

Mergers & Visualizations

CS171 Final Project

[Process Book](#)

[Video](#)

[Website](#)

Nicolas Lepore, Rebecca Lisk, Lin Zhu

Contents

11/2/2019 - Project Proposal	2
11/6/2019 - Initial Brainstorm	2
11/10/2019 - Detailed Project Plan	4
11/17/2019: Prototype V1	19
11/24/2019: Prototype V2	31
11/25/2019: Think-Aloud Study	34
12/3/2019: Fixing Visualizations, Design, Storytelling Implementation	38
12/7/2019: The Final Chapter	43

11/2/2019 - Project Proposal

- Project Proposal [Link](#)

11/6/2019 - Initial Brainstorm

- Timeline of companies being merged/acquired, swallowing them up perhaps
 - Bubbles taking over other bubbles
- Map with companies popping up
- Where we think the future of tech is going
- Separate out by industry
- Line graph of increase in tech startups
- Maybe only do tech industry?
- Dot com bubble
 - Map of USA with bubbles appearing
([https://angel.co/companies?company_types\[\]=%5BStartup%5D](https://angel.co/companies?company_types[]=%5BStartup%5D))
 - Line graph of num. of web-based companies over the years
- Bubble/scatter of size of company
- Network/connectivity plot of mergers and acquisitions/partnerships/competition between companies?
- Talk about IPOs separately?
- Categorization of different companies
- How big the market is between industries, break down within tech
- Number of acquisitions per company, which acquire the most
- The biggest tech companies through the years

Site Outline

Focus: Tech industry, Mergers & Acquisitions in the tech industry

Audience: General

Message:

- How (radically) has the tech industry changed over the years, key market trends
 - What drives mergers and acquisitions?
1. Title/thesis
 - a. What is a merger (simple visualization of bubbles & explanatory text)
 - b. Big vague statement about the value of mergers – why should you care
 2. Overview of the history of the tech industry
 - a. Who are the companies? Map of startups appearing in the US (bubble location on map is HQ, size = initial valuation, color = industry)
 - b. Bubble stacking map by time (bubble = startup, color = industry, size = IPO?)
 - c. Bubble force graph separated by industry over time
 - d. Most valuable industries over time (line or bar chart)
 - e. Alongside line graph with top 5 market cap in tech industries
 3. Intro to mergers

- a. Volume of mergers and acquisitions over time (line graph)
 - b. Force directed graph to represent connections between companies (mergers, acquisitions) inspired by <https://mariandoerk.de/edgemaps/demo/#phils:map::>
 - i. Cluster of bubbles representing companies, click on a bubble to see all connections to other companies
 - c. The Big Five: Five big bubbles labeled as Google, Amazon, Facebook etc – click on a bubble to reveal all the smaller bubbles inside of it (companies which have been acquired)
4. What drives M&A?
- a. Look at the rise of the internet, the rise of AI, the rise of chip technology, etc individually and somehow show how they drive M&A
 - b. Measles vaccine (from class) based heatmap visualization, broken down by industry

Storyboard

Key trends & Background info: Tech industry overview

- What is a merger and acquisition? Why companies merge? Types of mergers?
- What key tech trends over time drove different acquisitions? (rise of internet, streaming, AI, IoT, cybersecurity)
 - Which companies?
 - Where?
 - Values?
 - How have industries changed?

M&A

- Deal volume over time, corresponding to the key trends
- who has acquired who
- what trends drove these mergers

11/10/2019 - Detailed Project Plan

Contents

Names of Students	5
Goals and Tasks	5
Description of Data	6
Sketches of Visualization Ideas	7
Interaction Storyboard	11
Webpage Layout / Storytelling	12
Project Timeline	15
Feature List	16
Description of Team Roles	17
Presentation Slides	17

Names of Students

Lin Zhu, Rebecca Lisk, Nicolas Lepore

Goals and Tasks

Abstract: We want to visualize the tech industry Merger & Acquisition deal data, in a digestible way for the general public. This would be in the form of both interactive and static visualizations. From reading the news about many tech M&A deals over the summer, we became interested in more effectively visualizing the deal trends and data. Through preliminary online research, there are very few effective visualizations for the general public to learn about deals and trends. Additionally, current pitch decks used by industry professionals also do not include sophisticated yet clear data visualizations. This presents a large opportunity to harness the power of effective data visualization to highlight important technology M&A trends.

Detailed Project Goals: Our goal is to tell the story of the technology industry's trajectory over time and the M&A activity that has shape-shifted the landscape into what it is today. Other goals include communicating the website effectively and making it easily digestible, making our story engaging and exciting, and of course, winning the visualization project competition. We will do so through a story of visualizations that show companies coming into existence, key industry driving trends, tech companies being acquired by or merging with other companies, and lastly the important trends that appear in the M&A industry. Along the way, we will incorporate explanations of elements explained and used. We hope to publish our website and leave it for future use, so other students can gather key insights into the industry.

Some of the tasks of our project include creating interactive visualizations using maps, force layouts, and other timeline sensitive visualization techniques. The visualizations will be carried out using the D3.js library of JavaScript. This code will be managed and shared using GitHub, so our team members can collaborate as one. Some prototype testing will be done using the Tableau service, to get a feel for our visualizations. Other tasks include connecting each visualization through a textual story, and using this story to come to a conclusion about the tech industry's M&A practices. We will label and explain all components in detail. Smaller tasks include finding the most reliable data sources and cleaning this data, creating a multitude of sketches and other preliminary layout ideas, organizing logistics of meeting times and workflow.

