

Tactile Graphics Production and its Principles

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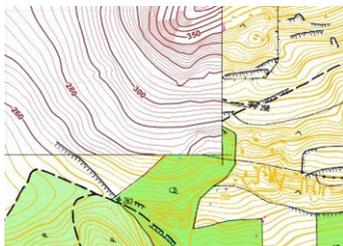
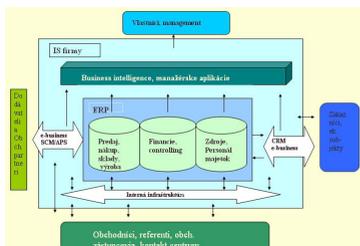
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Roles of Graphics in a Document

- » aesthetical (to make the content more attractive)
- » illustrative (to make the content more comprehensible)
- » structuring (to describe relations)
- » informative (to bring new information)
- » social (to enable discussion about the content)



Tactile vs. Visual Perception

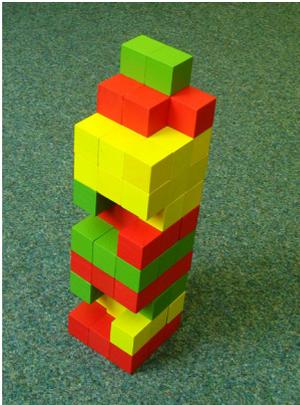
» contact, active ▶ slow



» distance, mostly pasive ▶ fast



» limited object dimensions



» practically unlimited dimensions



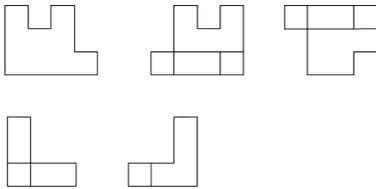
» limited object details



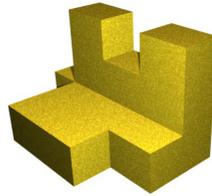
» practically unlimited details



» partial, not 3D in plane



» complex, including 3D in plane



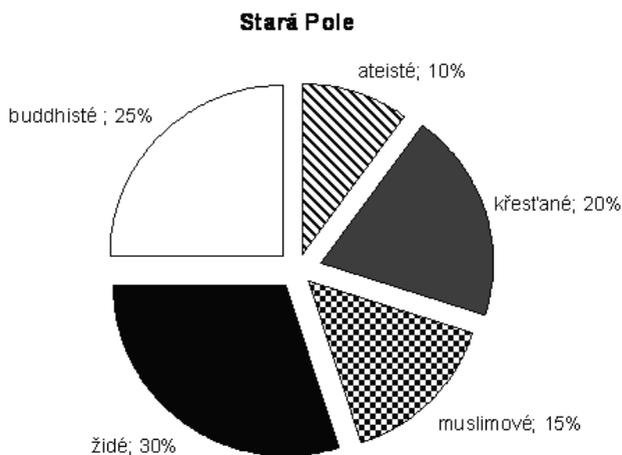
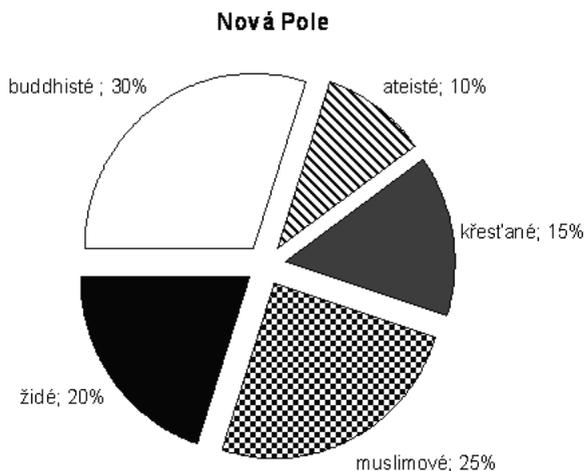
Principles of tactile graphic (technical point of view)

- » Enlarging the picture
- » Discrimination of the lines and surfaces by test sheet (max. 4 lines, 3–4 surfaces/patterns)
- » Distance between 2 lines if they should be detected as 2 lines is min. 5 mm
- » Space between line of the chart and its surrounding (including the axis and other intersections)
- » Space between the braille description and its surrounding min. 3–4 mm (usage of the abbreviations); substitution of braille description for sound interpretation (depending on technology) is possible

Theme 1: Charts and graphs

1. Pie chart – table

Graphs shows the religion structure of two cities New Field (Nová pole) and Old Field (Stará pole). In New field live 3000 inhabitants and in Old-field 5500 inhabitants. How many Muslims live in both cities together?



Adaptation

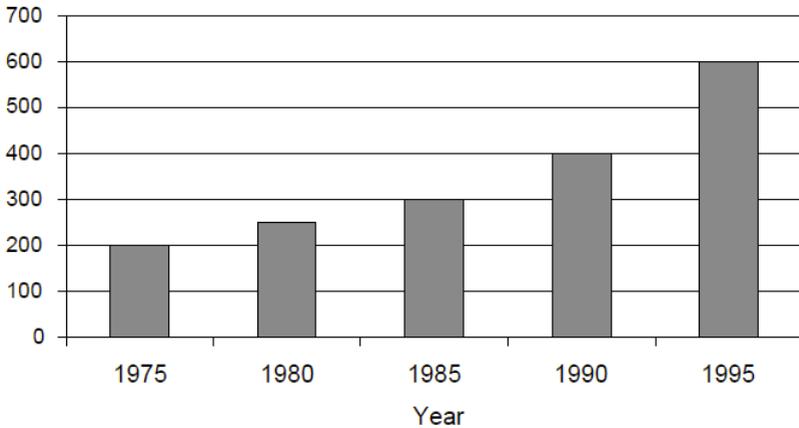
Convenient way is to convert the charts to a table.

	New Field	Old Field
Buddhists (budhisté)	30 %	25 %
Atheists (ateisté)	10 %	10 %
Jews (židé)	20 %	30 %
Christians (křesťané)	15 %	20 %
Muslims (muslimové)	25 %	15 %

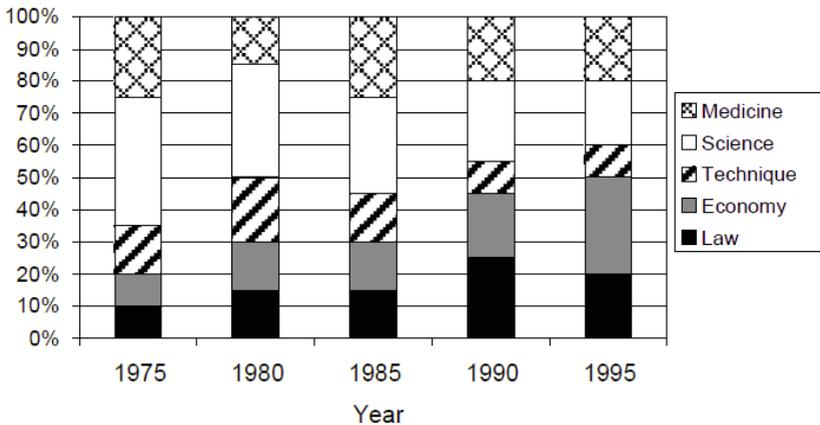
2. Bar graph – table

In charts is described in five year period development of students in years 1975–1995 and their structure of study fields.

