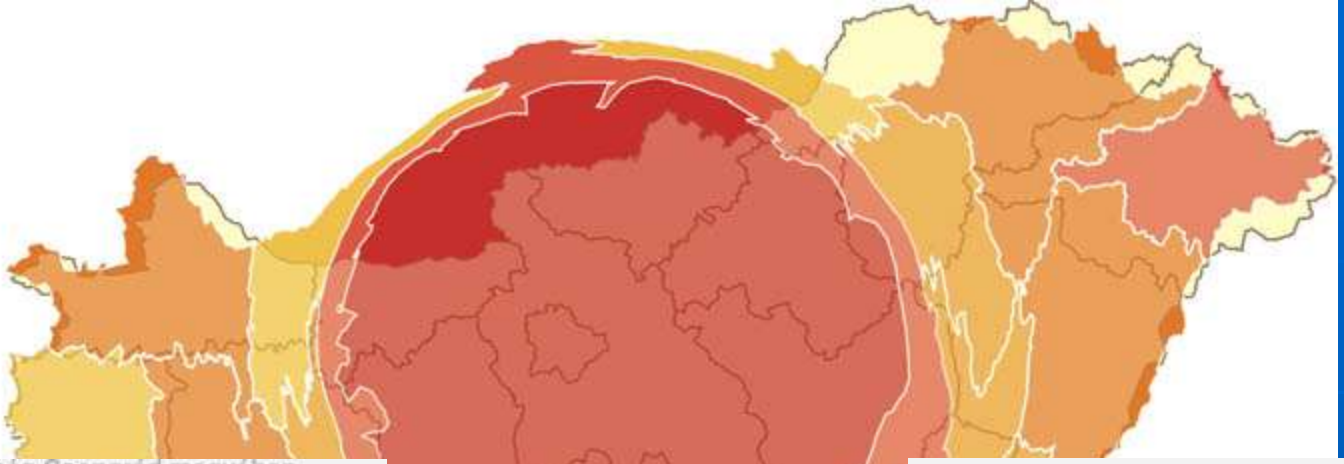
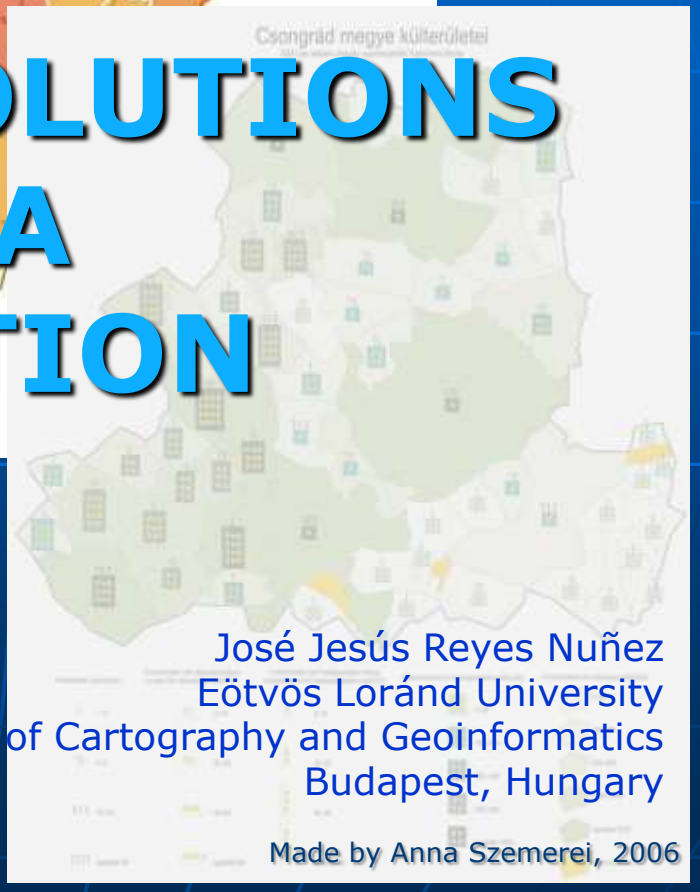


ALTERNATIVE SOLUTIONS FOR DATA VISUALIZATION

Made by
János Nyerges, 2005



Made by Anna Szemerei, 2006

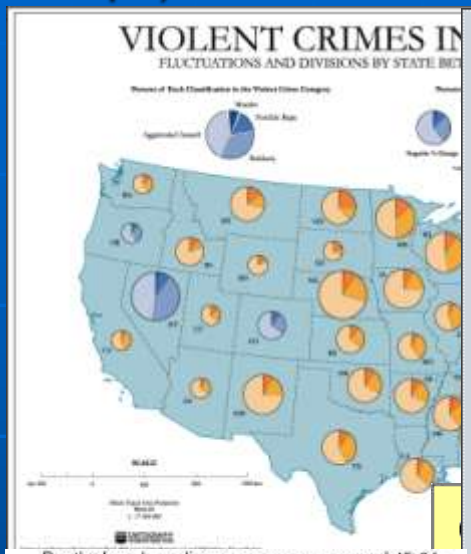
José Jesús Reyes Nuñez
Eötvös Loránd University
Dept. of Cartography and Geoinformatics
Budapest, Hungary

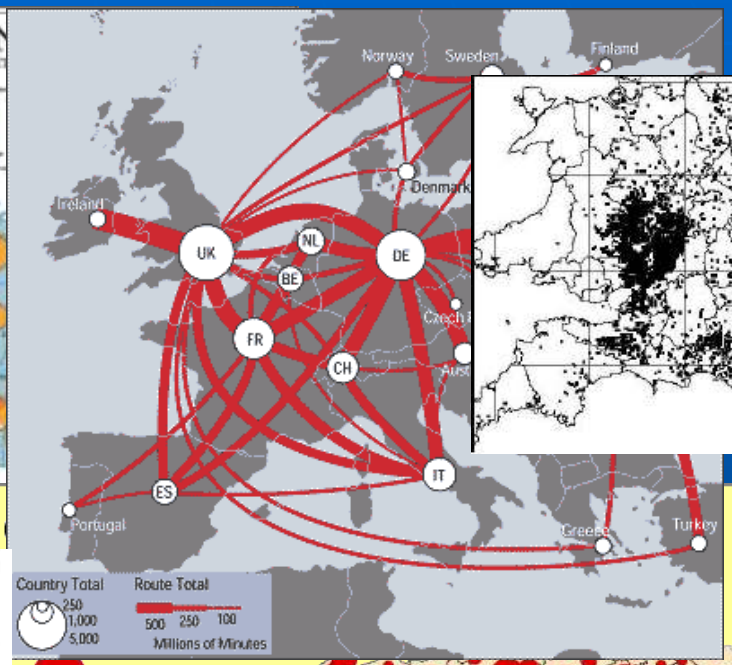
The European Union and the European Social Fund have provided financial support to the project under the grant agreement no. TÁMOP 4.2.1/B-09/1/KMR-2010-0003.

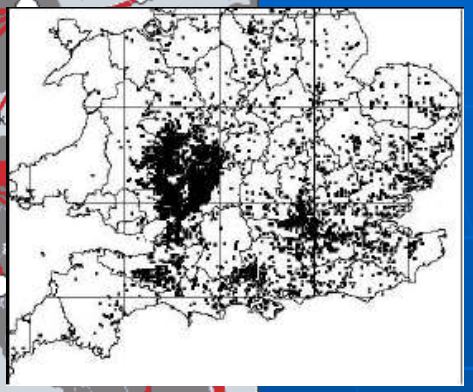
THEMATIC CARTOGRAPHY

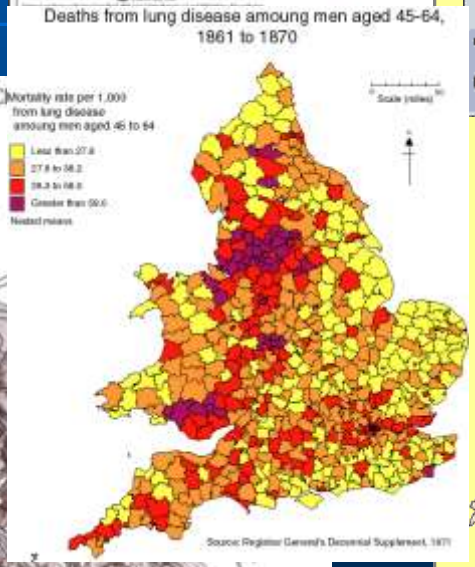
Traditional methods of thematic representation (or traditional methods for data visualization on maps):

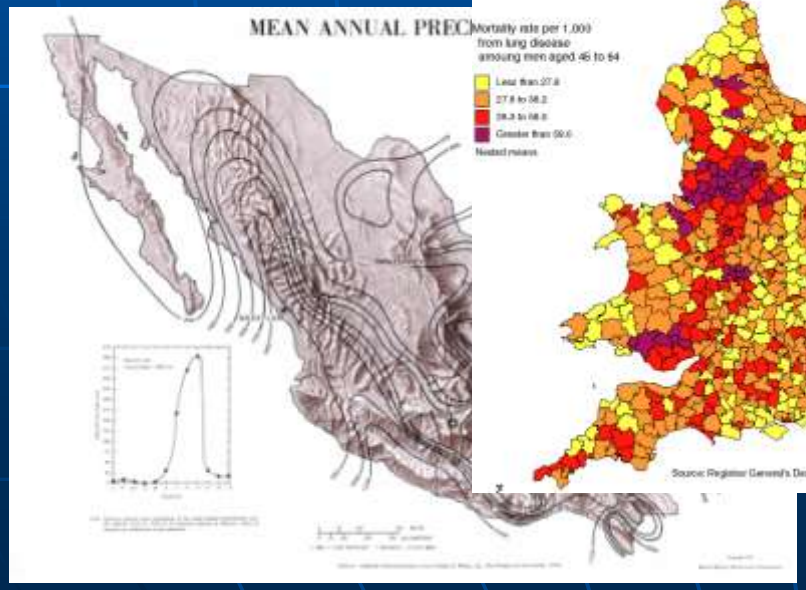
- Symbol
- Chart (diagram)
- Choroplet
- Isoline
- Dot
- Flow
- *Cartogram*

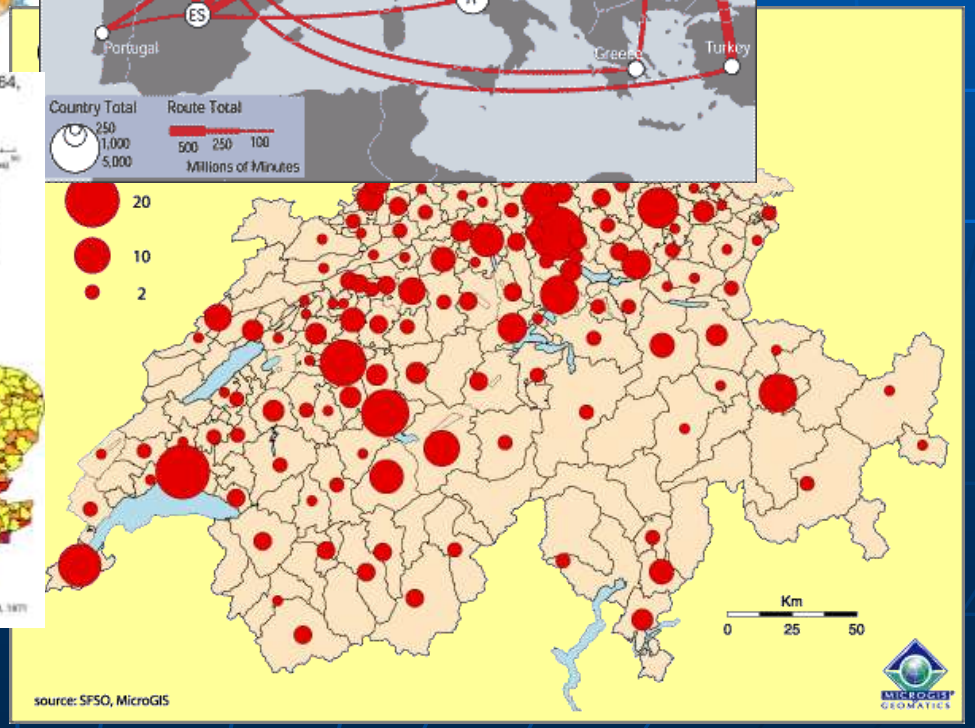


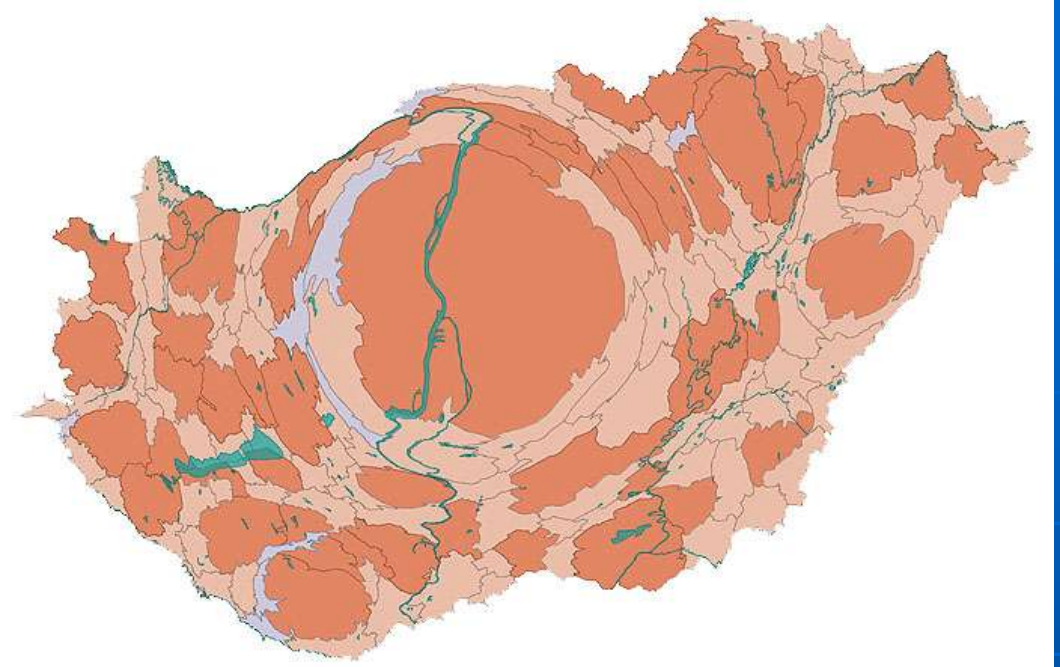


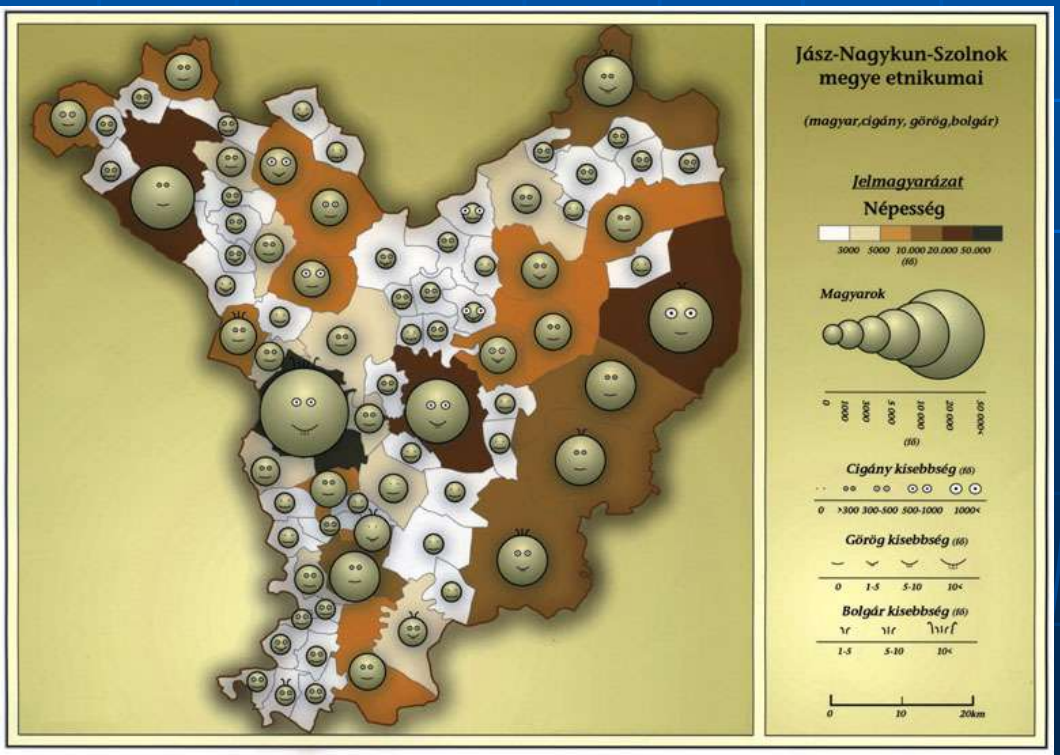












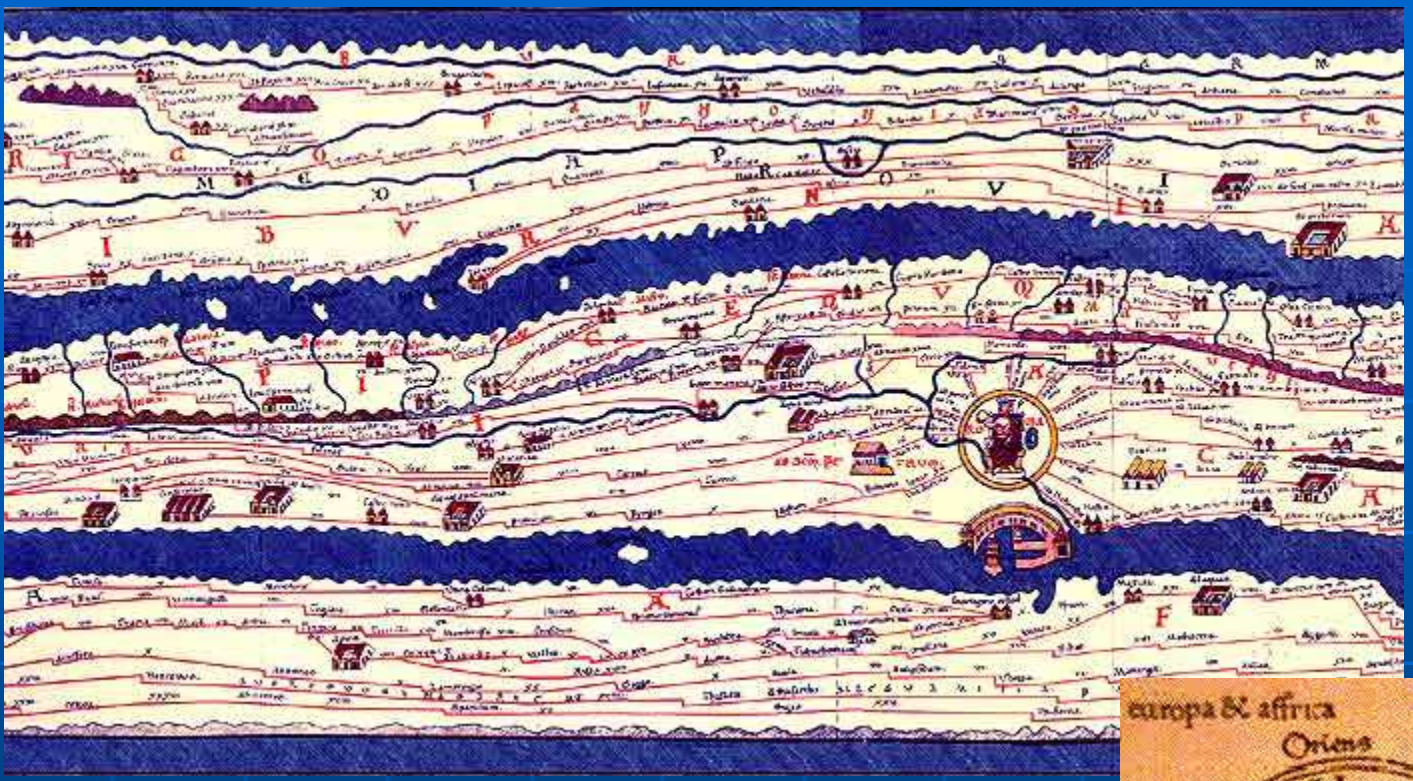
ALTERNATIVE SOLUTIONS IN THEMATIC CARTOGRAPHY

A research project developed in our department between 2007 and 2010.

The research included the study of two methods of representation less known in Hungary:

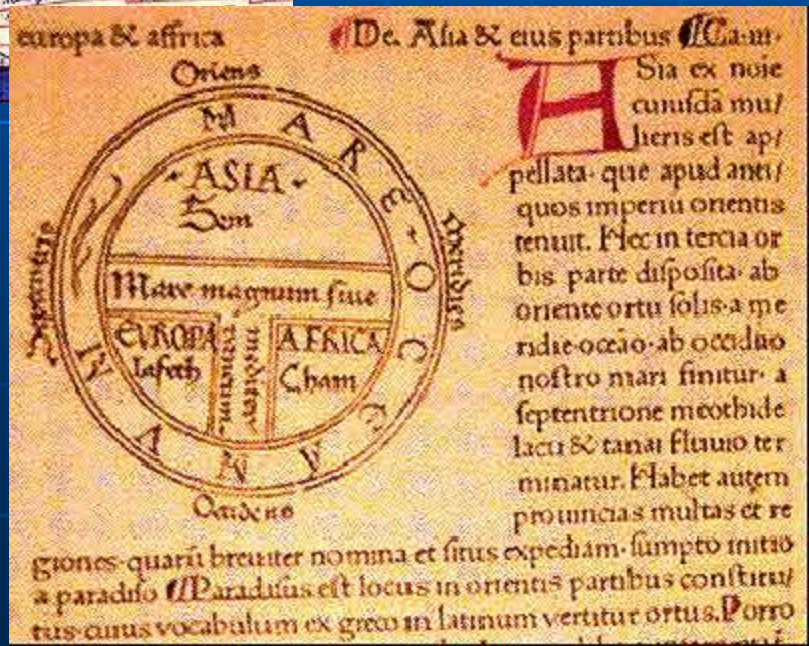
- Cartograms
- Chernoff faces

CARTOGRAMS



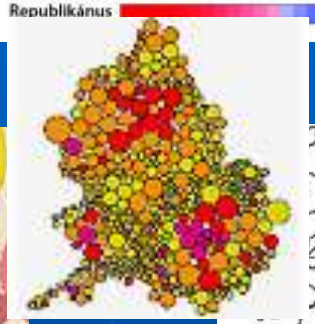
Roman Peutinger Tables

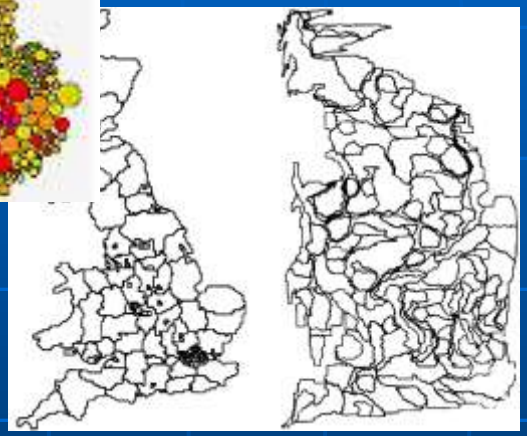
First cartograms before the 19th century?