Above all, our goal is also to produce meaningful and quality work that will highlight the most important trends in the technology M&A industry, and our tasks all build to achieving this goal.

Description of Data

- List of M&A Deals from 1990 - Present, of companies valued at more than \$500mil USD:** [PitchBook Companies & Deals Search](#)

The screenshot shows the PitchBook interface for 'Companies & Deals Search' with 451,330 deals. The 'Deals' tab is selected. The main table lists deals from 1990 to present, including columns for Company Name, Deal Date, Primary Industry Sector, Primary Industry Group, Value, Deal Type, and Deal Size. Notable deals listed include Charter Communications (31-May-2017), Broadcom (11-Mar-2018), Qualcomm (16-Mar-2018), WarnerMedia (14-Jun-2018), Tesla (24-Aug-2018), Monsanto (07-Jun-2018), and NXP Semiconductors (26-Jul-2018).

#	Company Name	Deal Date	Primary Industry Sector	Primary Industry Group	Value...	Deal Type	Deal Size
1	Charter Communications (...	31-May-2017	Information Technology	Communications and Networking	10.86	Merger/Acqui...	140,000.00
2	Broadcom (NAS: AVGO)	11-Mar-2018	Information Technology	Semiconductors	15.31	Merger/Acqui...	117,000.00
3	Qualcomm (NAS: QCOM)	16-Mar-2018	Information Technology	Communications and Networking	32.99	Merger/Acqui...	117,000.00
4	WarnerMedia	14-Jun-2018	Consumer Products and Services ...	Media	5.10	Merger/Acqui...	85,000.00
5	Tesla (NAS: TSLA)	24-Aug-2018	Consumer Products and Services ...	Transportation	-113.72	Merger/Acqui...	72,000.00
6	Monsanto	07-Jun-2018	Materials and Resources	Chemicals and Gases	15.28	Merger/Acqui...	63,000.00
7	NXP Semiconductors (NAS: ...	26-Jul-2018	Information Technology	Semiconductors	16.52	Merger/Acqui...	44,000.00

- List of IPO's from 2000 - Present:** [IPO Scoop](#)
- More list of IPO's from 1980-2018 with Shares** [Warrington](#)
- Market Cap Data** Morningstar (via Wolfram Alpha) “Microsoft vs Apple vs Amazon vs Facebook vs Googl vs Intel vs IBM vs Cisco Systems vs Salesforce vs Adobe Market Cap”
- S&P 500 index:** Google Finance, Bloomberg, SEC
- Historical Stock Prices** from Yahoo Finance
- Trend Revenue**
- Public Opinion Data** from Statista Tech Giants in the U.S. 2019 report
- Political Opinion Data** from YouGov / Data for Progress
- Volume of Acquisitions over Time** from Institute of Mergers, Acquisitions and Alliances (IMAA): Number & Value of M&A Worldwide

11. Textual background information: [Pitchbook Research Center](#)

Research Center

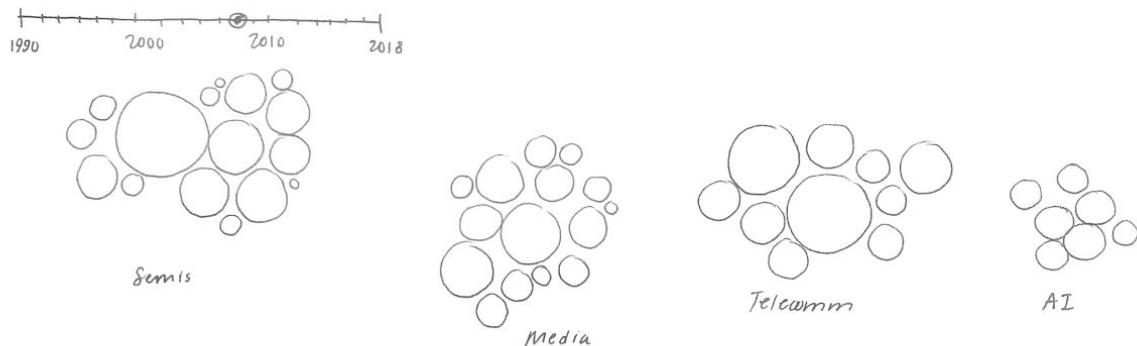
Key Filters		All Applied Filters		Multiple Sort	
technology industry		Date	Manage Filter (1)	Sort Columns (Date)	0 Selected
				Select Top	Deselect All
#	Date	Title	Availability	Report Type	Source
1	03-Nov-2019	3Q 2019 Emerging Tech Research: Mobility Tech	Download	Emerging Technology Re...	PitchBook
2	22-Oct-2019	3Q 2019 North American M&A Report	Download	Market Update	PitchBook
3	22-Oct-2019	3Q 2019 Emerging Tech Research: Healthtech	Download	Emerging Technology Re...	PitchBook
4	16-Oct-2019	3Q 2019 Emerging Tech Research: Internet of Th...	Download	Emerging Technology Re...	PitchBook
5	15-Oct-2019	3Q 2019 European PE Breakdown	Download	Market Update	PitchBook
6	09-Oct-2019	4Q 2019 PitchBook Analyst Note: Venture Debt ...	Download	Analyst Note	PitchBook
7	08-Oct-2019	3Q 2019 US PE Breakdown	Download	Market Update	PitchBook
8	07-Oct-2019	3Q 2019 PitchBook-NVCA Venture Monitor	Download	Market Update	PitchBook
9	23-Sep-2019	2Q 2019 Information Security Industry Spotlight:...	Download	Emerging Technology Re...	PitchBook

