after all, what one person sees in an image may differ from another person's point of view.

Early studies show that professional perspectives differ significantly from those of regular people, and that collaborative tagging opens museum collections to new interpretations (Trant & Wyman, 2006). An interesting question in this regard is *how* they differ. Little or no research has been done in this area. *What* do the users of an image collection, the "amateurs", see in images as opposed to the curators or librarians – or the "trained eye"? An investigation of these questions could possibly reveal what kinds of image descriptors one could expect taggers to contribute with – and in which areas a folksonomy can and can not supplement traditional, taxonomy-based annotations. For instance, do taggers identify emotional image content? To which extent do they contribute to object identification in images?

When one creates a collaborative tagging system, there are several choices to make. For example, some implementations allow only one instance of each tag per image, like Flickr, while others allow the same tag to be applied several times, like Delicious. Some implementations prohibit the use of tags that contain whitespace, like Delicious, while others, like Last.fm, do not. Another issue regarding the implementation of a collaborative tagging system is whether or not pre-existing tags should be present while a person applies tags. For instance, Delicious displays both popular and recommended tags when a user tags a bookmark. The following figure shows a screenshot of the popular and recommended tags for Delicious own webpage:

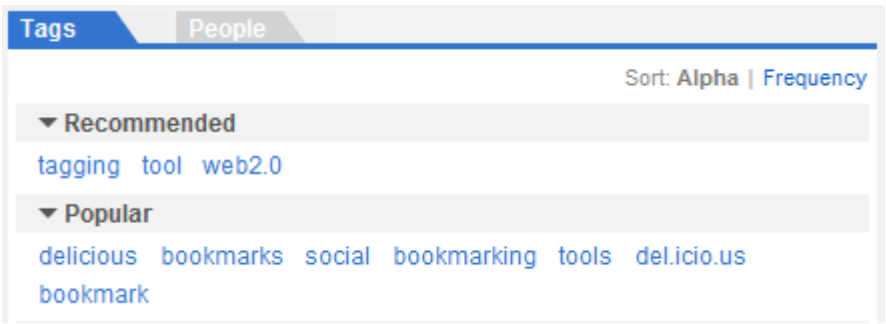



**Figure 1: Screenshot from Delicious[5] showing recommended and popular tags for http:/www.delicious.com**

[5] Source: http://www.delicious.com

This is interesting. What implications do access to existing tags have – how do they influence taggers? Do taggers simply choose from the already applied tags? Do they choose new tags that have not been applied before? How users respond to the presence of already applied tags in a user interface, as opposed to one where they have no access to previously assigned tags, is an important question in the context of collaborative tagging in general. As a result, it is also an interesting question with regards to the generation of a folksonomy for images.

## 1.1 Research project

### 1.1.1 Goals

This research project has two goals. The first goal is to investigate how access to previously assigned tags effect the generation of a folksonomy for images. The second goal is to investigate differences between two different approaches to manual generation of image metadata: descriptors based upon pre-defined taxonomies and user generated folksonomies.

### 1.1.2 Research questions and hypotheses

Based on the previous discussion, the following research questions and hypotheses are proposed:

Research question 1:

What differences exist between image descriptors based on pre-defined domain taxonomies and user generated folksonomies?

Hypothesis:

$H_0$: There exist no differences between image descriptors based on pre-defined domain taxonomies and user generated folksonomies.

Research question 2:

How does access to existing tags effect generation of a folksonomy for images?

$H_{0\ (a)}$: The presence / non-presence of previously assigned, popular tags for images has no effect on the number of tags users apply.

$H_{0\ (b)}$: The presence / non-presence of previously assigned tags for images has no effect on which tags users apply.

$H_{0\ (c)}$: The presence / non-presence of previously assigned tags for images has no effect on which types of tags users apply.

### 1.1.3 Methodological approach

This research project has been conducted by carrying out an experiment. This experiment has involved three core elements: a selection of 20 images, a group of 20 participants and a web-based image-tagging application. All of the 20 images were chosen from the University Library of Bergen's (ULB) image collection[6]. Following research question 1, regarding differences between image descriptors based on pre-defined domain taxonomies and user generated folksonomies, all original image annotations from ULB were stored. The 20 participants were all students from the Department of Information Science and Media Studies at the University of Bergen. The image-tagging application was developed in connection with the research experiment.

Each of the 20 participants have tagged all of the 20 images from ULB one by one, using the abovementioned image-tag application. The 10 first participants, the control group, have tagged the images with no access to previously assigned tags. The 10 last participants, the experiment group, have on the other hand tagged the collection while having access to the three most popular tags for each image, based on the tags provided by the control group. To answer research question 1, the folksonomy generated by the tags from all the participants taking part in the experiment has been used in comparison with the abovementioned annotations from ULB. These two different approaches to assigning image metadata have been compared in several different ways.

To answer research question 2, regarding how access to previous tags effect generation of a folksonomy for images, a comparison between the tags from the control and experiment group has been performed. In order to make this comparison, the tags applied by the control and experiment group have been treated as two different folksonomies.

[6] http://www.ub.uib.no/avdeling/billed/

# 2 Theoretical framework and literature review

In this chapter, concepts that are important for the discussion are presented. In addition, important terms are defined. A list of these definitions can be found in *appendix A*.

## 2.1 Images

The term *image* is broad, and is used commonly in various contexts. Mitchell (1984) puts it the following way: "We speak of pictures, statues, optical illusions, maps, diagrams, dreams, hallucinations, spectacles, projections, poems, patterns, memories, and even ideas as images". In this thesis, the focus is on the type of images that can be displayed on a computer screen; that are accessible via the web. The following definition of the term image is used throughout this thesis:

> **Definition 1:** *An image is a two dimensional, freeze-frame visual representation of an entity or entities, originally produced on a medium, that can be displayed on a computer screen.*

### 2.1.1 Image interpretation

How humans view and interpret images vary. An image has little meaning to a person if that person does not possess the tools to decode the symbols that it consists of. The amount and type of pre-existing knowledge determines how we see images – and as a result, what information we get from looking at them. Consider the following two images:

**Figure 2: Two images. The left images shows the old wharf 'Bryggen' in the city of Bergen, Norway. The right image shows some trees surrounded by water.**

Imagine that two different persons – person A and person B – were to describe the left image with their own words. Person A has no knowledge of the city at all, while person B is a native. A possible description by person A could be "The image shows some people walking by a number of old, wooden houses on a cloudy day." This description is of course entirely plausible – but is also fairly superficial. The description of Person B could perhaps sound like this: "The image shows the Hanseatic wooden houses of the old wharf 'Bryggen' in Bergen, Norway." This latter description has more depth – and provides additional information compared to that of person A.

The image to the right is perhaps more open to interpretation. If two different persons were to describe this image, one might use terms like darkness, gloomy and perhaps even death – as the trees are apparently drowning in water. The other person could interpret the image differently, and state that the image is for instance melancholic, beautiful and artistic.

### 2.1.2 The contents of an image

When humans interpret images, they analyze image content. Image content is diverse. Computers are able to extract low level image features like color distribution, shapes and texture. Humans, on the other hand, have abilities that go beyond those of computers. As the example following Figure 2 showed, we can identify objects, locations and activities in images; even get emotional responses from them. That being said, as humans, we draw our own subjective conclusions. We place emphasis on different parts of images. And even if we don't, the names and terms that we associate with the same concept may differ. In addition, our ability to make abstractions may vary. The emotion that one person gets from seeing in an image, and therefore associates with it, may differ from another person's point of view. And the symbolism that is so obvious to some people may be invisible to others.

Following research question 1, an important part of this thesis is to investigate and understand potential differences between image descriptors based on taxonomies and user generated folksonomies. As these descriptors are based on the contents of images, it is important to have a clear understanding of this topic. Therefore, two frameworks for understanding and classifying image content are presented here.

The first classification is by Jaimes & Chang (2002) and is by its creators referred to as a conceptual framework for indexing visual information. The second classification is by Burford, Briggs & Eakins (2003), and according to its originators, it provides a taxonomy of image content as extracted by the viewer of an image.

Both classification schemas rely on some similar basic concepts. Jaimes & Chang make a distinction between *percept* and *concept*. They state that at their most basic level, images simply cause a response to light – a response that we humans can *perceive* with our visual senses. Concept refers to a representation, an abstract or generic idea, generalized from particular instances of that. As such, it implies the use of background knowledge and an inherent interpretation of what is perceived – and is thus related to *semantics*. Similarly, the three first categories in the classification by Burford et al. represent visual primitives, needed to record an image through visual perception. The remaining categories, on the other hand, are related to the meaning of the elements, their potential for semantic interpretation.

The classification of image content by Jaimes & Chang is presented in a ten-level pyramid, shown in Figure 3 below. The width of each layer represents the amount of knowledge required for operating at that particular level:

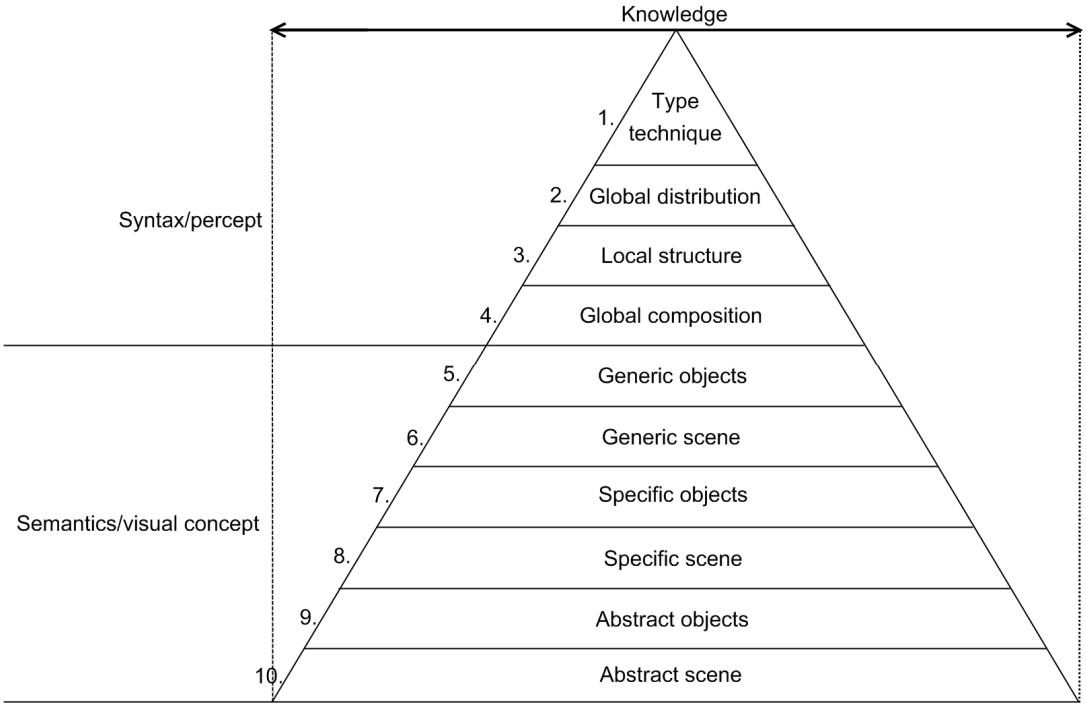



**Figure 3: The classification of visual image content given by Jaimes & Chang (2002).**

The proposed system of classification presented by Burford et al. consists of the nine categories, as shown in Figure 4 below:

| *Category* | *Definition* |
|---|---|
| Perceptual primitives | The content extracted by low-level perceptual systems. In a strict sense this is unlikely (even impossible) to be reported. In practical terms, though, colour and some textural descriptions which do not rely on a higher level may be categorized here. |
| Geometric primitives | Simple two- and three-dimensional non-representational forms, such as a line, arc, square, circle, etc. |
| Visual extension | Visual meaning which requires some inference. Most typical of these will be detection of depth, from shadow, occlusion, perspective, etc. |
| Semantic units | Names, both general and specific. Most descriptions will have some naming content, though it may be subsumed in higher levels. |
| Contextual abstraction | Associations or interpretations which depend on environmental knowledge. Such abstractions are presumed to be universal. |
| Cultural abstraction | Associations which rely on specific cultural knowledge. This may be the viewers' own culture (or subculture), or simply one of which they are aware. |
| Professional abstraction[7] | Associations which rely on detailed specialist knowledge and vocabulary. Again this may be through direct experience of an area, or second-hand knowledge. |
| Emotional abstraction | Emotional and affective associations. These may be generalizable, but will be filtered by the viewers' own experiences. |
| Metadata | Information which describes the image, but is not actual image content, such as image format, size, aspect ratio, etc. |

**Figure 4: Burford, Briggs & Eakins' proposed classification of image content.**

The categories at syntax/percept level in Jaimes & Chang's pyramid precedes image interpretation. So does the three first categories in the proposed classification by Burford et al. These categories are not discussed further. The remaining categories, however, concern the *meaning* of the visual elements and the way in which they are arranged:

### Generic and specific objects versus semantic units

Jaimes & Chang's categories *generic objects* refer to "the highest level of abstraction at which clusters of features are assigned to categories" (p. 505). To identify objects at this level, only

[7] This category is in Burford et al.'s overview of the taxonomy referred to as *technical abstraction*. However, it is later (p. 147) referred to as *professional abstraction*. The latter is used here.

everyday knowledge is required. *Specific objects* are objects that can be identified and named. To do so, specific knowledge of the objects is required. A simple example of an generic object image descriptor is 'person'. An example of a specific object would be 'Arne Næss', the name of a specific person. Looking at Burford et al.'s category *semantic units*, the link to Jaimes & Chang's generic and specific objects is obvious. But while Burford et al. include both general and specific names in their category – Jaimes & Chang divide this in two distinct ones.

**Generic scenes versus contextual abstractions**

*Generic scenes* are used by Jaimes & Chang to describe to content that require only general knowledge, and describe what images are of as a *whole*. Examples of an image descriptor that falls under the generic scene level would be 'portrait' for an image of a piece of art, or 'indoor' or 'outdoor' for images taken inside/outside. Burford et al. use *contextual abstraction* to represent generic scene-like image content. As they say in their article about this category: "A simple example is telling whether an image represents … an inside or outside scene" (p. 144). However, unlike Jaimes & Chang's generic scenes, Burford et al.'s contextual abstractions (or any of the abstraction categories for that instance), do not necessarily need to represent the image as a whole.

**Specific scenes versus cultural and professional abstractions**

*Specific scenes* are used by Jaimes & Chang to describe content that, like generic scenes, describes images as a whole, but require *specific* knowledge. An example of a specific scene image descriptor would be 'Paris' for an image of the Eiffel Tower, as it requires the user to know that the Eiffel tower is located in Paris. Burford et al. refer to such content as either *cultural* or *professional abstractions*, depending on what type of knowledge that the abstraction depends on. 'Paris' for the image of the Eiffel Tower would be regarded as a cultural abstraction.

**Abstract objects and scenes versus cultural and professional abstractions**

Jaimes & Chang's *abstract objects* deal with what the different objects in an image *represent*. *Abstract scenes* deal with what the image as a whole represents. When one compares these with Burford et al.'s *abstraction* categories, the link is clear. Consider the following: An image contains three different religious objects; a cross, a statue of Buddha and a copy of the Koran. The descriptor 'Christianity' for this image would refer to the cross, and represent an

abstract object. So would ‘Buddhism’ for the Buddha statue and ‘Islam’ for the Koran. With Burford et al. all these descriptors would be considered cultural abstractions as they require non-visual information about culture to decode. What about ‘religion’? Of course this descriptor could refer to *one* of the objects in the image (however, one would not know unless asking the person that applied the tag), but let us say that it was applied to the image as a *whole*. The descriptor would then fall under the abstract scene-level using Jaimes & Chang’s classification. Using Burford et al.’s classification, ‘religion’ would be considered a cultural abstraction, just as ‘Christianity’, ‘Buddhism’ and ‘Islam’. Other examples of image descriptors that would fall under the abstraction categories given by Burford et al., as opposed to the abstract object or abstract scene categories given by Jaimes and Chang, include: ‘carnivorous’ for an image of the plant Venus Flytrap, indicating that it is in fact flesh-eating (professional abstraction); ‘pain’ for an image of a weapon and ‘happiness’ for an image of children playing cheerfully (both emotional abstractions).

**Metadata**

Burford et al. state that this is information which describes the image, but is not actually image content, and cannot be derived from the image itself. An example of a descriptor in this category would be for instance the name of a photographer. Jaimes & Chang have no metadata-like category in their classification schema, since their classification is on *visual* image content. They do however mention non-visual content in their article and refer to this type of content as “information that is not depicted directly in the image but is associated with it in some way” (p. 508-509). Examples mentioned include title and date taken.

## 2.2 Image retrieval

*Image retrieval* can be considered a part of the field of information retrieval. Information retrieval was, according to Singhal, born in the 1950s. “With the advent of computers, it became possible to store large amounts of information; and finding useful information from such collections became a necessity. The field of Information Retrieval (IR) was born ...” (2001).

According to Rui, Huang & Chang (1997), image retrieval has been an active area of research since the 1970s. In the beginning, text-based retrieval was a very popular approach. Images were manually annotated using text, and text-based database management systems were used

to perform retrieval. In the 1990s, a new approach was proposed. Instead of being manually annotated, images were instead automatically indexed by their own visual content. The process of retrieving desired images from a large collection on the basis of features that can be automatically extracted from the images themselves, is called content based image retrieval, or CBIR (Eakins & Graham, 1999). Even though CBIR is a promising field of research and has several areas of application – for instance facial- and fingerprint recognition for crime prevention – there are limitations. Semantic content, which Jaimes & Chang (2002) refer to as the *meaning* of the visual elements and their arrangements, are still not extracted from images in generic collections. In an ideal world, CBIR could be used to answer user requests like "find all pictures of dogs", but in reality they can not. As Hove (2004) writes: "No satisfactory solution has yet been found for automatic generation of semantic metadata" (p. 16). What this means is that there is a difference between the information that a computer can extract from an image and the meaning that the image has to a human being. This is an example of what often is referred to as the semantic gap: "The semantic gap is the lack of coincidence between the information that one can extract from the visual data and the interpretation that the same data has for a user in a given situation" (Datta, Joshi, Li, & Wang, 2008).

This thesis is concerned with folksonomies and taxonomy-based annotations – which are two types of manually assigned, textual descriptors. CBIR is therefore not mentioned further. Instead, the attention is turned to the creation of text-based image metadata, which is essential prerequisite for text-based image retrieval.

## 2.3 Image metadata

Today, humans have access to vast amounts of images and image collections. This has become a reality due to factors such as increased computer and storage capabilities, but the most important factor has perhaps been the advent of the world wide web. Today, all major search companies like Microsoft[8], Google[9] and Yahoo[10] provide facilities for image search on the web.

[8] http://www.live.com/?scope=images
[9] http://images.google.com/
[10] http://www.yahoo.com/

For large amounts of images and image collections to be maneuverable and searchable – i.e. support image retrieval – there is a need for some sort of structure for classification and indexing. The traditional way of creating such a structure has been by the assignment of textual *metadata*. Sundgren defines metadata simply as "data about data" (1973). The National Information Standards Organization (NISO) focus on its purpose, and states that metadata "describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource" (2004). In this thesis, the following definition of image metadata will be used:

> **Definition 2:** *Image metadata is data about images which describe and explain them for purposes of management and retrieval.*

Nordbotten (2008) defines three *types* of metadata in the context of multimedia, which therefore apply to images: *Semantic metadata* include the features that describe the semantic content of the image. This type of image metadata correspond to the bottom levels in the classification of image content given by Jaimes & Chang (see Figure 3, page 7). *Context metadata* describe relationships to external objects. An example of this type of image metadata is photographer name. *Structural metadata* describe the internal structure and presentation for the image. Examples include file format and resolution. Contextual and structural metadata corresponds with the last category in the classification of image content by Burford et al., called metadata (see Figure 4, page 8).

## 2.4 Taxonomy-based image annotations

Many museums and libraries have large collections of images, collected over several years. Recently, several such actors have digitized their image collections and made them available to the public via the internet. This means that image collections become available to users independent of location – which in turn means that museums and libraries can reach a larger public. For instance, the museum of Louvre grants access to a several images of art on their webpage[11]. Another example of a large image collection is the New York Public Library's digital gallery[12] – which provides free and open access to over 640.000 images.

[11] http://www.louvre.fr/llv/commun/home.jsp?bmLocale=en
[12] http://digitalgallery.nypl.org/nypldigital/index.cfm

The image metadata of library- and museum collections are typically made by professional curators or librarians that have domain-specific knowledge of the topic in question. For instance, the metadata of the images in a museum collection that depict paintings from a specific era, is typically assigned by one or several persons that knows the important artists of the era, their works of art and so on. Similarly, a library collection of historical images are described by people that has specific knowledge of them: Where they are from, their motive, the time of which they were taken etc. To perform this task, curators and librarians typically use a controlled vocabulary such as a *taxonomy*. The following definition of the term taxonomy is used throughout this thesis:

> **Definition 3**: *A taxonomy is a pre-defined, hierarchical structure of terms used for description- and classification purposes, within a specific domain..*

Typically, taxonomies are related by subtype-supertype relationships, also often referred to as parent-child relationships. The following figure shows an example of a part of a taxonomy with parent-child relationships:

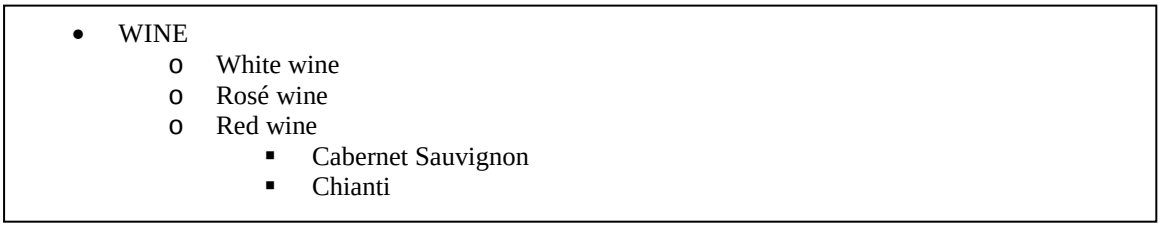



**Figure 5: An example of how a part of a taxonomy of wine could look like.**

As one can see from Figure 5, there are three main types of wine; white, rosé and red. These can be divided further. In this case, *Red Wine* has the child nodes *Cabernet Sauvignon* and *Chianti*. The taxonomies that curators and librarians chose terms from when assigning textual metadata to images works the same way; the terms that they can apply are organized in hierarchies with parent-child relationships.

While professionally created metadata such as image descriptions based on taxonomies are often considered of high quality, there are some problems related to this approach. First of all, it is a time consuming task to manually assign metadata to large amounts of content. As a result, it is also expensive. Mathes (2004) states that this creates a scalability problem, when new content is being produced, especially on the web. Second, professionally created metadata is potentially subjective. As illustrated in section 2.1.1, humans may interpret

images differently. As a consequence, the metadata assigned to an image by one or a few persons may not make sense to others. This can lead to retrieval problems. Furthermore, professionally created metadata may have a to technical or formal "voice". "Things that might seem exceptional to the general viewer – that a painting is *of a cow looking at a painting* – might not be mentioned at all in traditional museum documentation" (Trant & Project, 2006).

## 2.5 Collaborative tagging and folksonomies

Recently, a new way to describe digital content, at least in the context of the web, has grown popular. The main idea is that users of the content create the metadata in the form of keywords or short sentences, called tags, and that this metadata is shared among the users. Systems that incorporate a model like this for description of digital content are commonly referred to as *collaborative tagging systems* or *social tagging systems*. A widely used example of a collaborative tagging system is the one employed by the social bookmarking site *Delicious*[13]. Another often mentioned example is the image management and sharing tool *Flickr*[14], but there other examples as well, such as the music service *Last.fm*[15] and the social networking site *Facebook*[16].

Before continuing our discussion, it is important to have a clear understanding of some key terms. First of all, it is important to have a clear understanding of what a tag is. The following definition is proposed:

> **Definition 4:** *A tag is a freely chosen keyword or short sentence that is applied to digital content.*

Any creator of a collaborative tagging system needs to determine whether or not spaces should be prohibited in tags. Prohibiting spaces means allowing only single-word tags, which according to Mathes (2004) can make users put multiple words into a single tag. An example of such a tag could be for instance 'oldman' for an image of an old man. Delicious, for instance, does not allow spaces. Last.fm, on the other hand, does. This allows creation of tags like 'indie rock' and 'seen live'.

[13] http://delicious.com/
[14] http://www.flickr.com/
[15] http://www.last.fm/
[16] http://www.facebook.com/

Golder & Huberman (2006), state that collaborative tagging describes the process by which many users add metadata in the form of keywords to shared content. The following definitions of the terms *tagging* and *collaborative tagging* is proposed:

> **Definition 5:** *Tagging is the process of applying freely chosen keywords or short sentences to digital content.*

> **Definition 6**: *Collaborative tagging is the process by which several users apply keywords or short sentences to shared digital content.*

A collaborative tagging system is to be understood as:

> **Definition 7**: *A collaborative tagging system is a computer-based piece of software that enables several users to add keywords or short sentences to shared digital content.*

When users collaboratively tag digital content like for instance images, they create and maintain a *folksonomy*. This means that one can distinguish between the *process*, tagging, and the *result*, a folksonomy. The following definitions of folksonomy is used throughput this thesis:

> **Definition 8**: *A folksonomy is the result of collaborative tagging; the tags applied through that process and their potential.*

What is often considered one of the main strengths of folksonomies is that they, unlike taxonomy-based metadata, directly reflects user vocabularies. Merholz (2004) states that "The primary benefit of free tagging is that we know the classification makes sense to users. It can also reveal terms that 'experts' might have overlooked." The idea here is thus that if users describe the content, users are also more likely to find what they need. Folksonomies have the potential to address several of the limitations often associated with professionally created metadata. First, as a folksonomy is based on several users interpretations of the same content, it is not as subjective. Second, it is potentially free. Third, it can scale well and rapidly adapt to changing vocabularies. "Folksonomies are inherently open-ended and therefore responds quickly to changes and innovations in the way users categorize content" (Wu, Zubair & Maly,

2006). For instance, one the all time most popular tags with Flickr as of 27th of May 2009, is 'cameraphone'[17]. Mathes (2004) emphasizes serendipity as another advantage of folksonomies.

### 2.5.1 Broad and narrow folksonomies

It is important to notice that there are different types of folksonomies. Vander Wal (2005) makes a distinction between those that are *broad* and those that are *narrow*. In a narrow folksonomy, there is only one instance of each tag. This means that if someone has already applied a tag to an object like an image, it is not possible to 'vote' for the same tag for another person. In contrast, a broad folksonomy is the result of many people tagging the same items.

The folksonomy of Delicious is broad. One feature of the system is that users build personal collections of bookmarks, which they describe with the tags they feel are appropriate, in order to organize and retrieve their bookmarks at a later stage, from any computer anywhere in the world. For instance, a user might tag their CNN[18] bookmark with tags like with tags like 'news', 'media' and 'politics'. Another person might also use 'news' and 'media', but add 'tv' as well. A third user might apply 'news', 'politics' 'daily' and 'reference'. This gives the following tag distribution of tags for that bookmark:

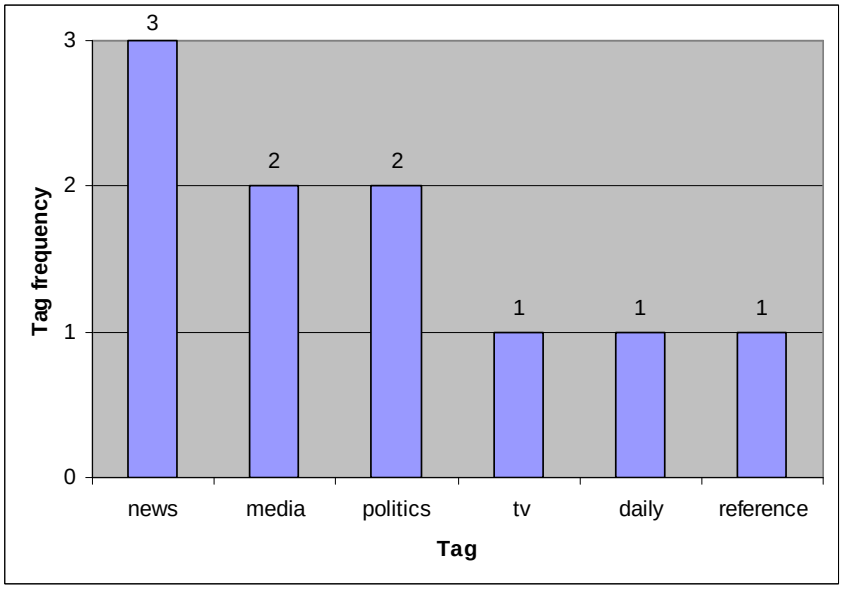



**Figure 6: Bar graph showing the potential distribution of tags for a Delicious bookmark.**

[17] http://www.flickr.com/photos/tags/
[18] http://www.cnn.com/

As one can see, ‘news’ is the most popular tag with three “votes”, then follows ‘media’ and ‘politics’, followed by ‘tv’, ‘daily’ and ‘reference’. This provides opportunity. As the folksonomy grows, it is possible to identify those tags that are most popular for a bookmark. This can improve search and retrieval. A user that either searches or browses for *news*, is more likely to find relevant pages. A similar approach can be used in an collaborative image tagging system.

### 2.5.2 Access to existing tags in collaborative tagging systems

A possible implementation of collaborative tagging systems is that users are presented with recommended or popular tags when they tag content themselves. Delicious is implemented this way. “One of the specific features of del.icio.us is the inclusion of ‘most common tags’ for a given site when a user saves that site, facilitating the use of tags others have used with the greatest frequency” (Halpin, Robu & Shepherd, 2007). The implications of providing access to existing tags have not been investigated in the context of images. Questions arise: How are taggers influenced by existing tags? How, if in any way, do they influence taggers? Do taggers simply choose from the already applied tags, or do they choose new tags that have not been applied before?

### 2.5.3 Limitations

As a folksonomy grows, it will consist of identical terms that have different meanings. For example, a user might apply the tag ‘Apple’ to an image of a MacBook computer, while another user might apply the same tag to an image of the fruit. This means that when a third user searches uses ‘Apple’ as a search term, the system will, based on the tags in the folksonomy, return images of both the MacBook and the apple. As Mathes (2004) says: “... the terms in a folksonomy have inherent ambiguity as different users apply terms to documents in different ways.”

Furthermore, there is typically no synonym control in a collaborative tagging system. Mathes (2004) states that this leads to the creation of different tags that have similar intended meanings, and uses an example where the tags ‘mac’, ‘macintosh’ and ‘apple’ are all used to describe materials related to Macintosh computers. This means that, a user that is interested in for instance all images of Macintosh computers in an image collection, and use only ‘mac’ as a search term, could miss out on several relevant images. Singular and plural forms are also

mentioned by Mathes. For example, an image may be tagged with ‘cat’ and ‘cats’. Another issue with folksonomies that is not mentioned by Mathes, but emphasized by Guy & Tonkin (2006), is that users misspell tags. This is probably a bigger problem with a collaborative tagging systems that create and maintain a narrow folksonomy than a broad folksonomy.

# 3 Research framework and data collection

Following the research question 1, the first goal of this research project is to investigate differences between image descriptors based upon pre-defined domain taxonomies and user-generated folksonomies. Following research question 2, the second goal is to investigate how access to existing tags effect the generation of a folksonomy for images.

Investigation of the first research question suggested a comparison of two the types of textual image descriptors. Therefore, a selection of images was needed. The images had to be annotated with terms from one or more taxonomies, and in addition, in order to make the comparison, a folksonomy for the same images was needed. Investigation of the second research question called for the generation of two folksonomies, created with and without access to existing tags. For a comparison of these folksonomies to be sensible, it was important that they originated from the same group of images.

One could argue that it is would have been possible to find a number of images that had already been annotated with descriptors based upon a taxonomy system *and* been collaboratively tagged. The second research question did however necessitate an experiment. An experiment means a high degree of control over variables such as for instance the number of experiment participants, their age and gender, the number and types of images etc. An experiment also makes participant observation and inquiry possible.

## 3.1 Design of the experiment

A basic posttest-only laboratory experiment has been conducted. It consisted of three main components: a number of participants, a number of images and a computer-based system for tagging images. According to Cozby (2007), there are three basic steps in a posttest-only design: The first is to obtain two equivalent groups of participants. The second is to introduce the independent variable, and the third is to measure the effect of the independent variable on the dependent variable.

