

Tallinn University Winter School: Data Analytics & Visualization.

Duration: 2 weeks (10 days, 3 hours per day)

Audience: Bachelor's & Master's students, mixed background

Structure: Lecture/discussion (60 min) → Break (30 mins) → Hands-on/lab (90 min) → Wrap-up (30 min)

Week 1: Foundations of Visualization & Data Literacy

Day 1 – Introduction to Data & Visualization

- **Lecture:**
 - What is data visualization, and why does it matter?
 - Historical perspectives (from Playfair to Minard to Florence Nightingale)
 - The data → information → knowledge → insight chain
 - **Lab:**
 - Exploring famous historical visualizations, group critique
 - Hands-on: simple plots (bar, line, scatter) in Python + Seaborn, Matplotlib
 - **Outcome:** Students understand the role of visualization in communication.
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Day 2 – Visual Perception & Cognitive Principles

- **Lecture:**
 - How humans perceive patterns (Gestalt principles, pre-attentive attributes)
 - Color perception, accessibility considerations (color blindness)
 - Common cognitive pitfalls (e.g., chartjunk, 3D effects)
 - **Lab:**
 - Critique of “bad charts” from media, redesign exercises
 - Experiment with color schemes using tools (ColorBrewer, Viz Palette)
 - **Outcome:** Students grasp perceptual principles behind effective visualization.
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Day 3 – Data Types & Chart Types

- **Lecture:**
 - Matching data types to visual forms (categorical, ordinal, quantitative, time series, spatial)
 - The grammar of graphics (what encodes what)
 - Strengths/weaknesses of common chart types
- **Lab:**

- Hands-on: creating appropriate charts for different datasets
 - Mis-matched visualizations (e.g., pie charts for time series) → critique and correction
 - **Outcome:** Students learn to select the right chart for the right data.
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Day 4 – Principles of Good Visualization

- **Lecture:**
 - Edward Tufte's principles (data-ink ratio, avoiding distortion, maximizing data density)
 - Stephen Few's guidelines on clarity
 - Storytelling vs. exploration
 - **Lab:**
 - Re-designing poor visualizations with Tufte/Few principles
 - Students annotate what makes a viz good or misleading
 - **Outcome:** Students can apply theoretical design principles to improve charts.
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Day 5 – Exploring Multivariate Data

- **Lecture:**
 - Beyond univariate: relationships between multiple variables
 - Visual encodings for multivariate data (scatterplot matrix, small multiples, parallel coordinates)
 - Trade-offs between simplicity and completeness
 - **Lab:**
 - Students visualize relationships in a multivariate dataset (e.g., cars dataset, world development indicators)
 - **Outcome:** Students practice handling richer datasets and balancing clarity vs. complexity.
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Week 2: Advanced Visualization Theory & Practice

Day 6 – Visualizing Time, Space, and Networks

- **Lecture:**
 - Time series visualization: trends, seasonality, uncertainty
 - Geospatial visualization: maps, choropleths, pitfalls of geographic encoding
 - Networks: when relationships matter more than values
- **Lab:**
 - Hands-on:
 - Time series exploration (temperature data, stock prices)
 - Basic mapping (choropleth or symbol map using simple tools)

- **Outcome:** Students understand challenges of visualizing time and space.
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Day 7 – Narrative Visualization & Storytelling

- **Lecture:**
 - Exploratory vs. explanatory visualization
 - Narrative structures in data stories
 - The role of annotation, sequencing, and interactivity
 - **Lab:**
 - Students turn a static dataset into a short “story” with 3–5 annotated visuals
 - Peer critique session
 - **Outcome:** Students practice turning data into a narrative, not just a chart.
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Day 8 – Ethics, Misrepresentation & Persuasion

- **Lecture:**
 - Ethics in visualization: cherry-picking, truncating axes, misleading design
 - Data privacy and responsible communication
 - Persuasion vs. manipulation
 - **Lab:**
 - Students “fix” misleading charts from media sources
 - Group debate: visualization as truth vs. visualization as rhetoric
 - **Outcome:** Students develop critical thinking about ethical choices in visualization.
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Day 9 – Workshop: Student Mini-Projects

- **Lecture:**
 - Framing a visualization project: asking good questions, choosing data, defining audience
 - Examples of successful student projects
 - **Lab (majority of session):**
 - Students (individually or in pairs) pick a small dataset and develop a **mini visualization project** (EDA + 2–3 clear visualizations with explanation)
 - **Outcome:** Students begin an end-to-end project applying theory & practice.
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Day 10 – Project Presentations & Course Wrap-Up

- **Student Presentations:**
 - Each student/group presents their project (5–7 min each)
 - Focus on clarity, storytelling, and application of design principles

- **Wrap-Up Lecture:**
 - Recap of major themes (perception, design principles, ethics, storytelling)
 - Trends in visualization (interactivity, AI, immersive viz)
- **Outcome:** Students leave with a completed mini-project and a strong grounding in theory.