*Geographic Information Technology Training Alliance (GITTA) presents:*

# Generalisation of Map Data

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# 1. Generalisation of Map Data

As a map is always at a smaller scale than the phenomena it represents, the elements it contains must be restricted by what can be presented graphically at map scale. This generalisation process is a powerful and absolutely necessary tool for the spatial data used nowadays in Cartography and in Geographical Information Systems (GIS).

However, although generalisation is fundamental, many different views about its scope and function have been expressed by many Institutions and Organisations.

Therefore, in this lesson you will discover a simple and synthetic view of the best known generalisation concepts, but also how generalisation works, and how to use it in your maps.

## Learning Objectives

- Know the generalisation necessity for cartography and GIS
- Know the aims of generalisation
- Know and be able to use the whole range of generalisation
- Know when and how to use the elements of generalisation in an optimal way
- Master all the common rules for generalisation
- Master the Douglas-Peucker smoothing algorithm
- Be able to generalise a map

# 1.1. Generalisation Concepts

## Generalisation

In this unit, you will learn what exactly generalization means, as well as the importance of generalisation in cartography. Most of the text come originally from the book "Kartengraphik und Generalisierung" (Schweizerische Gesellschaft für Kartographie 1975).
Prerequisites are knowledge about map scale and about the different readability rules. You need to have a look first at the following units

- Map Size and Scale
- Readability Rules

## 1.1.1. What is Generalisation?

The **International Cartographic Association** defines **Cartographic Generalisation** as "the selection and simplified representation of detail appropriate to the scale and/or the purpose of a map" (ICA 1967).
More generally, the objective of generalisation is to supply information on a content and detail level corresponding to the necessary information for correct geographical reasoning.
Generalisation inputs are :

- The needs
- The geographical data: density, distribution, size, diversity etc.
- The readability rules
- The means: time, money, technique etc.

**Show the Effect of Generalisation on a Map.**
Select the magnifying glass (black circle) with the mouse (continuous left click), and show the differences in level of detail between the basemap (1:250 000) and the magnifying glass (1:100 000).

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## 1.1.2. The Generalisation Necessity

On a map, the available space for all the cartographic representations of the objects and elements of a landscape model, is very small and decreases disproportionately from scale to scale.
Therefore a limitation on the essential map elements and objects is necessary with the reduction of an image area from scale to scale.

Characteristics of generalisation are:

- An extreme reduction compared to reality. Example: with a 1:25 000 scale, the image area 625 million times smaller than reality.

- A pure photographic reduction of the original scale leads to an illegible map.
- Already in the 1:25 000 scale, many objects of the landscape cannot be represented any more.
- At smaller scales, a representation of all objects of the landscape is impossible.
- A complex and unclear structured reality must be simplified according to the scale of the map.

**Visualise the Necessity of Generalisation**
Modify the scale of the following map extract by clicking with your mouse on the + and – buttons. Show the differences between the maps to realize the necessity of generalisation in cartography; you can also try to find examples of the aforementioned characteristics of generalisation in these maps.

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## 1.1.3. Aims of Generalisation

Cartographic generalisation is born of the necessity to communicate. As it is not possible to communicate map information at 1:1 scale, generalisation has many aims.
The following aims can also be considered as generalisation rules.

- Structure: The map content is well structured.
  - The estimation of map content priorities has to be adapted to the mapscale and to the intended purpose.
  - The objects have to be classified according to clear and reasonable criteria.
  - The grouping of objects has to be logical.
- Legend: Expressive and associative symbols constitute the base for clear map communication.
  - The size and the form of the symbols are adapted to the other symbols and to the reality.
- Generalisation level: The level of generalisation implies simplification and detailing.
  - A low level of generalisation signifies a high information density and a fine structured map.
  - A high level of generalisation signifies a low information density and a thick structured map.
  - The level of generalisation varies according to the purpose and to the mapscale.
  - The level of generalisation is carefully defined.
  - The level of generalisation affects the legend and the symbols.
- Selection of objects: The objects selection complies with the map purpose.
  - The objects selection complies with the mapscale and with the intended purpose.
  - The objects that are visible in reality (e.g. houses) are completed with non-visible objects as borders or labelling.
- Accuracy of objects: The optimal accuracy of the objects regarding position and form is reached. However, the visual placement of objects is more important than the geometrical accuracy.
  - Displacing objects is only needed for raising the legibility and for clarification.
  - The symbols of visible objects (in reality) have a high accuracy.
  - The symbols of non-visible objects (in reality) have a limited accuracy.

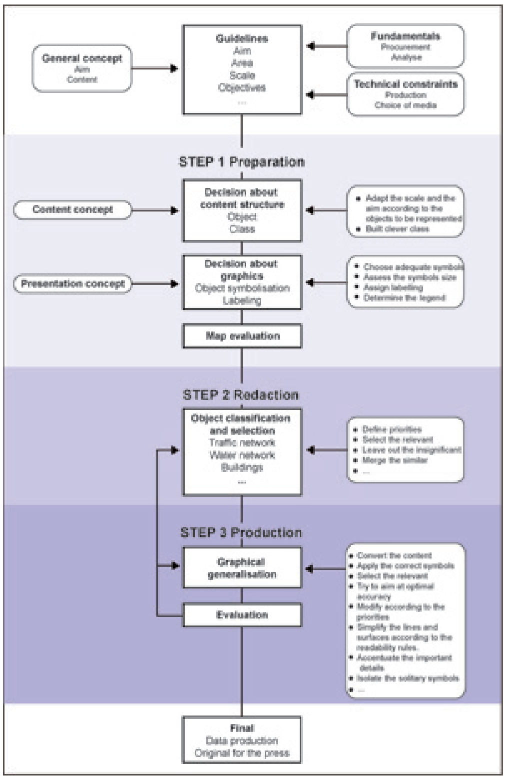
    - Object displacement is necessary, and the neighbouring objects are adapted.
    - TThe form accuracy is only limited by the good legibility and the respect proportions demand.
    - The contour lines are not treated as a single line, but are adjusted to the correct reproduction of the ground structure on each other.
- Reality accuracy: Indeed, the reality is revised and changed, but is still, as far as possible, represented truthfully.
    - All objects present in the map really exist.
    - Appropriate legend symbols are assigned to the objects.
    - Labelling is correctly raised, written and assigned.
- Legibility of the map elements: The map must be readable without auxiliary means (e.g. magnifying glass), and in bad conditions.
    - Good legibility is conditioned to the respect of the graphical minimal dimensions (sizes and distances) of the symbols.
    - Graphical minimal dimensions leads to an unscaled representation, i.e. to an enlargement of the dimensions scale.
    - Graphical readability rules support legibility.
- Graphical representation of the objects: Map content is adapted, legible and graphically convincing.
    - Legend is credible and exact.
    - The generalisation of the forms and line symbols respect the most exceptional forms and eliminates the small and fortuity ones.
    - The quantitative generalisation from strewn objects (e.g. houses) respects the density of objects in reality.
    - The relations and dependencies of objects in reality (e.g., streets, ways, waters, contour lines, etc.) are carefully considered.

**Visualise with Examples some Generalisation Aims**
Roll over the red circles of the following map with your mouse to visualize some generalisation aims.

**Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

### 1.1.4. Generalisation Workflow

In order to portray important aspects of reality, various manipulations of the data that represent information to be mapped are necessary. These manipulations can be divided in three steps: Preparation, Redaction, and Production.
The following image shows you the most important elements of these.




*Source: IKA ETHZ, according to* (Schweizerische Gesellschaft für Kartographie 2002)

To print out the generalisation workflow graphic, you can click **here** to get a PDF form.

# 1.2. Generalisation Procedures

## The Elements of Generalisation

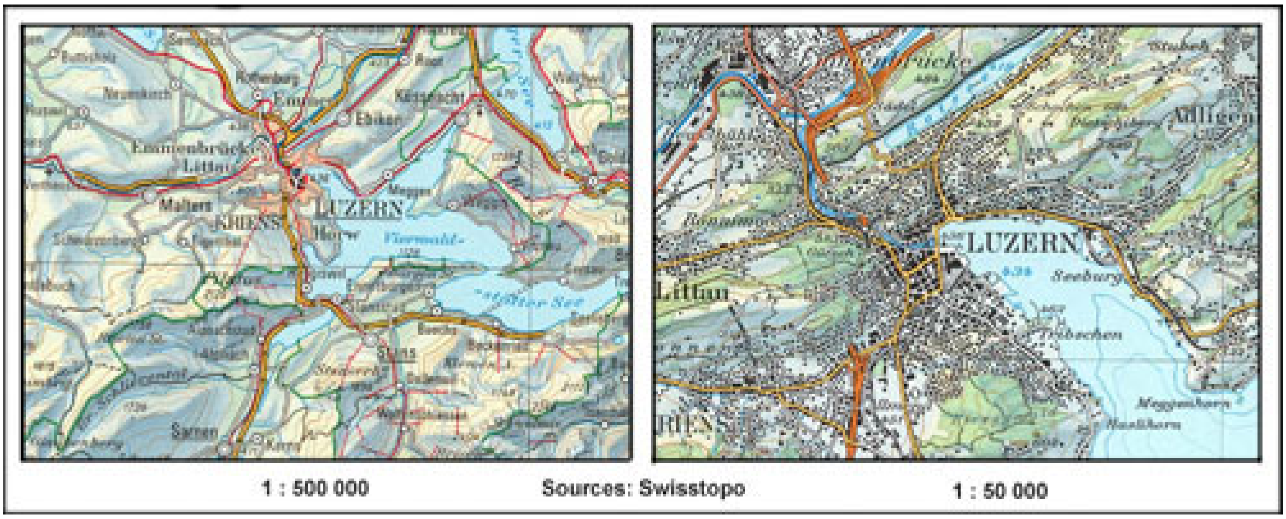
There are several processes included in generalisation. A first step, however, is always the selection of the information to be communicated by the map. Then, it is convenient to group the generalisation manipulations performed on the selected data into two main types:

- Semantic generalisation: Based on the initial choice of the relevant information to be presented on the map, semantic generalisation is closely related to classification, and aggregation, as well as symbolisation or exaggeration. Semantic generalisation has a main objective of simplifying the presented data, so at a given (small) scale the complexity of the map does not make the map impossible to read. Semantic generalisation normally takes place before geometric generalisation.
- Geometric generalisation: The complexity of the graphic characteristics of map objects may be still too great to show them clearly, especially if the scale of the map becomes smaller. Therefore, the objective of geometric generalisation is to preserve the important parts of the data and eliminate or simplify the less important ones in order to create a map that will have good visual communication characteristics. Geometric generalisation is closely related to simplification, omission, as well as displacement and orientation.

In this unit, you will learn how and when to use the different generalisation processes. However, as each map provides a different set of requirements, the combination of these fundamental processes will vary from map to map. So a typical workflow of these processes is only shown in the unit Generalisation Methods.
Prerequisites for this unit are knowledge of the generalisation concepts, and the different readability rules used in cartography.
Generalisation is not without danger for ethics: for each data modification, the character or the interpretation of a map can be shifted to a false representation, and brings the map reader to a flawed conclusion. Read the following text from L. Guelke about the danger of data modification to reach more information about this topic.
**Generalisation_and_ethics.pdf** (6KB)

## 1.2.1. Selection

Before you begin the generalisation process, a selection of available information must be made that is consistent with the purpose of the map. Thus, the selection process of generalisation can be defined as the "intellectual process of deciding which information will be necessary to carry out the purpose of the map successfully". No modification of the information is required in selection. The choice is either to depict secondary roads or not to depict secondary roads, to name or not name by lettering all cities below 50 000 population, etc. Selection is a critical process and may involve working very closely with the map user.
This example will show you the selection done on the federal map by Swisstopo (external link): on the 1:50 000 map, the small public highways are depicted. Whereas on the 1:500 000 they are not. This is done in order to increase the effectiveness of the communication by counteracting the undesirable consequences of reduction.

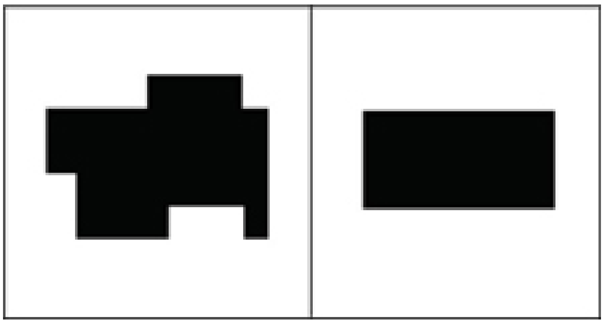



*Selection example, source: national maps, reproduced with the permission of swisstopo (BA057224), www.swisstopo.ch* (Swisstopo)

### 1.2.2. Simplification

Simplification is the process which determines the important characteristics of the data, the retention of these important characteristics and the elimination of the unwanted details. When reducing a map, each map item will occupy a proportionately larger amount of space. Consequently, simplification must be practised in order to insure legibility and truthful portrayal. The elimination of unwanted map elements details (points or features) is the most often used form of simplification. The question of which individual map element will be retained and which will be eliminated is one of the most difficult tasks of simplification. The determination of which individual map elements to retain can be deduced from the purpose of the map and the place assigned to the particular data distribution in the visual hierarchy specified in the map design. This determination demands you have knowledge about the data being mapped.

