Tallinn University Summer School: Data Analytics & Visualization.

Duration: 2 weeks (10 days, 3 hours per day + 30 mins break)
Audience: Bachelor's & Master's students, mixed background
Format: Lecture/discussion (60 min) → Break (30 mins) → Hands-on/lab (90 min) → Wrap-up (30 min)

What is it about?
The course is designed to teach you the fundamentals of data visualization, including key concepts and principles for producing clear and convincing plots and graphs. By the end of the course, you will know how to transform raw data into insightful representations that support discovery and decision making.

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
  - Key definitions and concepts in data visualization
- **Lab:**
  - Exploring famous historical visualizations, group critique
  - Hands-on: simple plots (bar, line, scatter) in Python + Seaborn, MatPlotLib

By the end of Day 1, students understand the history and role of visualization in communication.

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 Gestalt principles
  - Experiment with color schemes using tools (ColorBrewer, Viz Palette)

By the end of Day 2, students grasp the perceptual principles behind effective visualization and know how to utilize them effectively in their work.

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

By the end of Day 3, students will know the different types of data and the best ways to visualize them, and recognize when wrong ways of visualization can be used to change the facts and deceive the reader.

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

By the end of Day 4, Students know the principles of good visualization, can spot inconsistencies and mistakes in the visualizations they see in print and media, and can apply theoretical design principles to improve their charts.

Day 5 – 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 lab exploring:
    - Time series exploration (temperature data, stock prices)

        - Basic mapping (choropleth or symbol map using simple tools)

By the end of Day 5, students understand the challenges of visualizing time and space and can apply new knowledge to create interactive maps and networks.

Week 2: Advanced Visualization Theory & Practice

Day 6 – Ethics, Misrepresentation & Persuasion, Storytelling

- **Lecture:**
    - Ethics in visualization: cherry-picking, truncating axes, misleading design
    - Persuasion vs. manipulation
    - Exploratory vs. explanatory visualization
    - The role of annotation, sequencing, and interactivity
- **Lab:**
    - Students “fix” misleading charts from media sources
    - Group debate: visualization as truth vs. visualization as rhetoric

By the end of Day 6, students develop critical thinking about ethical choices in visualization, understand the role of specific design elements, and can apply these principles to their work.

Day 7 – AI tools (Google Collab, Anthropic, ChatGPT, Cursor, etc.)

- **Lecture:**
    - Abilities and limitations of tools;
    - Additional libraries and packages for data visualization.
- **Lab:**
    - Use more advanced tools to produce and interpret visualizations.

By the end of Day 7, students know an extensive list of AI-enabled tools that can help them use advanced AI models, agents, and skills to turn data into visualizations.

Day 8 – Advanced Prompting, AI Agents

- **Lecture:**
    - Programming better than simple prompting
    - AI Agents for visualizations
    - Skills for AI agents
- **Lab:**
    - Hands-on:
        - Writing your own skills (yourskill.md file)
        - Using skills for advanced data visualization

By the end of Day 8, students know advanced techniques for prompt writing, can navigate skill libraries, create their own AI skills, and command agents to use those skills for data visualization.

Day 9 – Workshop: Student Mini-Projects

- **Lecture:**
  - Framing a visualization project: asking good questions, choosing data, and 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)

By the end of Day 9, students have a draft of a project that applies previously learned theory to data of their choice.

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)

By the end of Day 10, students leave with a completed mini-project, can justify their choices, and can demonstrate the knowledge gained through a project presentation.