

Data Visualization (CIS 490/680)

Introduction

Dr. David Koop

What is Data Visualization?

How is it different from Computer Graphics?

The purpose of computing is about insight, not numbers

- R. W. Hamming

The purpose of **visualization** is about **insight**, not pictures

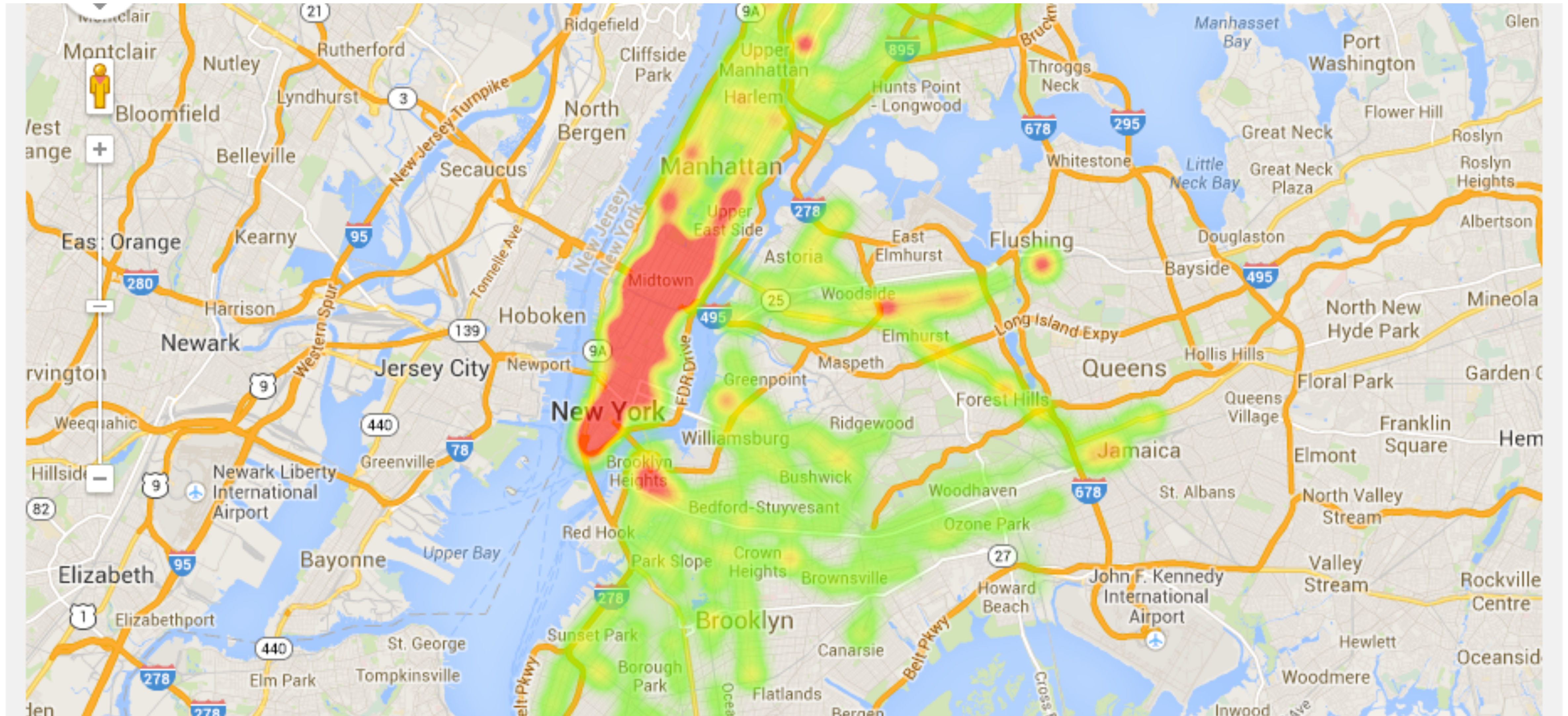
- Card, Mackinlay, Schneiderman

Why do we visualize data?
(vs. looking at tables?)

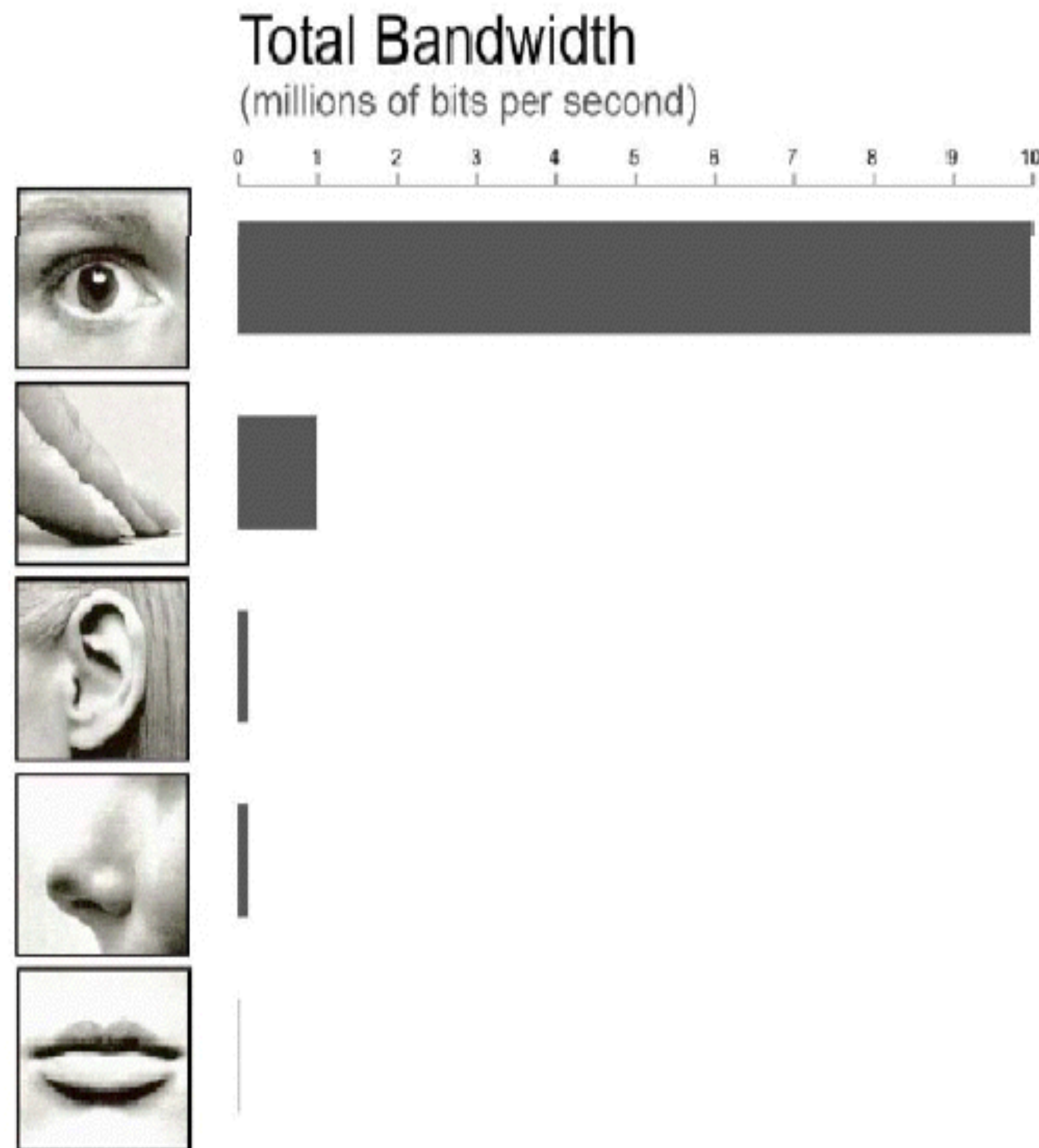
MTA Fare Data Table

	REMOTE	STATION	FF ▼	SEN/DIS	7-D AFAS UNL	D AFAS/RMF I	JOINT RR TKT	7-D UNL	30-D UNL
1	R011	42ND STREET & 8TH AVENUE	00228985	00008471	00000441	00001455	00000134	00033341	00071255
2	R170	14TH STREET-UNION SQUARE	00224603	00011051	00000827	00003026	00000660	00089367	00199841
3	R046	42ND STREET & GRAND CENTRAL	00207758	00007908	00000323	00001183	00003001	00040759	00096613
4	R012	34TH STREET & 8TH AVENUE	00188311	00006490	00000498	00001279	00003622	00035527	00067483
5	R293	34TH STREET - PENN STATION	00168768	00006155	00000523	00001065	00005031	00030645	00054376
6	R033	42ND STREET/TIMES SQUARE	00159382	00005945	00000378	00001205	00000690	00058931	00078644
7	R022	34TH STREET & 6TH AVENUE	00156008	00006276	00000487	00001543	00000712	00058910	00110466
8	R084	59TH STREET/COLUMBUS CIRCLE	00155262	00009484	00000589	00002071	00000542	00053397	00113966
9	R020	47-50 STREETS/ROCKEFELLER	00143500	00006402	00000384	00001159	00000723	00037978	00090745
10	R179	86TH STREET-LEXINGTON AVE	00142169	00010367	00000470	00001839	00000271	00050328	00125250
11	R023	34TH STREET & 6TH AVENUE	00134052	00005005	00000348	00001112	00000649	00031531	00075040
12	R029	PARK PLACE	00121614	00004311	00000287	00000931	00000792	00025404	00065362
13	R047	42ND STREET & GRAND CENTRAL	00100742	00004273	00000185	00000704	00001241	00022808	00068216