Number of students in thousands



Structure of students according the field of study



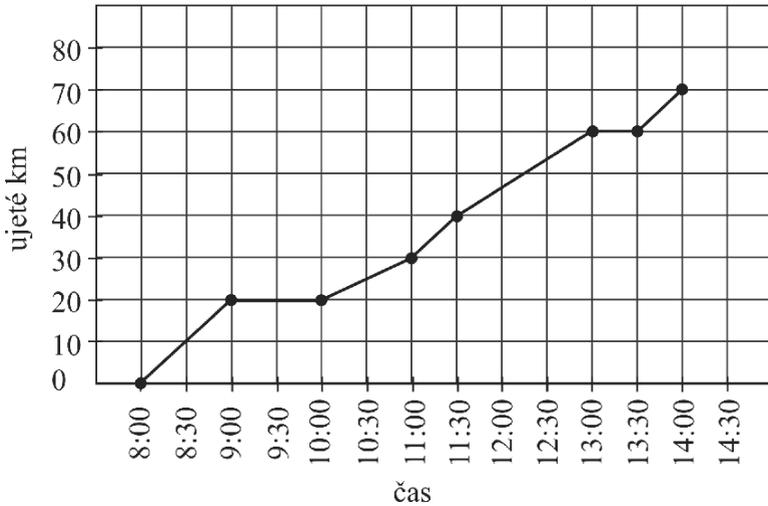
Adaptation:

In table is described student number development in years 1975 – 1995 and their structure of study fields.

	students	Law	Economy	Technique	Science	Medicine
1975	200	10 %	10 %	15 %	40 %	25 %
1980	250	15 %	15 %	20 %	35 %	15 %
1985	300	15 %	15 %	15 %	30 %	25 %
1990	400	25 %	20 %	10 %	25 %	20 %
1995	600	20 %	30 %	10 %	20 %	20 %

3. Line chart – tactile line chart

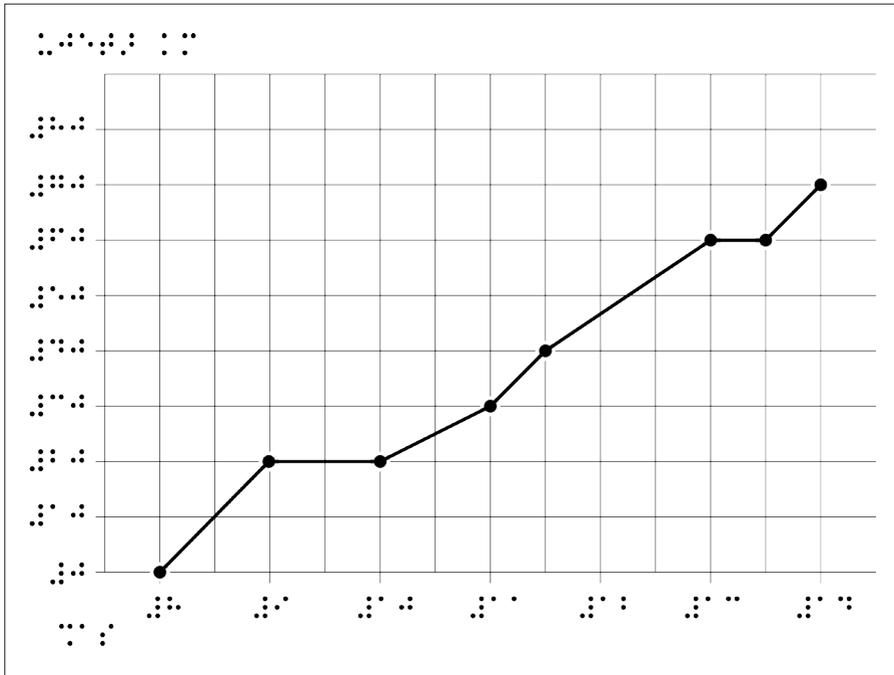
On chart is described time process (number of kilometres) of the cyclist's trip from 8.00 till 14.00



Tasks:

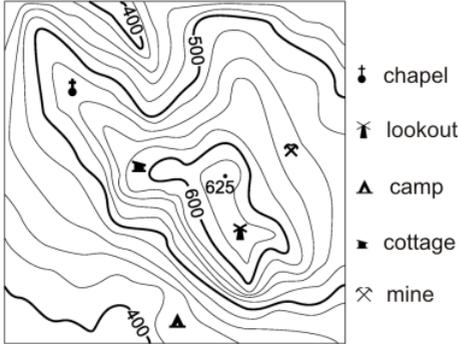
- 1. How long cyclist had a rest between 9.00 and 13.00, it means he did not move any speed?*
- 2. How many kilometres maximally cyclist drove during a one half of hour?*

Adaptation



Theme 2: Maps

1. Reading map with contour lines – test



Five objects are marked on the map. Your task is to select a variant, where the objects are sorted from the lowest to the highest situated.

- a) camp, chapel, mine, cottage, lookout
- b) chapel, camp, mine, cottage, lookout
- c) camp, mine, chapel, cottage, lookout
- d) camp, chapel, cottage, mine, lookout
- e) cottage, lookout, chapel, mine, camp

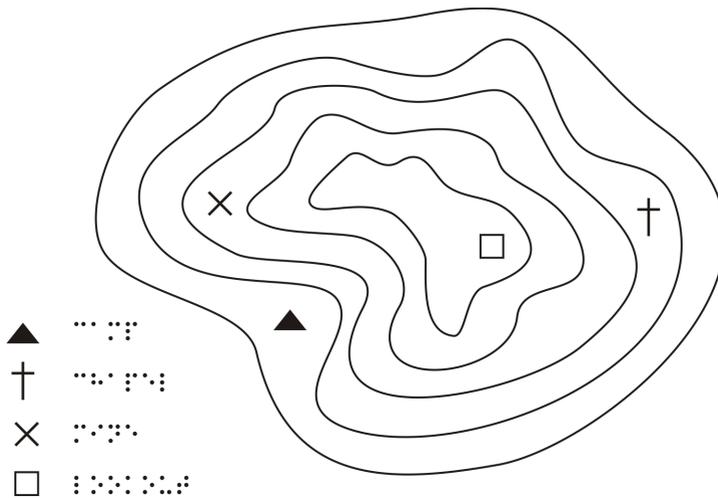
Adaptation:

In case the map is too complex it is better to reduce – 4 objects are sufficient to solve the exercise. Only the main contours are presented in the tactile version.

There was used a plastic model made by thermoform, the matrix was made using a cutting plotter.

Four objects are marked on the map (see the plastic model). Each level of the model represents one contour line (isohypse). Select a variant, where the objects are sorted from the lowest to the highest situated.

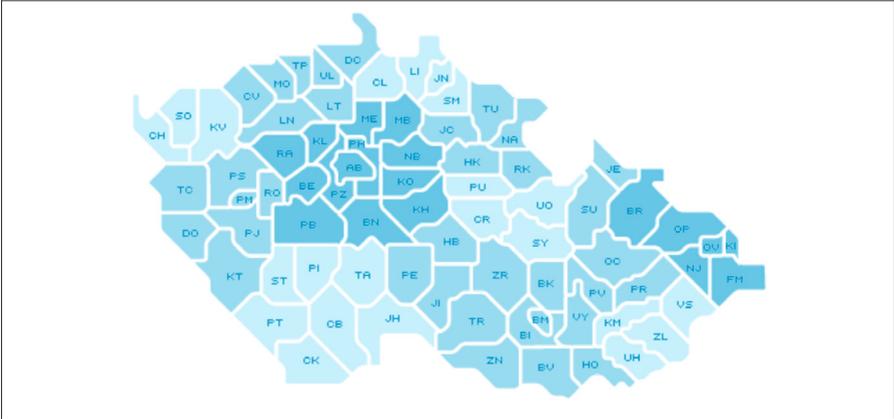
- a) camp, chapel, mine, lookout
- b) chapel, camp, mine, lookout
- c) camp, mine, chapel, lookout
- d) camp, chapel, lookout, mine
- e) lookout, chapel, mine, camp



- » the map with several layers of terrain is better to represent as a model
- » using of cutting plotter is an easy way how to prepare pieces of matrix but the foil is usually too thin to make a marked relief (more layers are necessary)

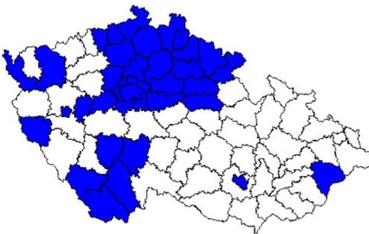
2. Electoral geography

It is a study material for the Faculty of Social Studies in Masaryk University. The author (teacher himself) attempted to explore basic characteristics of voting behaviour in the Czech Republic in years from 1990 to 2006, using the map of the Czech Republic divided to districts. You can see the map below.