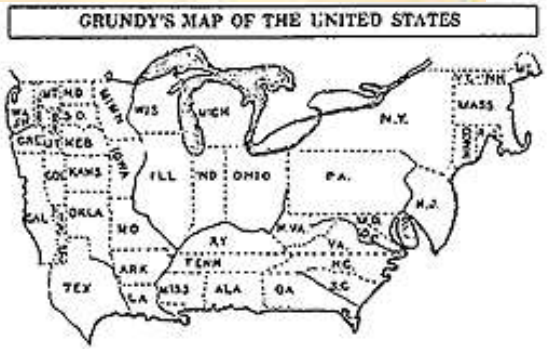


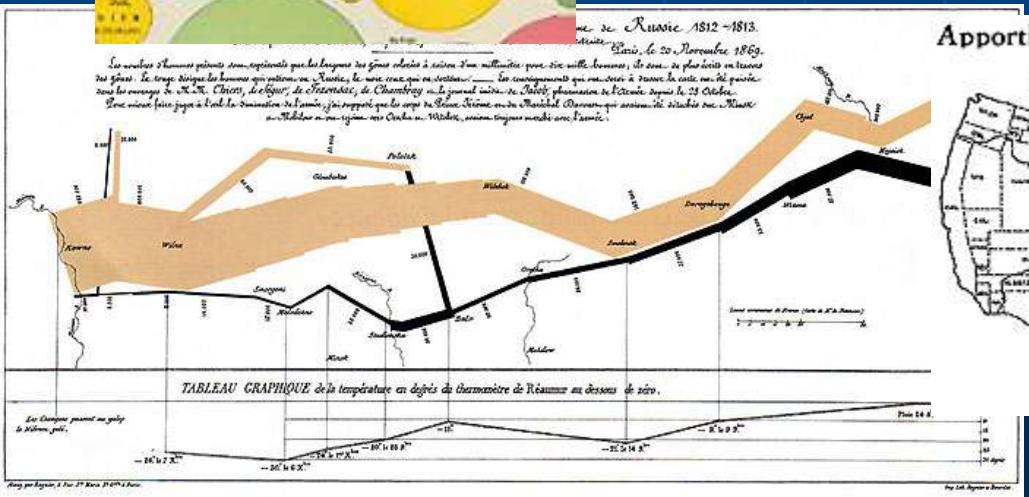
T-in-O maps of the Middle Age

CARTOGRAMS









Cartograms: 19th, 20th and 21th centuries

CARTOGRAMS

A research field that provokes serious discussion between cartographers, because the data representation is based on the distortion of the original areas, and it can cause difficulties to identify geographically the represented territory.

Can a cartogram be considered a „real" map?

„Every map departs to a certain degree from the original conception –a picture of the earth's pattern– in abstraction, conventionalization and selective use of its elements. How 'diagrammatic' a map must be in order to be called a cartogram depends largely on individual judgment…"

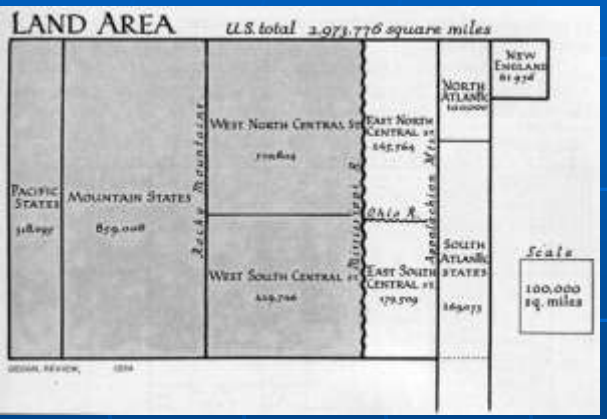
Erwin Raisz (1893 – 1968)
General Cartography, 1938
Harvard University, USA

„The most conservative use of the term is for those maps in which even the outlines of the land or the exact locations of other features are altered"

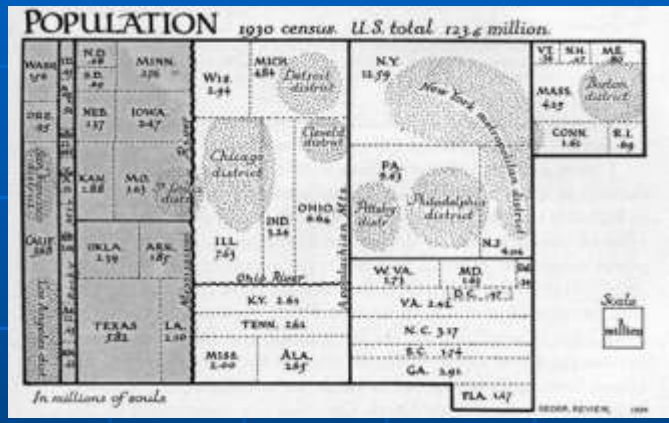
CARTOGRAMS

Why to make mention of Erwin Raisz?

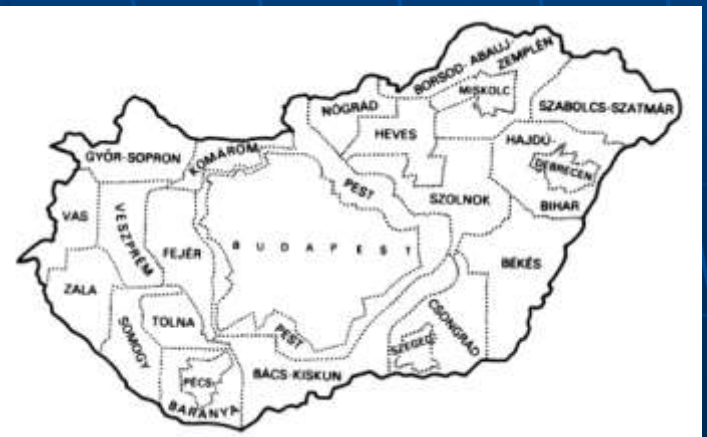
Because he was the first cartographer recognized internationally as the first researcher on this theme, who dedicated a chapter to the cartograms in his textbook "General Cartography" (1938)… and he was born and studied in Hungary… ☺



Two of the USA cartograms made by Raisz in the 30's



In Hungary, there was a very little research on this theme till the present project.



Cartogram of Hungary made by Lackó László in 1966

Cartogram of Hungary made by Dusek and Szalkai in 2006

CARTOGRAMS

Cartograms are „traditionally" classified according to two main aspects:

- Location of the represented (distorted) map areas

  - contiguous cartogram (areas touch each other)
  - non-contiguous cartogram

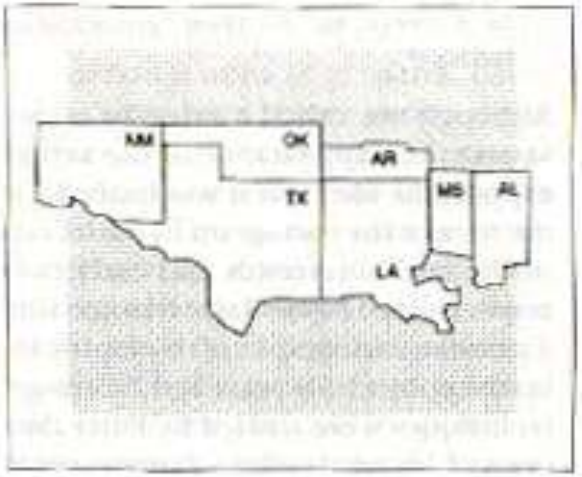


Figure 10.3. Contiguous and noncontiguous cartograms. Contiguous cartograms like (a) are compact and boundary relations are attempted. In noncontiguous cartograms, such as (b), enumeration units are separated and positioned to maintain relatively accurate geographic location.

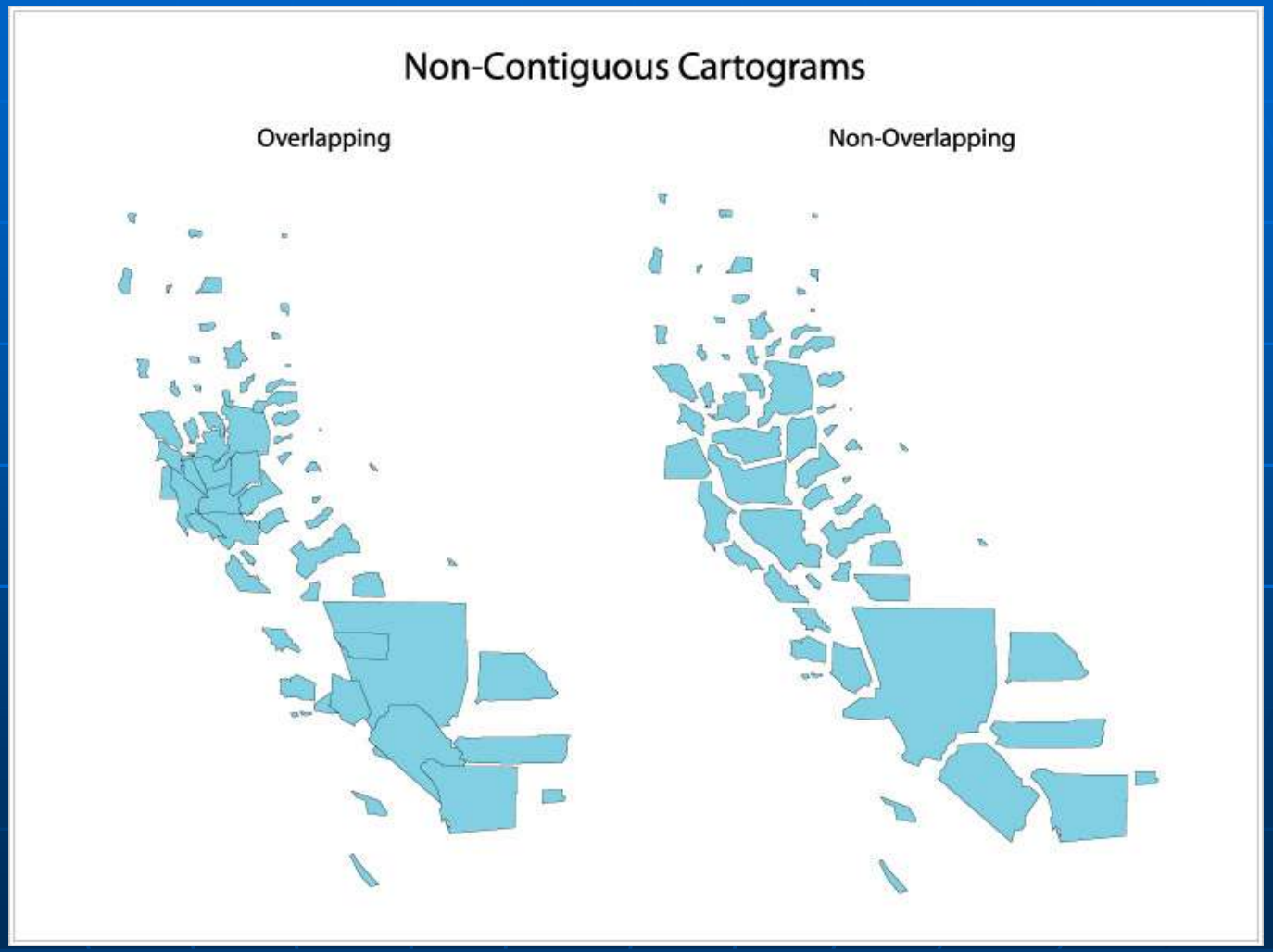
http://go.owu.edu/~jbkrygie/krygier_html/geog_353/geog_353_lo/geog_353_lo11.html
(Source: Dent fig. 10.3)

CARTOGRAMS

Non-contiguous cartograms are divided in two types:

- Overlapping

- Non-overlapping (*Island cartogram*)



http://www.ncgia.ucsb.edu/projects/Cartogram_Central/types.html

CARTOGRAMS

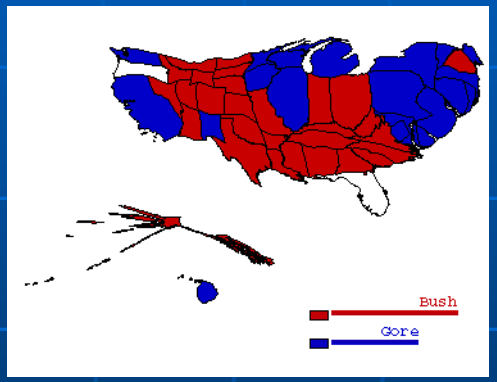
The cartograms developed during the last 15 years need a new classification

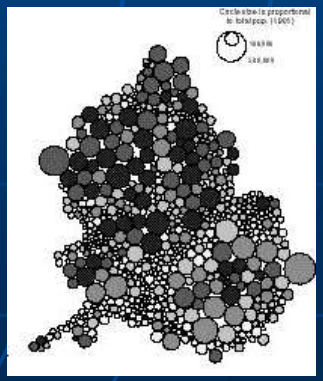
Based on the distorted base area:

- geographical cartogram – it is made modifying (deforming) the „real” (original) geographic territory represented on the map.

- geometrical cartogram – the real geographic territory is substituted using a geometrical shape (circle, square)

Sarah I. Fabrikant, Zurich





Daniel Dorling, London

CARTOGRAMS

Pseudo-cartograms (false cartograms)

Dr. Waldo Tobler (1986), University of California - Representations that may look like cartograms but do not follow certain cartogram rules. Based on moving the object's connections to a reference grid (latitude or longitude). This maintains good directional accuracy in the cartogram (if county A is directly north of county B, it will still remain directly north in the cartogram).

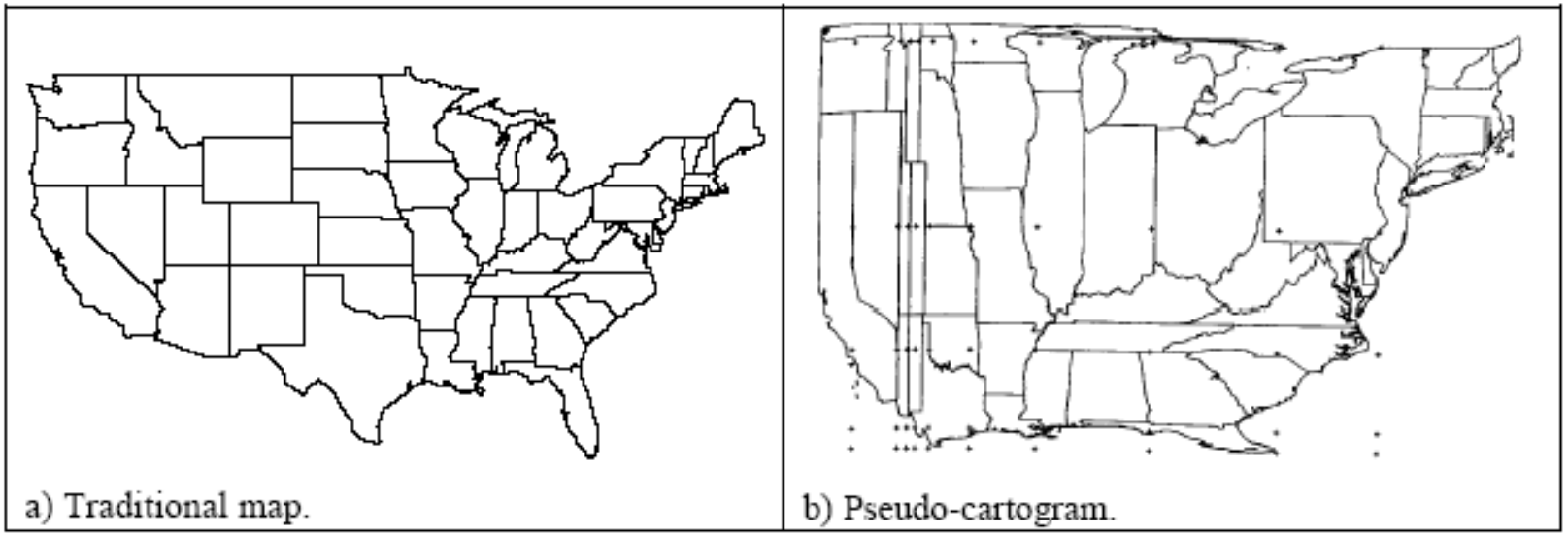
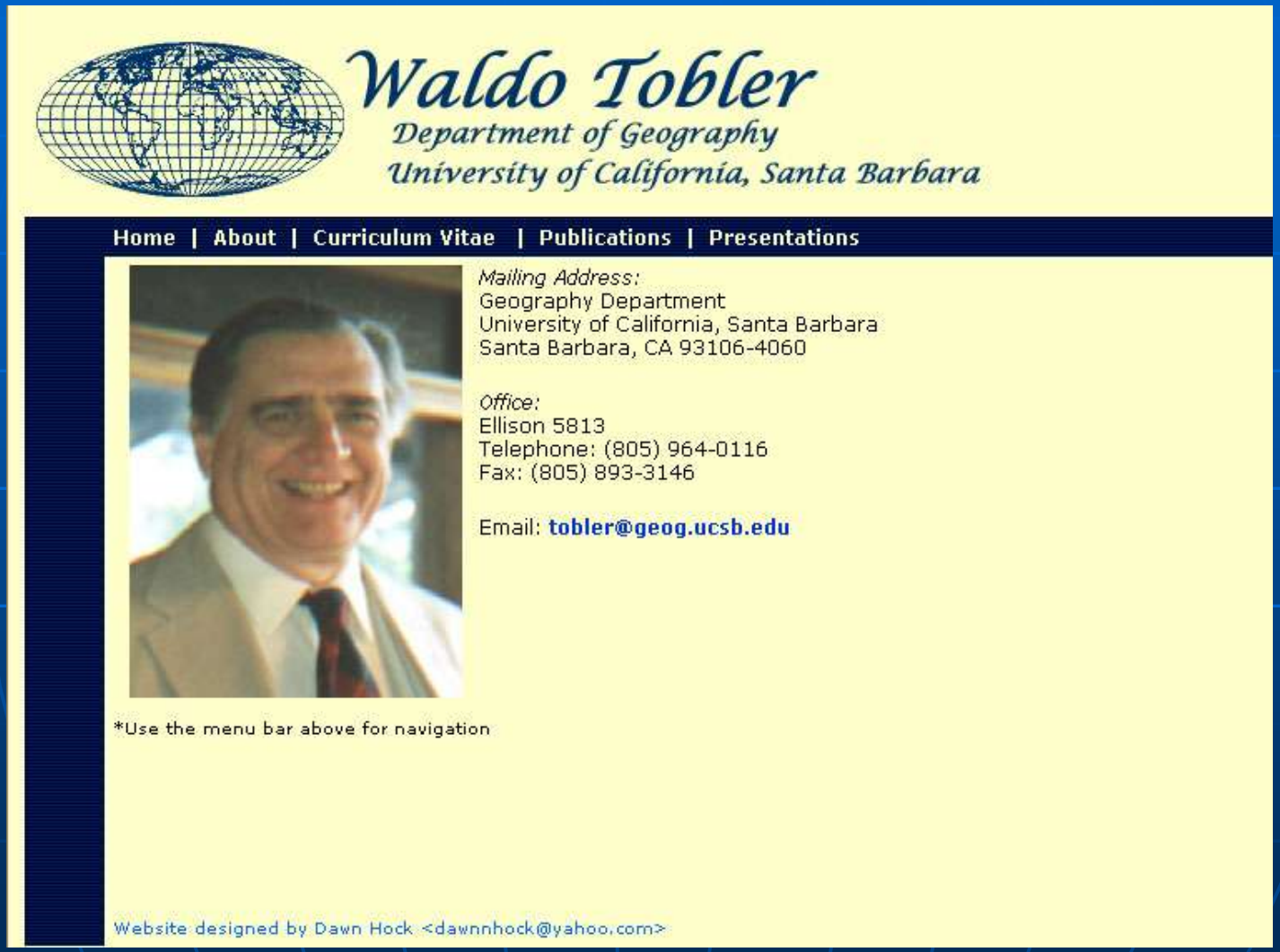


Figure 3.4: Pseudo-cartogram population density approximation of the U.S. by Tobler (b: Reproduced with permission from [25], page 49, figure 8, © 1986 American Congress on Surveying and Mapping).

http://www-viz.tamu.edu/faculty/house/cartograms/Chapt-03.PDF

CARTOGRAMS

Tobler's website



www.geog.ucsb.edu/ ~tobler/

CARTOGRAMS

Tobler's website

Projections

- The Hyperelliptical and Other New Pseudo Cylindrical Equal Area Map Projections
- Local Map Projections
- Medieval Distortions: The Projections of Ancient Maps
- Numerical Approaches to Map Projections
- Polycylindric Map Projections
- Qibla, and Related, Map Projections
- A Quadtree For Global Information Storage
- Oblique Map Projections Using Rotation Matrices
- Measuring the Similarity of Map Projections

Cartograms

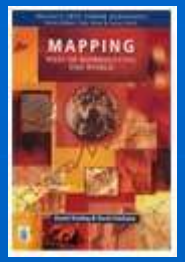
- Thirty Five Years of Computer Cartograms
- What is an Area Cartogram?
- Cartograms and Cartosplines
- A Continuous Transformation Useful for Districting
- Geographic Area and Map Projections
- Interactive Construction of Contiguous Cartograms
- Pseudo-Cartograms
- Map Transformations of Geographic Space

Geographical Analysis

- Non-Isotropic Geographic Modeling
- Bidimensional Regression
- Cellular Geography
- A Computer Movie Simulating Urban Growth in the Detroit Region
- An Analysis of a Digitized Surface
- The Equidominance Line: A New Geopolitical Concept

CARTOGRAMS

The most representative geometric cartograms are the Dorling and Dorling-like cartograms



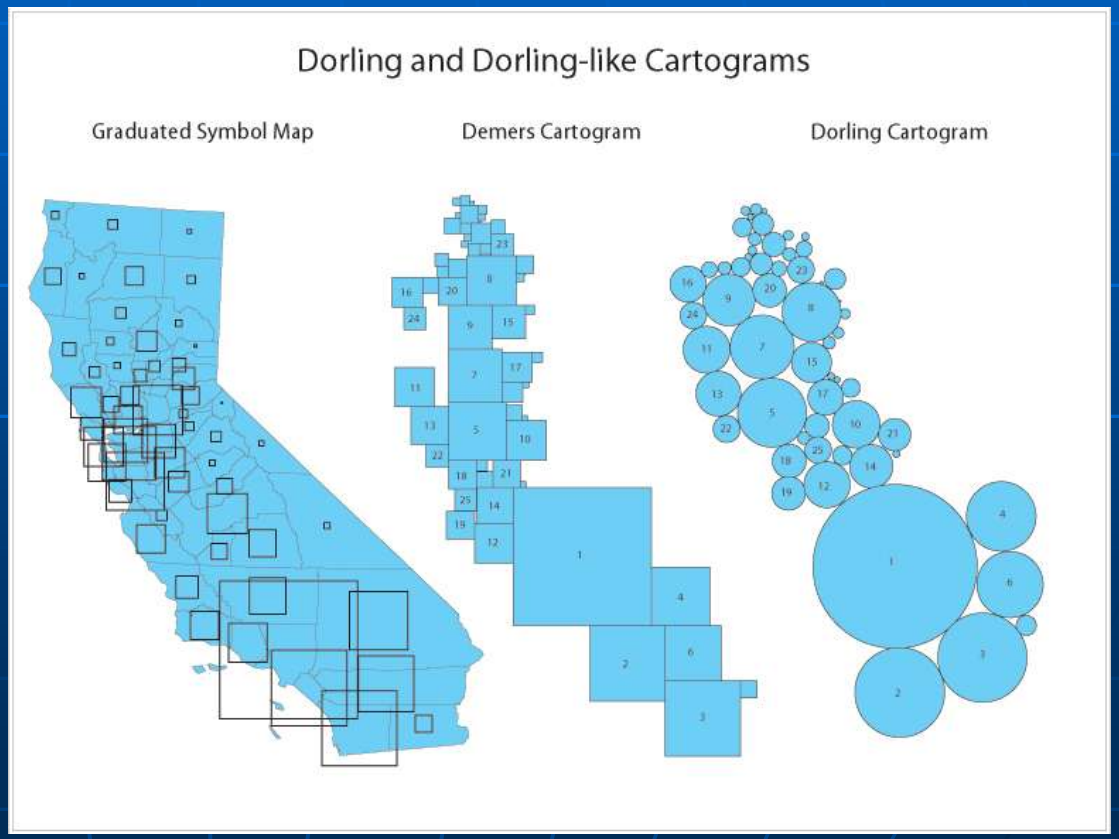
1. A New Social Atlas of Britain (Wiley, 1995)

