

Cartographic Software

- Introduction to cartographic software. Basic principles.
- The history of OCAD, older version's functionality
 - A general overview about OCAD: basic drawing and editing functions
 - Planning symbol sets, creating and editing symbols
 - Colors and spot colors in OCAD
 - Importing and exporting files. Importing OpenStreetMap data.
 - Printing
 - Database connection and management in OCAD: Shape files
 - Usage of digital elevation models: importing, file formats, contour lines, hypsometry and hill shading
 - GPS data import
 - Layout
 - Internet maps
- OpenStreetMap: the free editable map of the world. Volunteered geographic Information.
- Automations in cartographic generalization:
 - Basic principle of automations on maps.
 - The most important line and polygon generalization algorithms.
 - Point generalization
 - Testing of algorithms in software: ArcGIS and QGIS, mapshaper.org.

Literature:

www.ocad.com

Okada, Alexandra, Buckingham Shum, Simon, Sherborne, Tony (Eds.): Knowledge Cartography, Software Tools and Mapping Techniques
Springer, 2014

Ian Muehlenhaus: Web Cartography: Map Design for Interactive and Mobile Devices, CRC Press, 2013

Slocum, McMaster, Kessler, Howard: Thematic Cartography and Geographic Visualization. 2005. Scale and generalization chapter.

Suggested literature:

V. Vozenilek: Cartography for GIS

Palacky University Olomouc, 2005

ISBN 10: 8024410478 / ISBN 13: 9788024410470

Geoinformatics

- Outline of GIS: main data models
- Relational database and the vector based GIS
- Spaghetti topology and its standards (OGC)
- Relational databases and topology preserving data structures
- Network model: linear reference and dynamic segmentation
- Routing
- Software products and libraries for handling spatial data
- Spatial application development
- Raster based data structures
- Simple image processing tasks
- Digital filters
- Classification, segmentation
- 3D data models: TIN and DEM
- Tools for application development

Literature:

P. Rigaux, M. O. Scholl, A. Voisard: Spatial Databases: With Application to GIS, Morgan Kaufmann Publishers, 2002.

Hassan A. Karimi: Handbook of Research on Geoinformatics
IGI Global, 2009, ISBN 9781591409953

Kresse, Wolfgang, Danko, David M. (Eds.): Springer Handbook of Geographic Information
Springer, 2012, ISBN 978-3-540-72678-4

Suggested literature:

Hannan Samet: The design and analysis of spatial data structures, Addison-Wesley, 1994

Thomlinson: Thinking about GIS, ESRI Press, 2012

Geovisualization

Visualization importance in human cognition. Information visualization, data visualization, scientific visualization, geovisualization.

Processes of human vision, visual space. Spatial vision, language, memory and learning.

Spatial cognition, orientation, wayfinding and navigation. Reference frames for spatial orientation. The development of the category of space and representation.

External and internal spaces, cognitive and mental maps. Spatialization, abstract and virtual spaces.

Representational tools and cognitive evolution. The development of geovisualization methods.

Data model and representational model.

Graphic semiotics: data relations and visual variables.

Multimodal representation. Multimedia, virtual reality.

Time: animation, visualization of spatio-temporal processes.

Geovisualization and user interactivity.

The effectiveness of visualization: research methods. Cognitive geovisualization research experiments, visualization of research data.

Literature:

MacEachren, A.M. – Kraak, M.J.: Exploratory cartographic visualization: advancing the agenda. In: *Computers & Geosciences*, 23 (4), 1997.

Colin Ware: *Information Visualization: Perception for Design*. Interactive Technologies. Wiley, New York, 2011.

Griffin, A.L., Fabrikant, S. I. (2012). More Maps, More Users, More Devices Means More Cartographic Challenges, *Cartographic Journal*, Vol. 49, No. 4: 298-301.

Suggested literature:

Edward Tufte. *Envisioning information*. Plenum Press, Boston, 2001.

Jacques Bertin: *Semiology of Graphics*. Univ. Of Chicago Press, Chicago, 1985.

Introduction to Cartography

Introduction: maps and cartography.
Spatial orientation and cognitive maps.
The cultural history of maps as visualization interfaces.
Cartographic data and information: geodesy, remote sensing, GPS, data bases.
Spatial reference systems: geographic coordinates and geodetic datum.
Cartographic projections. Scale, coverage and format.
Generalization as graphic interpretation of information.
Cartographic communication: symbols and typography.
Relief representation methods.
Topographic and reference maps.
Thematic maps: representation of geospatial data.
Principles of designing maps: layout and visual hierarchy
Orientation, wayfinding and navigation with maps.
Digital cartography and GIS.
Webcartography and geocommunication.

Literature:

Kraak, M. J. and F. J. Ormeling: Cartography: visualization of spatial data. New York, Guildford Press. 2011, (2013)
Mark Monmonier: How to lie with maps. Univ. of Chicago Press, 2005.