The participants in the experiment group had access to the three most popular tags for each image, based on the tags applied by the participants in the control group. Although there is no such minimum requirement in most collaborative tagging system on the web today, due to the

limited number of experiment participants, this lower limit was set to both prevent users from not tagging some of the images, and to provide enough tags for all of them. The participants in the control group had no access to any previously assigned tags for the images. The independent variable was thus access to existing tags, while there were three dependent variables: the number of tags applied, which tags users applied and which types of tags users applied.

The following figure gives a visual representation of the experiment:

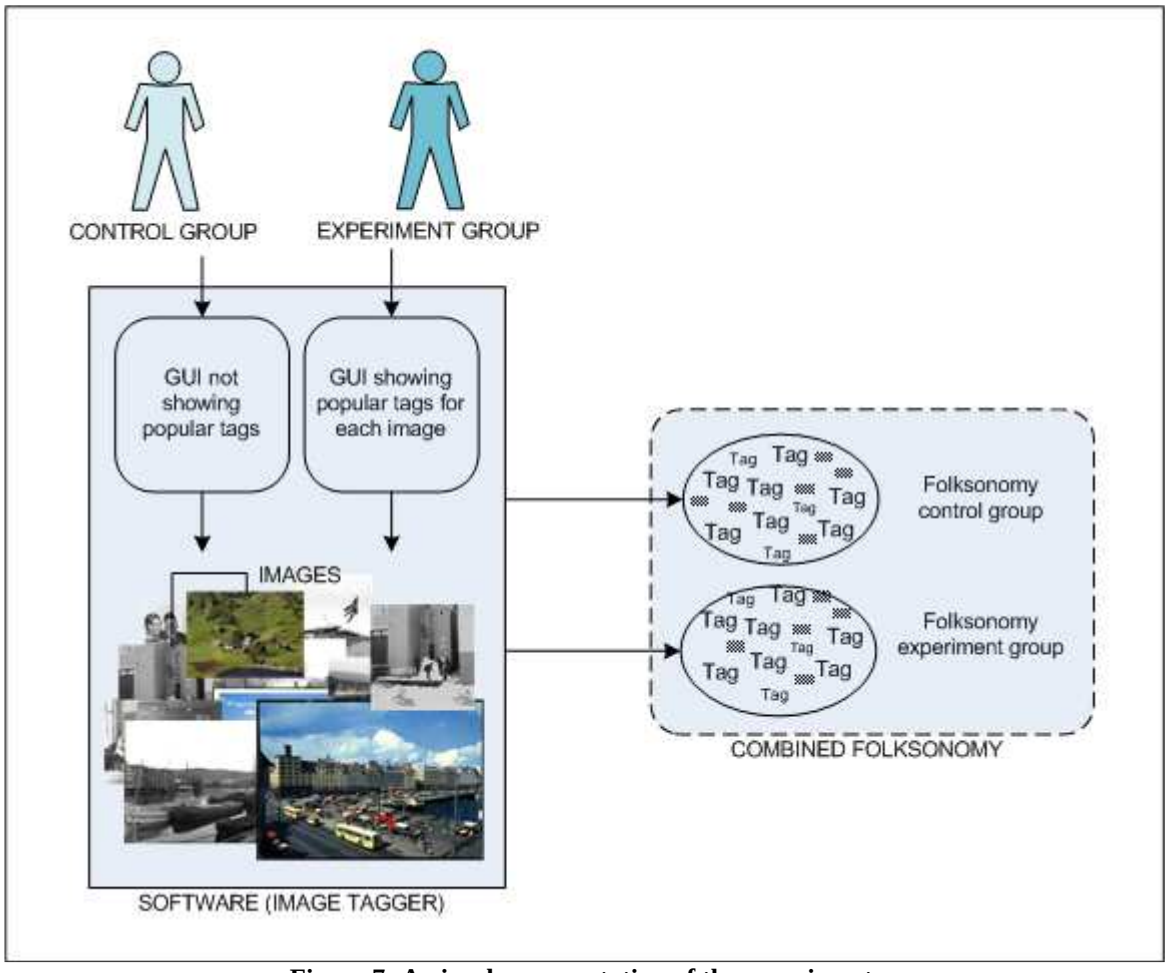



**Figure 7: A visual representation of the experiment.**

As Figure 7 shows, the control and experiment group created one broad folksonomy each. It is these two folksonomies that have been used to investigate research question 2. While one could have used either the folksonomy generated by the control group or the one created by the experiment group for comparison with taxonomy-based annotations following research question 1, it is also possible to combine the two, and view them as one. The dotted line

around the folksonomies marked “combined folksonomy” on Figure 7 illustrates this. This “combined” folksonomy was used in comparison with the taxonomy-based annotations.

### 3.1.1 The choice of experiment participants

The number of participants was limited to 20 due to the time constraints of the research project. Ideally, the number would have been larger. The time constraints also meant that the participants selected were all master students from the Department of Information Science and Media Studies at the University in Bergen. Their ages ranged from 22 to 34 years. Ideally, both age and background should have varied more, but again, the limited time frame prevented this. The participants were 10 women and 10 men. All of the women that participated came from Media Studies, and the majority of the men came from Information Science. To ensure that there were no unnecessary differences between the control and experiment group, it was decided that they should contain 5 men and 5 women each. Apart from this, to limit the influence of individual characteristics, the participants to the two groups were assigned in a random fashion.

Table 1 shows the gender and age distribution of the participants in the control and experiment group:

| **CONTROL GROUP** | | **EXPERIMENT GROUP** | |
|---|---|---|---|
| GENDER | AGE | GENDER | AGE |
| F | 25 | F | 23 |
| F | 25 | F | 23 |
| F | 25 | F | 24 |
| F | 25 | F | 24 |
| F | 33 | F | 25 |
| M | 22 | M | 24 |
| M | 24 | M | 25 |
| M | 25 | M | 26 |
| M | 27 | M | 26 |
| M | 34 | M | 27 |
| | AVG. = 26,5 | | AVG. = 24,7 |

**Table 1: The age and gender distribution in the control and experiment group.**

### 3.1.2 The choice of image provider

The following requirements for the images had to be met: First, it was vital to choose images that had been annotated with taxonomy-based descriptors. Next, the images would ideally be diverse in terms of image content – as this would make possible the generation of several different tags. In addition, it was anticipated that image diversity would minimize the chance of the participants becoming bored or unmotivated during the experiment.

The University Library of Bergen[19] (ULB) stores about half a million images. According to information on their web site, their image collection is one of Norway's largest. Also, it is one of the most reputable archives of historical photography in the country. Over 20.000 of the images from the ULB image collection are available for viewing on their website[20], free of charge. According to Solveig Greve (6.8.2008), one of the librarians at ULB, the images from ULB are annotated using two pre-defined hierarchies of terms that have been specifically developed for their image collection. These are the *topic* and the *geographic location* taxonomies. Greve states that these hierarchies are constantly refined, and that all the terms used to annotate images are taken from these two hierarchies. The fact that the ULB images were annotated by the use of two taxonomies and that there were a lot of images to choose from – along with the advantage that this library is the university's own – made the image collection of ULB a suitable choice for use with this experiment.

#### 3.1.2.1 The number of images to use

Only a limited number of images could be used in the experiment. This was due to the following reasons: First of all, it was decided that every participant should tag every image, both for simplicity and because the number of participants needed to be kept relatively low. In addition, one can only expect a person to tag a limited number of images. If the task of tagging is too time-consuming or found to be too repetitive, it is likely that the users will become tired or unmotivated. It was estimated that if each image is tagged by an average of five tags by each person (using a minimum limit of three tags per image), and one uses approximately 10 seconds on each tag, this would mean a tag time of around 50 seconds per image. This number, in accordance with the aspect of a decrease in motivation as a result of repetitiveness, was important when choosing the number of images.

[19] http://www.ub.uib.no
[20] http://www.ub.uib.no/avdeling/billed/

Based on the assumptions above, it was decided that 20 images were to be used in the experiment, which would mean an estimated tag time of just less than 17 minutes for each participant. Together with a short introduction to the research project and an explanation of the image-tagging task – along with a written user comment at the end of the experiment – it was expected that the total time spent by each participant could come close to 30 minutes.

#### 3.1.2.2 Which images to use

The fact that ULB have made more than 20.000 images digitally available via the web meant that there were a lot to choose from. As the collection contains mainly old images, the vast majority are in grayscale, but a minor selection of color images can however also be found. After a thorough review of several of the images in the collection, the choice fell a collection of images that were considered diverse in terms of image content. The two image content classification schemas that were presented in chapter 2 were used as an aid in this process – so that the images would have a potential for different type of image descriptors and tags. Of the final 20 images that ended up being used in the experiment, 15 were in grayscale, while 5 were color images. All these can be found in *appendix B*.

### 3.1.3 Software: Image Tagger

An application that allowed the participants to tag the images was needed. In order to have the greatest possible degree of control over both the development and data collection process, the application was developed from scratch. The application was given the name *Image Tagger*. The software, which is web based and thus runs in a web browser, basically allows users to tag images one at a time using freely chosen tags. Furthermore, it is possible to turn user access to existing popular tags for the images on and off. For a detailed explanation of the development process and the functionality of Image Tagger, see chapter 4.

### 3.1.4 Gathering the taxonomy-based annotations for the images

ULB provided a copy of their database. This made it easy to gather all the searchable annotations[21] for the 20 images selected. The following figure shows an example from one of

[21] The terms *taxononomy-based annotations* and *annotations* are used interchangeably troughout this thesis.

their two hierarchies, the *topic* hierarchy[22], to give an impression of what they look like. Leaf nodes are shown as ellipses:

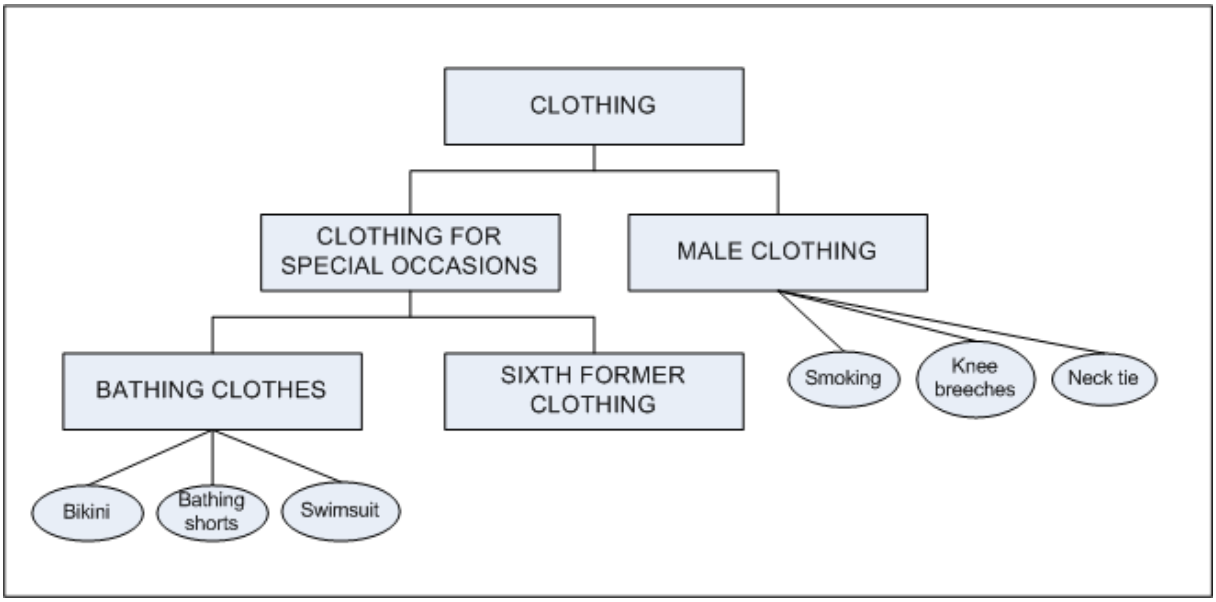



**Figure 8: An example from ULB's *topic* hierarchy.**

Altogether, there are 21 top terms in the topic hierarchy. Figure 8 shows one of these, namely *clothing*, and some of its nodes. In reality, the tree structure is much broader: As of August 2008, there were 23 nodes directly following the clothing node. Several of these, like both *clothing for special occasions* and *male clothing* which are shown in the figure above were divided further.

To illustrate what the ULB descriptors look like, an example image and all its annotations is shown below:

[22] The terms have been translated from Norwegian

**Photographer:**
Brosing, Gustav

**Date:**
05.02.1962 – 05.02.1962

**Annotations from the topic hierarchy:**
AGE AND GENDER GROUPS/Children
ARCHITECTURE AND BUILDING TRADITION/BUILDINGS/Domestic building
CLIMATE/WEATHER/Snow
OBJECTS/Sled

**Annotations from the geographic location hierarchy:**
NORWAY/HORDALAND/BERGEN/STRANDKAIEN/NORDNES/NORDNESVEIEN/Nordnesveien 30A
NORWAY/HORDALAND/BERGEN/STRANDKAIEN/NORDNES/NORDNESVEIEN/Nordnesveien 30B

**Figure 9: One of the images in the ULB collection and its taxonomy-based annotations.**

As one can see, the photographer and time frame of which the image was taken is included (where known). Some images also have a title, even though this image does not. All these attributes are searchable. One can also see that the image is annotated with the terms *children*, *domestic building*, *snow* and *sled* from the topic taxonomy, and *Nordnesvei 30A* and *Nordnesvei 30B* (these are addresses) from the geographic location taxonomy. It is important to note that the image is in fact also annotated with all the preceding terms, so if one were to

use for instance the top terms “climate” or “Norway” as search terms one would also get a positive match for this image.

## 3.2 Experiment conduction

### 3.2.1 Introduction

To begin with, each participant was told that the experiment that they were about to participate in was in conjunction with a masters thesis. They were also told that everything they said during their session would be recorded as audio, but that they would remain anonymous. The tag-sessions were recorded because it was assumed that participants could provide valuable, verbal comments along the way. The participants were therefore encouraged to ‘speak out loud’ if they experienced any problems or had any thoughts related to the tagging process during their tag-sessions. As it was anticipated that the participants would have different experiences with tagging, or even have unequal comprehensions of the meaning of the term, they were also given an introduction to the concept of tagging. Following the definition of tagging used in this research project, they were told that tagging is the process of applying freely chosen keywords or short sentences to digital content, in this case, images. It was added that there are no limitations with regards to which tags to use, as there is no ‘correct’ way of tagging an image.

After the participants were introduced to the concept of tagging, they were asked to fill out a questionnaire. The questionnaire looked like this:


**Figure 10: Screenshot of the questionnaire used in the experiment.**

As Figure 10 shows, the questionnaire consists of three questions, regarding *gender*, *age* and *experience with tagging*. For the question regarding gender, a radio box was used. For age, a drop-down menu with numbers from 15 to 90 was used. A drop-down menu was also used with the question regarding experience with tagging. The numbers range from 1 to 3, meaning:

1 = I've never tagged images before
2 = I've tagged images a few times
3 = I tag images often

After the participants had filled out their questionnaire, they were told that they were about to tag 20 images that had been chosen by the writer of this thesis by using a computer based system, and that they would have to use at least three tags per image. To prevent that the participants' tags were influenced in any way, they were told that no information *about* the images would be given during their session – even if asked. The participants were however told that technical questions regarding the *use* of Image Tagger would be answered as well as possible. Next, each participant was given a demonstration that taught them how to use Image Tagger, with the aid of an example image. Naturally, the example image was not one of the images selected for the experiment, and no clues as to what kind of tags to use during the demonstration were given.

### 3.2.2 The tagging of the images

Each participant carried out their part of the experiment one at a time, which made it possible to observe each tagger during the tag-sessions, and write down interesting observations. This approach to observation can be considered informal. Such approaches are less structured and allow the observer freedom in what information is gathered, and how it is recorded (Robson, 2002). With the one participant at a time-approach it was also possible to assist each person when technical issues were encountered.

Overall, the participants performed their image tagging tasks without any major problems. After tagging a couple of images, the participants generally became comfortable with the Image Tagger, and the interaction with the system went relatively smoothly. Some technical questions were however asked at the start of some sessions, and answered as well as possible.

For instance, some participants asked how to delete, or regret, a tag. Even though information on how to do this was given during the introduction to the Image Tagger, it was repeated on request. Some participants also asked questions about the images, but were then told, like in the introduction, that no information regarding the images would be provided.

### 3.2.3 Optional finishing comment

After tagging all the images, each participant was told that they could make a final, optional written comment about how they felt about tagging the images:

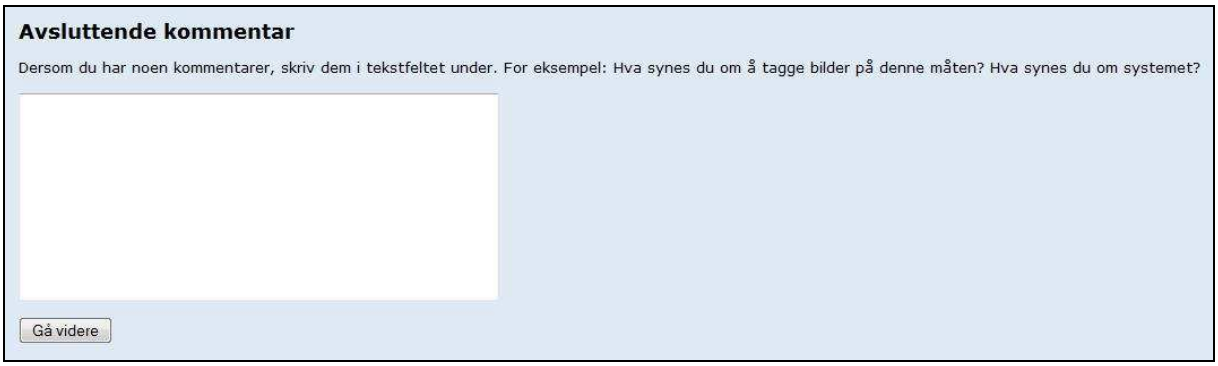



**Figure 11: Screenshot of the form used for an optional, written comment at the end of the experiment.**

Even though each participant was invited to make verbal comments during tagging, some people prefer making comments using text. This was the motive for including the optional written comment. Below the "Finishing comment" (Avsluttende kommentar) header, is a text that states the following: "If you have any comments, type them in the text field below. For instance: What do you think of tagging images this way? What do you think of the system?" This text was supplied to give the users a pointer as to what kind of comment they could provide. In total, 14 of the 20 participants provided a comment. Some of these are commented in chapter 4.

## 3.3 Classification of image descriptors

After the experiment was over and all participants had gone through with their part of the experiment, a total of 1711 tags had been applied to the images. This number naturally includes several duplicates, as the folksonomy created by the control and experiment group was broad. Nevertheless, is more than four times the number of annotations from ULB, which

were 391. For a complete list of all these image descriptors – both annotations and tags – see *appendix C*.

### 3.3.1 An image descriptor classification schema

Research question 1 calls for a comparison of two types of image descriptors, namely those that are based on taxonomies and user generated folksonomies. Therefore, there is a need for a framework that can help one understand and classify such image descriptors.

The classification schema for textual image descriptors presented in this section relies heavily on the proposals given in articles by Jaimes & Chang (2002) and Burford et al. (2003) presented in chapter 2. The schema is introduced to support the comparison of which types of image content or image related metadata that are applied by annotators using pre-defined taxonomies and taggers using freely assigned keywords. There were several reasons for creating a new categorization schema, as opposed to using just one of the abovementioned ones. First of all, as shown in chapter 2, not all categories proposed by Jaimes & Chang and Burford et al. were relevant in this context. Second, when one combines two different proposals based on somewhat different perspectives, it is possible to select the best of 'both worlds'. In addition, it was desirable to include some new categories not found with either Jaimes & Chang or Burford et al.

The image descriptor classification schema is presented in Figure 12 on the next page. It is followed by a detailed explanation of the categories and the reasoning behind the choices that were made.

| IMAGE DESCRIPTOR CLASSIFICATION SCHEMA | |
|---|---|
|  | ← **EXAMPLE IMAGE** |

| **ELEMENT LEVEL**<br>Descriptors that refer to specific elements in an image | | |
|---|---|---|
| CATEGORY | DEFINITION | EXAMPLE |
| 1. Objects | | |
| a) Generic | Basic level categories of objects | *man, airplane, coat, persons* |
| b) Specific | Specific, named objects | *James Smith* |
| 2. Object properties | Descriptive terms that say something about the state of an object/element or group of objects/elements | *nice (coat), elderly (man), six (persons)* |
| 3. Background activities | Actions/happenings which are descriptive for a specific part of the image, and not for the image as a whole | *shaking hands, walking, smiling* |
| 4. Element level abstractions | Associations or interpretations that are related to specific objects or elements in an image. These are: | |
| a) General | Non-emotional associations | *Airline* |
| b) Emotional | Emotional and affective associations | *happy, self-confident* |
| **GLOBAL LEVEL**<br>Descriptors that are linked to an image as a whole | | |
| CATEGORY | DEFINITION | EXAMPLE |
| 5. Main activities | Actions/happenings which describe the image as a whole | *Meeting* |
| 6. Global level abstractions | Associations or interpretations that describe or represent the image as a whole. These are: | |
| a) General | Non-emotional associations | *old days* |
| b) Emotional | Emotional and affective associations | *Pleasant* |
| 7. Location | The location of what is shown in the image | *Bergen* |
| 8. Structural and contextual metadata | Metadata not directly related to image content | *Grayscale, jpeg* |

**Figure 12: An image descriptor classification schema.**

#### 3.3.1.1 Distinguishing between descriptors referring to specific elements in an image versus the image as a whole

Jaimes & Chang have three different categories for descriptors that represents images as a whole. These are the generic, specific and global scenes. Burford et al. has no dedicated categories for this type of descriptors. The distinction between descriptors that represent specific elements in images versus the image as a whole is nevertheless interesting, as it provides a means to determine to which extent taggers and annotators use either of the two. The schema is therefore divided in two main levels; the categories at *element level* are for image descriptors that refer to specific elements in an image, while the categories at the *global level* are for image descriptors that refer to images as a whole.

#### 3.3.1.2 Objects and object properties

Burford et al. propose a single category for general and specific naming content, semantic units, while Jaimes & Chang distinguish between general and specific objects. Both tags and annotations have the potential for both types of descriptors. As it could be interesting to see whether taggers and annotators identify more generic than specific objects or vice versa, the categories general and specific objects are proposed kept. Furthermore, a category for descriptive terms that say something about the state of an object or group of objects is proposed, the *object properties* category.

#### 3.3.1.3 Activities

These stand out in the way that they are represented by *verbs*. Burford et al. do not include a specific category for such image content, while Jaimes & Chang use *scenes* for descriptors that represent images as a whole. Scenes, however, cover other types of image content as well, and are not limited to activities. Two categories for image descriptors that explicitly refers to *activities* in images – what is happening – are therefore proposed here. *Background activities*, which can be found at the element level, are activities that at the same time do not define what is happening in the image as a whole. In the classification schema, examples given are ‘shaking hands’, ‘walking’ and ‘smiling’; none of them being the defining event in the example image. Unlike background activities, *main activities* is for image descriptors that define actions and happenings that describe the images as *a whole*. The example given in the classification schema is ‘meeting’, which can be said to be the defining event in the example image.

#### 3.3.1.4 General abstractions

General abstractions is a merge of the contextual, cultural and professional abstraction categories proposed by Burford et al. First, it could prove hard to differentiate between image descriptors that rely on "environmental knowledge" (contextual abstractions), "specific cultural knowledge" (cultural abstractions) and "detailed specialist knowledge" (professional abstractions). Second, these three categories are quite similar as they all represent some form of abstraction. The proposed category *general abstractions at element level* is for associations that are based on specific elements in images. The example given in the classification schema is 'airline', which is an association based on the airplane in the example image. The proposed category *general abstractions at global level* is for associations that describe images as a whole. The example given in the classification schema is 'old days'.

#### 3.3.1.5 Emotional abstractions

Emotions are highly subjective. Different people associate different images with different emotions according to previous experience. Burford et al. state that an emotional abstraction is "distinct from cultural or technical abstractions in that a generalized affective response does not rely on particular, identifiable expertise or experience …" (p. 148-149). Because emotional abstractions differ from the other abstraction categories, keeping this category is proposed. This will make it possible to determine to which extent both taggers and annotators use emotional/affective image descriptors. As with the general abstractions, a distinction between emotional abstractions based on specific elements in images and the images as a whole has been done. These are *emotional abstractions at element level* and *emotional abstractions at overview level*.

#### 3.3.1.6 Locations

All images are captured somewhere. Several of these include objects that makes it possible to identify the *location* of where they are captured. Consider for instance an image of the famous Big Ben, which points to the city of London, or an image of Colosseum, which is located in Rome. An image descriptor that provides the name of a location would by Jaimes & Chang be referred to as a specific scene, while Burford et al. would refer to it as a cultural abstraction. Because locations are an important property of several images, a specific category for this type of image descriptors is proposed. The example from the classification schema is

‘Bergen’, which is the name of the city where the image is captured. As locations are representative for images as a whole, it is a global-level category.

#### 3.3.1.7 Structural and contextual metadata

Image descriptors that describe images, but are not actual image content, is called metadata by Burford et al. As the ten level classification by Jaimes & Chang is on visual image content, it does not include such a category. If one looks at the definition provided in chapter 2, the term *metadata* as used by Burford et al. is inconsistent with the meaning it has in this thesis. Therefore, a category called *structural and contextual metadata* is proposed; this way, semantic metadata are excluded. As structural and contextual metadata is about images as a whole, it is a global level category.

### 3.3.2 Division of complex multiple-word descriptors

Most of the image descriptors consisted of one single word, like ‘woman’ or ‘car’. The share of single-word descriptors among the tags were about 81 %, versus just below 70 % among the ULB annotations. This made them relatively easy to categorize. Some of the multiple-word descriptors, however, were relatively complex. Consider for instance the tag ‘6 boys in the street creating a snow igloo’ for image 3. How should one categorize such a descriptor? Placing it in one category would not make sense, as it contains both generic objects (*boys*, *street* and *snow igloo*) and an activity – the act of *creating* a snow igloo. One solution considered was therefore putting such image descriptors in several categories each. But this would have made the content of the categories somewhat faulty: For instance, both the categories generic objects and main activities would have contained a tag like ‘6 boys in the street creating a snow igloo’.

As a consequence, multiple-word descriptors that contained terms that fitted into several different categories have been *divided* in order to perform categorization. In other words, the problem has been broken down into more manageable pieces by treating the parts as separate descriptors. As an example, the tag ‘6 boys in the street creating a snow igloo’ was divided into:

- ‘6’
- ‘boys’
- ‘street’
- ‘creating’
- ‘snow igloo’

Not all multiple-word descriptors were divided. For instance, ‘snow igloo’ in the example above was not[23]. Other examples are descriptors that refer the names of photographers, like ‘Gustav Brosing’ for image 3, and descriptors that date the time of which an image was taken, like ‘1962-06-17 to 1962-06-17’ for image 20.

### 3.3.3 Placing each image descriptor in a category

After the division of complex, multiple-word descriptors had been performed, the categorization process was a relatively straightforward task altogether. For instance, ‘man’ for an image of a male person, and ‘woman’ for an image of a female person were both clearly generic objects. Still, some descriptors proved hard to categorize. For instance ‘fisker’ for image 14, which in Norwegian can refer both to *a fisherman* and the activity of *fishing*, was such a descriptor. This exemplifies that even though a person applies an image descriptor with a specific thought in mind – being either an annotation or a tag – it can be interpreted in various ways by others. In some cases, there is simply no way of knowing what the originator of the descriptor meant in the first place, at least without asking.

Therefore, it is probable that some image descriptors have been categorized in ways that are not compatible with the originators’ original thoughts. The following sections nevertheless try to explain the reasoning behind the choices made when categorizing ambiguous and other problematic image descriptors.

The image descriptors as categorized using the image descriptor classification schema can be found in *appendix E* and *appendix F*.

[23] Snow igloo is written in one word in Norwegian.

#### 3.3.3.1 Challenges related to ambiguity

The example with the tag ‘fisker’ for image 14, which one saw could refer to both an object and an activity, is an example of an ambiguous image descriptor. Although not many, there were some descriptors like this. In this case, the tag was finally categorized as a *generic object*, and not a *main activity*. The decision was made on the grounds that the person that applied the tag used other and perhaps more adequate terms when describing what was happening in the image, namely ‘catching’ and ‘whaling’. It was thus assumed that the tag was referring to the fisherman to the right in the image. Similar reasoning was used when dealing with other ambiguous image descriptors.

#### 3.3.3.2 Challenges differentiating between specific objects and locations

Some descriptors could be considered both *specific objects* and at the same time be regarded as *locations*. For instance, ‘Fisketorget’ was one of the descriptors for image 17, showing the Fish Market in Bergen. As the descriptor refers to the name of that specific market, it could be considered a *specific object*, thus going in that category. But; ‘Fisketorget’ also refers to a specific *location* in the city of Bergen, making it a candidate for that category as well.

The descriptor ‘Fisketorget’ for image 17 was finally put in the specific objects category, as it refers to the specific name of an object that is *present* in that image. All descriptors like this one were treated the same way. There were the specific naming content that a tag referred to was not present as an object or combination of objects in an image – and it referred to a location – the tag was put in the *locations* category. Examples of such tags include ‘Bergen’ and ‘Norway’ for image 17.

#### 3.3.3.3 Challenges differentiating between element and global level

In some cases, it was difficult to determine whether or not an image descriptor referred to specific elements of an image, or described an image as a whole. In other words, it was sometimes hard to decide whether or not a descriptor was element or global level. This was especially true for general abstractions – which have separate categories at each of these two levels. For instance, ‘journey’ for image 6 of an old train crossing a bridge is an example of a general abstraction. ‘Journey’ could be an association made because of the train, but is the train so central in the image that the tag is to be considered global level image content? In this case, the tag was considered an *element* level abstraction, because ‘journey’ was not

considered particularly descriptive for the image as a whole. Of course, the originator may have felt differently. Similarly, it was sometimes hard to determine whether or not some descriptors should be considered background or main activities. Again, the choices done during categorization of certain descriptors could have been in conflict with the originators thoughts.

#### 3.3.3.4 Descriptors and terms that were not categorized

’Apples’ was one of the tags for image 18. This descriptor probably refers to the text saying “apples” on one of the cardboard boxes that contains apples in the image, as it was the only tag in English applied by the participant in question. Taken out of context, it refers to a generic object, but as one assumes that the tag is replica of the text found on the cardboard box, it is not. There were only two descriptors of this type, but these were not categorized as no category was found suitable for them.

Also, stop words – for instance ‘a’, ‘in’, ‘the’, ‘are’ and ‘which’ were not categorized. Neither were words that referred to certain object’s placements in images, for instance ‘above’ or ‘under’, nor words or numbers that referred to the number of objects in images, for instance *6* in the tag ‘6 boys in the street creating a snow igloo’.

# 4 Image Tagger: a web-based prototype for tagging images

This chapter mainly focuses on the development of a web-based software prototype for tagging images, which was given the name *Image Tagger*. The application was used to gather tags and other data related to the tagging process from the participants in the experiment. In addition to explaining the development process, comments from the experiment participants with regards to usability and functionality of the application are included. So are some additional thoughts made through observation of the participants during the experiment sessions.

## 4.1 Requirements specification

The first step towards implementation of the Image Tagger was to define a requirements specification for the software. Below, a list of the functional requirements is set up. Functional requirements describe what the system should *do* (Sommerville, 2007). Because the image-tagging system is merely a prototype designed to support the gathering of data from a limited number of participants one at a time, non-functional requirements regarding for instance security or response time are not included here:

1. The system should be able to communicate with an image database
2. The system should show images from this database one at a time
3. The sequence in which images appear should be randomized
4. There should be a text field where users can provide tags for each image
5. It should be possible to write several tags at a time, comma separated
6. User should confirm the tags they have written in the text field
7. The system should provide relevant feedback to the users, showing:
    a. How many images the user has tagged, and how many are left
    b. Which tags the user has applied for each image
    c. Informative messages when the user performs 'illegal' operations. These operations are:
        i. Not providing at least three tags for each image when trying to move on to the next one
        ii. Trying to confirm tags when there is nothing written in the text field
        iii. Trying to move on to the next image when there are unconfirmed tag(s) in the text field
        iv. Trying to provide an already confirmed tag
8. It should be possible to 'regret' confirmed tags and remove them with a mouse-click
9. It should be possible to show a frame that contains the three most popular tags for each image (relevant for the experiment group only)
    a. It should be possible for users to choose these tags as their own with a mouse-click
10. The system should save and store the following data from each tag session in a database:
    a. Person data: age, gender, experience with tagging and user comment
    b. The tags each person applies to each image
    c. The time each user spends on tagging each image

**Figure 13: A list of functional requirements for Image Tagger.**

Some comments to the requirements: If images were to appear in the same sequence for each user, the result could be both fewer and less thought-through tags for the images that were

shown lastly, as participants could become unmotivated at the end of the experiment. This is the reason why the sequence in which images appear was randomized.

