Reminder: “Rules” for the course

- As class participation is 5% of your grade:
  - Using laptops during class is strongly discouraged
  - If you’re using your laptop you need to participate twice as much as everyone else because I’m going to assume you’re doing something else.

- Use of laptops for reference during paper discussion is allowed

- Sit in a different seat, next to different people, each lecture
  - Work with a different person for each in-class “worksheet”
Today

- “Good” Design (30 min)
  - Photography tips
  - Principles of Effective Website Design
  - Principles of Good User Interface Design
  - Examples of Good (Bad) Visualization Design

- Today’s Reading (30 min): “Useful Junk? The Effects of Visual Embellishment on Comprehension and Memorability of Charts”

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- Graph Drawing Preview: Terminology & Goals (15 min)

- Readings for Tuesday: Graph Drawing

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Kodak

Top Ten Tips

1. Get down on their level
2. Use a plain background
3. Use flash outdoors
4. Move in close
5. Take some vertical pictures
6. Lock the focus
7. Move it from the middle
8. Know your flash’s range
9. Watch the light
10. Be a picture director
“Canonical” Viewpoints

- From Dictionary.com:
  - authorized; recognized; accepted
  - the body of rules, principles, or standards accepted as axiomatic and universally binding in a field of study or art: the neoclassical canon
  - a fundamental principle or general rule: the canons of good behavior
  - a standard; criterion: the canons of taste

“What object attributes determine canonical views?” Blanz, Tarr, & Bulthoff, Perception 1999
• Salience and significance of the features
• Stability of viewpoint to small transformations
• Minimize number of occluded features
• Familiarity, functionality, aesthetic criteria

“What object attributes determine canonical views?” Blanz, Tarr, & Bulthoff, Perception 1999
Rule of Thirds


- Place horizon at top or bottom line.
- Place subject on guide lines and intersection points
- Avoid placing subject at center, avoid dividing picture in half

![Without Rule of Thirds](image1.png)

![With Rule of Thirds](image2.png)

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Principles of Effective Website Design

- Guiding the eye (position, color, contrast, size, design elements)
- Spacing, padding, white/empty space, reduce cognitive load
- Navigation/orientation
- Typography (font, size, color, paragraphs)
- Usability/standards/conventions, be obvious,
  “Don’t make users think”
- Consistency
- Alignment, polished, simplicity
- Effective writing
- Clarity, sharpness, contrast, exaggeration

http://psd.tutsplus.com/tutorials/designing-tutorials/9-essential-principles-for-good-web-design/
http://uxdesign.smashingmagazine.com/2008/01/31/10-principles-of-effective-web-design/

Principles of Good User Interface Design

- Consistency and standards
  - Match real world: words, phrases and concepts familiar to the user,
    real-world conventions, natural and logical order, coherency
- Flexibility and efficiency of use: cater/tailor to both inexperienced and experienced users
  - Know your user, user testing, listen to the user
- User control and freedom: a clearly marked "emergency exit" to leave the unwanted, support undo and redo
- Aesthetic and minimalist design: every extra unit of information competes with and diminishes visibility of relevant information
  - System status: keep users informed
- Recognize, diagnose, and recover from errors
  - Error prevention: good error messages, eliminate error-prone conditions, confirmation option
- Help and documentation
  - Recognition rather than recall: information/instructions should be visible or easily retrievable

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Worst pie chart ever?
Excellent use-case
For on-chart imagery

Unbiased reporting
Good data-ink ratio
Oversimplification?
Manipulative visualization?
Confusing / unnecessary colors/gradient

Simple, intuitive, effective
Educational for all ages
Compare players within team

Compare players on different teams

Different team choices/strategies

Effective non-pie shaped pie chart!
Are all datasets relevant to plot on a world map?

