



Course Syllabus

Course Code	Course Title	ECTS Credits
COMP-342	Data Visualization	6
Prerequisites	Department	Semester
COMP-240	Computer Science	Spring
Type of Course	Field	Language of Instruction
Required	Data Science	English
Level of Course	Lecturer(s)	Year of Study
1 st Cycle	Dr. D. Trihinas	3 rd
Mode of Delivery	Work Placement	Corequisites
Face-to-Face	N/A	None

Course Objectives:

The main objectives of the course are to:

- Provide a comprehensive overview of the practice of data visualization.
- Discuss the persuasive power of data visualization and the benefits of storytelling through data to visually communicate analysis results.
- Introduce techniques and aesthetic rules for creating effective visualizations based on principles and perspectives derived from the visual arts, perceptual psychology, journalism and cognitive science.
- Introduce a number of common data domains and corresponding visualization methods and algorithms for multivariate data, graphs, cartography and timestamped data.
- Demonstrate methods and algorithms to model, curate and visually depict distributions, uncertainty and error-bounds to aid the exploration of hidden relationships and correlations among visualized data.
- Present algorithms and techniques to efficiently and effectively model, curate and visually depict large datasets and streaming data.
- Summarize methods for designing and developing interactive and exploratory data visualizations.
- Provide an overview on available software tools for data visualization.

Learning Outcomes:

After completion of the course students are expected to be able to:

- Develop an understanding of the fundamentals of storytelling through data and the alignment around basic concepts that are required to effectively present and communicate analysis results.
- Distinguish between informative and deceitful data visualizations.
- Create relatively high-quality visualizations to aid statistical and exploratory data analysis by applying suitable visualization techniques and aesthetic principles.
- Apply appropriate principles to depict data distributions, uncertainty and error bounds to extract and explore hidden relationships and correlations among visualized data.
- Leverage incremental and approximation techniques to balance the complexity and clutter when visualizing large datasets and data streams.
- Demonstrate the ability to curate and visually depict spatio-temporal datasets.
- Understand the basic principles and concepts implied to visually apprehend and depict high-dimensional data.
- Acknowledge the basic methods and principles for creating informative, interactive and responsive data visualization dashboards and services.
- Develop an introductory level of competency on the use of software tools for data visualization.

Course Content:

1. Storytelling Through Data
 - a. The Art of Visual Communication
 - b. Exploratory vs Explanatory Visualizations
 - c. Reproducibility and Repeatability
 - d. Separation of Content and Design
 - e. Visualization Software
2. Aesthetics
 - a. Coordinate Systems and Axes
 - b. Data Types, Color Coding and Scales
 - c. Visualizing Univariate Data
 - d. Bar and Pie Plots, Scatter Plots, Heatmaps
3. Data Distributions and Correlations
 - a. Histograms and Density Plots
 - b. Cumulative Distribution Functions
 - c. Correlograms
 - d. Data Correlation vs Causality
4. Data Quality and Uncertainty

- a. The Data Quality Continuum
- b. Uncertainty in Empirical Data
- c. Measuring Data Quality
- d. Error-Bounds, Box Plots and Q-Q plots
5. Timeseries, Text and Spatio-Temporal Data
 - a. Point and Distance Data
 - b. Timestamped Data
 - c. Sliding Windows
 - d. Plotting Maps, Graphs and Word Clouds
 - e. Geographic Information Systems
6. Data Visualization at Scale
 - a. Interactive Latency and Big Data Navigation
 - b. Data Streams
 - c. Incremental Models and Approximation Techniques
 - d. Sampling, Filtering, Change Detection
7. Visualizing High-Dimensional Data
 - a. Multivariate Data
 - b. Dimensionality Reduction (e.g., PCA, t-SNE, Isomaps)
 - c. Paired Diagrams, 3D plots, Glyphs
 - d. Layered and Overlapping Data
8. Dashboards and Services
 - a. Monitoring and Logging
 - b. Responsiveness
 - c. Data Diffusion
 - d. Human Interaction
 - e. Exploratory Visualization Services

Learning Activities and Teaching Methods:

Lectures, In Class Exercises, Lab Sessions, Discussions.

Assessment Methods:

Final Exam, Midterm Exam, Semester Project, Weekly Homework.

Required Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Visualization Analysis and Design	Tamara Munzner	CRC Press	2014	978-1-466-50891-0

Recommended Textbooks / Readings:

Title	Author(s)	Publisher	Year	ISBN
Fundamentals of Data Visualization*	Claus O. Wilke	O'Reilly Media	2018	978-1-492-03108-6
Python Data Science Handbook	Jake VanderPlas	O'Reilly Media	2016	978-1-491-91205-8
The Visual Display of Quantitative Information (2 nd edition)	Edward Tufte	Graphics Press	2001	978-1-930-82413-3

* Made freely available online by the author: <https://serialmentor.com/dataviz/>