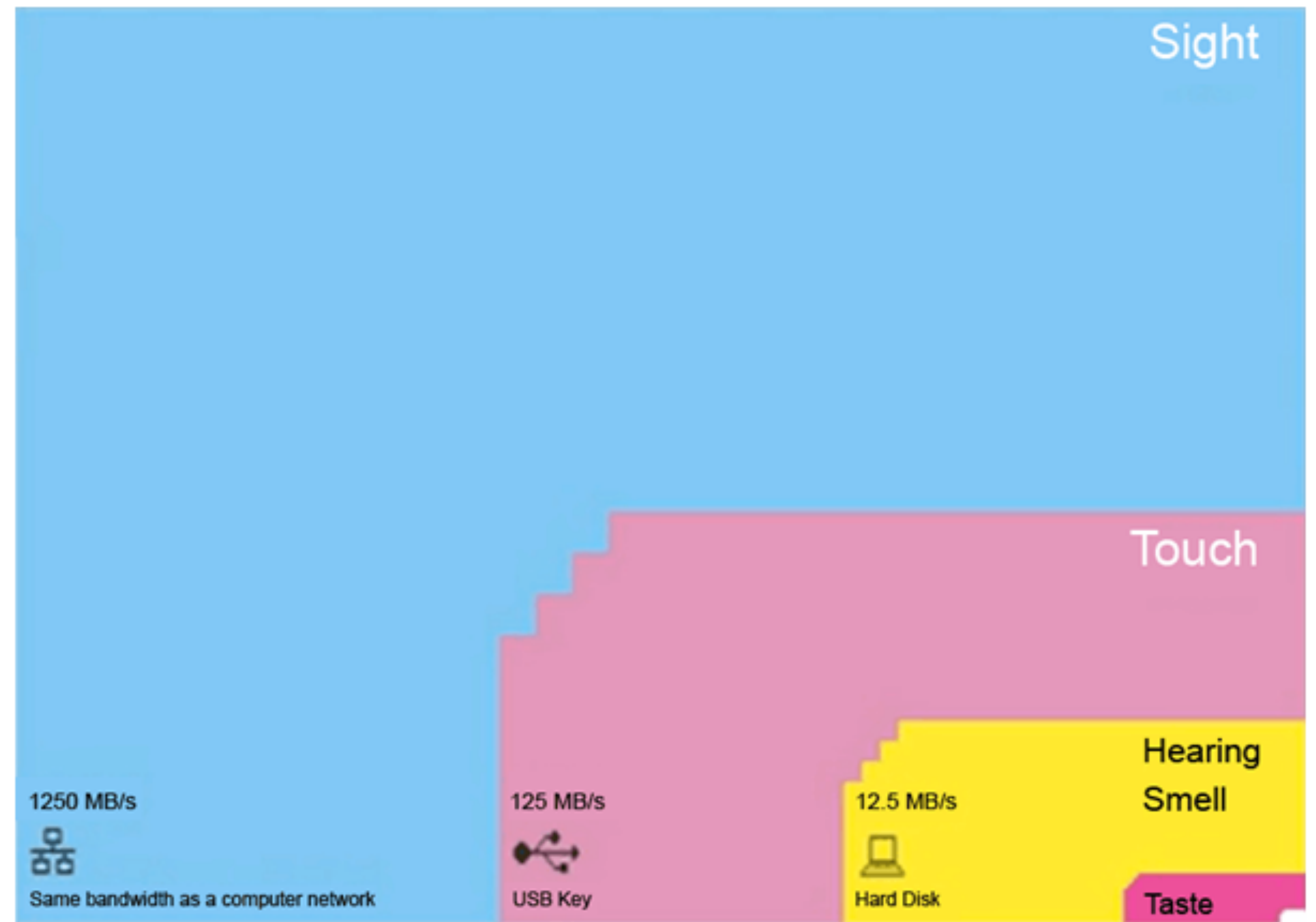
MTA Fare Data Visualization



Why do we visualize data?



[via A. Lex]



[T. Nørretranders]

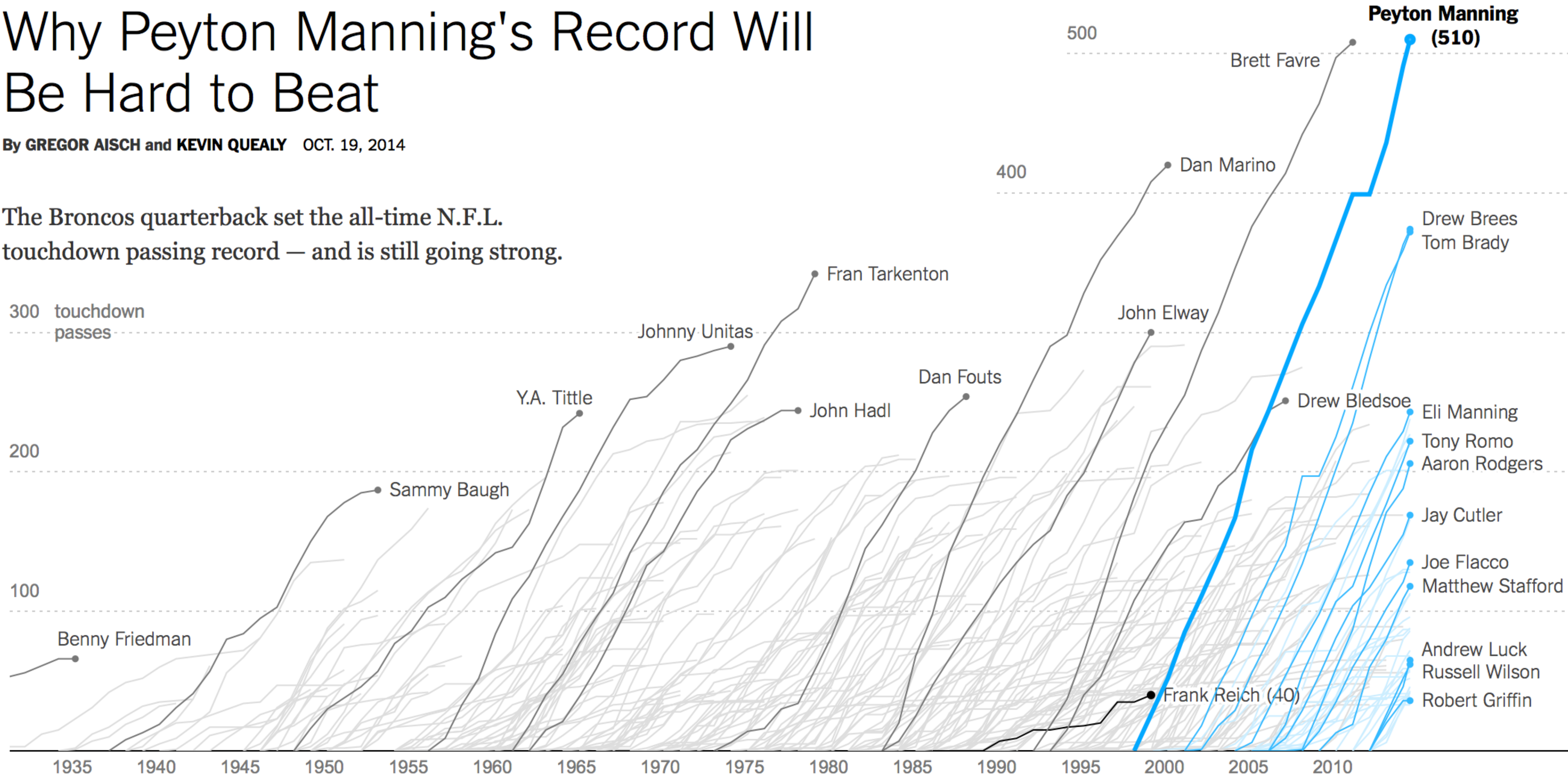
What are the purposes for visualization?