Allows us to clearly see significant variations in distributions of rivers AND use (overuse?) of technology to control nature
**Stereotypical Infographic**

http://www3.gehealthcare.com/en/Products/Categories/Healthcare_IT/Quality_Management#/tabs/tab1900328377C74CAC8AD7E8D4A2072591

**HEALTHY EATING PLATE**


*Vast improvement on original food pyramid*
• **Scientific Visualization (SciVis)**
  – really large quantities of data
  – data usually has inherent structure
  – often has a spatial and/or temporal component (coordinate system)
  – often appropriate to use of 3D visualization techniques
  – such as medical, hurricane, computational fluid dynamics (CFD) data

• **Information Visualization (InfoVis)**
  – smaller datasets
  – data that does not have an inherent structure (may not have coordinate system)
  – financial stock market data, demographic census data, genetic data, etc.

• **Visual Analytics**
  – involves a cycle of rapidly creating visualizations to answer questions and generate new questions about a dataset

• Infographics are typically in the realm of InfoVis, and often they show the results of the visual analytics process, but SciVis is not really a part of most infographics.

• Annual IEEE Visualization and IEEE InfoVis (Information Visualization) conferences are two separate entities. The set of people organizing, attending and involved one conference is almost disjoint from the other set.


An Interactive Visualization!
(interactive data collection)
Visualization Challenge: very large datasets

Average World Temperature Since 1850
20th century average 13.7°C, Data HadCRUT4

Visualization Challenge: representing different scales

Radiation Dose Chart
https://xkcd.com/radiation/
Theodor Benfey, “periodic snail”, 1964

Better proximity for related elements

(but more difficult to embed numerical data)
chicanaspice

this information is so satisfying but idk what to do with it
Figurative Map of the successive losses in men of the French Army in the Russian campaign 1812-1813.
Charles Joseph Minard, 1869.

The numbers of men present are represented by the widths of the colored zones at a rate of one millimeter for every ten thousand men; they are further written across the zones. The red designates the men who enter Russia, the black those who leave it. — The information which has served to draw up the map has been extracted from the works of M.M. Thiers, de Ségur, de Fezensac, de Chambray and the unpublished diary of Jacob, the pharmacist of the Army since October 28th.

In order to better judge with the eye the diminution of the army, I have assumed that the troops of Prince Jérôme and of Marshal Davout, who had been detached at Minsk and Mogilev and have rejoined near Orsha and Vitebsk, had always marched with the army.

Edward Tufte says it "may well be the best statistical graphic ever drawn"
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Reading for Today

- Article discussed here: http://eagereyes.org/criticism/chart-junk-considered-useful-after-all
What is “Chart Junk”?

• Extraneous elements in a chart or visualization
• Does not represent data
• Data-to-ink ratio (aim to convey more data with less ink)
• According to Edward Tufte: It’s not just unnecessary, it’s harmful (distracting)
• According to Nigel Holmes: Visualization should engage the reader’s interest

Study Design

“Useful Junk? The Effects of Visual Embellishment on Comprehension and Memorability of Charts” Bateman, Mandryk, Gutwin, Genest, McDine, & Brooks, CHI 2010

• Compare embellished charts to plain ones
• Measured:
  – interpretation accuracy was no worse for embellished charts
  – long-term recall (2-3 weeks later) was better for embellished charts, topic & details of the chart were more memorable
• Prior work:
  – Higher data-to-ink → faster response & greater accuracy [Gilan & Richman]
  – Other work shows a somewhat weak correlation between data-to-ink and interpretability or aesthetics
• Author’s caution:
  – Not an endorsement of chart junk
  – Embellishments can lead to bias!
• Relatively small sample pool
  – 10 tested with ~5 min recall
  – 10 tested with 2-3 week recall
• Found no difference in time to read & describe embellished vs. non-embellished
• Participants preferred the embellished charts and found them more attractive

