Layout Design Settings / Graphical Semiology

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December 2, 2013

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1   Layout Design Settings / Graphical Semiology

Maps are made with the fundamental objective of conveying as simple as possible some geographical information to the reader.

The layout design settings as well as the graphical semiology (generic term for theoretical consideration of cartographic symbols peculiar to a French Cartographer J. Bertin) are focused to that end. If the map has not been carefully designed, it will not only be poor but also an incomprehensible map. Take the objectives of this lesson as necessary needs to get answers to: How to set up map layout and cartographic symbols optimally.

Learning Objectives

- Be able to choose a map size and a map scale

- Be able to organise your map elements in an optimal way

- Know the meaning of typography in maps

- Know how lettering in maps is done

- Master all the rules for improving the readability of the map

- Be able to design beautiful maps.

1.1   Map Size and Scale

Importance of Map Size and Scale

Map size and map scale selection have very important consequences for the map's appearance and its potential as a communication device. Small-scale maps contain large areas of the earth and less specific detail and must use symbols that are more generalised.

The selection of map scale and map size is a very important design consideration because it will affect other map elements.

Thus, in this learning unit you will learn to choose an appropriate map size and a suitable scale. No prerequisites are needed.

1.1.1   Map Size

Choosing a good and appropriate map size is not simple, as it depends on many factors. You should take most of these factors into consideration before choosing your definitive map size. The factors affecting the map size are:

1. The map medium. Very often, it is this first factor which affects the final decision about the map size: you can not make a A0 map for a newspaper map, or a A5 map for an informative paper map such as a poster. The map size will not be the same for the following media:

   - Paper maps
   - Newspaper maps
   - Screen maps
   - TV maps
   - Web maps

2. The print costs. The costs are not the same for an A4 map than for an A0 map (which is much more expensive). So also take the print costs into account.

3. How many variables are to be mapped? Would it be better to do several maps with few variables, rather than one overloaded map?

4. Will the map be foldable? Can map information be written on the map back? If yes, you can choose a smaller size than predicted.

You need to know all the answers of these questions, in order to determine the map size. You need to know all the answers of these question in order to determine the map size. Generally, a rectangle with sides having a proportion of about three to five seems to be a pleasing format. Another good solution to size your map is the Golden Section method. This method will be explained in the unit "Definition and Organisation of Map Elements ".

The most used formats for paper maps

The sheet of 1 square meter of international normalised format is represented by the symbol A0, half a sheet by A1, and a quarter of sheet by A2. The proportions of these sheets are such as they allow to keep the same proportions when folding along the smallest of the medians.

The following example shows you the numerical and graphical relationship of these formats. Roll with your mouse over the various formats to see it graphically at the scale 1:10.

Format	Length	Width	Surface	L/W
	(mm)		(mm²)	
A0	1189	841	1000000	1,414
A1	841	595	500000	1,414
A2	595	420	250000	1,414
A3	420	297	125000	1,414
A4	297	210	62500	1,414
A5	210	148	31250	1,414

Figure 1: formatable.jpg

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Figure 2: International normalised format

1.1.2 Map Scale

Once you have decided the objects to be represented, you have to choose the map scale. What is a *map scale*[1] ? Scale is the amount of reduction that takes place in going from real world dimensions to the new mapped area on the map plane. Technically, the scale of a map is defined as the ratio of distance measured upon it to the actual distances, which they represent on the ground [**?**] . In a general way, this numerator will always be a round number (and not 1:25 350). For example, if a straight line on the ground of length 2.5 km is shown on a map by a line of length 2.5 cm, the scale of the map may be calculated from:

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Figure 3: Scale calculation

Three terms are frequently used to classify maps according to scale. The scale values attributed to each class is the following: Large-scale maps show small portions of the earth surface; detailed information may therefore be shown. Small-scale maps show large areas, so only limited detail can be carried on the map.

Large scale maps :	Scale larger than 1:25 000
Medium scale maps:	1:50 000 to 1:100 000
Small scale maps:	Scale less than 1:200 000

The following example shows different scales of the same town.

Select a scale by clicking with the mouse the appropriate radio-button.

To have an enlarged version click here (new window) : www.gitta.info/LayoutDesign/en/multimedia/Flash_Map_Scale.swf

SETUP INFORMATION FOR TUTORS: **Flash Player is required**

In the following exercise, you have to determine the correct scale. Choose the answer by clicking the correct checkbox, and submit your answer by clicking the "Submit" button.

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[1]Scale is the amount of reduction that takes place in going from real world dimensions to the new mapped area on the map plane. Technically, the scale of a map is defined as the ratio of distance measured upon it to the actual distances which, they represent on the ground .

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Figure 4: Map scale example

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Figure 5: Map scale calculation

1.1.3   How to Choose the Map Scale ?

On a small-scale map, such as a page-size map of Switzerland, places of religious worship occur at points, but on a large scale map, such as a map of a local neighbourhood, individual buildings would likely be apparent, and thus the focus might be on the area covered by the place of worship.

Similarly, a river could be considered a linear phenomena on a small-scale map, but on a large-scale map, the emphasis could be on the area covered by the river. So, the map scale must be adapted to:

- **The map content:** Some special themes can not have various scales, but only the most logical one. For example, population density maps cannot be larger than 1:100 000 otherwise the mapped people are not representative (commuters, day labourer, etc.).

- **The map purpose:** The map scale must be adapted to the purpose of the map and not to the first design or aesthetic idea of the author. Here you should think how wide will the earth area to be mapped be?

- **The map precision:** With what measuring and counting will the map be built? Here you should think how detailed the information you display on the map will be. With large scale maps, the information is precise because they are less generalised.

Large scale maps are on the whole not economic, not easy to handle, and sometimes misleading. And, small scales make on the whole the map difficult to read, complicate, and sometimes are meaningless. Which scale is selected for a given map design problem will finally depend on the map purpose and physical size. The amount of geographical detail necessary to satisfy the purpose of the map will also act as a constraint in scale selection.

Generally, the scale used will be a compromise between these two controlling factors. When you represent the scale graphically on the map, the measurement dimensions and the line thickness should be adapted to the map graphics.

The following example shows the interaction between the map component and the scale selection. Move the cursor with the mouse to change the map scale.

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Figure 6: Map scale relationship

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Figure 7: Map scale excercise

1.1.4   Working and Publication Scale.

Once you have selected a size and a scale for the finished map, you can then determine the worksheet scale. Some media do not allow reduction of your map. But if reproduction will be done by a process that allows reduction, you may want to compile and draft your map at a larger scale and then reduce it to the publication scale. Indeed, a large working scale, not more than 150 % or 200 % for *generalisation*[2] reasons, allows detailed and precise work. The greatest problem in designing for severe reduction involves line widths. Lines that appear correct at the working scale can appear a little "light" when the map is reduced. Consequently, you must make the map lines "heavy" so that it will not look too light after reduction. You also need to exaggerate type sizes somewhat, just as you must make lines and symbols a little too large on the drawing. The following illustration shows some of these relationships.

Effects of reduction

Effects of reduction.

When a map is designed for appropriate line contrasts (A), then reduction (B) will decrease the contrast too much. When the map is designed for reduction (C), then reduction (D) produces appropriate line contrast relationships.
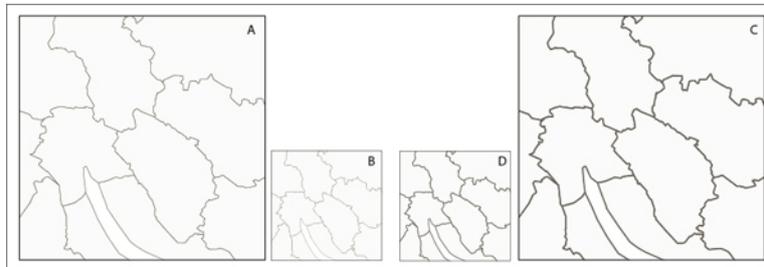
Figure 8: Working and Publication scale problems

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[2]Selection and simplified representation of detail appropriate to the scale and/or the purpose of a map .

1.1.5   Test your map size and scale knowledge

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Figure 9: SelfAssScale.swf

To have an enlarged version click here (new window) :   www.gitta.info/
LayoutDesign/en/multimedia/SelfAssScale.swf

1.2 Definition and Organisation of Map Elements

Why Organize your Map Elements

The parts that make up the design and layout of a map are visual elements, which allow the transfer of information. The cartographer arranges the visual elements into a functional composition to facilitate communication.

In this unit, you will learn the various elements that must be present on a good map. A very important step in creating good maps by arranging these elements on the layout into a meaningful, aesthetically pleasing design. Necessary prerequisites are knowledge about map size and map scale. This content was covered in the previous unit where you may need to have a look first.

1.2.1 Definition of Map Elements

A map usually contains the following elements:

Figure 10: title_thumb.jpg

Title (and subtitle) :

Usually draws attention by virtue of its dominant size; serves to focus attention on the primary content of the map. Should be an answer to "What? Where? When?".

Tips : Never underline a title (or a subtitle), and never put a colon after a title.
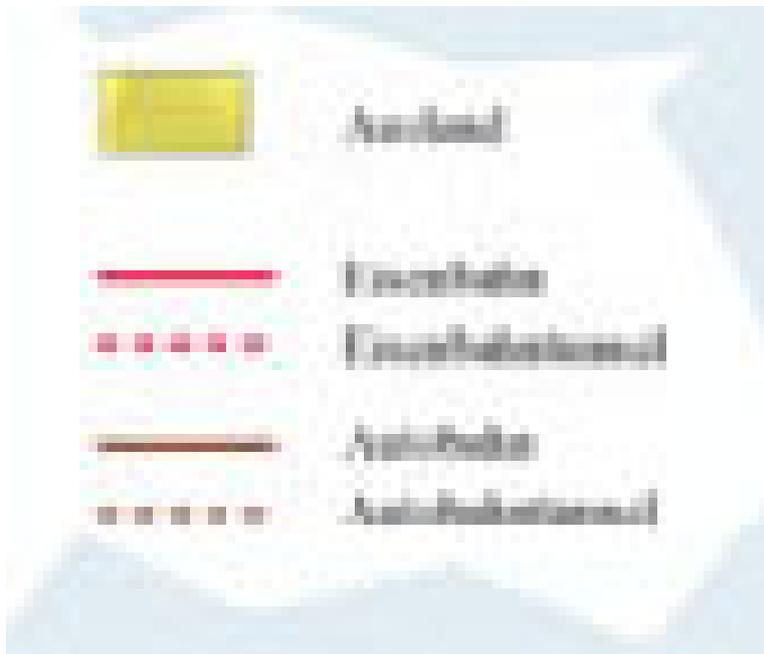
Figure 11: Legend_thumb.jpg

Legend :

The principal reference to the map symbols; subordinated to the title. However, this is still a key element for map reading; describing all unknown or unique map symbols used.

Tips :Only the word "Legend" should be written on your map (and not "Map Legend", or "Switzerland Legend", etc.).

Figure 12: Scale_thumb.jpg

Map Scale:

Provides the reader with important information regarding linear relations on the map. A scale can be numerical (for example 1:50000) or graphical.

Tips: The dimension and thickness of a graphical scale has to be adapted to the map content.

Figure 13: Credits_thumb.jpg

Credits:

Can include the map source, the author, indication of the reliability of accuracy of the map, dates, or other explanatory material.

Tips :Credits should always be written smallest as possible (but nevertheless readable) and be placed in a box without a frame.
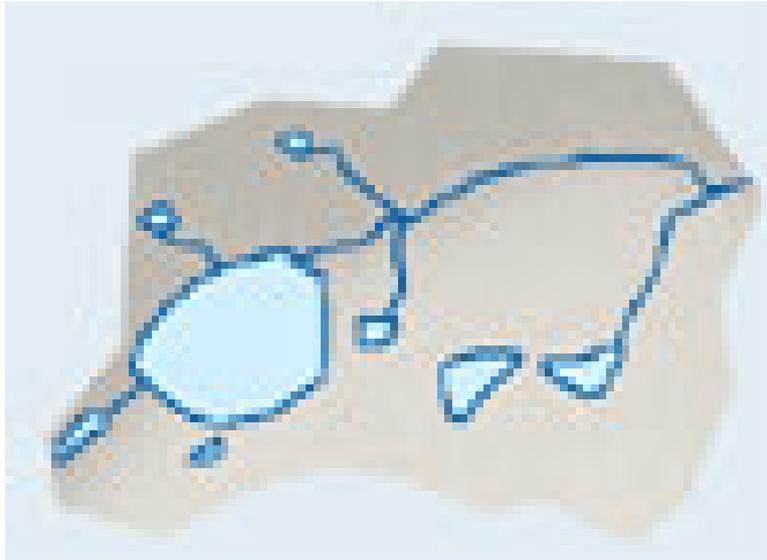
Figure 14: Mappedareas_thumb.jpg

Mapped Areas:

Objects, land, water, and other geographical features important to the purpose of the map.

Figure 15: Mapsymbols_thumb.jpg

Map Symbols:

Wide variety of forms and functions; the most important element of the map, along with the geographic areas rendered.