2. Mapping: Ways of Representing the World (Longman, 1997)

Named after it's author:

Daniel Dorling, Department of Geography, University of Sheffield, Great Britain

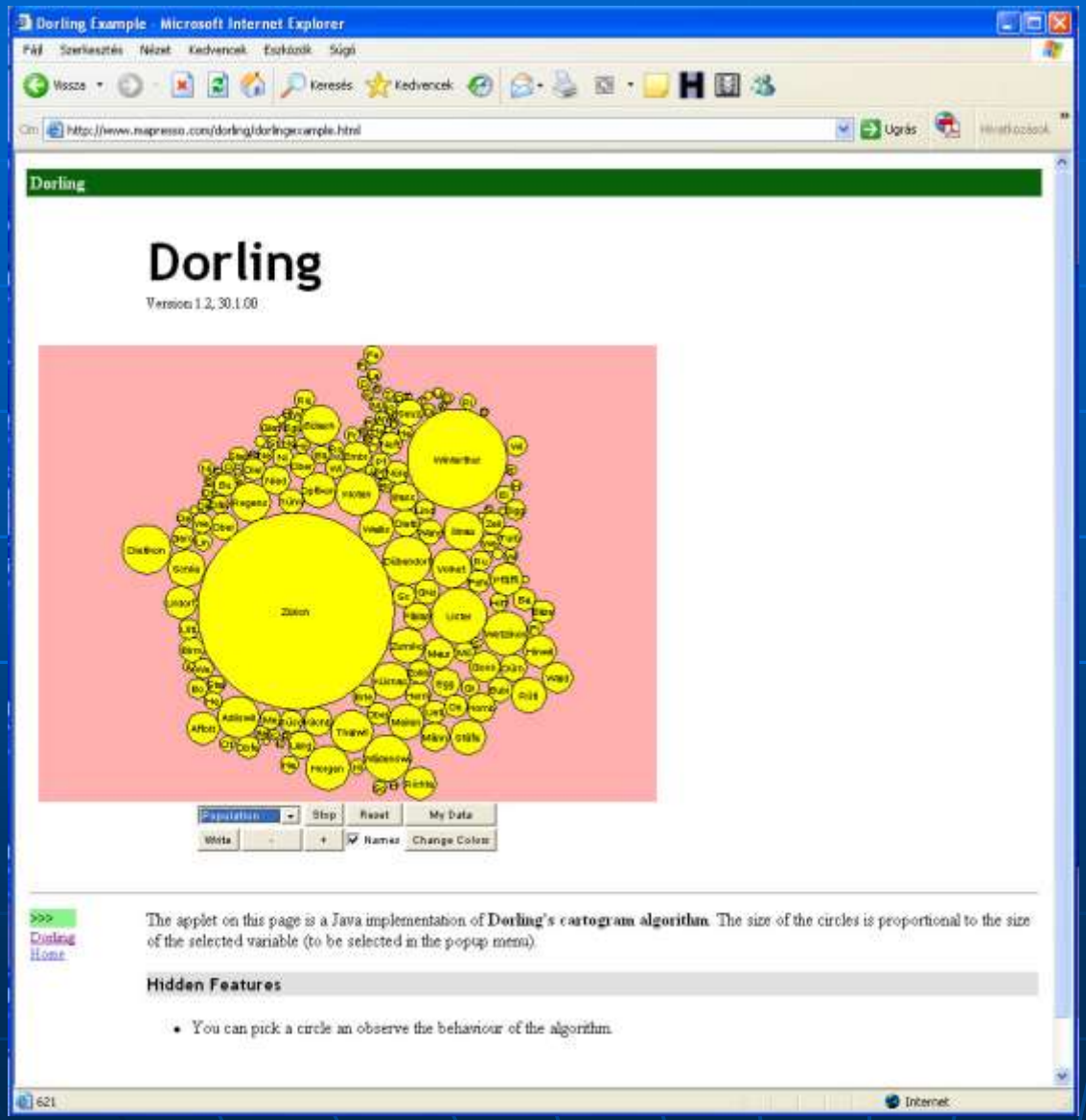
Essence: the mapped geographic territory is replaced using tangential circles



http://www.ncgia.ucsb.edu/projects/Cartogram_Central/types.html
http://www.sheffield.ac.uk/geography/staff/dorling_danny/index.html

CARTOGRAMS

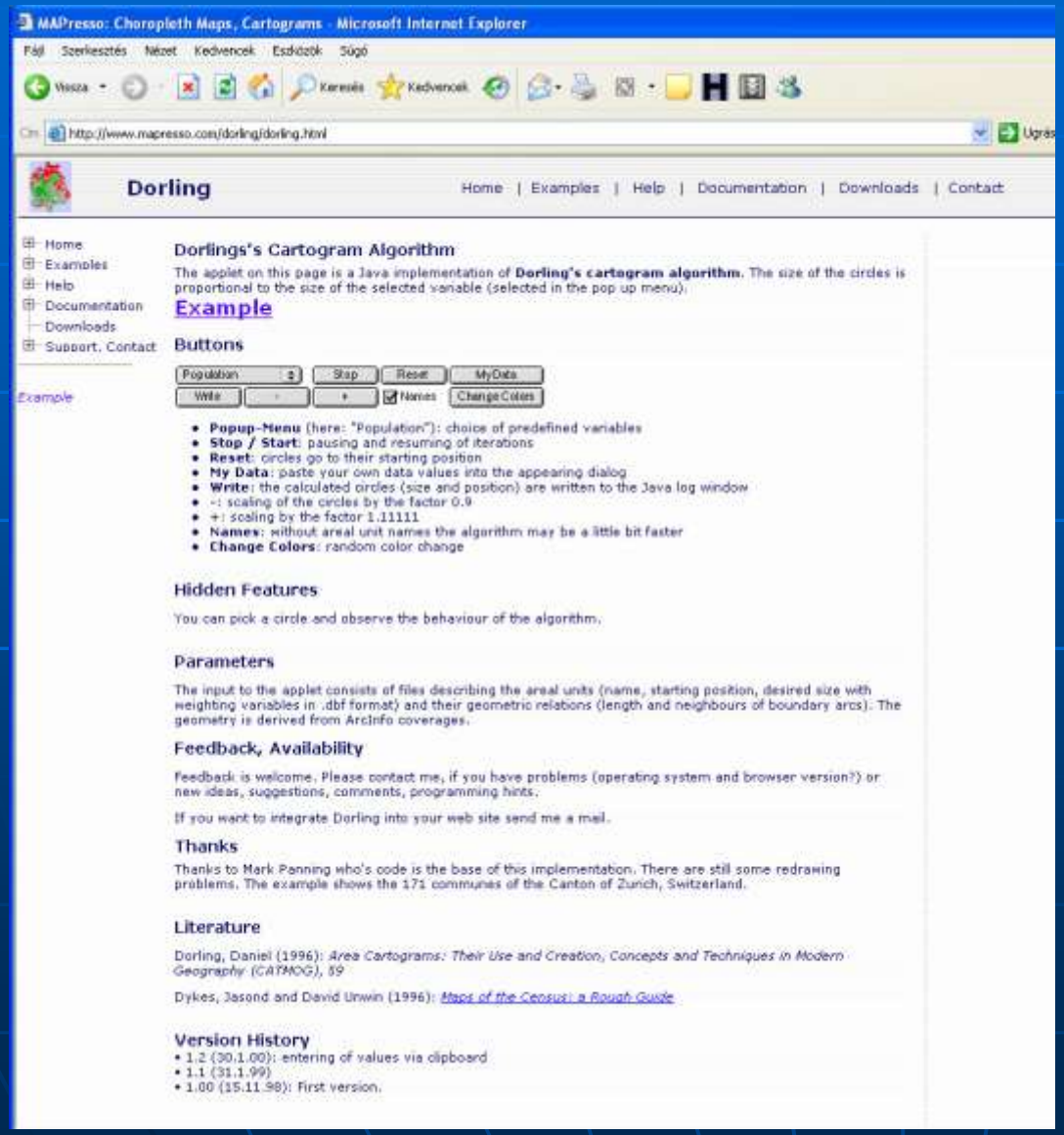
Dorling cartograms in the Web (interactive example)



http://www.mapresso.com/uploads/examples/karto/dorling/kreise.html

CARTOGRAMS

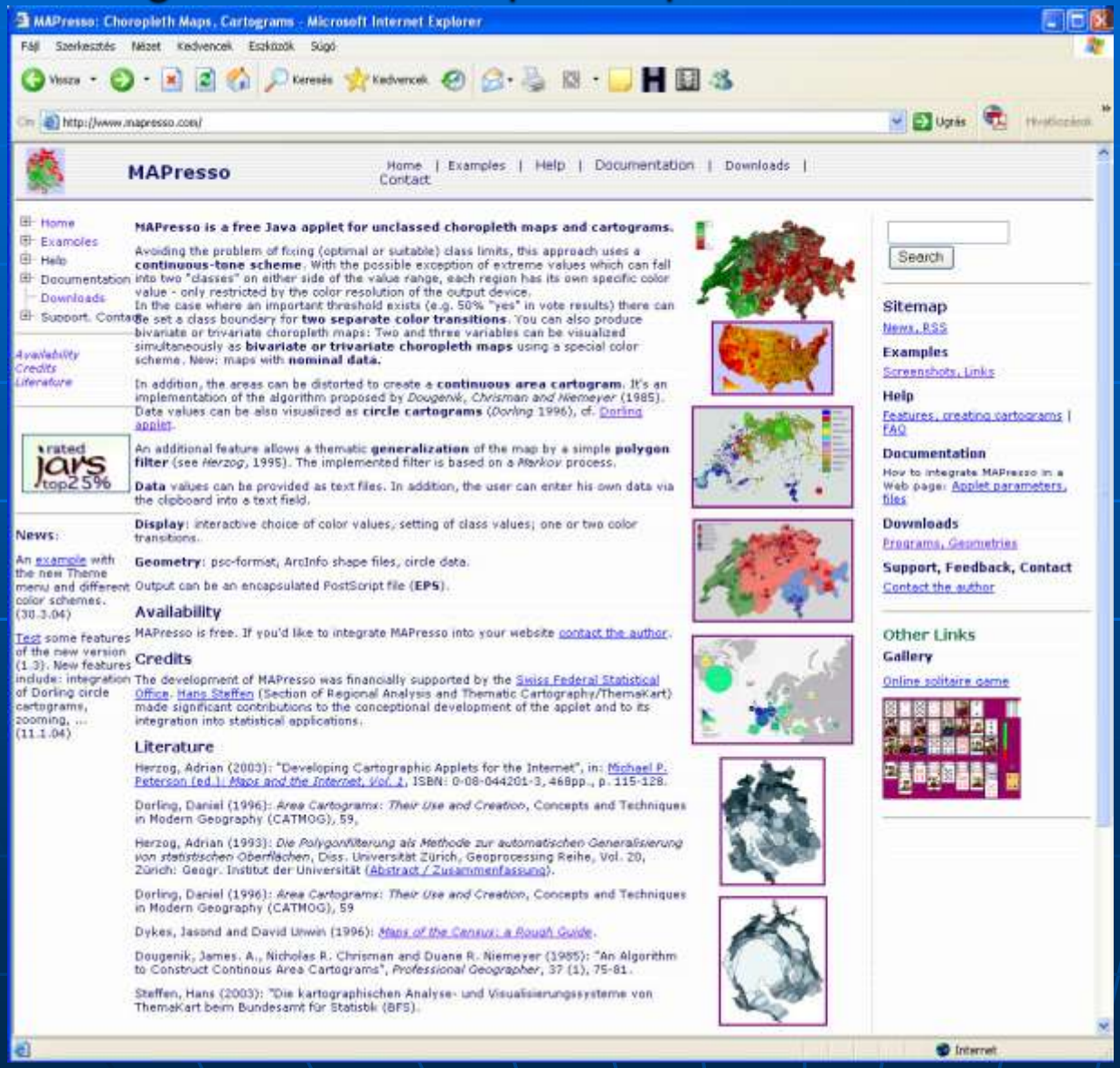
Dorling cartograms in the Web (interactive example)



http://www.mapresso.com/example/dorling

CARTOGRAMS

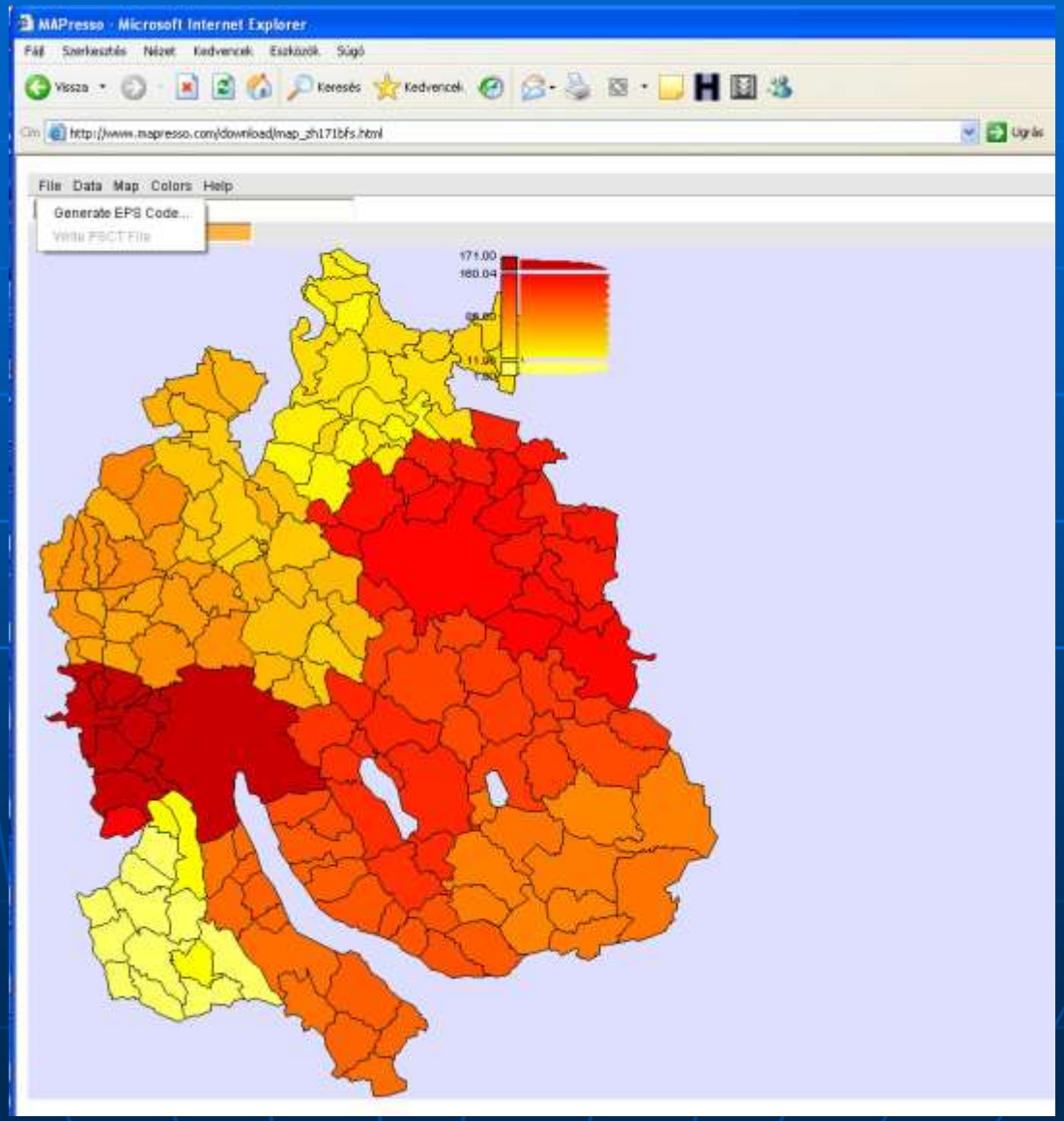
MAPRESSO: a free Java-applet to design cartograms and choroplet maps



http://www.mapresso.com

CARTOGRAMS

MAPRESSO: a free Java-applet to design cartograms and choroplet maps



http://www.mapresso.com

CARTOGRAMS

Danny Dorling's newest research: WORLDMAPPER

WORLDMAPPER The world as you've never seen it before

Search for a map: Go

Home | Map Categories | Map Index | About Worldmapper | News | Help

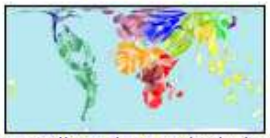
Worldmapper is a collection of world maps, where territories are re-sized on each map according to the subject of interest.
Maps and extra information will be added during 2006. Use the menu above or click on a thumbnail image below to view a map.

Reference maps....


Total Population


Land Area


Wealth (GDP) 2002


Appendix A (Areas included)

Newest maps ...


Illiterate Young Women


Girls not at Secondary School


Tertiary Education


Primary Education Spending

A bit more about Worldmapper...

- Use 'Map Categories' or 'Map Index' above to choose a map
- A large PDF poster is provided with each map for printing.
- Maps by Mark Newman, data by Danny Dorling, text by Anna Barford, quality control by Ben Wheeler, website by John Pritchard and poster design by Graham Allsopp.

- 25th Oct… contains
- 20th Oct… currently
- More new

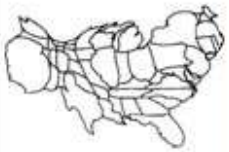
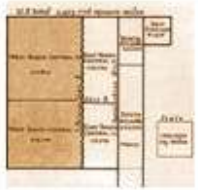
Articles | Copyright | Credits | Data | Links | Site Map

The University Of Sheffield.

Tourist Destinations

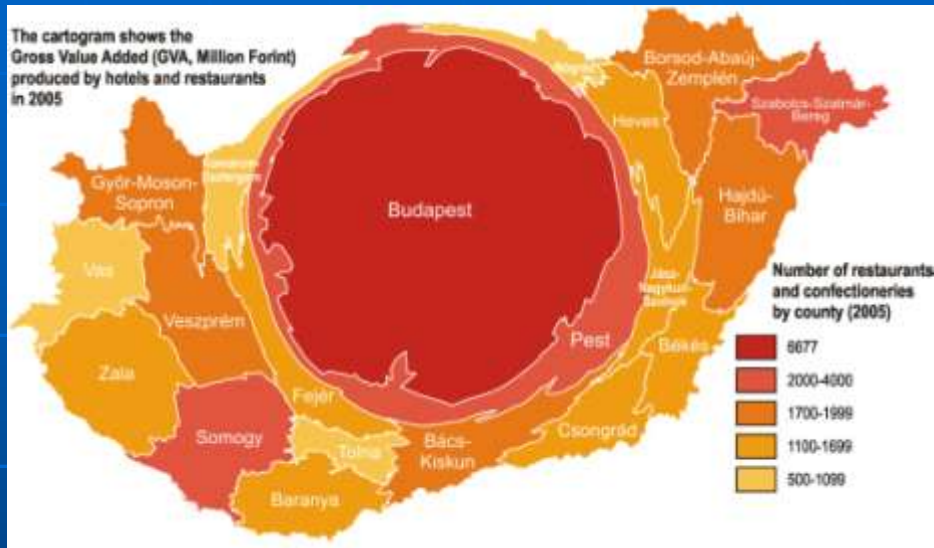
http://www.sasi.group.shef.ac.uk/worldmapper/about.html

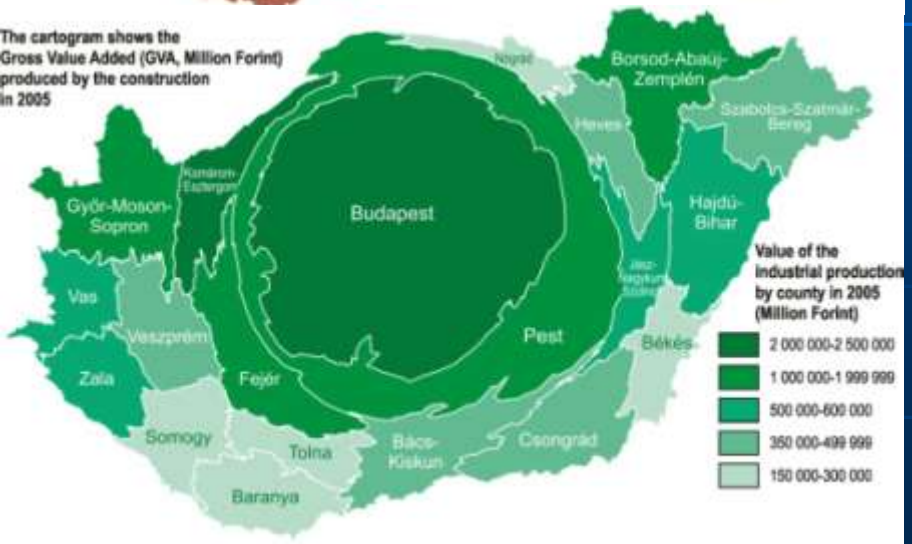
CARTOGRAMS

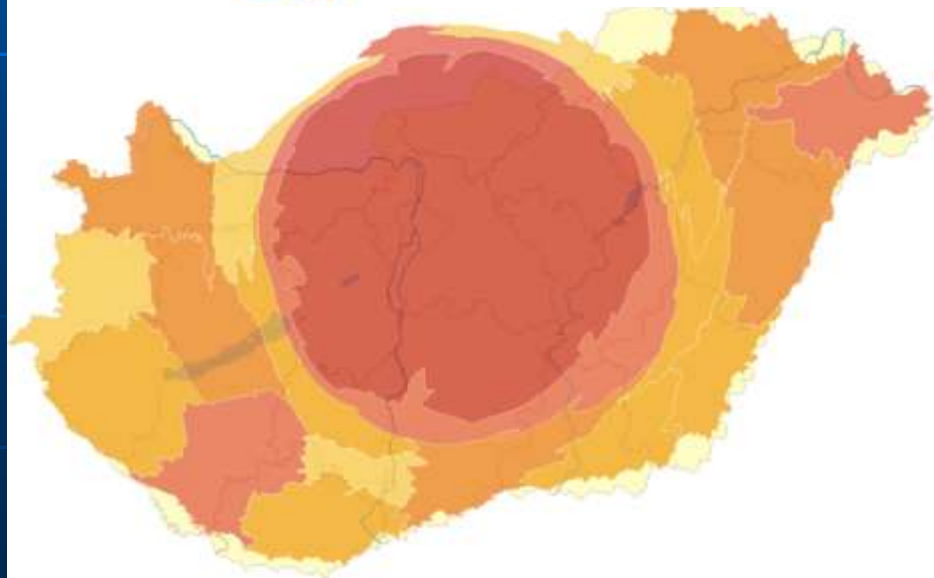
Most popular cartograms (in alphabetical order)	
	***Dorling, Daniel*** Dorling circular cartogram *http://www.ncgia.ucsb.edu/projects/Cartogram_Central/gallery.html*
	***Dorling, Daniel*** Cellular automata cartograms /Cellular automata machine method for cartograms/ *http://www.pnas.org/content/101/20/7499.full*
	***Gastner, Michael and Newman, Mark*** *Diffusion-based cartogram* *http://www-personal.umich.edu/~mejn/cartograms/*
	***Gusein-Zade, Sabir M. and Tikunov, Vlagyimir S.*** Gusein-Zade and Tikunov method to construct contiguous cartograms) *http://www.pnas.org/content/101/20/7499.full*
	***Raisz, Erwin*** Rectangular statistical cartogram, value-area cartogram
	***Tobler, Waldo*** *Pseudo-cartogram* *http://www.geog.ucsb.edu/~tobler/publications/reprints.html*

HUNGARIAN RESEARCH PROJECT (2007-2009)

The most recent research developed related to this theme was studied within this project, and a Hungarian website was created to present the general theory (history, definitions, terminology, classification and international examples), together with cartograms of Hungary developed using the Gastner-Newman method and the bibliography and links related to this topic.