Sketches of Visualization Ideas

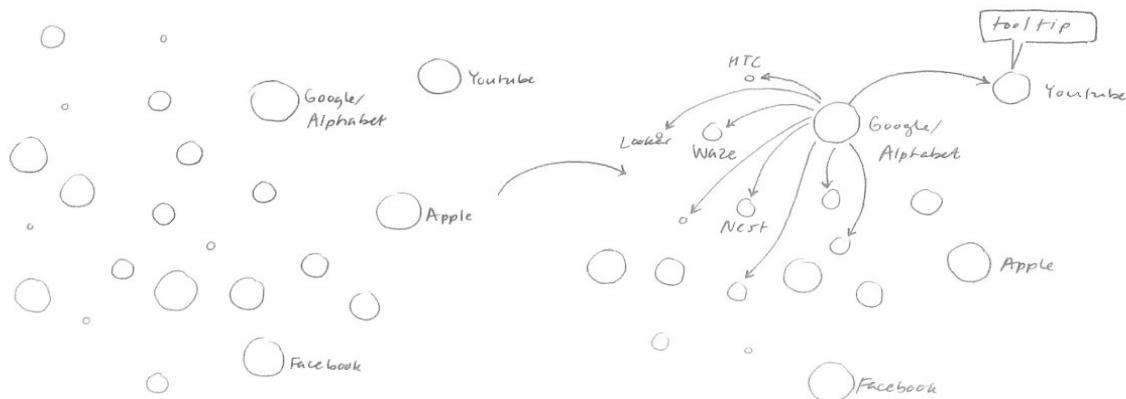
1. Startups around the U.S. over time



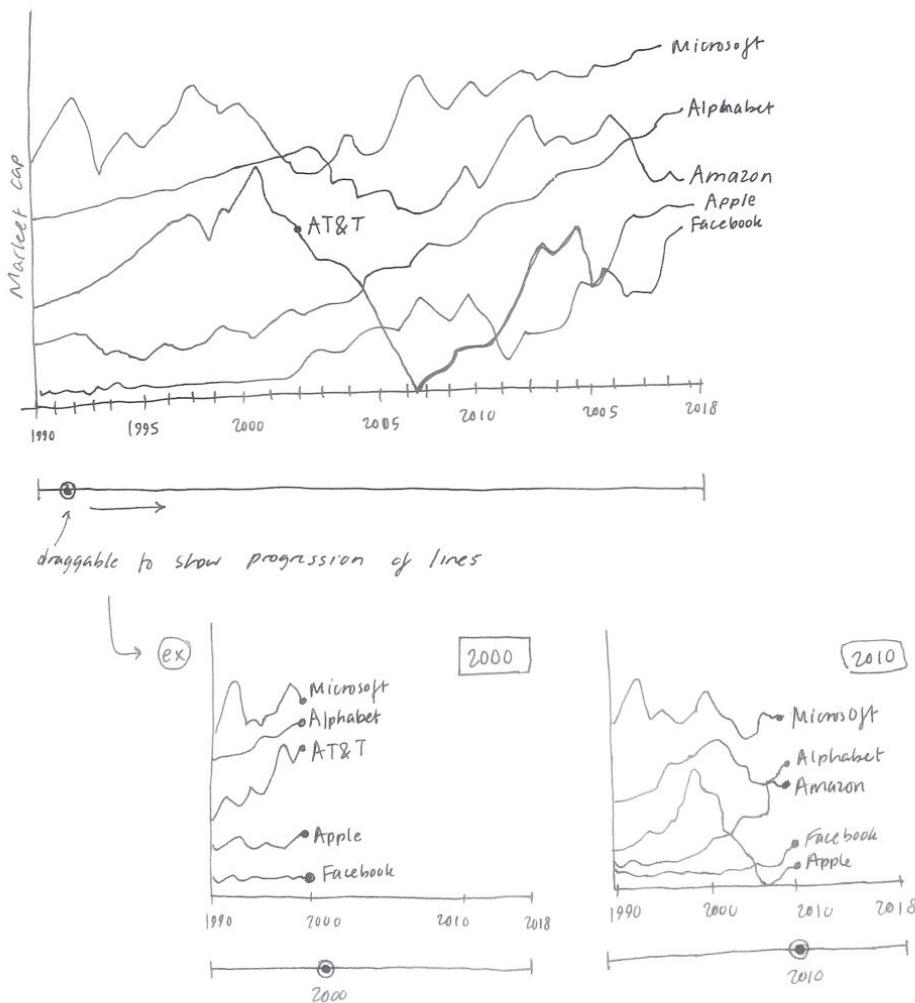
2. Tech startups grouped by sub-industry over time