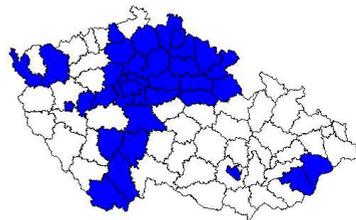


Then he tries to study Czech citizens' electoral behavior during the elections in 2002 in relation with the year 1998 and other past electoral years. He collected electoral maps for each political party and explored the districts where the party was successful. Below you can see the example of the electoral maps for the party ODS (year 2002 and 1998).

Districts of electoral support for ODS 2002

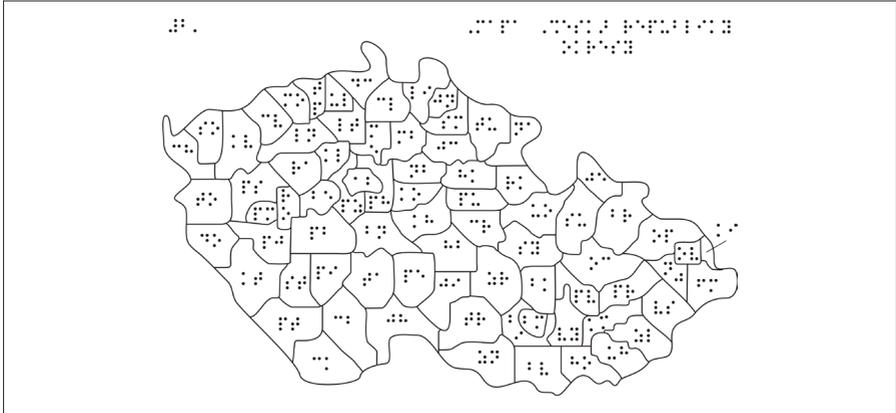


Districts of electoral support for ODS 1998

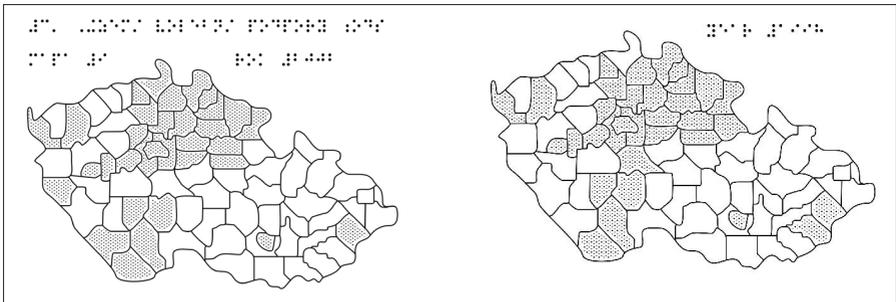


He compared the maps for all the years from 1990 to 2002 and tried to derive interesting results from these maps. And that was also the task for students of the subject Electoral Geography offered in the Faculty of Social Studies.

Adaptation



At first, students received the map of the Czech Republic divided to districts and printed on A3 paper in order to enable more comfortable tactile reading. Each district's name was abbreviated and described in the printed braille document. Students were also introduced with the division of districts to regions if they don't know it yet. They were supposed to know approximately where to find regions on the map.



Then they received adapted additional maps describing the electoral support for each political party. We attach that one for the party ODS, see bellow the year 1998 and then 2002.

Methods used to adapt the original pictures:

- » Enlarging the map of the Czech Republic and converting it on A3 paper.
- » Abbreviation of the districts' names and describing them in the printed braille document handed together with the tactile map.
- » Creating the electoral maps with the intension to differentiate successful and unsuccessful areas as much as possible.

3. Map as an illustration

Siberian tiger

(Panthera tigris altaica)

The Siberian tiger is typically 112–120 cm tall at the shoulders, 5–10 cm taller than the Bengal tiger which is about 107–110 cm tall. Males measure 270–330 cm long and weigh 180–306 kg; females measure 240–275 cm long and weigh 100–167 kg. Range of the Siberian tiger is not large (see map below).

Map of the Siberian tiger living area:



Adaptation

Siberian tiger

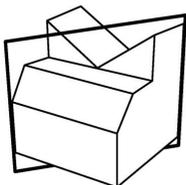
(Panthera tigris altaica)

The Siberian tiger is typically 112–120 cm tall at the shoulders, 5–10 cm taller than the Bengal tiger which is about 107–110 cm tall. Males measure 270–330 cm long and weigh 180–306 kg; females measure 240–275 cm long and weigh 100–167 kg. Range of the Siberian tiger is not large (see map below).

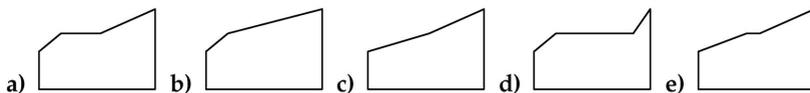
The Siberian tiger lives on area of Far East Russia (the Amur-Ussuri region of Primorsky Krai and Khabarovsk Krai) and neighbour regions of Northern east China and Korea.

Theme 3: Drawing with perspective

1. Using model



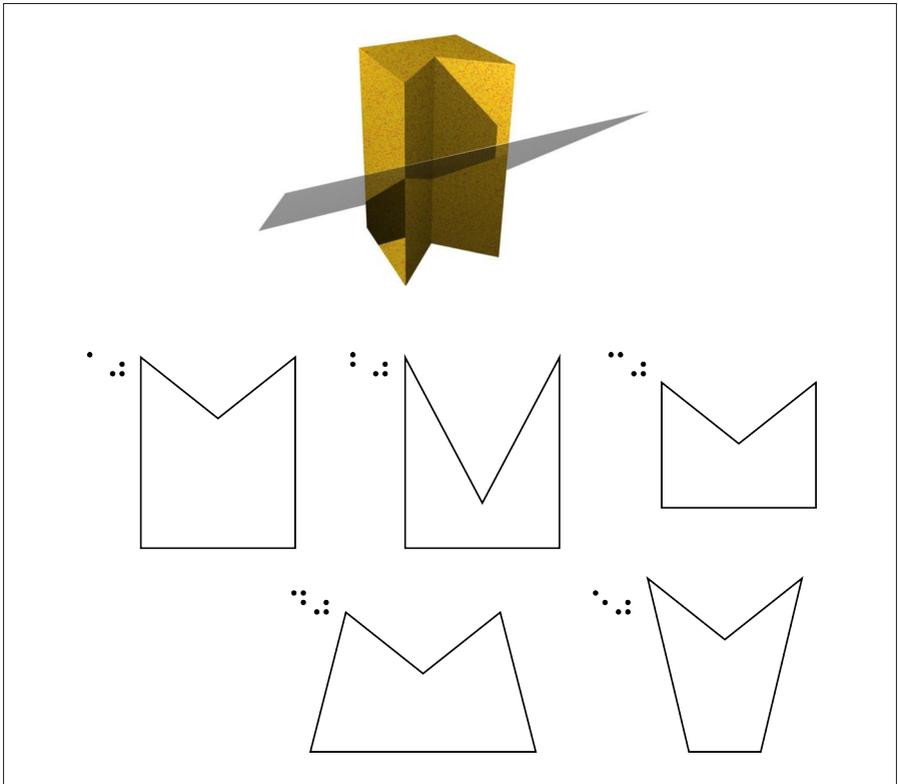
On the picture you can see the spatial object and plane which indicates the cut of the object.