Figure 16: Placename_thumb.jpg

Place name and Labelling:

The chief means of communicating with maps; serve to orient the reader on the map and provide important information regarding its purpose.

Tips: Use the same font for the map frame, the map layout, and the map content.

North arrow:

According to the rules, each map should have a north arrow. But if the map is north oriented, or if the geographical co-ordinate are already on the map the north arrow can be omitted.

Tips: The north arrow must be well readable, but not be too dominant on the map.

Border and Neatlines:

Both optional; borders can serve to restrain eye movements. Neatlines are finer lines than borders, drawn inside them and often intra-parallelism, rendered as part of the graticule; used mostly for decoration.

Graticule:

Often omitted in maps today; should be included if the location information is crucial to the map purpose, e.g. into topographical maps.

In the following example, you can observe a map which, consists of the

different map elements discussed.

Since you know now all the elements that constitute a map, you have to learn how to arrange them.

On the following map, try to find out visually all the cartographic elements presented previously. This exercise is not evaluated.
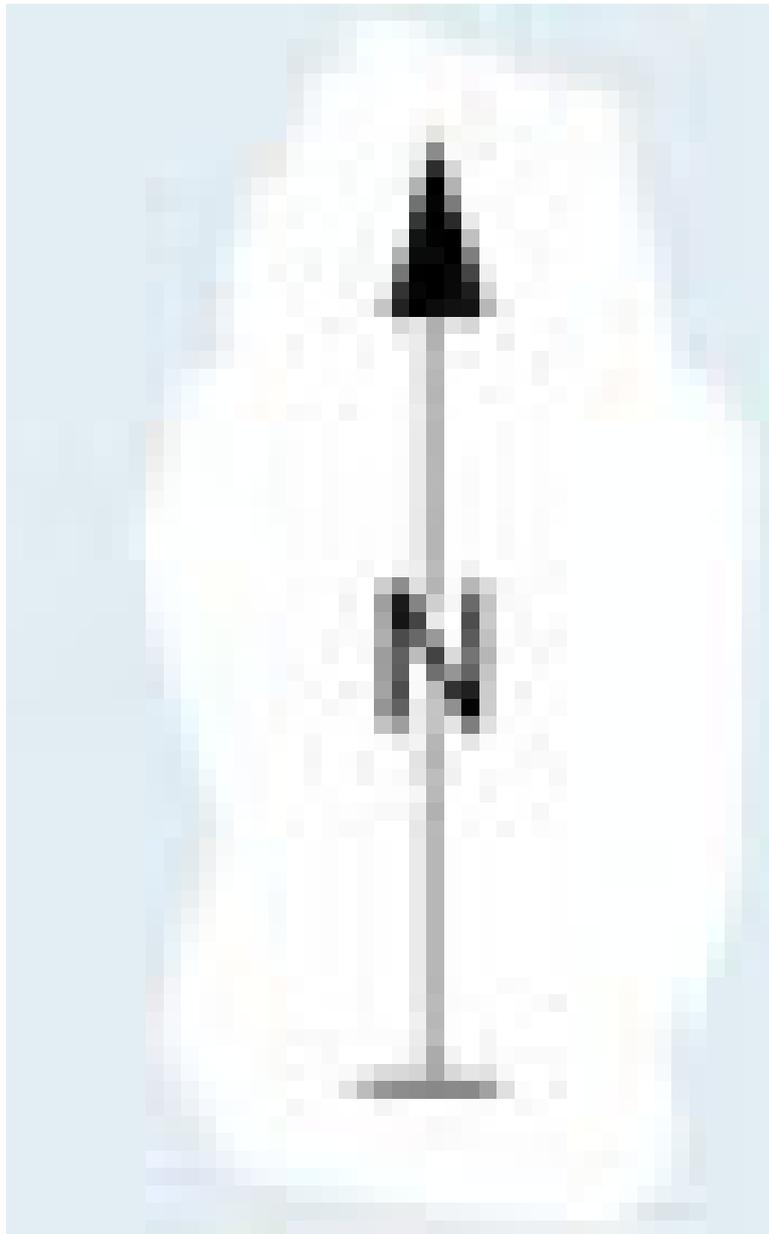
Figure 17: Northarrow_thumb.jpg

Figure 18: Border_thumb.jpg
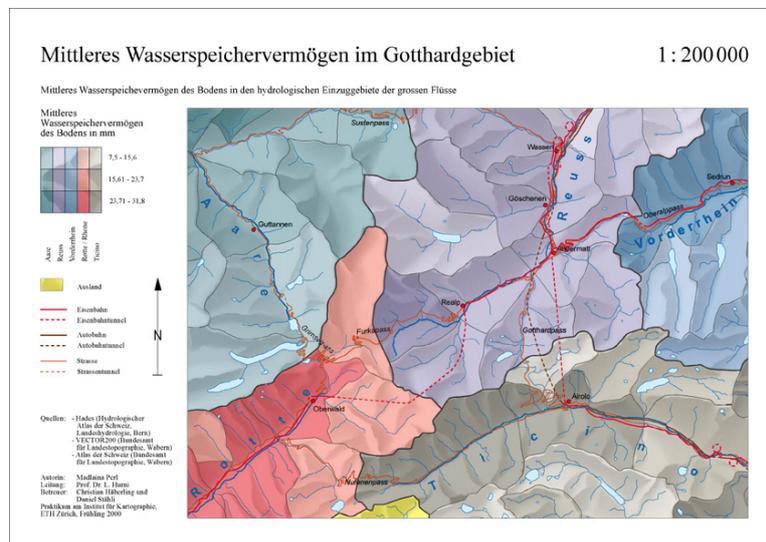
Figure 19: Example of map elements presentation (Student work, ETH Zurich)
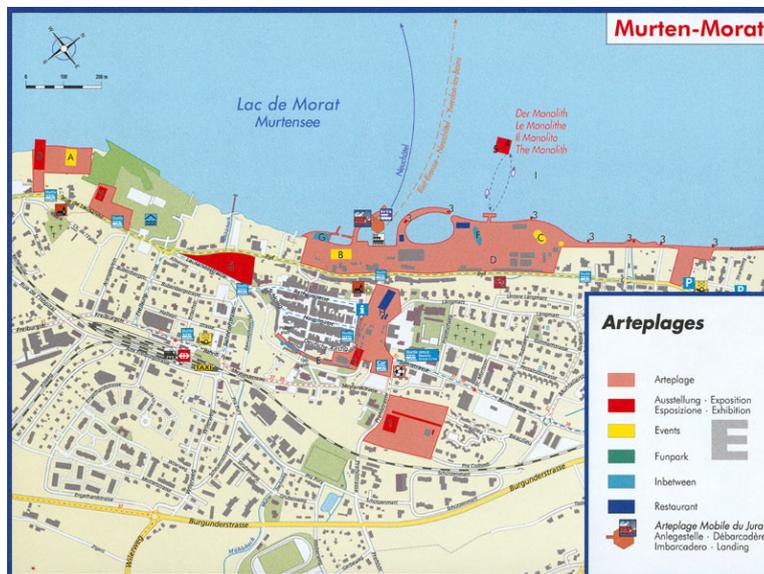
Figure 20: Expo 02 : Map of Morat [**?**]

1.2.2   Organisation of Map Elements

Map composition is much more than layout organisation, it consists of the intellectual dimension as well as of the visual dimension . Thus, map composition serves to:

- organise the source material into a coherent whole to facilitate communication, to develop an intellectual and a visual structure

- stress the purpose of the map

- direct the map reader's attention

- develop an aesthetic approach for the map

- maintain cartographic conventions consistent with good standards

- co-ordinate the base and the thematic elements of the map

Rudolf Arnheim, the author of several publications on psychological effects of design, has noted some general observations on element organisation. These observations can help you to organise in the correct manner your map elements.

Visual aspects (as weight and direction) of elements depend on their location:

- An element in the upper part of a map is heavier than one in the lower part

- Elements on the right of the map appear heavier than those on the left

- The weight of an element increases in proportion to its distance from the optical centre of the map

But, the visual aspect depend also on the size, the colour, the isolation, and the shape of these elements [**?**, p. 244] .

In the following animation, you will see how to avoid presentation and organisation errors, and how to present map elements in a correct manner. Map and Legend form a unit, therefore do not separate them with a frame. One special case, when the basemap take up all the layout space; you can use a frame to separate them.

If you set out a legend with increasingly large elements, place at top the light and small elements, and at bottom the dark and large elements. This is helpful for the map organisation, because otherwise the heaviest element will squash the smallest.

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Figure 21: Slide Show: Map and legend organisation

1.2.3 Internal Organisation of Map Elements

To achieve an uncomplicated but nevertheless aesthetic map, the graphical elements must be arranged into a logically ordered composition. A good solution to assign the elements a structure and therefore to reduce tension in perception, is intra-parallelism. Intra-parallelism simply means aligning the elements with each other to simplify the graphic design of maps. When you have aligned your map elements, you have to separate them with continual separations. This allows a correct map layout, a correct presentation, and also ensures a clear distinction between the map elements.

The following animation shows an example how to organise the map elements.

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Figure 22: Internal_Organisation.swf

1.2.4 Hierarchic Organisation 1

The communication of spatial phenomena always involves elements with differing significance or priority.

Most communication about reality involves more complex relations, which require a kind of internal graphic organisation or structuring. Because this usually involves "levels" of relative importance, we can call this "illegible" hierarchical organisation.

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Figure 23: 3D Hierarchic Organistion

The most important objects are rendered in a way that they are visually dominant within the map frame. The following video illustrates this hierarchical organisation.

1.2.5 Hierarchic Organisation 2

Three kinds of hierarchical organisation exist:

- Extensional: Hierarchical organisation of networks of lines with variable significance. This can also be applied to point symbols

- Subdivisional: Hierarchical organisation of areas of varying significance

- Stereogramic: This hierarchical organisation is different from the two precedent examples. It gives the map user the impression that the map components lie at different visual levels. The purpose is to assist the reader to focus on one set of data and, while doing so, to subordinate the rest of the data

The following sliders show you graphical examples of the three kinds of hierarchical organisation.

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Figure 24: Slider_Hierarchic_Organisation.swf

1.2.6   Hierarchic Organisation 3

How can hierarchical organisation be used to organise the map elements?

- Sort through the components of the map to determine the relative importance of each one. Seek then, a visual solution that will cast each component in a manner compatible with its hierarchical position.

- Map objects that are most important are rendered with the greatest contrast to their surroundings. Less important elements are placed lower in the hierarchy by reducing their edge contrasts.

- Mapped objects and their relative importance assume a place in the hierarchy. Although identical objects may vary in relevance, depending on the map on which they are placed.

The following illustration will explain to you how to achieve a hierarchical organisation of the map elements for a correct presentation.
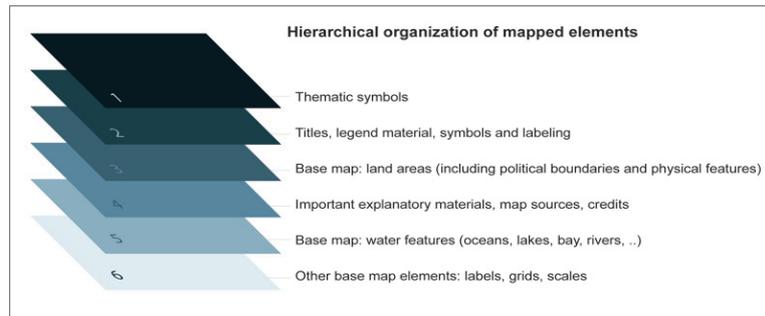
Figure 25: Hierarchical Map Organisation

1.2.7 The Golden Section

The golden section is a devising proportions method developed by Greek architects and sculptors. In cartography, this method is used to divide the map space in order to arrange the map elements in harmonious proportions. Golden section rule:

- The proportion of the smaller to the larger unit has to be the same as that of the larger unit to the entirety

- That proportion has to be equal to 1.618

- The golden section method can be duplicated any number of times

That harmony, considered as perfect by many people, can be found in various artistic fields: in the Kheops pyramid, in the "Modulor" from Lecorbusier, in the "Venus birth" form Botticelli,etc.

How to apply the golden section intuitive method to your map:

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Figure 26: Golden section

1.2.8   Focus of Attention

The reader's eye normally follows a path from the upper left corner to the lower right area in the visual field. Thereby the look passes through the optical centre.

You should use this pattern when arranging map elements, so that the position of important objects on the map always corresponds to natural eye movements.