Suggested literature:

John Kryger – Denis Wood: Making maps. A visual guide to map design for GIS. 2011.
Alan McEachren: How maps work. Representation, Visualization, and Design. 2004.
Judith Tyner: Principles of Map Design. The Guilford Press. 2002
Borden Dent: Thematic Map Design. 1993.
Norman J. Thrower, Maps and Civilization: Cartography in Culture and Society, 2008
International Cartographic association: The World of Maps. 2014.
http://mapyear.org/files/wom/IMY_WoM_en.pdf)

Map Design and Editing

Lecture 1.

The map. The concept of map. Scale, projection, generalization, graphical legend. Classification of maps according to scale. Map types: base maps, general maps, thematic maps. Sources of map making.

Lecture 2.

Maps for the public. Types and concepts. General characteristics, scale and legend. Additions to maps: insets, name registers, search grids, alphabetical arrangement.

Lecture 3.

Map frame. Types of frames. Map model. Map extract. Form of the map sheet. Technical symbols on the map. Legend and explanation of symbols. The process and phases of map making.

Lecture 4.

Map content. Aspects of representation. Characteristics of objects and phenomena. Map elements. Layers of map content: relief, planimetric features, place names. Representation methods. Generalization: steps, guidelines, limits.

Lecture 5.

Relief. Representation of relief. Modern cartographic methods. Relationship between method, scale and map type. **Planimetric features I.** Drainage, elements and groups. Hydrographic objects. Representation of hydrographic features in various scales.

Lecture 6.

Planimetric features I. Borders. Categories of borders and their representation. Transportation features, their categories and representation.

Lecture 7.

Planimetric features III. Land coverage. Representation of vegetation in various scales. Representation of land-use and geographical zones of vegetation cover. Representation of built-up areas and settlements.

Lecture 8.

Geographical names I. Place names. Labelling of places. Writing systems. Names in Latin script. Types of place names and categories of their representation. Parts of names. Typography of labelling place names. Letter types and traditions of labelling.

Lecture 9.

Geographical names II. Names referring to points and point-like features. Settlement names. Hydrographic names of point elements. Names of characteristics geographical points (peaks, passes). Explanatory names.

Geographical names III. Names referring to areas. Hydrographic names referring to areas. Micro topographical names. Physical landscape regions in cartography. Names of historical-geographical regions.

Lecture 10.

Geographical names IV. Administrative names. Names of states and administrative divisions. Names of protected areas. Names of linear elements. Hydrographic names of linear features. Representation of administrative names referring to area and line. Names of public domains.

Lecture 11.

Geographical names V. Types of supplementary information on maps. Pictograms and their representation.

Lecture 12.

Atlases. Types of atlases. Atlases of map sheets. Atlases of separate maps. Editing atlases.

Lecture 13.

Historical maps. The use of historical maps. Types of historical maps. Spatial representation of historical events. Showing dynamism on a static base. Publications. Relationship between the legend of popular maps and historical maps. Real historical map.

Lecture 14.

Cartographic fieldwork. Reconnaissance. Maps for orientation on the terrain. Revising tourist maps. Updating city maps. Sources of updating and revision.

Map Projections 1

General properties of map projections
The theory of map distortions
Relationship between the projection equations and the map distortions
Characterization and classification of map projections
Azimuthal projections
Cylindrical projections
Conical projections

Literature:

Bugayevskiy, L. M. - Snyder, J. P.: Map projections. Taylor & Francis 1995.
Grafarend, Erik W., You, Rey-Jer, Syffus, Rainer: Map Projections, Cartographic Information Systems, Springer, 2014.

Suggested literature:

Wagner, K.: Kartographische Netzentwürfe. Bibliographisches Institut, Mannheim 1962.

Operating systems

Introduction, analog/digital systems Virtualization, description of the job/task Structure of the OS Basic of the VMS/CMS/DOS The MS Windows (from v3.1 to v8.1) The Unix based operating systems The Linux based operating systems The Apple operating systems (leopards, tigers...) Mobile platforms (android, winCE, IOS etc.) Basic system commands Cross platform solutions 1. Cross platform solutions 2.
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Literature:

Online help and manual pages of the selected operation systems
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Suggested literature:

UNIX Tutorial for Beginners (http://www.ee.surrey.ac.uk/Teaching/Unix/)

Photogrammetry and Remote sensing

- Physical background of remote sensing (active and passive remote sensing, electromagnetic spectrum)
- Platforms for photogrammetry and remote sensing (satellites, aircrafts, unmanned platforms and sensors)
- Active and passive satellites and sensors for cartography
- Processing of remote sensing data I. (pre-processing, corrections, inner orientation for images)
- Processing of remote sensing data II. (outer orientation for images, orthorectification)
- Methods for aerial triangulation and their mathematical background
- Processing and classification of passive remote sensing data
- Processing and classification of active remote sensing data

Literature:

James S. Aber – Irene Marzloff – Johannes Ries: Small-format aerial photography: Principles, techniques and geoscience application, Elsevier, 2010

Rainer Sandau: Digital airborne camera: Introduction and technology, Springer, 2010

Adams and Gillespie: Remote sensing of landscapes with spectral images, Cambridge, 2006

Suggested literature:

Karl Kraus: Photogrammetry, de Gruyter, 2007. (English edition)

Processing of remote sensing data
<ul style="list-style-type: none">• Orthorectification of aerial and satellite based images• Structure-from-motion algorithms in practice – Processing of UAV based images• Processing of multispectral images (filters, pre-processing, classification methods, post-processing)• Segmentation methods
Literature: James S. Aber – Irene Marzolff – Johannes Ries: Small-format aerial photography: Principles, techniques and geoscience application, Elsevier, 2010 Adams and Gillespie: Remote sensing of landscapes with spectral images, Cambridge, 2006 Agisoft Photoscan user manual, 2015
Suggested literature: Intergraph Erdas Imagine 2013 File Guide and Manual Trimble eCognition handbook and tutorials

Cartographic visualization

Cartographic visualization and communication.