**Simplification of Areas**
The complex house on the left is simplified as a rectangle on the right.



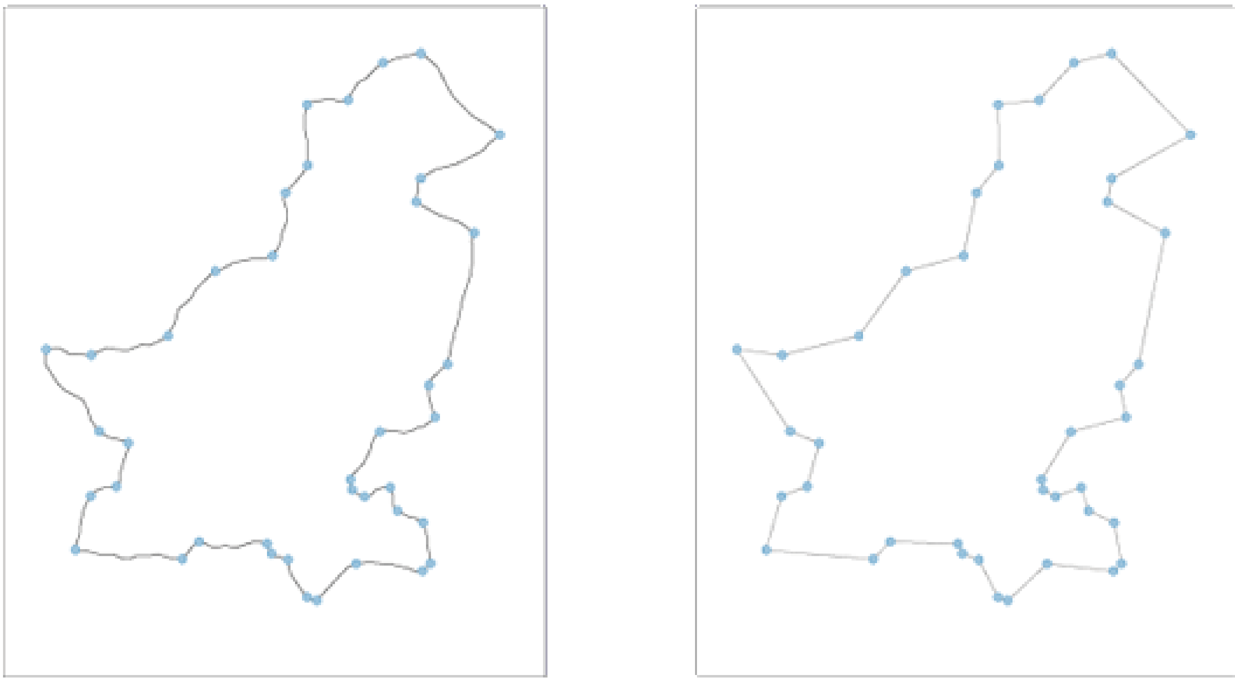
*Shape Simplification*

Further optional information and advice for simplification of areas can be found in the following: **Area_Simplification.pdf** (44 Kb).

**Simplification by Point Elimination**
In this manually systematic elimination of points, the manipulation consists of getting rid of the points that are unimportant. A feel for this elimination process probably only comes after considerable experience.

**Simplification by Point Elimination of the Outline of Pakistan.**

The points indicated the map to the left, were retained on the map to the right, where they were connected with straight line segments.

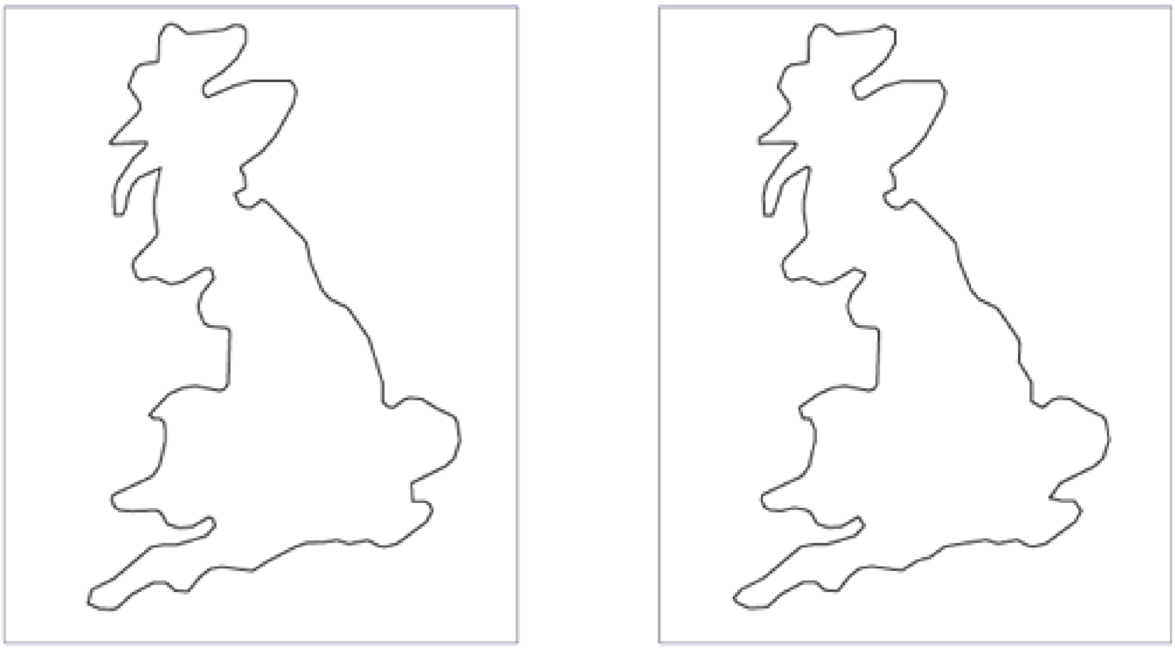


*Simplification by Point Elimination*

In computer-assisted cartography this simplification is less overtly subjective: point simplification is the simplification of a string of coordinate points defining a line or the outline of an area. This simplification is mostly done by a random selection of points.

**Computer-assisted Point Elimination Simplification of the Outline of Sardinia.**

The left simplified Sardinia map was produced by systematically retaining every 15th point in the original data file. The right one was produced by randomly selecting 1/15 of the point in the original data file.



*Computer-assisted Point Elimination*

**Simplification by Feature Elimination**

The simplification by feature elimination will be inconsistent if done manually. With computer-assisted feature elimination, the criteria may be the feature size, the features proximity, or a combination of both. The only thing you have to do with computer-assisted feature elimination is to specify the minimum size for retention based on output scale and line width and according to the readability rules (reference link).

**Computer-assisted feature elimination simplification.**

Areas on the left map are either shown in their entirety or completely eliminated in the feature-simplified map on the right. (Courtesy of American Congress on Surveying and Mapping).

*Computer-assisted Feature Elimination*

**Smoothing/Line Simplification**

Smoothing processes shift or suppress coordinates in an attempt to "plane" away small perturbations and capture only the more significant trends of the line. Many smoothing algorithms exist for computer-assisted cartography. Some of them are described in the unit Generalisation Methods. The smoothing process is often associated to displacement and classification.

Modify the smoothing degree of the road by dragging the slide-bar next to the varying scales.