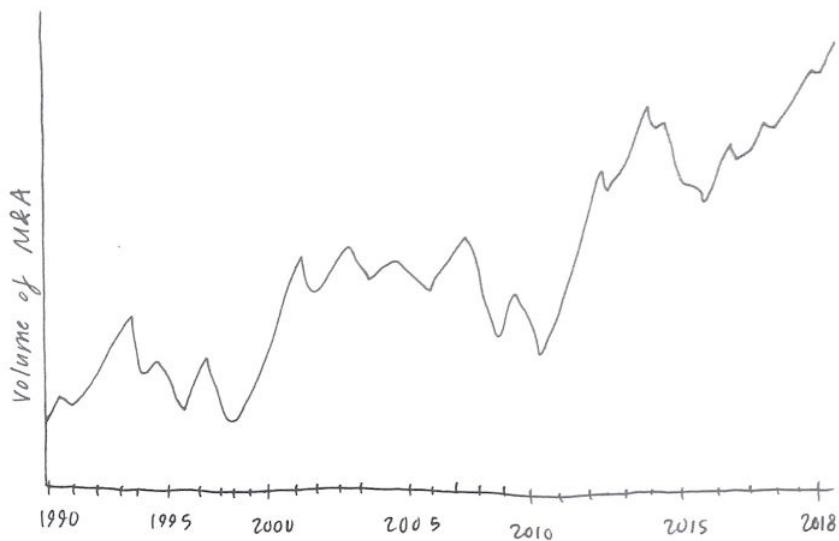
3. Force-directed mergers & acquisitions connection graph (inspired by [LINK](#))



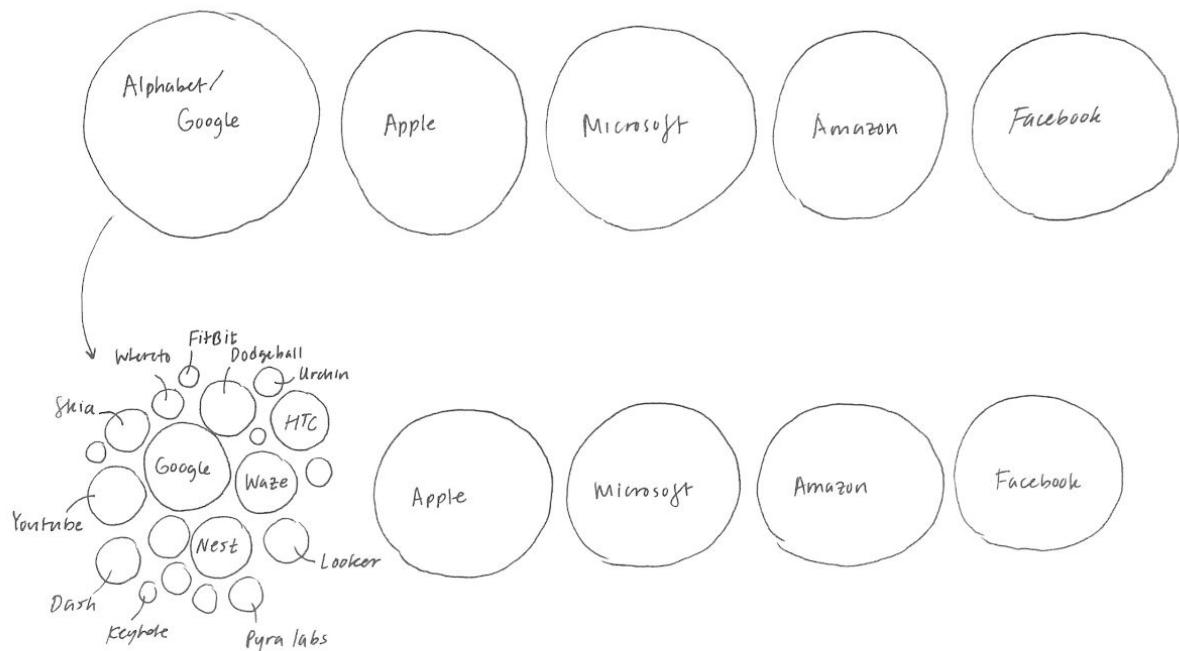
4. Line graph with top 5 market cap in tech industries over time



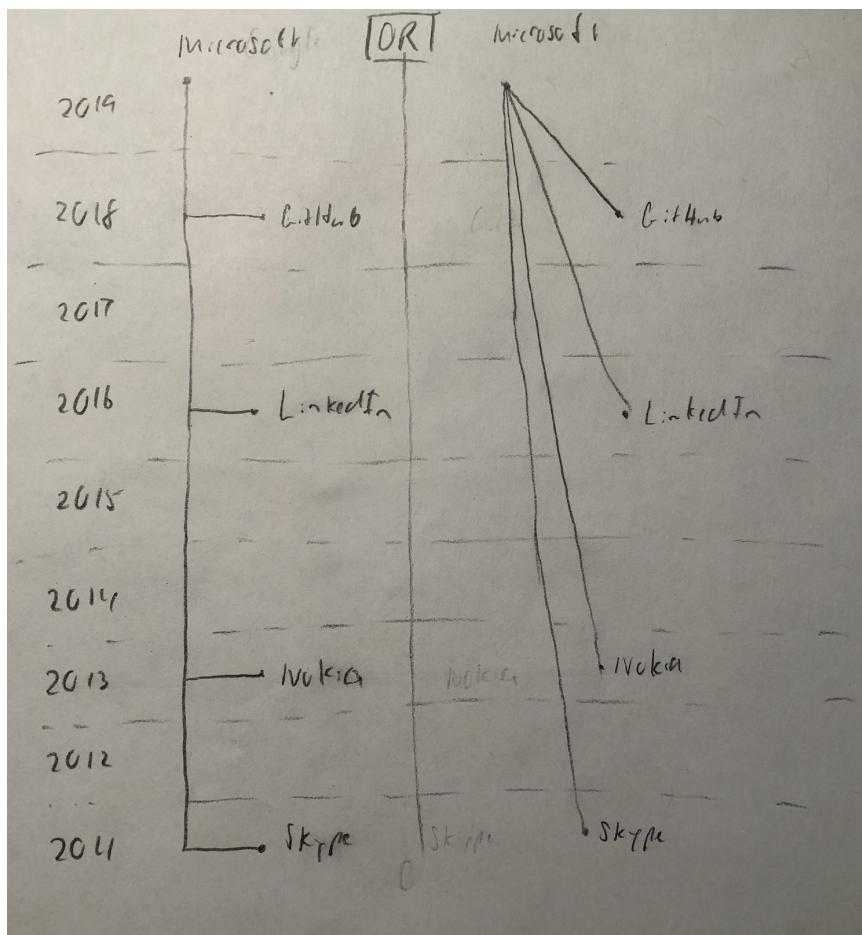
5. Volume of mergers and acquisitions over time