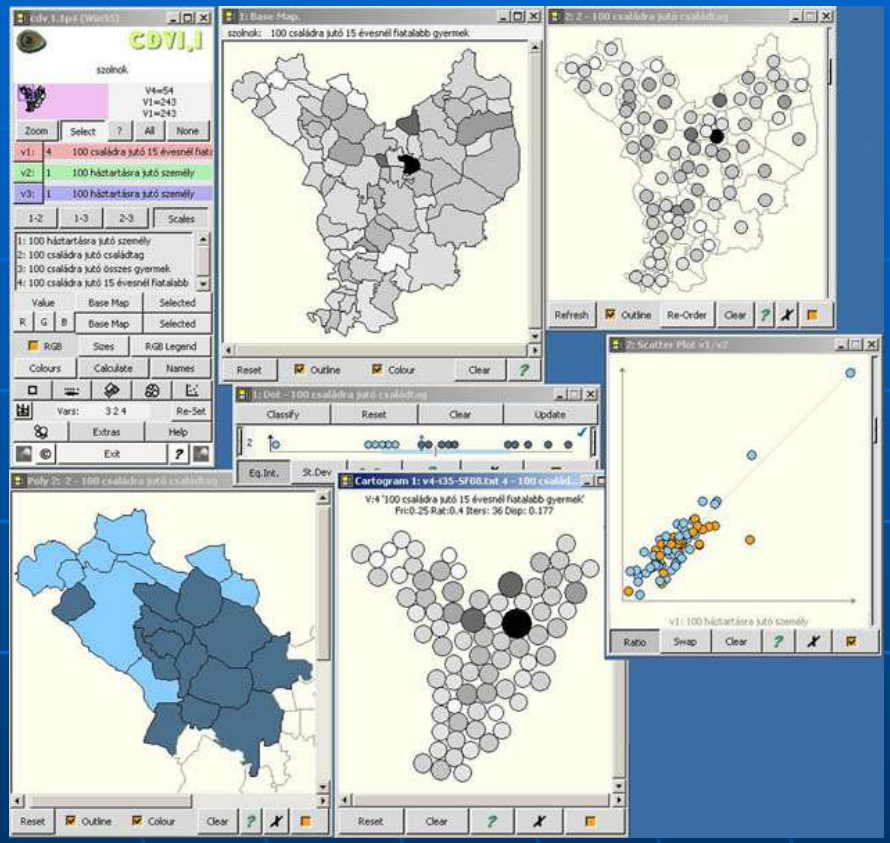
HUNGARIAN RESEARCH PROJECT (2007-2009)

Website of the research project

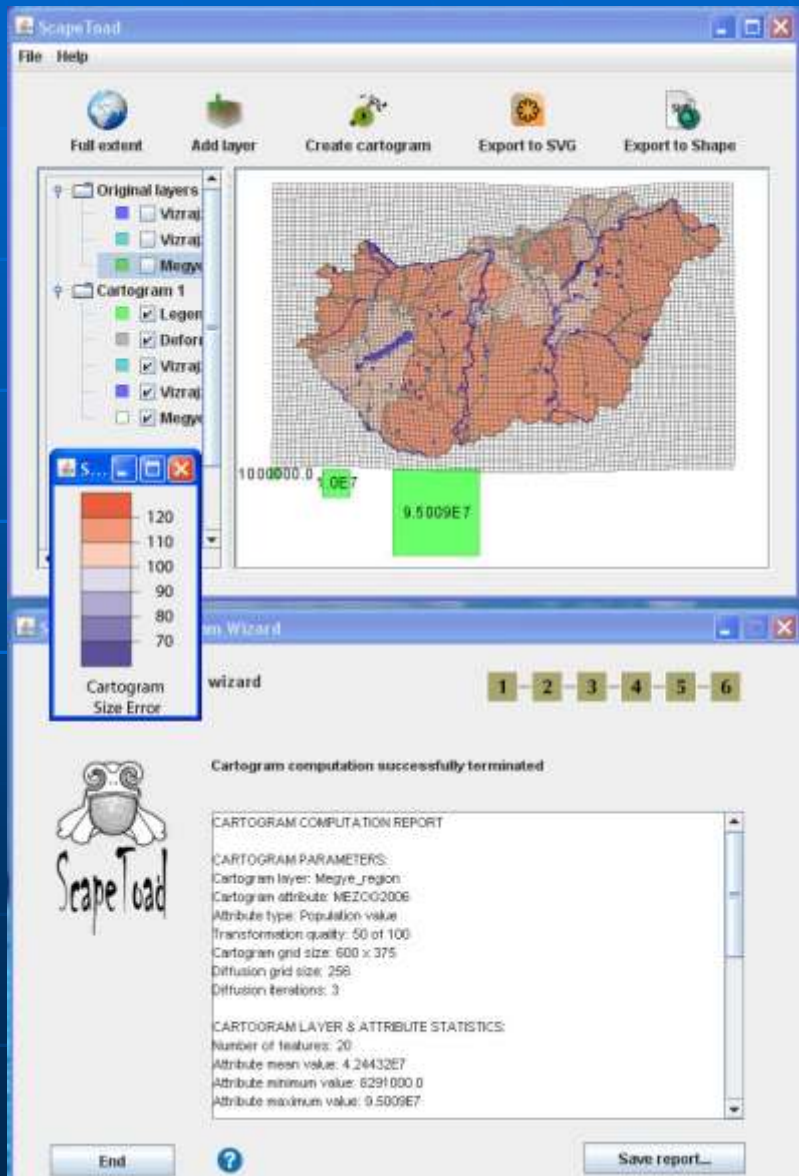
http://lazarus.elte.hu/hun/dolgozo/jesus/otka0810/tkartogram.htm

HUNGARIAN RESEARCH PROJECT (2007-2009)

The theme was included in the subject „Thematic Cartography 3” (MSc on Cartography): During the 4th semester students make cartograms using software that can be downloaded freely from the Web

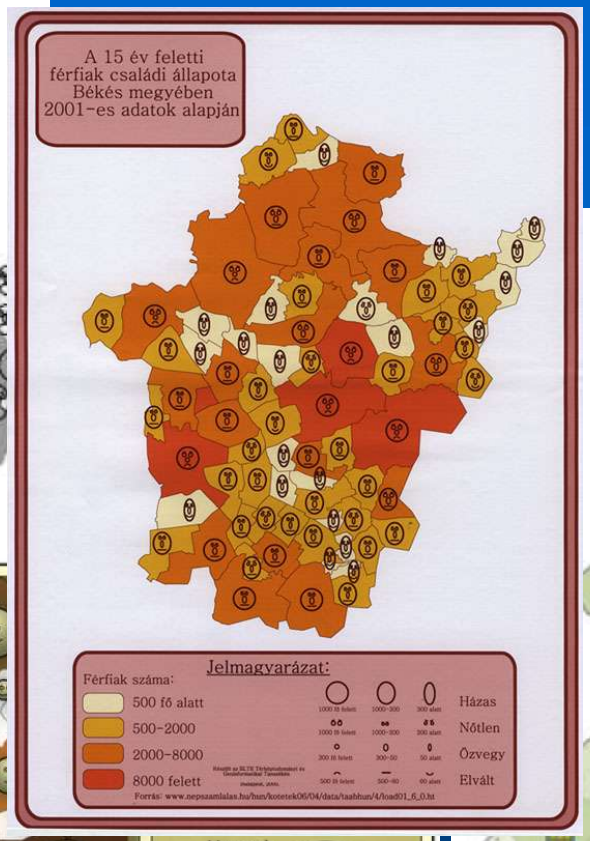


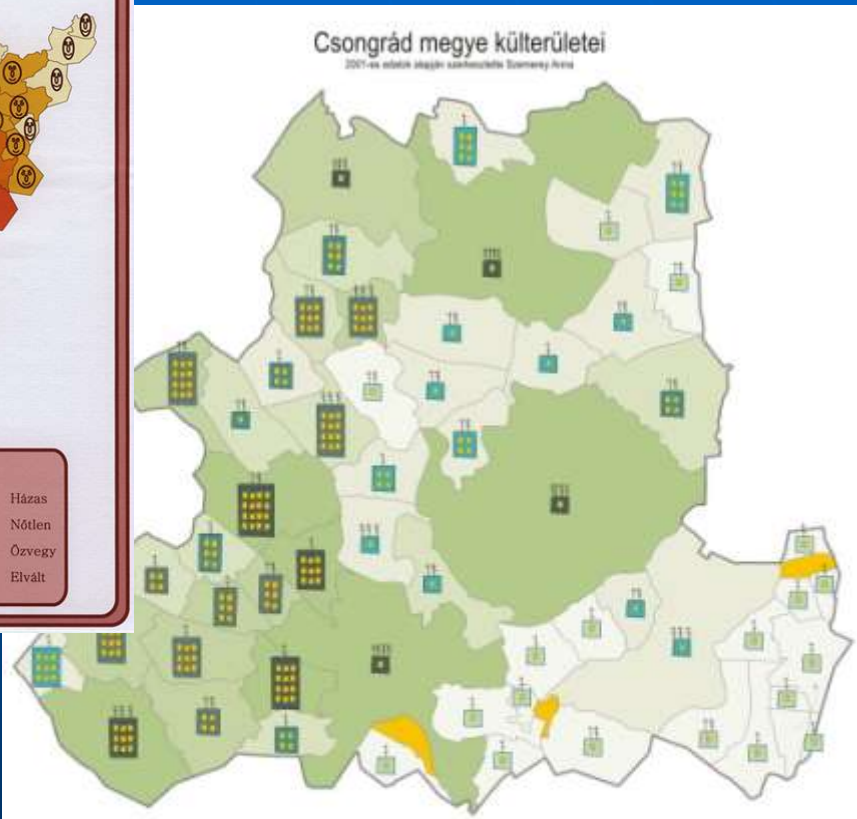
Cartographic Data Visualizer (CDV), 2001, London City University

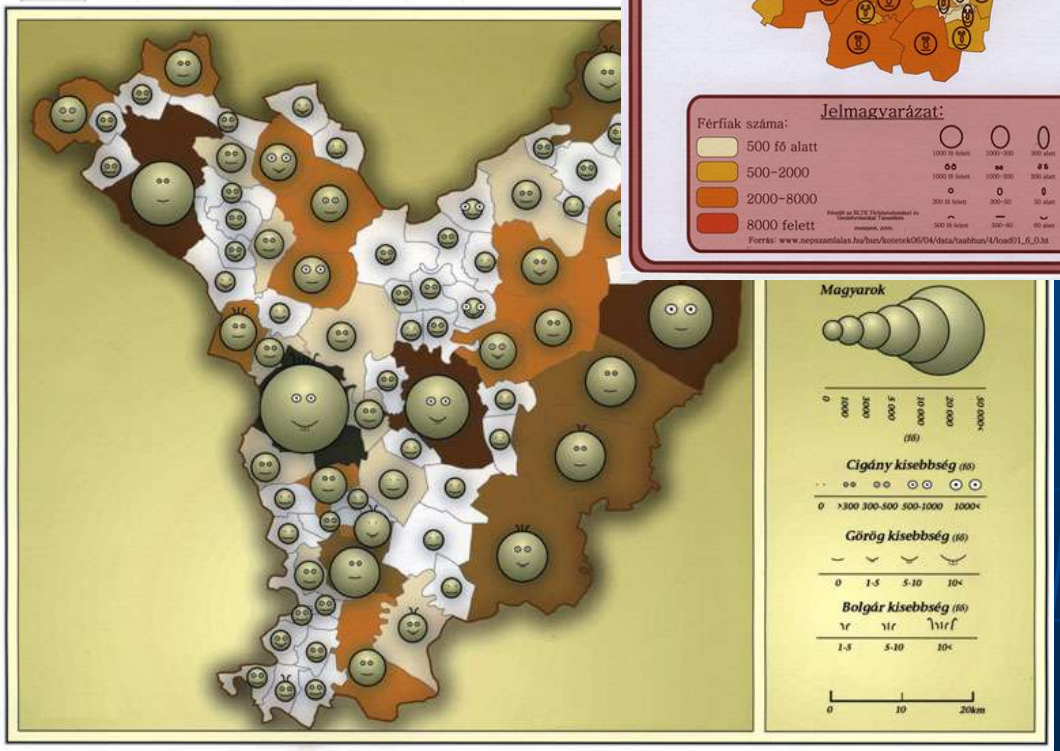


ScapeToad software : 2008, Swiss-French research

CHERNOFF FACES



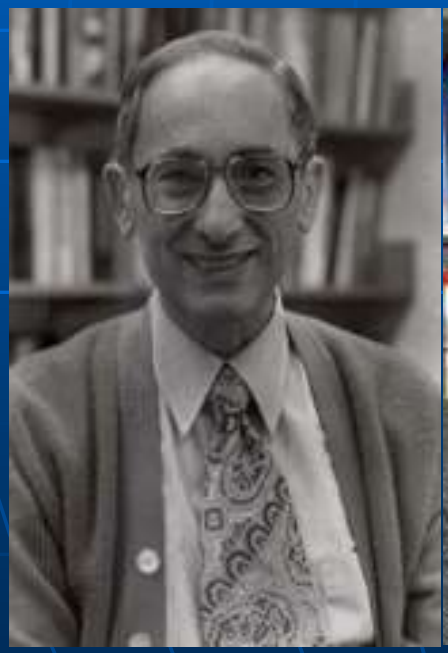


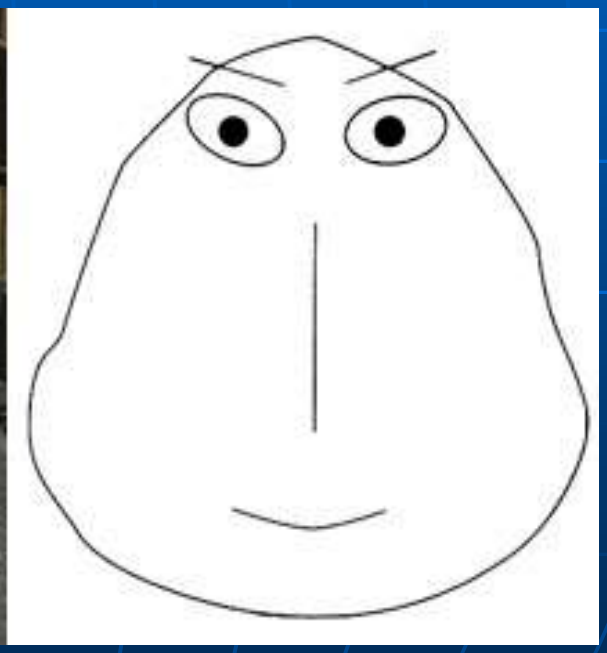


CHERNOFF FACES

• What are the Chernoff faces? ➡ Iconographic representation (glyph), a graphic method for the visualisation of multidimensional data

•Author: Hermann Chernoff (at present Professor Emeritus of Applied Mathematics, Department of Statistics at Harvad University)
•Published in 1973 („te use of faces to represent points in k-dimensional space graphically", *Journal of the American Statistical Association*

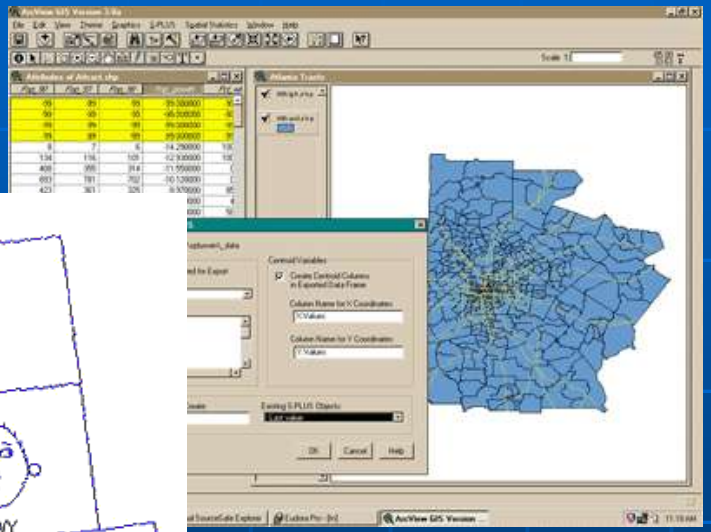


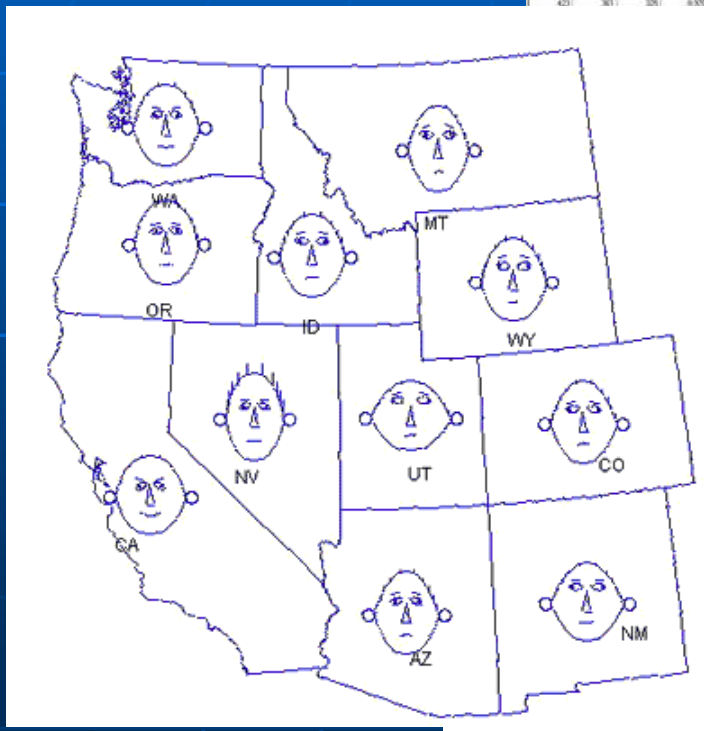


• Essence: Features of a human face (eyes, nose, mouth, etc) can be used to represent different data

CHERNOFF FACES

- According to Chernoff up to 18 features can be used for data representation
- The method is mainly used in statistical software (SYSTAT, S-PLUS, S-PLUS for ArcView 3.2)





Map made using SYSTAT software

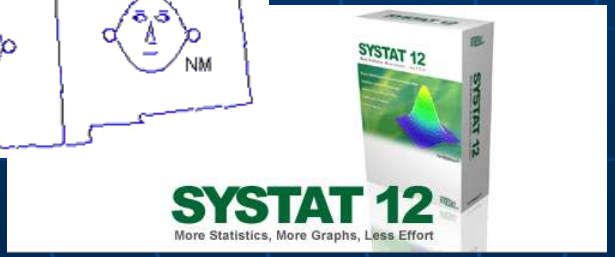


Table 1: Description of facial features of Chernoff face

Dimension	Facial Feature
1	Face width
2	Ear level
3	Half face height
4	Eccentricity of upper ellipse of face
5	Eccentricity of lower ellipse of face
6	Length of nose
7	Position of centre of mouth
8	Curvature of mouth
9	Length of mouth
10	Height of centre of eyes
11	Separation of eyes
12	Slant of eyes
13	Eccentricity of eyes
14	Half length of eye
15	Position of pupil
16	Height of eyebrow
17	Angle of brow
18	Length of brow
19	Radius of ear
20	Nose width

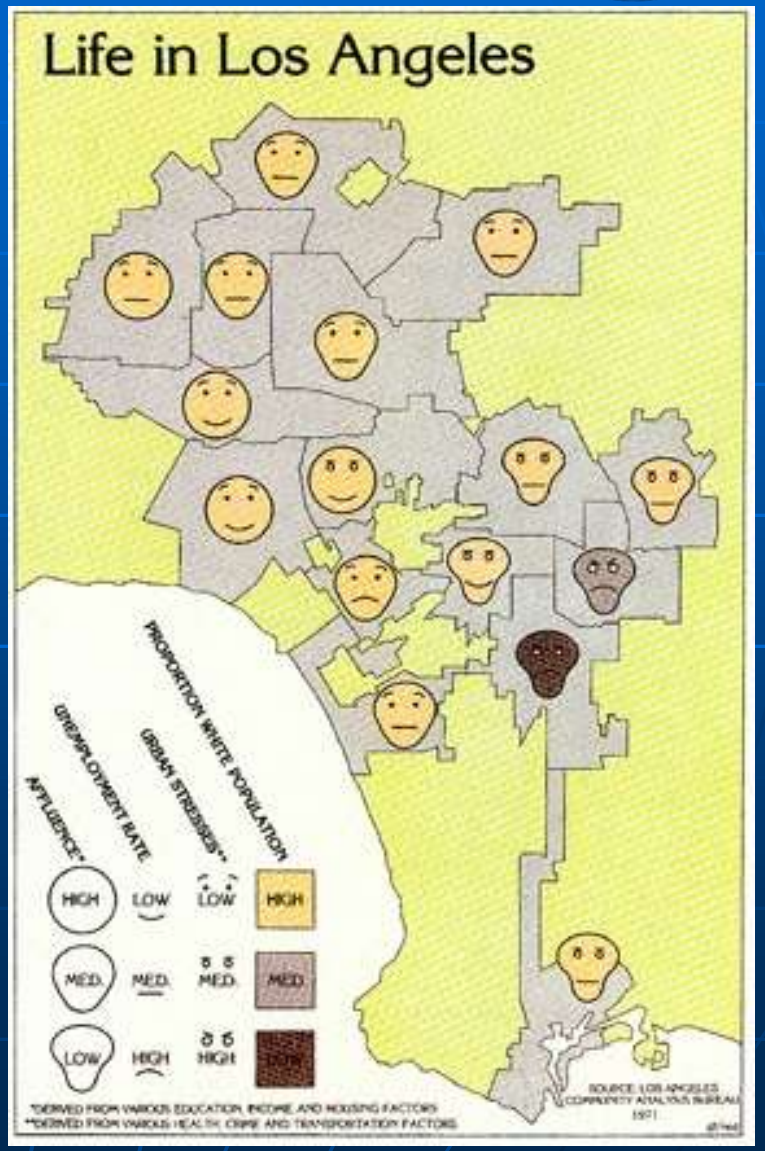
CHERNOFF FACES

During the last 30 years the Chernoff faces were sporadically used for the representation of data in thematic maps