Providing the opportunity to add several tags at a time using a comma as a separator, makes it possible to add tags more rapidly. This could also mean more tags. The thought behind forcing users to confirm the tags in the text field and show these confirmed tags to them, is that it could possibly make users evaluate what they have written. Users may find that tags they apply in the first place are not appropriate after all, or that there are more suitable alternatives. Showing confirmed tags could also prevent writing errors – as it is relatively easy to misspell words.

## 4.2 Development platform and software

### 4.2.1 A web-based application

For users to share tags among themselves, the web is a natural arena that provides this opportunity. Web-applications perform regardless of operating system or OS version. In addition, they are location independent and accessible from all over the world – as long as one has access to a computer with an internet connection and a web-browser that supports the application. For such reasons, web applications in general are becoming increasingly popular.

The requirements specification gave no indication that the required functionality would prove difficult to implement within a web application framework. For this reason, along with making the experiment as realistic as possible, the decision fell on a *web-based* prototype.

### 4.2.2 Choice of database system: MySQL

The choice of database system fell on MySQL[24], version 5.0 – which was the latest stable release when the development process started. First of all, MySQL provides all the facilities needed for storage and retrieval tasks in the research project. In addition, MySQL is a well documented and freely available database platform. Also, all major programming languages have extensive libraries that make it relatively easy to communicate with a MySQL database – which is an essential feature for Image Tagger. Furthermore, there are several graphical tools for MySQL – like MySQL Administrator and MySQL Query Browser. These tools were

[24] http://www.mysql.com/

employed for easy access to many functions like editing tables and table data, managing permissions, performing backups and more.

### 4.2.3 Choice of programming languages

The server-side programming language chosen was PHP (version 5). PHP is a scripting language that is used to build dynamic web applications. Importantly, PHP has an extensive library for communication with MySQL. As with MySQL, it has been available for a relatively long time – and has undergone several improvements and revisions over the years. It is also well documented and a much used language.

Because Image Tagger was implemented as a web application – HTML was used to code the contents of the web-pages that constitute it. Simply put, HTML – or HyperText Markup Language – is a computer language devised to allow website creation, and lies at the heart of most web pages. CSS – or Cascading Style Sheets – was used for the visual profile of Image Tagger. CSS provides a means both to apply different styles to different elements of the web pages, and to place those elements on the pages.

JavaScript is a scripting-language much used for client-side web development, and is much used with web-applications that bear the mark "Web 2.0" as it allows these kinds of applications to act more like client-side software. In recent years, several JavaScript frameworks have been developed. One of them is the Prototype[25] framework, which aims to ease development of dynamic web applications. For instance, Prototype offers several useful library functions which both simplify commonly used functions, and eliminates problems connected to the fact that different browsers have different JavaScript-implementations. The use of JavaScript and the Prototype framework in the development of Image Tagger reduced the amount of server requests and therefore decreased the response time when interacting with the system.

## 4.3 Implementation

The first implementation stage was to create the database structure to store the tags and other tag-related data from the sessions with the participants. The following Structural Semantic

[25] http://www.prototypejs.org/

Model (SSM), described by Nordbotten (2008), shows how the relational database was set up. The data types shown after the attribute names follow the MySQL-specification.

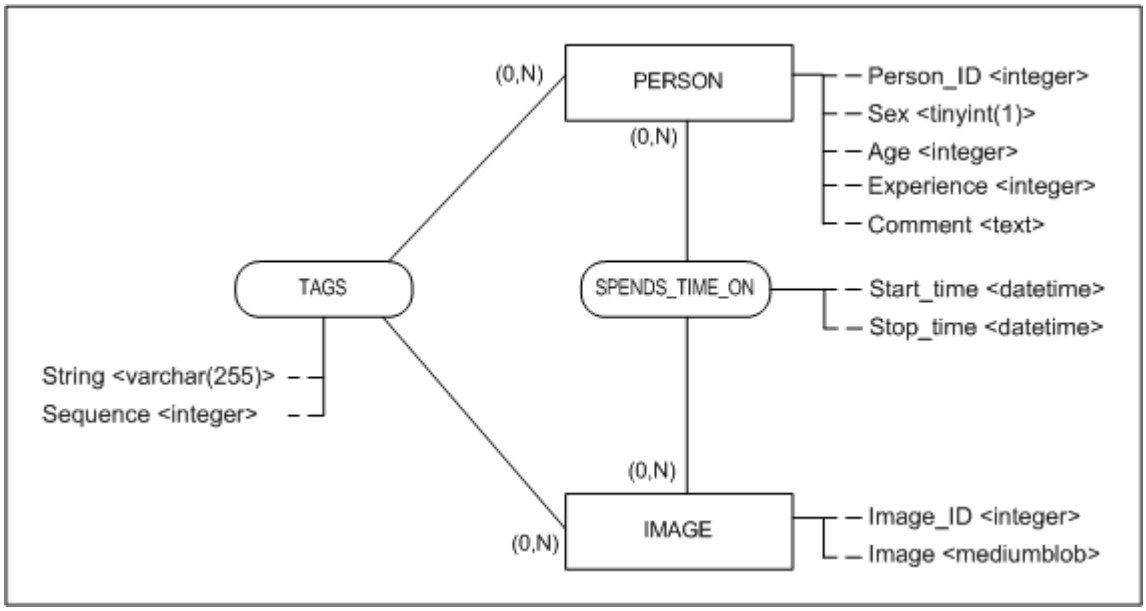



**Figure 14: SSM-model showing the relational structure of Image Tagger's underlying database.**

Hopefully, the model is relatively self-explanatory[26] – but some comments are nevertheless provided here. Starting from left, the *Sequence* attribute of the TAGS relation is the sequence of which a tag is applied by a person. For instance, if a person chose the tag 'man' as the third tag for a certain image, the sequence number for that tag would then be 3. The *Start_time* and *Stop_time* attributes in the relation SPENDS_TIME_ON between the entities PERSON and IMAGE, are timestamps taken when a user starts to tag an image and when he or she is done with that. This data can be used to establish how much time each participant spent on tagging each image.

Based on the model shown in Figure 14, the following SQL CREATE-statements was specified and executed:

[26] Basic knowledge of database modeling is assumed.

```
CREATE DATABASE `image_database`;
CREATE TABLE  `image_database`.`image` (
  `image_id` int(10) NOT NULL auto_increment,
  `image` mediumblob NOT NULL,
  PRIMARY KEY  (`image_id`)
) ENGINE=InnoDB;

CREATE TABLE  `image_database`.`person` (
  `person_id` int(10) NOT NULL auto_increment,
  `sex` tinyint(1) NOT NULL,
  `age` int(10) NOT NULL,
  `experience` int(10) NOT NULL,
  `comment` text,
  PRIMARY KEY  (`person_id`)
) ENGINE=InnoDB;

CREATE TABLE  `image_database`.`tags` (
  `tags_person_id` int(10) NOT NULL,
  `tags_image_id` int(10) NOT NULL,
  `string` varchar(255) NOT NULL,
  `sequence` int(10) NOT NULL,
  PRIMARY KEY  (`tags_person_id`,`tags_image_id`,`string`),
  KEY `FK_tags_2` (`tags_image_id`),
  CONSTRAINT `FK_tags_1` FOREIGN KEY (`tags_person_id`) REFERENCES `person` (`person_id`),
  CONSTRAINT `FK_tags_2` FOREIGN KEY (`tags_image_id`) REFERENCES `image` (`image_id`)
) ENGINE=InnoDB;

CREATE TABLE  `image_database`.`time_spent` (
  `person_id` int(10) NOT NULL,
  `image_id` int(10) NOT NULL,
  `start_time` datetime NOT NULL,
  `stop_time` datetime NOT NULL,
  PRIMARY KEY  (`person_id`,`image_id`),
  KEY `FK_time_spent_2` (`image_id`),
  CONSTRAINT `FK_time_spent_1` FOREIGN KEY (`person_id`) REFERENCES `person` (`person_id`),
  CONSTRAINT `FK_time_spent_2` FOREIGN KEY (`image_id`) REFERENCES `image` (`image_id`)
) ENGINE=InnoDB;
```

**Figure 15: The SQL CREATE-statements for the Image Tagger database.**

After creating the database and its four tables, the database was populated with the 20 images from ULB. The second stage of the implementation process was to design the graphical user interface of the Image Tagger. This was done by creating a mockup with pen and paper. The mockup was revised several times during the process. The third and final stage of the implementation process was to code the application using the programming tools and languages described in section 4.2. This was an iterative process. The Image Tagger underwent several changes during the development process as a result of testing and user feedback.

The Image Tagger source code (except CSS) can be found in *appendix G*. The code is distributed among seven PHP-files, which in turn includes PHP-code, PHP/HTML-code or PHP/HTML/JavaScript code. To comment on all the code is beyond the scope of this thesis. However, an example of an important function is provided here:

As mentioned in section 4.1, an essential matter was that for each user, the sequence in which the images appeared was randomized. The function that makes this possible was implemented the following way: First, the PHP-function `getForPersonUntaggedImageID` was written to allow retrieval of a random image ID for an image a person has not yet tagged. The function takes one argument; the ID of the person in question:

```
function getForPersonUntaggedImageID($person_id) {
	$query = "
		select image_id from image
		where image_id not in (
		select distinct tags_image_id from tags
		where tags_person_id='$person_id'
		)
		order by rand() limit 1
	";
	$result = mysql_query($query) or die(mysql_error());
	return mysql_numrows($result) == 0 ? 0 : mysql_result($result, 0);
}
```

**Figure 16: Screenshot showing an example from the Image Tagger source code.**

The query is first stored in a variable, namely `$query`. The inner `SELECT`-statement retrieves all the image-IDs of the images the user in question has tagged from the table *tags*. The outer `SELECT`-statement then retrieves all the image-IDs from the table *image* that are not among those. This gives a table of image-IDs for images the person in question has not yet tagged. The order of this table is then randomized using the statement `order by rand()`. Finally, only the first ID of the first row is selected, using `limit 1`.

The query is sent to the MySQL-database using the function `mysql_query`, which takes a SQL query as parameter – in this case, the variable `$query`. The result of the query is stored in the variable `$result` as a *resource*, which is a special PHP-variable, holding a reference to an external resource.

The last line of code is a conditional expression equivalent to an IF-ELSE-statement – expressed using the ternary operator. It is this line that determines what the function getForPersonUntaggedImageID actually returns. First, the function `mysql_numrows` provides the number of rows in the result set stored in the variable `$result`. If this number equals 0 – i.e. that there are no images left that the person in question has not yet tagged – the function returns 0. If, on the other hand, there are images that the person has not yet tagged, this number equals 1. In that case, the function returns the value of the only cell in the row, which is a random image ID for an image the person in question has not tagged.

## 4.4 Graphical user interface and functionality

This section provides an overview of how the GUI of the Image Tagger prototype works. There are several screenshots supplemented with comments.

### 4.4.1 Tagging an image

The users from the control- and experiment group were shown two different user interfaces. The experiment group had access to three most popular tags for each image, based on the tags applied by the control group, while the control group had no such access.

#### 4.4.1.1 Control group

The image below shows an example screenshot[27] where popular tags are *not* visible – i.e. the GUI that the participants from the control group used:

[27] None of the screenshots in this chapter are taken from the actual experiment.


**Figure 17: Screenshot from Image Tagger: Tagging images without access to existing tags.**

As the heading at the top indicates, the image is the first out of 20. This way, the user knows how many images there are left. Since the sequence in which the images appear is randomized, another image is likely to appear as the first image for another user.

Right below the image is a label, a text field and a button. The label simply states that the user should type preferred tags in the text field – and that it is possible to write several tags at a time using comma as a separator. Here, the text field contains two tags – namely 'komfyr' (stove) and 'kvinner' (women) – which are not yet confirmed. The button labeled "Bekreft tagger" (confirm tags) is used to confirm tags. When this button is pressed, the text field is cleared and the tags from the text field are confirmed. Confirmed tags are shown in the light blue frame to the right of the image. Here, there are two confirmed tags, namely 'husmorskole' (school of domestic science) and 'matlaging' (cooking). The header of the frame means "Your tags for this image (click to remove)". Confirmed tags can thus be regretted by simply clicking on them.

At the bottom of GUI is a second button, labeled "I am done tagging this image". By pushing this button, the user in question is taken to the next image – if at least three tags have been applied.

#### 4.4.1.2 Experiment group

The figure below shows an example screenshot where popular tags are visible – i.e. the GUI that the participants from the experiment group used:


**Figure 18: Screenshot from Image Tagger: Tagging images with access to the three most popular tags for each image.**

As one can see from Figure 17 and Figure 18, there is only one difference (apart from the image) between the GUI that the participants from the control and experiment are shown. This is of course the light blue frame below the text field on the figure above, here marked with a red ellipse, which displays the three most popular tags for each image.

In the example above, these tags are ‘munnspill’ (harmonica), ‘6 menn og 1 kvinne’ (6 men and 1 woman) and ‘lystig’ (cheerful). The text above these tags suggests that it is possible to select from these by simply clicking on a preferred tag. When a popular tag is clicked, it is automatically shown in the frame to the right of the image, along with the other confirmed tags that a user may have applied. In this example, the user has chosen the tag ‘harmonica’ (munnspill) from the popular ones, and has in addition applied and confirmed the tag ‘music’

(musikk). It is of course also possible to manually type a tag that is shown in the popular tags-frame using the text field. Also, tags chosen from the popular ones can also be removed/regretted by clicking on them, just like the tags that the users has written themselves in the text field.

### 4.4.2 Informative messages from the system

The system requirements state that the system should provide informative messages when a user has performed illegal operations. These messages have been implemented as modal dialog (alert) boxes. Modal dialog boxes are windows that force users to interact with them before they can return to operating the parent application. Because they cannot be ignored, the modal dialog boxes used in the Image Tagger force users to respond to the possible illegal operations they perform. Below are screenshots of the four different modal dialog boxes:


**Figure 19: Screenshots from Image Tagger: Four different dialog boxes..**

The dialog box to the upper left corner shows a screenshot of the message that is shown when a user presses the button labeled “Confirm tags” and there is no text (no tags) in the text field. The message “You have not applied any tags” provides the user with information that this is the case. The dialog box to the upper right corner shows the message provided by the system when a user tries to apply a tag that he or she has already confirmed. This is not allowed. As the text in the alert box below indicates, the user is told “You have already applied this tag”.

The dialog box to the lower left corner is shown when user a pushes the button labeled “I am done tagging this image” without having applied at least three tags for that particular image. The message text “You have to apply at least three tags” gives the user a good indication of why it is not yet possible to move on to the next image. Another way of preventing users from moving on to the next image before at least three tags had been applied, could have been to disable the “I am done tagging this image”-button by default, and then enabling it when three tags were applied. However, this would have given no clue to the user about why moving on to the next image was not possible – whereas the message in the alert box is explicit and to the point.

The dialog box to the lower right corner of Figure 19 is shown when a user tries to move on to the next image while there still is text, or unconfirmed tags, in the text field. The message displayed says “You have not confirmed the tag(s) in the text field”. This is done to make users understand that they either have to confirm the tags in the text field or remove them before proceeding to the next image.

## 4.5 Participant reactions and additional observations

The optional comment at the end of each experiment session, which 14 out of 20 participants responded to, provided several comments about the usability and functionality of the Image Tagger. There were several positive comments. One participant stated that “the system is easily understood”. Another participant wrote about the system design that it was “very nice and well-arranged”. A third participant reported that it was very fun to tag images, and that the system was very good. Furthermore, one of the participants valued the fact that the system at all times showed which tags one had applied, and that these tags could be removed with a mouse-click.

There were also some suggestions on how to improve the Image Tagger. Several participants felt that it should have been possible to go back to an image they had already tagged. For instance, one participants wrote that “it was a drawback that one could not go back and add/remove tags on already tagged images”. Another user elaborated why this can be a drawback, and stated that “I see new connections as I go along”. Observations done during the experiment also indicate that it should have been possible to go back and alter, add and remove tags. For instance, one participant made a verbal comment that ‘grayscale’ was an

appropriate tag for several images, and that she would have liked to go back – which unfortunately was not possible.

Although not mentioned in any of the optional written comments, an observation that was made during the experiment sessions was that many users pressed “Enter” on the keyboard after typing one or several tags in the text field – instead of clicking the button labeled “confirm tags”. When nothing happened – i.e. the tags were not confirmed – they were a bit surprised. The option of clicking “Enter” to confirm tags could therefore perhaps have been implemented, instead of forcing the participants to press the button.

The GUI that users interact with when tagging images includes two buttons – one for confirming tags, and one to move on to the next image. Although not a big issue, a few of the users pushed the wrong buttons at the wrong times; the button for confirming tags was pressed when the intention was to move on to the next image, and the button labeled “I am done tagging this image” was pressed when the intention was to confirm tags in the text field. In most of these cases, however, the informative messages from the system gave users directions if they were doing wrong. Nevertheless, it could be that the buttons were placed to close to each other, or that the buttons should have had more different layout – perhaps in terms of color and size – possibly making the distinction between the two more clear.

# 5 Image descriptors based on domain taxonomies versus user generated folksonomies

Before categorization of the image descriptors started – as explained in chapter 3 – there were 1711 tags and 391 annotations respectively for the 20 images. After the categorization process had taken place – which included division of certain complex multiple-word descriptors and removal of some descriptors that could not be categorized – the numbers had increased to a total of 1937 tags and 452 annotations.

A broad folksonomy enables different users to apply the same tag to an image – which means that it can contain several duplicate terms, as was the case with the one[28] created by the participants in the experiment. As an example, consider the following figure, which shows the distribution of the ten most popular tags for image 5 as they appear *after* categorization:

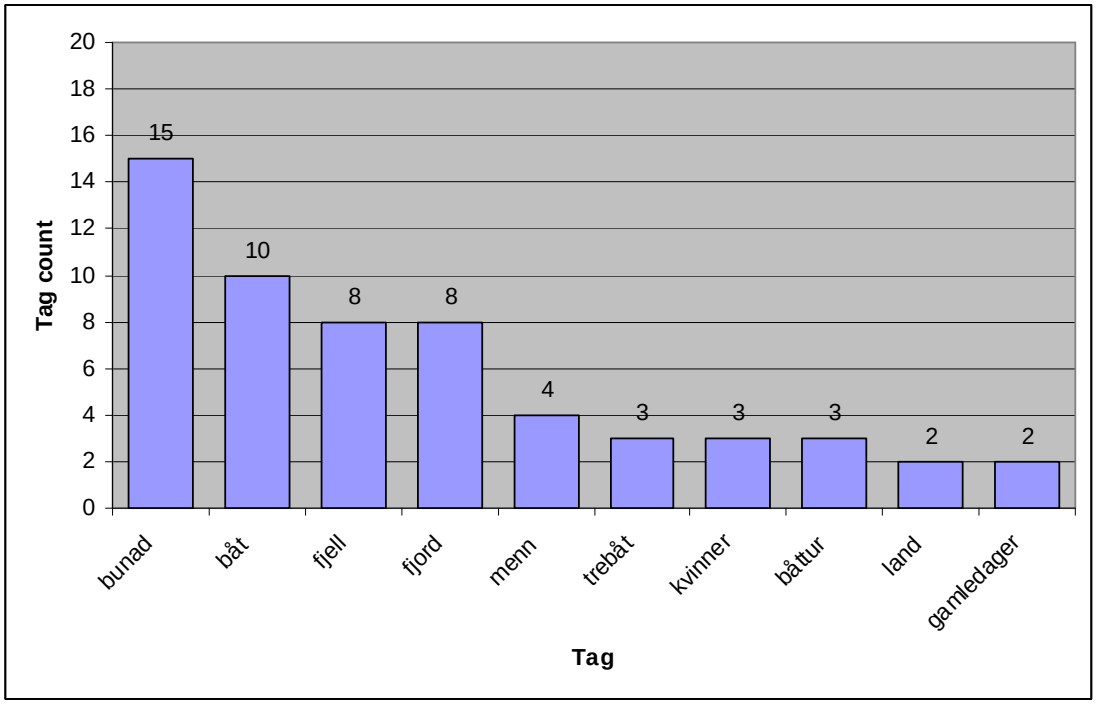



**Figure 20: Bar graph showing the 10 most popular tags for image 5.**

As to be expected with a broad folksonomy, there are some tags that are more popular than others, and have a high tag count. For instance, the tag 'bunad' (national costume), which is the most popular tag for image 5, has a tag count of 15. The second most popular tag for the

[28] As all tags applied by both the control and experiment group are viewed as one, single folksonomy during investigation of research question 1, it is referred to by using singular form throughout this chapter.

image, ‘båt’ (boat) has a tag count of 10. All in all, the ten most popular tags for image 5 have a total tag count of 58, but still only describe ten concepts. This gives a strong indication that several of the tags in the folksonomy are applied many times. A look at the number of unique descriptors in the folksonomy proves that this is the case: the number of terms drop from 1937 to 1051 – a decrease of more than 38 %.

Unlike a broad folksonomy, taxonomy-based annotations like the ones created by ULB do not originally hold any duplicate terms, as the annotators would not apply the same descriptors to images several times. The division of certain multiple-word annotations did however introduce a few duplicate terms for some of the images. Of 451 annotations for the images, 439 were unique descriptors for the images. This is drop is less than 3 %.

In order to make a rightful comparison of image descriptors based on pre-defined taxonomies and user generated folksonomies, only the unique terms for the images found in each of the two vocabularies are considered when investigating research question 1.

## 5.1 Percentile distribution of tags and annotations according to the image descriptor classification schema

The schema and its 11 categories provide a framework for understanding what types of image descriptors the folksonomy vocabulary and the ULB annotations consist of. A comparison based on it can help one understand differences between the two types of metadata specification, and strengths and limitations associated with the two approaches. Figure 20 below compares the distribution of terms in the two vocabularies among the categories from the schema  When reviewing the figures in the bar graph, it is important to have in mind that there were some challenges related to the categorization process. To differentiate between the element and global level was one of them, as described in section 3.3.3.3.

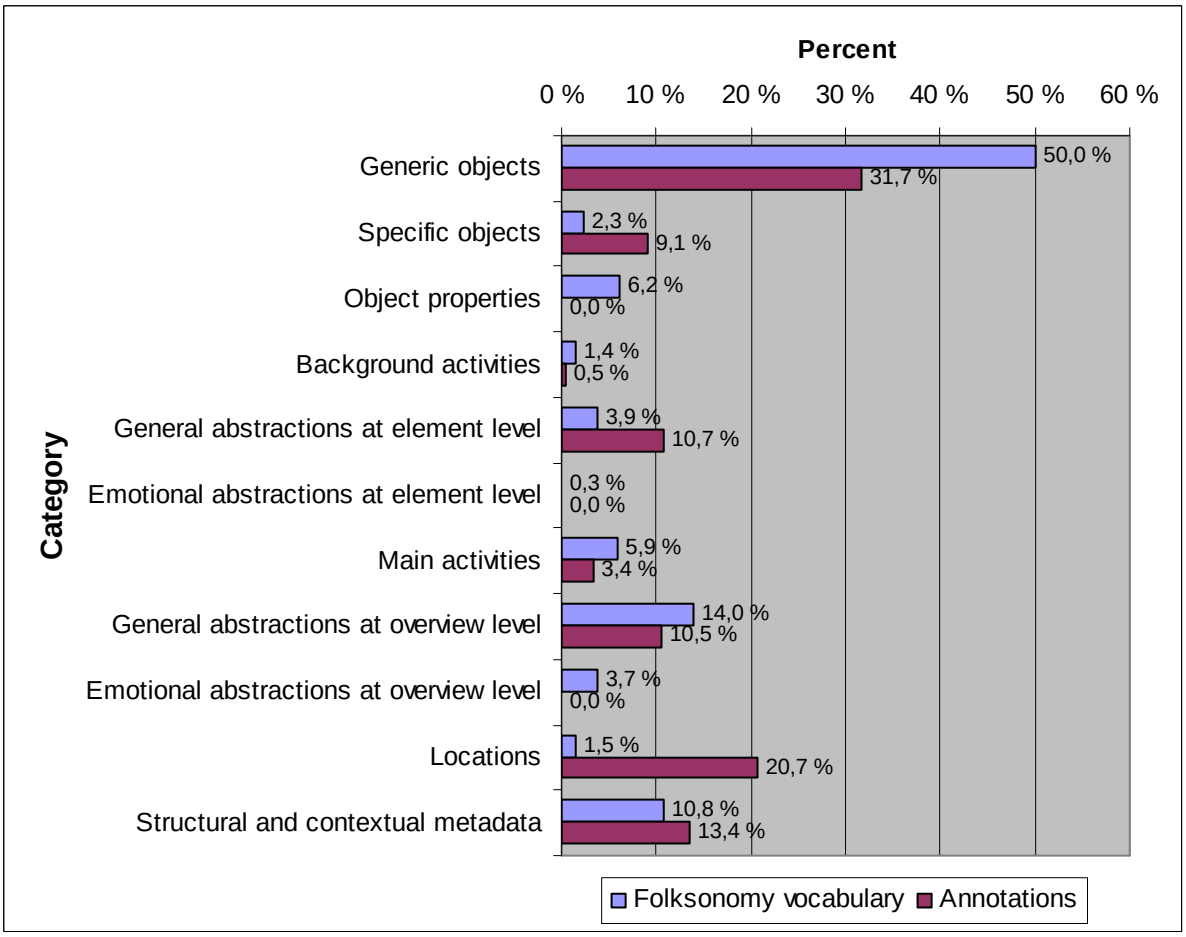



**Figure 21: Bar graph showing the distribution of unique image descriptors found in the folksonomy vocabulary and among the ULB annotations, by category.**

### 5.1.1 Generic and specific objects

Figure 21 above shows that the category that contains most descriptors for both tags and annotations, is *generic objects*. Examples of descriptors in this category are ‘sled’ and ‘snow’ for image 3 – which both originate from the ULB annotations. While nearly a third of the annotations refer to generic objects, as much as one half of the tags in the folksonomy vocabulary do the same. For the category specific objects, the situation is different; Just 2 % of all tags refer to such descriptors – against 9 % of the annotations.

The fact that the professional annotators identify a greater share of specific objects in images is not very surprising. They have access to taxonomies and can be expected to have deeper knowledge of the images in their collection than the taggers, and thus are able to apply more specific naming content. For instance, image 1 is annotated with the girl’s names ‘Gro Holm’

and ‘Karin Prestegård’ – which refer to the two women in the image. The taggers, on their hand, used only generic terms like ‘housewives’ and ‘women’ for the same image.

### 5.1.2 Object properties

Interestingly, there are no *object property* descriptors among the annotations, while over 6 % of the tags in the folksonomy vocabulary are such descriptors. Looking at the two hierarchies used by ULB to annotate the images, it seems that there are no terms that could fall in the object properties category there – which explains the reason for this being so. The absence of descriptive adjectives among the annotations means that it would be fruitless to for instance use a search term like ‘old’ when searching for an image of an old man, ‘yellow’ when searching for any object with that particular color or ‘tall’ when for instance searching for a building with that property. The folksonomy, on the other hand, does introduce such terms.

### 5.1.3 Activities

Regarding the category *background activities*, 1,4 % of the tags in the folksonomy vocabulary and 0,5 % of the ULB annotations refer to this type of image content. The figures are quite small and reveal that neither taggers nor annotators identify a lot of background activities. The category *main activities* is concerned with acts, actions and happenings which, in contrast to background activities, describe the image as a whole. Approximately 6 % of the descriptors in the folksonomy vocabulary were put in this category, against 3,4 % of the annotations. This indicates that for the images selected in this experiment, main activities are identified by both taggers and annotators to some extent, but the taggers seem to have a stronger focus on them than the annotators do.

Generally, it seems that there is a stronger potential for image descriptors that refer to activities that represent the images as a whole rather than background activities. It could of course also be that the taggers and annotators simply have a stronger *focus* on such activities – as they are perhaps easier to indentify. It could also be due to the images selected for this experiment. This is true for all the categories found at both element and global level, i.e. the activities and abstraction categories.

### 5.1.4 General abstractions

About 4 % of the tags in the folksonomy vocabulary and nearly 11 % of the annotations fell into the category *general abstractions at element level*, i.e. the one for abstractions that refer to specific elements in images. This indicates that annotators have a stronger focus on such descriptors than taggers do. One factor that could explain this difference is the hierarchical structure of which the ULB annotations originate from. As an example, one of the annotations provided by ULB for image 7 – which shows some houses on fire – was 'buildings'. The full hierarchy that this term comes from is two-leveled and looks like this:

| ARCHITECTURE AND BUILDING TRADITION/Buildings |
|---|

When one knows that each image is annotated with all the terms in the hierarchy, this gives an explanation as to why this category holds a relatively high amount of annotations: The image is, in addition to the term 'Buildings', which was considered a generic object, also annotated with 'Architecture and building tradition'. This phrase was later divided into 'Architecture' and 'Building tradition' – which where both categorized as general abstractions at element level. And here lies the point: as most of the top terms in the hierarchies are relatively broad, they are usually also good candidates for either of the two general abstraction categories (at element or global level). There are several similar examples.

The category *general abstractions at global level* is for associations or interpretations related to the images as a whole. Here, the distribution of terms in the folksonomy vocabulary and among the annotations respectively, is 14 % versus 10,5 %. For the tags, this is the second largest category. Compared to the general abstractions at element level category, the share of tags has gone from approximately 4 % to exactly 14 %. This could indicate that taggers – when making associations – tend to make them based on the images as a whole. The even distribution of ULB annotations between the categories general abstractions at element and global level for the exactly same images backs this theory.

The fact that 14 % of the tags in the folksonomy vocabulary and 10,5 % of the annotations were put in the generic abstractions at global level category does indicate that taggers have a stronger focus on non-emotional associations related to images as a whole. At the same time, there are more general abstractions overall – at both element and global level – in the

vocabulary of the folksonomy than in that of the annotations, just over 21 % versus approximately 18 %.

### 5.1.5 Emotional abstractions

Neither of the two emotional abstraction categories contain annotations. A look at the ULB hierarchies explains why this is so; there are in fact no emotional or affective terms to choose from. An image-search within the ULB annotations that uses keywords like for instance ‘sorrow’ or ‘tragedy’ would thus give an empty result set.

As opposed to the annotators, the taggers made emotional abstractions based on the images. However, only 0,3 % of the terms in the folksonomy vocabulary were *emotional abstractions at element level*. 0,3 % is merely 3 out of 1051 terms, and could lead one to think that the emotional abstractions at element level category is superfluous; that the potential for emotional associations related to specific elements in images is very limited. The category *emotional abstractions at global level*, on the other hand, contained 4 % of the terms in the folksonomy vocabulary. Examples of tags that fell in this category are ‘tragedy’ for image 7 of a fire, ‘happiness’ for image 8 of a cheerful harmonica group and ‘idyll’ for image 20 of a farm in picturesque surroundings.

The figures show that taggers do make emotional and affective associations, but that the majority of these seem to refer to the global level. This could in turn indicate that the potential for emotional and affective associations is greater if one looks at the image as a whole.

### 5.1.6 Locations

Among the eight categories that include both annotations and tags, *locations* is the one with the biggest percentile difference in distribution. As with the specific objects, it is likely that the knowledge of the annotators and their dedicated hierarchy of locations contribute to the relatively high annotation share of approximately 21 % in this category. To illustrate this, one can look at one of the terms from this hierarchy applied to image 3, which was ‘Nordnes’ – which is the name of a part of Bergen. The full hierarchy that this term comes from actually starts with the country of which Nordnes is located, and then narrows it down to city, province etc. It looks like this:

NORWAY/HORDALAND/BERGEN/STRANDKAIEN/Nordnes

The relatively low share of tags from the folksonomy vocabulary that fell in the locations category is probably related to lack of tagger knowledge. And the share could in fact have been even lower, as all of the participants were students from the University of Bergen and several of the 20 images portrayed well-known locations from the city.

### 5.1.7 Structural and contextual metadata

As the figures from the bar graph shows, a slightly greater portion of the annotations than the terms from the folksonomy vocabulary were categorized here. Over 13% of the annotations were considered belonging to this category, against close 11% of the tags. It is not surprising that the share of annotations in the structural and contextual metadata category is larger than the share of tags. After all, the annotators have access to image properties such as for instance the names of photographers and the time of which images were taken. What is perhaps a bit more surprising is the relatively small difference between the two vocabularies in this category. It is not really to be expected that taggers possess the same kind of detailed knowledge about the images that the annotators do. However, a closer look at the tags in this category explains why the share of tags in the structural and contextual metadata category comes close to the share of annotations:

A property that 15 of 20 of images have in common is that they are in grayscale. Of 113 unique tags that were put in the structural and contextual metadata category, as many as 72 – or close to 64 % – refer to this feature alone. This may seem strange, as there are only 20 images – but simply means that the taggers used several different ways of expressing themselves. The remaining 5 images were in color. 11 of 113 tags refer to this feature. This means the grayscale and color features combined created 83 of 113 tags in the folksonomy vocabulary that were put in the structural and contextual metadata category.