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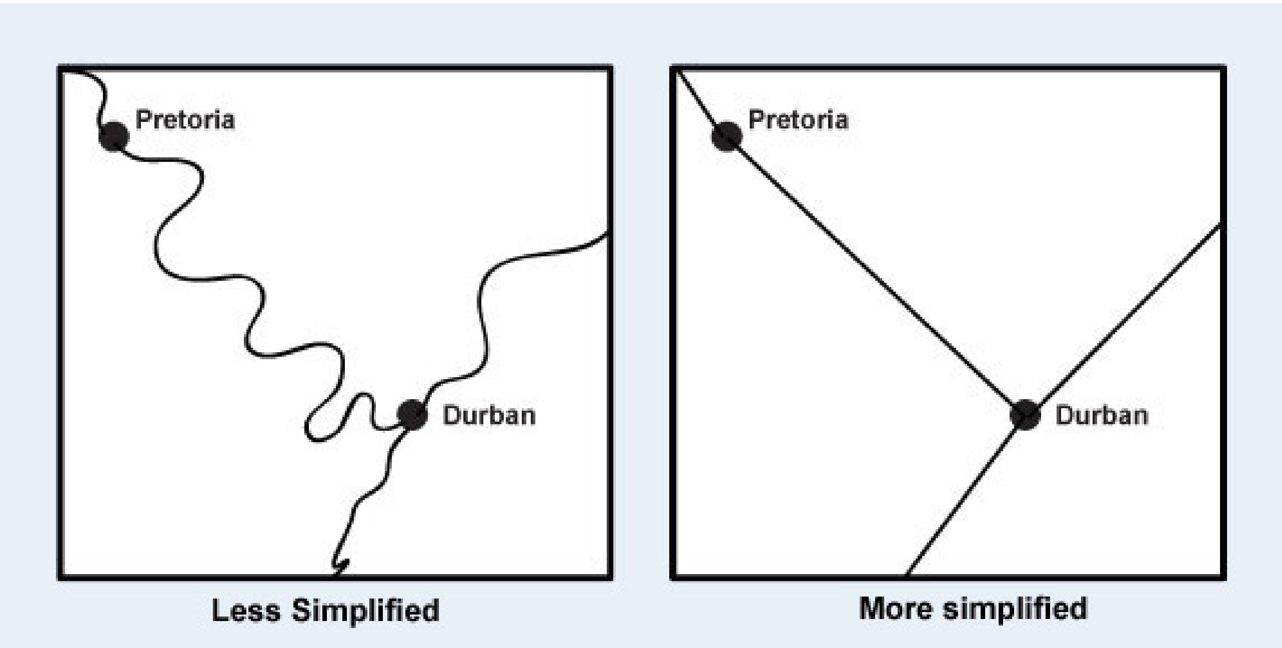
Further optional information and advice can be found in the following: **Smoothing.pdf** (107 Ko).

**Simplification and Map Purpose**

On the following example the road between the towns is straightened because the purpose of the map is simply to show connectivity between towns, and not to depict the road's precise location features.




## 1.2.3. Omission

The difference between "selection" and "omission" is sometimes confusing.

As seen previously, selection is the choice of which information will be necessary to carry out the purpose of the map successfully, so the choice of which types of information to include on a map. Whereas, leaving out the excess information from a given class is selective omission.

**Omission Example**

What happens to the houses if we go from a large scale to a small scale? Can we keep all of them or should we omit some? Roll over the different scales to get a view of the representation of houses varying with scale.

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**Omission and Map Character**

When omitting objects, the original character should not be changed in its essence.
The original form, size and spaces should be maintained despite the decreasing number. The following animation gives you some graphical advice to keep the original character, when representing houses at different scales

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**Self Evaluation about Omission**

Test your knowledge of the omission process. In the following built-up area map, the red squares represent houses. You have to generalise it (double scale). Find the ideal house placement for the new map by dragging and dropping (left continuous click) the left black square (houses at the new scale) next to the map.

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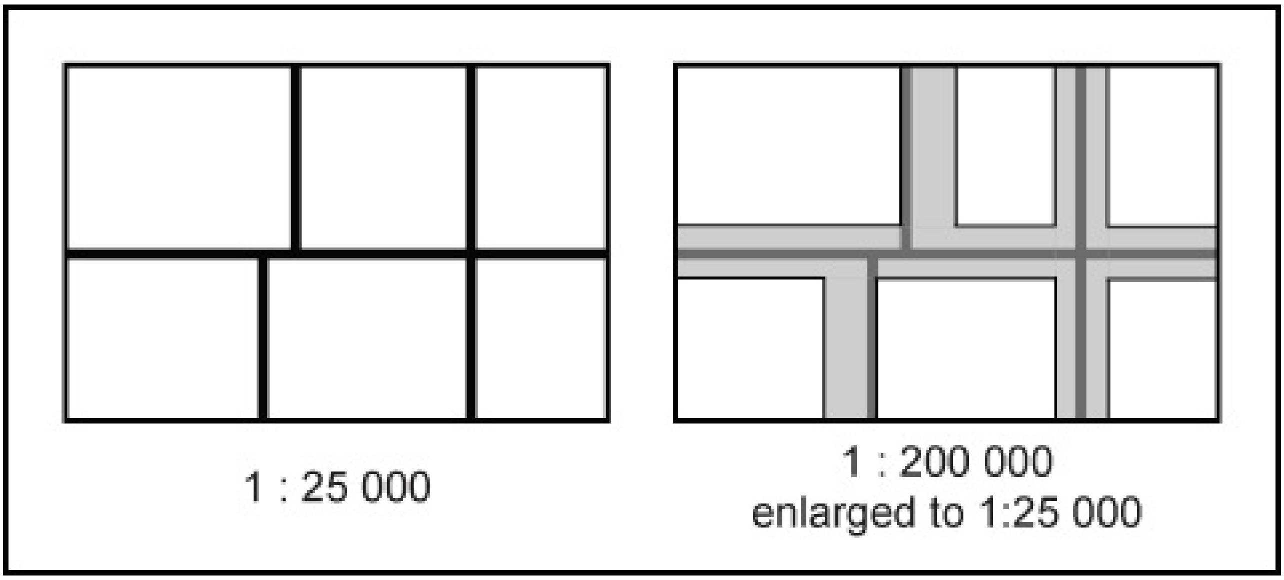
## 1.2.4. Exaggeration

When many features of the same type are in close proximity, omission and simplification are often accompanied by the exaggeration process, which can itself be accompanied by displacement and orientation. So, what is exaggeration? Exaggeration is the process where you make elements seem larger, more important, than they really are. So, why use exaggeration? The features that are important enough to be shown on the map, but in reality are small in size (e.g. roads, houses), are size exaggerated to be visible and well-interpreted by the map reader.

**Exaggeration Example**

A public highway shown on a **Swisstopo** paper map at 1:100 000 scale has a thickness of 0.5 mm. This 5 m wide road (in real world) should have proportional scaling of 0.005 mm.
Reminder: the minimal dimension of a line on white paper is 0.05 mm. Roll over the map to have an approximate view of proportional scaling without public highway exaggeration.

**Exaggeration - Displacement**
Exaggeration is often associated with displacement. In the following you, can observe how the exaggeration of streets affects displacement, in order to keep the main character.