A classic example:

The first thematic map drawn using Chernoff faces (1977)
Title: „Life in LA, 1970”
Author: Eugene Turner, Geography Dept. at California State University (drafted by Richard Doss)

http://www.csun.edu/~hfgeg005/eturner/gallery/gallery.htm

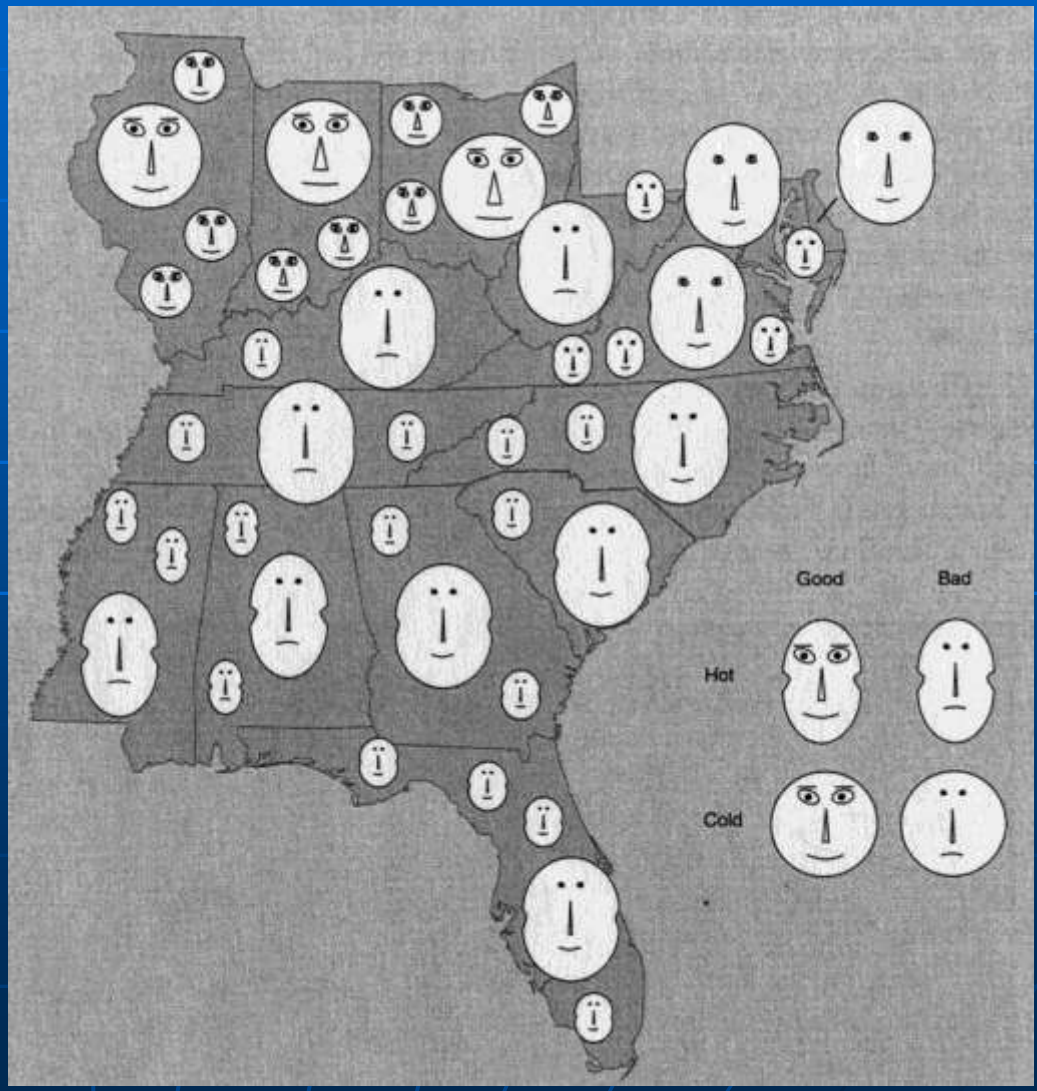


CHERNOFF FACES

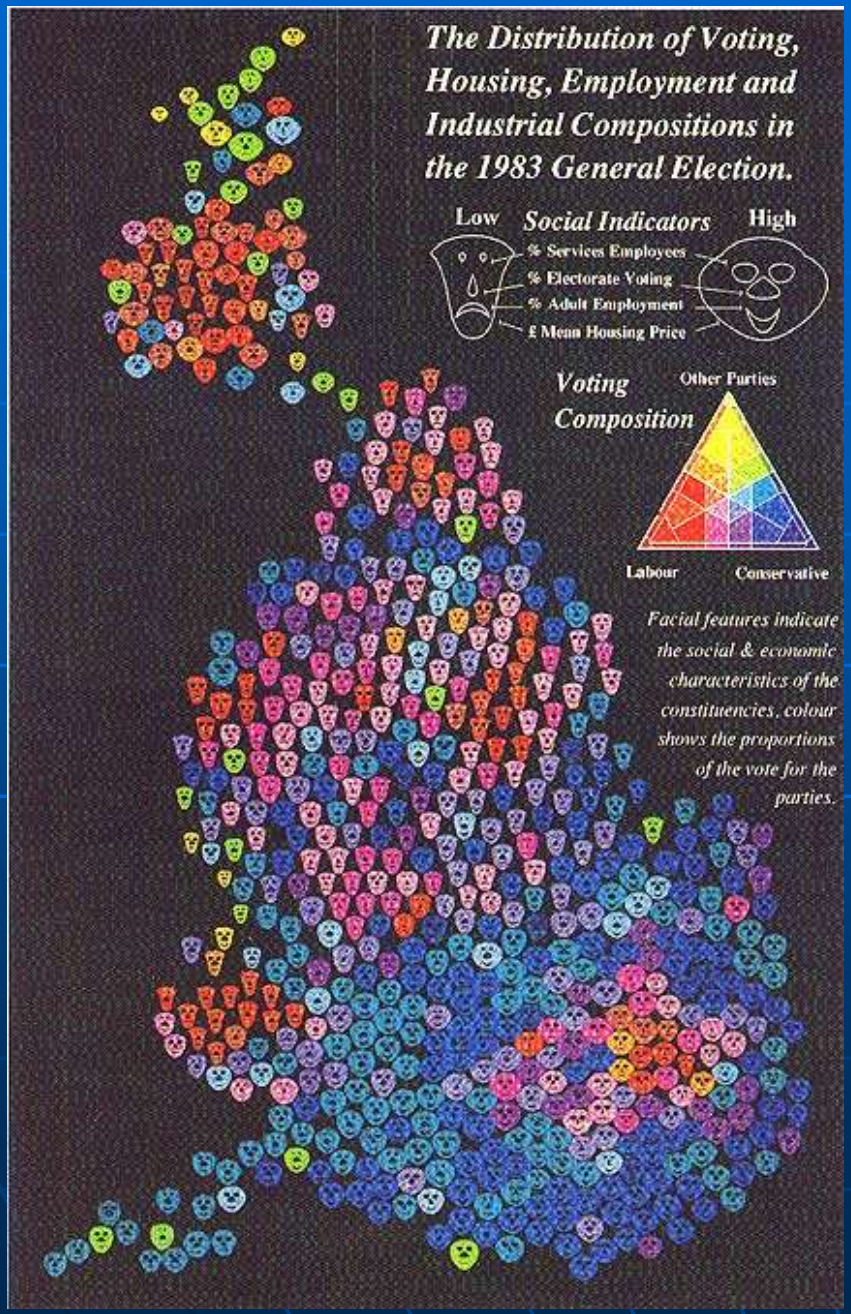
Other relevant research related to Chernoff faces on maps:

• Howard Wainer (1979, University of Pennsylvania) – Regional differences in USA, map using Chernoff faces to represent nine variables

First map applying a cartographic principle on Chernoff faces (using them as a proportional symbol)



CHERNOFF FACES



Other relevant research related to Chernoff faces on maps:

• Daniel Dorling (1991, University of Newcastle upon Tyne) – PhD thesis

Using Chernoff faces to represent results of general elections in UK, 1983, relating them to some social factors

• Elizabeth S. Nelson (1997-2007, University of North Carolina, Greensboro)

Research followed on different aspects of Chernoff faces: Feature slience and natural correspondence of the face symbol , search process

CHERNOFF FACES

Other relevant research related to Chernoff faces on maps:

- Sarah I. Fabrikant (2004, University of Zurich) – USA map of Presidential Elections

http://www.geog.ucsb.edu/~sara/html/mapping/election/election04/election.html

CHERNOFF FACES

My first experience

1998, ICA Joint Seminar
(Wroclaw, Poland)
Chernoff workshop
by Prof. Henry Castner
(Greensboro, USA)

From 2005 → MSc on Cartography, Practical lessons within the subject entitled „Thematic Cartography III”

Positive and negative experiences discussed with students – Psychological (Nelson, 2007) and editing factors using Chernoff faces

CHERNOFF FACES

Psychological and editing questions

Dorling (1991)

Psychological questions:

Nelson (1997,2007)

After Nelson (2007):
Reading of a face determined by two factors

Natural correspondence
Face as a whole expressing a human feeling (happiness, sadness)

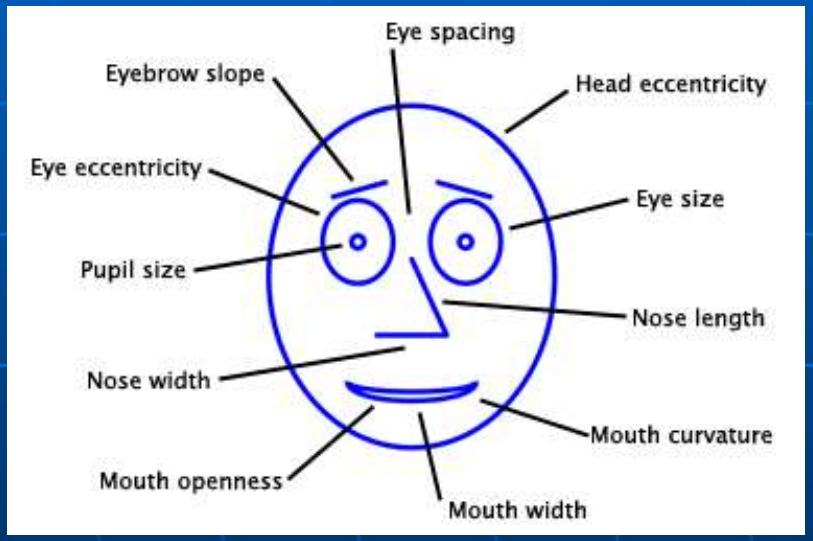
Feature salience
Role of a feature transmitting the psychological message of a face as a whole

„Individual" expression – can provoke a contradiction between features („angry" eyebrow – smiling mouth)

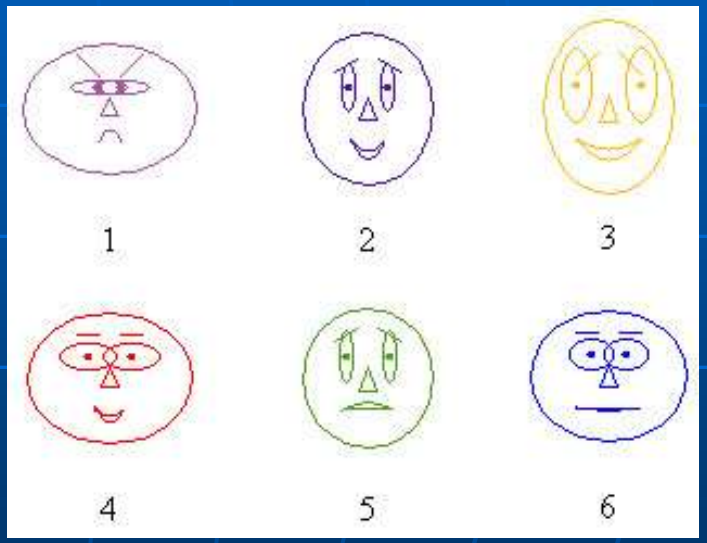
CHERNOFF FACES

Editing questions
Number of variables to be represented

Chernoff (1973) – up to 18 variables can be represented on a face



Bradley Mohr (1995-2003) –
11 features



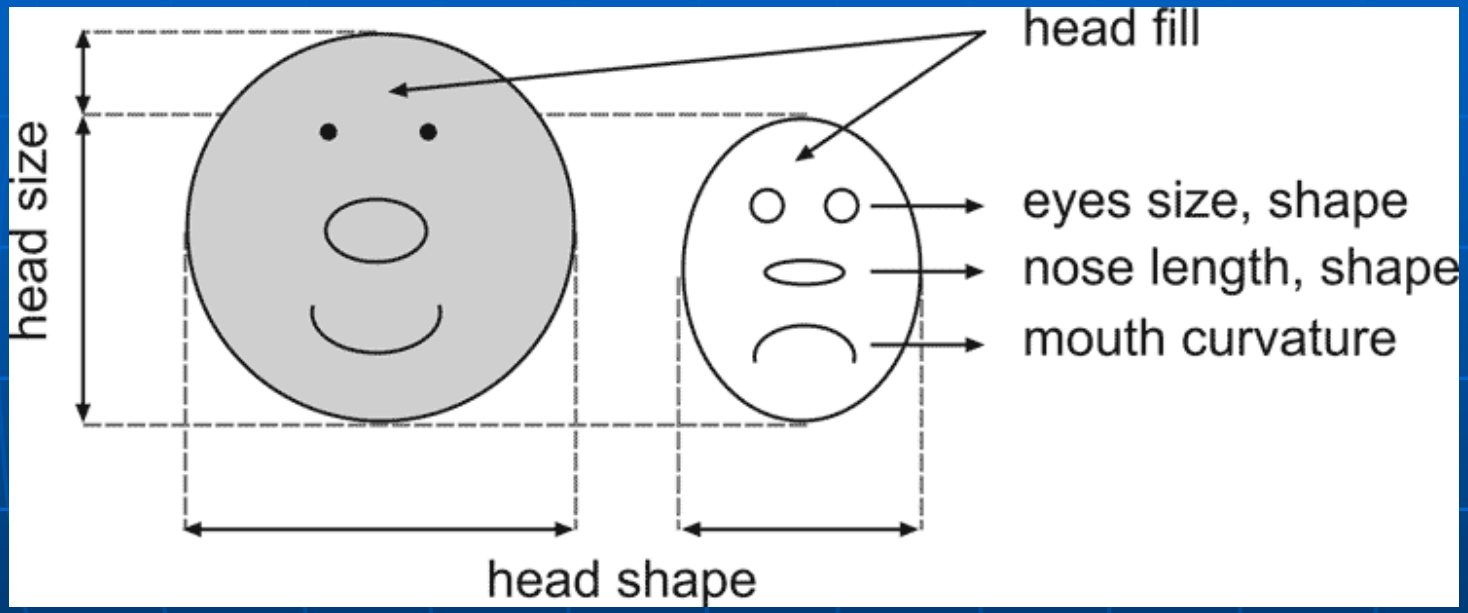
John Wiseman (1998) –
10 features

TOO MUCH!!!

CHERNOFF FACES

Number of variables that can be represented on a face:

MAX. SIX!!!

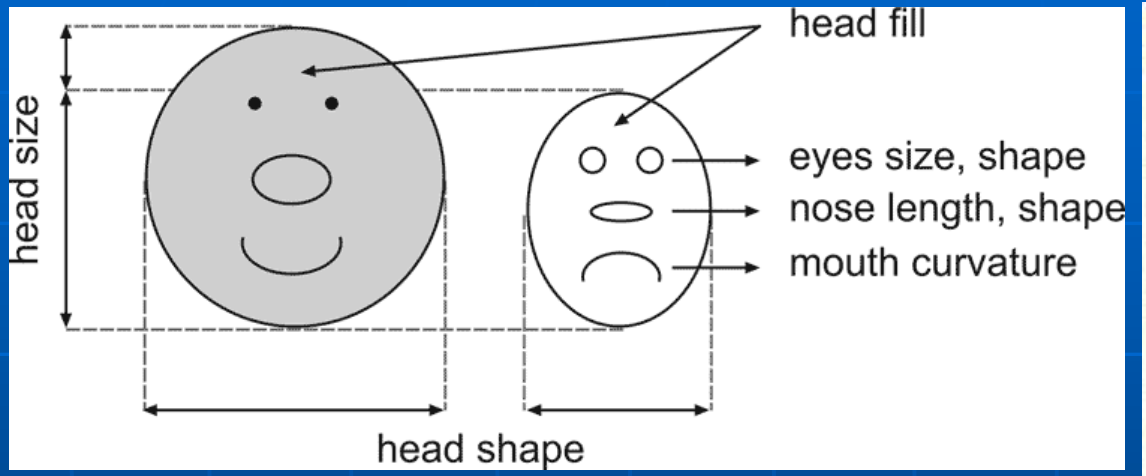


Head size and fill – two „purely” cartographic parameters

More important parameters:

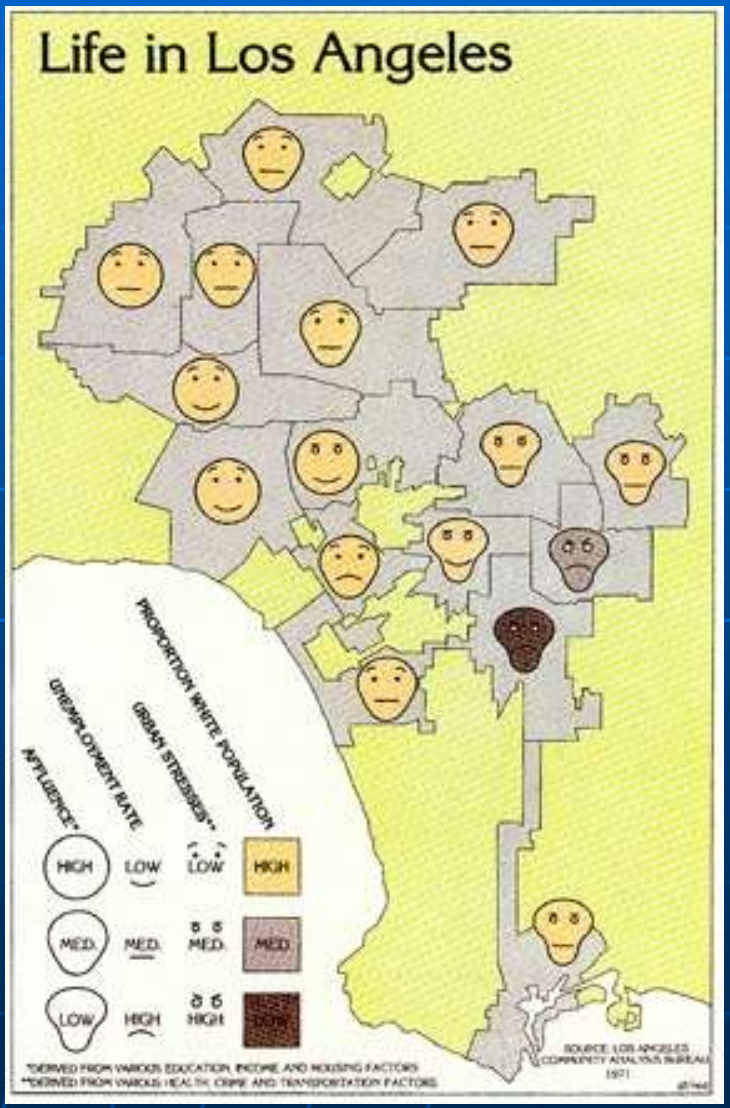
- **Curvature of mouth**: essential parameter to determine the expression of a face
- **Head size**/shape and fill: easily recognizable

CHERNOFF FACES

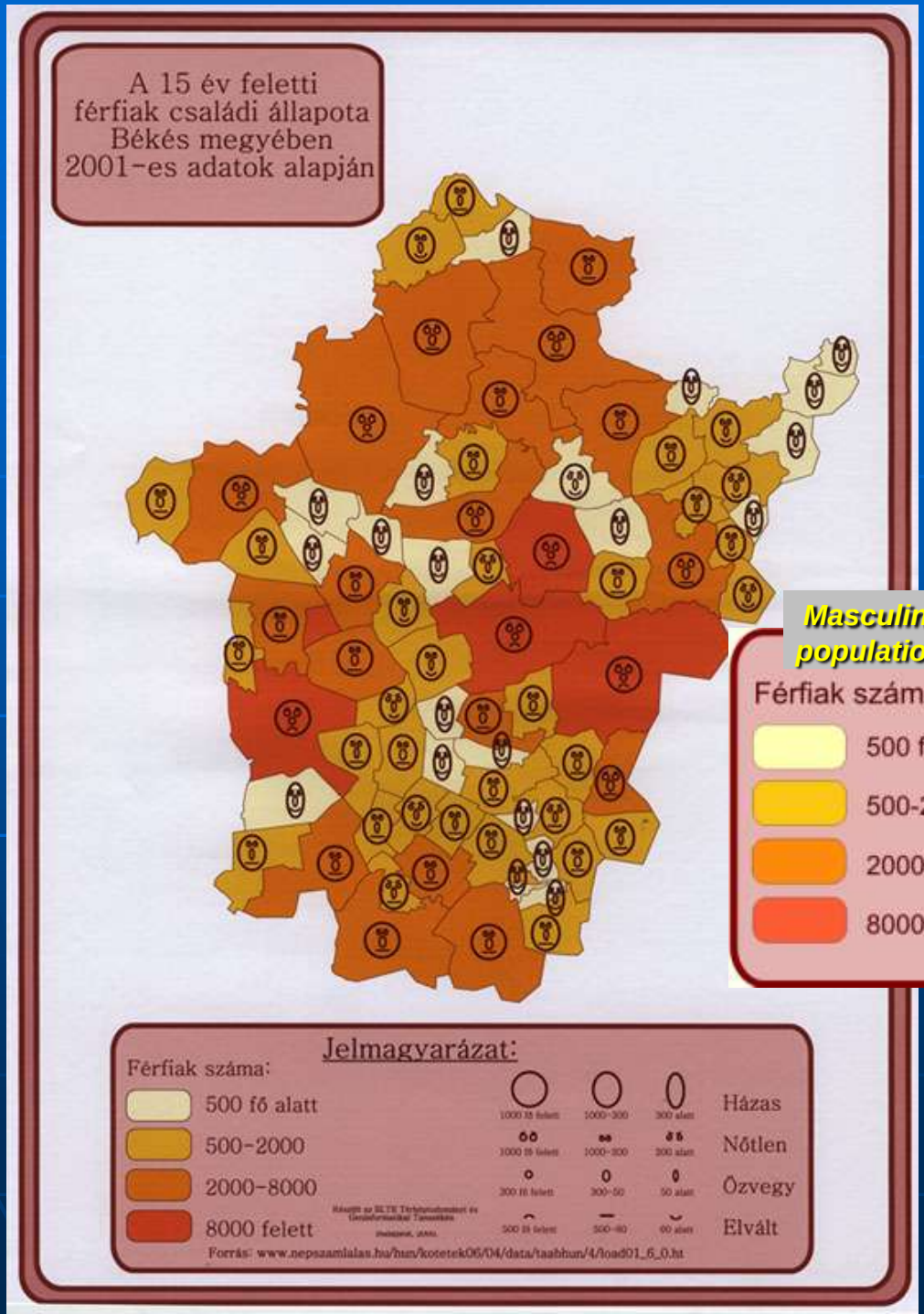


- **Curvature of mouth**: essential parameter to determine the expression of a face
- ***Head size***/shape and fill: easily recognizable