## 5.2 Additional findings

A comparison of the percentile distribution of tags and annotations among the categories from the image descriptor classification schema does not take into considerations the *size* of the two vocabularies. Consider the following example: The category structural and contextual metadata includes 10,8 % of all unique tags, and 13,4 % of all unique annotations. But even

though the focus on such descriptors is stronger with the ULB staff than with the taggers, the number of tags that belong in this category still exceeds the number of annotations: There are 113 tags versus 59 annotations in the structural and contextual metadata category. The reason for this, of course, is simply that the overall number of tags is more than two times greater than the number of annotations.

How *many* of the image descriptors are found both in the folksonomy vocabulary and among the ULB annotations? How many tags provide new descriptors for the images – i.e. are not found among the annotations? And finally, how many of the descriptors from the ULB annotations are not found in the folksonomy vocabulary? The following Venn-diagram answers these questions:

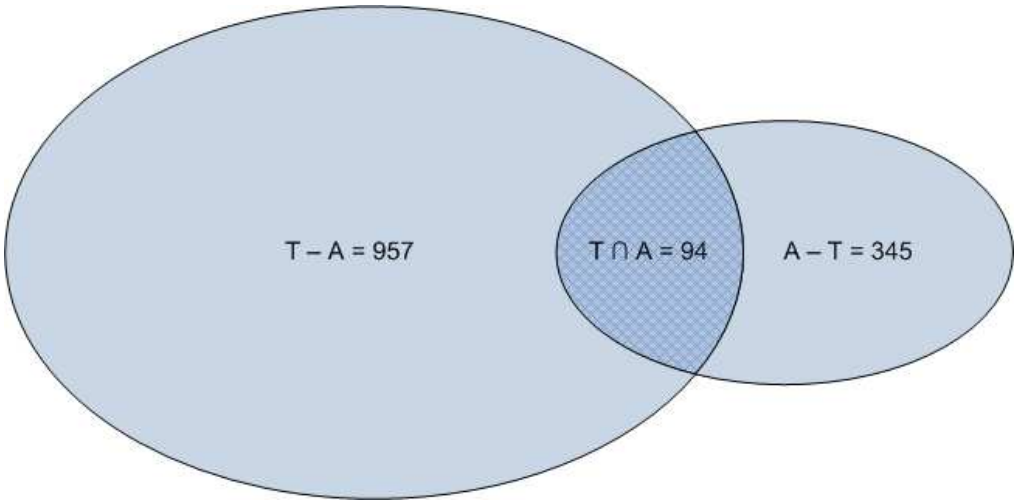



**Figure 22: Venn-diagram showing the number of descriptors only found in the folksonomy vocabulary (T-A), descriptors only found among the annotations (A-T) and descriptors found both in the folksonomy vocabukary and among the annotations (T∩A).**

### 5.2.1 Descriptors found both in the folksonomy vocabulary and among the annotations

As Figure 22 above shows, there are 94 descriptors for the images found both in the folksonomy *and* among the annotations; i.e. descriptors that the taggers and the ULB annotators "agreed" upon. One way to view these descriptors is to regard them as the number of tags that replicated the annotations. Taggers replicated 94 of 439 annotations, or about 21 %. The bright yellow bars in the bar graph below show the number of these overlapping descriptors for each category from the image descriptor classifications schema. In order to

provide a context, two additional bars are included for each category; the blue bars show the total number of unique tags, while the dark red bars show the total number of unique annotations:

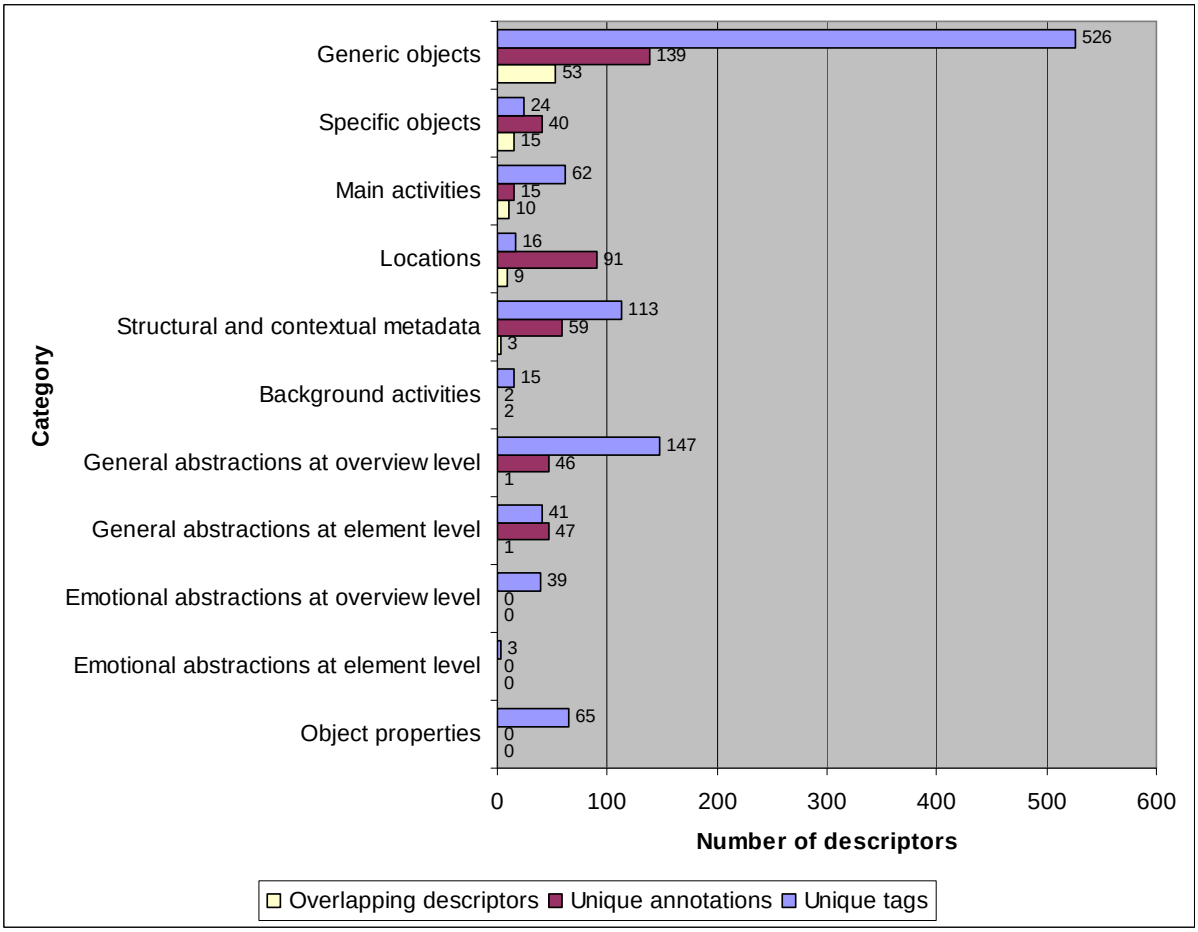



**Figure 23: Bar graph showing the total number of unique tags, unique annotations and overlapping descriptors, by category.**

As one can see, the category with the highest number of image descriptors that overlap is the *generic objects* category. This is hardly surprising, since this category is the one that contains both most tags (526) and most annotations (139) of all 11 categories. The number of image descriptors in this category that overlap is 53. This means that the taggers replicated 38 % of the annotations in the generic objects category.

The degree of overlap in the *specific objects* category is also relatively high. As one can see from the figures in the bar graph, 15 out of a total of 40 specific among the ULB annotations were duplicated by the taggers – which is 37,5 %. If one looks at the two activity categories

combined – background and main activities – the taggers duplicate 12 out of 17 annotations – which is over 70 %.

The degree of overlap in the rest of the categories is lower or totally absent. The category *locations* includes only 9 descriptors that overlap – or approximately 10 %. The structural and contextual metadata category has just 3 overlaps, which is 5 %. Both general abstraction categories include only one descriptor that overlap each. Because there were no annotations here, the categories emotional abstractions at element level, emotional abstractions at global level and object properties naturally do not include any descriptors that overlap at all.

### 5.2.2 Tags that provide new image descriptors

The Venn-diagram from Figure 22 shows that there are 957 image descriptors *only* found in the folksonomy vocabulary. This means that of all the 1051 unique tags that the participants provided, over 91 % of them were new descriptors when compared to the annotations from ULB. 957/20 gives approximately 48 new descriptors per image, which in turn means that every participant contributed with a mean 48/20 = 2,4 new descriptors per image each.

The fact that over 91% of the tags from the folksonomy provide new descriptors for the images could mean that the taxonomy-based descriptors from ULB lack many terms that users are likely to use as keywords in queries. Even though there is no guarantee that the tags from the folksonomy will be utilized by users when they search for images, the new descriptors, if employed, undoubtedly increase the number of search terms one can use to retrieve images.

Since it has been established that the folksonomy vocabulary includes many new descriptors for the images, a natural follow-up question is: What types of image descriptors are these? There are two bars for each category from the image descriptor classification schema in the bar graph below. The blue bars show the number of *all* unique tags within each category, and the bright yellow ones shows how many of these that provide *new descriptors* for the images:

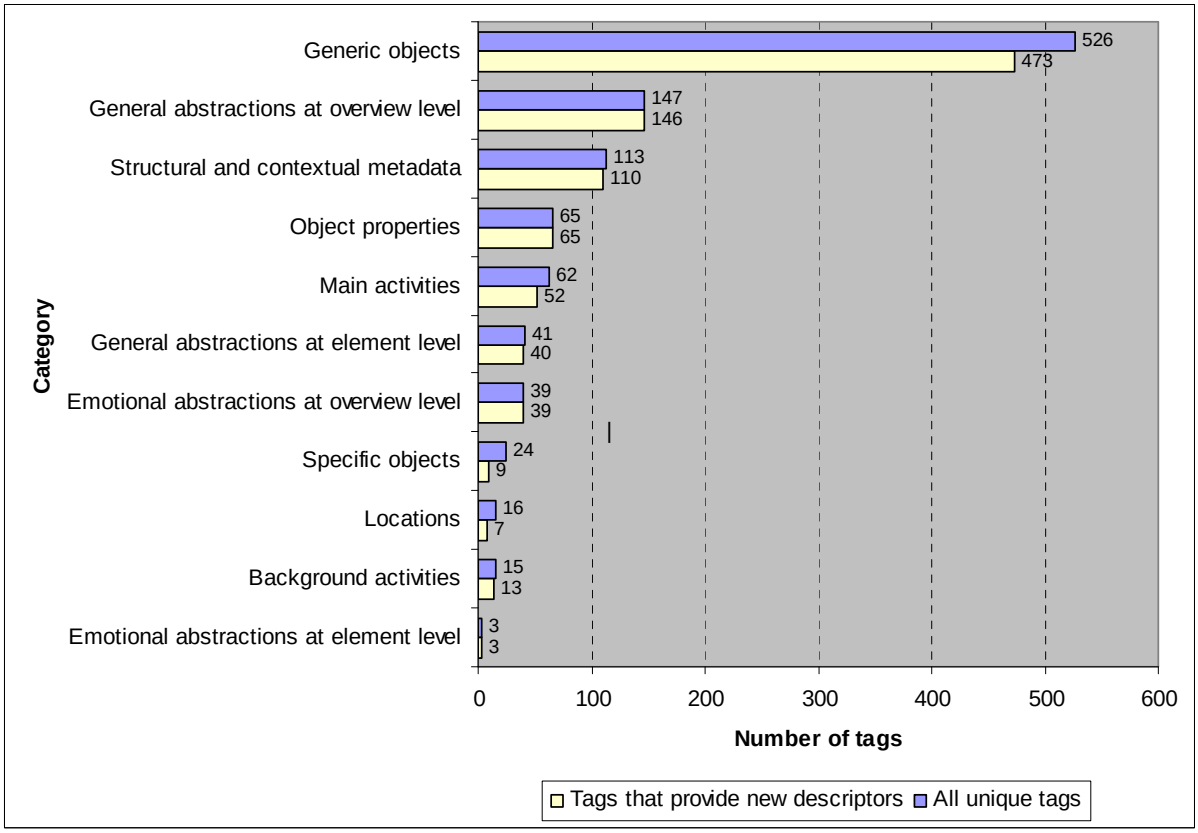



**Figure 24: Bar graph showing the total number of unique tags and the number of these that provided new descriptors for the images, by category.**

As one can see, just as the generic objects is the largest category when one considers all unique tags, it is also the category where taggers contribute with the highest number of new image descriptors – by far. 473 new generic object descriptors gives an average of 23,65 per image. This number may seem relatively high. But as one remembers, some tags describe the same concept – and generic objects are no exception. For instance, one can see some water at the bottom part of image 20. There were four different generic object descriptors that referred to this, namely ‘water’, ‘lake’, ‘sea’ and ‘fjord’. Singular and plural forms of nouns are also to be found. An example is ‘barn’ and ‘barns’, also for image 20. It is clear that when compared to the annotations from ULB, taggers do make a considerable contribution to generic object identification in the images.

The figures from the rest of the categories show that taggers in fact contribute with new image descriptors in all categories. This indicates that taggers have a different angle and view of the images than the trained curators.

### 5.2.3 The descriptions only found among the annotations

The Venn-diagram from Figure 22 on page 57 shows that there are 345 descriptors *only found among the annotations*, which is more than 78 % of the total annotation count of 439. This shows that just like the majority of the descriptors in the folksonomy are not found among the annotations, the majority of the descriptors among the annotations are descriptors that are not found in the folksonomy.

The bright yellow bars in the bar graph below show the number of descriptors only found among the ULB annotations in each of the categories from the image descriptor classification schema. The total number of unique annotations per category is also included, shown in the dark red bars:

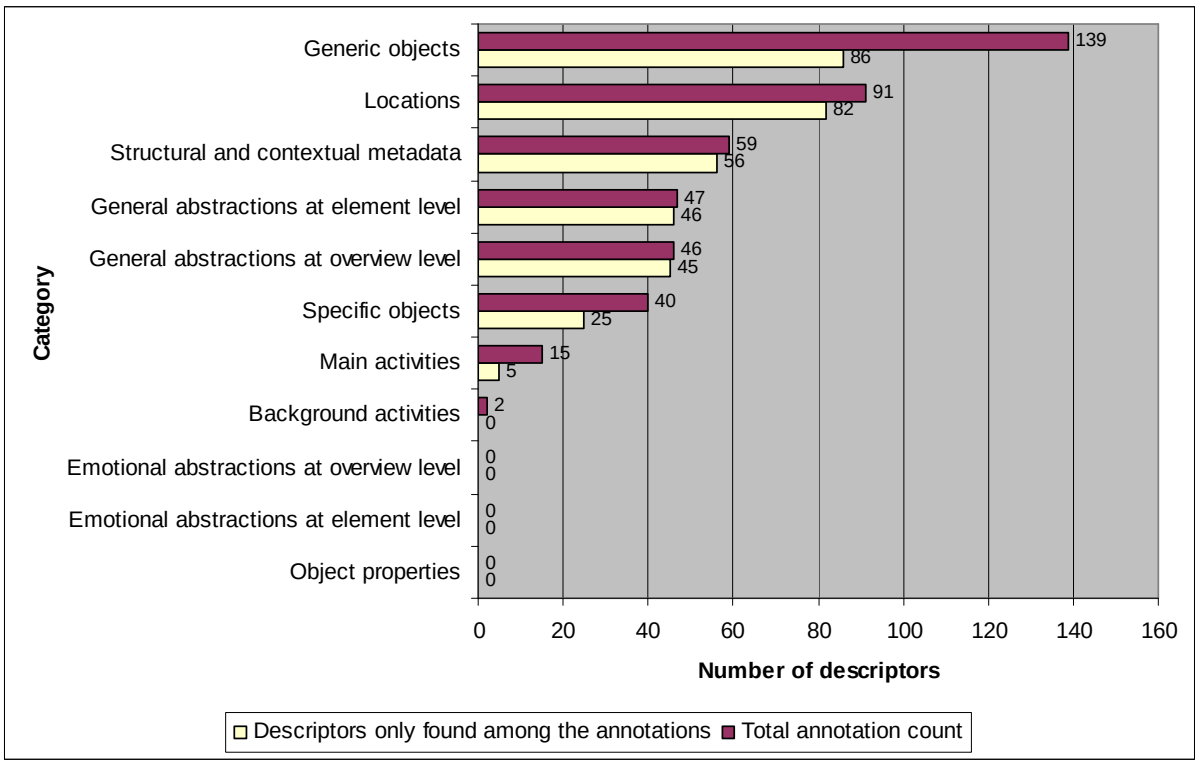



**Figure 25: Bar graph showing a) the total number of unique annotations and b) the number of descriptors *only* found among the annotations.**

Even though several of the generic objects among the annotations were replicated by the taggers, there are still several descriptors in this category only found among the annotations. Some of these are ‘farm’ for image 2, ‘musical orchestra’ and ‘harmonica group’ for image 8 and ‘fishing boat’ for image 16. None of these examples use a particularly technical jargon.

In general, there are many image descriptors that are annotation-specific, and not found in the folksonomy vocabulary. One could however speculate if some of these terms would have been added to the folksonomy and thereby replicated if there had been more participants in the experiment.

# 6 The effect of access to existing tags

The second research question asks: How does access to existing tags effect generation of a folksonomy for images? As explained in chapter 2, the participants from the control group utilized a graphical user interface with no access to previously assigned tags for the images. The participants from the experiment group, on the other hand, utilized a graphical user interface where the three most popular tags for each image were shown. These were based on the most frequent tags applied by the control group. For instance, for the following image, the popular tags visible to the experiment group participants were ‘children’, ‘snow’, and ‘winter’:


**Figure 26: One of the images used in the experiment. Its popular tags are shown in the upper right corner.**

If one utilizes the image descriptor classification schema, two of these three tags are generic objects, as both ‘children’ and ‘snow’ belong in this category. Unsurprisingly, as the analysis from chapter 4 revealed that this type of descriptors were popular with the taggers, there were

a lot of generic objects among the popular tags as well. In fact, an analysis of these tags reveals that 45 of 60 tags – or 75 % – were generic objects.

Each of the image descriptors that ended up in the pool of popular tags was in average applied 3,5 times by the participants in the control group. The least popular tags in this group were applied by 2 out of 10 participants, whereas the most popular tags – 'train' for image 6 and 'fire' for image 7 – were applied by as many as 7 out of 10 people. For a full list of the three popular tags for each of the 20 images, see *appendix D*.

Three null-hypotheses follow the second research question, and data related to each of them are presented chronologically throughout the remaining parts of this chapter. It is important to remember the following: For the two first hypotheses, all the tags as they were originally applied by the participants, *before* the categorization process started, are analyzed. In other words, division of certain multiple-word tags has at this stage not been performed, and duplicates have not been removed. In conjunction with the data analysis following the third hypothesis, however, which suggests that access to existing tags have no effect on generation of which types of tags users apply, the folksonomy vocabularies as they appear *after* categorization, are used for analysis.

## 6.1 The popular tags' effect on the number of tags applied

Does access to existing tags have any influence on the *number* of tags users apply? The first of two hypotheses following research question 2 – which assumes not – is repeated here:

> $H_{0\ (a)}$: The presence / non-presence of previously assigned, popular tags for images has no effect on the number of tags users apply.

As one remembers from the previous chapter, the 20 participants in the experiment applied a total of 1711 tags to the images. The following table shows the number of tags applied by the participants in the control and experiment group respectively:

| | **CONTROL GROUP** | **EXPERIMENT GROUP** |
|---|---|---|
| *Number of tags applied* | 977 (57,1 %) | 734 (42,9 %) |

**Table 2: The number of tags applied by the control and experiment group.**

The table shows that the control group applied 977 tags, or about 57 % of all tags. The experiment group applied 734 tags, or about 43 %. This basic comparison indicates that *taggers with access to previously assigned, popular tags apply fewer tags than those without that access.* There are at least two reasons for this possibly being so: First, one could imagine that when users see that tags they think of applying already have been applied by others, they may feel that there is no reason for them to apply the same tag as well. Second, one could imagine that since there are already tags applied – users don't have to think that much, or be that creative – just merely pick from the popular tags. In other words: less thinking could mean fewer tags.

It is important to remember that this result could also have happened by chance. A statistical test of significance[29] is therefore applied in chapter 6.

## 6.2 The popular tags' influence on which tags users apply

Does access to existing tags have any influence on *which* tags one applies, for instance in such a way that taggers merely replicate the image descriptors that they have access to? The second hypotheses following research question 1 – which assumes not – is repeated here:

> $H_{0\ (b)}$: The presence / non-presence of previously assigned tags for images has no effect on which tags users apply.

A reasonable way to approach this hypothesis is to start by answering the following question: How many of the 743 tags applied by the participants from the experiment group – i.e. the group with access to existing tags – were replica of the three popular tags shown for each image? An analysis of the tags applied by the experiment group revealed that as many as 306 of 734, or close to 42 %, were replica of the popular tags visible to them while they tagged the images. Initially, this seems like a large amount, and could lead one to assume that the popular tags were influential and made a solid impact on these participants. But this is not necessarily the case.

Consider the following: The image in Figure 26 on page 63 in the beginning of this chapter included the three most popular tags for that image based on the tags applied by the control

[29] Basic knowledge of significance testing is assumed throughout this thesis.

group. These were ‘children’, ‘snow’ and ‘winter’. All of them can be said to be relatively obvious; at least far from improbable. And the participants from the experiment group seemed to agree with the participants from the control group: ‘children’ was applied 5 additional times, while ‘snow’ and ‘winter’ were applied as many as 7 additional times. Doesn’t this only support the theory that the participants in the experiment group were influenced by the popular tags? That may be so, but the point here is that they easily could have applied these descriptors without access to the existing popular tags. In fact, the taggers from the control group already did this. Therefore, one should still not yet make any assumptions with regards to the null-hypothesis. In order to do so, one needs to compare how many of the tags applied by the control group that ended up among the popular tags, with how many of the tags from the experiment group that were replica of the popular tags. The following table shows this distribution:

| | **CONTROL GROUP** | | **EXPERIMENT GROUP** | |
|---|---|---|---|---|
| *Popular tags* | 212 | 21,7 % | 306 | 41,7 % |
| *Other tags* | 765 | 78,3 % | 428 | 58,3 % |
| *SUM* | *977* | *100,0 %* | *734* | *100,0 %* |

**Table 3: The number tags applied by the control and experiment group that were / were not among the popular tags.**

As one can see from Table 3 above, 212 out of 977 tags that were applied by the participants from the control group can be found among the popular tags. This is nearly 22 %. For the experiment group, the number of tags applied that were replica of the popular tags visible to them while tagging was 306 of 734, which is close to 42 %. These figures give an indication that *the participants from the experiment group were influenced by the three previously assigned, popular tags visible for each image in such a way that they applied several of the same descriptors that can be found among these*. A test of statistical significance is applied in chapter 6.

## 6.3 The popular tags’ influence on which types of tags users apply

So far, the analyses in this chapter have been based on the 1711 tags as applied originally by the participants in the experiment. The third and final hypothesis is concerned with the effect access to existing tags has on which types of tags users apply:

$H_{0\ (c)}$: The presence / non-presence of previously assigned tags for images has no effect on which types of tags users apply.

The interest here is thus potential differences between the two folksonomy vocabularies created by the control and experiment group. First of all, it is interesting to look at the size of the two vocabularies – i.e. the number of unique terms in each of them. As one remembers from section 6.1, the control group participants applied more tags than the ones from the experiment group. When one combines this with the fact that about 42 % of the tags applied by the participants from the experiment group were replicates of popular tags, as shown in section 6.2, it is not surprising that the size of the folksonomy vocabulary created by the control group is larger than the one created by the experiment group. The following table shows this:

| | **CONTROL GROUP** | **EXPERIMENT GROUP** |
|---|---|---|
| *Folksonomy vocabulary size* | 818 | 422 |

**Table 4: The size of the folksonomy vocabularies created by the control and experiment group.**

As the table shows, the size of the folksonomy that the experiment group created is only just more than half the size of the one generated by the control group; 422 versus 818[30]. Even though the control group originally applied more tags than the experiment group (977 versus 734), the difference between the size of the two folksonomy vocabularies further strengthens the impression that access to existing, popular tags for images reduce folksonomy vocabulary diversity. But the hypothesis has really not yet been addressed. Does access to existing tags effect which types of tags users apply? The image descriptor classification schema is here used to compare the percentile distribution of the terms from the two folksonomy vocabularies as distributed among its categories:

[30] These figures may initially seem confusing, as the analysis in chapter 5 revealed that there were 1051 unique tags for the images, while the table above displays a total of 818 + 422 = 1240 tags. But the reason for this is that here, unlike in chapter 5, the tags from the control group and experiment group are not compared against each other.

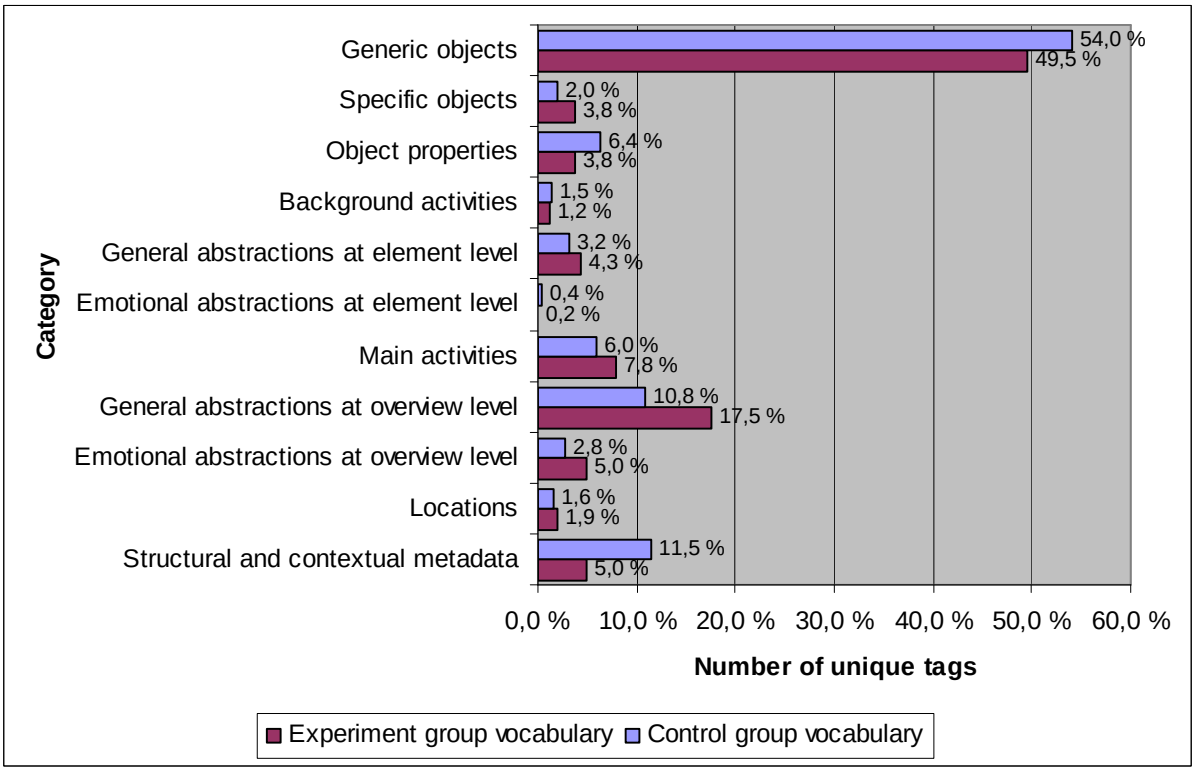



**Figure 27: Bar graph showing the distribution of terms from the control and experiment group folksonomy vocabularies, by category.**

As one can see from the figures in the bar graph, there are differences between the folksonomy vocabularies created by the control and experiment group. At the same time, there are also similarities between the two.

An interesting observation is that the experiment group participants seem to have a stronger focus on *abstractions*, especially if one looks at the general abstractions at global level category. A possible explanation for this could be that since the popular tags already contained several generic objects, the focus of the experiment group went elsewhere, to other aspects of the images. This could also perhaps explain the fact that the control group had a slightly stronger focus on both specific objects, main activities and emotional abstractions at element level. At the same time, several of the popular tags were replicated by the control group.

What does not support this theory however, is the percentile difference in the category structural and contextual metadata; 11,5 % for the control group and 5 % for the experiment group vocabulary. If the experiment group taggers concentrated on other aspects of the

images than generic objects – there is hardly no reason why they would not focus on this type of content as well, especially when one knows that there were no structural and contextual metadata descriptors among the popular tags.

Even though the figures from the bar graph above could give an indication as to what types of descriptors one could expect to find in image folksonomy vocabularies that was created with and without access to existing tags, they do not tell the story of *how many* terms that were found in each of the categories for the two vocabularies. As one remembers, there were nearly twice as many unique terms in the control group vocabulary than in the vocabulary created by the experiment group. The following bar graph therefore shows the number of unique terms in the two folksonomy vocabularies, as distributed among the categories from the image descriptor classification schema:

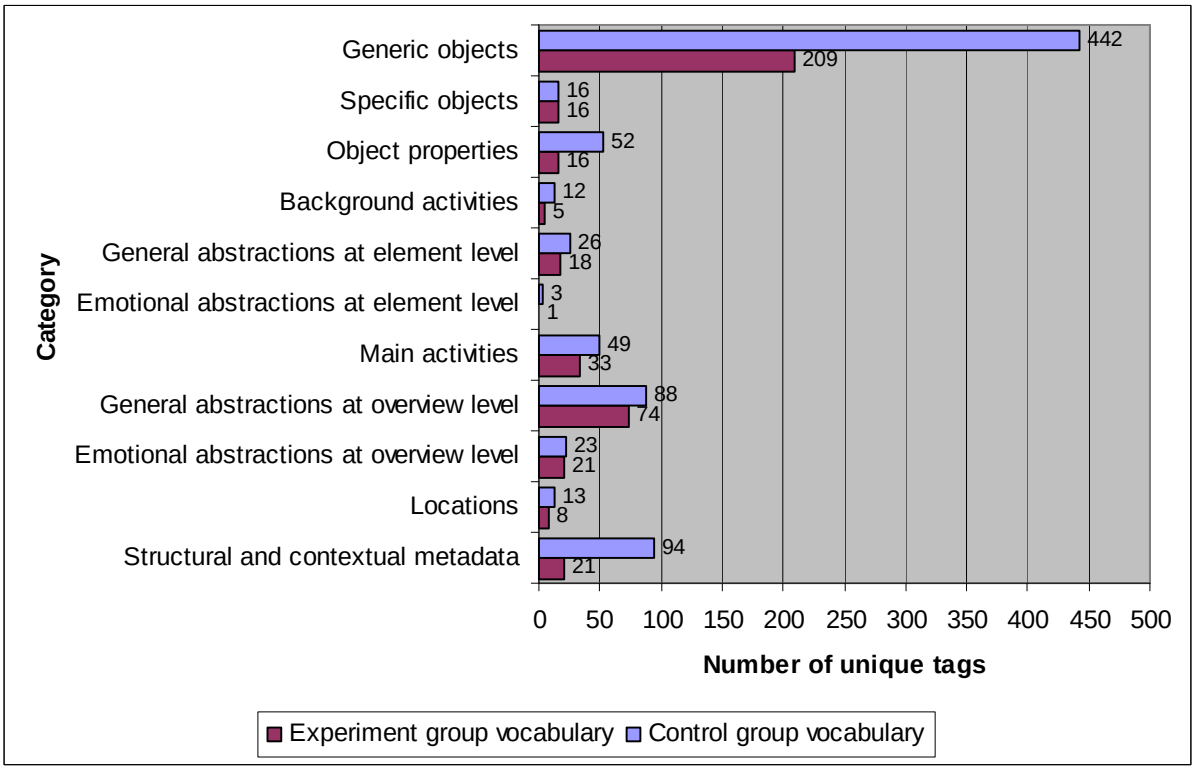



**Figure 28: Bar graph showing the vocabulary of a) the control group folksonomy and b) the experiment group folksonomy, distributed among the categories from the image descriptor schema.**

As the figures show, there are more unique descriptors in every category in the control group vocabulary, except for the category specific objects, where the number of unique tags are the same. Perhaps the most noticeable difference is the number of generic objects in each

vocabulary. While the vocabulary of the folksonomy created by the control group contains 442 tags that refer to generic objects, the experiment group vocabulary contains 209 – a decrease of 233 image descriptors.