Communication: Peyton's Records

Why Peyton Manning's Record Will Be Hard to Beat

By GREGOR AISCH and KEVIN QUEALY OCT. 19, 2014

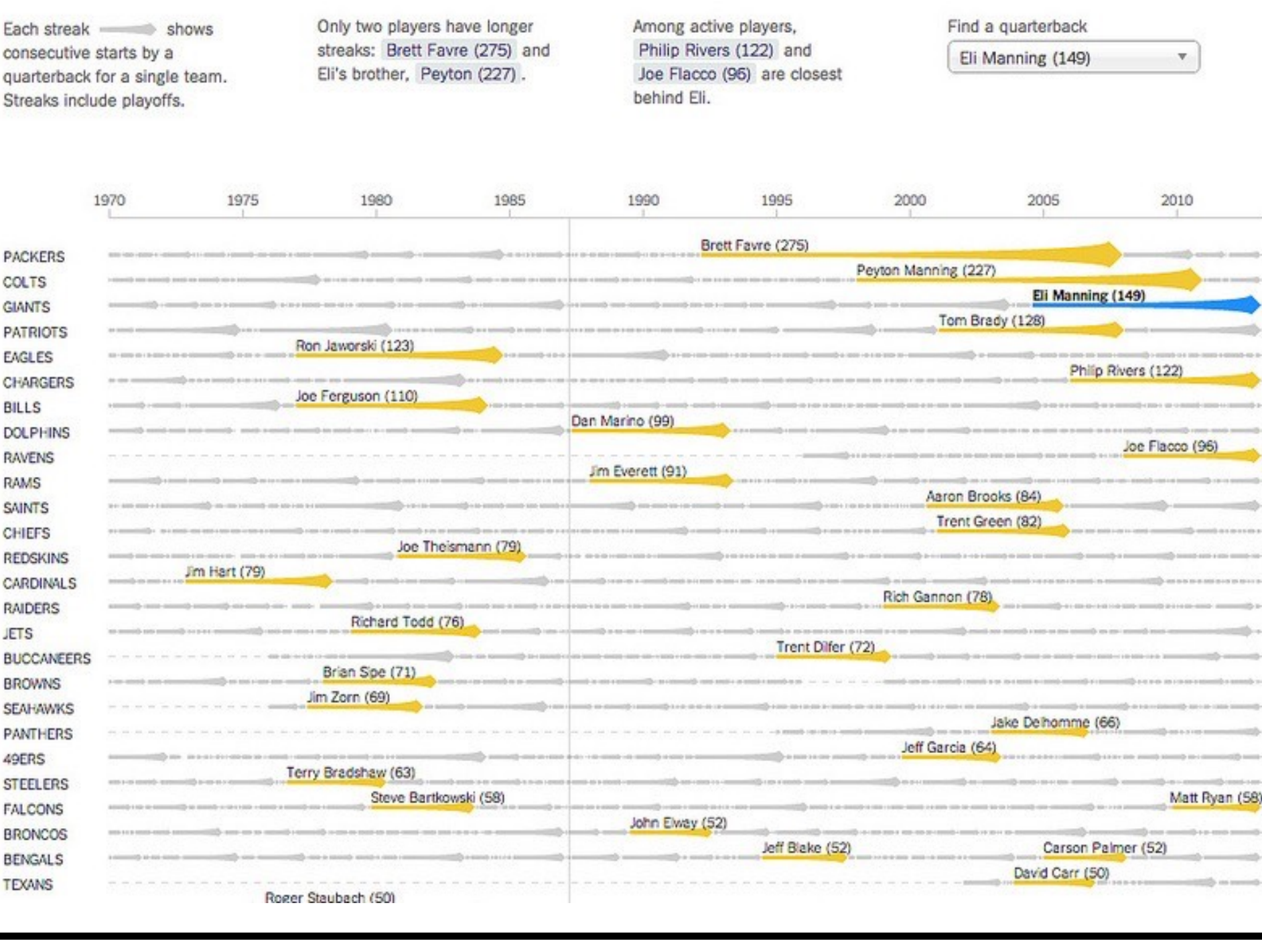
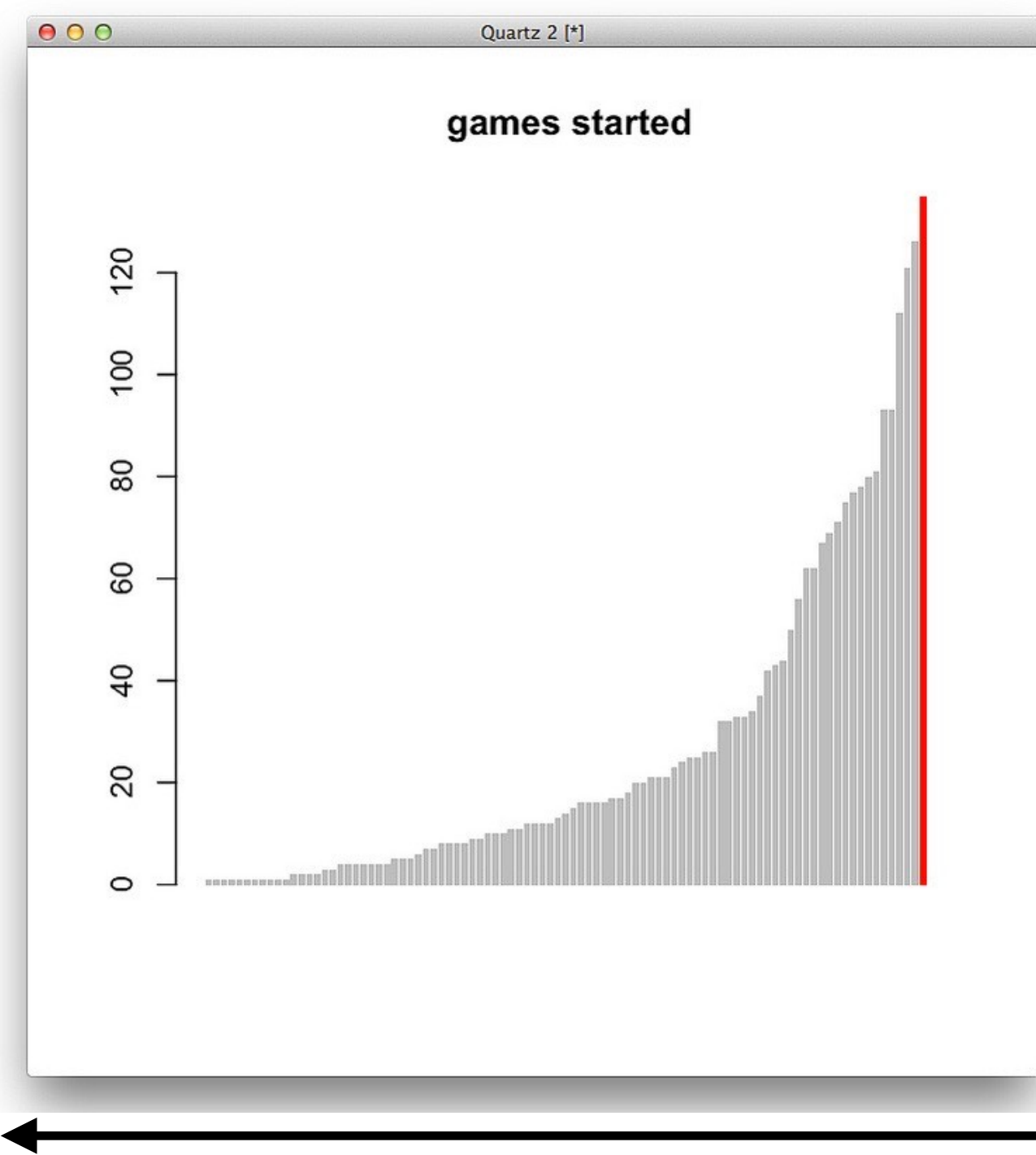
The Broncos quarterback set the all-time N.F.L. touchdown passing record — and is still going strong.



[G. Aisch and K. Quealy, [NYTimes](#)]

Exploration <-> Communication Spectrum

Consecutive Starts by a Quarterback for a Single Team



Exploration

Confirmation

Communication

Questions

Answers/Persuasion

[K. Quealy, 2013]

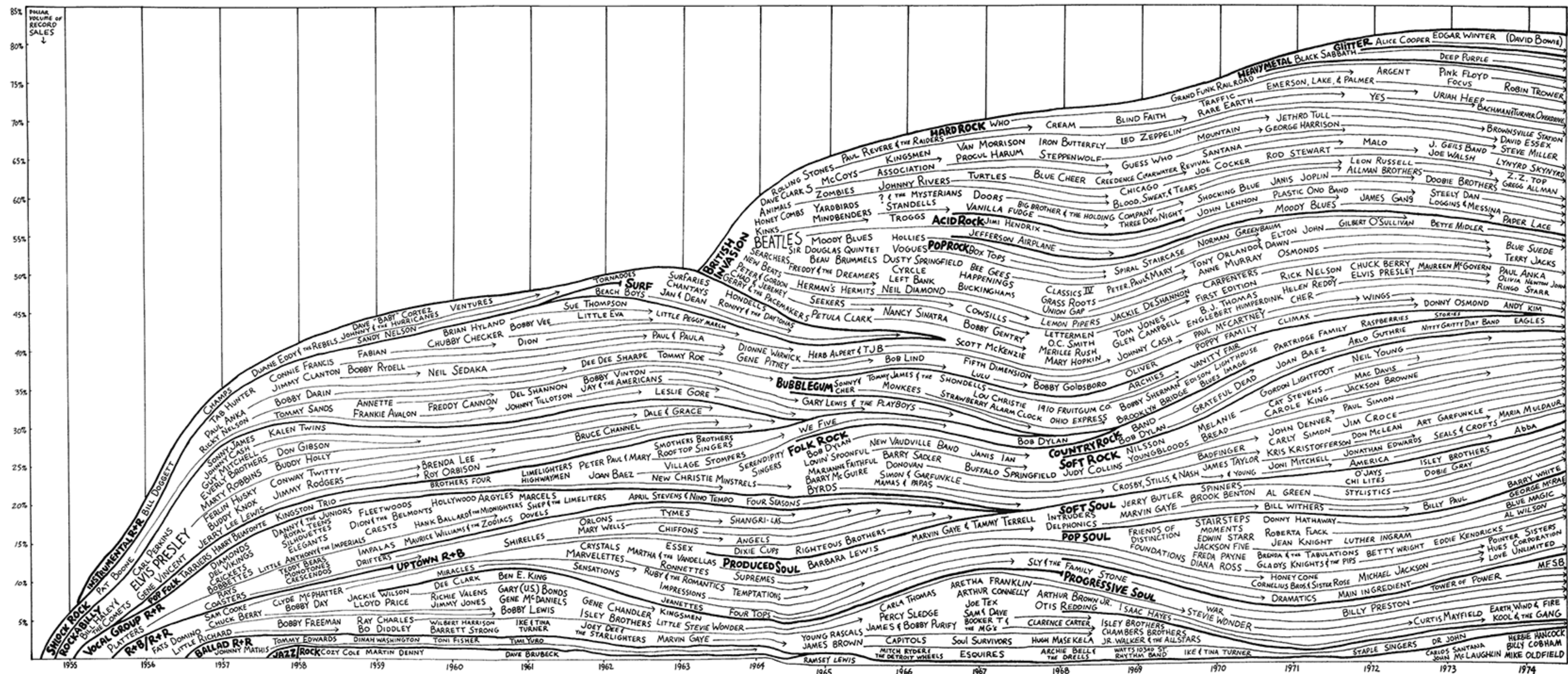
What types of data can we visualize?

