Visualization Designs

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CS 448B: Visualization
Spring 2016

Last Time: Data and Image Models

The big picture

task

data
- physical type
  - int, float, etc.
- abstract type
  - nominal, ordinal, etc.

domain
- metadata
- semantics
- conceptual model

processing algorithms

mapping
- visual encoding
- visual metaphor

image
- visual channel
- retinal variables

[based on slide from Munzner]

Nominal, ordinal and quantitative

On the theory of scales of measurements
S. S. Stevens, 1946

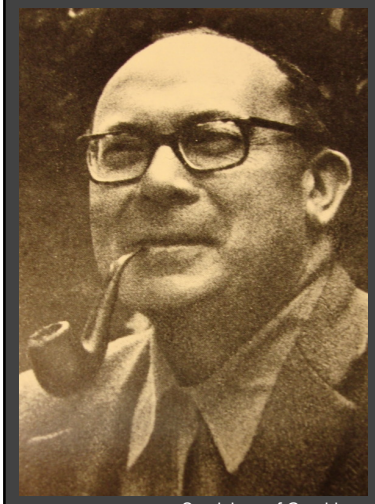
N - Nominal (labels)
Fruits: Apples, oranges, …
Operations: =, ≠

O - Ordered
Quality of meat: Grade A, AA, AAA
Operations: **=, ≠,** <, >, ≤, ≥

Q - Interval (location of zero arbitrary)
Dates: Jan, 19, 2006; Loc.: (LAT 33.98, LON -118.45)
Like a geometric point. Cannot compare directly
Only differences (i.e. intervals) may be compared
Operations: **=, ≠, <, >, ≤, ≥,** -

Q - Ratio (location of zero fixed)
Physical measurement: Length, Mass, Temp, …
Counts and amounts
Like a geometric vector, origin is meaningful
Operations: **=, ≠, <, >, ≤, ≥, -,** +

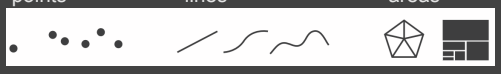
Marks and Visual Variables



Semiology of Graphics
J. Bertin, 1967

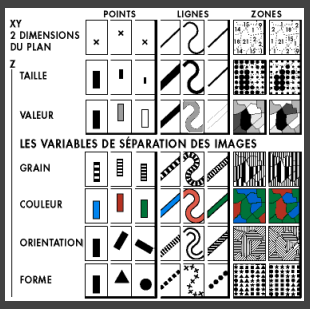
Marks: geometric primitives

points lines areas

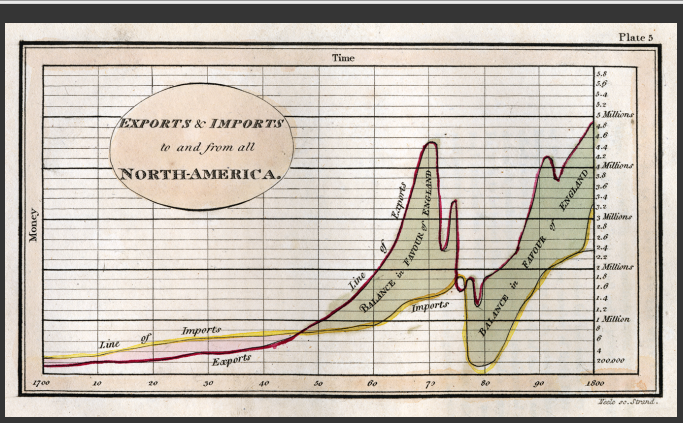


Visual Variables: control mark appearance

- Position (2x)
- Size
- Value
- Texture
- Color
- Orientation
- Shape



Playfair 1786/1801



- Time → x-position (Q, linear)
- Exports/Imports Values → y-position (Q, linear)
- Exports/Imports → color (N, O, nominal)
- Balance for/against → area (maybe length??) (Q, linear)
- Balance for/against → color (N, O, nominal)

Bertins' "Levels of Organization"

Position	N	O	Q
Size	N	O	Q
Value	N	O	Q
Texture	N	O	
Color	N		
Orientation	N		
Shape	N		

N Nominal
O Ordered
Q Quantitative

Note: Q < O < N

Note: Bertin actually breaks visual variables down into differentiating (≠) and associating (≡)