This example shows how the reader's eye follows a path from the upper left to the lower right area in the visual field while passing through the optical centre.
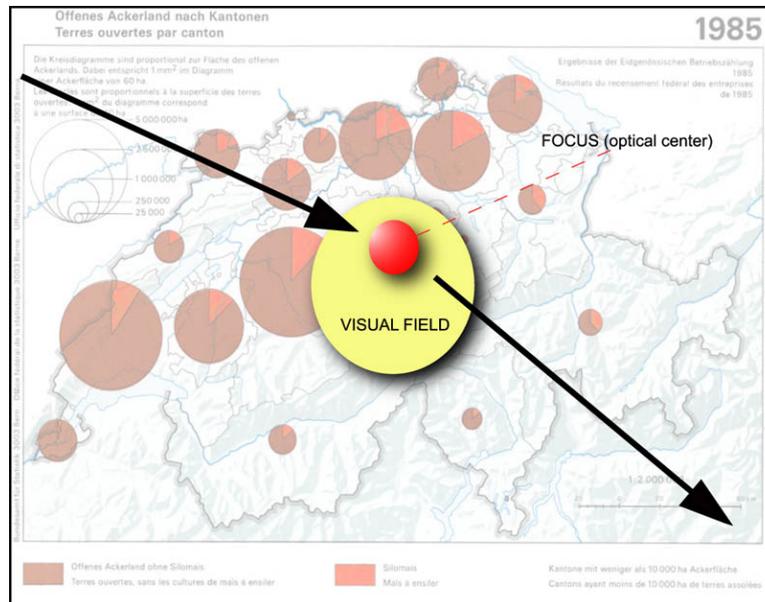
Figure 27: Reader's Eye Movement. Relief of background map reproduced with the permission of swisstopo(BA057224)

1.2.9 Construct your Map

SETUP INFORMATION FOR TUTORS: **Flash Player is required**

In this synthesis exercise, you have to place the different map elements in the map layout according to the rules you have learned in this unit.

After having chosen the map layout (radio-button), drag and drop (left mouse click) the map elements in the map layout to construct your map.

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Figure 28: Self Assessment

To have an enlarged version click here (new window) (`www.gitta.info/LayoutDesign/en/multimedia/test.swf`)Self Assesment.

1.2.10 Summary

This analogy directs attention to the fact that map design is a complex affair involving many decisions, each of which affect all the others. The best design will likely be a simple one that works well with the least amount of conflicts.

1.3 Typography

Meaning of Typography in Maps and Media

The term "typography" paraphrases activities such as the arrangement of words and the acceleration of legibility of them, and stands for a serial production of pre-thoughts. In a broader sense, it is the art of type setting that includes design, style, appearance, printing and the use of type. Type and space form an inseparable structure, whereas type delivers the content and the provided space allows it to have impact on us. Through organisation, you can build a logical structure and make it easy to read. Throughout history, people of any culture always had the urge to express themselves, starting with carved or painted symbols on rocks, which can still be found. Although we are far ahead of those times, written words are more important than ever before. Mobility, orientation and information-age are the keywords. With the introduction of computers, the creation of printouts are possible for everyone. Today the difference lies in the quality of the printed product and the professional organisation of the written letters. This applies to the lettering of maps, much like any media where letters function as a communication tool. Apart from the overall designing principles valid for printed media, and the presentation of media via web, there are special rules for letter and word positioning to bear in mind while generating maps. Making use of fonts on maps is the most important explanatory element. With its help, objects like churches, streets, etc. or thematic conditions can be:

- Identified,

- Evaluated or

- Differentiated.

Font placement is area-related, then allows:

- Expansions of landscapes

- Elevations or

- Political units may be expressed.

In this unit, you will learn the basics of typography valid for any sort of presentation. Furthermore, we will have a look at legibility rules for the monitor. A short excursion into the technical realisation will lead to the final objective that we would like to introduce to you: a profitable visual

communication reached by using typography, and how the influence of your product-design may affect the user. Although the latter is not specifically the concern of cartography, it will mediate important items which will enable you to present your papers that might go along with maps on a currently flat, overbought market.

http://server02.is.uni-sb.de/courses/ident/themen/gesch_schrift/ (`server02.is.uni-sb.de/courses/ident/themen/gesch_schrift/`)

http://www.kalligraphie.de/history.htm (`www.kalligraphie.de/history.htm`)

http://www.gutenberg.de/erfindun.htm (`www.gutenberg.de/erfindun.htm`)

http://www.wam.umd.edu/~rfradkin/alphapage.html (`www.wam.umd.edu/\char'~rfradkin/alphapage.html`)

You will not necessarily need prerequisites for this unit, but a slight understanding of the basics of how a computer and software works, in terms of practical application, are helpful. In the clarifying section, introducing 'Computer-Aided Lettering of Maps', we will prepare you for the intermediate module section that deals with 'Handling of GIS Data Sets'. Parallel to this content, it seems reasonable to have a look at the basic module unit colour theory.

1.3.1   Basics of Font and Typography

After the use of symbolic characters around 3000 BC and the development of syllable fonts in Japan, the first letter fonts in phonetics were used by the Phoenicians around 900 BC, with 22 consonants. The next big step in the development of fonts happened with the up-coming Greek alphabet around 500 BC that also included vowels. Here lies the origin of our alphabet consisting of 26 characters. Following the rapid sequence of epochs, today's known font style identification and variety were created. As a result of the long history of printing, a separate language was able to be built, which we would like to introduce to you, and remind you of every now and then.

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Figure 29: Timeline of Typography

For more detailed information on type history and development see the following optional link that offers a *.pdf file: Klassifikation_Typographie.pdf (`stud.fh-wedel.de/\char'~kh/Medienkonzeption1/V_MK1_UnterlagPdf/v_mk1_01_TypKlass.pdf`)

You, the designer might chose the font out of a huge amount of types available. Each of them has its own character and its individual expression build on its own aesthetic form. For creating maps you should choose one font family and vary just in-between this specific one. Take into account that type underlies a copyright and that the right of use needs to be acquired.

A detailed and official classification is also available. Please find this information in the attached DIN 16518 norm. Klassifikation nach DIN (`www.typolexikon.de/s/schriftklassifikation-din.html`)

If we want to use type, then we also need to be able to identify the different styles of type that we use. An analysis of the type helps direct visual attention. In the animation below, you can examine the different concepts we need to keep in mind in consideration of each letter. Move the mouse over the arrows to get the details of the letter's anatomy.

To make you able to juggle with letters of different fonts and its terminology, you also need to know the basics of the letter composition and its positioning system. In the following, we will inform you about its notions, measurements and the varying basic forms a font can adopt to meet the complex demands.

For official topographic maps, there are specific instructions, which need to be followed on which fonts or type variant is to be chosen. You will need to

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Figure 30: Type Notions

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Figure 31: Letter Measurements

make a type concept for your project to make sure that the various types will fit together.

Generally, we have to divide fonts by their character into two main groups: The serif or non- or sans-serif. Beneath this we can disregard the remaining group containing other font groups that are not significant for cartography.

In the following we won't concentrate on the type's type's time of origin as in the beginning, but on the attributes of it helping you to identify and differentiate the different types. This detailed treatment should prepare you to use type wisely:

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Figure 32: Attributes of Type

Now you will probably be wanting to know when it is best to make use of one or the other type we have just shown you. Optimising the appearance of your product by choosing a special font has the advantage of reaching the customer at the right moment with the right impact.

Font style	Usage	Effect

Table 1: Legend missing

Renaissance Roman	Classic Literature Bible Songbooks Representative printouts Business reports (Garamond)	August Very readable on paper Hard to read on screen
Baroque Roman	Newspapers Magazines Pocket books Dictionaries Tables Indexes (Times)	Consistent Quickly readable on paper Hard to read on screen
Classicist Roman	Certificates Art books Decorative brochures (Bodoni)	Rich in contrast Striking Optical strenuous to read
Roman with emphasised serifs = Slab serif	Instructions Packaging Transparencies Brochures (Rockwell)	Striking Memorable Short texts
Roman without serifs	Forms Handouts Leaflets Signposts Calendars Technical books and brochures Statistics (Arial)	Direct Static Compact Hard to read on paper Good to read on screen

Table 1: Legend missing

1.3.2 Legality of Map Fonts

Map fonts are considered to be a special component of the map content, because although they are the most important explanatory element of the map, they have the lowest geometrical significance. The font gives additional information and helps reading the map. Generally, with fonts we can distinguish on the one hand between the aspect of mode and on the other hand by its meaning. The mode can vary in font face, size and any further graphical variation possible.

For example, in cartography with the variation in size, a differentiation in the meaning of certain objects in a group is possible, e.g. a smaller size could characterise a town with less inhabitants, a larger size more inhabitants.

This proposition can also proceed on the level of logic and its meaning. Then we need to split this logic and meaning aspects into a primary and secondary statement. See the example for clarification of this more theoretical content:

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Figure 33: Semantic Aspect

Now we have given you some aspects on how to theoretically differ names and important background knowledge you need in order to set up your lettering concept later on. But how explanatory is a map name if the user group it is created for cannot understand it? What do we mean by this?

Depending on the area, people tend to speak dialects or in a multi-language country, like Switzerland, different names for the one place exists. So we may say:

In German:	Zürich	Solothurn	Neuenburg
In Dialect:	Züri	Soledurn	Nösch
In English or French:	Zurich (e)	Soleure (f)	Neuchâtel (f)
In Italian:	Zurigo	Soletta	etc.
In Latin:	Turicum	Solodurum	etc.

Table 2: Legend missing

For further information on lettering maps for Switzerland see the attached pdf file:

PDF_Letttering_Maps_of_Switzerland.pdf (www.gitta.info/LayoutDesign/en/multimedia/PDF_Letttering_Maps_of_Switzerland.pdf)

In your conception, you should take this into account. For e.g like you can visualise here:
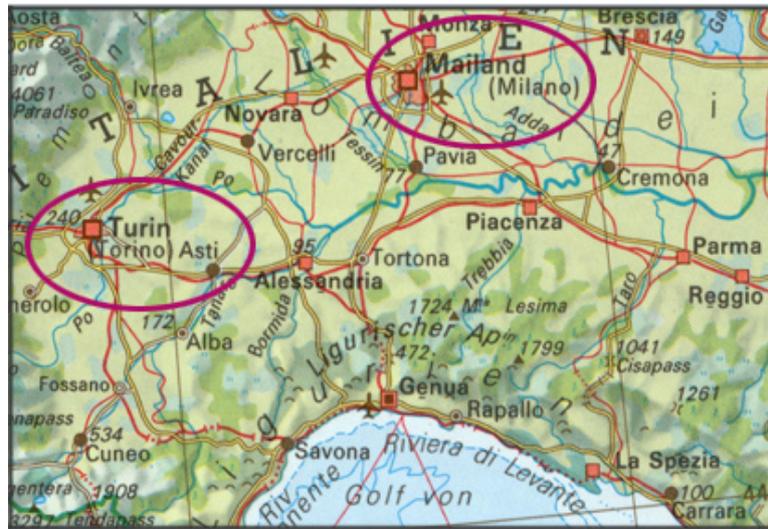
Figure 34: naming.jpg [**?**]

Beneath this, take into consideration the name changes, due to e.g. political modification, liable for changed country names. The principle for areas with latin scripting is, that names are written abiding its lettering. The rules of lettering are adequate to the official writing in the specific country. Nowadays we try to reduce the use of *exonyms*[3].

The optional link below links you to the Wikipedia site with extensive lists of German exonyms for places in non-German-speaking areas:

Lists of German exonyms (en.wikipedia.org/wiki/German_exonyms)

However sometimes, at the edge of language borders, compound names are accepted as soon as 30% of the minority of people are affected. For example, 'Biel' could also be 'Bienne'.

In areas where Latin is not the base of the language, e.g. Greek, Hebrew, Chinese or Indian, we can just paraphrase the names. They can either

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[3]These are names of places written in a language that is not spoken in the area where you are, but just outside this area. An example is: Genf is the German version for the original Genève. It is still often used in school atlases and can't be eliminated completely and also shouldn't be eliminated because of its historic rootage and preserving of the homeland dialect.

be *transcribed*[4] or *transliterated*[5]. Therefore special tables exist for any language.

---

[4]This is a method of replacing elements, fonts, characters or sounds however they may be written with characters or sounds of another language.

[5]This is a method of transcription. It describes the replacement of any character in one language, for a character in another language. Here we aspire reversibility. That means - out of a transliterated name, the original one can be reconstructed.

1.3.3   Theory of Lettering Maps

Official map sheets may contain between a hundred and a thousand names in all. See the *.pdf for a differentiated source concerning the density of type and its type size.

Name_Density.pdf: www.gitta.info/LayoutDesign/en/multimedia/Name_Density.pdf

The lettering is important in the means of linguistic, practical, technical and aesthetic aspects. Illegible or non-existing type on a map could cause enormous damage to man and nature. Think about a non-specified refuge in the Alps on a winter-season map and a snowshoeing group that suddenly needs shelter because of bad weather conditions. They might not consider the non-named house on the map to be a known shelter.

You will have to consider liability for linguistic-geographic problems as well as name quantity and its design. For the font design in maps, you need to decide on the font-family, its basic forms like size and the positioning of the type, dependant on the space that is left next to the other map elements. Then you need to differ between lettering topographic or thematic maps. In topographic maps, it is a main explanatory component, in thematic maps it is additionally important for orientation. Necessary requirements include:

- All names with their correct syntax

- The approximate position of the names

- The type classification according to its kind and size with correct colour identification

Those 3 points need to be defined in your editorial before you can actually start with type positioning.

> **Please note:**
> Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed.

Figure 35: 4 Steps for Lettering Maps

Map-type will be placed on the map after the situation has been placed and will certainly overlay parts of it. The attempt lies on remaining the readability of the situation on the map. This means you will need to generalise the amount of type you want to show.