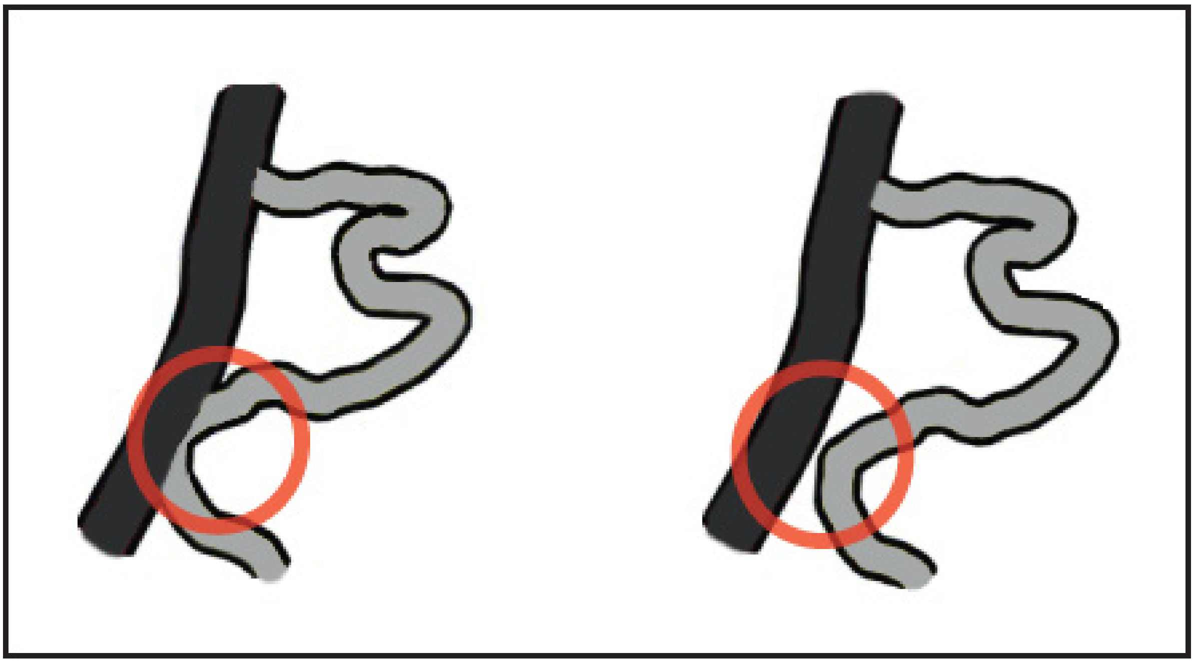



*Exaggeration is closely associate with displacement*

## 1.2.5. Displacement and Orientation

**Displacement**
When map elements are too close together after scaling, they must be displaced in order to avoid their visual merging. Displacement also occurs when small differences in position are important to the map user. A typical example of such displacement is shown in the last example of the previous learning object (exaggeration).
**Orientation**
When two map elements have an unusual angle (15°, 75°, etc), one of them has to be rotated in order to avoid visual conflict. Two solutions are usually possible: either the two elements are placed alongside, or at an angle of 45°.

**Displacement and Minimum Distance between Elements**
When a map element is exaggerated, the minimum distance between this element and others is often no longer respected. This element has to be displaced. Therefore, a road can be displaced to show there is no intersection with an other one.



*Road displacement*

In the following example, the minimum distance (0.2 mm) between the house (red square) and the road is not respected. This separation should be at least 0.2mm or the house should be displaced up to the road. Show graphically those two solutions by clicking the solution buttons.

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Further optional graphical information about displacement can be found in the following: **Displacement.pdf** (77Ko).

**Orientation and Angles**

In this example, the angle legibility (0 or 45°) between the house (red square) and the road is not respected. Show graphically the two solutions to correct it by clicking the solution buttons.

**Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

## 1.2.6. Classification

Classification is the process in which, objects are placed in groups (or classes) having identical or similar features. The information is conveyed through identification of the group boundaries. Classification brings relative order and simplicity, and helps to organize materials for communication.

Some of the most common operations of classification are  (Robinson et al. 1995, p. 460f):

- Grouping: The grouping of similar data elements into categories referred to as range grading.
- Typification: The selection of position and the modification of the data element at that position based on other data elements around the selected position to create a "typical" data element to portray on the map at that position.
- Other forms of typification may include the exaggeration or actual creation of map data in an attempt to typify.

### Visualise a Classification Example

The following example is a typical classification operation.
Roll over the picture to get a zoom.

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In thematic mapping, classification can be carried out with quantitative or qualitative information.

**Qualitative classification**

Qualitative data might include the identification of geographical regions: corn belt, sun belt, etc.


*Map example of qualitative classification* (Spiess 1993)

**Quantitative classification**

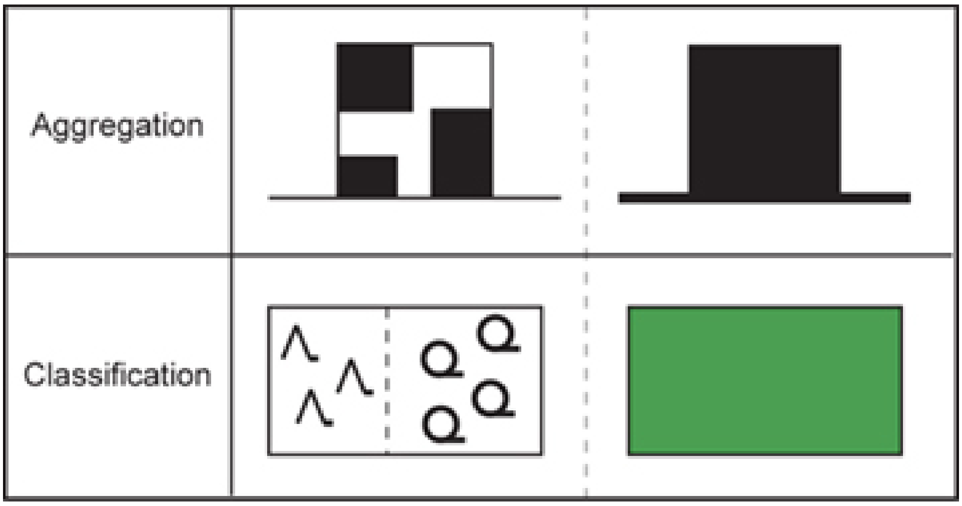
Quantitative classification generally divides entire data into numerical classes, and each value is placed in its proper class. Only class boundaries are shown on the map.


*Map example of quantitative classification* (Spiess 1993)

## 1.2.7. Aggregation

Aggregation is the process in which, information is gathered and expressed in a summary form. As with classification, a common aggregation purpose is to bring relative order and simplicity. So, what's the difference?
Aggregation is only used when the objects to be aggregated have exactly the same symbolisation: a block of houses will be aggregated as a single house. While classification is used when the objects to be aggregated have a different symbolisation; a new symbolisation is therefore needed.

**Aggregation vs Classification.**
The houses on the left are aggregated as a rectangle on the right.
The deal and broad-leaved forest on the left are classified as a forest on the right.




*Aggregation vs Classification*

**Aggregation Examples.**
The following examples, are typical aggregation operations.
Roll over the picture to get a zoom.