• Viewing time was unlimited for this study
  – Participants ended up spending the ~same amount of time on embellished vs. non-embellished
  – Effect of limiting time not measured
• Chart junk for these examples was tightly coupled with subject & details of chart
  – Quote from Holmes: “I think [Tufte] missed the point of much that I was trying to do: TIME magazine charts were aimed at lay readers, not unintelligent ones, but busy ones. I knew they’d get the point quicker if they were somehow attracted to the graphic.”
• What about charts from paper on last slide? What was their point? How good is your recall? Will your recall them in 2-3 weeks? Why didn’t the authors use embellishment?
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Pair Worksheet (~20 minutes)

• Meet new people
  – Work with someone you did not know before this class
  – Work with a different partner every time

• 1 worksheet per team of 2
  – Sketch & brainstorm on the page
  – (I’ll scan & upload to Submitty for your review)

• Use color! Be creative!
Homework 2: Time-Based Datasets

• Team of 2
• Obtain an interesting time-based dataset
  – Should be collectable* from online sources, and
  – Require a modest effort to prepare*
    * = you’ll submit your scripts/code to document
• Use Microsoft Excel or Google Sheets or LibreOffice Calc
  – Create a variety (one of each?!?) of the charts following the
guidelines from "Eenie, Meenie, Minie, Moe: Selecting
the Right Graph for Your Message"
  – Excellent labels and captions for each
• Upload your assignment to Submitty by Thursday @ 11:59pm
And post two of the charts on the forum

Tools for Scraping Data from the Web

• copy-paste
• wget
• grep / sed / awk / sort / uniq
• Favorite programming language to parse/strip out
  unnecessary html formatting
• Save as .csv (comma separated value) files to upload to
  Excel / Google Sheets
• Python has lots of packages for parsing (e.g., json format)
• Selenium for automated browsing of websites
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Graph Terminology I

- Directed vs. Undirected Edges
- Tree (no cycles) vs. Graph (cycles allowed)
  - Cycle: A path along edges through the graph starting & ending at the same vertex.
  - Cycle Variants: closed walk, simple cycle, directed cycle, …
- Valence (a.k.a. Degree) of a Vertex:
  # of edges incident on the vertex
- Regular: Each vertex has same valence,
  a 3-regular graph is also called cubic
Graph Terminology II

- Polygon: 2D flat or on a sphere, with straight or great circle edges
- Polyhedron: 3D solid formed by flat faces
- Polytope: flat sides in any dimension

- Bipartite: vertices can be split into two groups, A & B. No edge connects a vertex in A to another vertex in A. Same for B.
- Clique – subset of vertices in an undirected graph with an edge connecting every pair of vertices in the subset.
Graph Terminology III

- Upward Drawing (of a tree) – no child is drawn with vertically above (higher y value than) its parent.
- Plane Graph – A 2D drawing of the graph where no edges cross (touching at the endpoint vertices they share is ok)
- Planar Graph – A graph for which a Plane Graph exists.
- Euler’s Theorem for planar graphs:
  For a plane graph with \( n \) vertices, \( m \) edges and \( f \) faces, we have \( n - m + f = 2 \).
GraphVis automated layout
by Benjamin B. (from Spring ‘12)
Graph Drawing Goals

- Automated!
- Can read all of the labels
- Can follow the line and see exactly which 2 vertices it connects
- Aesthetically pleasing
- Layout should display as much symmetry as possible
- Crossing free or minimal-crossing layout
- All edge lengths are approximately equal
- Even vertex distribution
- Distance between nodes in final layout should be as close as possible to “graph distance” (# of edges on shortest path between those nodes)

Automated GraphViz layout from Justin J. (from Spring ‘12)
Graph Drawing Questions

- What is the metric of success for each of our goals?
- Can we guarantee to find a solution? The optimal or best solution?
- Can we use randomness? Does it help?
- How expensive/slow are the different algorithms to draw graphs?
- How does it scale with more nodes/edges?
  - Does it lose effectiveness in meeting our goals?
  - How is the running time affected?
- How do we label the nodes/edges with color/words/images?

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Reading for Tuesday *(pick one)*

“Improved force-directed layouts”,
Gansner and North, Graph Drawing, 1999.

Reading for Tuesday *(pick one)*