In general, based on the data presented here, the impression that access to existing, popular tags for images reduce folksonomy vocabulary diversity is strengthened.

# 7 Evaluation of results and conclusion

The aim of this research project was to study two different aspects of folksonomies for images. Two research questions were formulated.

Research question 1 asked what differences exist between image descriptors based on pre-defined domain taxonomies and user generated folksonomies. In brief, the first research question was investigated by comparing taxonomy-based annotations with a user generated folksonomy for a selection of 20 images, by employing an image descriptor classification schema. All images originated from the University Library of Bergen's digital collection. While the taxonomy-based annotations were already applied to the images, the folksonomy for the images were gathered by conducting an image-tagging experiment that involved 20 participants. The experiment was not only conducted because of research question 1, but also in order to investigate research question 2, which asked how access to previous tags effect generation of a folksonomy for images.

## 7.1 Evaluation of the difference between image descriptors based on domain taxonomies and user generated folksonomies

The null-hypothesis following research question 1 assumed no difference between the two:

> $H_0$: There exist no differences between image descriptors based on pre-defined domain taxonomies and user generated folksonomies.

The vocabulary of the folksonomy that was created by the experiment participants and the annotations from ULB have been compared by employing the image descriptor classification schema. Each and every one of the image descriptors have been analyzed and placed in the appropriate category. Beforehand, duplicate terms for each image had been removed, so that both the folksonomy and the annotations consisted of only one instance of each tag for each image.

To begin with, the percentile distribution of tags and annotations among the categories from the image descriptor classification schema was investigated. As described in chapter 2, there were some problems of differentiating between the image descriptors at element and global

level during the categorization process[31]. Therefore, the bar graph below shows the distribution of annotations and tags among a *combination*[32] of some of the related categories from the image descriptor schema, which does not take the element and global level into account:

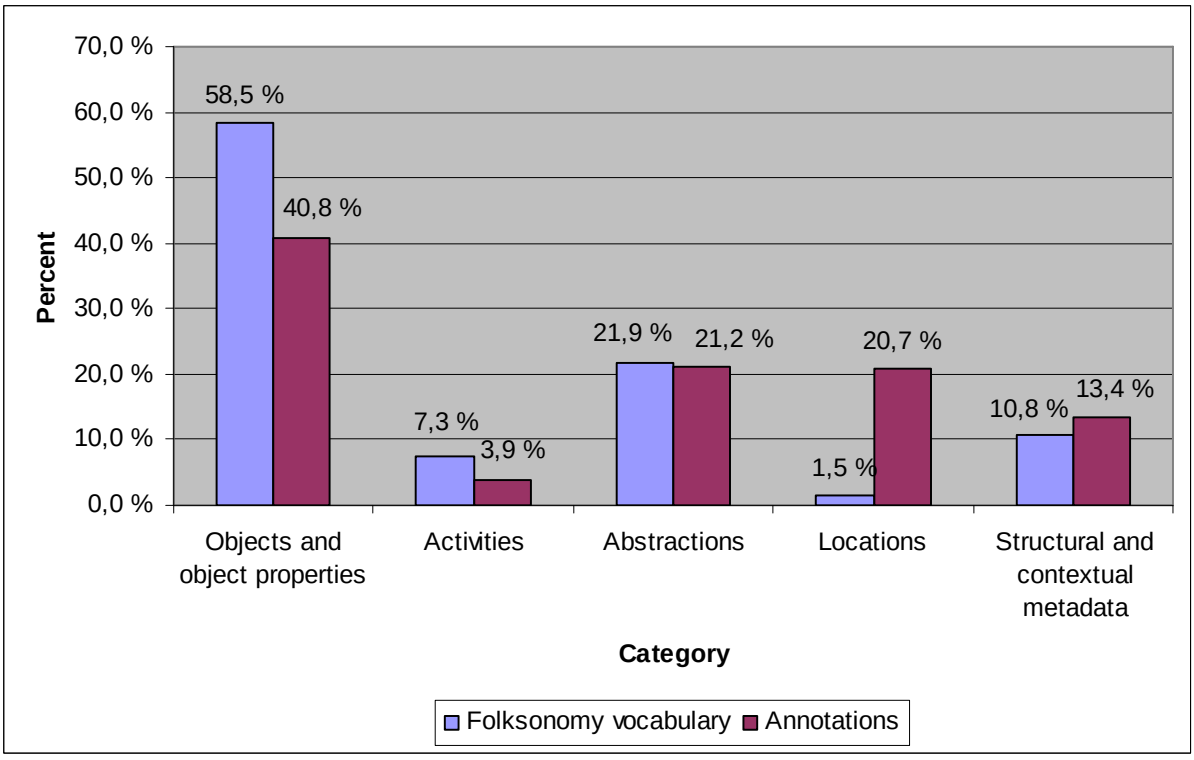



**Figure 29: Bar graph showing the percentile distribution of image descriptors in a) the folksonomy vocabulary versus b) the annotations, among five categories of image content.**

As one can see, close to 58,5 % of the terms in the folksonomy vocabulary referred to *objects or object properties*. As the analysis in chapter 5 revealed, of these, the vast majority were considered generic objects, while there some object properties and a few specific objects. The share of object and object property descriptors was lower among the ULB annotations, with 41 %. Of these, there were also mostly generic objects, but the percentile share was not as large as with the folksonomy vocabulary. Instead, the focus on specific objects was greater, which is rather unsurprising due to the knowledge of the annotators and their taxonomies. There were however not a single object property among the annotations.

[31] Se also section 7.3.2 later in this chapter for a more detailed discussion of this topic.
[32] *Objects and object properties* are a combination of the categories generic objects, specific objects and object properties. *Activities* is a merge of background and main activities. *Abstractions* represent the four different abstraction categories; general and emotional abstractions at both element and global level. Finally, the two last categories, *locations* and *structural and contextual metadata*, are kept in their original form.

The focus on *activities* is like the focus on objects and object properties, greater in the folksonomy vocabulary than among the annotations. The analysis revealed that there were mostly *main* activities in both the folksonomy vocabulary and among the annotations; i.e. descriptors that referred to what was happening in the images as a whole rather than background activities.

The category *abstractions* is the second largest of the five for both vocabularies. Even though the share of descriptors that referred to this type of content was approximately the same for the descriptors in the folksonomy vocabulary and among the annotations, there were differences. An interesting observation was that there were no emotional abstractions among the annotations. This was because there were no emotional or affective terms to choose from in the ULB hierarchies. The taggers, on the other hand, used several emotional or affective terms. These almost exclusively referred to the images as a whole.

The category *locations* is the one with the largest percentile difference between the two vocabularies. More than 20 %, or 1 of 5 terms among the annotations were descriptors that referred to the location of what was shown in images, against only 1,5 % of the terms in the folksonomy vocabulary. This had to do with the fact that the annotators from ULB had a dedicated location taxonomy. Close to 11 % of the term in the folksonomy vocabulary and above 13 % of the annotation referred to *structural and contextual metadata* – a relatively even distribution.

Finally, it is important to remember that the percentile distribution of terms from the two vocabularies does not tell the full story of differences between image descriptors based on taxonomies and user generated folksonomies. For one thing, the analysis from section 5.2, “Additional findings”, revealed that the majority of the terms in the folksonomy vocabulary were not found among the annotations, i.e. that the taggers provided many new descriptors for the images. Furthermore, it revealed that taggers replicated approximately 21 % of the terms among the annotations, and that the majority of the terms that were replicated were generic objects. At the same time, just like the majority of the descriptors in the folksonomy vocabulary were not found among the annotations, the majority of the descriptors among the annotations were not found in the folksonomy. This indicates that the two vocabularies supplement each other.

**Significance testing**

In order to determine if the observed differences between the image descriptors based on taxonomies and the user generated folksonomy are statistically significant, the results are tested for statistical significance. The null hypothesis will be rejected if it can be established with a 95 % probability that the results are not coincidence, i.e. a 0,05 level of significance is chosen. The type of significance test applied is a Chi-square ($\chi 2$) test. A Chi-square test can be used to examine whether a pattern of frequencies significantly differs from an expected pattern of frequencies. There are several variants of the Chi-square test, but in this case it is applied as a *test of independence*. This is done to establish whether two patterns of frequencies – the frequencies of annotations and tags among five image descriptor categories – are independent from each other or not.

The numbers of unique annotations and tags in each of the five combined categories were distributed as follows:

| **OBSERVED FREQUENCIES (O)** | | | | | | |
|---|---|---|---|---|---|---|
| | OBJECTS | ACTIVITIES | ABSTRACTIONS | LOCATIONS | S. & C. METADATA[33] | ROW TOTALS |
| **Annotations** | **179** | **17** | **93** | **91** | **59** | 439 |
| **Tags** | **615** | **77** | **230** | **16** | **113** | 1051 |
| Column totals | 794 | 94 | 323 | 107 | 172 | 1490 |

**Table 5: The observed frequencies of unique tags and annotations for five combined categories of image descriptors.**

These figures can be used to establish the *expected* frequencies if there are *no differences* between the two types of image descriptors – as the null hypothesis suggests. The expected frequency formula is:

$$E = \frac{R \times C}{N}$$

where:

[33] Short for structural and contextual metadata

R = row total,

C = column total and

N = total number of observations

For instance, the expected number of annotations in the objects category is:

$$E = \frac{439 \times 794}{1490} = 233{,}9$$

All of the expected frequencies are shown in the table below:

| **EXPECTED FREQUENCIES (E)** | | | | | | |
|---|---|---|---|---|---|---|
| | OBJECTS | ACTIVITIES | ABSTRACTIONS | LOCATIONS | S. & C. METADATA | ROW TOTALS |
| **Annotations** | **233,9** | **27,7** | **95,2** | **31,5** | **50,7** | 439 |
| **Tags** | **560,1** | **66,3** | **227,8** | **75,5** | **121,3** | 1051 |
| Column totals | 794 | 94 | 323 | 107 | 172 | 1490 |

**Table 6: The expected frequencies of unique tags and annotations for five combined categories of image descriptors – assuming the null hypothesis is true.**

The Chi-square (χ2) is calculated by the formula $\sum\left(\frac{(O-E)^2}{E}\right)$, where

*O* = observed value and

*E* = expected value

This gives a value of 185,2 for χ2. To decide whether or not the observed differences are significant, this value must be compared to the appropriate χ2 distribution. The degrees of freedom (*df*) is determined by the numbers of rows (*R*) and columns (*C*). As there are two rows, *R* = 2. There are five columns, so *C* = 5.

$df = (R - 1)(C - 1) = (2\text{-}1)(5\text{-}1) = 4$

By consulting a table of critical values for χ2 at different degrees of freedom, one can see that χ2 must be equal to or exceed 9,488 for the test to be statistically significant at the 0,05 level.

Because the calculated $\chi 2$-value of 185,8 is greater than the table value of 9,488 – the result is statistically significant at this level. In fact, the result is statistically significant also at a 0,01 level.

As a result, the null hypothesis can be rejected for this data.

## 7.2 Evaluation of the effect of access to existing tags

### 7.2.1 The effect on the number of tags users apply

The first null-hypothesis following RQ2 was:

> $H_{0\ (a)}$: The presence / non-presence of previously assigned, popular tags for images has no effect on the number of tags users apply.

A comparison of the number of tags applied by the participants in the control and experiment group showed that the former group – which had no access to existing tags – applied more tags than the latter, which had that access. The control group applied a total of 977 tags, while the experiment group applied 734. This is a decrease of 234 tags, or 24,9 %. This result gave an indication that the introduction of previously assigned, popular tags for images leads to a decrease in the amount of tags that taggers apply. A test of statistical significance is here introduced.

**Significance testing**

A *student's t-test* is a significance test which can be applied when the population is *assumed* to be normally distributed – but at the same time, the sample sizes are too small to achieve this. As there were only 20 participants in this research project, the sample sizes are undoubtedly too small for this to happen, but if the sample size of both the control and experiment group had been for instance 1000 instead of 10, one can assume that the distribution of the number of tags within both the control and experiment group would have come near a normal distribution. Based on these grounds, the student's t-test is applicable. In the hypothesis there are no expectations about the *direction* – no expectations with regards to an increase or a decrease in number of tags. Therefore, the test is two-tailed. The null hypothesis will be discarded if the student's t-test establishes with a 95 % probability that the results are not coincidence. In other words, a 0,05 level of significance is chosen.

The following table shows the results from the student's t-test. The test is based on the number of tags applied by each of the participants in the control and experiment group:

| | **CONTROL GROUP** | **EXPERIMENT GROUP** |
|---|---|---|
| Mean | 97,7 | 73,4 |
| Variance | 1230,233333 | 173,8222222 |
| Observations | 10 | 10 |
| Hypothesized Mean Difference | 0 | |
| Df | 11 | |
| t-Stat | 2,050756645 | |
| **P(T<=t) two-tail** | **0,064891034** | |
| t Critical two-tail | 2,200985159 | |

**Table 7: Two-sample t-test for the control and experiment group, presuming uneven variance.**

As Table 7 shows, the P-value for the two-tailed test is 0,06489. This value is larger than the selected significance level of 0,05. This means that the observed mean difference between the number of tags applied by the participants in the control and experiment group is not statistically significant. The first null hypothesis following research question 1 ($H_{0\ (a)}$) can therefore not be rejected for this data.

### 7.2.2 The effect on which tags users apply

The second null-hypothesis following RQ2 was:

> $H_{0\ (b)}$: The presence / non-presence of previously assigned tags for images has no effect on which tags users apply.

As one can remember, the number of tags applied by the experiment group was 734. 306 of these, or approximately 42 %, were replica of the popular tags. In comparison, of the 977 tags applied by the control group, 212 ended up among the popular tags, which is about 22 %. This gave an indication that the participants from the experiment group were in fact influenced by the popular tags – in terms of which tags they chose to apply. A test of statistical significance is once again introduced.

**Significance testing**

As one can assume normal distribution in both the control and experiment group – the student's t-test is applicable also here. The test, which yet again is two-tailed, is based on the *portion* of tags applied by each of the participants that were found among the popular tags. As an example, the first participant from the control group applied a total of 78 tags. Of these 78 tags, 21 ended up among the popular tags. This equals 26,9 % – which is used as one of ten observations from the control group sample. The first participants from the experiment group applied 69 tags overall. Of these 69 tags, 28 were found among the popular tags. This equals 40,6 % – which is used as one of ten observations from the experiment group sample.

The null hypothesis will be discarded if it can be established with a 95 % probability that the results are not coincidence. In other words, a 0,05 level of significance is yet again chosen. The following table shows the result of the t-test:

| | **CONTROL GROUP** | **EXPERIMENT GROUP** |
|---|---|---|
| Mean | 0,244897163 | 0,413328838 |
| Variance | 0,017482932 | 0,012158454 |
| Observations | 10 | 10 |
| Hypothesized Mean Difference | 0 | |
| Df | 17 | |
| t-Stat | -3,093673763 | |
| **P(T<=t) two-tail** | **0,0065933** | |
| t Critical two-tail | 2,109815559 | |

**Table 8: Two-sample t-test for the control and experiment group samples, presuming uneven variance.**

As Table 8 shows, the P-value for the two-tailed test is just over 0,006. This value is well below the selected significance level of 0,05 – which means that the observed difference between the control and experiment group with regards to the use of popular tags is statistically significant at a 0,05 level of significance. The results are also statistically significant at a significance level of 0,01. As a consequence, the null-hypotheses can be rejected. Based on the data gathered in this experiment, access to existing tags makes users apply more of the tags that they have access to, which can reduce the diversity of an image folksonomy vocabulary.

### 7.2.3 The effect on which *types* of tags users apply

The third and final null-hypothesis following research question 2 was:

> $H_{0\ (c)}$: The presence / non-presence of previously assigned tags for images has no effect on which types of tags users apply.

The following bar graph shows the distribution of terms from the folksonomy vocabulary created by the control and experiment group respectively, across a combination of related categories from the image descriptor classification schema. The combination of categories is identical to the one used in conjunction with the evaluation of the hypothesis following research question 1 (see section 7.1). It thus does not take the element and global level into account:

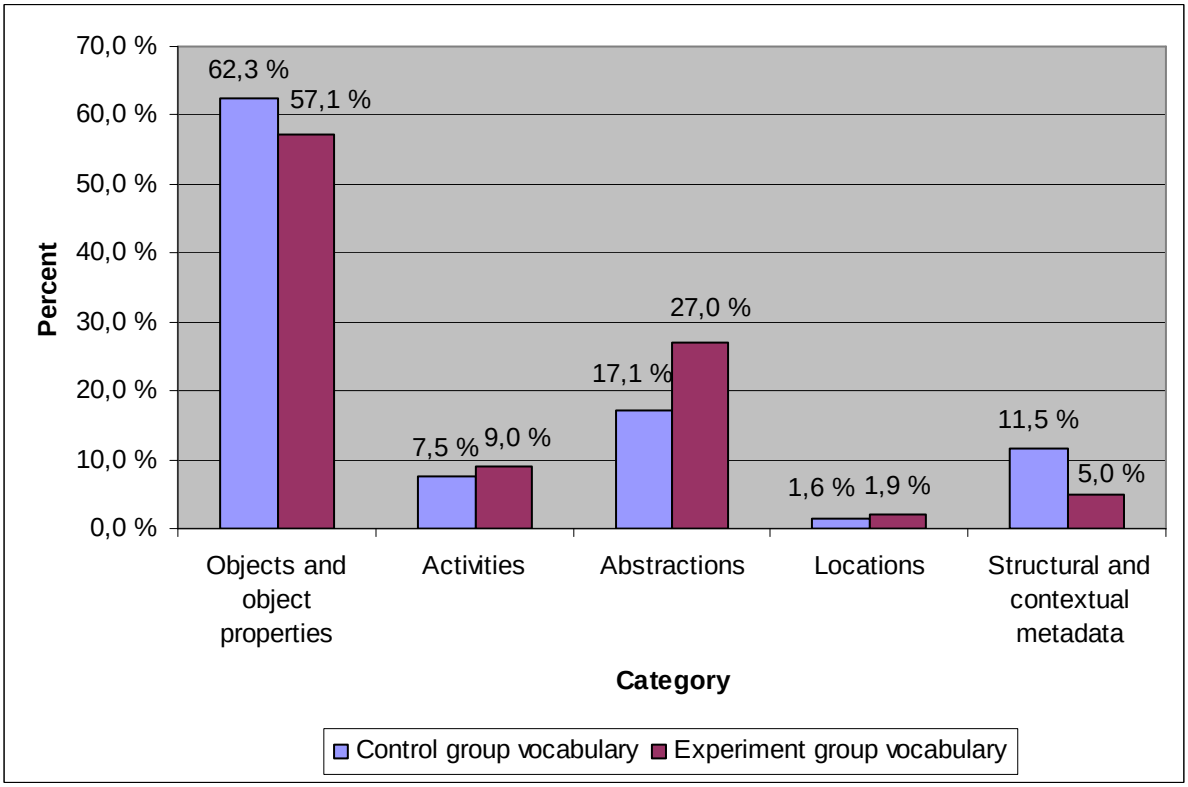



**Figure 30: Bar graph showing the percentile distribution of the terms from the folksonomy vocabularies created by a) the control group and b) the experiment group, across five combined categories from the image descriptor classification schema.**

As the bar graph show, there were differences in the distribution of tag types in the folksonomy vocabularies created by the control and experiment group. The largest percentile distribution is found in the activities category. It could be, as noted in the analysis in section

6.3, that the relatively large difference here is at least partially due to the fact that the control group had a stronger focus on objects and object properties. Most of the tags available to the experiment group participants were generic objects, and it is possible that these participants therefore focused on other types of image content and made abstractions instead. This could also perhaps explain the slight difference in the focus on activities in images. At the same time, the distribution tags from the control and experiment group vocabulary in the structural and contextual metadata category does not support this theory.

An additional finding was that it seems that access to existing tags for images reduce folksonomy vocabulary diversity. The overall number of unique terms applied by the experiment group was 422, against 818 for the control group. Then control group applied more tags than the experiment group in each and every one of the categories from the image description classification schema.

**Significance testing**

In order to determine if the observed differences between the folksonomy vocabularies created by the control and experiment group are statistically significant, the results are tested for statistical significance. As with the previous tests, a 0,05 level of significance is chosen; and because two patterns of frequencies are to be examined, a chi-square test of independence is yet again introduced[34]. The numbers of unique annotations and tags in each of the five combined categories were distributed as follows:

| **OBSERVED FREQUENCIES (O)** | | | | | | |
|---|---|---|---|---|---|---|
| | OBJECTS | ACTIVITIES | ABSTRACTIONS | LOCATIONS | S. & C. METADATA | ROW TOTALS |
| **Control group** | **510** | **61** | **140** | **13** | **94** | 818 |
| **Experiment group** | **241** | **38** | **114** | **8** | **21** | 422 |
| Column totals | 751 | 99 | 254 | 21 | 115 | 1240 |

**Table 9: The observed frequencies of unique tags in the folksonomy vocabularies created by a) the control group and b) the experiment group, for five combined categories of image descriptors.**

[34] As the process of determining the Chi-square has already been explained, calculations are omitted here.

The calculated expected frequencies as they would have appeared if there were no differences between the control group and experiment group vocabularies – as the null hypothesis suggests – are shown in the table below:

| EXPECTED FREQUENCIES (E) | | | | | | |
|---|---|---|---|---|---|---|
| | OBJECTS | ACTIVITIES | ABSTRACTIONS | LOCATIONS | S. & C. METADATA | ROW TOTALS |
| **Control group** | **495,4** | **65,3** | **167,6** | **13,9** | **75,9** | 818 |
| **Experiment group** | **255,6** | **33,7** | **86,4** | **7,1** | **39,1** | 422 |
| Column totals | 751 | 99 | 254 | 21 | 115 | 1240 |

**Table 10: : The expected frequencies of unique tags in the folksonomy vocabularies created by a) the control group and b) the experiment group, for five combined categories of image descriptors, assuming the null hypothesis is true.**

A table of critical values for $\chi 2$ shows that $\chi 2$ must be equal to or exceed 9,488 for the test to be statistically significant at the 0,05 level. Calculation gives a Chi-square ($\chi 2$) value of 28,3. As this value is greater than the table value of 9,488 – the result is statistically significant at this level. The result is also statistically significant also at a 0,01 level. As a result, the null hypothesis can be rejected for this data.

## 7.3 Evaluation of the research project design

### 7.3.1 Reliability and validity

Cozby (2007) states that *reliability* refers to "the consistency or stability of a measure of behavior". This means that if the same measuring tool is used repeatedly while studying the same subjects under the same condition and provides similar results each time, it is probable that the measure – and thus the test or experiment in question – has a high degree of reliability. Robson (2002) states that unreliability may have many causes, and that one of them is participant error. Factors such as tiredness could for instance mean that a participant's performance might fluctuate from occasion to occasion. Other possible causes of unreliability mentioned by Robson are participant bias and observer error.

Potential sources of error that could have jeopardized the reliability in this research project in general are (but are not limited to):

1. tag collection errors
2. classification assignment errors
3. the classification scheme

Since all participants received the same images in random order for tagging and used very similar machine-based interfaces for tagging, one can assume that the environment for the collection of tags was stable and thus reliable. The most serious source of error is in the classification phase of the annotations and tags. Here the same classification scheme was used by a single cataloger leading to reasonable stability in the classification process and thus reliability of the result.

High reliability is a prerequisite for high *validity*. Robson states that validity is "concerned with whether the findings are 'really' about what they appear to be about" (2002). Important factors that effect *external validity* in this research project, to which extent one can generalize from the results – are how good the taxonomy-based image annotations from ULB and the folksonomy (folksonomies) represent such image descriptors in general.

### 7.3.2 The image descriptor classification schema

The image descriptor classification schema that was used in this research project has had a strong influence on the investigation of research question 1. The schema is partially founded on two already existing classification systems and should thus have a relatively strong theoretical foundation.

The image descriptor classification schema differentiates between content at element level and global level – i.e. descriptors that refer to specific elements in images and the images as a whole. In theory, this seemed like a good solution, but in practice, it was sometimes difficult to determine whether image descriptors referred to the former or latter. This was especially true for the abstraction and activity categories. As a consequence, it could be that the element and global levels should have been dropped. This would have reduced the number of categories in the schema from 11 to 8, as background and main activities would just have

become *activities*, general abstractions at element and global level would just have been *general abstractions*, and emotional abstractions at element and global level would have become *emotional abstractions*.

Furthermore, the category emotional abstractions at element level contained very few image descriptors – as only 3 unique tags and zero annotations were put here. The emotional category at global level, on the other hand, contained 47 tags. This could indicate that the category *emotional abstractions at element level* is somewhat superfluous.

During the categorization process, two image descriptors could not be categorized. These were tags that replicated text found in images. It is hard to imagine that a category on its own for these types of descriptors is appropriate, but it could indicate that some of the categories are to narrow.

### 7.3.3 Image Tagger

The web-based prototype used during the experiment to gather tags was also an important part of this research project. Perhaps the most important thing about the software was that it enabled users to tag images in an easy and understandable fashion. User comments along with impressions made during participant observations has given the impression that the Image Tagger worked satisfactory. At the same time, there is room for improvement. For instance, one issue that several of the participants mentioned was the fact that there was no way to go back and re-tag an image; i.e. if a participant had confirmed that he or she was done tagging an image, there was no way of undoing this.

An alternative implementation of the Image Tagger could have given the participants the option of tagging certain parts or elements of images, in addition to the image in general. As an example, if a participant noticed a specific element in an image, he or she could mark that portion of the image and tag it. The image-tagging tool incorporated by Facebook makes it possible to tag persons this way, and similarly, Flickr now also enables users to select and tag a portion of an image. Such a feature could have reduced confusion as to whether or not a tag was about a specific element in an image or not, and would possibly have made analysis of the image tags – in terms of differentiation between the element and global level – easier. At

the same time, such a feature would have made no impact on the analysis of the taxonomy-based image descriptors.

### 7.3.4 The introduction the participants got to tagging

During the introduction each of the experiment participants got to tagging, they were told that they were about to tag a selection of images. Furthermore, the participants were told what the term "tagging" means. What was not explained to the participants was *why* they should tag the images – i.e. how tags can be employed to make image collection maneuverable and images in them retrievable. While the majority of the participants – especially those from information science – seemed familiar with the concept of tagging, a few of the participants from media science expressed a frustration over not knowing why they did what they did in their written comments.

In retrospect, it could seem that the taggers should have been provided with an explanation of why they were about to tag the images. At the same time, several web sites that encourage people to tag content – whether it is articles, images, audio, video or other information items – do not really tell people why they should do it. As a consequence, one could argue that the lack of motivational explanation made the experiment realistic.

### 7.3.5 Lacking pilot study

No formal pilot study was performed prior to the experiment. A pilot study is defined by Cozby (2007) as "a small-scale study conducted prior to an actual experiment; designed to test and refine procedures." Even though it can be said that there were few problems that occurred during the experiment sessions, a pilot study could for instance have improved the abovementioned introduction to the experiment which the participants were given.

## 7.4 Conclusions

The first research question in this research project was:

> *What differences exist between image descriptors based on pre-defined domain taxonomies and user generated folksonomies?*

Analysis showed that there is a significant difference between a folksonomy and a vocabulary built from a pre-defined domain taxonomy. In particular, taggers tend to have a strong focus on object descriptors, especially generic ones, such as ‘man’ and ‘car’. Annotators also focus on objects, but not as much as taggers. Also, they seem to have a stronger focus on specific object descriptors, such as person names, than taggers do. Another main difference found is the dissimilar focus on image descriptors that refer to locations in images. While there is a relatively strong focus on image descriptors that refer to locations among the taxonomy-based annotations, this is not the case with the image descriptors found in the folksonomy.

Furthermore, additional findings indicates that a folksonomy contains several terms not found among taxonomy-based descriptors. They also indicate that taggers can replicate some of the terms found among taxonomy-based image descriptors, but that the majority of them are not. This in turn, indicates that image descriptors based on taxonomies and user generated folksonomies complement each other.

The second research question in this research project was:

*How does access to existing tags effect generation of a folksonomy for images?*

First, the experiment indicated that access to existing tags – in the form of the three most popular ones for each image – caused taggers to apply fewer tags. A student’s t-test did however reveal that this result was not statistically significant. Based on the results in this research project, one cannot say that access to existing tags effect the number of tags users apply. Second, the experiment indicated that access to existing tags significantly affects which tags users apply; that they tend to replicate and copy the tags that they have access to. Based on the results in this research project, access to existing tags appears to make a folksonomy vocabulary less diversified. Third, the experiment showed that access to existing tags significantly affect what *types* of tags users apply.

As a final comment, it would be incorrect to state that the results from this project are strong enough to provide definite and conclusive answers to the questions that have been addressed. Further investigation and research have to be made in order to do so. At the same time, the results presented might prove interesting and useful when making similar or related enquiries in the future.

## 7.5 Future research

This research project has shown that a user-generated folksonomy can contribute with several new image descriptors when compared to taxonomy-based descriptors created by professionals. However, it does not tell the story of the quality of either the tags or the annotations with regards to image retrieval. An interesting future research project would be to study how good the two types of image descriptors, and perhaps especially the ones found in the folksonomy, perform in such a setting.

The first null-hypothesis following research question 2 assumed that access to existing, popular tags for images had no effect on the number of tags users apply. Even though the numbers gathered during the experiment indicated that such access reduces the number of tags taggers apply, the data gathered during the experiment were not sufficient to falsify the hypothesis. A research project that involves more participants, i.e. has a larger sample size, would perhaps give a different result. The question is still very interesting.

# 8 References

Burford, B., Briggs, P., & Eakins, J. (2003). A taxonomy of the image: on the classification of content for image retrieval. *Visual Communication, 2*(2), 123.

Cozby, P. (2007). *Methods in Behavioral Research* (9th ed.). New York: McGraw-Hill.

Datta, R., Joshi, D., Li, J., & Wang, J. Z. (2008). Image retrieval: Ideas, influences, and trends of the new age. *ACM Comput. Surv., 40*(2), 1-60.

Delicious: *http://www.delicious.com*

Eakins, J., & Graham, M. (1999). Content-based Image Retrieval. *Tech. rep., JISC Technology Applications Programs*. University of Northumbria at Newcastle.

Flickr: *http://www.flickr.com*

Golder, S. A. & Huberman, B. A. (2006). Usage patterns of collaborative tagging systems. *J. Inf. Sci.* 32, 2 (Apr. 2006), 198-208.

Guy, M., & Tonkin, E. (2006). Folksonomies: Tidying up tags? *D-lib Magazine, 12.* Retrieved May 27th, 2009, from http://webdoc.sub.gwdg.de/edoc/aw/d-lib/dlib/january06/guy/01guy.html

Halpin, H., Robu, V., & Shepherd, H. (2007). The complex dynamics of collaborative tagging. Paper presented at *the 16th International World Wide Web Conference (WWW 2007)*, Banff, Alberta, Canada.

Hove, L.-J. (2004). *Improving Image Retrieval with a Thesaurus for Shapes. The VORTEX prototype.* University of Bergen, Bergen.

Jaimes, A. and S.-F. Chang (2002). Concepts and Techniques for Indexing Visual Semantics. *Image Databases: Search and Retrieval of Digital Imagery.* V. Castelli and L. D. Bergman, John Wiley & Sons, Inc.**:** 497-565.

Mathes, A. (2004). *Folksonomies-cooperative classification and communication through shared metadata*. Retrieved 20th of May, 2009, from http://adammathes.com/academic/computer-mediated-communication/folksonomies.html

Merholz, P. (2004). Metadata for the masses. *Adaptive Path, 19.* Retrieved May 27th, 2009, from http://www.adaptivepath.com/ideas/essays/archives/000361.php

Mitchell, W. (1984). What is an Image? *New Literary History*, 503-537.

National Information Standards Organization (2004). *Understanding metadata*.

Nordbotten, J. C. (2008). *Multimedia Information Retrieval Systems.* Retrieved January 26th, 2009, from http://nordbotten.com/ADM/ADM_book/

Robson, C. (2002). *Real world research: a resource for social scientists and practitioner-researchers*: Blackwell Publishers.

Rui, Y., Huang, T., & Chang, S. (1997). Image retrieval: Past, present, and future. *International Symposium on Multimedia Information Processing, 1997*.

Singhal, A. (2001). Modern Information Retrieval: A Brief Overview. *IEEE Data Engineering Bulletin, 24*(4), 35-43.

Sommerville, I. (2007). *Software Engineering*: Addison-Wesley.