Definitions of map and cartography. The development trends of theoretical cartography.

Spatial representation in the arts and science. Perspective representation. Materiality of pictures, representational methods. Forms of modern maps.

Geographic ontology and cartographic representation: objects and space. The concept of scale, the accuracy of spatial representation.

Cartographic modelling: object information and spatial attributes, and semantic information.

Time in cartographic visualization and narratives.

Symbolization: cartosemiotics. Time in cartographic representation.

Object classes and semantic categories. Graphic and conceptual generalization.

Representational space in cartography, functions of maps, maps and map-like representational forms.

Graphic communication and expression. The elements of visual language, the construction of pictures.

The structure of map graphic: the horizontal organization. Vertical hierarchy.

The representational space: dynamic network visualizations. Cartographic representation of abstract and virtual spaces, cybercartography.

User-oriented cartographic research, maps in mass-media, maps and propaganda.

Literature:

Terry A. Slocum, Robert B. McMaster, Fritz C. Kessler, and Hugh H. Howard: Thematic Cartography and Geographic Visualization. Upper Saddle River, NJ: Pearson Prentice Hall. 2009.

John Kryger – Denis Wood: Making maps. A visual guide to map design for GIS. 2011.

Mark Monmonier: How to lie with maps. Univ. of Chicago Press, 2005.

Suggested literature:

Alan McEachren: How maps work. Representation, Visualization, and Design. 2004.

Judith Tyner: Principles of Map Design. The Guilford Press. 2002

Borden Dent: Thematic Map Design. 1993.

Complex Work Placement

Work in a company or in the university in summertime (min. 3 weeks).
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Geodesy and Topography

- The subject of geodesy. Positioning, units of measure.
- Locating points. Gravitational space, surfaces, elevation. Surfaces replacing the Earth. Projections, distortions. Sheet systems.
- Measurements, geodetic problems on plane. Measurement errors, accuracy, propagation of error.
- Point system of surveying. Networks. Marking points on the terrain.
- Geodetic instruments. Basics of optics.
- Theodolites.
- Horizontal measurement of angle. Methods of measuring. Orientation tools. Regular errors of theodolite.
- Positioning of points. Methods, calculations, building networks.
- Measuring distances. Optical tools of telemetry. Trigonometry. Measurement errors.
- Measuring elevations. Methods of determining elevation differences. Trigonometric, geometric and physical levelling. Levelling by satellites.
- Global positioning in geodesy. Types of GNSS (GPS, GLONAS, GALILEO, local navigation systems). Measurement methods and errors. GNSS services (permanent networks, GPRS).
- Detailed surveying. Instruments (Cartesian system, polar system, use of GPS, elevations, longitudinal and cross profiles, point clouds of mobile mapping systems).
- Cartographic visualization methods. Analogue and digital maps. Cartographic data models. Cadastral base maps and their content. Digital base maps. Standards and regulations.
- Surveying public utilities. Public utility maps.

Literature:

B. Hofmann-Wellenhof and H. Moritz, Physical Geodesy, Springer-Verlag Wien, 2005.
Lu, Zhiping, Qu, Yunying, Qiao, Shubo: Geodesy, Introduction to Geodetic Datum and Geodetic Systems, Springer, 2014.
Wolfgang Torge, Jürgen Müller: Geodesy
Walter de Gruyter, 2012

Suggested literature:

Günter Seeber: Satellite Geodesy
Walter de Gruyter, 2003
Peter J.G. Teunissen, Alfred Kleusberg: GPS for Geodesy
Springer Science & Business Media, 2012

Spatial application development

- summary of object oriented paradigm
- introduction to .NET and C# programming
- reading and displaying simple data (text files and pictures)
- reading binary data
- binary elevation data (ddm) reading and displaying
- implementing histogram equalisation for raster data
- satellite image file format (bil) handling
- reading and parsing satellite image file parameters
- reading and displaying multispectral images
- creation of RGB images from any 3 bands

Literature:

Rigaux, Scholl, Voisard: Spatial Databases, With Application to GIS
Elsevier, 2001, ISBN 9781558605886

Davis, Clodoveu Augusto, Monteiro, Antonio M. V. (Eds.): Advances in Geoinformatics
VIII Brazilian Symposium on Geoinformatics, GEOINFO 2006, Campos do Jordão (SP),
Brazil, November 19-22, 2006
Springer, 2006

Suggested literature:

Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner: Professional C# 2012
and .NET 4.5,
http://en.wikibooks.org/wiki/C_Sharp_Programming

Map Projections 2

Pseudoazimuthal projections
Pseudocylindrical projections
Pseudoconical projections
Miscellaneous projections
Projections on the ellipsoid
National and international map series on the ellipsoid
Identification of map projections
Calculation of local and global map distortions and errors
Choosing map projections

Literature:

Bugayevskiy, L. M. - Snyder, J. P.: Map projections. Taylor & Francis 1995.
Grafarend, Erik W., You, Rey-Jer, Syffus, Rainer: Map Projections, Cartographic Information Systems, Springer, 2014.