The labelling of the scalebar displays a specialty:

Place the digits in a group of three. For every blank space dispatch a quarter- to an eighth *quad*[6]. One turquoise box = 1 Quad. Today' s layout and text programs offer this possibility.

> **Please note:**
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Figure 36: Lettering a Scalebar

Guide yourself through the following list of spelling digits. You might need one or the other for marginal notes, e.g. explanatory notes, diagrams and source material declaration. The little blue boxes stand for white spaces!

> **Please note:**
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Figure 37: Lettering Numbers

The following link contains 5 considerations E. Imhof made on type presentation to guarantee an aesthetic, pleasing, quite and fluid effect while reading map names. For you it is optional, additional content.

General Viewpoints and Postulates.pdf (`www.gitta.info/LayoutDesign/en/multimedia/General_Viewpoints_and_Postulates.pdf`)

Based on experiences made by manual map lettering, the Institute of Cartography of the Federal Institute of Technology in Zurich created a composition about relevant factors. You may obtain this document as a further reading source. It is optional for you and written in German.

Basics for Lettering Maps with Sans-Serif Linear-Antiqua Type.pdf (`www.gitta.info/LayoutDesign/en/multimedia/Grundlagen_zur_Kartenbeschriftung.pdf`)

As promised, we now come to the specific lettering rules. Here are 4 general aspects:

After we explicated the basic rules, we would like to give you the facts about local-, linear and areal designation.

A speciality in this field is the placement of names on streetmaps. Have a look through the attached pdf document for deeper insight.

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[6]Definite interspace on the base of a square. Its side length is equal to the height of the current font.

Please note:
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Figure 38: Lettering Maps in General, Source background Map: Hydrological Atlas of Switzerland [**?**]

Please note:
Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed.

Figure 39: Lettering Maps with Local - Linear - Areal Designations, Source background Map: Hydrological Atlas of Switzerland [**?**]

Placing Type on Streetmaps.pdf (www.gitta.info/LayoutDesign/en/multimedia/Placing_Type_on_Streetmaps.pdf)

1.3.4   Typography and Readability on the Screen

Creating text for the screen, in case you plan to offer the product as a digital version, is a special challenge to face. The reason for this is the medium 'screen' that is tiring when reading for a longs period of time. This is due to an 18 times lower *resolution*[7] than you would have on a paper base. Furthermore, reading is more difficult because of overlaying eye movements and the refresh rate of the monitor.

This means, if you start reading continuous text phrases, the eye scans the line in loops of the possible focusable area, called saccades. When the eye reaches the next line, it might loose the focus at the beginning of the next line if the saccades overlay with the refresh rate. Especially difficult are long lines, because of the long distance they eye has to move from the end of the line to the beginning of the next.

These reasons lead to compromises. Technically, an electron beam is sent through a dot mask onto a gleaming layer on a monitor - see *Displaying on a Colour Monitor*[8]. The letters can only be displayed via this mask, that creates the steps you can see as follows:

Please note:
Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed.

Figure 40: Source: IKA ETH according to [**?**]

The explanation for the so called 'stair-case effect' is the fact that your

---

[7]Resolution is the number of pixels contained on a display monitor, expressed in terms of the number of pixels on the horizontal axis and the number on the vertical axis. The ratio of horizontal to vertical resolution is usually 4:3, the same as that of conventional television sets. The sharpness of the image on a display depends on the resolution and the size of the monitor. The same pixel resolution will be sharper on a smaller monitor and gradually lose sharpness on larger monitors because the same number of pixels are being spread out over a greater number of inches. A given computer display system will have a maximum resolution that depends on its physical ability to focus light and usually several smaller resolutions. For example, a display system that supports a maximum resolution of 1280 by 1023 pixels may also support 1024 by 768, 800 by 600 and 640 by 480 resolutions. Note that on a given size monitor, the maximum resolution may offer a sharper image but be spread across a space too small to read well.

[8]Via 3 electron beams and 3 kinds of phosphorus, 3 dots are activated to gleam in red, green and blue. Such dots, we call 'picture elements' or short: pixels. One such triplet forms 1 gleaming point we can perceive. The applied RGB system gives you the possibility to depict all colours possible for the RGB colour space depending on the intensity of the beam reaching the gleaming layer. The resolution of the screen depends on the interval between two triplet points. Depending on the quality of the graphic card, different colour depths are possible.

monitor most likely has a raster display, which means that the electronic beam always follows the same pattern with a special *refresh rate*[9].

You might produce relief with a technique called *Antialiasing*[10]
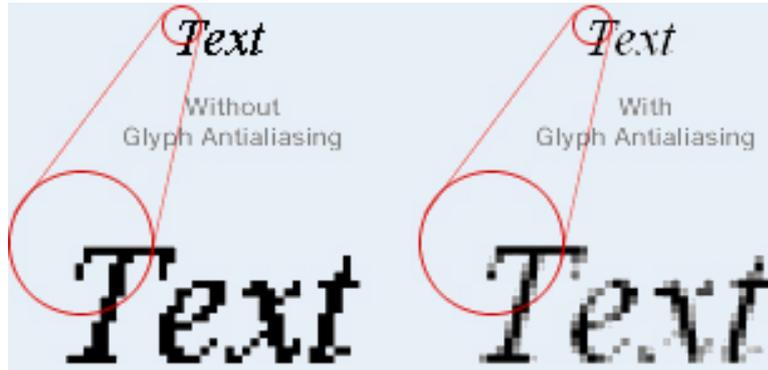
Figure 41: Antialiasing

Depending on the aim of your product, you generally have to decide on either creating text passages as *bitmap fonts*[11] or *scalable screen fonts*[12].

---

[9]Refresh Rate is the amount of time a display's image is redrawn per second. The refresh rate is expressed in hertz. A refresh rate of 75 means the image is refreshed 75 times per second. The refresh rate for each display depends on the video card used. You can change the refresh rate in the display properties of your computer. However, if you change the refresh rate to a setting that the display cannot support, the display goes blank or the image becomes distorted. Therefore, it is recommended to consult the manual before changing the setting in order to determine the supported refresh rates.

[10]Antialiasing describes the smoothing of the edges of fonts. Therefore pixels are added at the edges. The hue of the added pixels is between the colour of the font and the background colour

[11]Those fonts which have characters, specified as patterns of tiny dots. These patterns are necessary for every character in the font in all normal sizes. This method has a definite shortfall. If a pattern is not created for a certain size of a bitmapped character, a pattern for another size is contorted to provide the requested size. If you do this, dots in the original pattern are simply made larger. The net results are characters that display the 'stair-case effect'. Each Glyph is stored like a screened picture and is dependent on the resolution of the output medium. Microsoft used *.fnt and *.fon as format for their bitmap fonts, Adobe uses the *bdf and *.abf format to save the fonts. Bitmaps take up much less memory, which is especially important for devices sold in areas of the world where the characters are so much more complex than Western fonts. And perhaps most importantly, all of these devices require small font sizes, and scalable fonts do not look good at small sizes. Here are some advantages bitmap fonts have nowadays: If text must fit within a window, bitmap fonts can guarantee that every character is the exact pixel width wide. They are used in text passages that need high quality output and do not need to be editable. Bitmap fonts exactly define the distance between characters and control the spacing between lines of text, tracking and kerning are not applicable. Bitmap fonts at the same point size as scalable fonts are larger and easier to read. Bitmap fonts contain the exact character set we need, whether for Windows, DOS, or special symbols.

[12]These are fonts which outlines are described by mathematical formulae, permitting

Fonts for traditional paper layout are unfortunately mostly not transferable to computer layout. Exceptions exist, but need to be evaluated for individual point sizes of the text's height. For computer use, special fonts have been created, e.g.

- Chicago

- Verdana

- Geneva

- Trebuchet MS or

- OCR A/ B

Its design has been adjusted to 72 DPI[13] of a screen and for reading optimised.

With the knowledge about the different kind of fonts, you are now prepared to start with typographic presentation for maps on the web. In case you want to offer your map product via www, some special rules need to be followed. As it is a broad field where much information can be found on the web, we will propose some adequate links to this theme and recommend book titles, which you are invited to look at optionally. There you will find answers to:

- A book reference with promising and valuable information concerning optimal application of typography on the web and what you have to consider when publishing fonts on the web. Further Information concerning the layout on the www:

  http://www.typo-und-layout-im-web.de/ (`www.typo-und-layout-im-web.de/`)

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them to be shrunk or enlarged to almost any point size. Screen fonts are the representations of fonts that appear on your computer's screen. Within the realm of scalable fonts, there are several different techniques for generating fonts. Scalable fonts need elaborate "hinting instructions" to look good, which requires much larger fonts and sophisticated rasterizing technology to interpret the instructions. Moreover, the best-hinted TrueType scalable fonts still contain bitmaps for the smallest sizes, because it has turned out to be the best way of hinting them. Paradoxically, bitmap fonts are the ultimate way to hint scalable fonts. Fortunately, for most users, Microsoft Windows provides a technique that is both easy and powerful. These fonts are known as TrueType fonts, with the identification 'TT'. TrueType fonts are scalable to any size and look exactly the same on the screen as they do when printed. These fonts have a low screen resolution that precipitates the 'stair-case effect'. Here it is necessary to verify whether or not real antialiasing has occurred or if they were softened, which leads to an macerated look. Advantages of scalable screen fonts to be designated: Small needed disk space Texts stay editable Special sorts of fonts may not be available on all computers per default. Therefore these fonts need to be supplied separately if the screen design should still fit afterwards.

[13]Dots per Inch

- 4 different ways to publish type on the web:

  http://userpage.chemie.fu-berlin.de/~frech/fczb/font/ (`userpage.chemie.fu-berlin.de/\char'~frech/fczb/font/`)

- A book especially on typography and layout for digital media

  http://www.typo-digital.de/typo.htm (`www.typo-digital.de/typo.htm`)

- Here you will find anything about design, typography, etc.

  http://www.drweb.de/weblog-verzeichnis/webdesign-1.shtml (`www.drweb.de/weblog-verzeichnis/webdesign-1.shtml`)

- If you need special help for HTML and CSS generation, you will find a complete tutorial here:

  http://de.selfhtml.org/ (`de.selfhtml.org/`)

Have a look at the following information regarding writing for screen applications and consider it as a kind of reference book. The cartographic rules for positioning are still valid and have to be applied.

1.3.5   Computer-Aided Lettering of Maps

After explaining all the theoretic aspects of type, we will now introduce
you to the process of computer-based lettering of map names. When you
start lettering your map, you will have already imported your data into a
DTP[14] drawing program. More information on how to handle your data in
order to reach this step can be found in "Handling GIS data" as part of the
Intermediate module.

DTP drawing programs usually offer a range of different type options. In
most of the programs, you will find a palette of basic type settings as font-
family, font-size, letter- and *line-spacing* [15], *kerning*[16], *tracking* [17] and
baseline adjustment.

In case you are using *postscript*[18] font you will find options for special effects
like hollowed fonts, shaded fonts, 3D-fonts etc. It is important to know
that effects made on TrueType fonts are not able to be printed on a laser
illuminator. On the other hand, postscript fonts may be transformed into
pieces of signs. After this, its form can be changed to your own needs. But
there is more to think about if its use is to make sense in cartography.

For label positioning, many DTP drawing programs provide different stan-

---

[14]'Desktop Publishing' is the process of using the computer and certain types of software
to combine text graphics in order to produce documents such as newsletters, brochures,
books, maps, etc.- basically any kind of document that produces visual communication.
It is necessary to differentiate between drawing, painting and page layout programs. It
allows a professional organisation of your documents that enables a successful printing
process .

[15]The space between to lines of type. It can be a fixed number of points or relative to
the font size.

[16]The adjustment of horizontal space between individual characters in a line of text.
Adjustments in kerning are especially important in large displays and headline text lines.
Without kerning adjustments, many letter combinations can look awkward. The objective
of kerning is to create visually equal spaces between all letters so that the eye can move
smoothly along the text.

[17]The average space between characters in a block of text. Sometimes also referred to
as letter spacing .

[18]Developed by Apple Systems Inc. in 1985, PostScript is a page description language,
which allows the appearance of a printed page to be described in a device-independent
manner. It also runs on all major operating platforms. You can identify PostScript files
by its suffix 'ps'. Printing then becomes a two-stage process: An application language
produces a description of the text, graphical shapes and image appearance on printed pages
not as pixels but as mathematical shapes and curves. PostScript is used by certain printers
with built-in PostScript interpreters and by graphics programs that create PostScript
files. An advantage of PostScript is that it is resolution-independent and can consequently
support the highest resolution of your device, and at the same time it gives you a reasonable
preview on a low resolution screen. It has since become an industry standard for printing
and imaging. Take into account that the average home laser printer is not a Postscript
capable printer; which is usually more expensive and more often purchased for business
use.

dard transformation tools like rotation, translation, distorting and mirroring. In some programs, you will find a special lettering tool which is very useful for cartographers: aligning text along a path. It is used e.g. to easily label rivers or high mountain ranges.

Another important lettering effect for cartographers is the possibility to clear the details around the label to ensure an appropriate legibility. There are two ways to realize this:

- Give the text a contour with white colour.