Eugene Turner,
„Life in LA, 1970”



CHERNOFF FACES

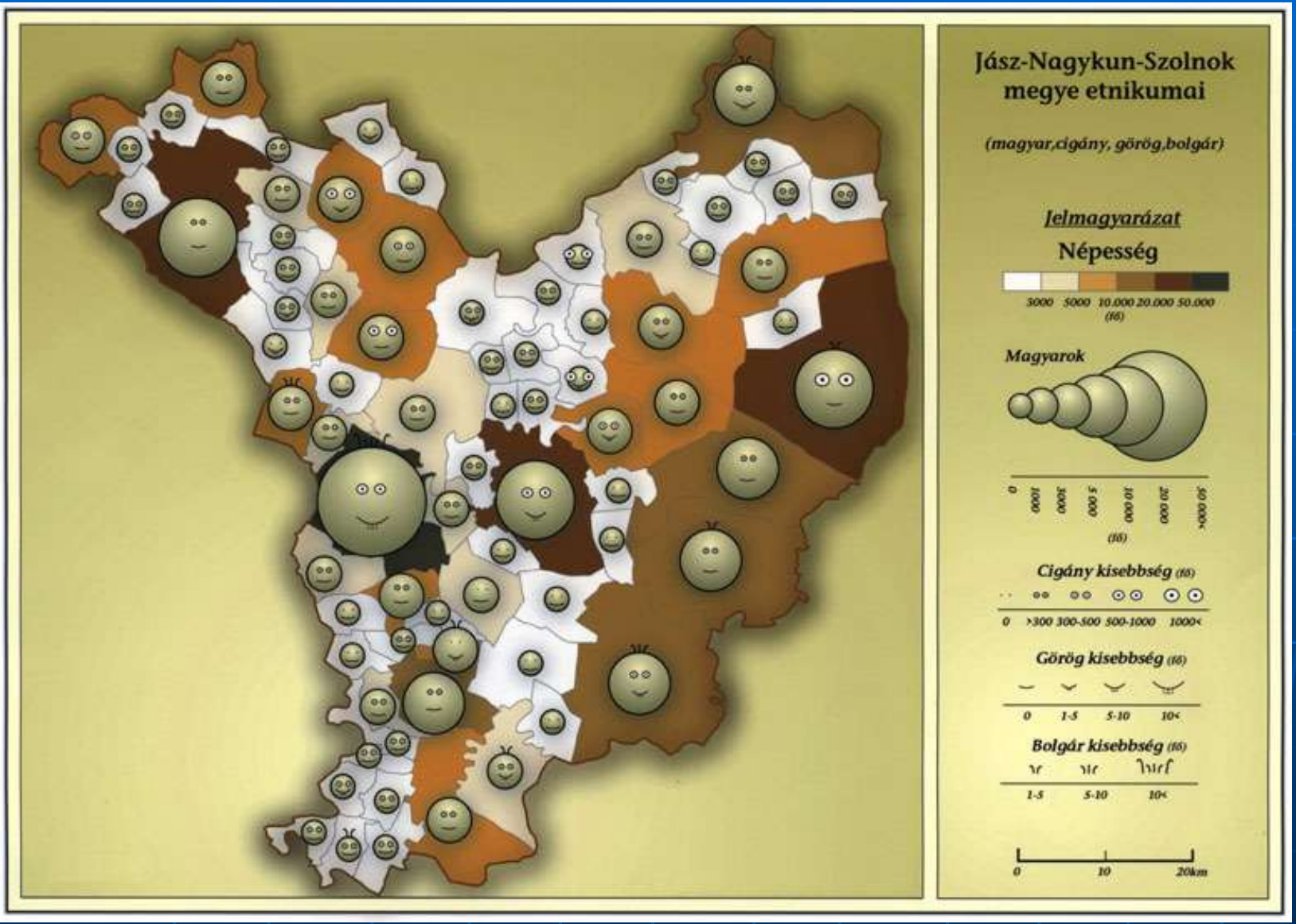


Combining „traditional” Chernoff faces with other methods of thematic representation

MSc on Cartography, Practical subject entitled „Thematic Cartography III”: Different solutions for the use of Chernoff faces on choroplet maps

Map made by Gyöngyi Strapkovics, 2005

CHERNOFF FACES



Population

Hungarians

Gipsies

Greeks

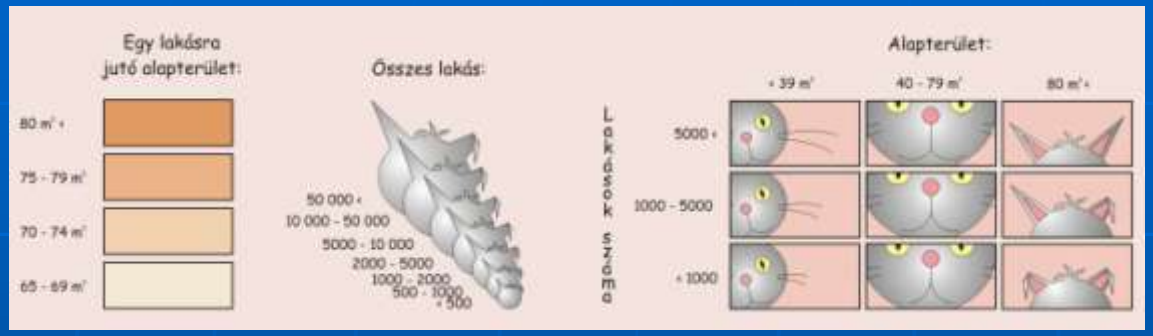
Bulgarians

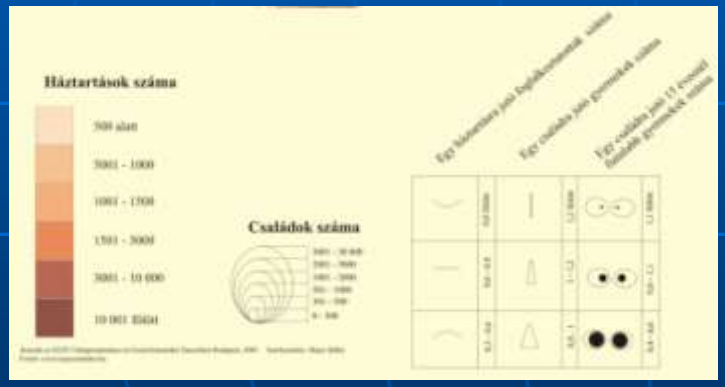
Combining „traditional” Chernoff faces
with other methods of thematic representation

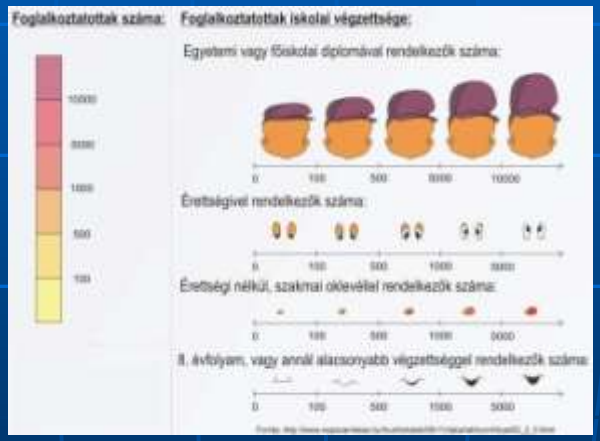
Map made by Bence Sprok, 2005

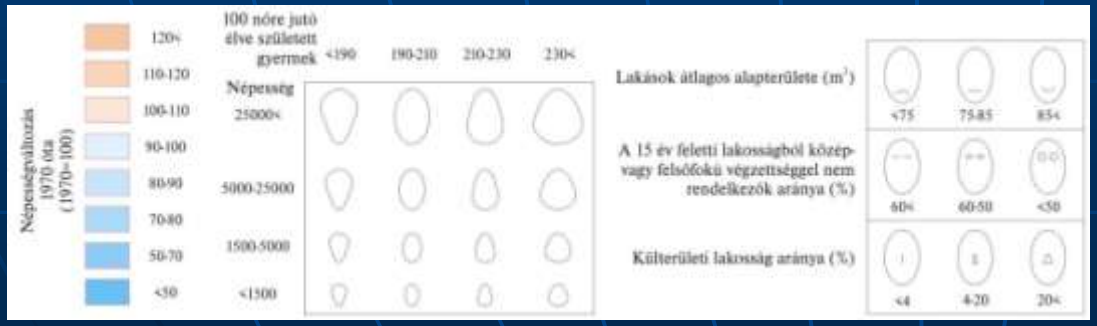
CHERNOFF FACES

Correct selection of colours and compilation of the legend

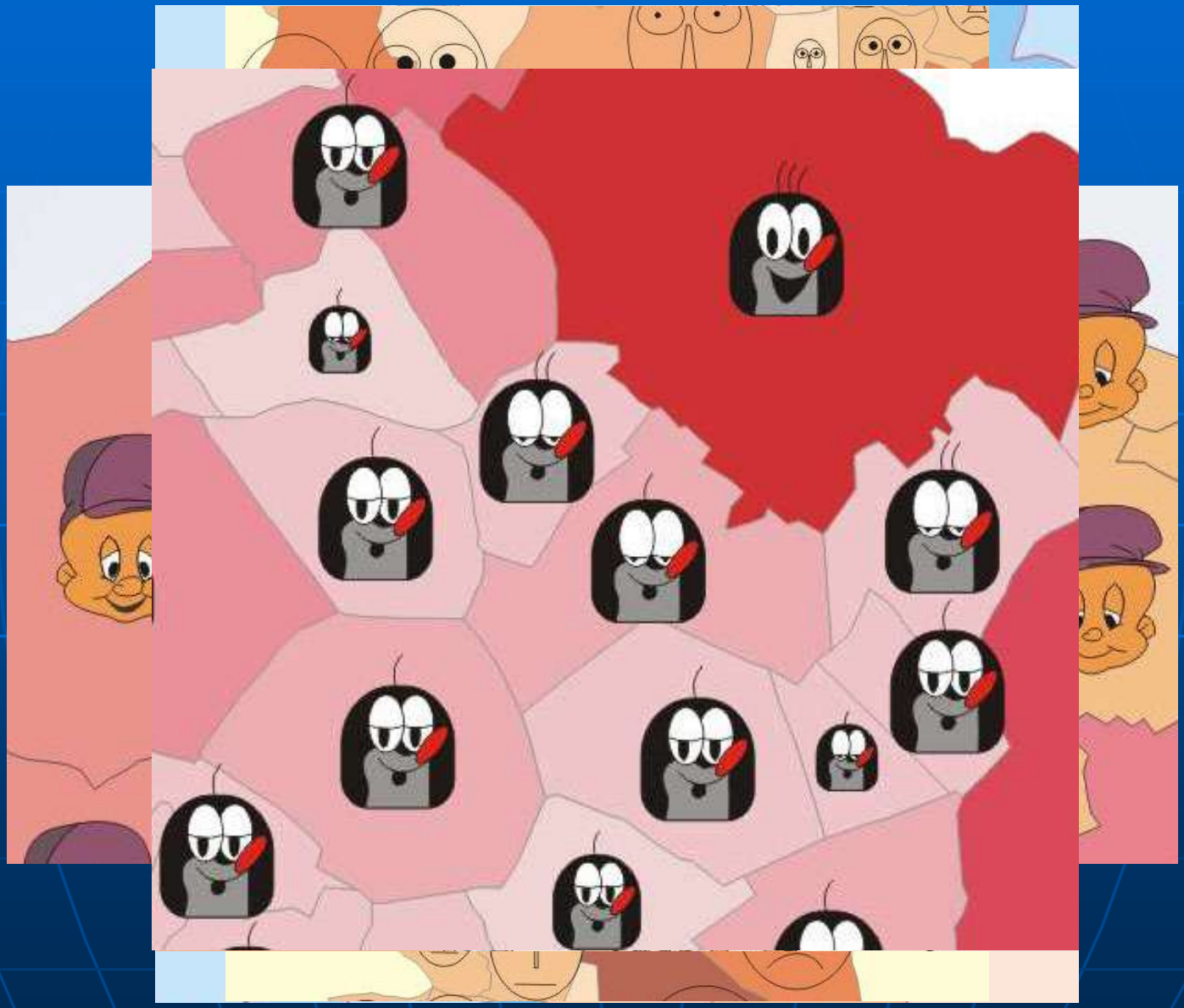








CHERNOFF FACES



Easy design, transparency, „original” pictorial solutions, etc

CHERNOFF FACES

Professional discussions about Chernoff faces

Positive

Negative

„Unusual” pictorial method of representation

Can or not arouse the children’s attention better than a traditional method of thematic representation?

Simplified version of Chernoff faces
(representing only 3-4 themes)
on easy thematic maps for school atlases

Why should only faces to be used???

CHERNOFF FACES

Adaptation of the principle followed by Hermann Chernoff
for cartographic symbols

↓

Improving the traditional use of symbols:
A cartographic (pictorial or geometric) symbol can be divided into its more relevant and graphically better recognizable elements (features)

↓

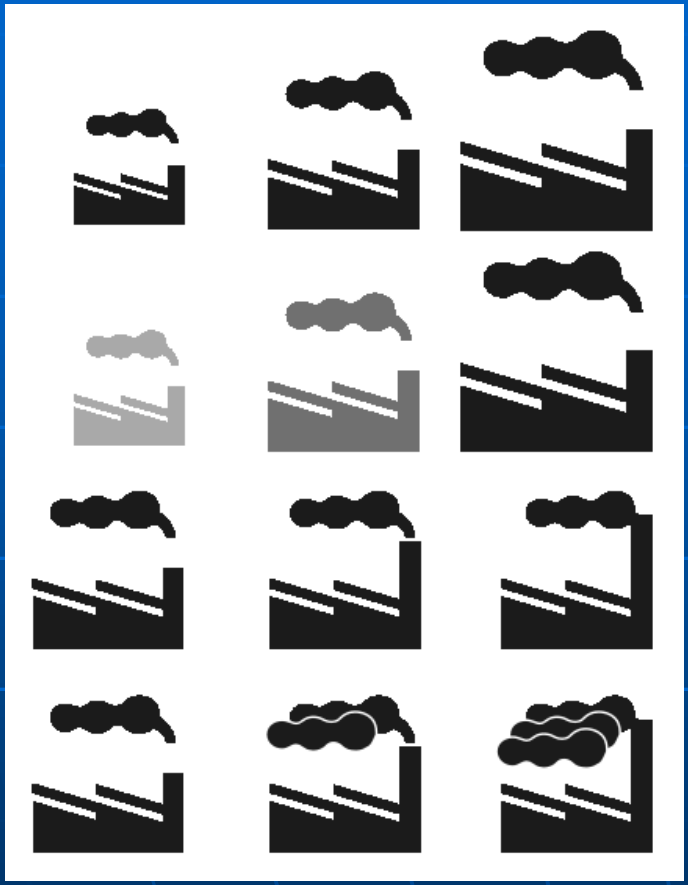
Different data (variables) related to a specific theme can be represented using each of these components

↓

Max. 4-6 variables, considering which are the more important features within the selected (pictorial) symbol

CHERNOFF FACES

factory symbol



size

colour

Parameters changed in traditional cartography

Nothing new…

height of the chimney stack

number of clouds of smoke

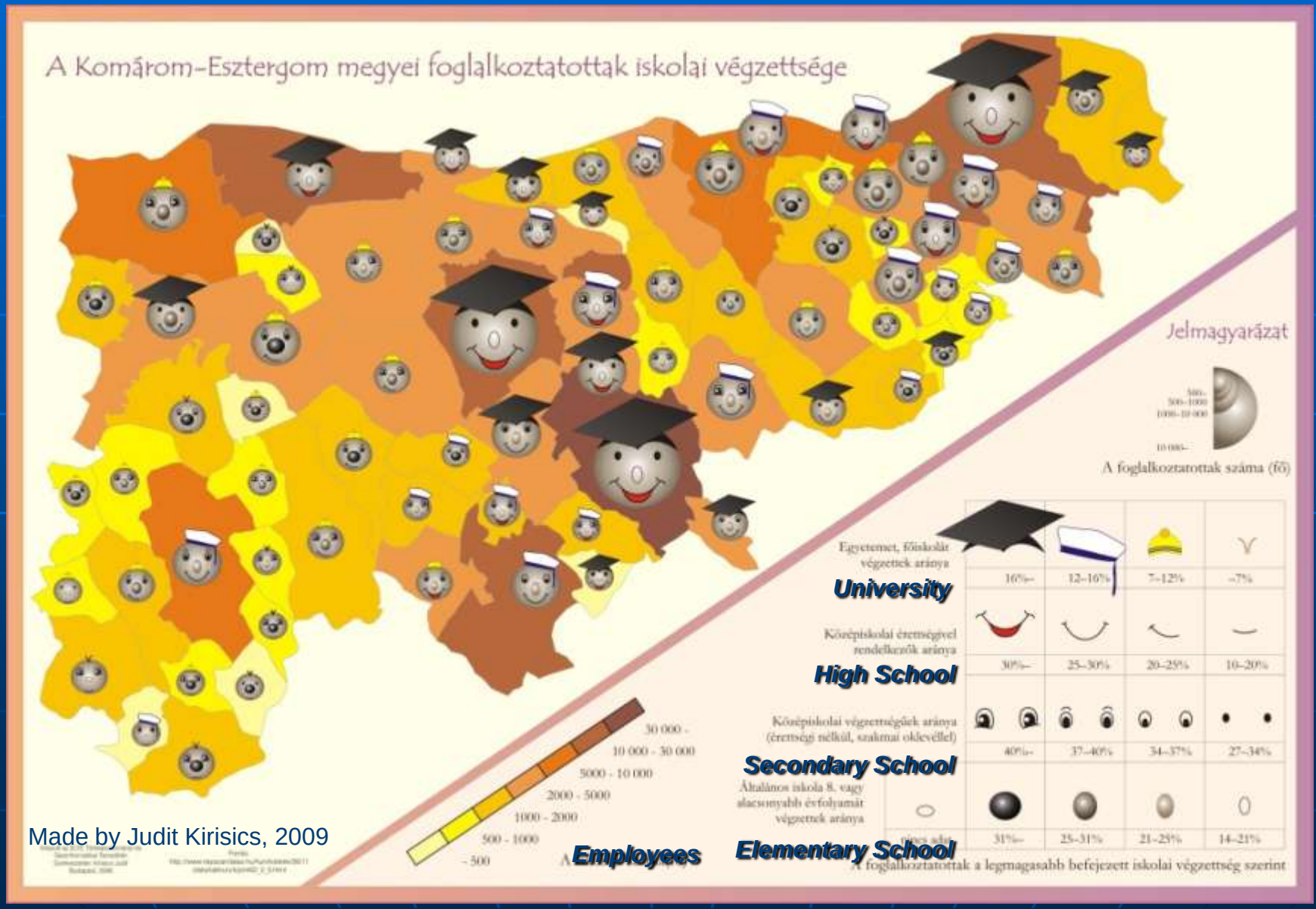
Parameters not changed while using a traditional symbol

Applying the Chernoff's principle…

Possible field of use: Atlases edited for first grades in Elementary Schools

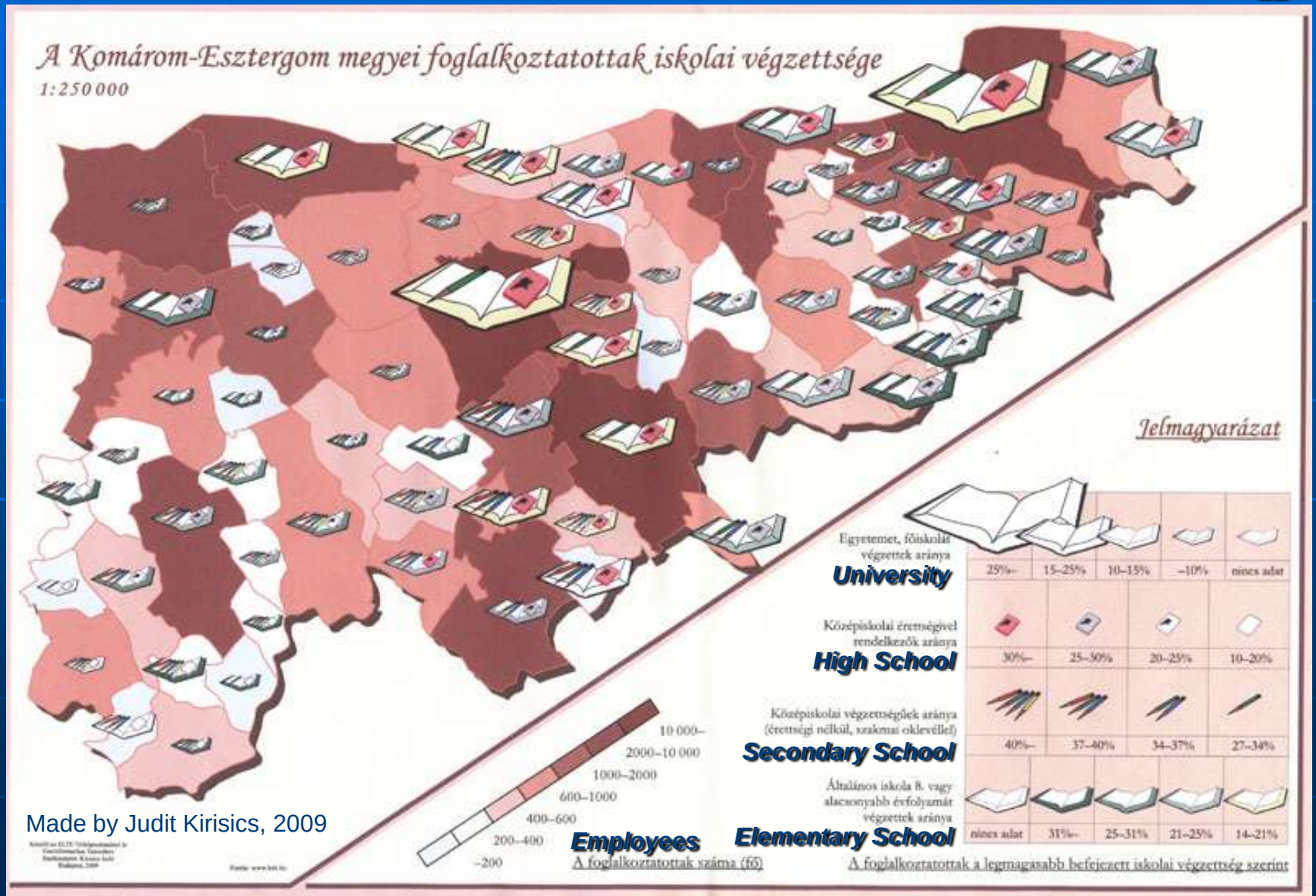
MSc on Cartography: During the 4th semester students make thematic maps using the traditional Chernoff faces and applying the Chernoff principle on pictograms created by themselves.