Suggested literature:

Wagner, K.: Kartographische Netzentwürfe. Bibliographisches Institut, Mannheim 1962.

Programming spatial databases

- Open spatial database handling systems: Postgres/Postgis, MySQL)
- Administering spatial databases (PgAdmin, MySQL workbench)
- Import /export of spatial data, troubles of conversion
- Spatial data standards (OGC) and topology handling
- Spatial data formats
- Displaying spatial data: Sharpmap, Gmap
- Database application development for spatial data in C#
- Connecting Postgres/Postgis data from c#
- Spatial functions
- Open access digital maps
- consultation of course work

Literature:

Hanan Samet: The design and analysis of spatial data structures, Addison-Wesley, 1994
Andrew Troelsen: Pro C# 5.0 and the .NET 4.5 Framework, Apress, 2012

Suggested literature:

Applications of Spatial Data Structures: Computer Graphics, Image Processing and GIS (by Hanan Samet, Addison-Wesley, 1989)

Thematic Cartography (Lecture)

Topic and requirements of the semester. Literature and theory of thematic cartography. Cartographic generalization. Overview of data representation techniques. Types of base maps. History and development of thematic cartography. Data sources, data types and their critical evaluation. Characteristics of the field-specific thematic maps. Map types in Geosciences. Maps of environmental, economic and social phenomena. Thematic maps in education. Thematic maps on special-purpose and in communication (e. g. maps in media, in propaganda). Thematic atlases. Color theories. Maps in black and white. Visualization of information. Relationship of graphic symbols and data representation. Projections of thematic maps. Thematic cartography in Geoinformatics. Thematic maps on Internet. Editing and processing errors on thematic maps.

Literature:

Slocum, McMaster, Kessler, Howard: Thematic Cartography and Geographic Visualization, Prentice Hall, 2008.

Dent, Torguson, Hodler: Cartography – Thematic Map Design, McGraw-Hill, 2008.

Suggested literature:

Tyner, J.: Principles of Map Design, The Guilford Press, 2010.

Thematic Cartography (Practice)

Students prepare different types of thematic maps from data sets provided by the instructor or they do independent team work, but driven by instructor, on a complex thematic topic. This task consists of searching for special data and learning the characteristics of a socio-economic or geographic field for a specified area. Students also have to prepare documentation on their work or to prepare a descriptive, technical text on the topic they work on. The aim of this course is to meet as many data format as possible and work with the main thematic map types.

Literature:

Slocum, McMaster, Kessler, Howard: Thematic Cartography and Geographic Visualization
2008, ISBN 978-0132298346

Dent, Torguson, Hodler: Cartography – Thematic Map Design

McGrawHill, 2009, ISBN 9780072943825

Suggested literature:

All the required and recommended literature of the concerned disciplines

3D modelling in GIS

Concepts and theoretic base of 3D modelling.
Data management systems of a 3D model and the structure of GIS databases for 3D modelling purposes.
The modelling procedure and the classification of 3D modelling methods.
The concept of tessellation.
Processing and storing grid data. Calculation of grid point values.
The real, the virtual and the conceptual 3D model.
Tools for visualization and querying.

Literature:

Albert, G. 2009: Methods of constructing and visualizing 3D geological models from the GIS approach, Ph.D dissertation – Manuscript, ELTE, Doctorate School of Earth Sciences, 150 p.
Kidner, D., Dorey, M., Smith, D. 1999: What's the point? Interpolation and extrapolation with a regular grid DEM. – IV International Conference on GeoComputation, Fredericksburg, VA, USA

Suggested literature:

Albert G, Csillag G, Fodor L, Zentai L. 2012: Visualisation of geological observations on web 2.0 based maps – In: Zentai L, Reyes Nunez J (eds.): Maps for the future – Springer.
Bohling, G. 2005: Introduction to geostatistics and variogram analysis. – Kansas Geological Survey, 25 p.
Gold C. M. 1991: Problems with handling spatial data - the Voronoi approach. CISM Journal ACSGC. Vol. 45, No. 1. Springer 1991. pp. 65-80.

Digital history of cartography

Map history and the history of cartography: theories, trends and methods. Overview of literature on the history of cartography, map sources.
The development models of cartography as independent discipline.
The problem of development: positivism, paradigms, multilinearity, cartographic modes.
Postmodern and critical cartography: power, politics and ideology.
The history of modern cartography from Enlightenment to the 20th century. Cognitive and social changes, the technological background.
Cartography in Hungary from the 18th century to the Compromise (1867).
The thematic mapping of the Carpathian Basin.
Hungarian cartography after WW I: state cartography, commercial cartography.
Old maps as sources of information: acquisition and evaluation of data. Historical GIS.
Digital methods in the preservation of cartographic heritage.
Visualization methods of early map, web interfaces, webGIS solutions.
The actual problems of the research in the history of cartography.