From the available options, select the profile that corresponds to the cut in the indicated place.

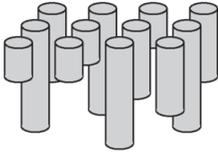
Adaptation

The object is presented as a model. The options are adapted as a tactile image:

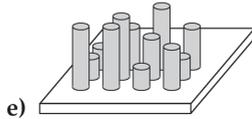
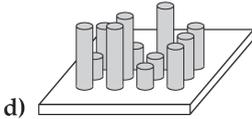
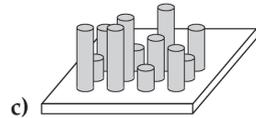
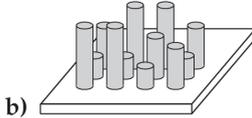
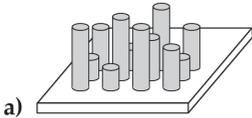


- » space concept of the object
- » perception problem of the 2D tactile graphic with spatial perspective

2. Transforming to 2D

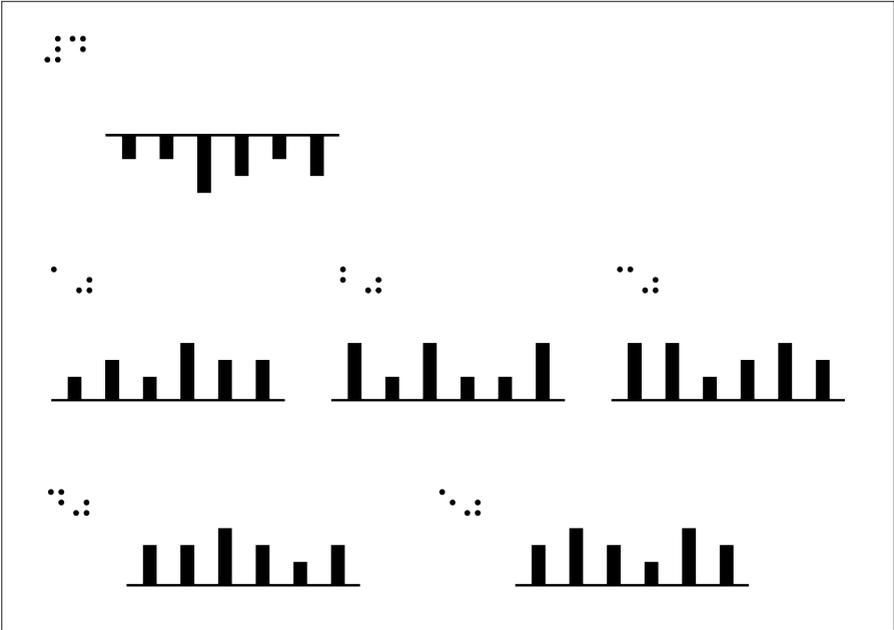


A group of 12 cylinders of the same length was split into two parts. The picture above shows one half. Select the second half from the variants a)–e) below.



Adaptation

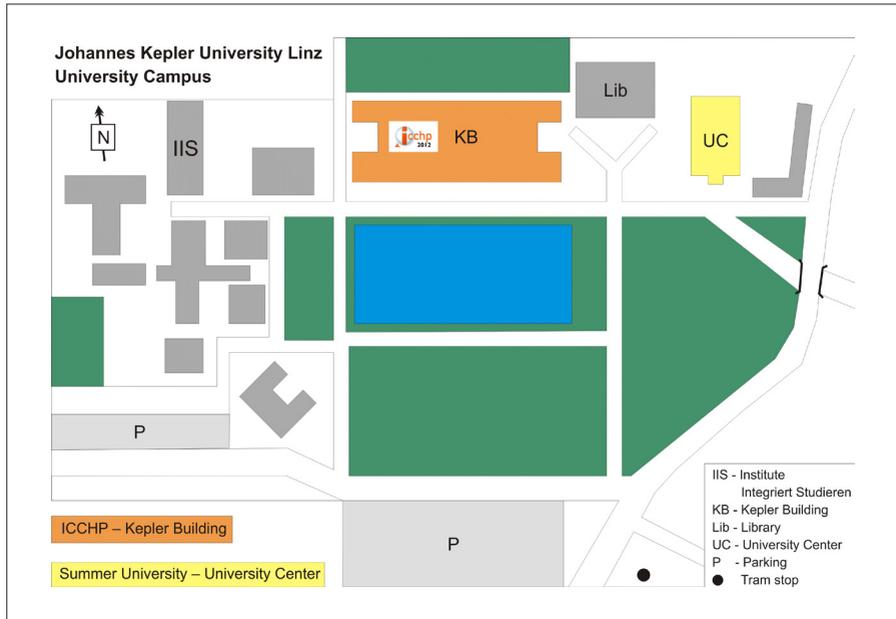
Conversion into 2D image. Reduced amount of the objects.



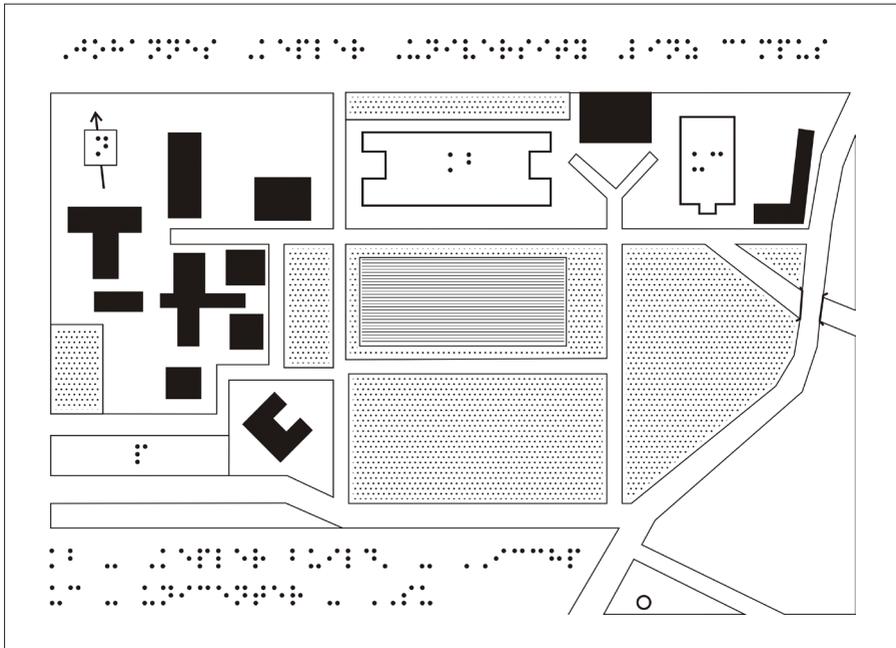
A 3D model is another possible solution; it's more expensive, it's harder to operate with and it's necessary to prevent user from putting two objects together.

