

Course Description

With the advent of powerful data-mining technologies, engineers in all disciplines are increasingly expected to be conscious of the interaction between massive quantities of information. This multidisciplinary course introduces the practical concepts of graphic design related to data visualization and interactive design through short hands-on projects. This course is specifically designed with engineering majors in mind; it focuses on their knowledge and provides a powerful tool for engineers to use to communicate their studies in technical fields.

Course topics include: cognitive load theory, communication design, identification of “chart junk”, graphical integrity, optimization of data-ink in multivariate data sets, infographics, vector graphics, and interactive data visualization using JavaScript.

Course Objectives

By the conclusion of this course students will:

- Understand how to more effectively communicate information using efficient visuals
- Be able to identify and analyze misleading charts and visualizations
- Articulate a practical understanding of symbolism as it applies to cognitive load theory
- Demonstrate familiarity with visual design by developing an interactive data visualization
- Present their skills in visual design and communication in a concluding conference

Prerequisites

No previous knowledge of course material is expected. Prior experience in image editing or object-oriented programming may lead to a more sophisticated final project but is not required.

Course Instructor

Kevin McVey: 4th Year Computer Engineering major with Architecture minor focused on art and visual design. Interests and current fields of study include embedded systems, computer graphics, HCI, and engineering applied to the study and analysis of real-world phenomena.

Email: kmm4ce@virginia.edu

Unresolved issues with the course, grades, or instructor, should be taken to the point of contact.

Point of Contact

Prof. Tom Horton: Associate Professor of Computer Science. Research interests include computer science education, software engineering, text analysis, and humanities computing.

Email: horton.uva@gmail.com

Optional Textbook

The Visual Display of Quantitative Information, 2nd Edition, by Edward R. Tufte

Note: Reading is not required but has been scheduled to enrich the experience for those interested.

Grading

- 40%: Attendance Only two class sections may be missed, all others are weighted equally.
- 30%: Homework Each homework assignment will be graded by the Instructor and given a score between 1 and 5 based upon the work's reflection of the student's understanding of course material.
- 30%: Final Project Students will be required to produce an interactive visualization by the conclusion of the course. On the final class meeting, students will present their projects and will be graded on the quality of their project and their understanding of course material as shown in their presentations.

Students are **not** graded on their artistic ability; previous design experience is **not** required.

Course Schedule

Week 1: Introduction to Visualization

- What is Data Visualization?
- What can engineers learn from graphic designers and why does it matter?
- Examples of bad graphics and good graphics in numerous situations

Week 2: Graphical Excellence

- Finding relationships in multivariate datasets
- How 2 and 2 together can tell the story of 5
- Organization and juxtaposition

Week 3: Chart Junk

- Beautiful design vs. useful design
- Paring down designs to make visuals more efficient
- Cognitive Load theory

Week 4: Communication Design

- Affordances
- Symbolism and cultural constraints
- Consistency in design
- Feedback and clarity

Week 5: Data-Ink and Redesign of graphs

- The essential, un-erasable portions of graphics
- Edward Tufte's "Data-Ink Ratio" equation
- Erasure, symmetry, and redundancy

Week 6: Graphical Integrity and Graph Evaluation

- How graphics are used to skew data: Omission, sampling, and graphic bias
- Edward Tufte’s “Lie Factor” and “Data Density” equations
- “Small Multiples”

Week 7: Welcome to Vector Graphics and Raphaël

- Shapes and paths, the vector graphic building blocks
- How to use Raphaël to draw vector graphics to the “Paper”
- Vector graphic attributes

Week 8: JavaScript Basics and Raphaël

- Weakly typed variables: “var”
- Prototypes in place of classes
- Functions as first-class objects

Week 9: Interactivity and Animation in Raphaël

- How to use Raphaël Element functions that enable interactivity
- Using the Animation class to make vector graphics visually responsive

Week 10: Moving from Table to Visual

- Modulating vector graphics using actual data
- Automating the process of data dense image generation

Week 11: A Short Crash Course in Aesthetics

- Line weight
- Color schemes
- Typography
- Scale and juxtaposition

Week 12 / 13: Final Project Workshops

- Share final project progress and discuss improvements

Week 14: Final Project Presentations – Visualization Conference

- Present final projects to peers and guests

Reading Schedule

Course readings are entirely optional. Those who want a more in-depth look at course topics are encouraged to follow the following reading schedule from the course text:

Week	Best Paired With Chapter...
Weeks 1 – 2	1: Graphical Excellence
Weeks 3 – 4	5: Chartjunk: Vibrations, Grids, and Ducks
Week 5	4: Data-Ink and Graphical Redesign
Week 6	2: Graphical Integrity
Week 10	7: Multifunctioning Graphical Elements
Weeks 11 – 12	9: Aesthetics and Technique in Data Graphical Design