Literature:

- J. B. Harley – D. Woodward: The History of Cartography. Vol. I–III., Univ. of Chicago Press, Chicago, 1987-
- Klinghammer I. – Pápay Gy. – Török Zs.: Kartográfia történet. ELTE Eötvös Kiadó, Budapest, 1995.
- Jeremy Crampton: Mapping. A critical introduction to Cartography and GIS. Univ. Of Chicago Press, Chicago, 2009.
- Anne Burdick: Digital Humanities. MIT Press, Cambridge, 2012.

Suggested literature:

- I. Kretschmer – J. Dörflinger–F. Wawrik: Lexikon zur Geschichte der Kartographie. Deuticke, Wien, 1986.
- Matthew H. Edney: The Origins and Development of J. B. Harley's Cartographic Theories. Cartographica 40, nos. 1 & 2: Monograph 54, 2005.
- Rob Kitchin – Martin Dodge: Rethinking Maps. New Frontiers in Cartographic Theory. Routledge, 2012.
- John Brian Harley: Deconstructing the map. Cartographica, 32.1. 1989.

Geovisualization-based solutions in cartography

1. Cartograms 1: Analysis of early examples made finishing the XIX and in the first half of the XX century
2. Cartograms 2: Analysis of modern examples made finishing the XX and beginning the XXI century
3. Cartograms 3: free software and applications for their making
4. Chernoff faces 1: Analysis of non-map-based and map-based examples made from 1973 to nowadays
5. Chernoff faces 2: Their use in different software
6. Chernoff faces 3: Practical examples of using the Chernoff principle in school cartography
7. The use of sound in cartography: Presentation and analysis of practical examples (maps and atlases for blind and visually impaired people)
8. Cybercartography: Thematic solutions in past and current research projects
9. The use of word and data clouds in cartography 1: Analysis of examples
10. The use of word and data clouds in cartography 2: presentation of web-based applications
11. Non-map-based and map-based geovisualization 1: Analysis of examples stored on the Web
12. Making of thematic maps using a web-based application 1
13. Making of thematic maps using a web-based application 2

Literature:

- 10 great examples of data visualization design, 2013 [Online] Available at <http://www.designer-daily.com/10-great-examples-of-data-visualization-design-37927> [Accessed 26 May 2016]
- Andrieu, D., Kaiser, C. & Ourednik, A., 2008. ScapeToad: not just one metric [Online] Available at <http://chorogram.choros.ch/scapetoad/index.php> [Accessed 26 May 2016]
- Geographic Information Systems, 2011. Examples of geovisualizations of global connectivity [Online] Available at <http://gis.stackexchange.com/questions/16227/examples-of-geovisualizations-of-global-connectivity> [Accessed 26 May 2016]
- Geographic Information Systems, 2011. Examples of building-level geovisualization [Online] Available at <http://gis.stackexchange.com/questions/7582/examples-of-building-level-geovisualization> [Accessed 26 May 2016]
- Feinberg, J., 2014. Wordle [Online] Available at <http://www.wordle.net/> [Accessed 26 May 2016]
- Learn to create maps on the web and visualize geospatial data [Online] Available at <https://docs.cartodb.com/> [Accessed 26 May 2016]
- Tagxedo: Word Clouds with Styles [Online] Available at <http://www.tagxedo.com/> [Accessed 26 May 2016]
- Tagul: Word Cloud Art [Online] Available at <https://tagul.com/> [Accessed 26 May 2016]
- Yau, N., 2007–2016. How to visualize data with cartoonish faces ala Chernoff [Online] Available at <http://flowingdata.com/2010/08/31/how-to-visualize-data-with-cartoonish-faces/> [Accessed 26 May 2016]
- Zygomatic, 2016. WordClouds [Online] Available at <http://www.wordclouds.com/> [Accessed 26 May 2016]

Suggested literature:

- Other websites related to the topics included in the course.

Geovisualization-based solutions in cartography

1. Milestones in the history of the thematic cartography and data visualization
2. Cartograms 1: history, definitions, classification
3. Cartograms 2: results of newest research projects
4. Chernoff faces 1: history, definition, principle, classification
5. Chernoff faces 2: results of newest research
6. Chernoff faces 3: The use of the Chernoff principle in school cartography
7. Geovisualization-based solutions in school cartography 1
8. Geovisualization-based solutions in school cartography 2
9. The use of sound in cartography 1: early experiments on thematic maps, use on multimedia maps.
10. The use of sound in cartography 2: maps and atlases for blind and visually impaired people
11. Cybercartography: past and current research projects
12. 'Non map-based' geovisualization: antecedents, current graphic solutions and applications
13. Map-based geovisualization: newest solutions and applications developed in current research projects

Literature:

- Castreghini de Freitas, M. I., 2011. Tactile Cartography in Brazil: Spatial Representation by Visually Impaired Students. Work presented in the Dept. of Cartography and Geoinformatics at ELTE (18 November 2011).
- Coll Escanilla, A. and Pinto Soto, J., 2016. Tactile Cartography: Essential for the Visually Disabled [Online] Available at http://mapyear.org/files/wom/18_IMY_WoM_en.pdf [Accessed 26 May 2016]
- Dorling, D. & Fairbairn, D., 2007. Mapping ways of representing the world. Pearson, United Kingdom.
- Dorling, D., 2004. The advantages of cartograms. [Online] Available at http://www.csiss.org/streaming_video/csiss/dorling_cartograms.htm [Accessed 15 January 2008]
- Fraser Taylor, D.R., 2005. Cybercartography – Theory and practice. Elsevier, United Kingdom.
- Fraser Taylor, D.R., 2014. Developments in the theory and practice of Cybercartography (applications and indigenous mapping) (D.R.F. Taylor & T. Lauriault, eds.), Elsevier, United Kingdom.
- Geomatics and Cartographic Research Centre – Carleton University, 2015. Cybercartography [Online] Available at <https://gcrcc.carleton.ca/confluence/display/GCRCWEB/Cybercartography> [Accessed 26 May 2016]
- Lobben, A., 2015. Tactile Maps and Mapping [Online] Available at <https://nfb.org/images/nfb/publications/jbir/jbir15/jbir050102.html> [Accessed 26 May 2016]
- Mei-Po, K. and Jiyeong, L., 2003. Geovisualization of Human Activity Patterns Using 3D GIS: A Time-Geographic Approach [Online] Available at http://meipokwan.org/Paper/Best_2003.pdf [Accessed 26 May 2016]
- Nöllenburg, M., 2016. Geographic Visualization [Online] Available at <http://i11www.iti.uni-karlsruhe.de/extra/publications/n-gv-07.pdf> [Accessed 26 May 2016]
- Raisz, E., 1938. General Cartography: Cartographic specialties, pp. 235-265. McGraw-Hill Book Company, USA.
- Reyes J., 2010. Ideas to the use the Chernoff faces in the school cartography. Boletim de Geografia 28:(1) pp. 5-15. Brazil. [Online] Available at <http://lazarus.elte.hu/hun/dolgozo/jesus/ma0809/docs/chernoff-ppt.pdf> and https://www.academia.edu/8026644/IDEAS_FOR_THE_USE_OF_CHERNOFF_FACES_IN_SCHOOL_CARTOGRAPHY [Accessed 26 May 2016]
- Reyes J., 2013. Smartphone-based school atlases? Cartographica: The International Journal for Geographic Information and Geovisualization, 48:2, pp. 126–133, University of Toronto Press
- Reyes J., 2015. Hungarian survey on the use of cartograms in school cartography. International Journal of Cartography, 1:1, pp. 5-17. Taylor & Francis Group, London.
- Simonné Dombóvári E., Reyes J., Gartner G., Schmidt M. and Rohoncz A., 2012. Chernoff faces as an alternative method of representation in schools: Austrian-Hungarian survey. In: Bandrova T, Konecny M, Zhelezov G (Eds.) Proceedings 4th International Conference on Cartography and GIS.
- Tobler, W., 2016. Reprinted articles [Online] Available at <http://www.geog.ucsb.edu/~tobler/publications/reprints.html> [Accessed 26 May 2016]

Suggested literature:

- Other websites related to the topics included in the course.
- Proceedings of International Cartographic Conferences [Online] Available at <http://icaci.org/publications/> [Accessed 26 May 2016]
- International bibliography on the Hungarian website recommended for the study of cartograms: <http://lazarus.elte.hu/hun/dolgozo/jesus/otka0810/hivatk.htm>

Individual Cartographic Project (practice)

Students, independently manage a complex cartographic project, which is driven by instructors, The tasks must contain the interpretation of problem solving of a relevant topic in cartography, it can be a complex map creation project.

Segments of the task:

- preparations
- creating the legend
- selection of the software
- symbols, styles, colours
- map overlay design
- printing

All the required and recommended literature of the concerned disciplines

Individual Geoinformatic Project (practice)

Students, independently but driven by instructors, carry out a complex task on the basis of previous studies. The tasks must contain the interpretation of problem solving of a relevant topic in GIS environment or creating and interpretation of a complex spatial information system.

Segments of the task:

- formulation of the topic and the basic questions
- data collection, digitization
- designing the database / programming
- queries
- analysis, evaluation of the results, conclusions
- development of the system and publication of the results
- documentation of the project

Literature:

All the required and recommended literature of the concerned disciplines

Open Source Web GIS Programming

MapServer

Fundamentals. Structure and contents of the Mapfile

Classification, styling

Map projections

Various inputs: Shape files, other file formats, relational databases

Output possibilities: „map” mode, WMS, WFS

OpenLayers

OpenLayers fundamentals. Adding simple controls

Layer types: third party maps, images, vectors

Vector styling.

Combining MapServer with OpenLayers

Advanced controls.