Theme 4: Working with fillings (colours)

1. Orientation plan

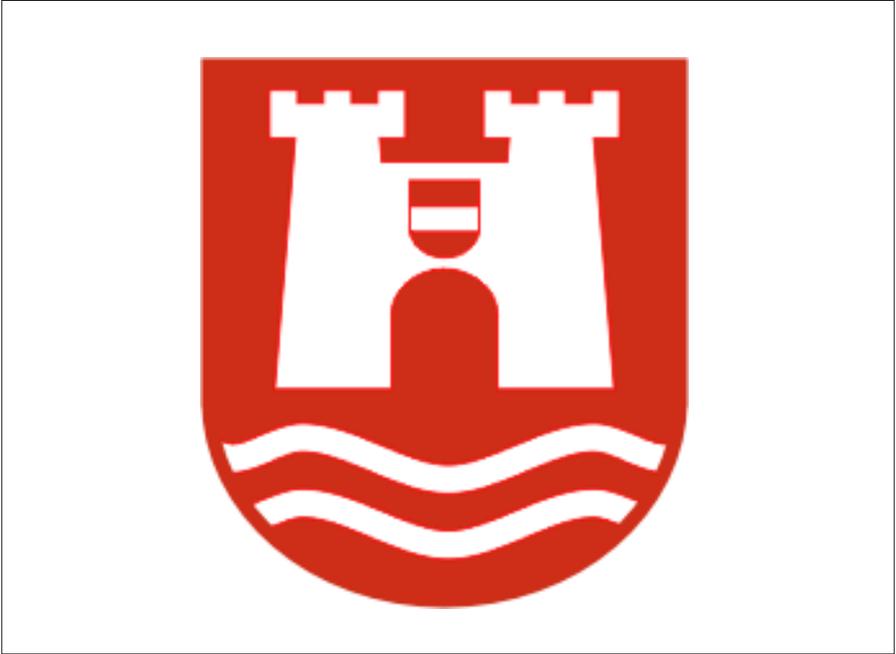


Adaptation

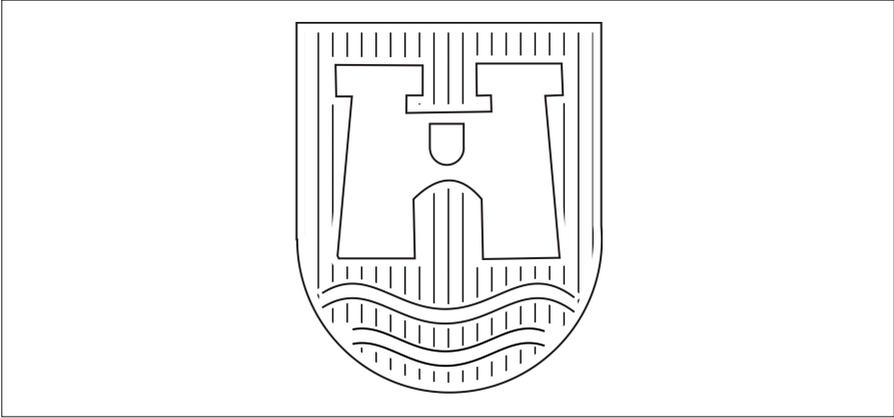


- » colours are substituted by fillings (patterns)
- » limited amount of fillings (from six in original plan to three now), the rest is adapted by using text (abbreviations: e.g. kb – Kepler building, uc – Uni-Center)
- » style of pattern:
 - › as most usual (conventional/intuitive) as possible (e.g. buildings in general – compact (black) filling , water – horizontal lines...)
 - › as most consistent use as possible of identical pattern for identical phenomenon (e.g. standard buildings always black...)
 - › distinguishing clearly (by touch) between all pattern used at the same time
 - › small distance between filling and line is left for more tactile comfort

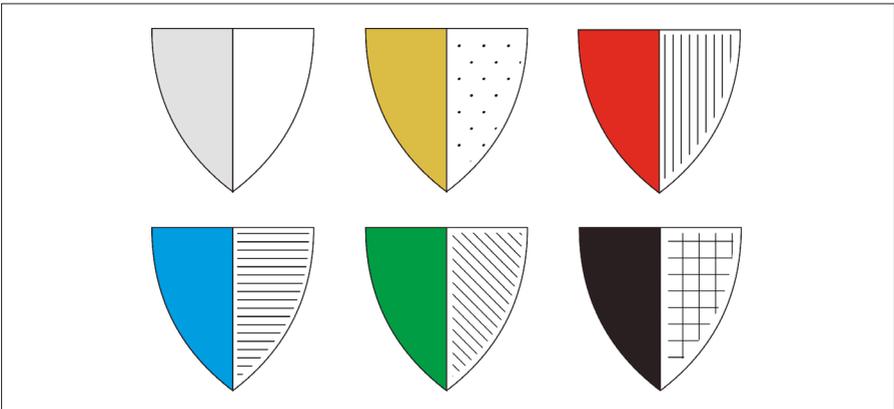
2. Heraldry



Adaptation (with respect to colours only)



- » colours can be easily adapted in accordance to the ordinary heraldic rules – in heraldic practice, individual surfaces of the shields are distinguished using different colours, in general called tinctures. For practical reasons, these tinctures have in standard heraldry also a **black and white variant** (see below). Various types of hatching lines can be used also in the tactile adaptation (advantage: teacher is not obliged to both investigate and learn new fillings)
- » disadvantage: angle of hatching is done by rules and defines the relevant colour > for correct interpretation the sheet of paper can't be held turned

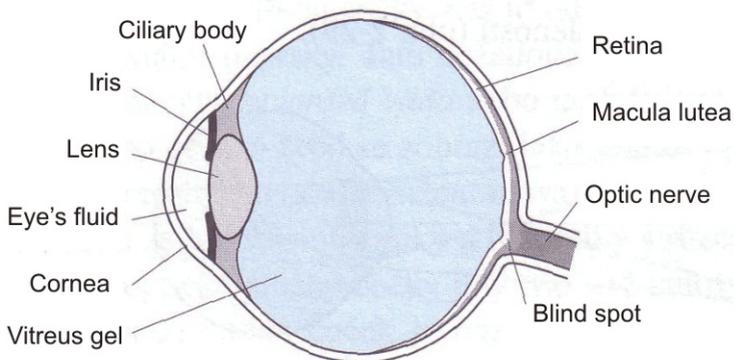


Tinctures of shield and their black and white variant – standard heraldry practice.

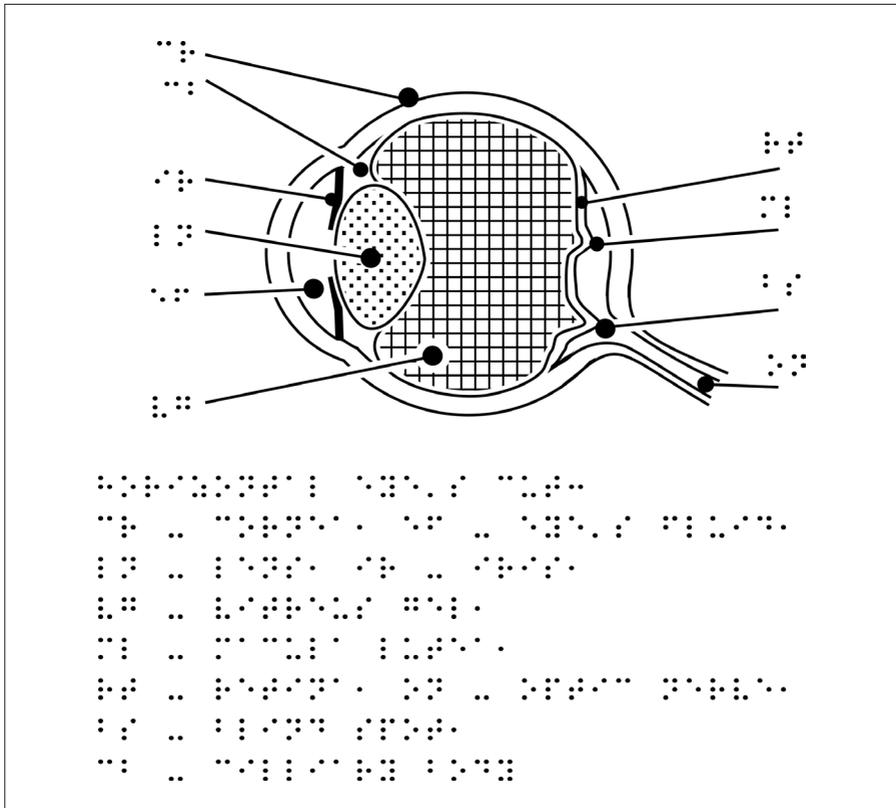
Theme 5: Schemes or Diagrams

1. Horizontal Eye's Cut

On the picture one can follow a structure of a human's eye. It was created according to the horizontal eye's cut and includes ten elements.