- Draw a white textbox without stroke around the label.

The following interactive svg animation shows you the different possibilities in computer-aided lettering.

Please note:
Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed.

Figure 42: index.svg

1.3.6   Placing Type on a Map

Concluding this unit, take the chance to test your knowledge about placing names.

Name placement is one of the most important elements relating to map design and production. Appropriately positioned type is more legible and, furthermore, does not disturb other map components. This exercise is intended to create awareness of this. Be aware that the name placing workflow would also cover first creating a name manuscript and to search for the right names in the right amount. In this exercise, we will just focus on the correct placement.

First, visualise the following map excerpt and take a couple of minutes to think about the placement mistakes in this example. Click on the picture to enlarge and to print or save the enlarged picture as your working base.

Please note:
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Figure 43: poor_name_placement_original.gif [**?**]

Secondly, just in case you might not be sure, take the following map-type placement-sketch into account. The included numbers refer to the corresponding comments in the associated text. You may visualise those by opening the *.pdf file here. (www.gitta.info/LayoutDesign/en/multimedia/poor_name_placement_comments.pdf) Click on the picture to enlarge and to print or save the enlarged picture.

Please note:
Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed.

Figure 44: poor_name_placement_comment.gif [**?**]

Thirdly, your active part begins! Take a piece of tracing paper, join it onto the map example and mark it with register marks at the corners. Start reorganising the chaotic name placement by placing boxes instead of the written names at the new position (Placement of boxes only to minimise the effort). Allow at least half an hour for this. It is also possible, depending on the tutors specifications, to find a digital solution by using a DTP Drawing program (e.g. Macromedia Freehand, Adobe illustrator, etc.). Here, create

a new layer. Digitally, you should place the written names at the new positions, not only text boxes!

When you have finished, pass your solution on to the tutor (don't forget to place your name on the solution).

Underneath you see a possible solution to the student work. On the left the sketch and on the right the final product with type.

Please note:
Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed.

Figure 45: improved_name_placement_sketch.gif [**?**]

Please note:
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Figure 46: improved_name_placement_original.gif [**?**]

1.4 Colour Design

Function of Colour in Map Design

In our information-age it is a fact that 80% of man's perceived information is colour information. We can make use of this in the way we can direct attention and set moods with application of specific colours in maps and graphs. Colour is produced physically but our reaction to it is psychological, while our perception is on the one hand influenced by the environment and on the other hand affected by the connotations that we attach to them. Although the use of colour is considered beneficial, it does present some problems to the cartographic designer that need to be solved or at least find some compromises. In addition to the aforementioned examples, there are the colour conventions, preferences and interactions with other colours and map elements. Colours may also take over functions like etc.:

- Aesthetics

- Emphasis

- Interpretation

- Structure

- Distinguishing classes

- Increasing readability

- Leading attention

- Unifying map elements

- Simplifying and

- Flexibility in design etc. that help to improve map user communication

In the following unit, we are going to introduce you to the essentials of colour theory, colour harmony, the effectiveness of contrasts, and figure ground relationships. The use of colour schemes in maps will be explained separately in the intermediate module in the unit "Colour Schemes".

You won't need any prerequisites for this learning unit.

1.4.1 Colour Basics

The human eye and light of the *visible spectrum*[19] in any state, are the two agents that allow us to recognise colours. They are responsible for *colour appearance*[20]. In other words: Our light-sensitive receptors on the retina pass those light impulses from the *rods* [21]and *cones* [22]to our brain where they are bundled into a picture. Which colours we specifically identify is dependant on the characteristics of each individuals' visual system.

The matter of colour perception allowed man to set up theories about how

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[19]Light, along with invisible non-ionising radiation such as radio waves and microwaves, is a form of electro-magnetic energy. Light is distinguished from these other forms of e-m radiation because we can see it and it is defined by this property. Wavelengths between 380 - 700 nanometres are visible to the human eye. Electromagnetic energy below 380 nm is termed ultra-violet (u-v), and that above 700 nm. is termed infra-red (i-r). Both u-v and i-r are absorbed by the media of the eye, and do not generally reach the photoreceptors in the retina. As they are not visible, u-v and i-r radiation is not generally considered to be 'light'. The human lens acts as a u-v filter, and if it is removed (e.g. by a cataract operation) the person can then have an extended range of vision. The absorption of the non-visible radiation can have short-term and long-term effects, causing, for example, snow-blindness and cataracts respectively. The sensitivity of the eye over the spectrum changes with light level. At low light levels, the active photoreceptors of the eye are the rods rather than the cones. Rods have a different spectral sensitivity from that of cones, and consequently, longer wavelengths (reds), tend to look relatively darker at night than during the day, whilst shorter wavelengths (blue) tend to look relatively lighter. Other creatures have different ranges which, make up their visible spectrum, and butterflies can see in ultra-violet, whilst some snakes can see in infra-red. Some 'night-vision' enhancers convert invisible infra-red radiation into visible light by using cameras that are sensitive in this 'invisible' portion of the spectrum. The camera output is then viewed on screens that display the image using a portion of the spectrum that is visible to people.

[20]For someone with normal colour vision, the colour of an object will depend upon three things: - the wavelength of the light falling on the object, - the reflection properties of the object, and - the context in which it is seen. Two objects with different reflection properties can appear to be matched in colour under one light source (a metameric match') but look quite different from each other under a different source. Individual wavelengths give rise to the sensation of a particular colour, as can be seen in the colours of the rainbow. White' daylight, containing all wavelengths, is split into its individual wavelengths because the refractive index of water is wavelength-dependent. Consequently, the position of the colour within the rainbow is a function of the wavelength that gives rise to that sensation, with the short-wavelength radiation (seen as purple-blue) at one end, the long-wavelength radiation (seen as red) at the other, and the middle wavelengths (seen as green, yellow and orange) between them.

[21]These receptors on the retina enable vision under darker light conditions at around 500nm. They are not responsible for any colour reception. They contain pigments tuned to receive wavelengths in three parts of the visible spectrum that gives us trichromatic vision. Further information can be found on the following page: http://www.yorku.ca/eye/specsens.htm (last updated on 28.5.2003)

[22]Human beings have 3 kinds of cones. One for perceiving Red, another one for Green and one for Blue. Their differences are continuously analysed and sent to our brain. Deeper information can be found on the following web-page: http://www.yorku.ca/eye/specsens.htm

colour works and can be ordered, and we will point out the most significant components in this learning unit.

A colour circle, based on red, yellow and blue has long been traditional in the field of art. Besides Goethe, who concentrated on the theory of colours in the philosophy of natural science, Sir Isaac Newton - from a mathematical and physical point of view - developed the first circular diagram of colours in 1666. This colour wheel is a 2-D description. It shows the purely saturated, spectral colours of the *visual spectrum*. The colours between red and blue, including purple, that are not covered in the spectrum, can be seen as an overlap of the two ends of the spectrum.

> **Please note:**
> Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed.

Figure 47: Colour Wheel

The ability to measure and define colours is most important if preparing the map for printing. All visible colours can be described via this 3 parameters:

- *Hue*[23]

- *Brightness* [24]or *lightness*[25] or Value

- *Saturation*[26]

These characteristics may firstly be illustrated with a 2-D colour model:

---

[23]This attribute is responsible for the perception of the tone itself. It sets colour groups like green red or orange.

[24]This attribute is responsible for the intensity of the visual attraction of the colour-hue. The range varies from light white, to dark black colour perception, which we can recognise via the cones in our eyes.

[25]This attribute is responsible for the intensity of the visual attraction of the colour-hue. The range varies from light white, to dark black colour perception, that we can recognise via the cones in our eyes.

[26]This attribute describes the intensity of the colour experienced. It describes the tone of a coloured area in relation to the colour's lightness. This means white is not saturated at all, light-blue is partly saturated and dark blue is very saturated.

Please note:
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Figure 48: Relief: reproduced with the permission of swisstopo (BA027224)

1.4.2 Colour Models

Many people from different fields of research have tried to explain colours and order colours during the last 2600 years. Today, we can clearly define the colour models used in our time. On one hand there are the *physical - technical models*[27] and on the other hand we can portray the *perceptive oriented colour models*[28].

Physical - Technical Models

When we talk about the physical - technical models, we are talking about models representing colours as ordered sets of numbers. The most common colour models are the physiological, additive RGB[29] system and the physical, subtractive $CMYK$[30] system. The CIE[31], *CIE- Lab* and *CIE-LUV*[32] systems may also be included in this group, but can be clearly differentiated by their description in space. That is to say, they form a group of independent hardware and software colour models. RGB and CMYK are working within a 2-D rectangular co-ordinate system whereas the CIE, CIE-Lab and CIE-LUV systems belong to the category of 3-D colour-ordering systems.

The question arising from this is:

Why do we need a 3-D colour system? In practice, the 3-D systems meet our needs to enable an objective description of any colour, also in light to dark gradations, that can't be met by 2-D co-ordinate systems.

Perceptive Oriented Models

Within the group of perception oriented colour models we need to mention, the HSL or so called HSB system, this is one of the systems you will often see when working with colour. HSL stands for Hue, Saturation and Lightness where, Hue is the base colour (from the wheel), Saturation is the purity, in fact how much grey is mixed with the colour and, Lightness is how much black or white is in the colour. In case of HSB, B stands for Brightness. This perceptive HSL model also works in a cylindrical 3-D co-ordinate system to describe colour tones. Have a look at the following animation operating in a 2-D co-ordinate system:

In addition to the colour ordering models, we can visualise dimensions in

---

[27]These models describe colours as mixture of 3 primary colours. Their differences lay mostly in the chosen primary colours and the chosen type of mixing system. The RGB, CMYK and CIE LAB as well as the CIE LUV model belong in this section.

[28]These models work with values of hue, saturation and brightness or sometimes also called lightness. They are adapted to man's perception. We place the HSB or HSL and the LCH model into this category.

[29]Red Green Blue, the base colours of the additive colour model

[30]Cyan Magenta Yellow Black, the base colours of the subtractive colour model.

[31]Commission International de l'Eclairage

[32]Colour system based on the velencimetric measurements of colours .

a colour-space. This space is described as a mathematical presentation of colour-valences. The bigger the colour-space, the larger the amount of presentable colours. The technical terminology for this colour-space is Gamut.

For further, optional information regarding this course, you can find on the internet-page:

- http://www.farbe.com/framed.htm (`www.farbe.com/framed.htm`)

- http://www.sohnrey.de/druckseiten/index.htm (`www.sohnrey.de/druckseiten/index.htm`)

Have a look at the animation to increase your understanding of how each colour model works:

Please note:
Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed.

Figure 49: colour_models_3.swf

1.4.3 Colour Rules

Knowledge about colour's origin and ordering principles does not yet give you the ability to make use of them in the right way. For generation of a well-formed end-product there are some important basic rules to consider, because there is hardly another system to find that effects on the psychology of the recipient more directly than colour. Colour works on three levels:

- Visual and objective

- Expressive, emotive and subjective

- Symbolic or cultural

You, the designer, may make intuitive decisions at some stage, but nevertheless rules have to be observed. Those rules you can call 'Colour Harmony', 'Harmonious Proportions' and 'Expressions' as well as 'Contrasts' and 'Colour Interaction'.:

When planning colour concepts, be aware of colour-deficient vision, also known as colour-blindness. You can test yourself with the following test-plates. There are different defects that can appear.

Have a look at the PDF for deeper information: Colour_Deficient_Visioning.pdf (www.gitta.info/LayoutDesign/en/multimedia/Colour_Deficient_Visioning.pdf)

One out of 12 men will have colour preception deficiencies. To minimise the effort for colour-blind users of maps and graphics, without making changes to the colour palette, you should internalise some propositions:

- Be consistent in using colour, that means to choose the same colour for the same level of information or the same meaning.

- Do not use colours just for their own sake

- Think about using colours just as an additional instrument beside your basic proposition

- Use more colours only if it helps clarify the logical structure of the information

If you intend to adapt your colour concept to the colour-deficient visioning, then have a look on this web page, where the RGB values or the code via hexadecimal numerals is directly converted. It will show you the 216 colours of the web palette. (www.btplc.com/age_disability/ClearerInformation/Colours/colours1.htm)

The content of the following external link concentrates on designing for colour blind users in general; it is just optional Designing for Colour-Blind Users.pdf (`www.gitta.info/LayoutDesign/en/multimedia/The_eye_of_the_beholder_christine_rigden.pdf`)

If you want to see how colour-blind people perceive colours, then have a look here: What do colour-blind people see? (`tsi.enst.fr/\char'~brettel/colourblindness.html`)

If you are interested in this topic, please check the web with the search item "safe web colors color-deficient". You will find extensive information.

Colour has already been mentioned as a means of grouping and emphasising. However, although it is very effective you should use it with care.

- Too many colours destroy the unity of the display.

- If colours are over-used they lose their impact.

- Avoid using colours in ways which contradicts their conventional meanings e.g. red is not a good colour for showing that a fact is clear.

- Remember that meaning also depends on circumstances e.g. blue indicates water on a map and cold seasons.