Literature:

Erik Hazzard: OpenLayers 2.10 Beginner's Guide. Packt Publishing, 2011

Suggested literature:

Antonio Santiago Perez: OpenLayers Cookbook. Packt Publishing, 2012

Spatial System Design

Methodology of system design and system construction, schematic system architecture.
Building strategies, analysis and function planning.
Physical design: tables, charts, functions.
System implementation, documentation, deliverance and monitoring.
Finding appropriate data sources, data parameterization, critical analysis and synthesis of data sources.
Advanced use of ArcGIS: spatial queries (is within, overlap, intersect, contains, near to, etc), attribute queries, spatial queries, spatial data analysis: buffer zones, overlay.
Map conversions to different projection systems.
Joint management of vector and raster data.
Editing maps: editing tools and complex spatial editing operations (join, modify, merge by geometry, attributes by merge) in Arc Map.
Linking external data to map projects: geocoding.
Construction and use of address register, address based geocoding.
Methods of map finishing and map publishing.
Consultation.

Literature:

ESRI: Building Spatial Databases

Suggested literature:

Modeling Our World: The ESRI Guide to Geodatabase Concepts Paperback, by Michael Zeiler, ESRI Press, 2010

Output-oriented Digital Cartography

Theoretical background of computer cartography

The effect of IT development to computer cartography

Hardware elements

- computers
- input devices
- output devices

Software elements

- operation systems
- colours
- texts
- software types in computer cartography
- file formats

Evolution of output devices in computer cartography

Offset printed maps

Colour separation

Proofs

Imagesetting

Digital printing

Practice

A general graphic software

Map drawing software

Geovisualization

Visualization importance in human cognition. Information visualization, data visualization, scientific visualization, geovisualization.

Processes of human vision, visual space. Spatial vision, language, memory and learning.

Spatial cognition, orientation, wayfinding and navigation. Reference frames for spatial orientation. The development of the category of space and representation.

External and internal spaces, cognitive and mental maps. Spatialization, abstract and virtual spaces.

Representational tools and cognitive evolution. The development of geovisualization methods.

Data model and representational model.

Graphic semiotics: data relations and visual variables.

Multimodal representation. Multimedia, virtual reality.

Time: animation, visualization of spatio-temporal processes.

Geovisualization and user interactivity.

The effectiveness of visualization: research methods. Cognitive geovisualization research experiments, visualization of research data.

Literature:

MacEachren, A.M. – Kraak, M.J.: Exploratory cartographic visualization: advancing the agenda. In: *Computers & Geosciences*, 23 (4), 1997.

Colin Ware: *Information Visualization: Perception for Design*. Interactive Technologies. Wiley, New York, 2011.

Griffin, A.L., Fabrikant, S. I. (2012). More Maps, More Users, More Devices Means More Cartographic Challenges, *Cartographic Journal*, Vol. 49, No. 4: 298-301.

Suggested literature:

Edward Tufte. *Envisioning information*. Plenum Press, Boston, 2001.

Jacques Bertin: *Semiology of Graphics*. Univ. Of Chicago Press, Chicago, 1985.

Scripting Languages in Webcartography

JavaScript

- Language basics
- Styling: CSS and JavaScript
- Event handling
- Case study
- Google Maps JavaScript API

PHP

- Language basics
- Database connections
- Dynamic content generation

Literature:

HTML 5 Specification: <http://www.w3.org/TR/html5/>

Google Maps JavaScript API:

<https://developers.google.com/maps/documentation/javascript/tutorial>

Suggested literature:

PHP Manual: <http://php.net/manual/en/index.php>

Web cartography

- 1.- Introduction: Brief history of the Web and HTML language. More frequent file formats. Vector- and raster-based graphic formats.
- 2.- Web resources for making maps 1: base maps
- 3.- Web resources for making maps 2: thematic data and maps
- 4.- Basics of HTML language 1: Basic characteristics of HTML5. Internal structure of the HTML files and its components. Heading of a file, HTML tags in the heading. Main HTML codes.
- 5.- Basics of HTML language 2: Brief description of CSS and JavaScript. Use of styles and JavaScript modules in HTML files.
- 6.- Types of HTML editors, practical presentation of free software, including Web-based editors.
- 7.- Definition and characteristics of an image map, HTML codes needed for its programming. Use of image maps in websites related to Cartography: advantages and disadvantages.
- 8.- Preliminary steps to make an image map: re-edition of vector-based files, conversion to raster format.
- 9.- Free software and websites to make image maps.
- 10.- Newest map-based solutions on the Web 1: Cloud-based thematic mapping. The Google World
- 11.- Newest map-based solutions on the Web 2: Cloud-based thematic mapping software (Google Drive Fusion Tables)
- 12.- Google-based collaborative cartography 1
- 13.- Google-based collaborative cartography 2

Literature:

- HTML(5) Tutorial [Online] Available at <http://www.w3schools.com/html/default.asp> [Accessed 26 May 2016]
- CSS Tutorial [Online] Available at <http://www.w3schools.com/css/default.asp> [Accessed 26 May 2016]
- JavaScript Tutorial [Online] Available at <http://www.w3schools.com/js/> [Accessed 26 May 2016]
- HTML <map> Tag (for images maps) [Online] Available at http://www.w3schools.com/tags/tag_map.asp [Accessed 26 May 2016]
- Thematic mapping blog [Online] Available at <http://blog.thematicmapping.org/> [Accessed 26 May 2016]
- Google for Education [Online] Available at <https://www.google.com/edu/products/productivity-tools/#> [Accessed 26 May 2016]
- Google Fusion Tables (About Fusion Tables) [Online] Available at <https://support.google.com/fusiontables/answer/2571232?hl=en> [Accessed 26 May 2016]

Suggested literature:

- BlueGriffonTM: The next-generation Web Editor based on the rendering engine of Firefox [Online] Available at <http://bluegriffon.org/> [Accessed 26 May 2016]
- CKEditor [Online] Available at <http://ckeditor.com/> [Accessed 26 May 2016]
- Plone CMS: Open Source Content Management [Online] Available at <http://plone.org/> [Accessed 26 May 2016]
- Segal, N. How to Create Image Maps With HTML and CSS. [Online] Available at <http://www.htmlgoodies.com/beyond/css/how-to-create-image-maps-with-html-and-css.html> [Accessed 26 May 2016]
- Google Maps APIs: Static Maps API V2 Developer Guide [Online] Available at <https://developers.google.com/maps/documentation/staticmaps/> [Accessed 26 May 2016]

Software, applications:

- BlueGriffonTM: The next-generation Web Editor based on the rendering engine of Firefox [Online] Available at <http://bluegriffon.org/pages/Download> [Accessed 26 May 2016]
- CKEditor [Online] Available at <http://lazarus.elte.hu/~jesus/ckeditor/> [Accessed 26 May 2016]
- Maschek Online Image Map Editor [Online] Available at <http://www.maschek.hu/imagemap/imgmap> [Accessed 26 May 2016]
- Image-Maps [Online] Available at <https://www.image-maps.com/> [Accessed 26 May 2016]
- Image Map Editor for Firefox [Online] Available at <https://addons.mozilla.org/hu/firefox/addon/ime/> [Accessed 26 May 2016]

Coordinate systems on the earth ellipsoid and on the maps

- Elements of the coordinate systems on several surfaces
- Geometry of the ellipsoid and its parametrization
- Transformation of different coordinates of the sphere
- Transformation of different coordinates of the ellipsoid
- Direct and inverse problem of the sphere and ellipsoid
- Converting between different geodesic data coordinates
- Direct mapping from the ellipsoid onto a plane and its using in the cartography
- Mapping from the ellipsoid onto an aposphere and its using in the cartography
- Azimuthal projections of the ellipsoid
- Transverse and oblique cylinder projections of the ellipsoid
- Global map coordinate systems (Gauss-Krüger, UTM, MGRS)
- Conical projections of the ellipsoid and their using in the cartography

Literature:

Snyder, J. P.: Map Projections – A Working Manual. USGS Professional Paper 1395. Washington 1987.

Maling, D. H.: Coordinate Systems and Map Projections. 2nd edn. Pergamon, Oxford 1992.

HTML Tutorial [Online] Available at

http://mercator.elte.hu/~gyorffy/jegyzete/Coord_sys/Coord_systems.html [Accessed 25 May 2016]

Suggested literature:

Bugayevskiy L. M. - Snyder, J. P.: Map Projections. A Reference Manual. Taylor and Francis, 1995.

Navigation systems

Introduction, historical review
Celestial positioning, basic of navigation, chronograph systems
Earth based radio navigation systems (GEE, LORAN, DECCA, OMEGA etc.)
Doppler and NNSS – from the beginnings
LEO systems (Oscar, Transit, Tsikada, Parus etc.)
MEO, HEO systems, inter planetary navigation systems
NAVSTAR/GLONASS
GALILEO/COMPASS
Augmentation systems (EGNOS, WAAS, MTSAS, GZSS, GAGAN etc.)
GNSS permanent stations and systems, NTRIP
High precision positioning and navigation
Mobile solutions
Measurements error solutions
Field measurement

Literature:

Hofmann-Wellenhof, Bernhard, **Lichtenegger**, Herbert, **Wasle**, Elmar, 2008. GNSS – Global Navigation Satellite Systems, Springer-Verlag Wien, ISBN: 978-3-211-73012-6
Esmat Bekir: Introduction to Modern Navigation Systems
World Scientific Publishing Company, 2007
Mohinder S. Grewal, Lawrence R. Weill, Angus P. Andrews: Global Positioning Systems, Inertial Navigation, and Integration, Wiley, 2007, ISBN: 978-0-470-09971-1

Suggested literature:

Laurie Tetley et al: Electronic Navigation Systems, Taylor & Francis, 2012, ISBN: 978-0-7506-5138-7

The English language terminology of cartography
<ul style="list-style-type: none">• The vocabulary of earth sciences• The vocabulary of auxiliary sciences (mathematics, history)• Professional periodicals in English
Literature: Basic Cartography 1–2. International Cartographic Association, 1984 Science in the News. Voice of America, 1989
Suggested literature: H. Dreyfuss: Symbol Sourcebook. McGraw Hill, London, 1972