Adaptation



The picture description

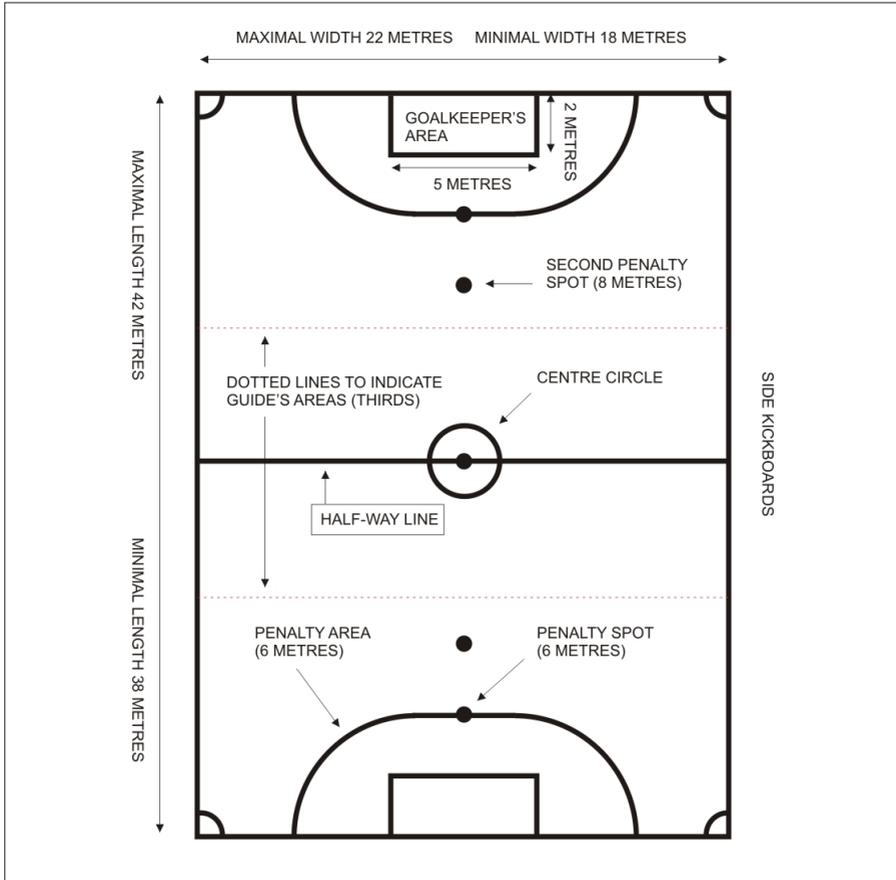
cr – cornea, ef – eye’s fluid, ln – lens, ir – iris, vg – vitreus gel, ml – macula lutea, rt – retina, on – optic nerve, bs – blind spot, cb – cilliary body

Methods used to adapt the original picture

- » Enlarging details:
 - › the width of the iris, cornea, retina
 - › the size of the retina’s elements (macula lutea, blind spot)
 - › the size of the lens
- » The element’s labels abbreviation, the proposal respects original element’s names so one can recognise them more easily and intuitively.
- » Differentiating among the largest parts (lens, vitreus gel)

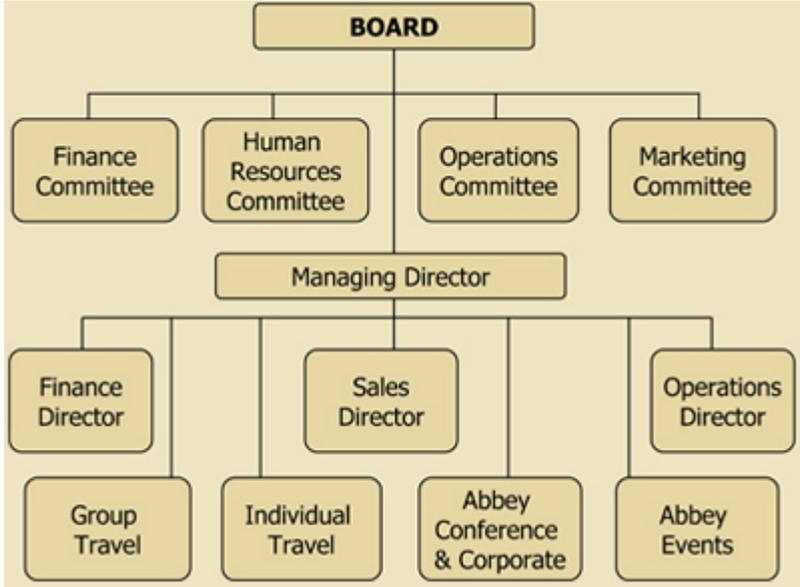
2. The Blind Football pitch

On the picture you can recognise a diagram describing the layout of a blind football pitch. You get to know where the important parts of the field are. You also learn the distances and sizes between them.



3. Structure of the company

On the picture you can follow the structure of the Abbey Tours company and competence distribution among the company members and groups.



Adaptation:

Textual description

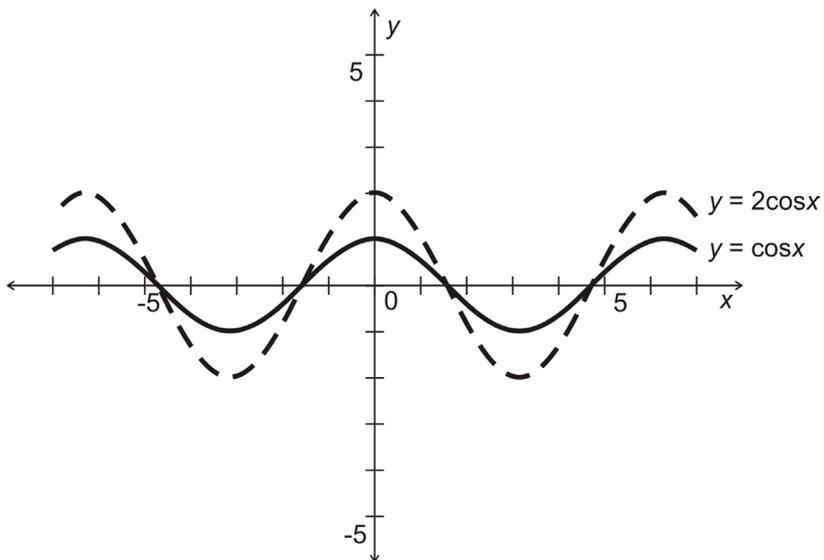
- » The picture shows the structure of the Abbey Tours company and competence distribution of its members and groups. By the notation $x > y$ we mean, the object x is superior (above) the object y . There are two hierarchical levels of competence:
 - › Board > Finance Committee, Human Resources Committee, Operations Committee, Marketing Committee, Managing Director
 - › Managing Director > Finance Director, Sales Director, Operations Director, Group Travel, Individual Travel, Abbey Conference & Corporate, Abbey Events.