1.4.4 Colour Harmony

In visual experiences, harmony is something that is pleasing to the eye. It engages the viewer and it creates an inner sense of order, a balance in the visual experience. When something is not harmonious, it's either boring or chaotic. The human brain will reject under-stimulating information and the human brain rejects what it cannot organise or understand. Visual tasks require that we present a logical structure. Colour harmony delivers visual interest and a sense of order; it is a dynamic equilibrium.

What does this mean, especially for cartography? Harmony relates to the overall architecture for the entire map. What is necessary will be pointed out by a special colour or by a colour of the overall scheme, but with more opacity or more saturation. It will let you ask the question: Have you respected the traditionally given colour conventions or is there another possibility for design - will this have a negative influence on the ease of communication?

The colour scheme with its individual expression, does it match relatively to the content? Another question, which you should answer positively in order to reach harmony is: Have you applied the colouring rule for showing quantities, i.e. is the brightness or the saturation corresponding with the numerical gradations?

Last but not least: Is the map colour balanced - are dominant colours applied to larger areas, in relation to weak ones, not overpowering the map - dominant colours are all colours that contrast greatly with the surrounding. In most cases, the areas to colour are fixed geographically, which means that you only have colours to play with that build a non relocatable composition. This needs to be planned carefully.

If you now should be afraid of choosing any colour because of its more evident complexity, take the following statement made by **E. Imhof** , the founder of the Institute of Cartography, into account: "*A colour in itself is neither beautiful nor ugly. The attributes will be significant not until you perceive it with an object. [..] To analyse graphics with scientific methods is very difficulty. [..] It can just be seen as an explanation of general experiences and customs*" [**?**, p. 51] .

1.4.5   Colour Harmonious Proportions

Colours have relative strengths, for example Yellow is a strong colour and Violet is quite weak. If you put equal amounts of these two colours they would be unbalanced, there is a near numerical method of calculating this. The numbers in this table show the relative strengths of the colours. For example, 3 squares of Yellow would be balanced by 9 squares of Violet. 4 squares of Orange would be balanced by 8 squares of Blue.

- 3 - Yellow - Strong

- 4 - Orange

- 6 - Red / Green

- 8 - Blue

- 9 - Violet - Weak

Putting this information into practice, this means for the shown map clipping:

> **Please note:**
> Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed.

Figure 50: Colour Harmonious Proportion

1.4.6   Colour Expressions

Our personal and cultural associations affect our experience of colour. Colours are seen as warm or cool, mainly because of long-held associations. They bear some general truth, but may vary in different societies.

> **Please note:**
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Figure 51: Colour Model

1.4.7 Colour Contrasts

Around us, we are encircled by many colours and various adjacent colours beneath these. Equivalent to our daily life, the maps we want to create in the majority of cases will contain more than one colour. A map rendered in colour with little contrast will look lifeless and generally does not demand for much attention. Just think about the difference between generation of a map for a hydrologic atlas for scientists and a map of Switzerland for Japanese tourists. You will probably choose different colour schemes for each and also different contrasts to adapt it most suitably to the users needs. Next to the contrast, we will point out as follows; you may also think about the expression of colours and their meaning to different cultures.

Explore the different boxes expressing various contrast possibilities:

Please note:
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Figure 52: Colour Contrasts

With the understanding of the different contrasts, you are prepared for a self-assessment:

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Figure 53: Colour Contrast Exercise

1.4.8 Colour Interaction

During the development of colour theory through the years, general guidelines for the usage of colour combinations were made. At the stage of outlining your map concept or documents that go with it, they will serve you, the cartographer, as a starting point for colour selection.

Pleasing combinations:

- Large differences in lightness or brightness, the light-dark contrast generates pleasant figure ground relationships

- Choose a rather light or rather black background, but try to avoid an intermediate background colour

- Figure colour needs to be definitely lighter or darker than the background colour

- Pure or vivid colours in combination with grey are pleasant

- Among cold and warm tones of equal brilliance, the warm will advance and the cold retreat. Distant objects seem colder because of the intervening depth of air

- A pure colour advances relative to a duller one of equal brilliance.

- On white background, violet seems to advance, while yellow, just as any light tone, is held back.

- Warm colours take on figural qualities better than cold colours, which are mostly better for background creation

- Identical hues appear differently, depending on their environment

1.4.9 Colour Conventions

Traditionally the use of colour in mapping can be divided into qualitative and quantitative agreements. Breaking those, will leave the map reader extremely confused. Now you will probably ask what are qualitative and what are quantitative map agreements?

Qualitative use of colour in mapping addresses points, lines, areas or symbols. The element's colour is seen as a qualitative value, i.e. it is not applying an amount to the elements. Qualitative value is expressed through colour hue and its intensity or saturation. You will recognise in the following examples that the logic of use is appropriate.

- Water - Blue

- Vegetation - Green

- Land - Brown

- Climate - Blue to Red

With hues, you can express classes of one and the same amount, but it is hard to associate hue psychologically with varying amounts of data.

Quantitative use of colour may address the same elements as in the qualitative way, but at this time, value differences are best shown with a differing amount of one colour hue for one theme.

Beneath the differentiation between qualitative and quantitative use of colour, in general, there are 4 rules existing, established by E. Imhof, the founder of the Institute of Cartography. They may seem philosophically verbalised, but are essential for designing coloured maps [**?**, p. 53p] .

Rule 1:	Pure, bright or very strong colours have loud, unbearable effects when they stand unrelieved over large areas adjacent to each other. Extraordinary effects can be achieved when they are used sparingly on or between dull background tones.
Rule 2:	The placing of light, bright colours mixed with white next to each other usually produces unpleasant results, especially if the colours are used for larger areas.

Rule 3:

Large area background or base-colours should do their work most quietly, allowing the smaller, bright areas to stand out most vividly, if the former are muted greyish or neutral. For this very good reason, grey is regarded in painting to be one of the prettiest, most important and most versatile colours. Strongly muted colours, mixed with grey, provide the best background for the coloured theme. This philosophy applies equally to map design.

Rule 4:

If a picture is composed of two or more large, enclosed areas in different colours, then the picture falls apart. Unity will be maintained, however, if the colours of one area are repeatedly intermingled in the other, if the colours are interwoven carpet-fashion throughout the other. All colours of the same theme should be scattered like islands in the background colour. The complex nature of the earth's surface leads to enclosed coloured areas, all over maps. They are the islands in the sea, the lakes on continents, they are lowlands, highlands, etc., which often appear in thematic maps and provide a desirable amount of disaggregation, interpretation and reiteration within the image.

1.4.10   Colour Schemes in General

Designing a map, including all named aspects like colour harmony and contrasts, etc. that apply to the user's habits, is combined in the activity of creating colour schemes for maps. Today, mostly all kinds of a map's output is either printed in colour or prepared for a digitally coloured output for multimedia applications. This means, that there is a need for generating a colour-concept beforehand, at any time, for maps of all different scales, different functions like thematic or reference maps or for maps classed by different subject matters.

When you start designing with colours the progressions should be designed to:

- Allow the user to correctly match the colour on the map with the corresponding legend colour.

- Convey a correct impression of how the feature changes in magnitude across the map area.

- Allow the comparison of quantitative data for features on two or more maps of the same area.

For the last 140 years, researchers have thought about generating colour plans for all kinds of mapping. To make it a bit easier for you to combine those three needs into a workable result, take the following suggestions into account:

- Make use of a series of brightness and saturation in between one core colour hue.

- Try to use a sequence of colours grading between two endpoint hues.

- Think about using a progression of several hues or simply use a black to white value progression.

Differentiated illumination on colour schemes for maps can be found in the intermediate unit module, that concentrates on "colour schemes for thematic mapping".

1.5 Readability Rules

Rules for Improved Readability

Rules for the readability in cartography are comparable to the rules improving a text's comprehensibility: An excellent diction and expression can be incomprehensible within an abstract if the pronunciation is incorrect. In contrast, a very bad text can be pronounced perfectly by an excellent speaker, in conditions of comprehensibility. So to speak, a good perception of the map content completely depends on its readability. By taking the following points into account, you will be able to create readable maps:

- Make use of the global readability rules, which are presented in this unit.

- Apply the cognitions of graphic semiology, set up by Jaques Bertin, a french Cartographer, which are presented in this unit.

- Try to create good quality graphics by continuously having the following catchwords in mind: neatness, suitable choice of colours and how can a good technique for a print product be achieved.

In this learning unit, you will learn the most important readability rules, beginning by giving a general overview of graphic semiology as far as pointing out some basic, special, outstanding rules. Necessary prerequisites are knowledge about colours and typography. This content was dealt within the previous units, where you may need to have a look first to get the new aspects in the right sense. This learning unit will introduce you to general readability rules.

Necessary prerequisites are knowledge about colours and typography. This content was dealt within the previous units where you may need to have a look first to get the new aspects in the right sense.

1.5.1   Balance of Map Elements

Let's start with one of the general rules:

Balance involves the visual impact of the arrangement of image units in the map frame. A bad arrangement of map elements, which appear all on one side, can cause the map to "look heavy" on the right or left, top or bottom.

An image space has two centres: a geometric centre and an optical centre. You should always arrange the elements of the map to be balanced visually around the optical centre.

Beneath are rules concerning the cartographic balance, other rules exist. Two of these further rules are called "Rule of The Golden Section" and "Rule of R. Arnheim". They are better for the distribution of the whole map frame. Please find these rules in unit Definition and organisation of map elements (Page 14).

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Figure 54: Optical versus Geometric Centers, Source: IKA ETH according to [**?**]

This SVG animation shows the localisation of the two centres in an image. The geometric centre, that is equal to the image's balance point, and the optical centre. You should arrange the map elements around the optical centre rather than around the geometric centre. The reason for this has a cognitive-psychological foundation.

SETUP INFORMATION FOR TUTORS: **Adobe SVG Viewer is required**

Please note:
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Figure 55: Positioning Map Elements

The position of map elements in the image affects the balance of the map. The draft, exemple shown beneath, is a map where details do not extend over the whole map-face. Move the base map element by clicking on the arrows to get an impression of balance and imbalance. France will appear in green when the optical centre is reached.

1.5.2 Contrast Design of Visual Tone

Keeping an eye on the creation of visual contrasts will help you generating well-designed maps. If these most important visual contrasts are missing, the map user will lose interest in the map. A further consequence of missing contrasts is the difficulty in distinguishing between important and unimportant elements. The goal of contrasting elements is to emphasize perceptible differences and to give the eye the ability to discern them. Contrasts are achieved by modulating several visual variables: line, texture, value and colour. Below we suggest a few general principles of contrast:

Line Contrast

Lines are everywhere on a map: borders, neatlines, boundaries and symbols, for example, are very important map elements. Thereby, the need for well considered line contrasts emerge. There are 4 different possibilities for creating line contrasts that need to be taken into consideration when defining lines.

Have a look at the following specification:

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Figure 56: Line Characters

A The most simple line character is shown - a black solid line

B The first variation is made in adding a stroke character to the basic appearance

C The second variation consists in adapting another line width to the stroked line

D The third possible variation is made by adding the colour or brightness components

For creation of well designed maps, line characters are not used in the same way as line widths. Indeed, a large line is visually dominant and brings more intellectual importance than a variable line character. Try to have different line characters and line widths on your map: a map with all lines of one width is boring and lacks potential in figural information.

These 2 examples will show you the visual effect of varying line widths on a map. In figure A , all the lines have the same widths, while three different line widths are used in figure B.
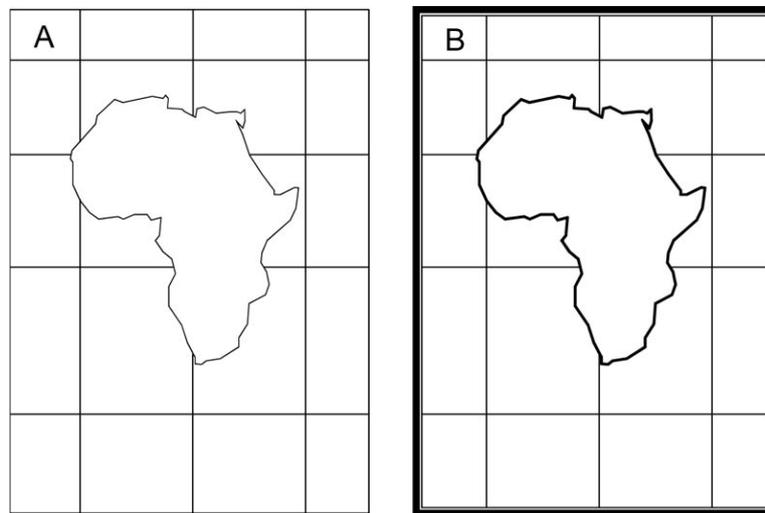
Figure 57: Visual effect of varying line widths

Do not overdo it with variations - they may confuse the map user. Stick to one line width within one information group! Have a look at the following rule from Richard D. Wright. It may be of help if you are confronted with choosing line widths to assure noticeable differences in maps.

Rule of Richard D. Wright

(according to Wright (1967) cited in [**?**])

- Multiply the width of the current line by the coefficient 1.8. The outcome is the minimal width, which allows the differentiation for the second line.

- If a third line is necessary, take the second line width and multiply it by 2.18 to have the width of the third line.