Graphical Perception

Most accurate

Position (common) scale
Position (non-aligned) scale

Length

Slope

Angle

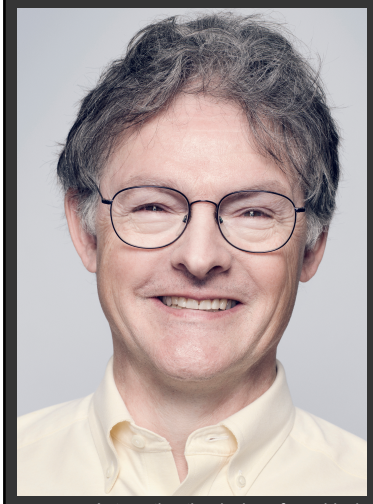
Area

Volume

Least accurate

Color hue-saturation-density

APT: Automatic Chart Construction



Automating the design of graphical presentation of relational information

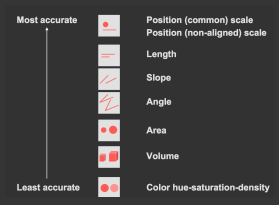
J. Mackinlay, 1986

Encode most important data using highest ranking visual variable for the data type

Year	Exports	Imports
1700	170,000	300,000
1701	171,000	302,000
1702	176,000	303,000
...	...	...

→

1. Year (Q)
2. Exports (Q)
3. Imports (Q)



→

mark: lines

Year → x-pos (Q)
Exports → y-pos (Q)
Imports → y-pos (Q)

Mackinlay's effectiveness criteria

Effectiveness

A visualization is more effective than another visualization if the information conveyed by one visualization is more readily *perceived* than the information in the other visualization.

Mackinlay's expressiveness criteria

Expressiveness

A set of facts is expressible in a visual language if the sentences (i.e. the visualizations) in the language express *all* the facts in the set of data, and *only* the facts in the data.

Announcements

Announcements

Class participation requirements

- Complete readings before class
- In-class discussion
- Post at least 1 reading response by 1:30pm on day of lecture

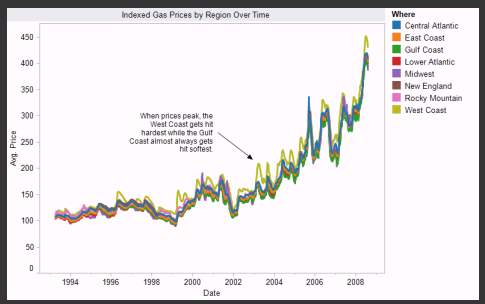
Class wiki
http://web.stanford.edu/class/cs448b/

Assignment 2: Exploratory Data Analysis

Use Tableau to formulate & answer questions

First steps

- Step 1: Pick a domain
- Step 2: Pose questions
- Step 3: Find data
- Iterate



Create visualizations

- Interact with data
- Question will evolve
- Tableau

Make wiki notebook

- Keep record of all steps you took to answer the questions

Due before class on Apr 18, 2016

Assignment 1: Visualization Design

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	name	age	gender	raceethnicity	month	day	year	streetaddres	city	state	latitude	longitude	state_fp	county_fp
2	A'donte Was	16	Male	Black	February	23	2015	Clearview Ln	Millbrook	AL	32.529577	-86.362829	1	51
3	Aaron Rutlec	27	Male	White	April	2	2015	300 block Iris	Pineville	LA	31.3217392	-92.43486	22	79
4	Aaron Siler	26	Male	White	March	14	2015	22nd Ave an	Kenosha	WI	42.5835597	-87.83571	55	59
5	Aaron Valde	25	Male	Hispanic/Lat	March	11	2015	3000 Semino	South Gate	CA	33.9392976	-118.21946	6	37
6	Adam Jovicic	29	Male	White	March	19	2015	364 Hiwood	Munroe Falls	OH	41.1485748	-81.429878	39	153
7	Adam Reinhe	29	Male	White	March	7	2015	18th St and F	Phoenix	AZ	33.4693799	-112.04332	4	13
8	Adrian Hern	22	Male	Hispanic/Lat	March	27	2015	4000 Union /	Bakersfield	CA	35.3956975	-119.00274	6	29
9	Adrian Solis	35	Male	Hispanic/Lat	March	26	2015	1500 Bayvies	Wilmington	CA	33.7930495	-118.27093	6	37
10	Alan Alverso	44	Male	White	January	28	2015	Pickett Runn	Sunset	TX	30.6653042	-96.401482	48	41
11	Alan James	31	Male	White	February	7	2015	200 Abbie St	Wyoming	MI	42.8932381	-85.660584	26	81
12	Albert Hansc	76	Male	White	April	26	2015	7th Ave and	Hanford	CA	36.2109603	-119.58288	6	31
13	Alec Ouzoun	40	Male	White	May	12	2015	28 Paseo Vie	Rancho Sant	CA	33.6533852	-117.61337	6	59
14	Alejandro Sa	Unknown	Male	Hispanic/Lat	February	20	2015	1200 E Airtes	Houston	TX	29.9832049	-95.403857	48	201
15	Alexander Lc	31	Male	White	February	25	2015	25th St and F	Terre Haute	IN	39.4629302	-87.37886	18	167
16	Alexander M	23	Male	White	April	6	2015	5700 block A	Indianapolis	IN	39.7669106	-86.149963	18	97
17	Alexander Ri	39	Male	Hispanic/Lat	May	30	2015	1128 Murfre	Nashville	TN	36.1259117	-86.709015	47	37
18	Alexia Christi	25	Female	Black	April	30	2015	141 Pryor St	Atlanta	GA	33.7512627	-84.393028	13	121
19	Alfredo Rials	54	Male	Hispanic/Lat	May	19	2015	4219 2nd Ro	Arlington	VA	38.8731527	-77.10501	51	13
20	Alice Brown	24	Female	White	March	17	2015	Van Ness Av	San Francisc	CA	37.7894309	-122.4221	6	75
21	Alvin Haynes	57	Male	Black	January	26	2015	1 Moreland (	San Francisc	CA	37.6279793	-122.45393	6	81