Types of Data

- Tables
- Networks (Graphs)
- Spatial Data
 - Geography
 - Physical (e.g. Scientific, Medical)
- Text
- Sets

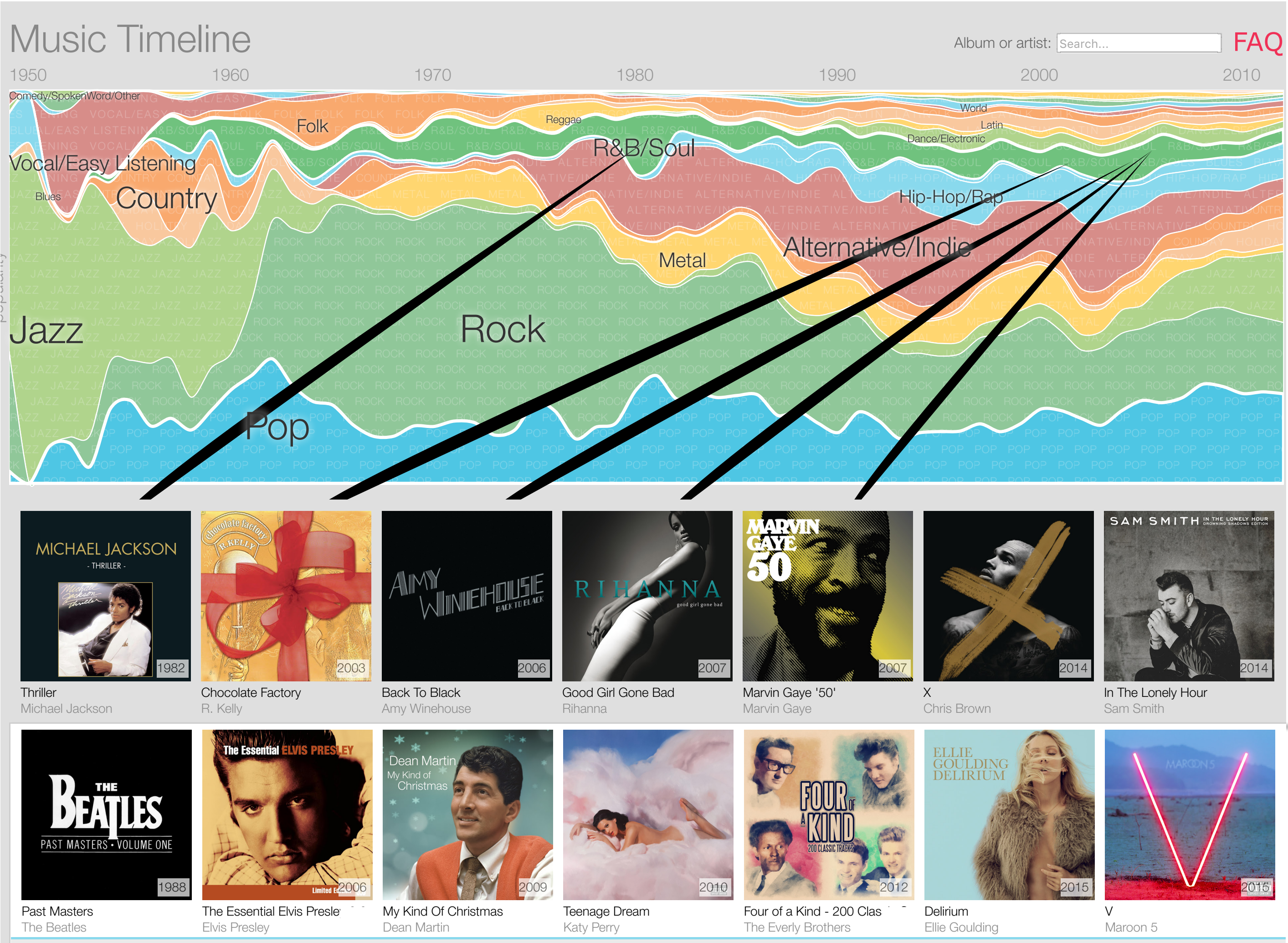
Where have you seen visualizations?

Books / Posters



[Rock 'N' Roll is Here to Pay, R. Garofalo, 1977 (via Tufte)]

Web



[Music Timeline, Google Research]

What is the advantage of the second version?

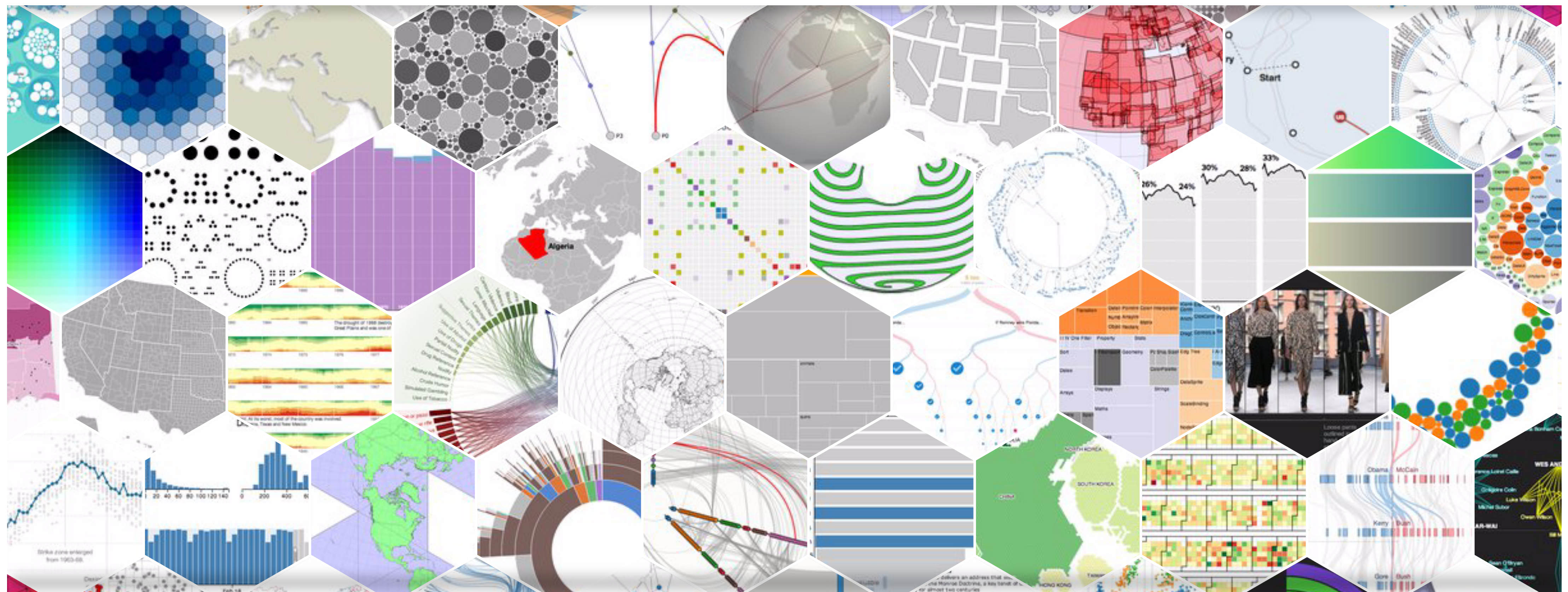
Interaction

How do we create modern visualizations?

