CSE 564
Visualization & Visual Analytics

INFOGRAPHICS DESIGN

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<table>
<thead>
<tr>
<th>Lecture</th>
<th>Topic</th>
<th>Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intro, schedule, and logistics</td>
<td></td>
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<tr>
<td>2</td>
<td>Applications of visual analytics, basic tasks, data types</td>
<td></td>
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<tr>
<td>3</td>
<td>Data sources and introduction to D3</td>
<td>Project #1 out</td>
</tr>
<tr>
<td>4</td>
<td>Data wrangling and preparation</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Bias in visualization</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Data reduction and dimension reduction</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Visual perception and cognition</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Visual design and aesthetics</td>
<td>Project #1 due, Project #2 out</td>
</tr>
<tr>
<td>9</td>
<td>Python/Flask hands-on</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Cluster analysis: numerical data</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Cluster analysis: categorical data</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Foundations of scientific and medical visualization</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Computer graphics and volume rendering</td>
<td>Project #3 out</td>
</tr>
<tr>
<td>14</td>
<td>Scientific and medical visualization</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>(extended Spring break)</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>(extended Spring break)</td>
<td></td>
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<tr>
<td>17</td>
<td>Illustrative rendering</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>High-dimensional data, dimensionality reduction</td>
<td>Final project proposal call out</td>
</tr>
<tr>
<td>19</td>
<td>Principles of interaction</td>
<td>Project #2 due</td>
</tr>
<tr>
<td>20</td>
<td>Visual analytics and the visual sense making process</td>
<td>Project #3 due</td>
</tr>
<tr>
<td>21</td>
<td>Visualization of hierarchical data</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Visualization of maps and data with a geo-spatial reference</td>
<td>Final project proposal due</td>
</tr>
<tr>
<td>23</td>
<td>Visualization of time-varying and time-series data</td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>How to design effective infographics</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Memorable visualizations, visual embellishments</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Narrative visualization, storytelling, data journalism, XAI</td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>Evaluation and user studies</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Midterm #2</td>
<td></td>
</tr>
</tbody>
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A clipped compound of "information" and "graphics"

A graphic visual representations of information, data or knowledge intended to present information
- quickly
- clearly

Can improve cognition by utilizing graphics to enhance the human visual system's ability to see patterns and trends
Graphical displays should
- show the data
- induce the viewer to think about the substance rather than about methodology, graphic design, the technology of graphic production, or something else
- avoid distorting what the data has to say
- present many numbers in a small space
- make large data sets coherent
- encourage the eye to compare different pieces of data
- reveal the data at several levels of detail, from a broad overview to the fine structure
- serve a reasonably clear purpose: description, exploration, tabulation, or decoration
- be closely integrated with the statistical and verbal descriptions of a data set.
Minard’s 1869 map of Napoleon’s campaign to Russia

Shows 6 variables in one 2D visualization:
- number of Napoleon's troops, temperature
- distance traveled, direction of travel
- latitude and longitude, location relative to specific dates
Some More Random Examples ...
The Time We Spend on the Internet

We send over 200 million emails per minute.

...which includes time spent on the Internet at work.

Stress in the Workplace

70% of American workers experience stress-related illnesses.

34% think they’ll burn out on the job in the next two years.

33% more heart attacks are occurring on Monday mornings.

45% of entrepreneurs said they were stressed.

The Average Work Week

The average work week is closer to 50 hours than 40.

70 hours a week.

You get 168 hours a week.

Professionals and business leaders who use mobile devices like smartphones work more than to work.

The average commute time is 47 minutes round trip.
WHAT ARE WE EATING?

What the Average American Consumes in a Year

- Fats & Oils: 85.5 lbs
- Red Meat: 110 lbs
- Poultry: 73.6 lbs
- Fish & Shellfish: 16.1 lbs
- Eggs: 32.7 lbs
- Cheese: 31.4 lbs
- Dairy Products (non-cheese): 600.5 lbs
- Coffee, Cocoa & Nuts: 24 lbs
- Fruits: 273.2 lbs
- Vegetables: 415.4 lbs
- Corn: 56 lbs
- Cereals, Cocoa & Nuts: 134.1 lbs
- Wheat flour: 135 lbs
- Bev. Milk: 15.1 lbs
- Caloric Sweeteners: 1996.3 lbs

The Average American

Age: 36.6
Height: 5'9" (m) 5'4" (f)
Weight: 190 lbs (m) 164 lbs (f)
There are **1.4 Billion** students on Earth.

**THE CHALLENGE:** Too many children remain out of school, and those who are in school aren't learning the skills they need for life and work.

Children leaving school before completing their Primary Education

- In the Sub-Saharan, 11.07 million children leave school before completing their primary education.
- In South and West Asia, that number reaches 13.54 million.

Children out of primary school

- 61 Million children are still out of primary school.
- 32 Million of these children are Girls.

1 in 5

- 15 to 24 years old has not completed primary school and lacks skills for work.