Sundgren, B. (1973). *An Infological approach to Data Bases.* Doctoral thesis, University of Stockholm, Department of Administrative Information Processing. Central Bureau of Statistics, Sweden.

The University Library of Bergen: *http://www.uib.no/ub/*

Trant, J., & Project, W. (2006). Exploring the potential for social tagging and folksonomy in art museums: proof of concept. *New Review of Hypermedia and Multimedia, 12*(1), 83-105.

Trant, J., & Wyman, B. (2006). Investigating social tagging and folksonomy in art museums with steve.museum. In *proceedings of the WWW 2006 Collaborative Web Tagging Workshop*.

Vander Wal, T. (2005). *Explaining and Showing Broad and Narrow Folksonomies.* Retrieved May 25th, 2009, from http://www.vanderwal.net/random/entrysel.php?blog=1635

Wu, H., Zubair, M., & Maly, K. (2006). Harvesting social knowledge from folksonomies. In *Proceedings of the Seventeenth Conference on Hypertext and Hypermedia* (Odense, Denmark, August 22 - 25, 2006). HYPERTEXT '06. ACM Press, New York, NY, 111-114.


# AN ANALYSIS OF IMAGE FOLKSONOMY GENERATION

APPENDICES

# Appendix A – List of definitions

*This appendix contains definitions of central terms used in the masters thesis, ordered alphabetically. Definition numbers are shown in parentheses behind the main term.*

---

**Collaborative tagging** (6): The process by which several users apply keywords or short sentences to shared digital content.

**Collaborative tagging system** (7): A computer-based piece of software that enables several users to add keywords or short sentences to shared digital content.

**Folksonomy** (8): The result of collaborative tagging; the tags applied through that process and their potential.

**Image** (1): A two dimensional, freeze-frame visual representation of an entity or entities, originally produced on a medium, that can be displayed on a computer screen.

**Image metadata** (2): Data about images which describe and explain them for purposes of management and retrieval.

**Tag** (4): A freely chosen keyword or short sentence that is applied to digital content.

**Tagging** (5): The process of applying freely chosen keywords or short sentences to digital content.

**Taxonomy** (3): A pre-defined, hierarchical structure of terms used for description- and classification purposes, within a specific domain.

# Appendix B – The images

*This appendix contains the images that were used in this research project. All originates from the ULB image collection.*

**Image 1**

**Image 2**

**Image 3**

**Image 4**

**Image 5**

**Image 6**

**Image 7**

**Image 8**

**Image 9**

**Image 10**

**Image 11**


**Image 12**

**Image 13**

**Image 14**

**Image 15**

**Image 16**

**Image 17**

**Image 18**

| | |
|---|---|
|  |  |
| **Image 19** | **Image 20** |

# Appendix C – The original image descriptions

*This appendix contains all the original image descriptions for the 20 images – both the ULB annotations and the tags as they were applied by the experiment participants. Each image and its descriptions have a page of their own.*

*The annotations for each image is listed first. These are sorted alphabetically. Then follows the tags, which are sorted by popularity, and then alphabetically. The numbers after each description displays how many times it was applied.*

---

## Image 1

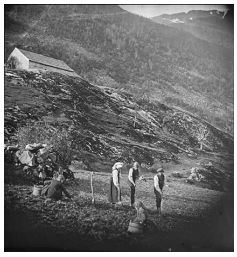
### Annotations

| | |
|---|---|
| 1906-01-01 til 1906-12-31 | 1 |
| Amatørbilde | 1 |
| Arbeidsliv og næringer | 1 |
| Arkitekttegning | 1 |
| Arkitektur og byggeskikk | 1 |
| Gjenstander | 1 |
| Hordaland | 1 |
| Interiør | 1 |
| Karin Prestegård | 1 |
| Kvinnearbeid | 1 |
| Norge | 1 |
| Odda | 1 |
| Olav Holm | 1 |
| To kvinner ved stuebord. (gro Holm t.h.) | 1 |
| Vase | 1 |

### Tags

| | |
|---|---|
| Stue | 9 |
| husmødre | 6 |
| damer | 4 |
| kvinner | 4 |
| Brodering | 3 |
| gardiner | 3 |
| håndarbeid | 2 |
| sofa | 2 |
| vase | 2 |
| 2 kvinner | 1 |
| antakelig i en stue | 1 |
| Bebyggelse utenfor vindu | 1 |
| bildet er tatt mot et vindu | 1 |
| blomster | 1 |
| bord | 1 |
| bord med blomstervaser | 1 |
| dame som syr | 1 |
| dannet hjem | 1 |
| eldre damer | 1 |
| eldre klær og gardiner | 1 |
| flette | 1 |
| Fletter | 1 |
| fredelighet | 1 |
| Frukt | 1 |
| gamle dager | 1 |
| gamledager | 1 |
| gammeldags kvinnesyssel | 1 |
| gammeldags rom | 1 |
| Gardin | 1 |
| hygge | 1 |
| Inne | 1 |
| Kjole | 1 |
| kjoler | 1 |
| kvinnen hekler | 1 |
| kvinnen sitter i en stol | 1 |
| kvinner med oppsatt hår og lange kjoler | 1 |
| Oppholdsrom | 1 |
| Rolig stemning | 1 |
| situasjonsbilde | 1 |
| sort hvitt | 1 |
| Sort-hvit | 1 |
| sort-hvitt bilde | 1 |
| stemning | 1 |
| strikke | 1 |
| strikking | 1 |
| Svart-hvitt | 1 |
| Svart/hvitt | 1 |
| Svart/kvitt | 1 |
| Sy | 1 |
| syersker | 1 |
| søndag | 1 |
| tjenestekvinne (?) som fletter håret til en kvinne | 1 |
| tjenestekvinnen sitter bak | 1 |
| to kvinner | 1 |
| to kvinner som sitter i stuen i sofaen ved vinduet | 1 |
| vennskap | 1 |
| Vindu | 1 |

## Image 2



### Annotations

| | | | |
|---|---|---|---|
| 1864-01-01 til 1869-12-31 | 1 | Jente | 1 |
| Alders og kjønnsgrupper | 1 | Klær | 1 |
| Arkitektur og byggeskikk | 1 | Knud Knudsen | 1 |
| Barn | 1 | Knudsen områder | 1 |
| Barn i arbeid | 1 | Kvinne | 1 |
| Fjell | 1 | Landskap | 1 |
| Folkelivsbilde | 1 | Mann | 1 |
| Gård | 1 | Norge | 1 |
| Hardanger | 1 | Norske folkedrakter | 1 |
| Hardangerdrakt | 1 | Odda | 1 |
| Hardangerskaut | 1 | Potetesoptagning, potetopptak | 1 |
| Hordaland | 1 | Tokheim | 1 |
| Hverdagsklær | 1 | Tradisjonell byggeskikk | 1 |

### Tags

| | | | |
|---|---|---|---|
| fjell | 8 | hus | 1 |
| bønder | 7 | ikledd drakter? | 1 |
| jordbruk | 5 | Innhøsting | 1 |
| familie | 3 | jente | 1 |
| arbeid | 2 | jobber med jorden | 1 |
| bondegård | 2 | kvinner og menn | 1 |
| folkedrakt | 2 | landsakp | 1 |
| gårdsarbeid | 2 | låve | 1 |
| såing | 2 | nasjonalromantisk | 1 |
| åker | 2 | natur | 1 |
| arbeid med åkeren | 1 | norsk kultur | 1 |
| aude stad | 1 | perspektiv | 1 |
| barn | 1 | plukker poteter? | 1 |
| bratt | 1 | poteter | 1 |
| budeie om sommeren | 1 | situasjonsfoto | 1 |
| bøtte | 1 | Skog | 1 |
| dal | 1 | sort hvitt | 1 |
| dyrke | 1 | Sort-hvit bilde | 1 |
| ein stad der ingen kunne tru at nokon kunne bu | 1 | sort-hvitt bilde | 1 |
| eldre foto | 1 | spade | 1 |
| et hus synes i bakgrunnen | 1 | stein | 1 |
| fem personer | 1 | Svart/hvitt | 1 |
| fjellandskap | 1 | såing og høsting | 1 |
| fjellgard | 1 | tine | 1 |
| forholdsvis unge | 1 | tradisjon | 1 |
| gamle dager | 1 | trange kår | 1 |
| grave | 1 | trær | 1 |
| gårdsbruk | 1 | ungdom | 1 |
| Gårdsbyging | 1 | vidde | 1 |
| gårdsdrift | 1 | voksne og barn | 1 |

## Image 3

### Annotations

| | |
|---|---|
| 1962-02-05 til 1962-02-05 | 1 |
| Alders og kjønnsgrupper | 1 |
| Amatørbilde | 1 |
| Arkitektur og byggeskikk | 1 |
| Barn | 1 |
| Bergen | 1 |
| Bolighus | 1 |
| Bygninger | 1 |
| Gjenstander | 1 |
| Gustav Brosing | 1 |
| Hordaland | 1 |
| Kjelke | 1 |
| Klima | 1 |
| Nordnes | 1 |
| Nordnesveien 30A | 1 |
| Nordnesveien 30B | 1 |
| Norge | 1 |
| Nornesveien | 1 |
| Snø | 1 |
| Snøhytte i kroken mellom Nordnesvei 30A og 30B | 1 |
| Strandkaien | 1 |
| Vær | 1 |

### Tags

| | |
|---|---|
| snø | 11 |
| vinter | 11 |
| barn | 10 |
| kjelke | 5 |
| lek | 4 |
| rattkjelke | 4 |
| kjelker | 3 |
| snømann | 3 |
| 3 Rattkjelker | 2 |
| akebrett | 2 |
| leik | 2 |
| Lek i snø | 2 |
| 6 gutter i gaten som lager snøborg | 1 |
| aking | 1 |
| barn som leker | 1 |
| barn som leker i snøen | 1 |
| barn? | 1 |
| Bolighus | 1 |
| by | 1 |
| bygård | 1 |
| gamledager | 1 |
| gutter | 1 |
| gøy | 1 |
| hus | 1 |
| kjelkar | 1 |
| lek i snøen | 1 |
| personene leker med en stor snøhaug foran et hus | 1 |
| rattkjelker | 1 |
| seks personer leker i snøen | 1 |
| situasjonsfoto | 1 |
| sort hvitt | 1 |
| Sort-hvit | 1 |
| sort-hvitt bilde | 1 |
| svart-hvitt | 1 |
| Svart/hvitt | 1 |
| tilbake i tid | 1 |
| tre rattkjelker | 1 |
| trehus | 1 |
| trehusbebyggelse | 1 |
| ungdomsgjeng | 1 |
| vinter i Bergen | 1 |
| vinter og snø | 1 |

## Image 4

### Annotations

| | | | |
|---|---|---|---|
| 1957-01-01 til 1957-12-31 | 1 | Forsvaret | 1 |
| Amatørbilde | 1 | Gjenstander | 1 |
| Bergen | 1 | Gustav Brosing | 1 |
| Bergenhus | 1 | Hordaland | 1 |
| Bergenhus på Kong Haakons begravelsesdag | 1 | Kanon | 1 |
| Flagg | 1 | Norge | 1 |
| Flaggstang | 1 | Samfunn, stat og kommune | 1 |

### Tags

| | | | |
|---|---|---|---|
| kanoner | 13 | kraner | 1 |
| flagg | 9 | markering | 1 |
| kanon | 7 | mast | 1 |
| festning | 3 | master | 1 |
| flagg på halv stang | 3 | militær festning | 1 |
| halv stang | 3 | mur | 1 |
| sorg | 3 | nasjon | 1 |
| krig | 2 | norske flagg | 1 |
| Norsk flagg | 2 | norskeflagg på halvstang | 1 |
| norsk flagg på halv stang | 2 | perspektiv | 1 |
| 17.mai | 1 | På halv stang | 1 |
| artilleri | 1 | salutt | 1 |
| Borg | 1 | sjø | 1 |
| død | 1 | sort hvitt | 1 |
| en rekke med kanoner som er vendt mot venstre side av bilde | 1 | sort-hvitt bilde | 1 |
| | | stillhet | 1 |
| et minnesmerke? | 1 | svart-hvitt | 1 |
| flaggstang | 1 | Svart/hvitt | 1 |
| forsvar | 1 | svart/kvitt | 1 |
| fort | 1 | tragedie | 1 |
| gamle kanoner | 1 | utsiktsplass | 1 |
| halvstang | 1 | vaiende flagg | 1 |
| heisekraner | 1 | voll | 1 |
| kran | 1 | | |

## Image 5

### Annotations

| | | | |
|---|---|---|---|
| 1894-01-01 til 1900-12-31 | 1 | Landskap | 1 |
| Alders og kjønnsgrupper | 1 | Mann | 1 |
| Aust- og Vest-Agder | 1 | Norge | 1 |
| Aust-Agder | 1 | Norske folkedrakter | 1 |
| Fartøy | 1 | Paa Kirkefærd. Dragter Fra Sætersdalen. På Helle-siden mot Straume | 1 |
| Folkelivsbilde | 1 | | |
| Klær | 1 | Robåt | 1 |
| Knud Knudsen | 1 | Setesdalen | 1 |
| Knudsen områder | 1 | Setesdalsdrakt | 1 |
| Kommunikasjon | 1 | Sjøfart | 1 |
| Kristiansand og Sætersdalen | 1 | Vann | 1 |
| Kvinne | 1 | | |

### Tags

| | | | |
|---|---|---|---|
| bunad | 14 | Hav | 1 |
| båt | 10 | høy bunad føring | 1 |
| fjord | 7 | innsjø | 1 |
| fjell | 6 | kvinnene har hodetørkle | 1 |
| båttur | 2 | kvinner | 1 |
| robåt | 2 | menn | 1 |
| sjø | 2 | mennene har hatt | 1 |
| strand | 2 | nasjonalisme | 1 |
| trebåt | 2 | nasjonalromantisk | 1 |
| åre | 2 | Norge i gamledager | 1 |
| 2 menn på land i strandkanten | 1 | personene på land er i ferd med å stige opp i båten | 1 |
| 3 menn | 1 | | |
| 3 menn og 6 damer | 1 | pram | 1 |
| 6 kvinner | 1 | på veg til feiring | 1 |
| alle kvinnene og den ene mannen er i båten | 1 | romantisk | 1 |
| alle personene er ikledd bunad | 1 | seks kvinner og en mann i en robåt | 1 |
| brudeferd i hardanger | 1 | situasjonsbilde | 1 |
| budnad | 1 | skinnbukse | 1 |
| bunader | 1 | sommer og sol | 1 |
| bunadskledde kvinner og menn ved strandkanten i en trebåt | 1 | sort hvitt | 1 |
| | | stille fjord | 1 |
| båttur i finstasen | 1 | stor begivenhet | 1 |
| festdag | 1 | Svart/hvitt | 1 |
| fjell og fjord | 1 | svart/kvitt | 1 |
| folkedrakt | 1 | tenker automatisk på Brudeferden i Hardanger | 1 |
| gamledagar | 1 | to menn på land | 1 |
| gamledager | 1 | tradisjonsrikt | 1 |
| hardanger | 1 | ved et vann omgitt av høye fjell | 1 |
| hatt | 1 | | |

## Image 6

### Annotations

| | | | |
|---|---|---|---|
| 1917-05-27 til 1918-12-31 | 1 | Industri og håndverk | 1 |
| Arbeidsliv og næringer | 1 | Jernbane | 1 |
| Atelier KK | 1 | Jernbanebro | 1 |
| Bergensbanen | 1 | Jernbaneskinner | 1 |
| Buskerud | 1 | Kommunikasjon | 1 |
| Byggeplass | 1 | Landfart | 1 |
| Bygningshåndverk | 1 | Norge | 1 |
| Damplokomotiv | 1 | Reportasje | 1 |
| Geilo | 1 | Statsbanene | 1 |
| Godstog | 1 | Stillas | 1 |
| Handel og industri | 1 | Tog | 1 |
| Hol | 1 | | |

### Tags

| | | | |
|---|---|---|---|
| tog | 12 | gamledager | 1 |
| Jernbane | 10 | gammel bro | 1 |
| bro | 6 | gammel jernbane | 1 |
| damplokomotiv | 6 | godstog | 1 |
| fjell | 3 | industri | 1 |
| konstruksjon | 2 | industrialisering | 1 |
| lokomotiv | 2 | jernbanebro | 1 |
| planker | 2 | jernbanen er omgitt av fjell | 1 |
| røyk | 2 | Kraftlinje | 1 |
| banen ser ganske vaklevoren ut | 1 | landskap | 1 |
| bergensbanen | 1 | reise | 1 |
| bru | 1 | ser ut som damplokomotiv | 1 |
| bygda | 1 | skinner | 1 |
| byggearbeid | 1 | svart-hvitt | 1 |
| damplokmotiv | 1 | Svart/hvitt | 1 |
| damplokomotivet kommer mot oss i bildet | 1 | svart/kvitt | 1 |
| dampmaskin | 1 | tog som kjører over en bro | 1 |
| damptog | 1 | Togbro | 1 |
| difor eldre bilde | 1 | togvogner | 1 |
| dårlig konstruert | 1 | trær i bakgrunnen | 1 |
| fjell og skog | 1 | Ustødig bro | 1 |
| fjøler | 1 | utbygging | 1 |
| frakt av gods | 1 | vidde | 1 |
| gamle dager | 1 | | |

## Image 7

### Annotations

| | |
|---|---|
| 1926-03-13 til 1926-03-13 | 1 |
| Arkitektur og byggeskikk | 1 |
| Atelier KK | 1 |
| Bergen | 1 |
| Brann | 1 |
| Brannen i Haakonsgaten 13.3.1926. Hustak med brannmenn | 1 |
| Brannmann | 1 |
| Brannvesen | 1 |
| Bygninger | 1 |
| Bygningselementer | 1 |
| Haakonsgaten | 1 |
| Historie - hendelser | 1 |
| Hordaland | 1 |
| Murbolig | 1 |
| Norge | 1 |
| Reportasje | 1 |
| Samfunn, stat og kommune | 1 |
| Sentrum | 1 |
| Tak | 1 |

### Tags

| | |
|---|---|
| brann | 16 |
| røyk | 12 |
| bybrann | 4 |
| Brannmenn | 2 |
| brennende hus | 2 |
| bygning | 2 |
| Bygård | 2 |
| tak | 2 |
| antakelig et eldre bilde | 1 |
| bakgård | 1 |
| bilde i svart-hvitt | 1 |
| brann og røyk | 1 |
| brannmenn på taket | 1 |
| by | 1 |
| bygårder | 1 |
| de øverste etasjene i bygårdene | 1 |
| et par brannmenn | 1 |
| fabrikk | 1 |
| fare | 1 |
| fare for spredning | 1 |
| folk på taket | 1 |
| gamle bygninger | 1 |
| hus | 1 |
| Husbrann | 1 |
| hustak | 1 |
| hustak og piper | 1 |
| krise | 1 |
| kullos | 1 |
| mye røyk | 1 |
| oversiktsbilde | 1 |
| røykutvikling | 1 |
| skorsteiner | 1 |
| sort røyk | 1 |
| Sort-hvit | 1 |
| sort-hvitt bilde | 1 |
| storbrann | 1 |
| svart | 1 |
| Svart/hvitt | 1 |
| tragedie | 1 |
| trehus | 1 |
| vinter | 1 |

## Image 8

### Annotations

| | | | |
|---|---|---|---|
| Bergen Munnspillorkester | 1 | Munnspillorkester | 1 |
| Gruppebilde | 1 | Musikk (instrumental og vokal) | 1 |
| Kulturell virksomhet | 1 | Musikkinstrument | 1 |
| Ludvig Thunes | 1 | Orkester | 1 |
| Munnspill | 1 | | |

### Tags

| | | | |
|---|---|---|---|
| munnspill | 15 | kor | 1 |
| 6 menn og 1 kvinne | 4 | kvinne | 1 |
| lystig | 4 | lek | 1 |
| latter | 3 | lystige mennesker | 1 |
| musikk | 3 | mann | 1 |
| glede | 2 | menn | 1 |
| lystig lag | 2 | menn i dress og slips | 1 |
| morsomt | 2 | moro | 1 |
| 70 tallet | 1 | morsomme ansiktsuttrykk | 1 |
| alle spiller på munnspill | 1 | munnspel | 1 |
| band | 1 | munnspilling | 1 |
| ei kvinne i midten | 1 | Musikere | 1 |
| eldre bilde i svart-hvitt | 1 | musikk og morro | 1 |
| fest | 1 | penklær | 1 |
| fest og morro | 1 | ring | 1 |
| festhumør | 1 | seks menn og en kvinne | 1 |
| festlig sammenkomst | 1 | sikkert dårlig musikk | 1 |
| gammeldags | 1 | situasjonsbilde | 1 |
| gammeldags fyll | 1 | smil | 1 |
| glade mennesker | 1 | sort hvitt | 1 |
| god steming | 1 | Sort-hvitt | 1 |
| godt humør | 1 | sort-hvitt bilde | 1 |
| gruppe | 1 | Spiller | 1 |
| harmonica | 1 | strikkegenser | 1 |
| hygge | 1 | Svart/hvitt | 1 |
| hårsveiser | 1 | svart/kvitt | 1 |
| jakke | 1 | tilbake i tid | 1 |
| klokke | 1 | | |

## Image 9

### Annotations

| | |
|---|---|
| 1924-01-01 til 1926-12-31 | 1 |
| Alders og kjønnsgrupper | 1 |
| Atelier KK | 1 |
| Dal | 1 |
| Fjell | 1 |
| Gruppebilde | 1 |
| Gutt | 1 |
| Hordaland | 1 |
| Jente | 1 |
| Kvinne | 1 |
| Kvinne med to barn fotografert på Stalheim ca. 1925 | 1 |
| Landskap | 1 |
| Norge | 1 |
| Stalheim | 1 |
| Voss | 1 |

### Tags

| | |
|---|---|
| fjell | 9 |
| barn | 6 |
| familie | 5 |
| fjord | 4 |
| hatt | 3 |
| portrett | 3 |
| dal | 2 |
| Høye fjell | 2 |
| idyll | 2 |
| landskap | 2 |
| sommer | 2 |
| søsken | 2 |
| 2 barn og 1 voksen | 1 |
| blide personer | 1 |
| bratte fjellsider | 1 |
| bror og søster | 1 |
| dameog barn-trolig mor og barn | 1 |
| eldre foto | 1 |
| en gutt og ei jente | 1 |
| en voksen kvinne og to små barn | 1 |
| famileidyll | 1 |
| familiebilde | 1 |
| fantastiske fjell | 1 |
| fjellandskap omkring | 1 |
| fjellheim | 1 |
| fjelltur | 1 |
| gammelt foto | 1 |
| gras | 1 |
| gudvangen | 1 |
| hyggelig | 1 |
| hånd i hånd | 1 |
| jente og gutt | 1 |
| kjernefamilie | 1 |
| lykke | 1 |
| nasjonalromantisk | 1 |
| naturskjønn bakgrunn | 1 |
| pene klær | 1 |
| pynt | 1 |
| solskinnstur | 1 |
| sommerdag | 1 |
| Sort-hvit | 1 |
| sort-hvitt bilde | 1 |
| svart-hvitt | 1 |
| Svart/hvitt | 1 |
| svart/kvitt | 1 |
| tre personer poserer | 1 |
| turisme | 1 |
| utsikt | 1 |
| veldig nasjonalromantisk | 1 |
| vestlandsk natur | 1 |
| vår/sommer | 1 |

## Image 10

### Annotations

| | | | |
|---|---|---|---|
| 1928-01-01 til 1928-12-31 | 1 | Interiør og innredning | 1 |
| Alders og kjønnsgrupper | 1 | Kalfaret | 1 |
| Arbeidsliv og næringer | 1 | Kalfarveien | 1 |
| Atelier K. Knudsen | 1 | Kalfarveien 2 | 1 |
| Bergen | 1 | Laboratorium | 1 |
| Bergens Handelsgymnasium | 1 | Lærer | 1 |
| Elever i laboratoriet på Bergens Handelsgymnasium | 1 | Mann | 1 |
| | | Mikroskop | 1 |
| Gjenstander | 1 | Norge | 1 |
| Gruppebilde | 1 | Skoleelever | 1 |
| Gymnas | 1 | Ungdom | 1 |
| Haukeland | 1 | Utdanning | 1 |
| Hordaland | 1 | Yrker | 1 |
| Interiør | 1 | | |

### Tags

| | | | |
|---|---|---|---|
| labratorium | 9 | kjemikaler | 1 |
| kjemi | 8 | krakk | 1 |
| lab | 5 | Laboratorie | 1 |
| forskere | 3 | laboratorium | 1 |
| mikroskop | 3 | leger | 1 |
| undervisning | 3 | mansdominert | 1 |
| Hvite frakker | 2 | medisinstudier før i tiden | 1 |
| skole | 2 | naturvitenskap | 1 |
| 7 forskere | 1 | reagensglas | 1 |
| arbeidsplass | 1 | sort hvitt | 1 |
| bok | 1 | stol | 1 |
| dag | 1 | studenter | 1 |
| ekpsperimenter | 1 | Studere | 1 |
| eksperiment | 1 | studering | 1 |
| eksperimentering | 1 | Studier | 1 |
| ekspriment | 1 | svart-hvitt | 1 |
| eldre bilde | 1 | Svart/hvitt | 1 |
| en uten hvit frakk | 1 | svart/kvitt | 1 |
| fem av dem ved et langbord/disk | 1 | syv gutter | 1 |
| Forskning | 1 | tavle | 1 |
| frakker | 1 | tilbake i tid | 1 |
| gamledagar | 1 | to sitter ved et bord | 1 |
| hvit frakk | 1 | undervisningsrom? | 1 |
| hvite fragger | 1 | unge menn | 1 |
| innendørs | 1 | Vitenskapsmenn | 1 |
| kjemiforsøk? | 1 | votenskap | 1 |

## Image 11

### Annotations

| | | | |
|---|---|---|---|
| 1945-01-01 til 1950-12-31 | 1 | Interiør og innredning | 1 |
| Alders og kjønnsgrupper | 1 | Kjøkken | 1 |
| Arbeidsliv og næringer | 1 | Klær | 1 |
| Atelier KK | 1 | Komfyr | 1 |
| Bergen | 1 | Kvinne | 1 |
| Bergens Husmorskole | 1 | Kvinnearbeid | 1 |
| Bord | 1 | Møbler | 1 |
| Forkle | 1 | Møhlenprisbakken | 1 |
| Gruppebilde | 1 | Møhlenprisbakken 12 | 1 |
| Hordaland | 1 | Norge | 1 |
| Husmorskole | 1 | Nygårdshøyden | 1 |
| Hverdagsklær | 1 | Skoleelever | 1 |
| Interiør fra Husmorskolen i Bergen | 1 | Utdanning | 1 |

### Tags

| | | | |
|---|---|---|---|
| Matlaging | 14 | jentene/kvinnene lager mat | 1 |
| husmorskole | 11 | Jenter | 1 |
| Kvinner | 11 | kasserolle | 1 |
| husmor | 3 | kjedelig | 1 |
| mat | 3 | kjønnsroller | 1 |
| forkle | 2 | komfyr | 1 |
| Kjøkken | 2 | konsentrasjon | 1 |
| opplæring | 2 | mange jenter i forkler med tørkler på hodet | 1 |
| skole | 2 | mange unge kvinner i forklé og skaut | 1 |
| uniform | 2 | rutine | 1 |
| 50 tallet | 1 | skolekjøkken | 1 |
| 80-tall | 1 | skuff | 1 |
| alvorlig stemning | 1 | sort hvitt | 1 |
| bolle | 1 | Sort-hvit | 1 |
| bord | 1 | sort-hvitt bilde | 1 |
| damer med hodebryd | 1 | svart-hvitt | 1 |
| elever | 1 | Svart/hvitt | 1 |
| gamle komfyrer og møbler | 1 | svart/kvitt | 1 |
| husmorskkole | 1 | trangt | 1 |
| husmorskole? | 1 | undervisning i matlagning | 1 |
| husmødre | 1 | vedkomfyr | 1 |
| ikkje akkuratt femininsme | 1 | | |

## Image 12

### Annotations

| | | | |
|---|---|---|---|
| 1900-01-01 til 1903-12-31 | 1 | Kommunikasjon | 1 |
| Bergen | 1 | Landskap | 1 |
| By- og småsteder | 1 | Norge | 1 |
| Byprospekt | 1 | Parti av Havnen i Trondhjem | 1 |
| Båter | 1 | Sjøfart | 1 |
| Fartøy | 1 | Storheia | 1 |
| Fraktefartøy | 1 | Sør-Trøndelag | 1 |
| Havn | 1 | Trondheim | 1 |
| Hordaland | 1 | Trondheim havn | 1 |
| Knud Knudsen | 1 | Trondhjem og Omegn | 1 |
| Knudsen områder | 1 | | |

### Tags

| | | | |
|---|---|---|---|
| brygge | 8 | gammelt | 1 |
| havn | 7 | garn | 1 |
| båt | 5 | gråvær | 1 |
| Båter | 4 | hansa | 1 |
| fiskebåter | 3 | havneby | 1 |
| Fjell | 3 | Hus | 1 |
| våg | 3 | husene minner igjen om Bergen | 1 |
| fiske | 2 | Jakt | 1 |
| Kai | 2 | last i båtene? | 1 |
| mast | 2 | lave fjell i bakgrunnen | 1 |
| pram | 2 | seilskute | 1 |
| seilbåter | 2 | seilskuter | 1 |
| sjø | 2 | sjøhus | 1 |
| skip | 2 | snekker | 1 |
| bergen | 1 | sort hvitt | 1 |
| bilde fra en havn | 1 | sort- hvitt bilde | 1 |
| by | 1 | Sort-hvit | 1 |
| bylandskap | 1 | stille sjø | 1 |
| båtar | 1 | storheia | 1 |
| båthavn | 1 | sund | 1 |
| fint | 1 | svart-hvitt | 1 |
| fjell og sjø | 1 | Svart/hvitt | 1 |
| flere trebåter ligger til kai | 1 | svart/kvitt | 1 |
| fortøyning | 1 | trebåt | 1 |
| fortøyninger | 1 | trebåter | 1 |

## Image 13

### Annotations

| | | | |
|---|---|---|---|
| 1930-01-01 til 1935-12-31 | 1 | Hverdagsklær | 1 |
| Arbeidsklær | 1 | Klær | 1 |
| Arbeidsliv og næringer | 1 | Kvinneklær | 1 |
| Bergen: Fisketorvet | 1 | Landskap | 1 |
| By- og småsteder | 1 | Postkort | 1 |
| Fisk | 1 | Torg | 1 |
| Fiskehandel | 1 | Torghandel | 1 |
| Fiskehandler | 1 | Vekt | 1 |
| Fisketorget | 1 | Yrker | 1 |
| Gjenstander | 1 | Yrkesklær og uniformer | 1 |
| Handel | 1 | Zachariasbryggen | 1 |
| Hodetørkle | 1 | | |

### Tags

| | | | |
|---|---|---|---|
| fisk | 13 | historie | 1 |
| handel | 12 | innkjøp | 1 |
| dame | 3 | kjøp og salg | 1 |
| fiskehandel | 3 | kvinne | 1 |
| torg | 3 | mange mennesker på en åpen plass med bygninger i bakgrunnen | 1 |
| fisketorg | 2 | marked | 1 |
| fisketorget | 2 | mye folk | 1 |
| hatt | 2 | nesten alle mennene har hatt | 1 |
| kjøpmann | 2 | samling mennesker | 1 |
| mann | 2 | situasjonsbilde | 1 |
| salg | 2 | solskinnsdag | 1 |
| torghandel | 2 | sort hvitt | 1 |
| betaling | 1 | sort-hvitt bilde | 1 |
| bybebyggelse | 1 | striler | 1 |
| Bygninger | 1 | svart-hvitt | 1 |
| eldre bilde | 1 | Svart/hvitt | 1 |
| eldre foto | 1 | svart/kvitt | 1 |
| en kvinne kjøper fisk av en mann | 1 | tilbake i tid | 1 |
| fiskemarked | 1 | torghandler | 1 |
| Fiskertorg | 1 | tradisjon i bergen | 1 |
| fiskesalg | 1 | trangt | 1 |
| folksomt | 1 | | |
| gamle fisketorget | 1 | | |
| gamledager | 1 | | |

## Image 14

### Annotations

| | | | |
|---|---|---|---|
| 1904-01-15 til 1904-01-15 | 1 | Hvalstæng paa Bildøen | 1 |
| Amatørbilde | 1 | Klima | 1 |
| Arbeidsliv og næringer | 1 | Kommunikasjon | 1 |
| Bildøy | 1 | Norge | 1 |
| Fartøy | 1 | Ralph L. Wilson | 1 |
| Fiske og fangst | 1 | Robåt | 1 |
| Fjell Ho | 1 | Sjøfart | 1 |
| Hordaland | 1 | Snø | 1 |
| Hval | 1 | Vær | 1 |
| Hvalfangst | 1 | | |