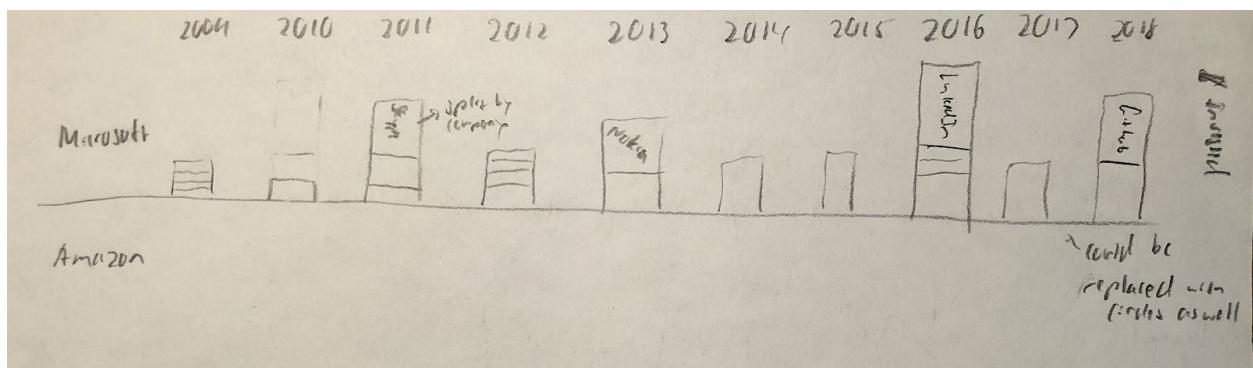
6. The big 5 tech companies, split into their acquisition constituents on-click



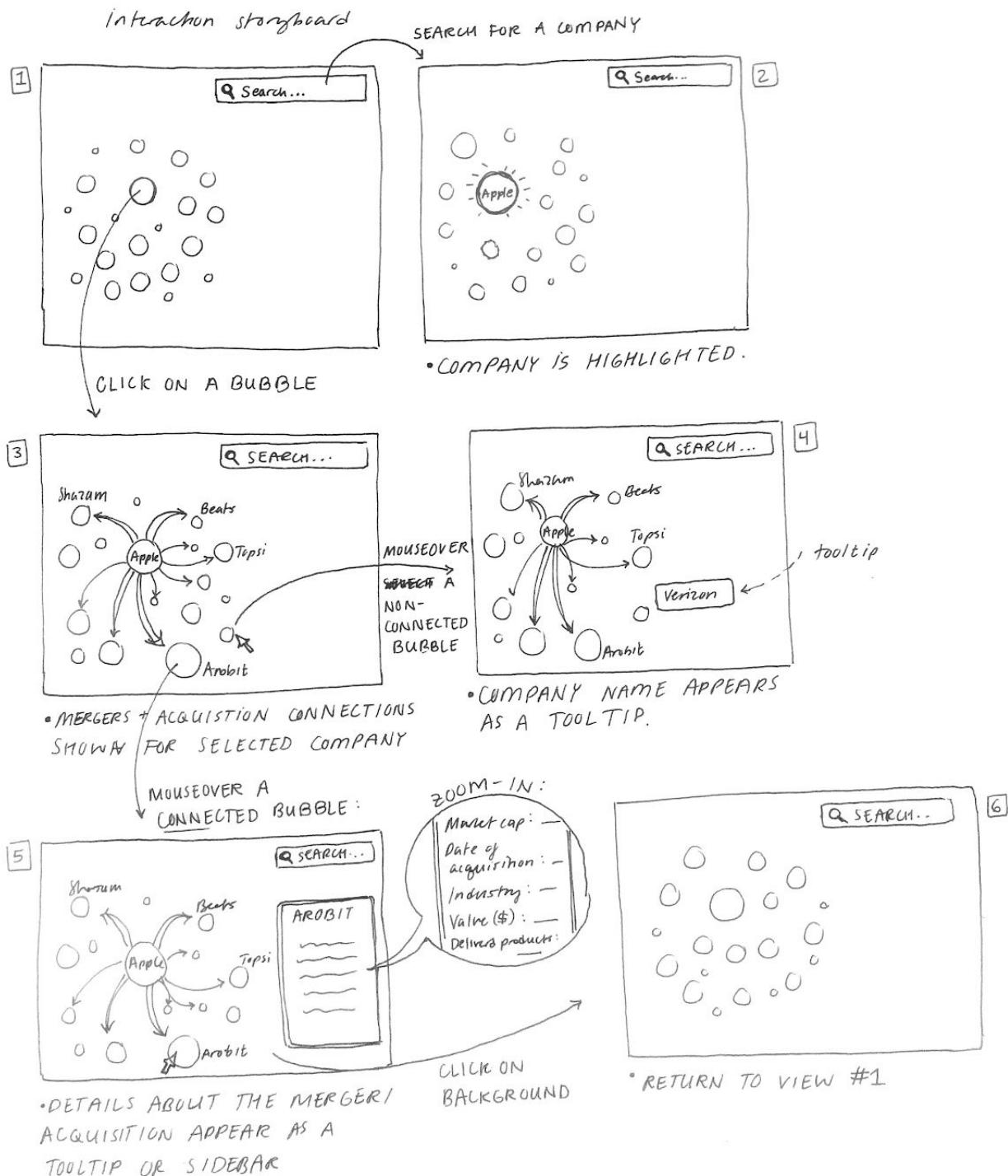
7. Timeline of companies being acquired, two possible line schemes