Tools

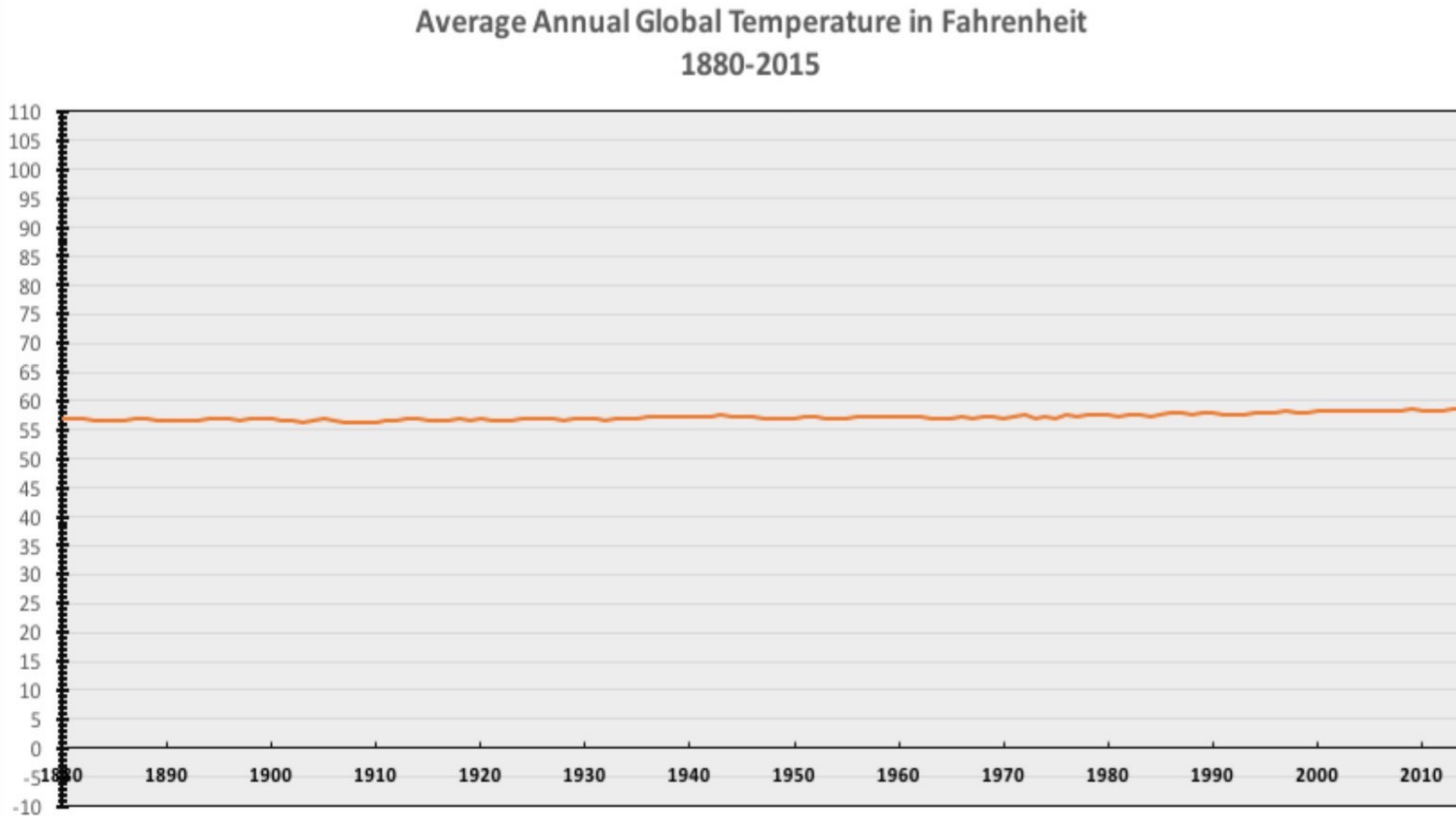
- Desktop Applications:
 - Excel (see excelcharts.com)
 - Tableau
 - ...
- Programming Frameworks
 - Processing
 - d3.js
 - deck.gl, MapboxGL
 - ...
- Tradeoffs
 - Speed
 - Customization
 - Understanding
 - Dissemination

d3.js



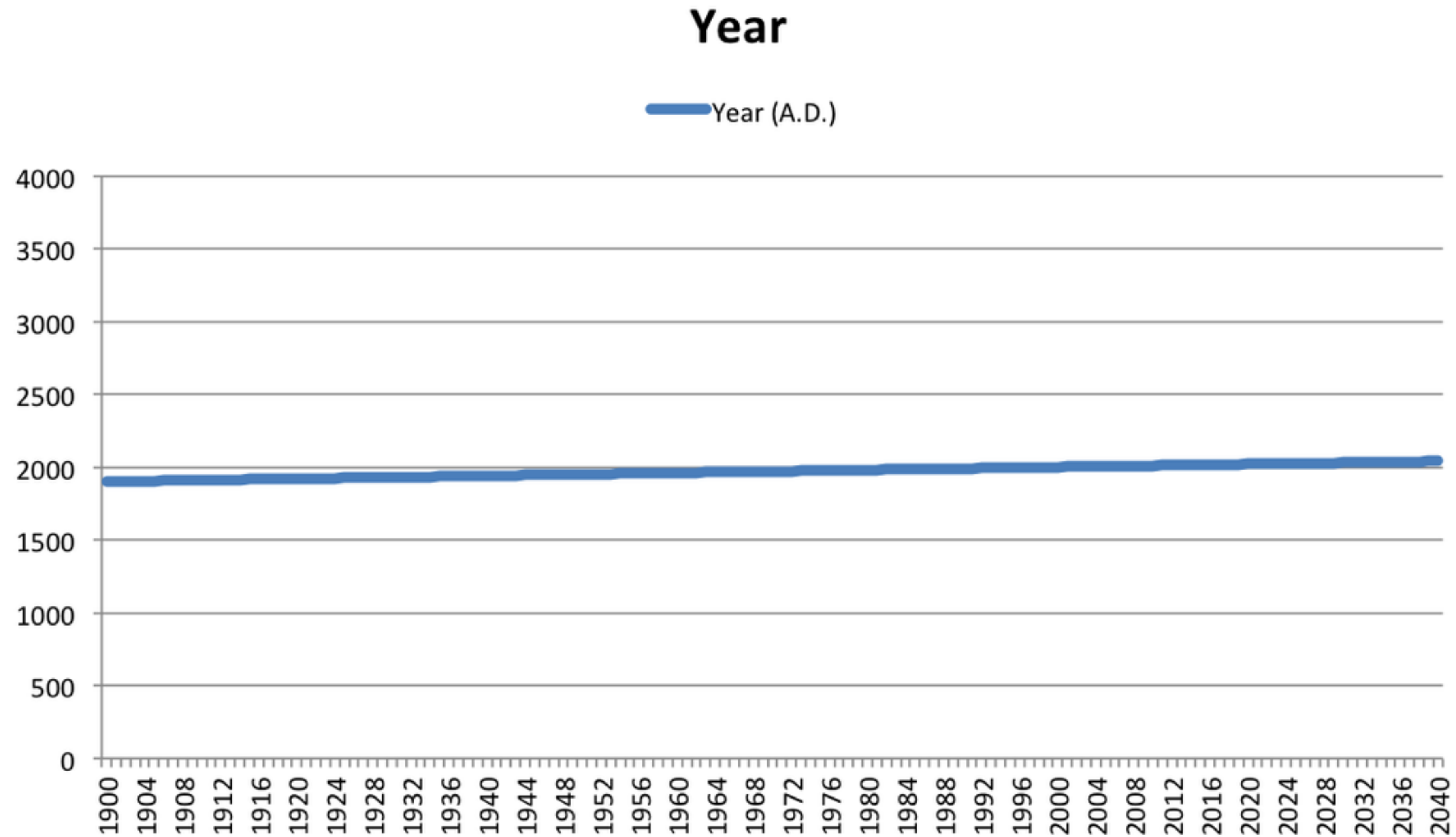
Why do we care about the design of visualizations?

Design: Focus on only the y-axis



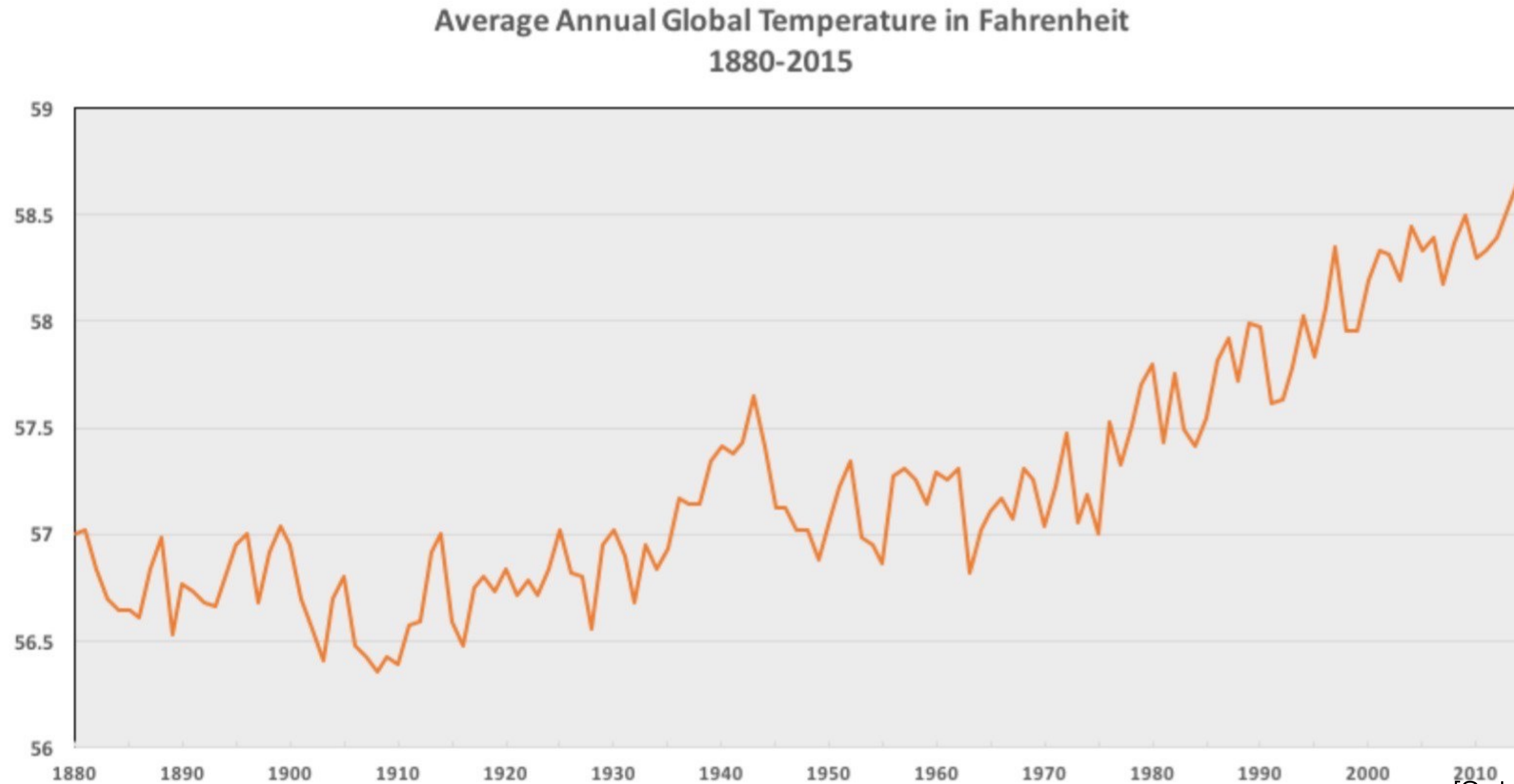
[S. Hayward, 2015]