Theme 6: 2D curves

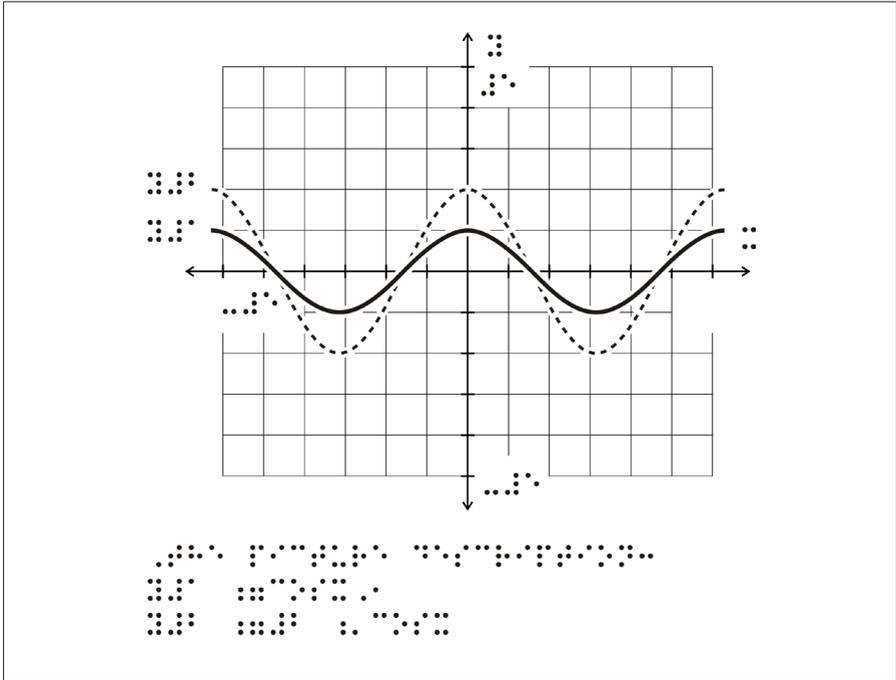
1. Trigonometric functions

There are two curves of the cosine function on the picture. The first of them ($y = \cos x$) is the general form of the cosine function. The second one is $y = 2\cos x$. You can compare these two curves and recognise:

1. both of them are periodical,
2. both of them have the same x -points in which they intersect with y -axis periodically – these points are $x = \pi/2 + k \cdot \pi$, where k is an integer.
3. The difference is in maximal and minimal y -value of the curves – $\cos x$ results from -1 to 1 while $2\cos x$ is between -2 and 2 – so its amplitude is twice more than in the case $\cos x$ function.



Adaptation



The picture description

$$y_1 = \cos x, y_2 = 2 \cdot \cos x$$

Methods used to adapt the original picture

- » The curves' general forms are abbreviated and described below the picture.
- » The network of the size 1 is used under the picture so a blind user can follow the function's values (y values).
- » Two different types of lines are used so a blind user can recognise a difference between them.
- » We have to say, the picture is in most cases only a demonstration and a teacher should explain all the important pieces of information to a blind student in advance. While a sighted student can easily understand the function's value from -1 to 1 (respectively from -2 to 2), a blind student is not able to estimate this fact as the most important difference between these two curves.

2. Logarithmic and exponential function and their comparison

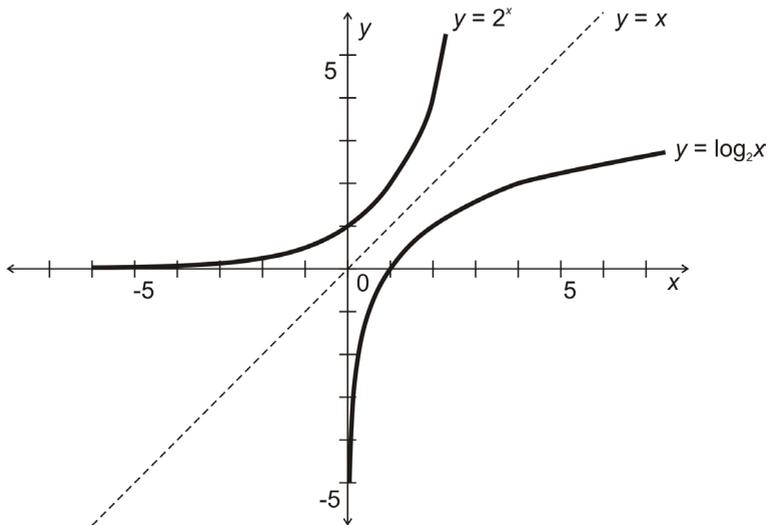
There two curves are symmetrical, if we reflect one of them at the line $y = x$, we obtain the second. Exponential function is positive for each x -value. On the other hand, logarithmic function is defined only for positive x .

Important points:

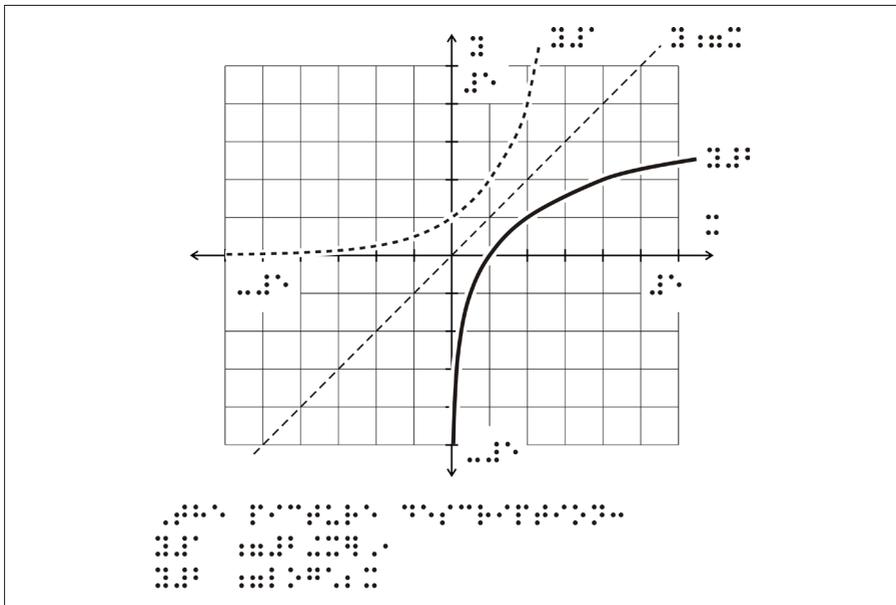
- » Exponential function intersects with the y -axis for $x = 0$ ($f(0) = 1$),
- » Logarithmic function intersects with the x -axis for $y = 0$ ($f(1) = 0$).

Interesting results:

- » Exponential function: for negative x the curve is approaching to the x -axis from the right side.
- » Logarithmic function: for x less than 1 the curve is approaching to the y -axis from the right side.