An estimated **250 million** children are not able to read or write.

- The poorest and most marginalized are the most affected.

In some emerging economies, **3 in 10** youths cannot do basic arithmetic.

Fragile and conflict-affected countries account for more than **30%** of all children not completing primary school.

In some developing countries, one quarter to one-half of youth who have graduated from primary school cannot read a single sentence.

**OF THE 775 MILLION ILLITERATE ADULTS**

- **TWO-THIRDS** are women.

Connect. Inspire. Empower.

www.ubuntuemail.com
**Student Bullying**

**Bullying**
Physical, verbal, or psychological attacks or intimidation against a person who cannot properly defend himself or herself. It includes two key components: 1. Repeated harmful acts 2. Imbalance of power.

**Effects of Bullying**
Bullying can have a significant impact on both child and teenage students. Students who are bullied often suffer from anxiety, fear, withdrawal, low self-esteem, and poor concentration. A bullied student will often avoid school, have lower grades, and become socially isolated. There have been numerous reports of suicide due to bullying.

**Most Common Types of Bullying:**
- Physical: Hitting, pushing, kicking, tripping
- Verbal: Name-calling, teasing, threatening
- Social: Exclusion, spread rumors, damage belongings
- Cyber: Sending cruel messages, cyberstalking

**Playground School Bullying Statistics**
Every 7 Minutes a Child is Bullied

**Effects on Bullies**
Bullying is often a warning sign that children and teens are heading for trouble and are at risk for serious violence. Teens (particularly boys) who bully are more likely to engage in other antisocial/inappropriate behavior (e.g., vandalism, shoplifting, truancy, and drug use) into adulthood. They are four times more likely than nonbullies to be convicted of crimes by age 24, with 60 percent of bullies having at least one criminal conviction.

**Sources:**
- [http://www.cope.usdoj.gov](http://www.cope.usdoj.gov)

Produced by: Buckfire & Buckfire PC
Five steps (from Venngage.com)

1. Outline the goals of your infographic
2. Collect data for your infographic
3. Visualize the data for your infographic
4. Layout your infographic using an infographic template
5. Add style to your infographic design
Step 1: Outline Your Goals

Use the question pyramid

1 Burning Problem
The main question the infographic will answer.

2-3 Supporting Questions
Questions to provide information (what, which).

1-2 Probing Questions
Questions to provide insight (why).

Venngage.com
EXAMPLE: FOOD – WINE PAIRING

Burning Problem
How to pair food and wine

Supporting Questions
Which food components matter?
What are the types/categories of wine?
Which category works with each component?

Probing Questions
Why do certain pairings work better?
We discussed this
Decide what are your primary goals

- what data aspect do you want to convey

The ICORE method

- Inform,
- Compare,
- Change,
- Organize,
- Reveal relationships, or
- Explore.

Venngage.com
Convey an important message or data point that doesn’t require much context to understand:

Make a numerical stat stand out with large, bold, colorful text:

The brain makes 700 neural connections per second before the age of 5.

Demand extra attention by pairing icons with text:

4200 VACCINES ADMINISTERED

Highlight a percentage or rate with a donut chart or a pictograph:

- 25% were children
- 25% were children
COMPARE

Show similarities or differences among values or parts of a whole.

Use a pie chart, donut chart, pictograph, or tree map to compare parts of a whole.

Use a stacked bar chart or stacked column chart to compare categories and parts of a whole.

Use a stacked area chart to compare trends over time.

Venngage.com
Show trends over time or space

Use a line chart or an area chart to show changes that are continuous over time.

LINE CHART

AREA CHART

Use a timeline to show discrete events in time.

TIMELINE

Use a choropleth map to show spatial data.

CHOROPLETH MAP

Use a map series to show data that changes over both space and time.

MAP SERIES

Venngage.com
Organize

Show groups, patterns, rank or order

Use a list to show rank or order when you want to provide extra information about each element.

<table>
<thead>
<tr>
<th>LIST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
</tbody>
</table>

Use a table to show rank or order when you want readers to be able to look up specific values.

<table>
<thead>
<tr>
<th>TABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cars</td>
</tr>
<tr>
<td>BMW</td>
</tr>
<tr>
<td>Aston Martin</td>
</tr>
<tr>
<td>Bentley</td>
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</tbody>
</table>

Use a flowchart to show order in a process.

Otherwise, show rank or order with a bar chart, column chart, bubble chart, or pyramid chart.
Reveal more complex relationships among things

Use a scatter plot when you want to display two variables for a set of data.

Use a multi-series plot when you want to compare multiple sets of related data.
Add interaction

- filtering, sorting, and drilling down
- can’t do with a static chart
- but useful for online infographics displays
- will discuss later
Create a natural flow

- could use the question pyramid to guide the layout
- burning question into header
- follow with charts to address the supporting questions
- finish with the probing questions

Use a grid layout

- guides the reader’s eye
- symmetrical grid
- consider that people read
  - top to bottom
  - left to right
One Column for Linear Flow

Venngage.com
Who Said What?