Police Killings 2015

Design Considerations

Expressiveness

- Do the mappings show the facts and only the facts?
- Are visual mappings consistent? (e.g., respect color mappings)

Effectiveness

- Are perceptually effective encodings used?
- Are the most important data mapped to the most effective visual variables?

Cognitive Load (Efficiency)

- Are there extraneous visual elements?

Data Transformation

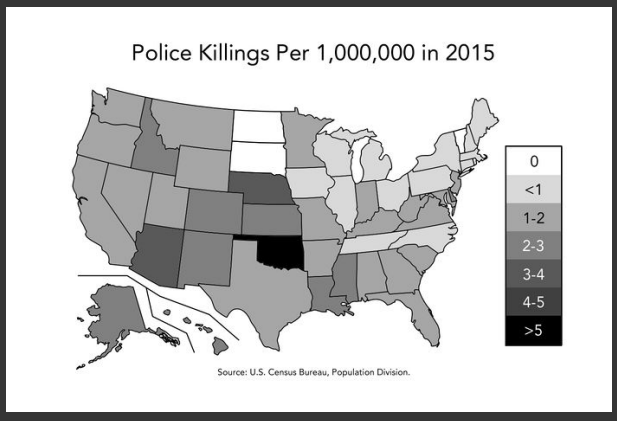
- Are transformations (filter, sort, derive, aggregate) appropriate?

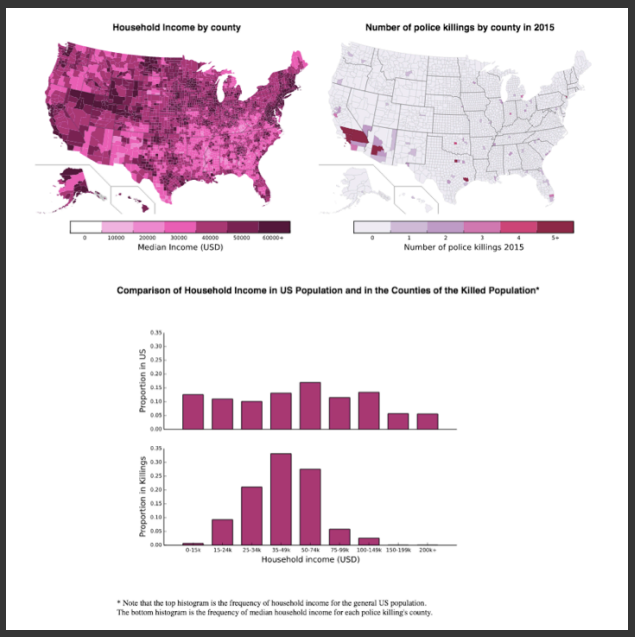
Guides (Non-Data Elements)

- Descriptive, consistent: Title, Label, Caption, Source, Annotations
- Meaningful references: Gridlines, Legend

Design Space of A1 Submissions

Spatial Encoding	**Bar charts, Maps, Pie charts** **Scatterplots**
Color Encoding	**Mostly nominal, Quantitative (maps)**
Data Transformation	**Often normalized data in some way**
Labeling	**Title, Caption, Axis labels, Legends** **Not many annotations**





In-Class Review

Procedure

Break into groups of 3

Present your visualization – in order by last name – 5 min each to describe what your visualization shows, and design choices

We will keep time and tell you to switch

Critique in alphabetical order – rubric on next slide (~5 min each)

- Write down feedback and score on rubric (be specific). We will collect critiques.
- Author takes notes (post critique notes/feedback to wiki after class) and keeps them

Turn in critiques you wrote for others

Authors add feedback notes to wiki page for A1