Adaptation



The picture description

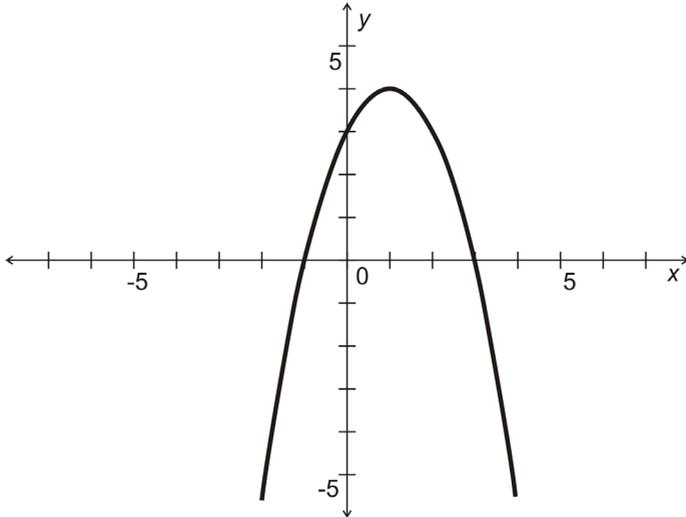
$$y_1 = 2^x, y_2 = \log_2 x$$

Methods used to adapt the original picture

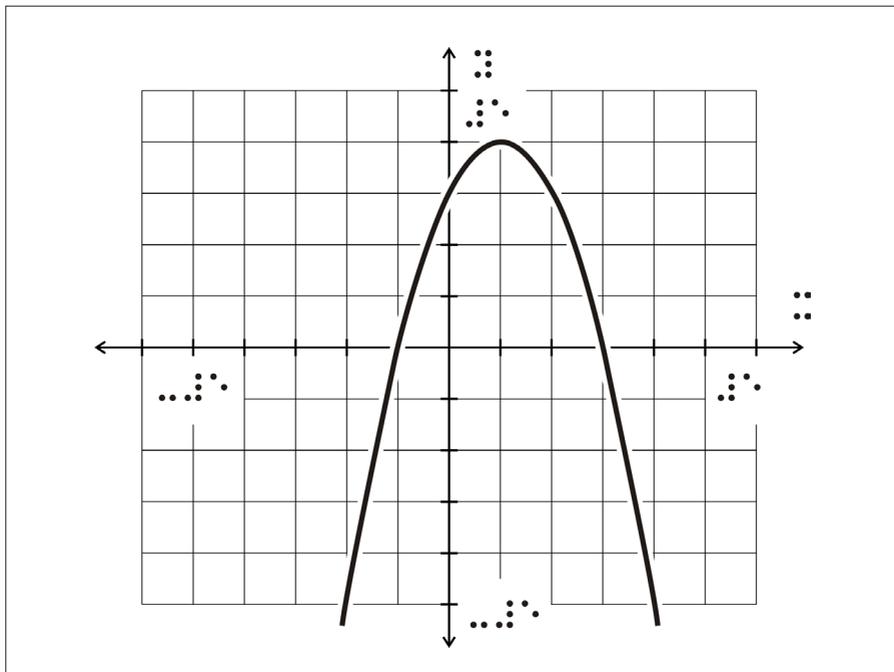
- » The curves' general forms are abbreviated and described below the picture.
- » The network of the size 1 is again used under the picture so a blind user can follow the key function's values (y values).
- » Three different types of lines are used so a blind user can recognise a difference between them.
- » We have to say, the picture is again only a demonstration. A teacher should explain all the important pieces of information (mentioned above) to a blind student in advance. A sighted student can easily understand the exponential and logarithmic functions are symmetrical. On the contrary, a blind student is not able to estimate this fact without help of the teacher.
- » The teacher's assistance is very needed to explain the fact that exponential function's value cannot be 0, it is only approaching to 0.

3. Determining the general form of the function

On the picture you can follow a curve. Try to determine which function is represented by the curve and write down the function's general form.



Adaptation

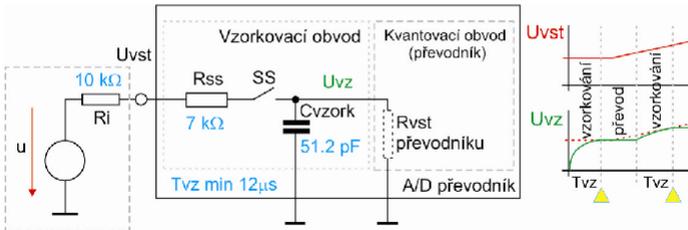


Theme 7: Electronic circuits

This text is a part of the Digital Technology studying material (author: Jiří Hrbáček).

Vzorkování

Tak tedy jak pracuje vzorkovací obvod?

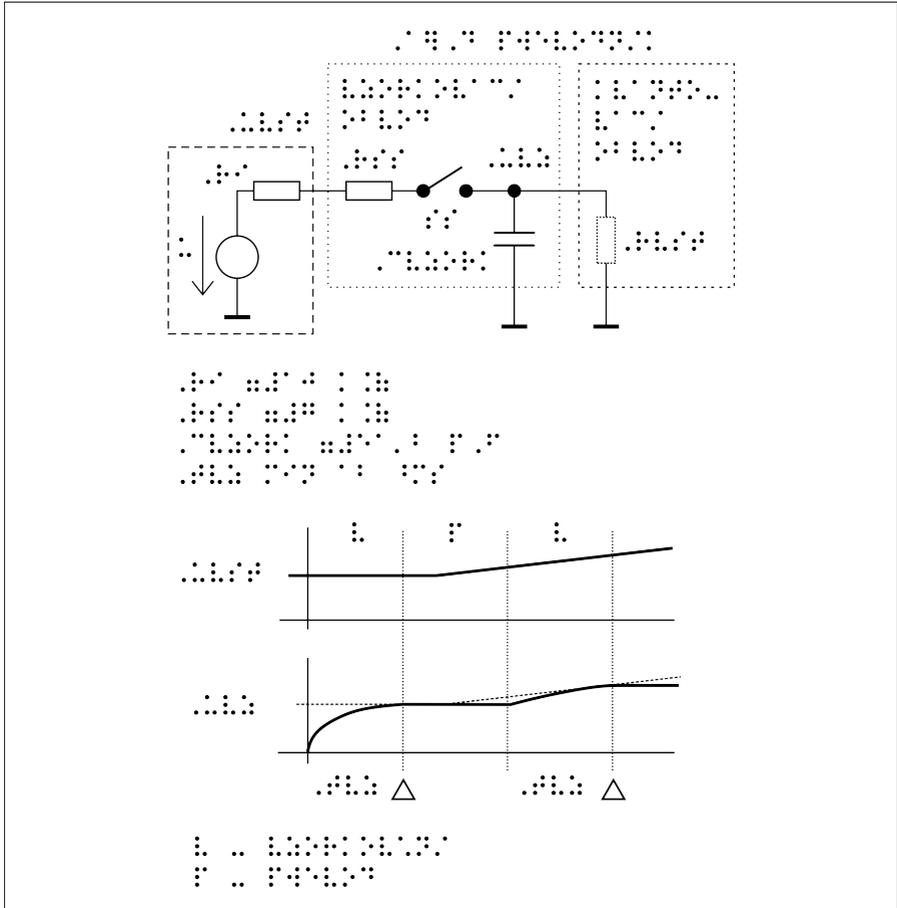


obr. 18 Vzorkovací obvod

The first picture shows a sampling circuit and two graphs of signals – the red one is input (analog) and the green one is output (digitalized).

Adaptation

The circuit is made of standard electronic components, which may be converted to tactile version by standardized way. Colours in the image should be replaced by comments if necessary. The image must be large enough to express all details.



Another possible solution is to use real electronic components to demonstrate the electronic circuit, but there is no possible (or very limited) using of Braille labels and comments. Also the difference between the components is not always obvious – sometimes resistors and diodes etc. looks very similar, but two capacitors may look totally different. But this fact is also useful to know, however.

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Teiresiás – Support Centre for Students with Special Needs
Brno 2012–2013
(last update September 2013)