Democrats

McCain: 18
God: 6
Iraq: 12
Change: 24
Jobs: 14
War: 9
Hurricane: 8
Economy: 16

Republican

God: 25
Energy: 18
Bush: 6
Economy: 18
Terror: 12
Jobs: 8
Iraq: 15
War: 18
Bush: 18

Number of times words were used

The Words They Used - Graphic - NYTimes.com
CLEAN WATER SYSTEMS

2.64 Billion people around the world do not have access to adequate sanitation

780 Million people do not have access to improved water sources

Every $1 spent on water and sanitation generates at least $4 in increased productivity

SOURCE
Multi-Section Layout For Random Visual Access

Easiest Indoor Plants To Keep Alive

- Aloe vera
- English Ivy
- Jade Plant
- Pothos Plant
- Rubber Tree
- Difenbahia
- Spider Plant
- Fiddle Leaf Fig Tree
- Snake Plant

Benefits & Tips for Working Remotely

- Work from anywhere in the world.
- No commute to a company office.
- Ability to focus.
- There are no geographical limitations for who can join the team.
- Work close to family.

Venngage.com
Overall goal
- make your infographics aesthetically pleasing
- make it easy to consume and understand

Minimize text
- should supplement the visuals
- short paragraphs (at most) at about a grade six reading level

Use font to point out importance
- readable font for the bulk of the text,
- amp up size and style of your main header, section headers, and data highlights
- make sure that the gist of your infographic is immediately apparent
Example

Venngage.com
Repeat basic shapes to reinforce the underlying grid.
Use basic shapes to emphasize headers and list elements.
Add icons to reinforce important concepts in the text

- keep icon color, style, and size consistent
- pull everything together with extra background shapes

Venngage.com
BE DILIGENT

Make sure the repeated elements you add are aligned!

Venngage.com
Negative (white) space is often used in advertising
- the space around and between the subject of an image
- helps to define a subject
- helps emphasizing a message
Just as important as any other element of a design

- simplest negative space are margins around the graphics
**Negative Space: Gaps**

Use gaps between unrelated elements

- makes it easier to immediately understand which elements are grouped together

<table>
<thead>
<tr>
<th>Basic</th>
<th>Premium</th>
<th>Business</th>
</tr>
</thead>
<tbody>
<tr>
<td>$14</td>
<td>$20</td>
<td>$35</td>
</tr>
</tbody>
</table>

**Table 1:**
- **What kind of plan are you interested in?**
- **Storage space:** 4GB, 8GB, Unlimited
- **Validity:** 1 Year, 1 Year, 2 Years
- **Posts per month:** 4, 8, Unlimited
- **Branding:** No, No, Yes
- **Social Bookmarking:** No, No, Yes
- **Tracking per month:** 50, 100, Unlimited

**Table 2:**
- **What kind of plan are you interested in?**
- **Storage space:** 4GB, 8GB, Unlimited
- **Validity:** 1 Year, 1 Year, 2 Years
- **Posts per month:** 4, 8, Unlimited
- **Branding:** No, No, Yes
- **Social Bookmarking:** No, No, Yes
- **Tracking per month:** 50, 100, Unlimited

Venngage.com
Much easier to make colors play nicely with each other by adding a little whitespace
Use color to highlight important information
COLOR FOR GROUPING

Use color to group related elements together
Use neutrals to offset bright colors

- helps put together a composition
- can group in a more subtle way
There are Templates on the Web
Color Harmony

Non-harmonic colors

Harmonic colors

Hue wheel:
Harmonic Color Schemes

i type    V type    L type    I type

T type    Y type    X type    N type
Given arbitrary hue histogram $H(p)$ for image $X$, find the closest harmonic template $T_m$

- minimize the distance of the histogram to template coverage (delineated by template edges $E$)
- use an optimization procedure for this
- also find the orientation angle $\alpha$

$$F(X(m, \alpha)) = \sum_{p \in X} \| H(p) - E_{T_m(\alpha)}(p) \| \cdot S(p)$$

from Cohen ‘08
Given closest template and $\alpha$ has been found (user may specify other template)

- shift all hues $H(p)$ to the closest harmonic template position $H'(p)$ with width $w$
- a Gaussian $G$ controls the clustering of the hues around the sector mean $C$ of the template (greater $\sigma$ clusters more, we use $w/2$)

$$H'(p) = G(p) + \frac{w}{2} (1 - G_{\sigma}(||H(p) - C(p)||))$$

This may break up coherent regions into disjointly colored regions

- to avoid this, may embed a graph-cut labeling into the shifting procedure

from Cohen '08
Collage harmonization (from Cohen ’06):

non-harmonic

harmonized (T type)
COLOR HARMONIZATION: EXAMPLE

Collage harmonization (from Wang ‘08):

![Collage harmonization example](image_url)