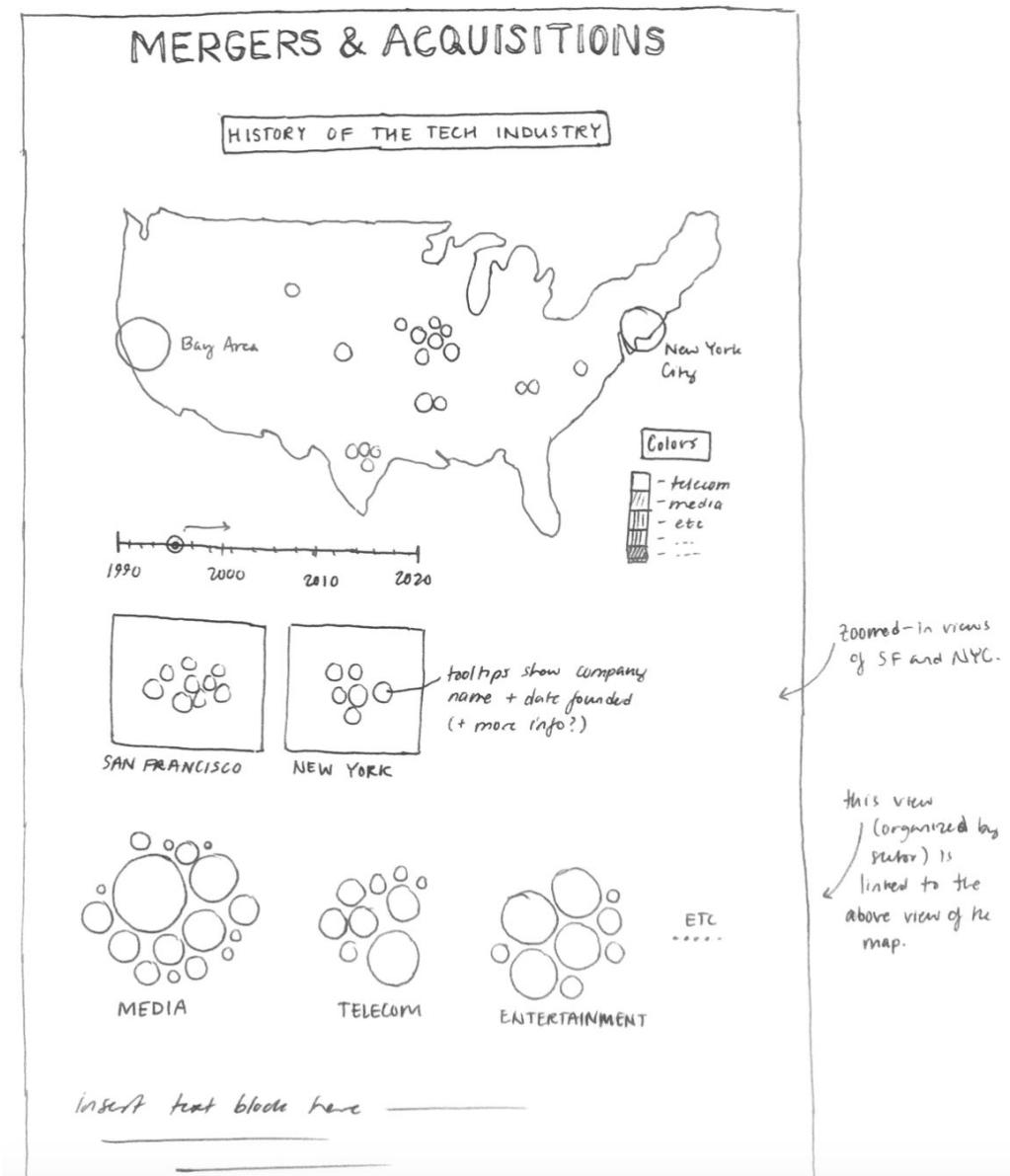
8. Breakdown of each acquisition in bar chart by \$ invested, can be replaced by bubbles



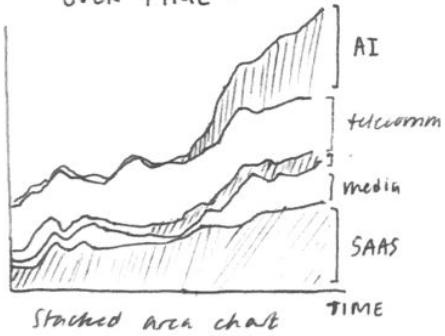
Interaction Storyboard



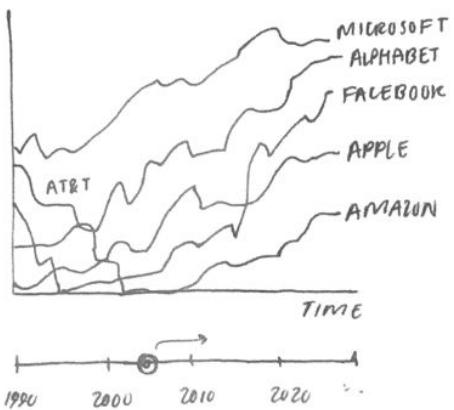
Webpage Layout / Storytelling



MOST VALUABLE INDUSTRIES
OVER TIME :



TOP 5 MARKET CAPS OVER TIME :



HOW DO COMPANIES INTERACT?