- Finally, if a fourth line is still necessary, operate as you did for the third line, but with a coefficient of 2.52.

For example: If your first line width is 1

- the second line weight will be 1.8 (1X1.8=1.8),

- the third 3.9 (1.8X2.18) and

- the fourth 9.8 (3.9X2.52 =9.8)

Texture Contrast

Texture is often chosen to represent quantitative or qualitative information, but without any contrast consideration. What is contrast of texture about? Contrast of texture involves areal patterns of small symbols. They are repeated in such way that the eye can perceive the individual elements and are chosen for different reasons:

- Patterns can be used on a map solely to provide graphic contrast

- Texture is sometimes applied in order to direct the reader's attention to a particular part of the map.

Colour Contrast

The most applied technique in the designing process is to make use of colour contrasts. They are of major importance, as its impression has an immediate affect on the user. Colour contrasts and colour in general, as they are a major design element, are treated in detail within the Colour Design unit.

All mentioned principles of design contrasts could be used within one project layout but the result might be visually disharmonious or might appear without contrasts at all.

Designing with contrasts requires careful juggling with lines, textures, and colour-characteristics. It is a subtle element to use economically and with care. In the beginning, much may be generated by trial-and-error, but in most cases, you will see intuition to be explainable by designing rules. Then you will choose the right combination built up on your experience and knowledge.
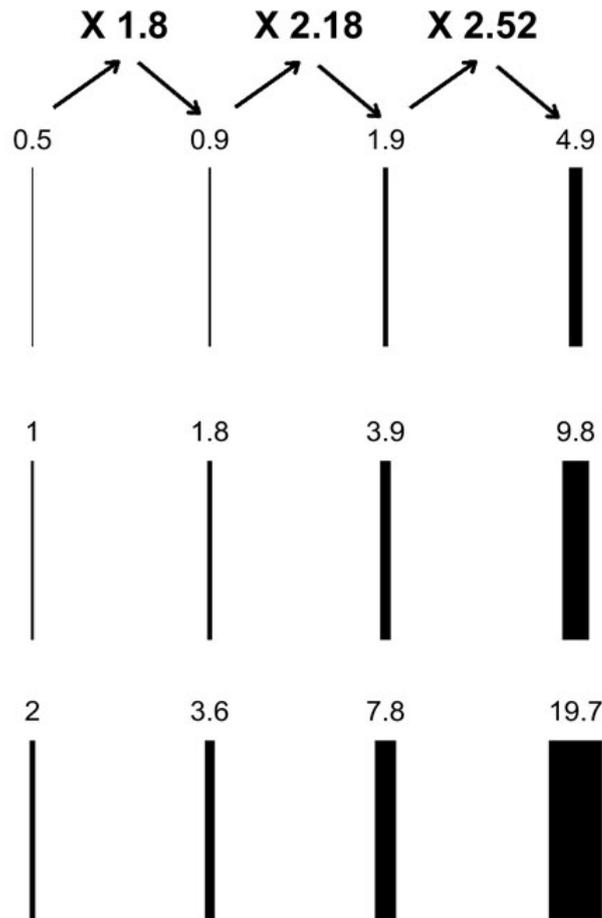
Figure 58: Rule of Richard D.Wright

Please note:

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Figure 59: Pattern Textures

1.5.3   Graphic Density

Graphic Density is another aspect of graphic semiology mentioned in [**?**] . The bottom line of his achievements states: The readability of maps is conversely proportional to the amount of represented cartographic information. That means, the more elements you have, the less readable they are. Two or three additional and thus readable maps should always replace one overloaded and difficult to understand map. An optimal quantity of cartographic elements per cm2 is needed in order to achieve a readable and comprehensible map.

If the graphic density of cartographic elements is too high, the readability will be badly affected. This means: The outcome of high density is just a sum of graphics where all detailed bits-and-pieces of map elements are mixed together. This mixture is mostly insignificant for the map user. In contrast to this, presenting too little density, the graphic expression will be underdeveloped.

Ideal is a graphic density of 10 elements or signs per cm 2 . It is necessary that the element density be considered on your map. You can either decrease the number of graphic variables or modify the map scale if the density is too high.
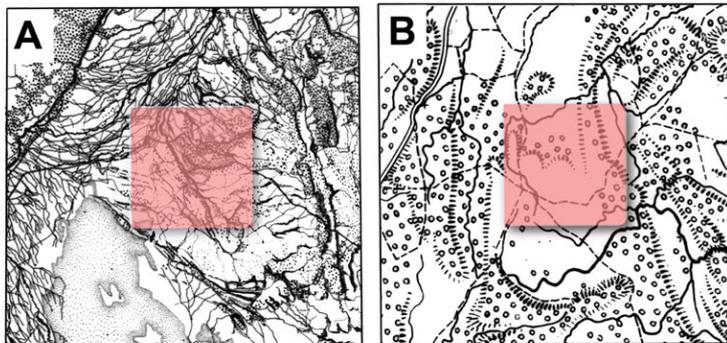
Figure 60: The Maximal Graphic Density of 1 cm2 [**?**]

Two map examples of India, taken from the "Graphic Semiology" of J. Bertin depict this difficulty. In map **A** you can see a too high density, e.g. The orange square in this case represents an area of 1 cm^2 . The graphic information is not significant here. In map **B** a correct density of elements is shown. The information here is legible and thus significant.

1.5.4 Shape Readability

Small cartographic elements and signatures do have a lower size limit in order to stay readable and do not get mixed up. The problem is significant if the map afterwards should be *generalised* to a smallest scale. In order to avoid clashing elements and instead raise the readability, various graphic rules need to be considered. There are existing limits of visual perception to follow, which form the physical border for reading maps and graphics.

- Approximately, the human eye has a maximum resolution of 0.3 mm from a 50 cm distance.

- The rods and cones in our eyes set the limit to 0.0002 mm for elements perceived next to each other on the retina

Based on this and a good contrast between map elements and background, the following numeric values are needed for our eyes to perceive signatures from an approximately 30 cm distance. The values apply to stand-alone, black objects on a white background.

Please note:
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Figure 61: Minimal Dimensions

For lighter colours, the numeric values have to be modified, the elements need to be enlarged and the distance between them extended. Another interesting point of reflecting on minimal numeric values is the level of differentiation on shapes. For presenting signatures on the map, a difference in shape between two of them need to be noticeable. See the following animation for graphical explanation:

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Figure 62: Minimal dimensions

1.5.5   Angular Readability

The visual presentation of any object is bordered by angles. The presentation of the angles can be less readable, depending on:

- shorter angle lengths

- angles that approach the 0°or 180°- axis.

In general, there is a need to differentiate between two types of angles:

1. **Clearly legible angles:**

   Clearly legible angles are perceived by taking a deep look at each element on the elementary level on a map.

2. **The "vague" angle:**

   This angle can just be seen, within the entire image. For example: In a 2-D diagram this one points out the relationship between the 2 aspects of the x and y axis.

For further explanation have a closer look at the following graphic, a diagram that could be part of a legend on a thematic map:
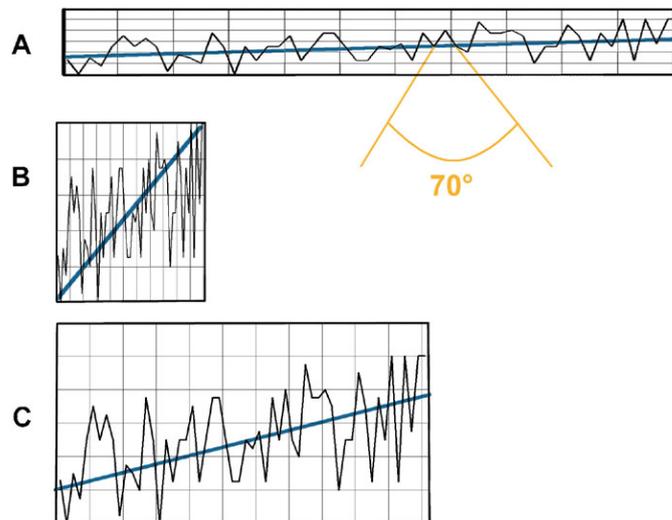

Figure 63: Legible and Vague Angles

In graph **A** , , the net and legible angles are perceived at once because they are close to 70°, an optimal stage for angle readability. The secondary vague angle (blue line) is too weak and almost invisible. In contrast to **A** the vague angle perfectly visible in **B** (blue line), but here the disadvantages of the clearly legible angles appear. They are close to 0°. Finally, the angular legibility is ideal in graph **C** : It corresponds to a compromise between the elementary and secondary level of reading. Neither acute angles or obtuse angles are used and neither a long or too higher stretched diagram-form chosen.

SETUP INFORMATION FOR TUTORS: **Flash Player is required**

Test your knowledge of angle readability with the following animation.

Please note:
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Figure 64: The Angle_readability

1.5.6   Readability of Colour Patterns

In the previous learning objective about angular readability, we concentrated on perceptive contrasts on 2-D a surface. Now the focus lays on readability of colour patterns, which relate to the height above the 2-D surface.

This means if you take a global look at a map - during the stage of initial perception - the expected and therefore relevant information has to stick out immediately. The background information needs to be subtle, and not dominating over the foreground.

Many rules deal with the readability of colour patterns. Here we will present the most evident ones, while the more complex ones will be treated on a intermediate level.

Optimal contrasts can be reached if:

- all shapes and other elements are visible

- those shapes stick out of their surroundings

- the tallest elements can be separated from each other

Optimal readability is ensured if:

- the total amount of black symbols lays between 5% and 10% of the entire surface.

- If it is less than 5%, the smaller elements will be invisible, whereas, if the percentage is above 10 %, the tallest elements can overlap. The overlap would present illegible information.

From this quantity of black symbols, it will be necessary to have the maximum range. You should try to use the full sensitive range of a given variable.

Now we give those rules a cartographic touch:

Choose radio-buttons one by one, by clicking on them to get the equivalent amount of colour in your presentation. This allows you to test the readability of the map.

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Figure 65: The Right Amount of Black

1.5.7 Land-Water Contrast

One particular case is the land-water contrast. The differentiation between land and water on a map is often unclear. The reason for this arises through graphic elements being arranged in such a way, creating a conflict when reading.

During your group discussion, you were given an expression of the land-water-displaying problem. Land areas, if not presented correctly, are perceived as figures and water-areas as ground. The following solution for better differentiation exist - you may compare them with your own results: The problem was solved by vignetting at the coastlines. A continuous tone of increasing brightness, away from the coastline is best for reading and is more aesthetically pleasing. If you cannot make use of the vignetting technique, at least, surface-texture differences between land and water should be developed. One last suggestion is to arrange the shapes in a map frame to reduce the possibilities of ambiguous or reversible figures.

The following examples finally show five simple sketch maps to illustrate various aspects of the land-water relationship:

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Figure 66: Land-Water-Relationship

1.5.8   whiteboard discussion

Gather in groups of 2 or 3 students for an online whiteboard discussion. For the discussion please keep the following aspects in mind:

- After welcoming each other, make an agreement on who is loading the attached file into your workspace.

- Take a minute to get a first impression of the image's content.

- Then start to clarify each others impressions. Allow at least 15 minutes for this textual and graphical communication part. Keep objective! Find an answer to the following questions:

1. What is displayed? - textual communication

2. How is its graphical expressed? - Create a legend on the existing elements

3. What are the problems exist with this map? - Would you, the user, be happy with it? - Record headwords, textually.

4. Test some new presentation possibilities. - Be creative but keep the subject matter in mind. Finish this when you have agreed on a new legend.

5. Make some closing comments on your results.

Leave your communication group and come back to this learning objective.

It is often difficult to adhere readability rules on a map, but without paying attention to them, lower quality maps are the result. Cartography is not an intuitive type of art in which the graphic elements may be rearranged at will. Many of the shapes and their locations are imposed by geographical or locational facts. Nevertheless, these guidelines should be applied whenever possible.
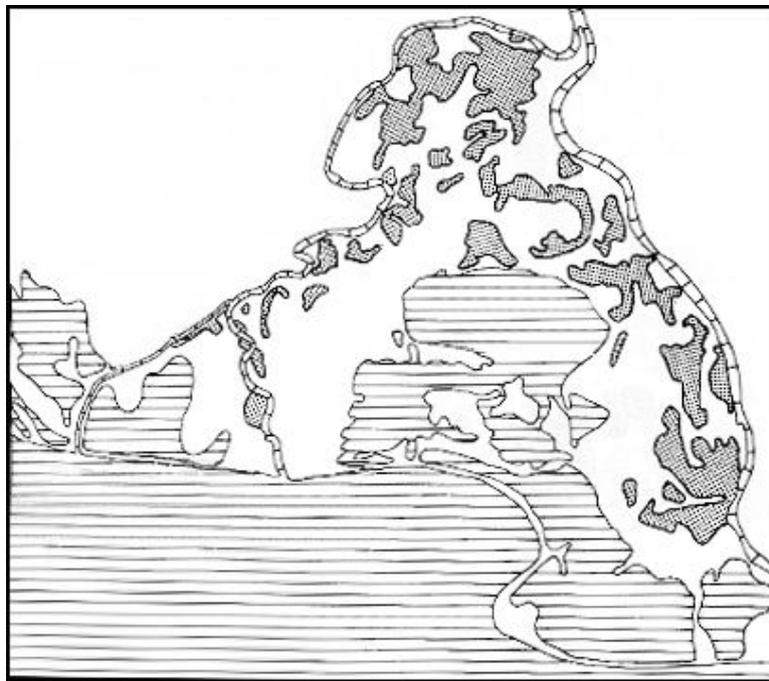
Figure 67: Map for Discussion

1.5.9   Test your knowledge about readability here

Setup Information for Tutors: **Flash Player is required**

Concluding to this unit, a readability test should top the content of the readability rules unit. Find at least three legibility errors on the presented map. Test yourself and note down the errors in fields 1 - 5. Test your answers by clicking the "validation" button.