### Tags

| | | | |
|---|---|---|---|
| spekkhogger | 15 | forferdelig | 1 |
| fangst | 7 | gamledager | 1 |
| vinter | 7 | garn | 1 |
| hvalfangst | 6 | inne ved land | 1 |
| fiskere | 4 | kanskje snø | 1 |
| båt | 3 | menn | 1 |
| båter | 3 | menn i åpne tre-robåter | 1 |
| fiske | 2 | nordnorge | 1 |
| Fjord | 2 | Robåter | 1 |
| robåt | 2 | samarbeid | 1 |
| snø | 2 | sjø | 1 |
| trebåt | 2 | slipp willy fri | 1 |
| Berg | 1 | sort hvitt | 1 |
| beskyttelse | 1 | Sort-hvit | 1 |
| bilde i svart-hvitt | 1 | sort-hvitt bilde | 1 |
| eldre bilde | 1 | spekkhogger? | 1 |
| eldre fiske | 1 | striler | 1 |
| en spekkhogger ligger i vannflaten | 1 | Svart/hvitt | 1 |
| fangstteknikk | 1 | svart/kvitt | 1 |
| fiskebåter | 1 | vann | 1 |
| fisker | 1 | vinter og snø | 1 |
| Fjell | 1 | willy | 1 |

## Image 15

### Annotations

| | | | |
|---|---|---|---|
| 1900-01-01 til 1904-12-31 | 1 | Interiør og innredning | 1 |
| Altertavle | 1 | Kirke | 1 |
| Arkitektur og byggeskikk | 1 | Knudsen områder | 1 |
| Bergen og omegn | 1 | Knudsen, Knud & Co | 1 |
| Bergenhus | 1 | Mariakirken | 1 |
| Bygninger | 1 | Norge | 1 |
| Hordaland | 1 | St. Mariekirken, Bergen. Interiør. Eneret 1904 | 1 |

### Tags

| | | | |
|---|---|---|---|
| kirke | 15 | Jesus på korset | 1 |
| alter | 12 | konfirmasjon | 1 |
| altertavle | 7 | kristelig | 1 |
| kors | 6 | kristendom | 1 |
| jesus | 4 | kunst | 1 |
| gud | 3 | lys | 1 |
| religion | 3 | Lysestaker | 1 |
| alter i en kirke | 2 | muligens et bilde av maleri | 1 |
| Døpefont | 2 | mur | 1 |
| krusifiks | 2 | relieff | 1 |
| kyrkje | 2 | svart-hvitt | 1 |
| Sort-hvitt | 2 | Svart/hvitt | 1 |
| Steinkirke | 2 | svart/kvitt | 1 |
| alterbenk | 1 | takhvelving | 1 |
| Alterring | 1 | takhvelvinger | 1 |
| Benker | 1 | tro | 1 |
| hvit duk og hvite lys | 1 | uklart bilde | 1 |
| ingen mennesker | 1 | Vindu | 1 |
| interiør | 1 | | |

## Image 16

### Annotations

| | |
|---|---|
| 1960-01-01 til 1963-12-31 | 1 |
| "Bergen, Bryggen. ""Oster"" gikk sin siste tur 01.01.1964" | 1 |
| Bergenhus | 1 |
| Bryggen | 1 |
| By- og småsteder | 1 |
| Bymiljø | 1 |
| Dampskip | 1 |
| Fartøy | 1 |
| Fiskebåt | 1 |
| Fjordabåt | 1 |
| Hordaland | 1 |
| Kommunikasjon | 1 |
| Landfart | 1 |
| Landskap | 1 |
| Mittet & Co. | 1 |
| Motorkjøretøy | 1 |
| Norge | 1 |
| Oversiktsbilde | 1 |
| Personbil | 1 |
| Postkort | 1 |
| Sjøfart | 1 |
| Torget | 1 |
| Varebil | 1 |
| Vågen | 1 |
| Vågsbunnen | 1 |

### Tags

| | |
|---|---|
| bryggen | 12 |
| bergen | 11 |
| vågen | 5 |
| Trafikk | 4 |
| biler | 3 |
| båt | 3 |
| gamle biler | 3 |
| havn | 3 |
| byliv | 2 |
| Båter | 2 |
| torg | 2 |
| torget | 2 |
| bergen 1950-tallet | 1 |
| bergen i gamledager | 1 |
| bergen i solskinn | 1 |
| bergenhus | 1 |
| bilar | 1 |
| Bilder | 1 |
| biler i gatene | 1 |
| biltrafikk i gatene | 1 |
| brannbil | 1 |
| Brygge | 1 |
| bryggen i bergen | 1 |
| byfjord | 1 |
| bylandskap | 1 |
| Eldre bilde av Bryggen | 1 |
| eldre bilde fra Bergen | 1 |
| en del mennesker | 1 |
| fargebilde | 1 |
| farger | 1 |
| festning | 1 |
| fint vær | 1 |
| flaggdag | 1 |
| folksomt | 1 |
| fra Fisketorget mot Bryggen | 1 |
| frederlig krigstid? | 1 |
| fruksalg | 1 |
| hamn | 1 |
| Hansa | 1 |
| havet | 1 |
| i farger | 1 |
| lastebil | 1 |
| lett fugleperspektiv | 1 |
| liv og røre | 1 |
| mange båter ligger til kai | 1 |
| norske flagg | 1 |
| postkort | 1 |
| postkort? | 1 |
| rosenkrantztårnet | 1 |
| sol | 1 |
| sommer | 1 |
| tilbake i tid | 1 |
| torget i Bergen | 1 |
| torghandel | 1 |

## Image 17

### Annotations

| | | | |
|---|---|---|---|
| 1960-01-01 til 1970-12-31 | 1 | Landfart | 1 |
| Arbeidsliv og næringer | 1 | Motorkjøretøy | 1 |
| Bergen. Parti fra Vågen | 1 | Norge | 1 |
| Buss | 1 | Normanns Kunstforlag | 1 |
| Bygningsportrett | 1 | Personbil | 1 |
| Fisketorget | 1 | Postkort | 1 |
| Handel | 1 | Torget | 1 |
| Hordaland | 1 | Torghandel | 1 |
| Kommunikasjon | 1 | Vågsbunnen | 1 |

### Tags

| | | | |
|---|---|---|---|
| Bergen | 13 | fisketorget i Bergen | 1 |
| fisketorget | 12 | Fraktebåter | 1 |
| buss | 7 | gamle busser | 1 |
| bryggen | 2 | Gul buss | 1 |
| Busser | 2 | gule busser | 1 |
| Bygninger | 2 | hamn | 1 |
| diplom is | 2 | handel | 1 |
| Fargebilde | 2 | havn | 1 |
| sommer | 2 | Kai | 1 |
| torget | 2 | kløverhuset | 1 |
| antakelig fisketorget i Bergen for en del år siden | 1 | mange fiskeboder | 1 |
| | | nesten folketomt fisketorg | 1 |
| bergen sentrum | 1 | oversikt | 1 |
| bildet er tatt mot Torgalmenningen og Strandkaien | 1 | Salgsbygninger | 1 |
| | | sjø | 1 |
| Biler | 1 | skyer | 1 |
| bod | 1 | sol i bergen | 1 |
| boder | 1 | sommer og sol | 1 |
| bussar | 1 | strandkaien | 1 |
| by | 1 | tilbake i tid | 1 |
| bybebyggelse | 1 | torg | 1 |
| bylandskap | 1 | torghandel | 1 |
| båt | 1 | Trafikk | 1 |
| farger | 1 | veteranbuss | 1 |
| fargerikt | 1 | vågen | 1 |
| fint vær | 1 | vår | 1 |
| firsketorget | 1 | vår/sommer | 1 |
| Fiskertorg | 1 | | |

## Image 18

### Annotations

| | |
|---|---|
| 1950-01-01 til 1960-10-07 | 1 |
| Arbeidsliv og næringer | 1 |
| Bergen, Torget med Bryggen | 1 |
| Bergenhus | 1 |
| Bryggen | 1 |
| Bymiljø | 1 |
| Fisketorget | 1 |
| Handel | 1 |
| Hordaland | 1 |
| Hverdagsklær | 1 |
| Klær | 1 |
| Mittet & Co. | 1 |
| Norge | 1 |
| Postkort | 1 |
| Torghandel | 1 |
| Vågen | 1 |
| Vågsbunnen | 1 |

### Tags

| | |
|---|---|
| Frukt | 8 |
| Handel | 8 |
| Bergen | 6 |
| bryggen | 5 |
| appelsiner | 4 |
| båt | 3 |
| Torg | 3 |
| eple | 2 |
| epler | 2 |
| fisketorget | 2 |
| hatt | 2 |
| marked | 2 |
| torget | 2 |
| torget i Bergen | 2 |
| appelsin | 1 |
| apples | 1 |
| bil | 1 |
| Biler | 1 |
| box | 1 |
| Brygge | 1 |
| bryggen i bergen | 1 |
| Båter | 1 |
| båthavn | 1 |
| eldre mennesker | 1 |
| fargebilde | 1 |
| farger | 1 |
| fisketorget i bergen | 1 |
| Frukthandel | 1 |
| Frukthandler | 1 |
| fruktmarked | 1 |
| fruktsalg | 1 |
| fruktselgere | 1 |
| frukttorg | 1 |
| gamle damer | 1 |
| gamledager | 1 |
| gammel kjærring | 1 |
| gammel mann | 1 |
| grønnsakstorg | 1 |
| handlende damer | 1 |
| hansa | 1 |
| kai | 1 |
| kjerre | 1 |
| kjøpmann | 1 |
| kvinne | 1 |
| kåpe | 1 |
| mann | 1 |
| mannlig fruktselger med hatt og frakk | 1 |
| omgivelsene minner om Bryggen/fisketorget i Bergen | 1 |
| skip | 1 |
| solskinnsdag | 1 |
| tilbake i tid | 1 |
| tonhi apples | 1 |
| torghandel | 1 |
| tyskerbryggen | 1 |
| veske | 1 |
| våg | 1 |
| vågen | 1 |
| vår eller sommer | 1 |

## Image 19

### Annotations

| | | | |
|---|---|---|---|
| 1960-07-04 til 1960-07-04 | 1 | Kronstad Idrettsplass | 1 |
| Bergen | 1 | Landskap | 1 |
| Boligblokk | 1 | Minde | 1 |
| By- og småsteder | 1 | Norge | 1 |
| Fjøsangerveien | 1 | Oversiktsbilde | 1 |
| Fjøsangerveien 38b | 1 | Sentrum | 1 |
| Flyfoto | 1 | Solheim | 1 |
| Hordaland | 1 | Sport, idrett og friluftsliv | 1 |
| Idrettsbane | 1 | Store Lungegårdsvann | 1 |
| Kronstad | 1 | Widerøes Flyveselskap A/S | 1 |

### Tags

| | | | |
|---|---|---|---|
| fotballbane | 10 | fjord | 1 |
| By | 8 | folketom idrettsstadion | 1 |
| bylandskap | 5 | fotballbane i midten av bildet | 1 |
| danmarksplass | 3 | Fotballstadion | 1 |
| sjø | 3 | Fritidsbåter | 1 |
| stadion | 3 | Gater | 1 |
| fotball | 2 | hamn | 1 |
| oversiktsbilde | 2 | Hav | 1 |
| sommer | 2 | havn | 1 |
| store lungegårdsvann | 2 | hus | 1 |
| vann | 2 | i | 1 |
| allé | 1 | Idrettsanlegg | 1 |
| Bergen | 1 | idyllisk | 1 |
| bildet er i farger | 1 | ingen mennersker kan skimtes | 1 |
| blokker | 1 | ingen menneske | 1 |
| bukt | 1 | kronstad | 1 |
| bybebyggelse | 1 | landskap | 1 |
| bybilde | 1 | mange hus på alle kanter | 1 |
| bydel | 1 | moderne | 1 |
| Byggninger | 1 | natur | 1 |
| bygninger | 1 | oversikt | 1 |
| Bygårder | 1 | ovresiktsbilde | 1 |
| Båter | 1 | seilbåter | 1 |
| båthavn | 1 | sol | 1 |
| eneboliger | 1 | solskinn | 1 |
| et vann lengst vekk i bildet | 1 | sommerdag | 1 |
| Fargebilde | 1 | tank | 1 |
| farger | 1 | utsikt | 1 |
| fint ver | 1 | vår/sommer | 1 |

## Image 20

### Annotations

| | | | |
|---|---|---|---|
| 1962-06-17 til 1962-06-17 | 1 | Landskap | 1 |
| Arkitektur og byggeskikk | 1 | Langavatnet | 1 |
| Bergen | 1 | Norge | 1 |
| By- og småsteder | 1 | Nyborg | 1 |
| Espelid | 1 | Oversiktsbilde | 1 |
| Espelid, Nyborg | 1 | Tradisjonell byggeskikk | 1 |
| Flyfoto | 1 | Widerøes Flyveselskap A/S | 1 |
| Gård | 1 | Åsane | 1 |
| Hordaland | 1 | | |

### Tags

| | | | |
|---|---|---|---|
| gård | 11 | Landskap | 1 |
| bygd | 5 | låve | 1 |
| vann | 4 | løe | 1 |
| gårdstun | 3 | løer | 1 |
| sommer | 3 | mark | 1 |
| fjord | 2 | muligens bilde av en gård | 1 |
| Fjøs | 2 | muligens norsk bygdelandskap | 1 |
| Gard | 2 | mye grønn mark | 1 |
| grønn | 2 | nasjonalromantisk men bare moderne versjon | 1 |
| jorder | 2 | natur | 1 |
| sjø | 2 | noen hus ved et vann | 1 |
| Steingjerde | 2 | rødmalte låver | 1 |
| beitemark | 1 | samhold | 1 |
| bondegård | 1 | Skog | 1 |
| en åkerflekk | 1 | sommer og sol | 1 |
| farger | 1 | steingard | 1 |
| fjell | 1 | tun | 1 |
| flyfoto | 1 | utenfor allfarvei | 1 |
| grend | 1 | utmark | 1 |
| gress | 1 | Vei | 1 |
| grønne enger | 1 | vestlandsgård | 1 |
| grønne jorder | 1 | våg | 1 |
| grønt | 1 | vår/sommer | 1 |
| gårdsbruk | 1 | Åker | 1 |
| gårdsdrift | 1 | åker og eng | 1 |
| Hovedhus | 1 | | |
| hvitmalte gårdshus | 1 | | |
| idyll | 1 | | |
| innland | 1 | | |
| innsjø | 1 | | |
| jordet | 1 | | |
| kulturlandskap | 1 | | |
| landlige omgivelser | 1 | | |
| landsbygda | 1 | | |

# Appendix D – The popular tags

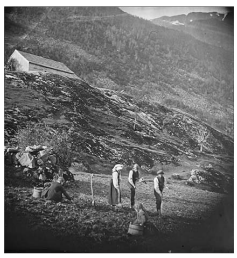
*This appendix contains the three popular tags for each image that were visible to the participants in the experiment group while they tagged images. The tags' popularity are based on the tags that were applied by the participants in the control group.*

---

## Image 1

| Popular tags | Count |
|---|---|
| stue | 3 |
| damer | 2 |
| husmødre | 2 |

## Image 2



| Popular tags | Count |
|---|---|
| fjell | 4 |
| bønder | 3 |
| familie | 2 |

## Image 3

| Popular tags | Count |
|---|---|
| barn | 5 |
| vinter | 4 |
| snø | 4 |

## Image 4

| Popular tags | Count |
|---|---|
| kanoner | 5 |
| flagg | 3 |
| kanon | 3 |

## Image 5

| Popular tags | Count |
|---|---|
| bunad | 5 |
| båt | 4 |
| fjell | 3 |

## Image 6

| Popular tags | Count |
|---|---|
| tog | 7 |
| jernbane | 3 |
| bro | 3 |

## Image 7

| Popular tags | Count |
|---|---|
| brann | 7 |
| røyk | 4 |
| bybrann | 2 |

## Image 8

| Popular tags | Count |
|---|---|
| munnspill | 6 |
| 6 menn og 1 kvinne | 2 |
| lystig | 2 |

## Image 9

| Popular tags | Count |
|---|---|
| barn | 3 |
| fjell | 2 |
| fjord | 2 |

## Image 10

| Popular tags | Count |
|---|---|
| kjemi | 3 |
| lab | 2 |
| labratorium | 2 |

## Image 11

| Popular tags | Count |
|---|---|
| matlaging | 4 |
| husmorskole | 4 |
| kvinner | 3 |

## Image 12

| Popular tags | Count |
|---|---|
| brygge | 3 |
| fjell | 3 |
| havn | 3 |

## Image 13

| Popular tags | Count |
|---|---|
| handel | 6 |
| fisk | 4 |
| dame | 2 |

## Image 14

| Popular tags | Count |
|---|---|
| spekkhogger | 6 |
| fangst | 4 |
| hvalfangst | 3 |

## Image 15

| Popular tags | Count |
|---|---|
| kirke | 6 |
| alter | 4 |
| altertavle | 3 |

## Image 16

| Popular tags | Count |
|---|---|
| Bergen | 5 |
| Bryggen | 5 |
| trafikk | 3 |

## Image 17

| Popular tags | Count |
|---|---|
| Fisketorget | 5 |
| Bergen | 4 |
| buss | 3 |

## Image 18

| Popular tags | Count |
|---|---|
| handel | 3 |
| frukt | 3 |
| appelsiner | 2 |

## Image 19

| Popular tags | Count |
|---|---|
| fotballbane | 4 |
| by | 3 |
| bylandskap | 2 |

## Image 20

| Popular tags | Count |
|---|---|
| gård | 5 |
| vann | 3 |
| bygd | 2 |

# Appendix E – The ULB annotations categorized

*This appendix shows the ULB annotations categorized using the image descriptor classification schema, which was presented in chapter 3. As explained in that same chapter, some of the annotations were divided in order to perform the classification.*

---

## Image 1

### ELEMENT LEVEL

**GENERIC OBJECTS:**
Gjenstander
Interiør
kvinner
stuebord
Vase

**SPECIFIC OBJECTS:**
Gro Holm
Karin Prestegård

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
Arkitekttegning
Arkitektur
Byggeskikk

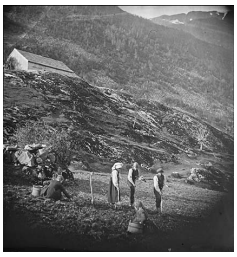
### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
Arbeidsliv
Kvinnearbeid
næringer

**LOCATIONS:**
Hordaland
Norge
Odda

**STRUCTURAL AND CONTEXTUAL METADATA:**
1906-01-01 til 1906-12-31
Amatørbilde
Olav Holm

## Image 2



### ELEMENT LEVEL

**GENERIC OBJECTS:**
barn
Fjell
Gård
Hardangerdrakt
Hardangerskaut
Hverdagsklær
Jente
Klær
Kvinne
Landskap
Mann
Norske folkedrakter

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
Alders og kjønnsgrupper
Arkitektur
byggeskikk
Tradisjonell byggeskikk

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
arbeid
Potetesoptagning
potetopptak

**LOCATIONS:**
Hardanger
Hordaland
Knudsen områder
Norge
Odda
Tokheim

**STRUCTURAL AND CONTEXTUAL METADATA:**
1864-01-01 til 1869-12-31
Folkelivsbilde
Knud Knudsen

## Image 3

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Barn

Bolighus

Bygninger

Gjenstander

Kjelke

kroken

Snø

Snøhytte

**SPECIFIC OBJECTS:**

Nordnesveien 30A

Nordnesveien 30B

Nornesvei 30A og 30B

Nornesveien

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Alders og kjønnsgrupper

Arkitektur

Byggeskikk

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Klima

Vær

**LOCATIONS:**

Bergen

Hordaland

Nordnes

Norge

Strandkaien

**STRUCTURAL AND CONTEXTUAL METADATA:**

1962-02-05 til 1962-02-05

Amatørbilde

Gustav Brosing

## Image 4

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Flagg

Flaggstang

Gjenstander

Kanon

**SPECIFIC OBJECTS:**

Bergenhus

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Forsvaret

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

begravelsesdag

kommune

Kong Haakons

samfunn

stat

**STRUCTURAL AND CONTEXTUAL METADATA:**

1957-01-01 til 1957-12-31

Amatørbilde

Gustav Brosing

**LOCATIONS:**

Bergen

Hordaland

Norge

## Image 5

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Dragter
Fartøy
Klær
Kvinne
Landskap
Mann
Norske folkedrakter
Robåt
Setesdalsdrakt
Vann

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Alders og kjønnsgrupper

Kommunikasjon

Sjøfart

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**

Kirkefærd

**LOCATIONS:**

Aust- og Vest-Agder
Aust-Agder
Helle-siden
Knudsen områder
Kristiansand
Norge
Setesdalen
Straume
Sætersdalen

**STRUCTURAL AND CONTEXTUAL METADATA:**

1894-01-01 til 1900-12-31

Folkelivsbilde

Knud Knudsen

## Image 6

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Byggeplass

Damplokomotiv

Godstog

Jernbane

Jernbanebro

Jernbaneskinner

Stillas

Tog

**SPECIFIC OBJECTS:**

Bergensbanen

Statsbanene

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Bygningshåndverk

Handel

Håndverk

Industri

Kommunikasjon

Landfart

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Arbeidsliv

næringer

Reportasje

**LOCATIONS:**

Buskerud
Geilo
Hol
Norge

**STRUCTURAL AND CONTEXTUAL METADATA:**

1917-05-27 til 1918-12-31

Atelier KK

## Image 7

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Brannmann

brannmenn

Bygninger

Bygningselementer

Hustak

Murbolig

Tak

**SPECIFIC OBJECTS:**

Haakonsgaten

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Arkitektur

Brannvesen

byggeskikk

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**

Brann

Brannen

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

13.3.1926

hendelser

Historie

kommune

Reportasje

samfunn

stat

**LOCATIONS:**

Bergen
Hordaland
Norge
Sentrum

**STRUCTURAL AND CONTEXTUAL METADATA:**

1926-03-13 til 1926-03-13

Atelier KK

## Image 8

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Munnspill

Munnspillorkester

Musikkinstrument

Orkester

**SPECIFIC OBJECTS:**

Bergen Munnspillorkester

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

instrumental

Vocal

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Kulturell virksomhet

musikk

**STRUCTURAL AND CONTEXTUAL METADATA:**

Gruppebilde

Ludvig Thunes

## Image 9

### ELEMENT LEVEL

**GENERIC OBJECTS:**

barn

Dal

Fjell

Gutt

Jente

Kvinne

Landskap

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Alders og kjønnsgrupper

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

1925

**LOCATIONS:**

Hordaland

Norge

Stalheim

Voss

**STRUCTURAL AND CONTEXTUAL METADATA:**

1924-01-01 til 1926-12-31

Atelier KK

Gruppebilde

## Image 10

### ELEMENT LEVEL

**GENERIC OBJECTS:**

elever
Gjenstander
Gymnas
innredning
Interiør
laboratoriet
Laboratorium
Lærer
Mann
Mikroskop
Skoleelever
Ungdom

**SPECIFIC OBJECTS:**

Bergens Handelsgymnasium

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Alders og kjønnsgrupper
Yrker

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Arbeidsliv

næringer

Utdanning

**LOCATIONS:**

Bergen
Haukeland
Hordaland
Kalfaret
Kalfarveien
Kalfarveien 2
Norge

**STRUCTURAL AND CONTEXTUAL METADATA:**

1928-01-01 til 1928-12-31
Atelier K. Knudsen
Gruppebilde

## Image 11

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Bord
Forkle
Husmorskole
Husmorskolen
Hverdagsklær
innredning
Interiør
Kjøkken
Klær
Komfyr
Kvinne
Kvinnearbeid
Møbler
Skoleelever

**SPECIFIC OBJECTS:**

Bergens Husmorskole

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Alders og kjønnsgrupper

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Arbeidsliv
næringer
Utdanning

**LOCATIONS:**

Bergen

Hordaland

Møhlenprisbakken

Møhlenprisbakken 12

Norge

Nygårdshøyden

**STRUCTURAL AND CONTEXTUAL METADATA:**

1945-01-01 til 1950-12-31

Atelier KK

Gruppebilde

## Image 12

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Båter

Fartøy

Fraktefartøy

Havn

havnen

Landskap

**SPECIFIC OBJECTS:**

Storheia

Trondheim havn

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Kommunikasjon

Sjøfart

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

By- og småsteder

**LOCATIONS:**

Bergen

Hordaland

Knudsen områder

Norge

Sør-Trøndelag

Trondheim

Trondhjem

**STRUCTURAL AND CONTEXTUAL METADATA:**

1900-01-01 til 1903-12-31

Byprospekt

Knud Knudsen

## Image 13

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Arbeidsklær
Fisk
Fiskehandler
Gjenstander
Hodetørkle
Hverdagsklær
Klær
Kvinneklær
Landskap
Torg
uniformer
Vekt
yrkesklær

**SPECIFIC OBJECTS:**

Fisketorget
Zachariasbryggen

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Yrker

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**

Fiskehandel
Handel
Torghandel

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Arbeidsliv
By- og småsteder
næringer

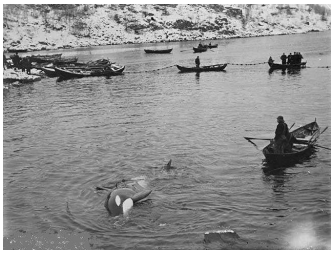
**LOCATIONS:**

Bergen

**STRUCTURAL AND CONTEXTUAL METADATA:**

1930-01-01 til 1935-12-31
Postkort

## Image 14



### ELEMENT LEVEL

**GENERIC OBJECTS:**

Fartøy

Hval

Robåt

Snø

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Kommunikasjon

Sjøfart

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**

fangst

fiske

Hvalfangst

Hvalstæng

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Arbeidsliv

Klima

næringer

Vær

**LOCATIONS:**

Bildøen

Bildøy

Fjell Ho

Hordaland

Norge

**STRUCTURAL AND CONTEXTUAL METADATA:**

1904-01-15 til 1904-01-15

Amatørbilde

Ralph L. Wilson

## Image 15

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Altertavle

Bygninger

innredning

Interiør

Kirke

**SPECIFIC OBJECTS:**

Mariakirken

St. Mariekirken

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Arkitektur

byggeskikk

**STRUCTURAL AND CONTEXTUAL METADATA:**

1900-01-01 til 1904-12-31

Knudsen, Knud & Co

**LOCATIONS:**

Bergen

Bergenhus

Hordaland

Knudsen områder

Norge

## Image 16

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Bymiljø
Dampskip
Fartøy
Fiskebåt
Fjordabåt
Landskap
Motorkjøretøy
Personbil
Varebil

**SPECIFIC OBJECTS:**

Bryggen
Oster
Torget
Vågen
Vågsbunnen

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

01.01.1964
gikk sin siste tur
Kommunikasjon
Landfart
Sjøfart

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

By- og småsteder

**LOCATIONS:**

Bergen
Bergenhus
Hordaland
Norge

**STRUCTURAL AND CONTEXTUAL METADATA:**

1960-01-01 til 1963-12-31
Mittet & Co.
Oversiktsbilde
Postkort

## Image 17

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Buss

Motorkjøretøy

Personbil

**SPECIFIC OBJECTS:**

Fisketorget

Torget

Vågen

Vågsbunnen

**BACKGROUND ACTIVITIES:**

Handel

Torghandel

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Kommunikasjon

Landfart

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Arbeidsliv

næringer

**LOCATIONS:**

Bergen

Hordaland

Norge

**STRUCTURAL AND CONTEXTUAL METADATA:**

1960-01-01 til 1970-12-31

Bygningsportrett

Normanns Kunstforlag

Postkort

## Image 18

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Bymiljø

Klær

Hverdagsklær

**SPECIFIC OBJECTS:**

Bergenhus

Bryggen

Fisketorget

Torget

Vågen

Vågsbunnen

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**

Handel

Torghandel

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

Arbeidsliv

næringer

**LOCATIONS:**

Bergen

Hordaland

Norge

**STRUCTURAL AND CONTEXTUAL METADATA:**

1950-01-01 til 1960-10-07

Mittet & Co.