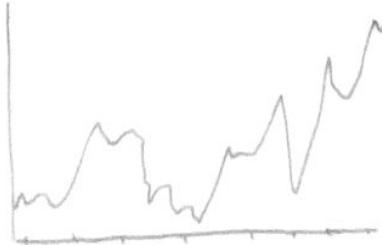
MERGERS



ACQUISITIONS

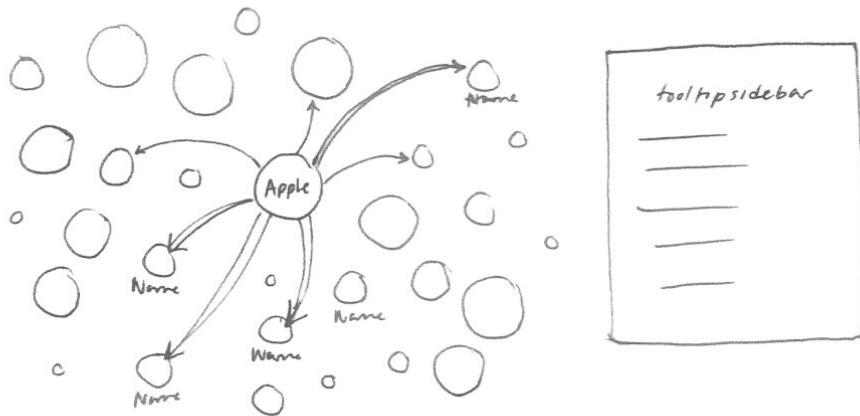


Volume of mergers and acquisitions
over time.

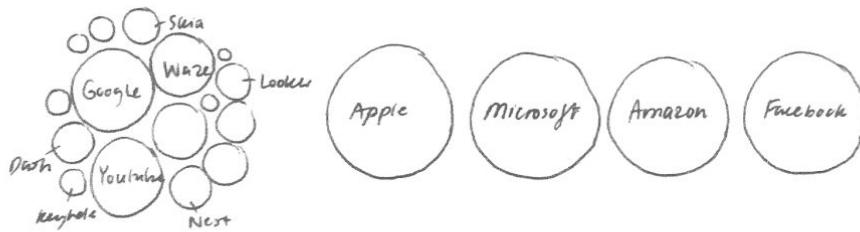


text block

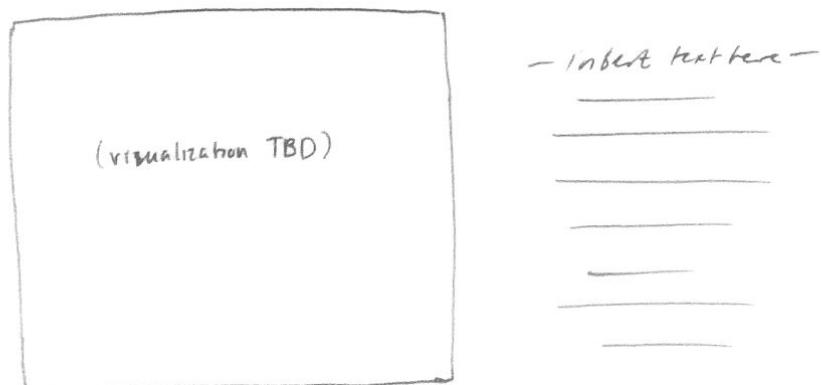
CONNECTIONS BETWEEN COMPANIES



THE GIANTS



WHAT DRIVES M&A?



Insert text here : takeaways, conclusions, etc.

Project Timeline

Course Schedule [Here](#). See features below.

Due Nov 10: Project Plan

- Submitted

Due Nov 17: Prototype V1

- **Finish Introduction Features, begin M&A features**
- Do background research on M&A
- Decide on the “story” we are going to tell with our data
- Create a folder with downloaded dataset CSV files
- Each person create 2 interactive charts
- Meet with TF

Due Nov 24: Prototype V2

- **Finish M&A Features, begin Future Features**
- Create full website skeleton
- Each person create 1 more chart
- Do user tests
- Talk to someone with professional knowledge about industry and get feedback on improvement
- Meet with TF

Due Dec 1: Test and Eval Report

- **Finish All Features**
- Beautify website with CSS
- Test for edge cases
- Meet with TF
- Final Edits
- Create Video
- Complete Evaluation

Due Dec 7: Final Project

Feature List

Must-have

Good to have

Optional BONUS

1. Introduction (see different chart options in visualizations above)
 - a. Hook
 - i. What is M&A?
 1. Textual Background
 2. Diagram of what a M&A is
 - ii. What is the importance of technology industry M&A?
 1. Textual Background & Key Statistics
 2. Infographics
 - iii. Why should I care?
 1. Textual Background & Key Statistics
 2. Visual of the future
 - b. Background and history of the general tech industry
 - i. Which companies and where?
 1. Map with startups popping up
 - ii. Major sectors & key players over time
 1. Bubble Map / line chart
 - iii. Key Trends
 1. Chart
 2. M&A (see different chart options in visualizations above)
 - i. Key Drivers of M&A
 - ii. Visualization of M&A of all companies
 - iii. M&A Deal Volume
 - iv. Key Trends in M&A
 3. Future
 - i. Upcoming Deals
 - ii. Where the industry is headed
 - iii. Learn More Here