CHERNOFF FACES



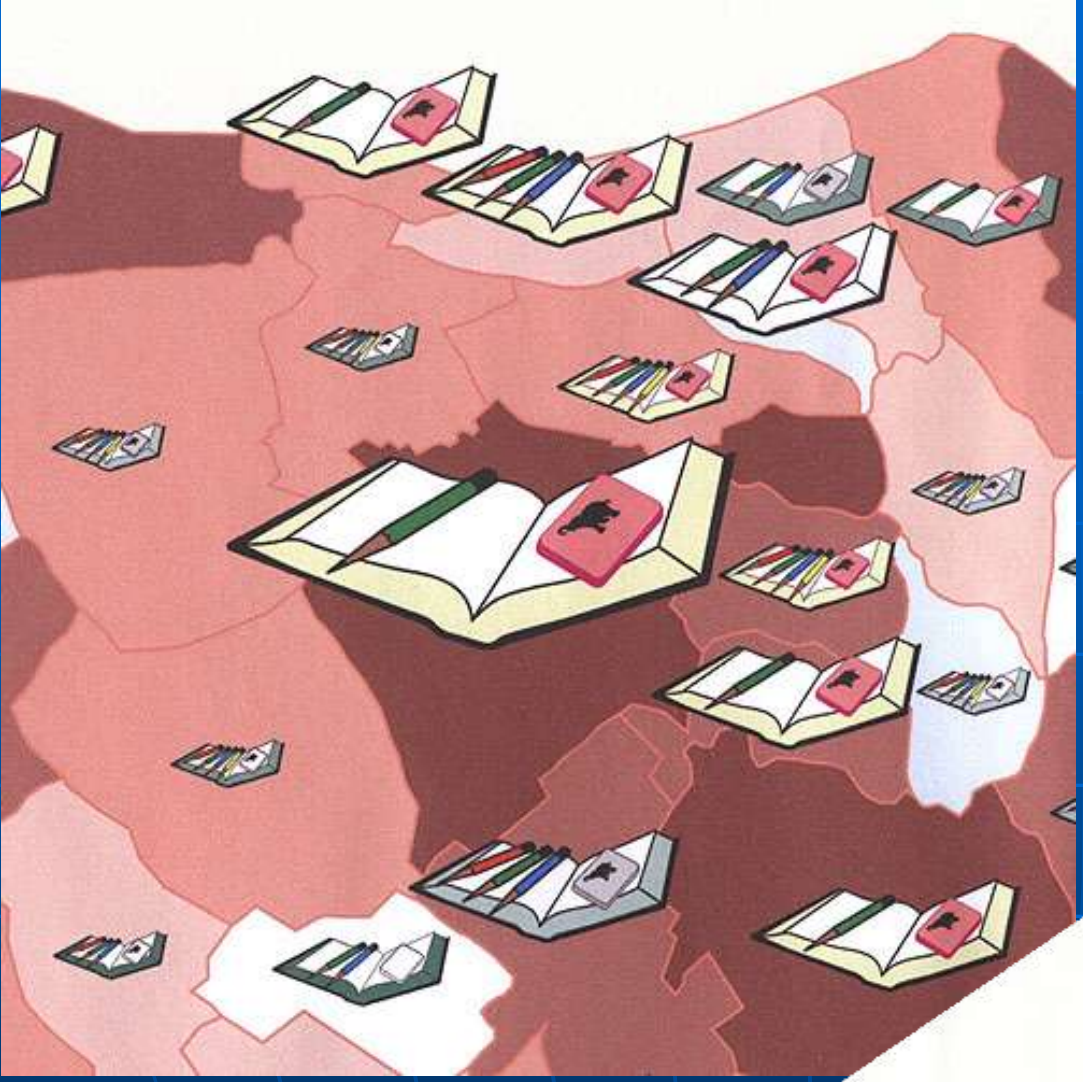
Made by Judit Kirisics, 2009

CHERNOFF FACES



Made by Judit Kirisics, 2009

CHERNOFF FACES



Jelmagyarázat

Egyetemet, főiskolát végzettek aránya
University

25%–	15–25%	10–15%	–10%	nincs adat

Középiskolai érettségivel rendelkezők aránya
High School

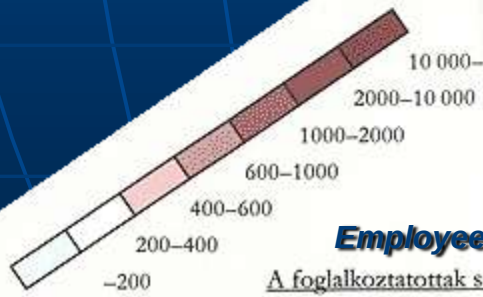
30%–	25–30%	20–25%	10–20%

Középiskolai végzettségűek aránya (érettségi nélkül, szakmai oklevéllel)
Secondary School

40%–	37–40%	34–37%	27–34%

Általános iskola 8. vagy alacsonyabb évfolyamát végzettek aránya
Elementary School

nincs adat	31%–	25–31%	21–25%	14–21%



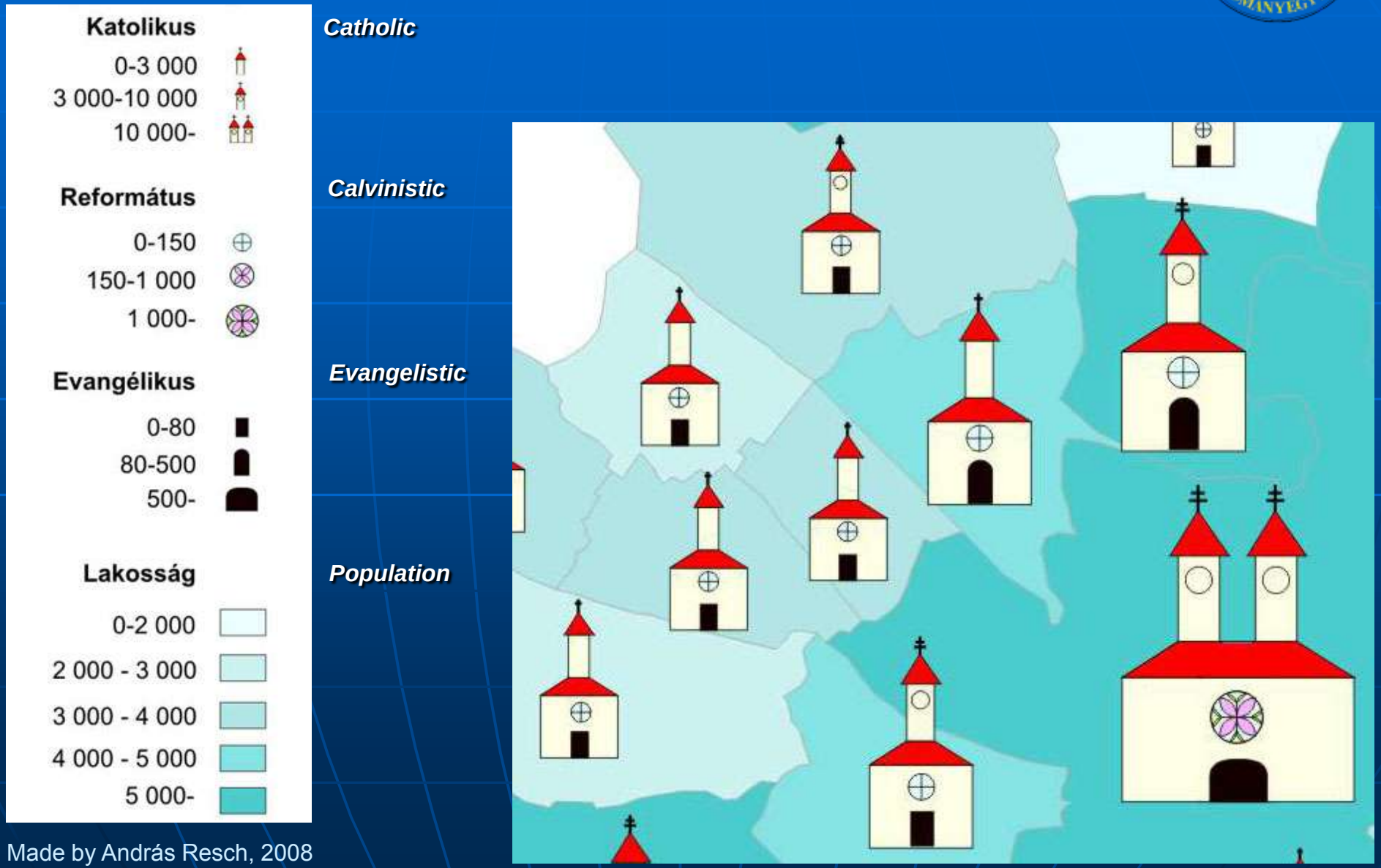
Employees

A foglalkoztatottak száma (fő)

A foglalkoztatottak a legmagasabb befejezett iskolai végzettség szerint

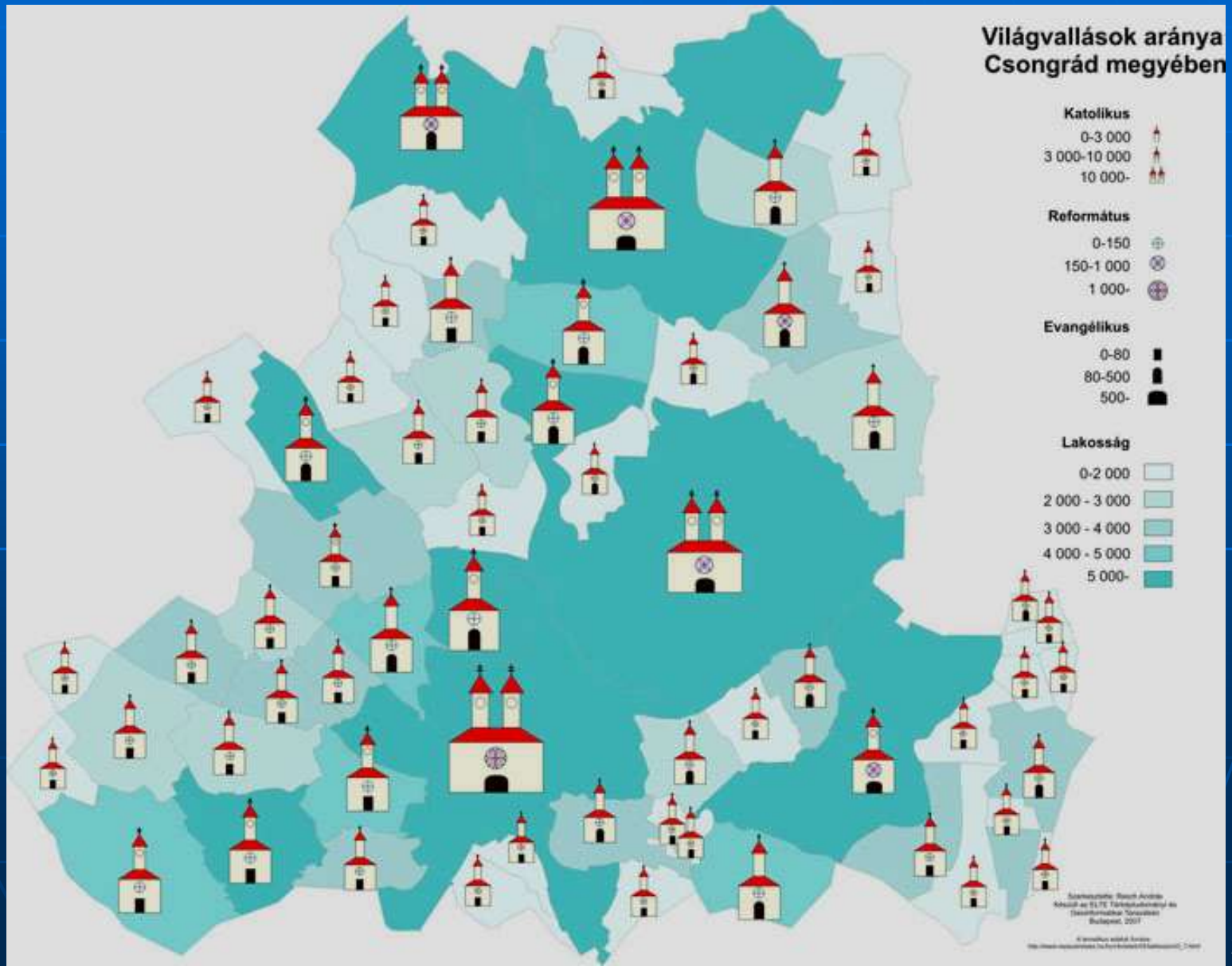
Made by Judit Kirisics, 2009

CHERNOFF FACES



Made by András Resch, 2008

CHERNOFF FACES



World religions in Csongrád county (Hungary)

Catholic

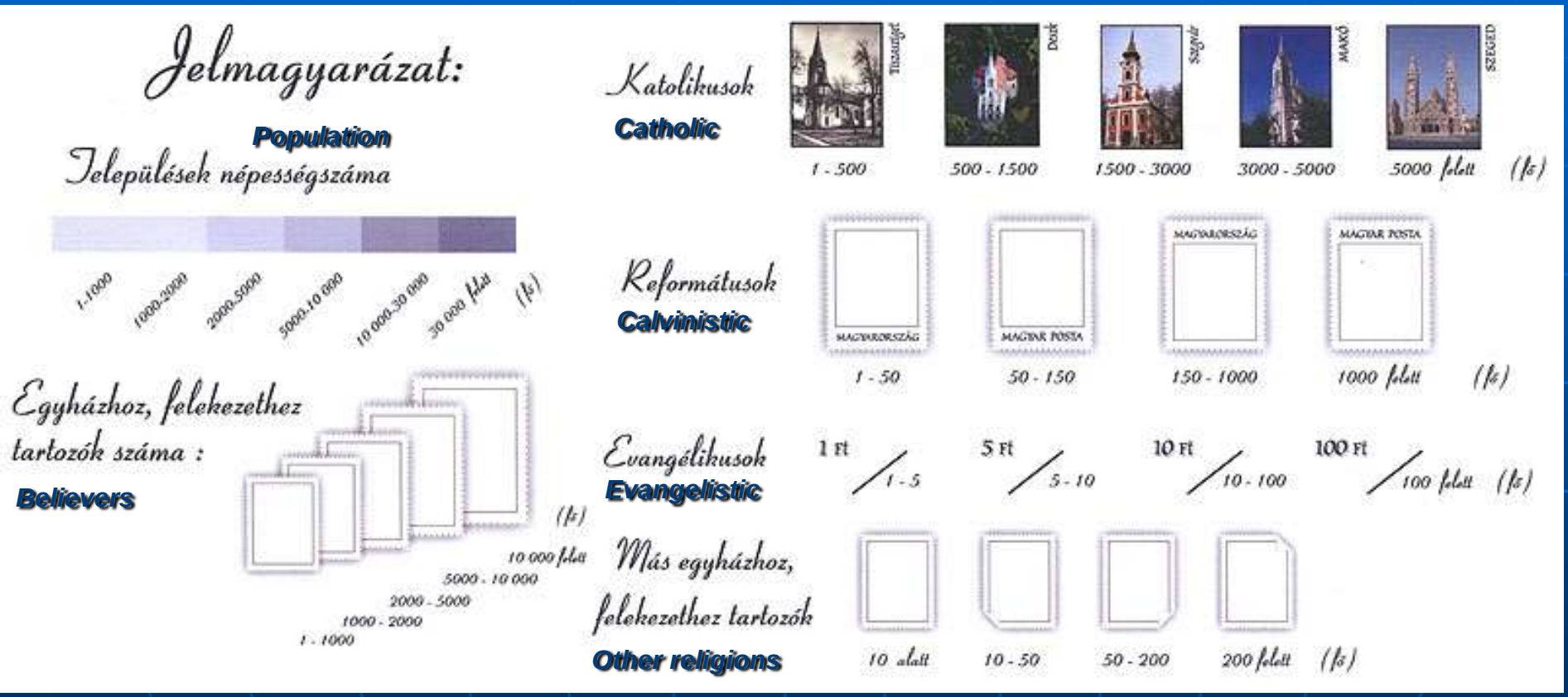
Calvinistic

Evangelistic

Population

Made by András Resch, 2008

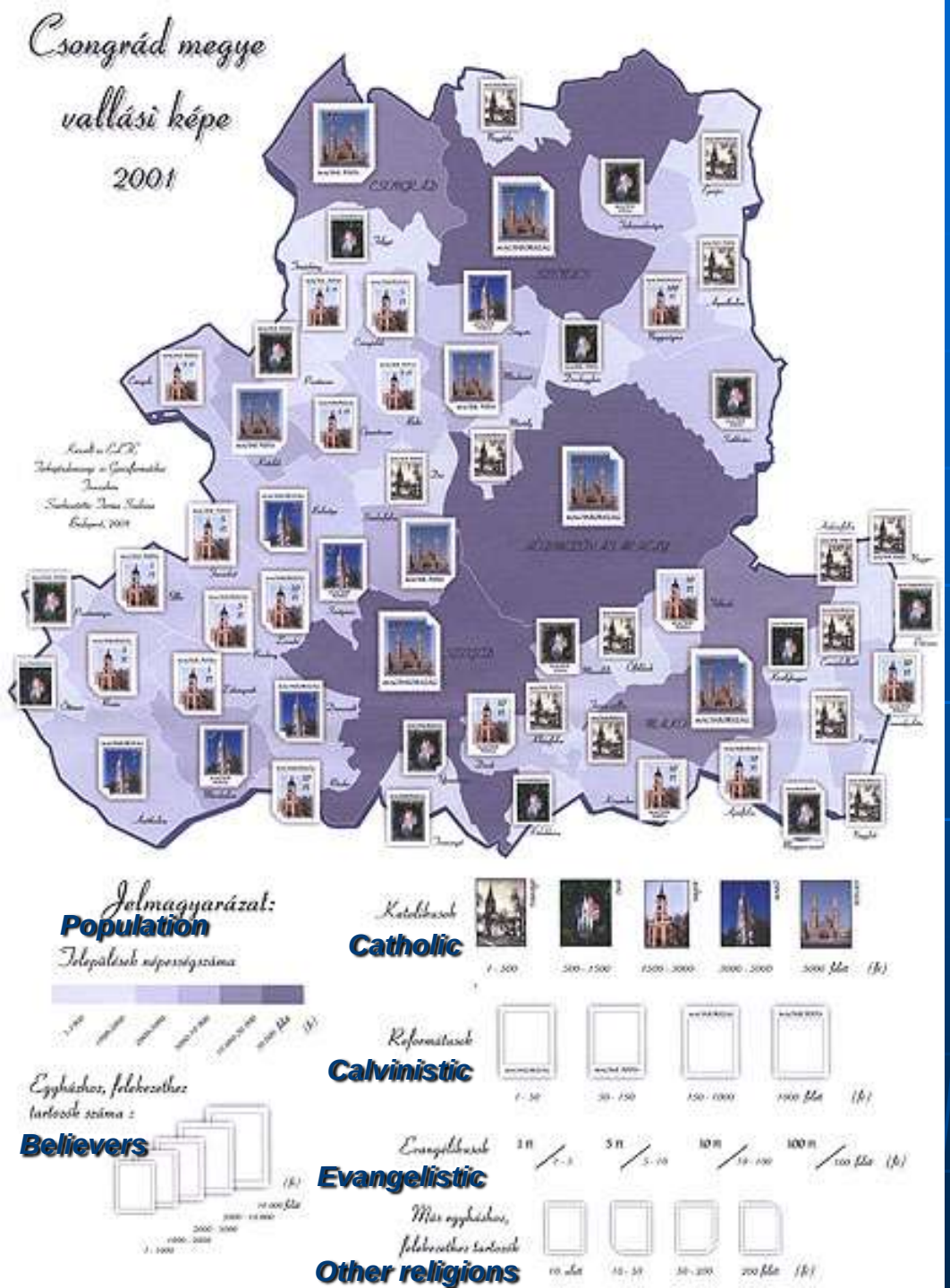
CHERNOFF FACES



Made by Szabina Torma, 2009

CHERNOFF FACES

Made by Szabina Torma, 2009



CHERNOFF FACES

Argentine-Hungarian project:
The possible use of the Chernoff faces for data visualisation in school cartography
(2008/2009)

Testing the theoretical results in Argentine and Hungarian (Elementary, High?) schools

-„Traditional” Chernoff faces on maps
- Chernoff principle using other pictorial symbols on maps

2008 – Theoretical research and exchange of experiences, first steps to organize a survey
2009 – Making of the test and survey, analysis and presentation of results

CHERNOFF FACES

Based on the specific characteristics of both educational systems

HUNGARY

7th and 8th grades in Elementary Schools

(13, **14** and 15 years old pupils)

ARGENTINA

1st grade in Secondary Schools

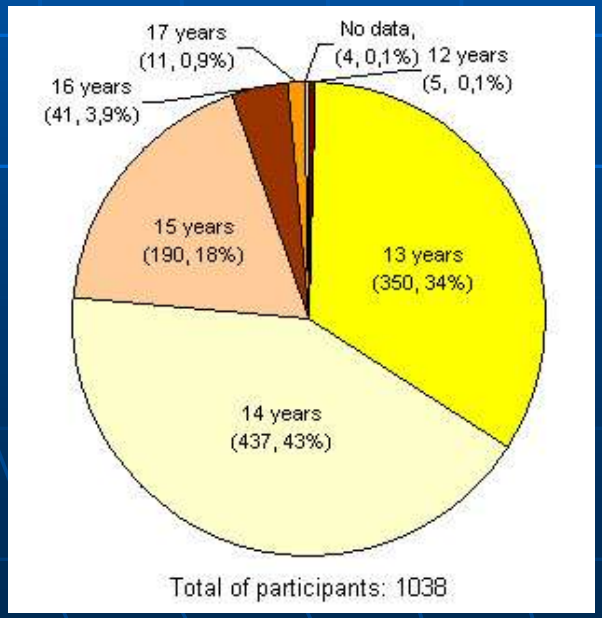
(12, **13** and 14 years old pupils)