> **Please note:**
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Figure 68: Self assesment

1.6   Map Critics

SETUP INFORMATION FOR TUTORS: **to be seen**

Objective : Train your sensitivity to Layout Design.

Task

Find a map or a map related illustration in a newspaper, leaflet, book, internet, etc. Prepare a well-designed written discussion taking the following into account: Present your discussion in 2-3 written DIN A4 page layout together with a digital version of your map example. The text should be clear, explicit and without spelling errors including the following information: Name, Date, Map reference/Source as well as the time you required. Your Course Leader will decide about the language to use (German/French/Italian/English). The questions below can be considered as a thread for your discussion:

- Is the scale well chosen? Propose a better solution.

- Are the map elements well positioned? How can you improve it?

- Is the colour composition done well? How can you improve it?

- Is the typography appropriate? Is there a reason for improvement ?

- Have the readability rules been respected?

- Can you find aspects to set-up an improved layout?

Presentation

Submit your results (mail or printed) depending on the deadline your course leader conveyed to you.

1.7 Summary

We have seen that designing a map involves working with a variety of components ranging from scale to the lettering- and colour choice. Also, during your cartographic designing time be always aware of the fact that you are not designing maps for yourself. Try as much as possible to follow the rules given in this lesson, even if they seem to be sometimes odd or too time consuming;

especially those rules are important for creating 'good maps'.

1.8 Recommended Reading

- DENT, B. D., 1999 *Cartography - Thematic Map Design* [**?**, Part III especially]

- SLOCUM, T. A., 1999 *Thematic Cartography and Visualization* [**?**]

Glossary

Antialiasing: Antialiasing describes the smoothing of the edges of fonts. Therefore pixels are added at the edges. The hue of the added pixels is between the colour of the font and the background colour

bitmap fonts: Those fonts which have characters, specified as patterns of tiny dots. These patterns are necessary for every character in the font in all normal sizes. This method has a definite shortfall. If a pattern is not created for a certain size of a bitmapped character, a pattern for another size is contorted to provide the requested size. If you do this, dots in the original pattern are simply made larger. The net results are characters that display the 'stair-case effect'. Each Glyph is stored like a screened picture and is dependent on the resolution of the output medium. Microsoft used *.fnt and *.fon as format for their bitmap fonts, Adobe uses the *bdf and *.abf format to save the fonts. Bitmaps take up much less memory, which is especially important for devices sold in areas of the world where the characters are so much more complex than Western fonts. And perhaps most importantly, all of these devices require small font sizes, and scalable fonts do not look good at small sizes. Here are some advantages bitmap fonts have nowadays: If text must fit within a window, bitmap fonts can guarantee that every character is the exact pixel width wide. They are used in text passages that need high quality output and do not need to be editable. Bitmap fonts exactly define the distance between characters and control the spacing between lines of text, tracking and kerning are not applicable. Bitmap fonts at the same point size as scalable fonts are larger and easier to read. Bitmap fonts contain the exact character set we need, whether for Windows, DOS, or special symbols.

brightness: This attribute is responsible for the intensity of the visual attraction of the colour-hue. The range varies from light white, to dark black colour perception, which we can recognise via the cones in our eyes.

CIE: Commission International de l'Eclairage

CIE_LUV: Colour system based on the velencimetric measurements of colours [**?**] .

CMYK: Cyan Magenta Yellow Black, the base colours of the subtractive colour model.

colour appearance: For someone with normal colour vision, the colour of an object will depend upon three things: - the wavelength of the

light falling on the object, - the reflection properties of the object, and - the context in which it is seen. Two objects with different reflection properties can appear to be matched in colour under one light source (a metameric match') but look quite different from each other under a different source. Individual wavelengths give rise to the sensation of a particular colour, as can be seen in the colours of the rainbow. White' daylight, containing all wavelengths, is split into its individual wavelengths because the refractive index of water is wavelength-dependent. Consequently, the position of the colour within the rainbow is a function of the wavelength that gives rise to that sensation, with the short-wavelength radiation (seen as purple-blue) at one end, the long-wavelength radiation (seen as red) at the other, and the middle wavelengths (seen as green, yellow and orange) between them.

cones: Human beings have 3 kinds of cones. One for perceiving Red, another one for Green and one for Blue. Their differences are continuously analysed and sent to our brain. Deeper information can be found on the following web-page: http://www.yorku.ca/eye/specsens.htm

Displaying on a Colour Monitor: Via 3 electron beams and 3 kinds of phosphorus, 3 dots are activated to gleam in red, green and blue. Such dots, we call 'picture elements' or short: pixels. One such triplet forms 1 gleaming point we can perceive. The applied RGB system gives you the possibility to depict all colours possible for the RGB colour space depending on the intensity of the beam reaching the gleaming layer. The resolution of the screen depends on the interval between two triplet points. Depending on the quality of the graphic card, different colour depths are possible.

DPI: Dots per Inch

DTP: 'Desktop Publishing' is the process of using the computer and certain types of software to combine text graphics in order to produce documents such as newsletters, brochures, books, maps, etc.- basically any kind of document that produces visual communication. It is necessary to differentiate between drawing, painting and page layout programs. It allows a professional organisation of your documents that enables a successful printing process [**?**] .

Exonym: These are names of places written in a language that is not spoken in the area where you are, but just outside this area. An example is: Genf is the German version for the original Genève. It is still often used in school atlases and can't be eliminated completely and also shouldn't be eliminated because of its historic rootage and preserving of the homeland dialect.

generalisation: Selection and simplified representation of detail appropriate to the scale and/or the purpose of a map [**?**] .

hue: This attribute is responsible for the perception of the tone itself. It sets colour groups like green red or orange.

kerning: The adjustment of horizontal space between individual characters in a line of text. Adjustments in kerning are especially important in large displays and headline text lines. Without kerning adjustments, many letter combinations can look awkward. The objective of kerning is to create visually equal spaces between all letters so that the eye can move smoothly along the text.

lightness: This attribute is responsible for the intensity of the visual attraction of the colour-hue. The range varies from light white, to dark black colour perception, that we can recognise via the cones in our eyes.

line spacing: The space between to lines of type. It can be a fixed number of points or relative to the font size.

perceptive oriented colour models: These models work with values of hue, saturation and brightness or sometimes also called lightness. They are adapted to man's perception. We place the HSB or HSL and the LCH model into this category.

physical - technical models: These models describe colours as mixture of 3 primary colours. Their differences lay mostly in the chosen primary colours and the chosen type of mixing system. The RGB, CMYK and CIE LAB as well as the CIE LUV model belong in this section.

PostScript: Developed by Apple Systems Inc. in 1985, PostScript is a page description language, which allows the appearance of a printed page to be described in a device-independent manner. It also runs on all major operating platforms. You can identify PostScript files by its suffix 'ps'. Printing then becomes a two-stage process: An application language produces a description of the text, graphical shapes and image appearance on printed pages not as pixels but as mathematical shapes and curves. PostScript is used by certain printers with built-in PostScript interpreters and by graphics programs that create PostScript files. An advantage of PostScript is that it is resolution-independent and can consequently support the highest resolution of your device, and at the same time it gives you a reasonable preview on a low resolution screen. It has since become an industry standard for printing and imaging. Take into account that the average home laser printer is not a Postscript capable printer; which is usually more expensive and more often purchased for business use.

Quad: Definite interspace on the base of a square. Its side length is equal to the height of the current font.

Refresh Rate: Refresh Rate is the amount of time a display's image is redrawn per second. The refresh rate is expressed in hertz. A refresh rate of 75 means the image is refreshed 75 times per second. The refresh rate for each display depends on the video card used. You can change the refresh rate in the display properties of your computer. However, if you change the refresh rate to a setting that the display cannot support, the display goes blank or the image becomes distorted. Therefore, it is recommended to consult the manual before changing the setting in order to determine the supported refresh rates.

Resolution: Resolution is the number of pixels contained on a display monitor, expressed in terms of the number of pixels on the horizontal axis and the number on the vertical axis. The ratio of horizontal to vertical resolution is usually 4:3, the same as that of conventional television sets. The sharpness of the image on a display depends on the resolution and the size of the monitor. The same pixel resolution will be sharper on a smaller monitor and gradually lose sharpness on larger monitors because the same number of pixels are being spread out over a greater number of inches. A given computer display system will have a maximum resolution that depends on its physical ability to focus light and usually several smaller resolutions. For example, a display system that supports a maximum resolution of 1280 by 1023 pixels may also support 1024 by 768, 800 by 600 and 640 by 480 resolutions. Note that on a given size monitor, the maximum resolution may offer a sharper image but be spread across a space too small to read well.

RGB: Red Green Blue, the base colours of the additive colour model

rods: These receptors on the retina enable vision under darker light conditions at around 500nm. They are not responsible for any colour reception. They contain pigments tuned to receive wavelengths in three parts of the visible spectrum that gives us trichromatic vision. Further information can be found on the following page: http://www.yorku.ca/eye/specsens.htm (last updated on 28.5.2003)

saturation: This attribute describes the intensity of the colour experienced. It describes the tone of a coloured area in relation to the colour's lightness. This means white is not saturated at all, light-blue is partly saturated and dark blue is very saturated.

scalable screen fonts: These are fonts which outlines are described by mathematical formulae, permitting them to be shrunk or enlarged to almost any point size. Screen fonts are the representations of fonts

that appear on your computer's screen. Within the realm of scalable fonts, there are several different techniques for generating fonts. Scalable fonts need elaborate "hinting instructions" to look good, which requires much larger fonts and sophisticated rasterizing technology to interpret the instructions. Moreover, the best-hinted TrueType scalable fonts still contain bitmaps for the smallest sizes, because it has turned out to be the best way of hinting them. Paradoxically, bitmap fonts are the ultimate way to hint scalable fonts. Fortunately, for most users, Microsoft Windows provides a technique that is both easy and powerful. These fonts are known as TrueType fonts, with the identification 'TT'. TrueType fonts are scalable to any size and look exactly the same on the screen as they do when printed. These fonts have a low screen resolution that precipitates the 'stair-case effect'. Here it is necessary to verify whether or not real antialiasing has occurred or if they were softened, which leads to an macerated look. Advantages of scalable screen fonts to be designated: Small needed disk space Texts stay editable Special sorts of fonts may not be available on all computers per default. Therefore these fonts need to be supplied separately if the screen design should still fit afterwards.

scale: Scale is the amount of reduction that takes place in going from real world dimensions to the new mapped area on the map plane. Technically, the scale of a map is defined as the ratio of distance measured upon it to the actual distances which, they represent on the ground [**?**] .

tracking: The average space between characters in a block of text. Sometimes also referred to as letter spacing [**?**] .

Transcription: This is a method of replacing elements, fonts, characters or sounds however they may be written with characters or sounds of another language.

Transliteration: This is a method of transcription. It describes the replacement of any character in one language, for a character in another language. Here we aspire reversibility. That means - out of a transliterated name, the original one can be reconstructed.

visible spectrum: Light, along with invisible non-ionising radiation such as radio waves and microwaves, is a form of electro-magnetic energy. Light is distinguished from these other forms of e-m radiation because we can see it and it is defined by this property. Wavelengths between 380 - 700 nanometres are visible to the human eye. Electromagnetic energy below 380 nm is termed ultra-violet (u-v), and that above 700 nm. is termed infra-red (i-r). Both u-v and i-r are absorbed by the media of the eye, and do not generally reach the photoreceptors in the

retina. As they are not visible, u-v and i-r radiation is not generally considered to be 'light'. The human lens acts as a u-v filter, and if it is removed (e.g. by a cataract operation) the person can then have an extended range of vision. The absorption of the non-visible radiation can have short-term and long-term effects, causing, for example, snow-blindness and cataracts respectively. The sensitivity of the eye over the spectrum changes with light level. At low light levels, the active photoreceptors of the eye are the rods rather than the cones. Rods have a different spectral sensitivity from that of cones, and consequently, longer wavelengths (reds), tend to look relatively darker at night than during the day, whilst shorter wavelengths (blue) tend to look relatively lighter. Other creatures have different ranges which, make up their visible spectrum, and butterflies can see in ultra-violet, whilst some snakes can see in infra-red. Some 'night-vision' enhancers convert invisible infra-red radiation into visible light by using cameras that are sensitive in this 'invisible' portion of the spectrum. The camera output is then viewed on screens that display the image using a portion of the spectrum that is visible to people.