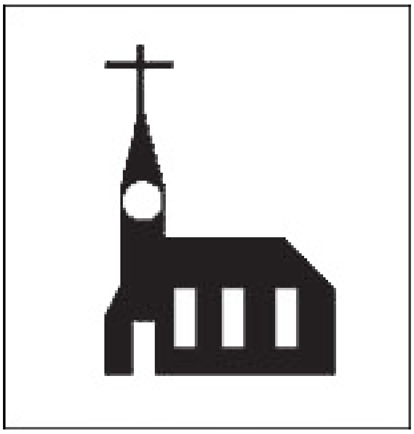
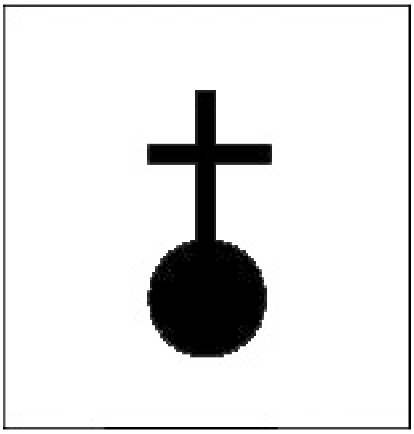
**Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

## 1.2.8. Symbolisation

Because it is not possible to create a reduced image of the real world without devising a set of *symbols* [1] that stand for real-world things, mapmaking requires symbolisation. Symbolisation can be defined as the graphic coding of the summarisation resulting from classification and the coding of the essential characteristics, comparative significance, and relative positions that result from simplification.
Two major classes of symbols are used:

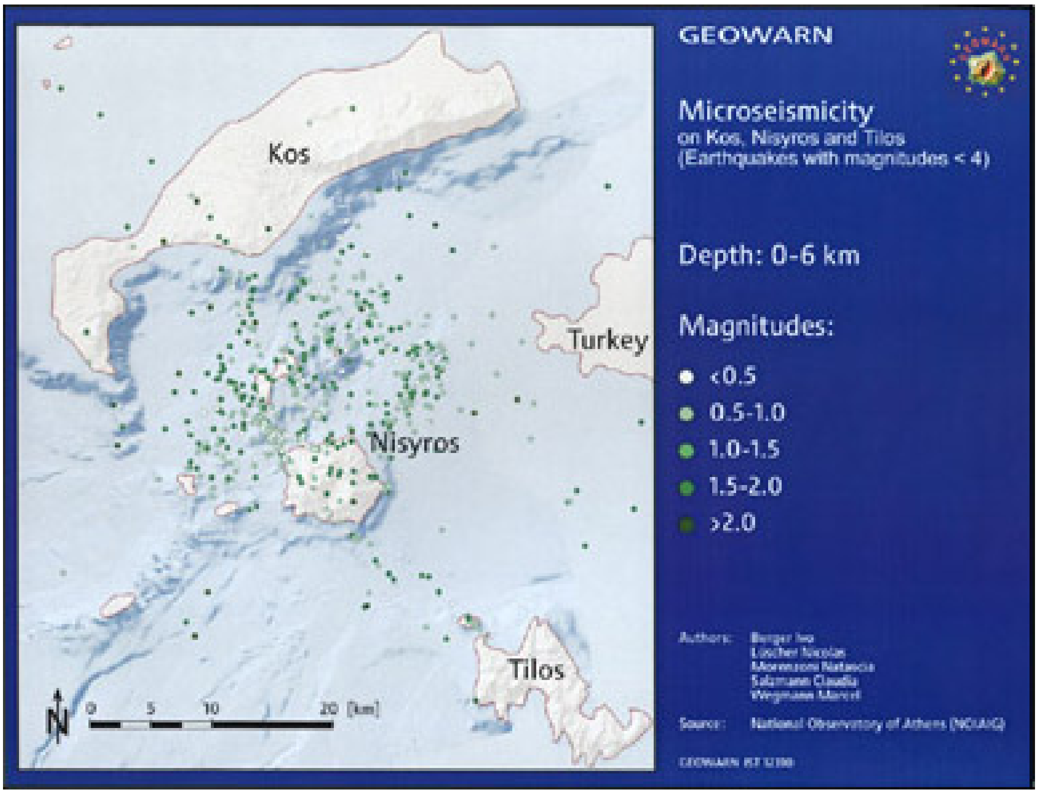
[1] A cartographic symbol is a letter, character or other graphic device representing some feature, quality or characteristic on a map.

**Representational Symbols:**
Representational symbols are symbols whose form is derived from the appearance or nature of the feature or phenomena represented. They are designed to look like their real-world counterparts. Various forms of representational symbols exist:

| **Pictorial symbol** | **Stylised symbol** |
|---|---|
| A symbol whose form is a simplified portrayal of the feature or phenomena it represents. | A symbol whose form is derived from the salient characteristics of the feature represented. |
|  |  |

For further representational symbols examples, download **here** a PDF form of the **Swisstopo** conventional signs to the Swiss topographic maps (optional).

**Abstract Symbols:**
Abstract symbols are symbols whose form bears little or no relationship to the form of the feature represented. For this purpose geometric symbols are often used, e.g. circle, square, rectangle, triangle, or semi-circle. The following map of microseismicity localisation is a typical example for abstract symbols.




*Abstract symbol example*

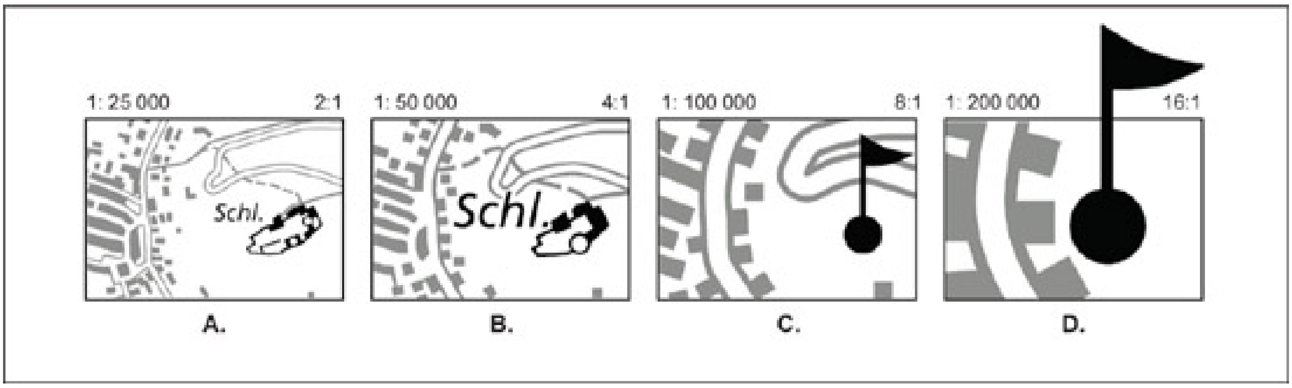
The symbolisation process is shaped by the influence of scale: at smaller scales, it is impossible to represent geographical features at true-to-scale likeness. Therefore, distortions are necessary when changing the scale. Symbol distortion should be based on the logical association between the level of measurement of the map's data and certain graphic variables, conventions or standards, appropriateness, reader's abilities to use the symbols, ease of construction, and similar considerations.

**Discover Symbolisation with Examples.**

On the following animation, you can visualize the symbolisation differences for the same original element (a castle on the top, and a church on the bottom). Select the slider (blue rectangle) with the mouse (continuous left click), and drag it to the different scales to show the symbol differences.