Design: Year on the y-axis



[@bizweekgraphics]

Design: Different y-axis



[S. Hayward, 2015]

Data Exploration through Visualization

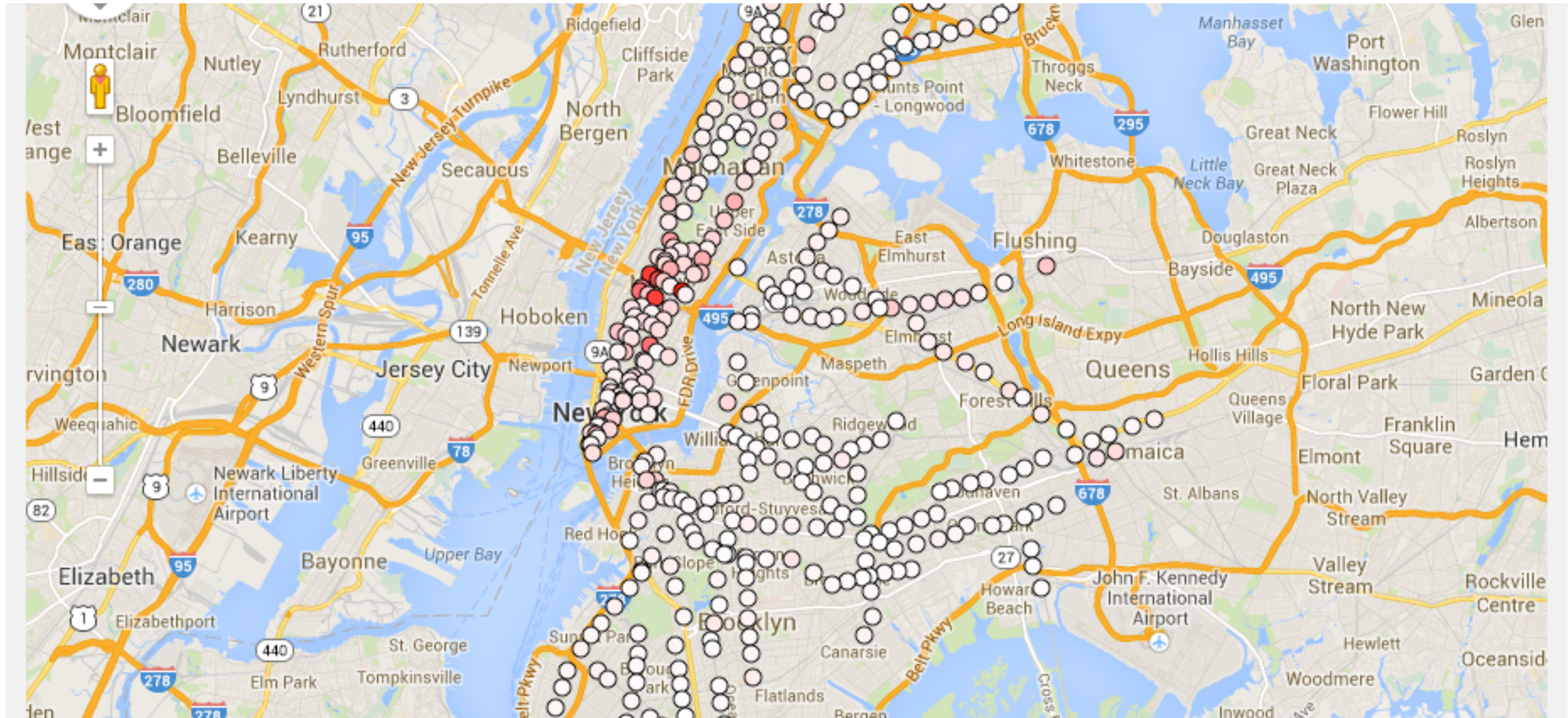
Transportation Data - NYC MTA



MTA Fare Data Exploration

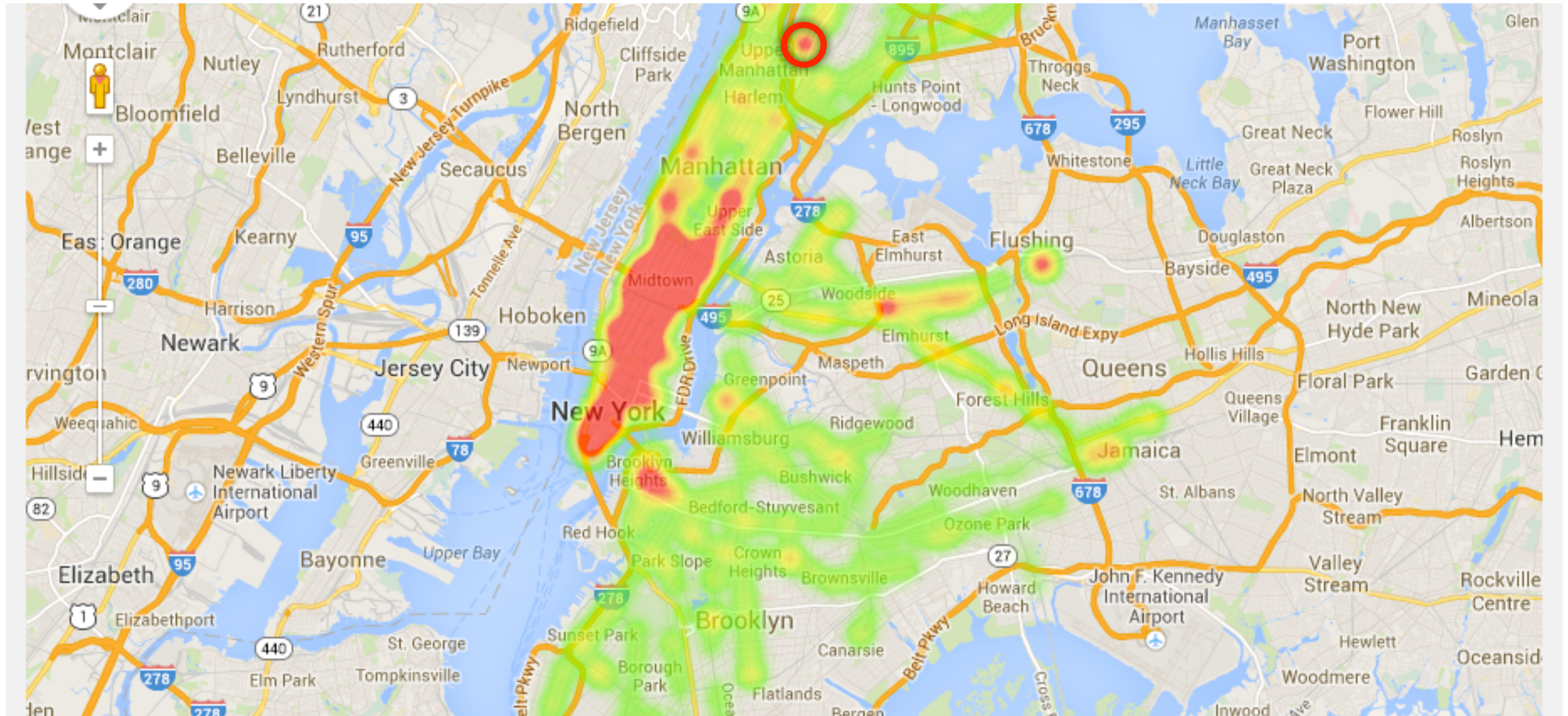
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MTA Fare Data Exploration