Postkort

## Image 19

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Boligblokk

Idrettsbane

Landskap

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

friluftsliv

idrett

Sport

**SPECIFIC OBJECTS:**

Fjøsangerveien

Fjøsangerveien 38b

Kronstad Idrettsplass

Store Lungegårdsvann

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

By- og småsteder

**LOCATIONS:**

Bergen

Hordaland

Kronstad

Minde

Norge

Sentrum

Solheim

**STRUCTURAL AND CONTEXTUAL METADATA:**

1960-07-04 til 1960-07-04

Flyfoto

Oversiktsbilde

Widerøes Flyveselskap A/S

## Image 20

### ELEMENT LEVEL

**GENERIC OBJECTS:**

Gård

Landskap

**SPECIFIC OBJECTS:**

Langavatnet

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**

Arkitektur

byggeskikk

Tradisjonell byggeskikk

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**

By- og småsteder

**LOCATIONS:**

Bergen

Espelid

Hordaland

Norge

Nyborg

Åsane

**STRUCTURAL AND CONTEXTUAL METADATA:**

1962-06-17 til 1962-06-17

Flyfoto

Oversiktsbilde

Widerøes Flyveselskap A/S

# Appendix F – The folksonomy tags categorized

*This appendix shows the folksonomy tags applied by the experiment participants categorized using the image descriptor classification schema. This schema was presented in chapter 3. As explained in that same chapter, some of the tags were divided in order to perform the classification.*

---

## Image 1

### ELEMENT LEVEL

**GENERIC OBJECTS**
bebyggelse
bildet
blomster
blomstervaser
bord
dame
damer
flette
Fletter
Frukt
Gardin
gardiner
gradiner
hjem
husmødre
hygge
hår
håret
kjole
kjoler
klær
kvinne
kvinnen
kvinner
Oppholdsrom
rom
sofa
sofaen
stol
Stue
stuen
syersker
tjenestekvinne
tjenestekvinnen
vase
Vindu
vinduet

**OBJECT PROPERTIES:**
dannet
eldre
gammeldags
lange
oppsatt

**BACKGROUND ACTIVITIES:**
sitter

### OVERVIEW LEVEL

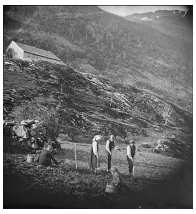
**MAIN ACTIVITIES**
Brodering
Hekler
Håndarbeid
Strikke
Strikking
Sy
Syr

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
gamle dager
gamledager
inne
kvinnesyssel
søndag

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
fredelighet
rolig stemning
stemning
vennskap

**STRUCTURAL AND CONTEXTUAL METADATA:**
situasjonsbilde
sort hvitt
Sort-hvit
sort-hvitt bilde
svart-hvitt
Svart/hvitt
svart/kvitt

## Image 2



### ELEMENT LEVEL

**GENERIC OBJECTS:**
bakgrunnen
barn
bondegård
budeie
bønder
bøtte
dal
drakter
familie
fjell
fjellandskap
fjellgard
folkedrakt
gårdsbruk
Gårdsbyging
hus
jente
jorden
kvinner
landsakp
låve
menn
personer
poteter
Skog
spade
stein
trær
ungdom
vidde
voksne
åker
åkeren

**OBJECT PROPERTIES:**
bratt
ikledd

**BACKGROUND ACTIVITIES:**
grave

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
forholdsvis unge

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
arbeid
dyrke
gårdsarbeid
gårdsdrift
høsting
Innhøsting
jobber
jordbruk
plukker
såing

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
aude stad
ein stad der ingen kunne tru at nokon kunne bu
gamle dager
kultur
natur
norsk
perspektiv
sommeren
tine
tradisjon

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
nasjonalromantisk
trange kår

**STRUCTURAL AND CONTEXTUAL METADATA:**
eldre foto
situasjonsfoto
sort hvitt
Sort-hvit bilde
sort-hvitt bilde
Svart/hvitt

## Image 3

### ELEMENT LEVEL

**GENERIC OBJECTS:**
akebrett
barn
barn?
Bolighus
bygård
gaten
gutter
hus
kjelkar
kjelke
kjelker
personene
personer
rattkjelke
rattkjelker
snø
snøborg
snøen
snøhaug
snømann
trehus
trehusbebyggelse
ungdomsgjeng

**OBJECT PROPERTIES:**
stor

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
aking
by

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
lager
leik
lek
leker

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
gamledager
tilbake i tid
vinter

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
Gøy

**LOCATIONS:**
Bergen

**STRUCTURAL AND CONTEXTUAL METADATA:**
situasjonsfoto
sort hvitt
Sort-hvit
sort-hvitt bilde
svart-hvitt
Svart/hvitt

## Image 4

### ELEMENT LEVEL

**GENERIC OBJECTS:**
artilleri
bildet
Borg
festning
flagg
flaggstang
fort
heisekraner
kanon
kanoner
kran
kraner
mast
master
mur
norskeflagg
sjø
utsiktsplass
voll

**OBJECT PROPERTIES:**
gamle
halv stang
halvstang
militær
norsk
norske
På halv stang
vendt mot venstre

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
17.mai
død
forsvar
krig
nasjon
rekke
stillhet

**EMOTIONAL ABSTRACTIONS AT ELEMENT LEVEL:**
sorg
tragedie

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
markering

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
et minnesmerke?
Perspektiv
salutt

**STRUCTURAL AND CONTEXTUAL METADATA:**
sort hvitt
sort-hvitt bilde
svart-hvitt
Svart/hvitt
svart/kvitt

## Image 5

### ELEMENT LEVEL

**GENERIC OBJECTS:**
budnad
bunad
bunader
båt
båten
båttur
damer
en robåt
finstasen
fjell
fjord
folkedrakt
hatt
Hav
hodetørkle
innsjø
kvinnene
kvinner
land
mann
mannen
menn
mennene
personene
pram
robåt
sjø
skinnbukse
strand
strandkanten
trebåt
vann
åre

**OBJECT PROPERTIES:**
bunadskledde
høye
ikledd
stille

**BACKGROUND ACTIVITIES:**
i ferd med å stige opp
på veg

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
brudeferd i hardanger
Brudeferden i Hardanger
feiring
festdag
gamledagar
gamledager
høy bunad føring
nasjonalisme
på veg til feiring
sol
sommer
stor begivenhet
tradisjonsrikt

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
nasjonalromantisk
romantisk

**LOCATIONS:**
hardanger
Norge

**STRUCTURAL AND CONTEXTUAL METADATA:**
situasjonsbilde
sort hvitt
Svart/hvitt
svart/kvitt

## Image 6

### ELEMENT LEVEL

**GENERIC OBJECTS:**
bakgrunnen
banen
bildet
bro
bru
damplokmotiv
damplokomotiv
damplokomotivet
damptog
fjell
fjøler
gods
godstog
Jernbane
jernbanebro
jernbanen
konstruksjon
Kraftlinje
landskap
lokomotiv
planker
røyk
skinner
skog
tog
Togbro
togvogner
trær
vidde

**SPECIFIC OBJECTS:**
bergensbanen

**OBJECT PROPERTIES:**
gammel
ganske vaklevoren
ustødig

**BACKGROUND ACTIVITIES:**
kommer mot oss

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
byggearbeid
dampmaskin
dårlig konstruert
industri
industrialisering
reise
utbygging

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
frakt
kjører

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
bygda
gamle dager
gamledager

**STRUCTURAL AND CONTEXTUAL METADATA:**
eldre bilde
svart-hvitt
Svart/hvitt
svart/kvitt

## Image 7

### ELEMENT LEVEL

:

**GENERIC OBJECTS**
bakgård
Brannmenn
bygning
bygninger
Bygård
bygårdene
bygårder
etasjene
fabrikk
folk
hus
hustak
piper
røyk
skorsteiner
tak
taket
trehus

**OBJECT PROPERTIES:**
brennende
gamle
mye
sort
svart
øverste

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
by
kullos

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
brann
bybrann
Husbrann
røykutvikling
storbrann

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
fare for spredning
vinter

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
fare
krise
tragedie

**STRUCTURAL AND CONTEXTUAL METADATA:**
bilde i svart-hvitt
eldre bilde
oversiktsbilde
Sort-hvit
sort-hvitt bilde
Svart/hvitt

## Image 8

### ELEMENT LEVEL

**GENERIC OBJECTS:**
band
dress
gruppe
harmonica
hårsveiser
jakke
klokke
kor
kvinne
mann
menn
mennesker
munnspel
munnspill
Musikere
ring
slips
strikkegenser

**OBJECT PROPERTIES:**
glade
lystige

**BACKGROUND ACTIVITIES:**
latter
smil

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
ansiktsuttrykk
penklær

**EMOTIONAL ABSTRACTIONS AT ELEMENT LEVEL:**
morsomme

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
fyll
lek
munnspilling
sammenkomst
Spiller

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
70 tallet
dårlig
fest
gammeldags
musikk
tilbake i tid

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
festhumør
festlig
glede
god steming
godt humør
hygge
lystig
lystig lag
moro
morro
morsomt

**STRUCTURAL AND CONTEXTUAL METADATA:**
eldre bilde
situasjonsbilde
sort hvitt
Sort-hvitt
sort-hvitt bilde
svart-hvitt
Svart/hvitt
svart/kvitt

## Image 9

### ELEMENT LEVEL

**GENERIC OBJECTS:**
bakgrunn
barn
bror
dal
dame
familie
fjell
fjellandskap
fjellheim
fjellsider
gras
gutt
hatt
hånd
jente
klær
kvinne
landskap
mor
personer
søsken
søster
voksen

**OBJECT PROPERTIES:**
blide
bratte
fantastiske
høye
naturskjønn
pene
små

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
fjord
kjernefamilie
pynt

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
poserer

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
fjelltur
natur
solskinnstur
sommer
sommerdag
turisme
utsikt
vestlandsk
vår/sommer

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
famileidyll
hyggelig
idyll
lykke
nasjonalromantisk
veldig nasjonalromantisk

**LOCATIONS:**
gudvangen

**STRUCTURAL AND CONTEXTUAL METADATA:**
eldre foto
familiebilde
gammelt foto
portrett
Sort-hvit
sort-hvitt bilde
svart-hvitt
Svart/hvitt
svart/kvitt

## Image 10

### ELEMENT LEVEL

**GENERIC OBJECTS:**
bok
bord
disk
forskere
frakk
frakker
gutter
kjemikaler
krakk
lab
Laboratorie
laboratorium
labratorium
langbord
leger
menn
mikroskop
reagensglas
stol
studenter
tavle
Vitenskapsmenn

**OBJECT PROPERTIES:**
hvit
hvite
unge

**BACKGROUND ACTIVITIES:**
sitter

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
en uten hvit frakk

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
eksperiment
eksperimentering
ekspriment
Forskning
kjemiforsøk?
Studere
studering

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
arbeidsplass
dag
ekpsperimenter
før i tiden
gamledagar
innendørs
kjemi
mansdominert
medisinstudier
naturvitenskap
skole
Studier
tilbake i tid
undervisning
undervisningsrom?
votenskap

**STRUCTURAL AND CONTEXTUAL METADATA:**
eldre bilde
sort hvitt
svart-hvitt
Svart/hvitt
svart/kvitt

## Image 11

### ELEMENT LEVEL

**GENERIC OBJECTS:**
bolle
bord
damer
elever
forkle
forkler
hodebryd
hodet
husmor
husmorskkole
husmorskole
husmorskole?
husmødre
jentene
Jenter
kasserolle
Kjøkken
komfyr
komfyrer
kvinnene
Kvinner
mat
møbler
skaut
skole
skuff
tørkler
uniform
vedkomfyr

**OBJECT PROPERTIES:**
gamle
unge

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
konsentrasjon

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
lager
Matlaging
matlagning
opplæring
undervisning

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
50 tallet
80-tall
ikkje akkuratt femininsme
kjønnsroller
rutine
skolekjøkken
trangt

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
alvorlig stemning
kjedelig

**STRUCTURAL AND CONTEXTUAL METADATA:**
sort hvitt
Sort-hvit
sort-hvitt bilde
svart-hvitt
Svart/hvitt
svart/kvitt

## Image 12

### ELEMENT LEVEL

**GENERIC OBJECTS:**
bilde
brygge
by
bylandskap
båt
båtar
båtene
Båter
båthavn
fiskebåter
Fjell
fortøyning
fortøyninger
garn
havn
havneby
Hus
husene
Jakt
Kai
mast
pram
seilbåter
seilskute
seilskuter
sjø
sjøhus
skip
snekker
sund
trebåt
trebåter
våg

**SPECIFIC OBJECTS:**
hansa
storheia

**OBJECT PROPERTIES:**
lave
ligger
stille

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
fiske
last

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
gammelt
gråvær

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
fint

**LOCATIONS:**
bergen

**STRUCTURAL AND CONTEXTUAL METADATA:**
sort hvitt
sort- hvitt bilde
Sort-hvit
svart-hvitt
Svart/hvitt
svart/kvitt

## Image 13

### ELEMENT LEVEL

**GENERIC OBJECTS:**
bybebyggelse
Bygninger
dame
fisk
fiskemarked
Fiskertorg
fisketorg
folk
hatt
kjøpmann
kvinne
mann
marked
mennene
mennesker
plass
striler
torg
torghandler

**SPECIFIC OBJECTS:**
fisketorget

**OBJECT PROPERTIES:**
gamle
åpen

**BACKGROUND ACTIVITIES:**
innkjøp

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
betaling
samling

### OVERVIEW LEVEL

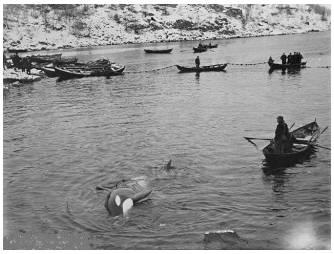
**MAIN ACTIVITIES:**
fiskehandel
fiskesalg
handel
kjøp
kjøper
salg
torghandel

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
folksomt
gamledager
historie
solskinnsdag
tilbake i tid
tradisjon
trangt

**LOCATIONS:**
bergen

**STRUCTURAL AND CONTEXTUAL METADATA:**
eldre bilde
eldre foto
situasjonsbilde
sort hvitt
sort-hvitt bilde
svart-hvitt
Svart/hvitt
svart/kvitt

## Image 14



### ELEMENT LEVEL

**GENERIC OBJECTS:**
Berg
båt
båter
fiskebåter
fisker
fiskere
Fjell
Fjord
garn
land
menn
robåt
Robåter
sjø
snø
spekkhogger
spekkhogger?
striler
tre-robåter
trebåt
vann
vannflaten

**OBJECT PROPERTIES:**
åpne

**BACKGROUND ACTIVITIES:**
ligger

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
beskyttelse
slipp willy fri
willy

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
fangst
fiske
hvalfangst
samarbeid

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
eldre
fangstteknikk
gamledager
vinter

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
forferdelig

**LOCATIONS:**
nordnorge

**STRUCTURAL AND CONTEXTUAL METADATA:**
bilde i svart-hvitt
eldre bilde
sort hvitt
Sort-hvit
sort-hvitt bilde
Svart/hvitt
svart/kvitt

## Image 15

### ELEMENT LEVEL

**GENERIC OBJECTS:**
alter
alterbenk
Alterring
altertavle
Benker
duk
Døpefont
interiør
kirke
kors
korset
krusifiks
kyrkje
lys
Lysestaker
mur
relieff
Steinkirke
takhvelving
takhvelvinger
Vindu

**OBJECT PROPERTIES:**
hvit
hvite

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
kunst

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
gud
jesus
konfirmasjon
kristelig
kristendom
religion
tro

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
ingen mennesker

**STRUCTURAL AND CONTEXTUAL METADATA:**
maleri
Sort-hvitt
svart-hvitt
Svart/hvitt
svart/kvitt
uklart bilde

## Image 16

### ELEMENT LEVEL

**Image 16**
**GENERIC OBJECTS:**
bilar
Bilder
biler
brannbil
Brygge
byfjord
bylandskap
båt
Båter
festning
flagg
gatene
hamn
havet
havn
kai
lastebil
mennesker
torg

**SPECIFIC OBJECTS:**
bergenhus
bryggen
Hansa
rosenkrantztårnet
torget
vågen

**OBJECT PROPERTIES:**
gamle
ligger
norske

**BACKGROUND ACTIVITIES:**
fruksalg
torghandel

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
biltrafikk
flaggdag
Trafikk

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
1950-tallet
byliv
fint vær
folksomt
frederlig
gamledager
krigstid
lett fugleperspektiv
sol
solskinn
sommer
tilbake i tid

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
liv og røre

**LOCATIONS:**
bergen
Fisketorget

**STRUCTURAL AND CONTEXTUAL METADATA:**
eldre bilde
fargebilde
farger
i farger
postkort
postkort?

## Image 17

### ELEMENT LEVEL

**GENERIC OBJECTS:**
bildet
Biler
bod
boder
buss
bussar
Busser
by
bybebyggelse
Bygninger
bylandskap
båt
fiskeboder
Fiskertorg
fisketorg
Fraktebåter
hamn
havn
Kai
Salgsbygninger
sjø
skyer
torg
veteranbuss

**SPECIFIC OBJECTS:**
bryggen
firsketorget
fisketorget
kløverhuset
strandkaien
torget
vågen

**OBJECT PROPERTIES:**
gamle
gul
gule

**BACKGROUND ACTIVITIES:**
handel
torghandel

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
nesten folketomt
Trafikk

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
fargerikt
fint vær
for en del år siden
sol
sommer
tilbake i tid
vår
vår/sommer

**LOCATIONS:**
Bergen
bergen sentrum
Torgallmenningen

**STRUCTURAL AND CONTEXTUAL METADATA:**
Fargebilde
farger
oversikt

## Image 18

### ELEMENT LEVEL

**GENERIC OBJECTS:**
appelsin
appelsiner
bil
Biler
box
Brygge
båt
Båter
båthavn
damer
eple
epler
frakk
Frukt
Frukthandler
fruktmarked
fruktselger
fruktselgere
frukttorg
grønnsakstorg
hatt
kai
kjerre
kjerring
kjøpmann
kvinne
kåpe
mann
marked
mennesker
skip
Torg
veske
våg

**SPECIFIC OBJECTS:**
bryggen
fisketorget
hansa
torget
tyskerbryggen
vågen

**OBJECT PROPERTIES:**
eldre
gamle
gammel
mannlig

**BACKGROUND ACTIVITIES:**
handlende

### OVERVIEW LEVEL

**MAIN ACTIVITIES:**
Frukthandel
fruktsalg
Handel
torghandel

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
gamledager
solskinnsdag
sommer
tilbake i tid
vår

**LOCATIONS:**
Bergen

**STRUCTURAL AND CONTEXTUAL METADATA:**
fargebilde
farger

## Image 19

### ELEMENT LEVEL

**GENERIC OBJECTS:**
allé
bildet
blokker
bukt
By
bybebyggelse
Byggninger
bygninger
Bygårder
bylandskap
Båter
båthavn
eneboliger
fjord
fotballbane
Fotballstadion
Fritidsbåter
Gater
hamn
Hav
havn
hus
Idrettsanlegg
idrettsstadion
landskap
seilbåter
sjø
stadion
tank
vann

**SPECIFIC OBJECTS:**
store lungegårdsvann

**GENERAL ABSTRACTIONS AT ELEMENT LEVEL:**
folketom
fotball

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
bydel
fint ver
ingen mennersker kan skimtes
ingen menneske
moderne
natur
sol
solskinn
sommer
sommerdag
utsikt
vår/sommer

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
idyllisk

**LOCATIONS:**
Bergen
danmarksplass
kronstad

**STRUCTURAL AND CONTEXTUAL METADATA:**
bildet er i farger
bybilde
Fargebilde
farger
oversikt
oversiktsbilde
Ovresiktsbilde

## Image 20

### ELEMENT LEVEL

**GENERIC OBJECTS:**
beitemark
bilde
bondegård
bygdelandskap
eng
enger
fjell
fjord
Fjøs
Gard
grend
gress
gård
gårdsbruk
gårdshus
gårdstun
Hovedhus
hus
innsjø
jorder
jordet
kulturlandskap
Landskap
låve
låver
løe
løer
mark
sjø
Skog
steingard
Steingjerde
tun
utmark
vann
Vei
vestlandsgård
våg
Åker
åkerflekk

**OBJECT PROPERTIES:**
grønne
hvitmalte
norsk
rødmalte

### OVERVIEW LEVEL

**GENERAL ABSTRACTIONS AT OVERVIEW LEVEL:**
bygd
grønn
grønt
gårdsdrift
innland
landlige omgivelser
landsbygda
moderne versjon
natur
sol
sommer
utenfor allfarvei
vår/sommer

**EMOTIONAL ABSTRACTIONS AT OVERVIEW LEVEL:**
idyll
nasjonalromantisk
samhold

**STRUCTURAL AND CONTEXTUAL METADATA:**
farger
flyfoto

# Appendix G – ImageTagger source code

*This appendix includes the Image Tagger source code. Image Tagger is the web-based prototype for tagging images that was used by the participants in the research project experiment. The code is commented and includes seven php-files. In addition to php and HTML, there are also some lines of JavaScript code. CSS has however been omitted.*

## db.php

```php
<?php

/************************************
 * Opens a connection to the database.
 ************************************/

function connectToDatabase() {
      $username="---";
      $password="---";
      $hostname="---";
      $dbh = mysql_connect(
      $hostname,
      $username,
      $password) or die("Unable to connect to MySQL");
      $db = mysql_select_db("image_database", $dbh)
       or die("Could not select the image_database DB");
}

?>
```

## sql.php

```
<?php

/*************************************************************************
 * Functions for DB-communication. Both insert-statements and get-methods.
 *************************************************************************/

// Inserts a person into the DB
function insertPerson($sex, $age, $tagging_xp) {
	mysql_query("
		insert into person(sex, age, experience)
		values('$sex', '$age', '$tagging_xp')
	") or die(mysql_error());
}

// Inserts image tags and image tag-related data into DB
function insertImageTags($person_id, $image_id, $tag, $sequence_nr) {
	mysql_query("
		insert into tags(tags_person_id, tags_image_id, string,
sequence)
		values ('$person_id', '$image_id', '$tag', '$sequence_nr')
	") or die(mysql_error());
}

// Inserts into the DB the time of which a person started to tag an image:
function insertStartTime($person_id, $image_id, $start_time) {
	$query = "
		insert into time_spent(person_id, image_id, start_time)
		values ('$person_id', '$image_id',
from_unixtime('$start_time'))
	";
	mysql_query($query) or die(mysql_error());
}

// Inserts into the DB the time of which a person was done tagging an
image:
function insertStopTime($person_id, $image_id, $stop_time) {
	mysql_query("
		update time_spent
		set stop_time = from_unixtime('$stop_time')
		where person_id = '$person_id' and image_id = '$image_id'
	") or die(mysql_error() + " Feil under kall på InsertStopTime.");
}

// Inserts into DB a comment provided by a user:
function insertComment($person_id, $text) {
	mysql_query("
		update person
		set comment = '$text'
		where person_id = '$person_id'
	") or die(mysql_error());
}

// Retrieves an image from the DB based on an image ID:
function getImage($image_id) {
	$result = mysql_query("select image from image where
image_id='$image_id'");
	return $result;
}
```

```
// Retrieves from the DB the popular tags for an image, based on image ID:
function getPopularTags($img_id) {
	$result = mysql_query("
		select string from popular_tags
		where image_id = '$img_id'
		order by count desc, string
	");
	return $result;
}

// Function that selects a random Image ID for an image
// that has not yet been tagged by a user:
function getForPersonUntaggedImageID($person_id) {
	$query = "
		select image_id from image
		where image_id not in (
		select distinct tags_image_id from tags
		where tags_person_id='$person_id'
		)
		order by rand() limit 1
	";
	$result = mysql_query($query) or die(mysql_error());
	return mysql_numrows($result) == 0 ? 0 : mysql_result($result, 0);
}

// Retrieves the number of images in the DB:
function getNumberOfImagesInDatabase() {
	$result = mysql_query("select count(image_id) from image");
	return mysql_result($result, 0);
}

// Retrieves from the DB the number of images a person has tagged:
function getNumberOFTaggedImagesByPerson($person_id) {
	$result = mysql_query("
		select count(*) from (
			select * from tags
			where tags_person_id = '$person_id'
			group by tags_image_id
		)
		as t
	");
	return mysql_result($result, 0);
}

// Checks if a person has spent time on tagging an image.
// Returns TRUE or FALSE:
function existsTimeSpent($person_id, $image_id) {
	$query = "
		select count(1)
		from time_spent
		where person_id = '$person_id' and image_id = '$image_id'
	";
	$result = mysql_query($query);
	return mysql_result($result, 0) > 0;
}

?>
```

## login.php

```
<?php

/*********************************************
 * Displays a form with three questions regarding
 * gender, age and experience with tagging.
 *********************************************/

// When the user submits the form:
if (isset($_POST['submit'])) {
      include 'include/db.php';
      include 'include/sql.php';
      connectToDatabase();
      insertPerson($_POST['sex'], $_POST['age'], $_POST['experience']);
      $person_id = mysql_insert_id();
      header("Location: tag_image.php?" . "person_id=" . $person_id);
}

?>

<html>
<head>
<title>Vennligst fyll ut følgende skjema</title>
<link rel="stylesheet" type="text/css" href="include/style_login.css" />
<script type="text/javascript" src="include/prototype-1.6.0.2.js"></script>
<script type="text/javascript">

// Javascript function that validates the form:
function checkForErrors() {
      if (($F('female') == null) && ($F('male') == null)) {
            alert("Vennligst oppgi kjønn!");
            return false;
      }
      if ($('age').selectedIndex == 0) {
            alert("Vennligst oppgi alder!");
            return false;
      }
      if ($('experience').selectedIndex == 0) {
            alert("Vennligst oppgi erfaring med tagging av bilder!");
            return false;
      }
      return true;
}
</script>
</head>

<body>
<form name ="user_registration" method="post" action="<?php echo
$_SERVER['PHP_SELF'] ;?>">

<div id="wrapper">
<h1>Vennligst fyll ut skjemaet under:</h1>

<div class="frame">
<div class="label">Kjønn:</div>
<div class="radio"><input type="radio" id="female" name="sex" value="0">
<span class="radiolabel">Kvinne</span>
</div>
<div class="radio"><input type="radio" id="male" name="sex" value="1">
<span class="radiolabel" >Mann</span>
```

```
</div>
</div>
<div class="frame">
<div class="label">Alder:</div>
<select name ="age" id="age">
      <option></option>
      <?php
      for ($i = 15; $i <= 90; $i++) {
            echo "<option>";
            echo $i;
            echo "</option>";
      }
      ?>
</select>
</div>

<div class="frame">
<div class="label">Erfaring med tagging av bilder (velg det alternativet
som passer best):
<br>
<span class="regular">
1 = Jeg har aldri tidligere tagget bilder.
2 = Jeg har tagget bilder noen få ganger.
3 = Jeg tagger bilder ofte.
</span>
</div>

<div class="xp">
<select name="experience" id="experience">
      <option></option>
      <?php
            for ($i = 1; $i <= 3; $i++) {
            echo "<option>";
            echo $i;
            echo "</option>";
      }
      ?>
</select>
</div>
</div>

<div id="button">
<input type="submit" name="submit" id="submit" onClick="return
checkForErrors()"class="large_btn" value="Gå videre">
</div>

</div>
</form>
</body>
</html>
```

## image_data.php

```php
<?php

/*********************************************
 * Reads image data from the DB and displays it
 *********************************************/

include 'include/db.php';
include 'include/sql.php';
connectToDatabase();
$result = getImage($_GET['image_id']);
header("Content-type: image/jpeg");
echo mysql_result($result, 0);

?>
```

## tag_image.php

```
<?php

/*************************************************************
 * Displays the user interface that allows users to tag images
 * and provides functionality related to tag activity.
 *************************************************************/

?>

<html>
<head>
<title>Eksperiment: tagging av 20 bilder</title>
<link rel="stylesheet" type="text/css" href="include/style_tag_image.css"
/>
<script type="text/javascript" src="include/prototype-1.6.0.2.js"></script>
<script type="text/javascript">

/* Javascript-function that enables users to select 'popular' tags their
own
   with the click of a mouse: */
function tagChosen(tag) {
      var exists = false;
      var chosen_tag = tag.innerHTML;
      var collected_tags = $('collected_tags');
      if (collected_tags.value.strip())
            var arr = collected_tags.value.split(',');
      else arr = []
      for (var i = 0; i < arr.length; i++) {
            if (arr[i] == chosen_tag) {
                  exists = true;
            }
      }
      if (!exists) {
            arr.push(chosen_tag);
            collected_tags.value = arr.join(',');
            var li = new Element('li');
            var span = new Element('span', { 'class' : 'tag' }
).update(chosen_tag);
            span.onclick = removeTag.curry(span);
            li.insert(span);
            $('chosen_tags_list').insert(li);
            $('chosen_tags_frame').show();
      } else {
            alert("Du har allerede valgt denne taggen!");
      }
}
```

```
/* Javascript-function that enables users to remove tags
   they have applied: */
function removeTag(tag) {
      var tagValue = tag.innerHTML;
      var collected_tags = $('collected_tags');
      var arr = collected_tags.value.split(',');
      for (var i = 0; i < arr.length; i++) {
            if (arr[i] == tagValue) {
                  arr.splice(i, 1);
            }
      }
      collected_tags.value = arr.join(',');
      tag.up('li').remove();
      if (collected_tags.value == "") {
            $('chosen_tags_frame').hide();
      }
}

/* Javascript-function. If a user presses the button 'submit tags' and
   the textfield is empty, this function is called: */
function tagfieldEmpty() {
      if ($F('tags') == "") {
            alert("Du har ikke oppgitt noen tagger!");
            return false;
      }
      return true;
}

/* Javascript-function that checks for errors */
function checkForErrors() {
      if ($F('tags') != "") {
            alert("Du har ikke lagret taggen(e) i tekstfeltet!");
            return false;
      }
      var collected_tags = $('collected_tags');
      var arr = collected_tags.value.split(',');
      if (arr.length < 3) {
            alert("Du må oppgi minst tre tagger!");
            return false;
      }
      return true;
}

</script>
</head>

<body>
<form name="form" method="post" action="<?php echo $PHP_SELF;?>">

<?php
include 'include/db.php';
include 'include/sql.php';
connectToDatabase();

// Variables:
$showTagCloud = true;
$person_id = $_GET['person_id'];
$collected_tags = array();
$new_tags = array();
$merged_tags = array();
```

```
// Creates a table of the terms in the hidden text field 'collected tags':
if (isset($_POST['collected_tags'])) {
    $collected_tags = explode(",", $_POST['collected_tags']);
}

/* When the user is done with tagging an image, a timestamp and the tags
for the
   image in question is inserted into the DB: */
if (isset($_POST['database_submit'])) {
      insertStopTime($person_id, $_POST['img_id'], time());
      for ($i = 0; $i < sizeof($collected_tags); $i++) {
            insertImageTags($person_id, $_POST['img_id'],
$collected_tags[$i],
       $i + 1);
      }
}

/* Retrieves a random image ID from DB for an image that the person in
   question has NOT tagged yet: */
if (!isset($_POST['img_id']) || isset($_POST['database_submit'])) {
      $img_id = getForPersonUntaggedImageID($person_id);
} else {
      $img_id = $_POST['img_id'];
}

/* Inserts into the DB the time of which the person in question started
tagging
   an image: */
if ($img_id && !existsTimeSpent($person_id, $img_id)) {
      insertStartTime($person_id, $img_id, time());
}

/* Checks to see if there are any images that the person in question has
not
   tagged. If not, the user is redirected to comment.php */
if (getNumberOFTaggedImagesByPerson($person_id) -
getNumberOfImagesInDatabase()
    == 0) {
      header("Location: comment.php?" . "person_id=" . $person_id);
}

// Retrieves the number of images that the person in question has tagged:
$row_count = getNumberOfTaggedImagesByPerson($person_id);

echo "<div id=\"wrapper\">";
echo "<h1>Bilde nummer " . ($row_count + 1) . " av " .
      getNumberOfImagesInDatabase() . "</h1>";
echo "<input type=\"hidden\" name=\"img_id\" value=" . $img_id . ">";
echo "<img src='image_data.php?image_id=" . $img_id . "'>"; // Displays
image

// When the button 'confirm tags' is pressed:
if (isset($_POST['submit_tags'])) {
      if (($_POST['tags'])) {
            $_POST['tags'] = trim($_POST["tags"], " ,._");
            $new_tags = split(" *,+ *", $_POST["tags"]);
      }
      $merged_tags = array_merge($collected_tags, $new_tags);
      $merged_tags = array_unique($merged_tags);
      $tags = trim(implode(",", $merged_tags), ",");
      $merged_tags = explode(",", $tags);
```

```
      // Writes the current tags for an image to a hidden text box:
      echo "<input type=\"hidden\" value=\"" . $tags . "\"
name=\"collected_tags\"
         id=\"collected_tags\">";
} else {
      echo "<input type=\"hidden\" name=\"collected_tags\"
d=\"collected_tags\">";
}

// Displays the tags a user has applied in a frame:
if (sizeof($merged_tags) == 0) {
      echo "<div id=\"chosen_tags_frame\" style=\"display: none\">";
} else {
      echo "<div id=\"chosen_tags_frame\">";
}
echo "<div id=\"chosen_tags_label\">Dine tagger for dette bildet
     (klikk for å fjerne):<br></div>";
echo "<ul id=\"chosen_tags_list\">";
for ($counter = 0; $counter < sizeof($merged_tags); $counter++) {
      echo "<li><span class=\"tag\" onClick=\"removeTag(this)\">" .
         $merged_tags[$counter] . "</span></li>";
}
echo "</ul>";
echo "</div>";
echo "<div class=\"clear\"></div>";

// Displays a text box where the user can type in tags:
echo "<div id=\"type_your_tags\">";
echo "<span class=\"label\">Skriv inn ønskede tagger her (du kan skrive inn
      flere på en gang ved å separere med komma):<br></span>";
echo "<input type=\"text\" name=\"tags\" id=\"tags\" size=\"75\">";
echo "<input type=\"submit\" class=\"small_btn\"
      onClick=\"return tagfieldEmpty()\" id=\"submit_tags\"
      name=\"submit_tags\" value=\"Bekreft tagger\">";
echo "</div>";

/* If the variable $showTagCloud is set to TRUE, 'popular tags'
   are displayed.: */
if ($showTagCloud) {
      $result = getPopularTags($img_id);
      echo "<div id=\"popular_tags_frame\">";
      echo "<div id=\"popular_tags_label\">De tre mest populære taggene for
dette
          bildet (klikk for å velge):</div>";
      while($row = mysql_fetch_array($result, MYSQL_NUM)) {
            echo "<span class=\"popular_tag\" onClick=\"tagChosen(this)\">"
             . $row[0] . "</span>";
      }
      echo "</div>";
}

echo "<div class=\"clear\"><input type=\"submit\"";
echo "class=\"large_btn\" name=\"database_submit\"
      onClick=\"return checkForErrors();\" value=\"Jeg er ferdig med å
tagge
      dette bildet\"></div>";
echo "</div>";
?>

</form>
</body></html>
```

## comment.php

```
<?php

/*************************************************
 * Displays a form that includes a textarea where the
 * user can provide an optional comment.
 *************************************************/

// Retrieving the ID of the user that is currently tagging:
$person_id = $_GET ['person_id'];

// When the user submits the form:
if (isset ( $_POST ['submit'] )) {
      include 'include/db.php';
      include 'include/sql.php';
      connectToDatabase ();
      $person_id = $_POST ['person_id'];
      insertComment ( $person_id, $_POST ['comment'] );
      header ( "Location: thankyou.php" );
}

echo "<head>";
echo "<title>Avsluttende kommentar</title>";
echo "<link rel=\"stylesheet\" type=\"text/css\"
      href=\"include/style_upload_image.css\" />";
echo "</head>";

// The form:
echo "<body>";
echo "<h1 class=\"other\">Avsluttende kommentar</h1>";
echo "<p>Dersom du har noen kommentarer, skriv dem i tekstfeltet under. For
      eksempel: Hva synes du om å tagge bilder på denne måten? Hva synes du
      om systemet?</p>";
echo "<form method=\"post\" action=\"" . $_SERVER ['PHP_SELF'] . "\">";
echo "<input type=\"hidden\" name=\"person_id\" value=" . $person_id . ">";
echo "<textarea name=\"comment\" cols=50 rows=10></textarea>";
echo "<p><input type=\"submit\" name=\"submit\" value=\"Gå videre\"></p>";
echo "</form>";
echo "</body>";

?>
```

## thankyou.php

```
<?php

/**************************************************************************
 * Displays a page that thanks users for participating in the experiment
 **************************************************************************/

echo "<head>";
echo "<title>Takk for hjelpen!</title>";
echo "<link rel=\"stylesheet\" type=\"text/css\"
      href=\"include/style_upload_image.css\" />";
echo "</head>";

echo "<body>";
echo "<h1 class=\"other\">Takk for hjelpen..! :-)</h1>";
echo "</body>";

?>
```