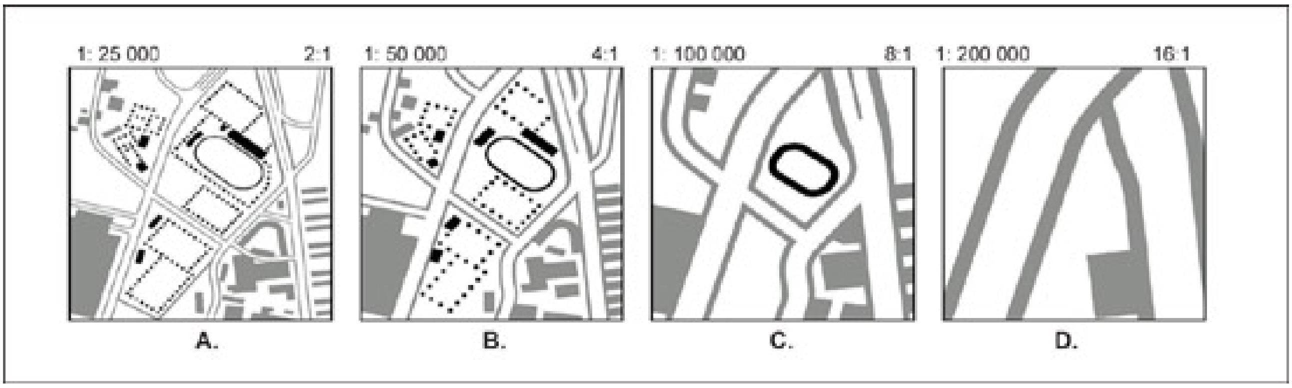
**Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

The following will show you two map examples where symbolisation is used:




*Symbolisation example* (Schweizerische Gesellschaft für Kartographie 2002)

**A**: Castle representation as plan view.
**B**: Castle representation as simplified plan view.
**C**: Castle representation as symbol without plan view.
**D**: Castle representation with equivalent symbol size.

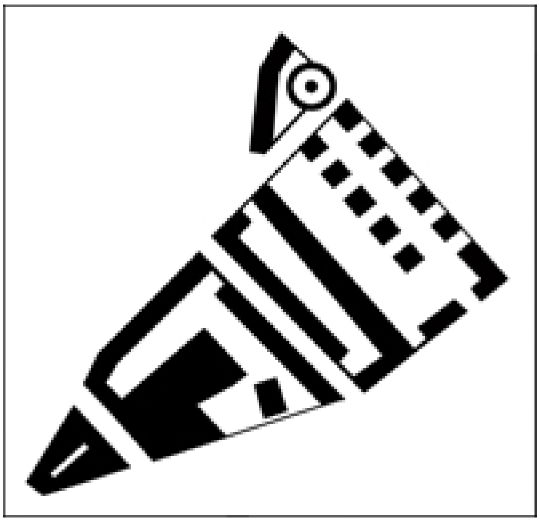



*Symbolisation example* (Schweizerische Gesellschaft für Kartographie 2002)

**A**: Representation as plan view: stadium with stands, football pitch, tennis court, and parking block.
**B**: Regrouping of the small tennis courts.
**C**: Only the stadium has a sufficient size to be represented.
**D**: The Stadium is to small to be represented (according to the ‚A' map is always minimal dimensions used in cartography).

## 1.2.9. Generalise your Map

In this synthesis exercise, you have to generalise, according to the rules you have learned in this unit, the following map.



*Map to generalise*

You can download the map in the following formats:
**Gen_exercise_raster.jpg** (73 Ko)
**Gen_exercise_vector.svg** (4 Ko)
The generalisation must be at the scale 1 : 2. You should spend about 1h to carry out this exercise.
There are two solutions for giving your work to the teacher/tutor (before the deadline he/she gave you) back:

1. Send your generalised map as *.jpg picture (format: 700 X 670; 72 dpi) to your teacher/tutor by mail.
2. Give him/her the original printed map (on a DIN A4 white page), highlighted (red pen) with your generalised solution.

## 1.2.10. Summary

As a map is always at a smaller scale than the phenomena it represents, the information it contains must be graphically restricted to the map scale. This adjustment consists of several generalisation processes. Each cartographic institution has its favourite ones, but as the processes are often chained, they are all important.
Following, an exhaustive list of the process taught by the cartographic institution:

- **ICA/ACI**: Selection, Simplification, Omission, Smoothing, Displacement, Aggregation, Classification, Symbolisation, Exaggeration.
- **Institute of Cartography ETH Zurich**: Selection, Simplification, Displacement, Aggregation, Classification, Exaggeration.
- German Cartography (Hake et al. 2002): Simplification/Smoothing, Enlargement, Displacement, Aggregation, Selection, Classification/Symbolisation, Exaggeration.
- US Cartography (Dent 1999): Selection, Classification, Simplification, Symbolisation.

# 1.3. Generalisation Methods

## Methods for Generalising

Generalisation is often a dilemma for the cartographer. On one hand, the display quality of data must be improved, and on the other, if data are transformed the topology of geographical phenomena will be altered and subsequent statistical or geometrical calculations will be affected.
In this unit, you will learn how and when to use the different generalisation processes in order to minimise such problems.
Prerequisites for this unit are knowledge of the generalisation concepts and procedures.

## 1.3.1. Common Rules for Generalisation

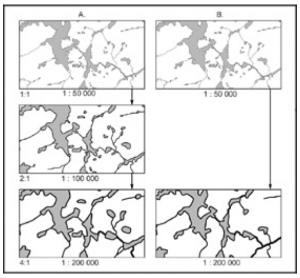
Cartographer's have the first role in deciding the purpose and the extent of generalisation. The following common rules will help you to organize your map generalisation.
Generalisation can be carried out in two ways:

- The map elements are generalised at the scale of the source map, and then reduced to the desired scale.
- The map elements are reduced to a smaller scale, and then generalised.

Both methods have advantages and disadvantages: If you work at the source scale, you will have a clearer picture of all the details, and this can be very important if the map is complex. For example, the omission process can be handled much easier in this way. If you work at the reduced scale, the generalisation will be more appropriate to the derived map, but the reduction of the source can lead to an incorrect interpretation for the generalisation. Therefore, you have to anticipate the effect of scale reduction when deciding the generalisation method to use.
In a more general way, you should always generalise original data. Or if you cannot on the smallest scale possible data. Indeed, several problems exist with an already generalised basis:

- The decisions, choices and grouping are unknown.
- The displacement carried out, as well as the simplifications are unknown.
- A badly generalised basis becomes worse still in the next generalisation step.

**Generalisation and Generalised Basis.**
This illustration shows you by a concrete example, why it is necessary to use original data and not an already generalised basis. The outcome of the right method is bad, and can lead the map reader to incorrect conclusions, because it is based on an already generalised basis. While the outcome of the left method is, correct.