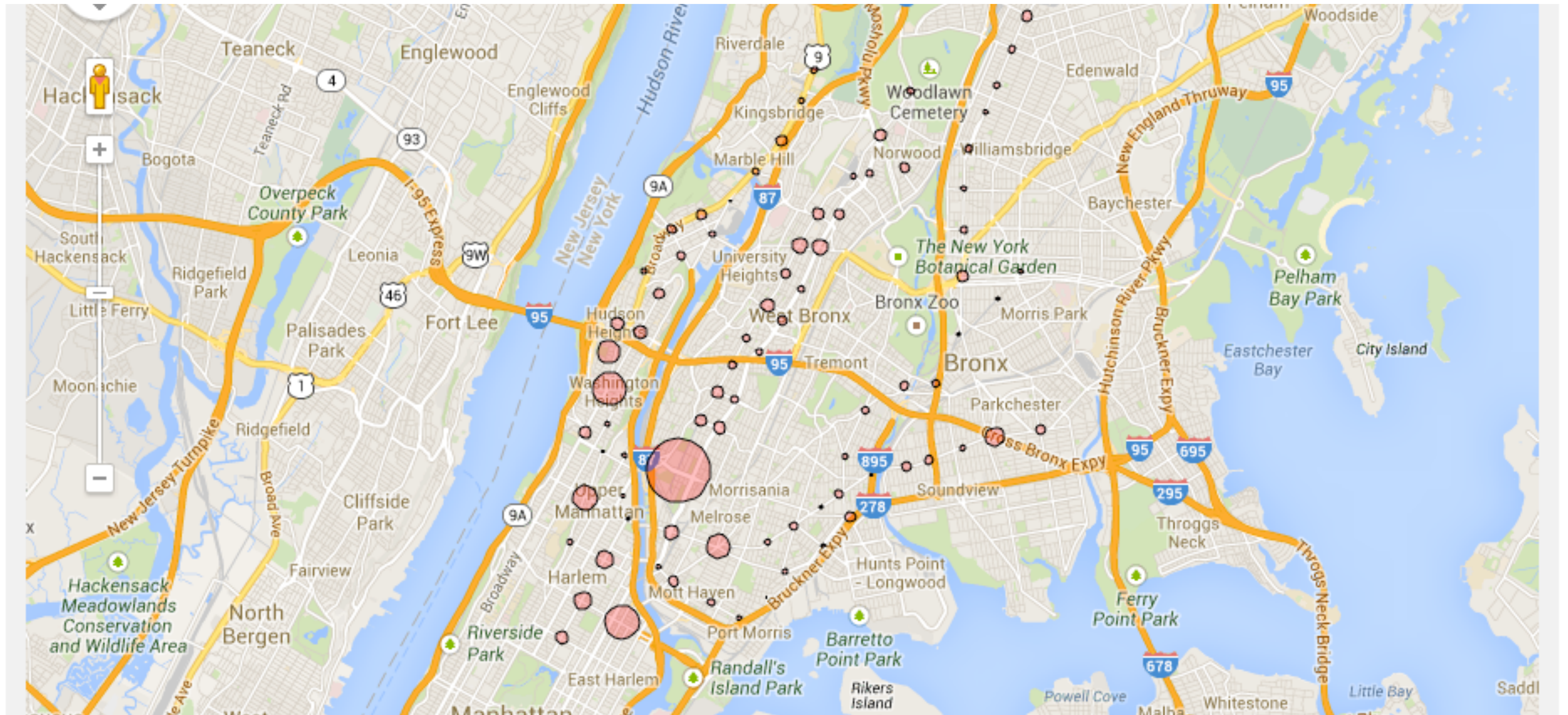


A detailed map of New York City and its surrounding metropolitan area. The map includes major highways such as I-95, I-278, I-495, and I-678. Key locations like Manhattan, Brooklyn, Queens, and New Jersey are labeled. A red shaded area is visible in the center, likely indicating a specific region of interest. The map also shows various neighborhoods, water bodies, and transportation infrastructure.