Total of participants and number of schools

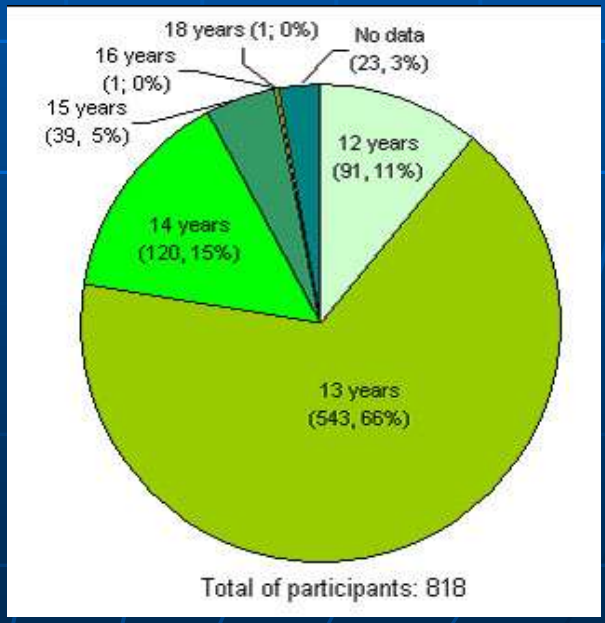
1038 pupils

818 pupils

12 schools in Budapest and other two provinces



8 schools in the province of Buenos Aires

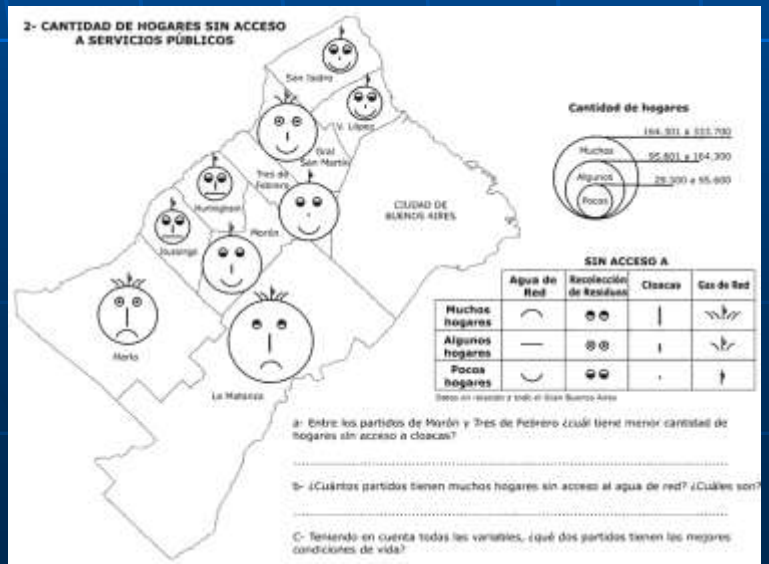


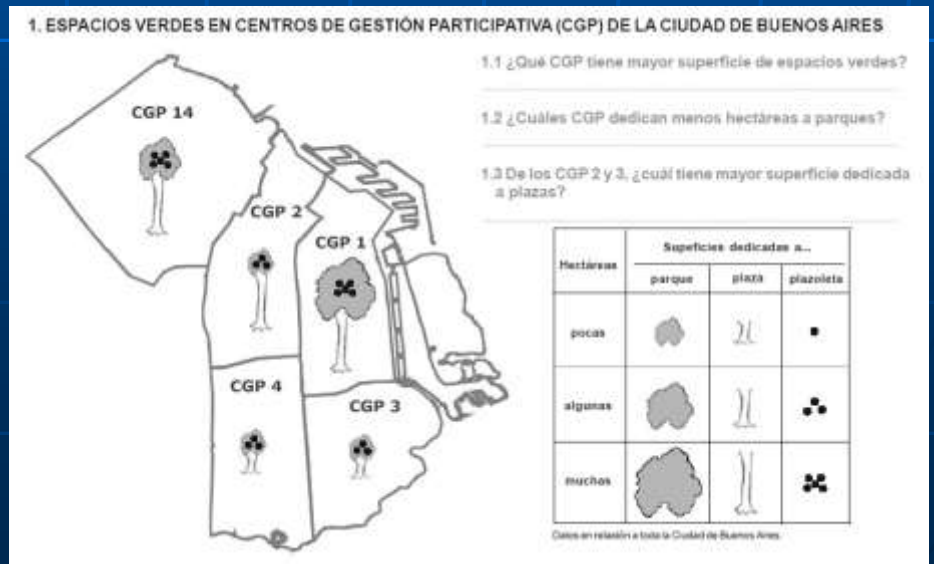
Questionnaire in A5 format, black and white ➡ Four questions

CHERNOFF FACES
Questionnaires

Four questions:

- Question using „traditional” Chernoff faces (Changing only the shape of a face, keeping the same size and fill or unfilled)
- Question with Chernoff faces applying cartographic principles (Shape of the faces was not changed and size was modified according to data, in Hungary: change of the fill according other variable)
- Question applying the Chernoff principle in pictograms (Comparison of pictograms divided into its more characteristic elements, and each of these elements represent a specific variable)
- Question to draw thematic data on an outline map using Chernoff faces



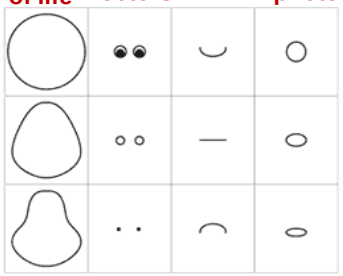


CHERNOFF FACES

1. A lakosság várható élettartama szerint tedd növekvő sorrendbe az országokat! A sorszámot a pontozott vonalra írd! Ha több ország azonos várható élettartamával rendelkezik, akkor ugyanazt a sorszámot lehet megadni nekik.

..... (A) Horvátország
..... (B) Bosznia és Hercegovina
..... (C) Szerbia
..... (D) Románia
..... (E) Bulgária

Expectancy of life | Dentists | Doctors | Aphotec.



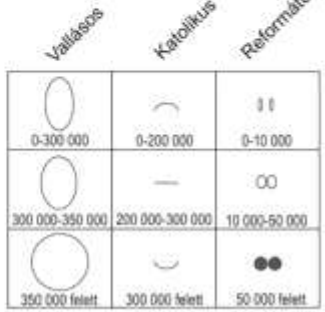
2. Hol alacsony a gyógyszerészek száma? Small Alacsony

Where is small the number of aphotecaries?

4. A következő térképen ábrázold a táblázatban található adatokat a jelkulcs alapján! Példaként a Vas megyei adatokat előre ábrázoltuk.

	Vallásos	Katolikus	Református
Esztergom	240 000	208 000	9 000
Fejér	308 000	227 000	67 000
Győr-Moson-Sopron	370 000	323 000	17 000
Veszprém	303 000	237 000	42 000
Vas	222 000	170 000	43 000

A táblázatban olvasható adatokat fel- vagy lekerekítettük.



Megjegyzéseid a feladatokkal kapcsolatban:

2. A térképen ábrázolt adatok alapján válaszolj a következő kérdésekre:

(A) Ausztria
(B) Magyarország
(C) Csehország
(D) Szlovákia
(E) Lengyelország

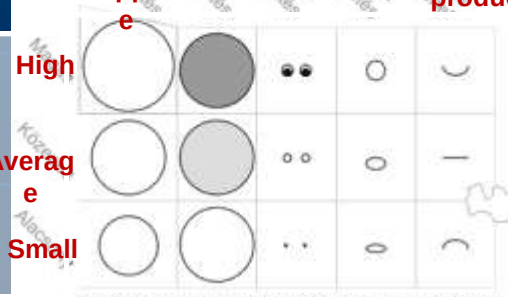
1. Csehországban vagy Ausztriában termesztenek több almát az ábra alapján?

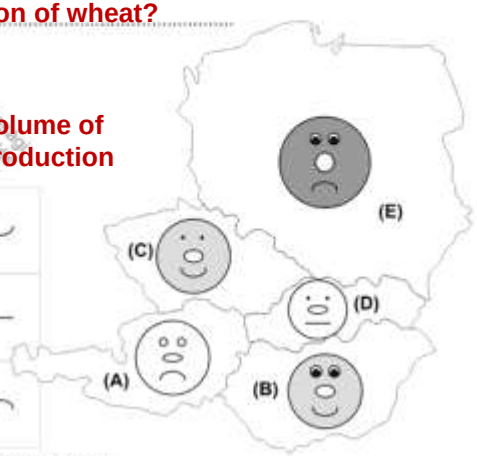
Where is the highest the production of apples: in Czech Rep. or Austria?

2. Melyik országban legnagyobb a búzatermesztés?

Where is the highest the production of wheat?

Apple | Wheat | Maize | Potato | Volume of production





*A mezőgazdaság termelésének változása az előző évhez képest

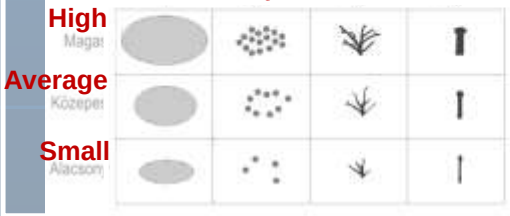
3. A térképen láthatod a különböző citrusfélék termelését Spanyolországban.

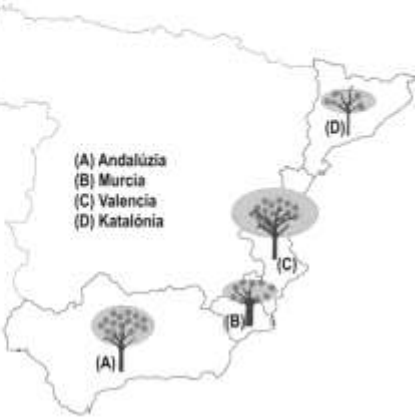
Highest total production
- Melyik tartományban a legmagasabb az összes citrusféle termelése? .....

Lowest production of tangerine
- Melyik tartományban a legkevesebb a mandarin termelése? .....

Highest production of lemon
- Melyikben a legnagyobb a citromtermelés? .....

Total production | Orange | Tangerine | Lemon





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General results and analysis of some answers

MAIN RESULTS OF THE SURVEY						
QUESTIONNAIRE	**ARGENTINA**			**HUNGARY**		
	Right answers	**Answers with one or more errors**	**No answer**	**Right answers**	**Answers with one or more errors**	**No answer**
Question using "traditional" Chernoff faces **S**	493 **(60%)**	313 **(38%)**	12 **(2%)**	828 **(79,8%)**	207 **(19,9%)**	3 **(0,3%)**
Question with Chernoff faces applying cartographic principles **C?**	285 **(35%)**	527 **(64%)**	6 **(1%)**	665 **(64%)**	367 **(35,4%)**	6 **(0,6%)**
Question applying the Chernoff principle on pictograms **C**	294 **(36%)**	520 **(63,5%)**	4 **(0,5%)**	908 **(87,5%)**	123 **(11,8%)**	7 **(0,7%)**
Question to draw thematic data on an outline map using Chernoff faces	540 **(66%)**	257 **(31%)**	21 **(3%)**	798 **(76,9%)**	211 **(20,3%)**	29 **(2,8%)**

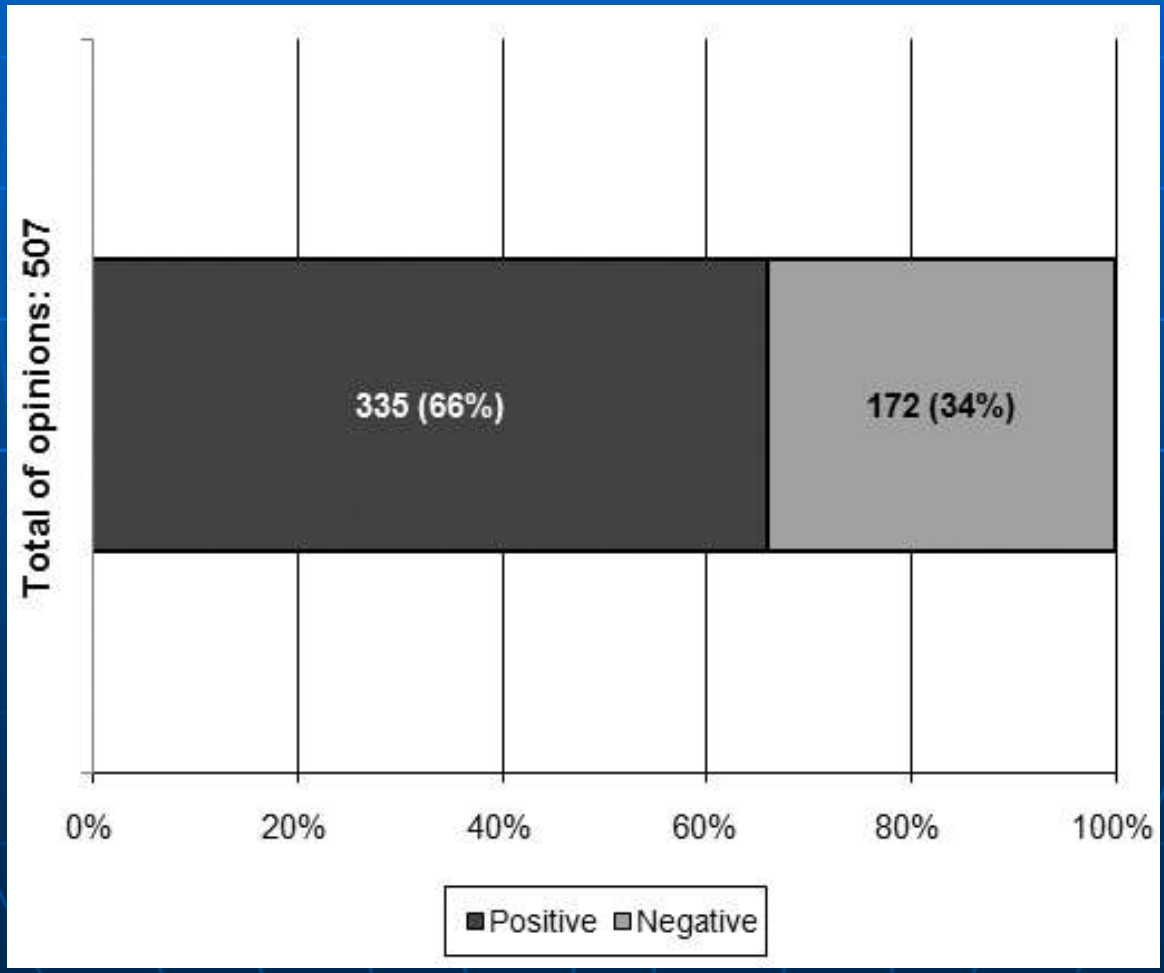
Similar and **C**ontradictory results !!!

CHERNOFF FACES

General results and analysis of some answers

Analysis of opinions expressed by Hungarian pupils

507 pupils (48,8% of 1038 participants) wrote their opinions



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General results and analysis of some answers

Analysis of opinions expressed by 507 Hungarian pupils

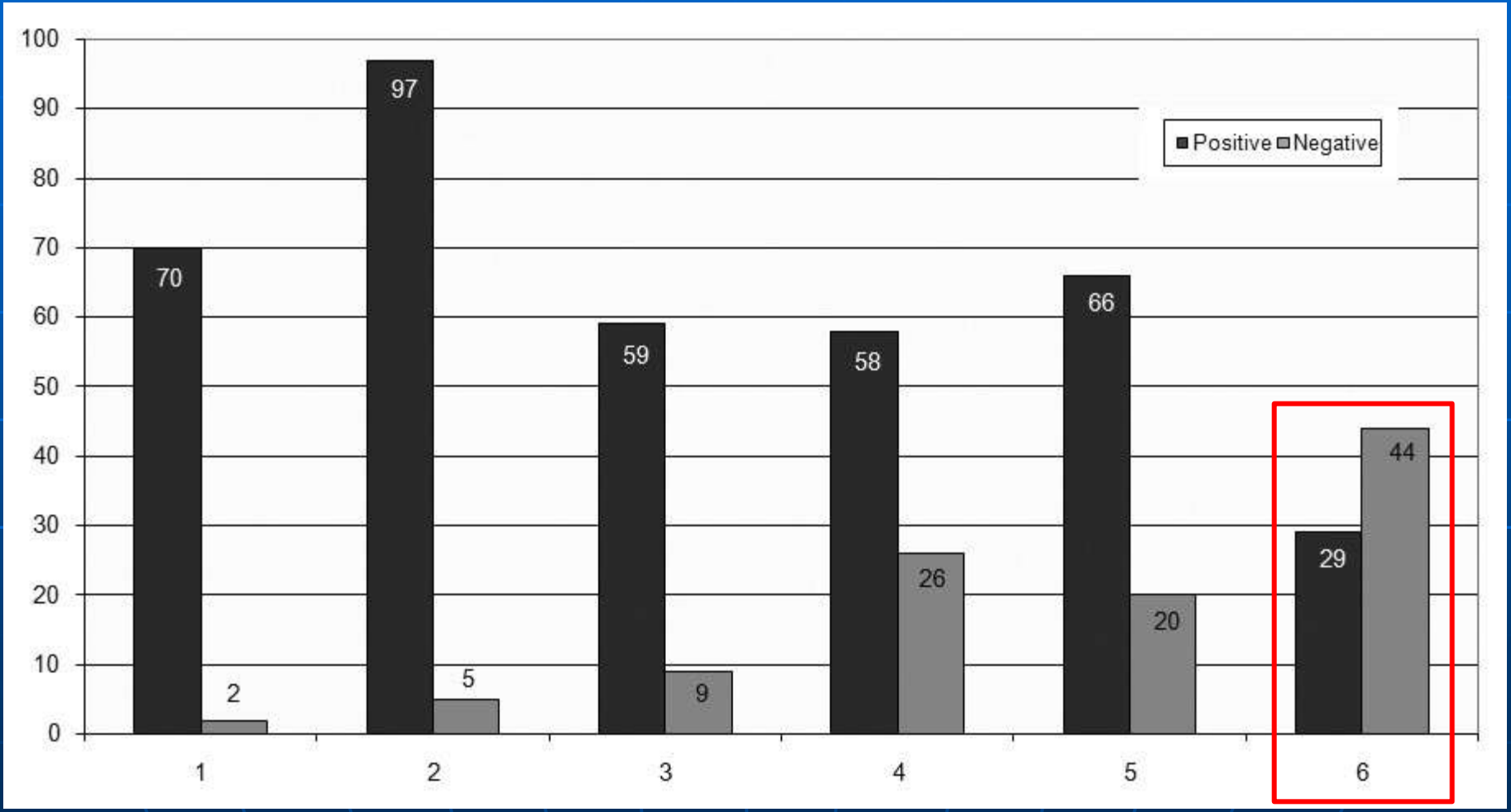

Diagram showing the frequency of the numbered doublets in the pupils' opinions:
(1) interesting – bored, (2) good – wrong, (3) like – do not like, (4) easy – hard, (5) funny – infantile (childlike), (6) understandable, suggestive, unequivocal – incomprehensible, inexplicable

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Website of the project

1er año

Email

Proyecto intergubernamental de colaboración bilateral entre Argentina y Hungría en ciencias y tecnología

Posibles usos de las fases de Chernoff para la visualización de datos en la cartografía escolar (2do año)

Ministerio de Ciencia, Tecnología e Innovación Productiva (MinCyT) de Argentina
Oficina de Investigaciones y Tecnología del Ministerio de Educación de Hungría
Fondo para las Investigaciones Científicas (OTKA, proyecto 68302) de Hungría

Idioma húngaro

Descripción | Participantes | Misiones técnicas | Investigaciones

- **Cuestionarios:**
  - Cuestionario para alumnos (Hungría)
  - Carta para docentes (Hungría)
  - Cuestionario para alumnos (Argentina)
- **Resultados:**
  - Tabla con los resultados de la encuesta para alumnos (Argentina)
  - Tabla con los resultados de la encuesta para alumnos (Hungría)
- **Ponencias y publicaciones:**
  - XXIV Conferencia Cartográfica Internacional de la ACI (ICC 2009)(Santiago de Chile, 15-21 de noviembre de 2009):
    - Ideas for the use of Chernoff faces in school cartography
      ponencia és presentación
      Ponencia: 24th International Cartographic Conference CD proceedings (The World Geo-Spatial Solutions), ISBN: 978-1-907075-02-05
  - Centro Argentino de Cartografía:
    - Posibles usos de las fases de Chernoff para la visualización de datos en la cartografía escolar
      artículo
      Publicado en: Boletín Nro. 45 del Centro Argentino de Cartografía. Publicación semestral, año 53, Junio de 2009 (1/2009),pp.42-51, ISSN 1667-8508

http://lazarus.elte.hu/hun/dolgozo/jesus/ma0809/proyect1.htm

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General results and analysis of some answers

Results left open questions to be study in the future, eg.: How will react the younger (8-10 years) children to a psychological message of a Chernoff face?

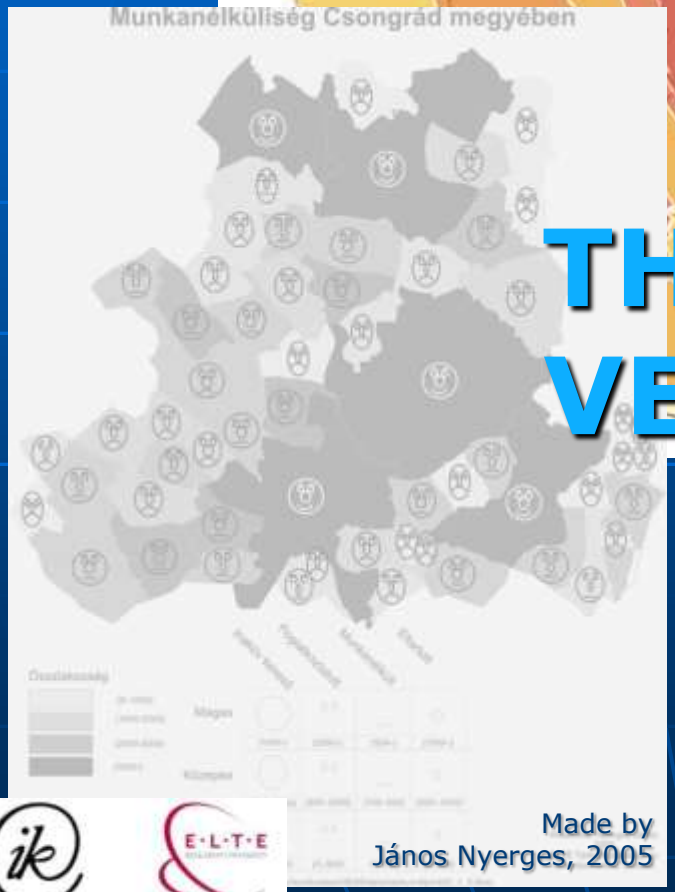
Research project (2010-2011):

Institute for Geoinformatics and Cartography – Vienna University of Technology

Department of Cartography and Geoinformatics – Eötvös Loránd University

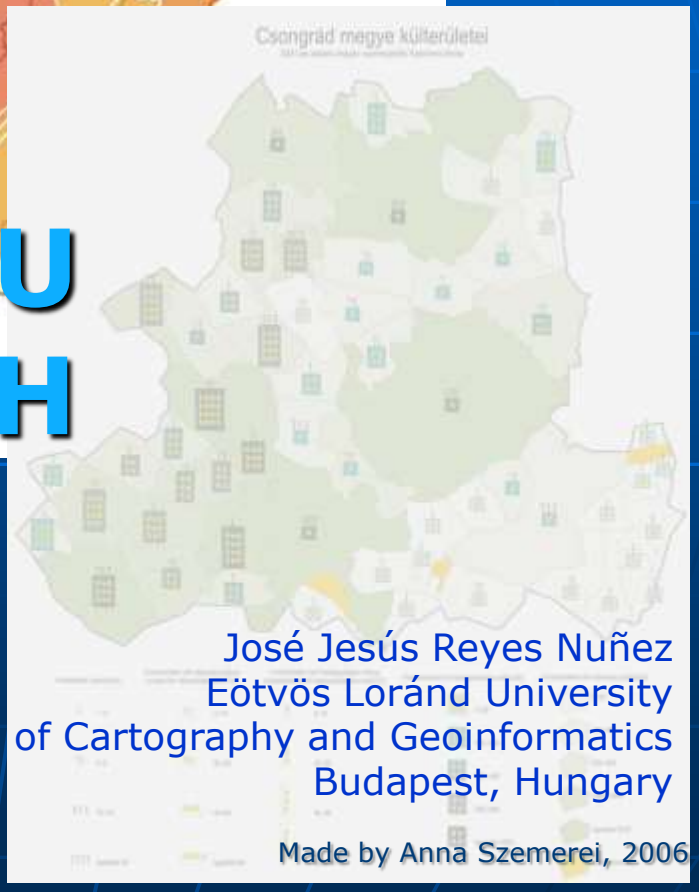
http://cartography.tuwien.ac.at/content07en/index.php?Research:Projects:Chernoff_Faces

ALTERNATIVE SOLUTIONS FOR DATA VISUALIZATION



Made by
János Nyerges, 2005

THANK YOU VERY MUCH



Made by Anna Szemerei, 2006

José Jesús Reyes Nuñez
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