*Generalisation and Generalised Basis* (Schweizerische Gesellschaft für Kartographie 2002)

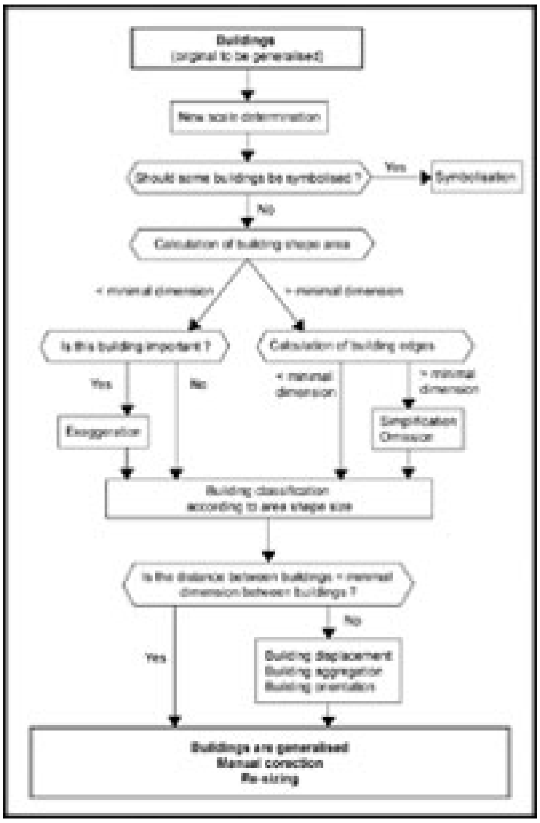
## 1.3.2. Generalisation Workflow

As the generalisation of one element will affect the generalisation of others, it is necessary to follow the procedure, in the correct sequence.
Because the location of many human features are relative to physical features, the basic topographic information is generally dealt with first. Thus, the usual order for generalising is:

1. Generalisation of hydrographic features.
2. Generalisation of contours lines and heights.
3. Generalisation and correction of the place locations.
4. Generalisation of human features and of all the features connected to inhabited places: roads, paths, etc.
5. Generalisation of landuse and vegetation areas. They are generalised last as their outlines depend on the positioning of both physical and human features.

However, as each map has different features, elements and objectives, this sequence is not absolute. This sequence can vary from map to map and even from scale to scale.

**Flux Diagram of Building Generalisation**
The following flux diagram is a typical example of computer based building generalisation. Such diagrams can only be used for a specific developed site: the house density should not be too high (historic centre) or too low (hamlet), otherwise this generalisation method could not be adapted anymore.




*Building Generalisation* (Spiess)

See below the generalisation result of the previous flux diagram.

- The picture on the left is the original map at 1:5 000 scale.
- The picture in the center is the generalisation result of the previous flux diagram (1: 25 000).

- The picture on the right is the generalisation result, including manual correction (the houses on the top of the map).

| | | |
|---|---|---|
| <br>*Original Map* | <br>*Generalised Map* | <br>*Generalised Map with Manual Correction* |

*Generalisation results* (Spiess)

This example shows you that each map context is different, and that the method should be adapted to it. This example also shows that inputs and manual correction are still needed in modern computer-aided generalisation.

## 1.3.3. Generalisation Algorithms

Over the past 25 years, automating map generalisation has seen major improvements. Generalisation algorithms constitute the building blocks of the automation process. Generalisation algorithms are more common with individual types of objects such as lines or polygons. Generalisation of the map as a whole is normally conducted manually.
Several algorithms are used for generalisation. The most typical are classified as following:

- Algorithms for simplification: They include the independent point algorithms, e.g. the random selection of points, as well as the local processing algorithms, and global routines. The Douglas-Peucker (Douglas-Peucker, 1973) is the most representative of this class.
- Enhancement algorithms: They include the exaggeration process and the smoothing process.
- Collapsing algorithms: This operation is mainly used for broad rivers because they are usually digitized by their bank lines, but needs to be reduced to a centre line.

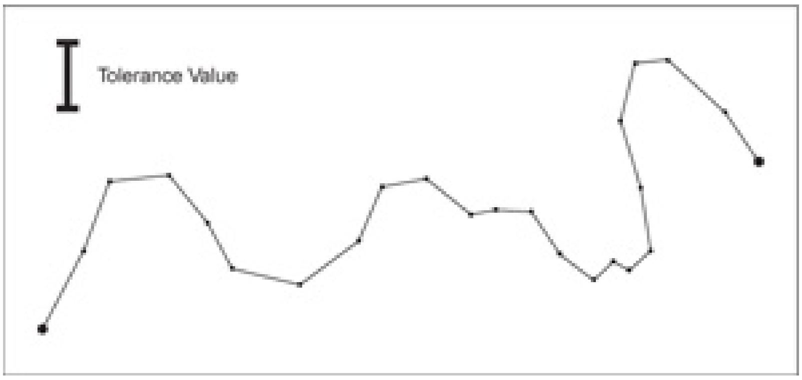
To find more information about algorithms used in generalisation, you can have a look on the following project from the University of Zurich: **Agent_Esprit.pdf** (493 Ko)

**The Douglas-Peucker Simplification Algorithm**
Discover graphically the Douglas-Peucker generalisation algorithm with the following animation. This simple and easy to understand algorithm is used for road simplification: the cartographer has just to define the tolerance value (according to the degree of generalisation), and the road is then generalised segment by segment.

**Only pictures can be viewed in this version! For Flash, animations, movies etc. see online version. Only screenshots of animations will be displayed. [link]**

## 1.3.4. Generalise your Map

In this synthesis exercise, you have to generalise, according to the Douglas-Peucker algorithm, the following road:




*Road to generalise*

You can download the map in the following formats:

- **Gen_ex_raster.jpg** (16 Ko)
- **Gen_ex_vector.svg** (6 Ko)
- **Gen_ex_pdf.pdf** (162 Ko)

The tolerance value for generalising is given in the map. You should spend about 1/4h to carry out this exercise. There are two solutions to give your work to the teacher/tutor (before the deadline he/she gave you) back:

1. Send your generalised map as *.jpg picture (format: 600 X 280; 72 dpi) to your teacher/tutor by mail.
2. Give him/her the original printed map (on a DIN A4 white page), highlighted (red pen) with your generalised solution and your name.

## 1.3.5. Summary

Various computer applications can be used for generalisation. However, for a single and simple map it is advisable to use a human judgement rather than algorithms. Indeed, experienced cartographer’s may be able to make more correct decisions, which cannot be synthesised by computer programs.

## 1.4. Summary

Each generalisation procedure is unique. A rigid predetermined formula is difficult to use. How well your map will be generalised depends on your experience in cartography, especially in generalisation, but also on your artistic sensitivity for the map balance, colours, global harmony, or disposition of the map.

# 1.5. Recommended Reading


- **Schweizerische Gesellschaft für Kartographie**, 1975. *Kartengrafik und Generalisierung - Topographische Karten*. Schweizerische Gesellschaft für Kartographie.

# 1.6. Glossary

**Symbol:**

A cartographic symbol is a letter, character or other graphic device representing some feature, quality or characteristic on a map.

# 1.7. Bibliography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- **swisstopo**. National Map 1:250000. Wabern: Bundesamt für Landestopogtrafie.
- **Swisstopo**. National Map, 1:500000. Wabern: Bundesamt für Landestopographie.
- **Swisstopo**. National Map, 1:50000. Wabern: Bundesamt für Landestopographie.