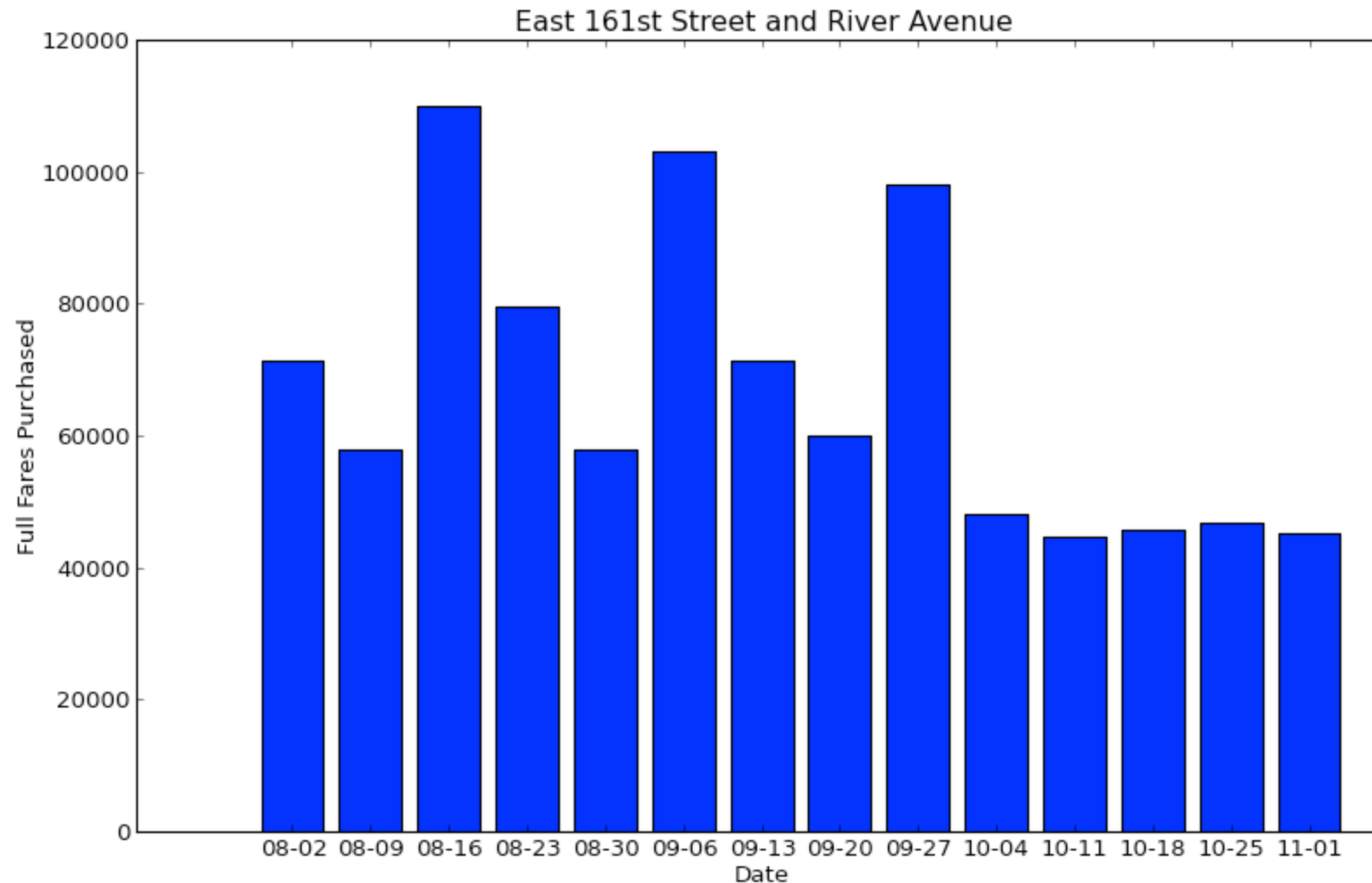
MTA Fare Data Exploration



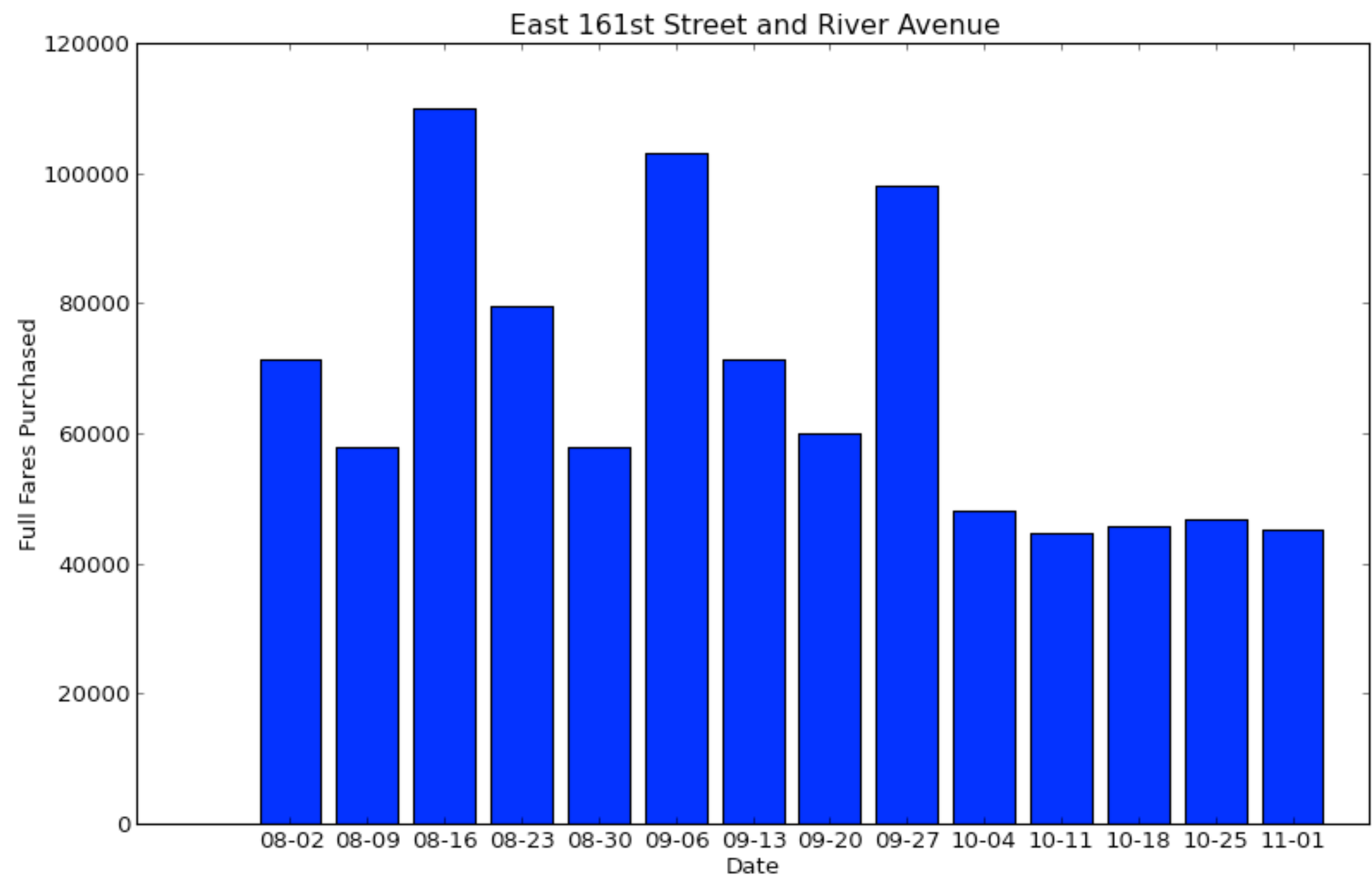
MTA Fare Data Exploration



MTA Fare Data Exploration



MTA Fare Data Exploration



New York Yankees

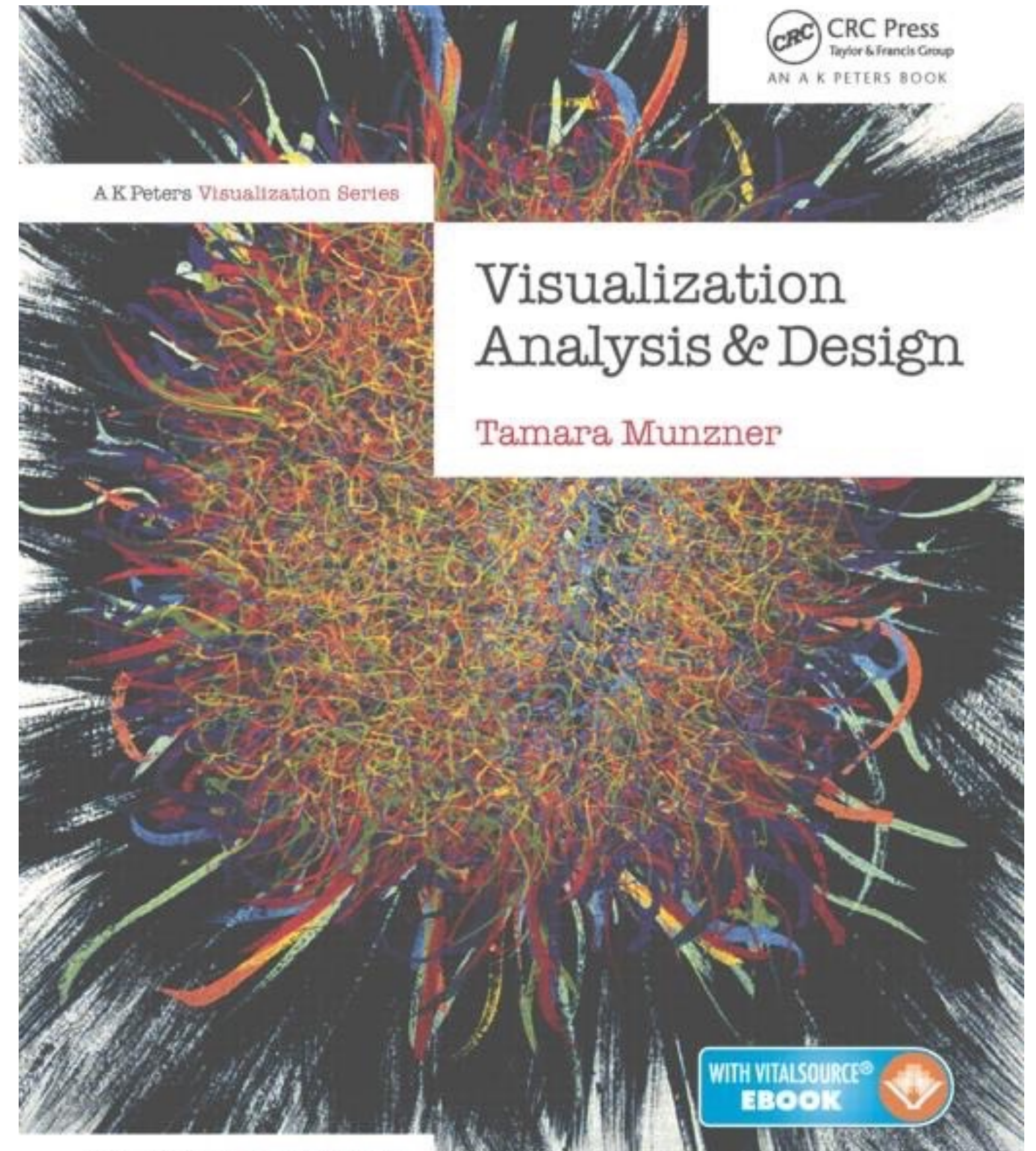
AUGUST						
SUN	MON	TUE	WED	THU	FRI	SAT
	yankees.com			1	2 SD 10:10 YES	3 SD 8:40 YES
4 SD 4:10 YES	5 CHW 8:10 YES	6 CHW 8:10 MY9	7 CHW 8:10 YES	8	9 DET 7:05 YES	10 DET 1:05 YES
11 DET TBA TBA	12 LAA 7:05 YES	13 LAA 7:05 YES	14 LAA 7:05 YES	15 LAA 1:05 YES	16 BOS 7:10 MY9	17 BOS 4:05 FOX
18 BOS TBA TBA	19	20 TOR 7:05 MY9	21 TOR 7:05 YES	22 TOR 1:05 YES	23 TB 7:10 MY9	24 TB 7:10 YES
25 TB 1:40 YES	26 TOR 7:07 YES	27 TOR 7:07 YES	28 TOR 7:07 YES	29	30 BAL 7:05 YES	31 BAL 1:05 YES

SEPTEMBER						
SUN	MON	TUE	WED	THU	FRI	SAT
1 BAL 1:05 YES	2 CHW 1:05 YES	3 CHW 7:05 YES	4 CHW 7:05 YES	5 BOS 7:05 YES	6 BOS 7:05 YES	7 BOS 1:05 FOX
8 BOS TBA TBA	9 BAL 7:05 YES	10 BAL 7:05 MY9	11 BAL 7:05 YES	12 BAL 7:05 YES	13 BOS 7:10 MY9	14 BOS 1:05 FOX
15 BOS TBA TBA	16	17 TOR 7:07 MY9	18 TOR 7:07 YES	19 TOR 7:07 YES	20 SF 7:05 YES	21 SF TBA TBA
22 SF 1:05 YES	23	24 TB 7:05 MY9	25 TB 7:05 YES	26 TB 7:05 YES	27 HOU 8:10 YES	28 HOU TBA TBA
29 HOU 2:10 YES	30	ALL GAMES ARE EASTERN TIME.				

♦ 2013 REGULAR SEASON SCHEDULE ♦

Administrivia

- Course Web Site
- Syllabus
 - Plagiarism
 - Accommodations
- Textbook:
 - Required: Munzner (VAD)
 - Recommend: Murray, 2nd ed. (IDV)
- Assignments
- Exams: Midterm (Oct. 17) and Final (Dec. 11)
- Registration



Administrivia

- Undergraduate (CS 490) and Graduate (CS 680)
 - Extra reading, exam questions, project emphasis
- Research Topics:
 - Also investigate some topics in depth
 - Research papers as assigned reading (CS 680)
- Project: Create an interactive visualization (or vis research)
 - Design
 - Data analysis
 - Insight
 - **Presentations:** Last week of class

Office Hours & Email

- Scheduled office hours are open to all students
 - TTh: 11am-12pm, or by appointment
- You do not need an appointment to stop in during scheduled office hours
- If you need an appointment outside of those times, please email me with **specific details** about what you wish to discuss
- Many questions can be answered via email. **Do not** waste my time scheduling an appointment to ask a question that could be answered via email

About Me

About You

Programming

- "Programming is blindly manipulating symbols." - B. Victor
- "Code is often the best tool we have because it is the most **general** tool we have; code has almost unlimited expressiveness" - M. Bostock
- You will write code in this class
 - Your assignments will involve code
 - Your project will involve code
- JavaScript is the language of the Web
 - Somewhat forgiving, not always the easiest to debug
 - Lots of references out there
 - A quickly-changing environment of frameworks

Questions?