Description of Team Roles

Rebecca: 2-3 visualizations, visualization/website layout/storyboard sketcher, assist with storyboarding and planning, assist with text/titles/layout and web design

Lin: 2-3 visualizations, assist with storyboarding and planning, lead logistics (scheduling, task assignment), help with finding datasets, assist with text/titles/layout and web design

Nick: 2-3 visualizations, Github leader, assist with storyboarding and planning, help with finding datasets and organizing data

Presentation Slides

https://docs.google.com/presentation/d/1XhyoMNwAHNtj_KOPlYNMwzi8zkY-4L6i7iZydU6dbM/edit?usp=sharing

11/17/2019: Prototype V1

Names of Students

Lin Zhu, Rebecca Lisk, Nicolas Lepore

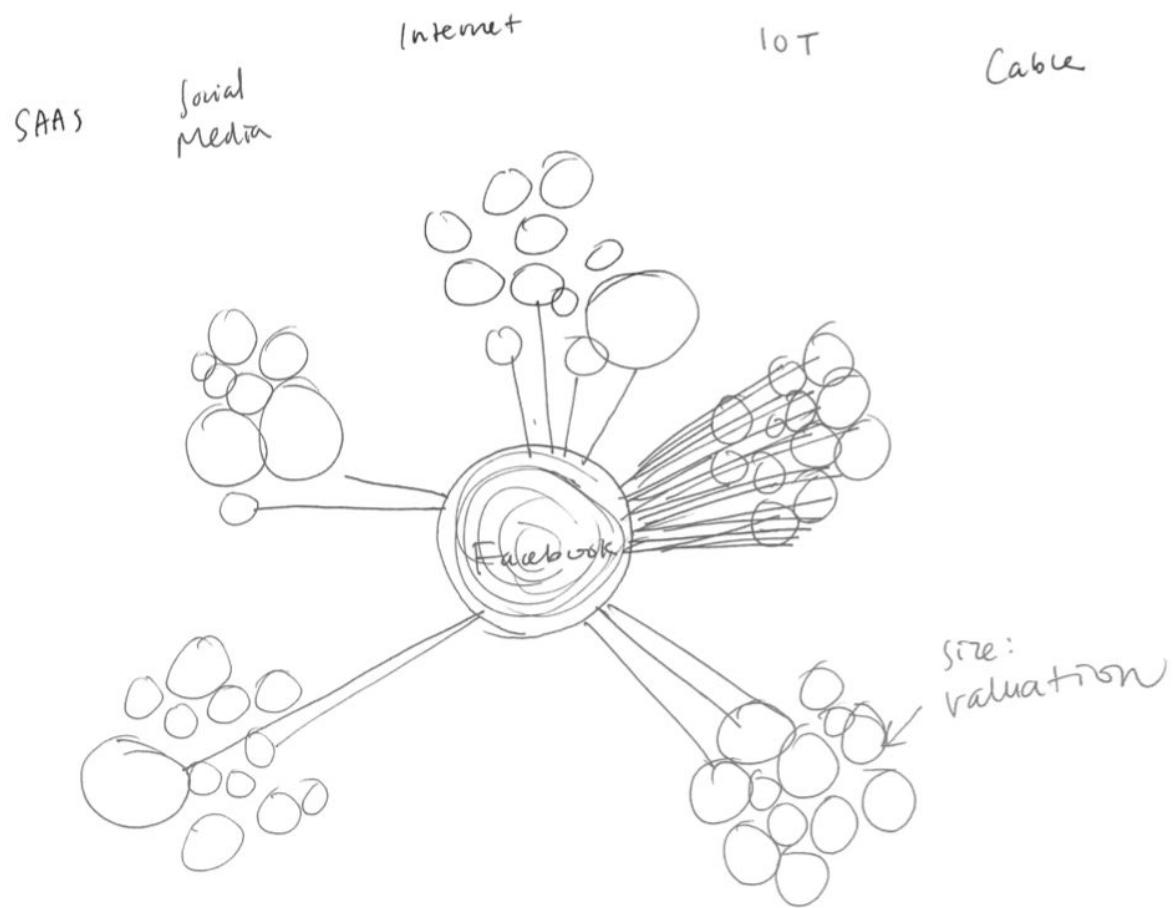
Due Nov 17: Prototype V1

- Finish [Introduction Features](#), begin M&A features
- Do background research on M&A
- Decide on the “story” we are going to tell with our data
- Create a folder with downloaded dataset CSV files
- Each person create or begin creating an interactive chart
- Meet with TF

Notes from Alain from TF video call

- Date range
- Industry specific
- Technology industry
- Asking some questions that interest us
 - Is it necessarily the companies overtaking others
 - Elizabeth Warren
 - Big tech giants
 - Take a stance
 - Research questions
 - Narrow down
 - Question: What is the critical mass for a company before it gets broken down (revenue, workforce, market cap)
 - What threshold does Microsoft get broken up vs. big tech giants
 - When do companies typically get acquired or merged, what features are useful
 - Peyton Manning line chart stops
- Mergers draw story parallel

New website outline sketch:



time : ~~+~~

Map of network and reach

Revenues

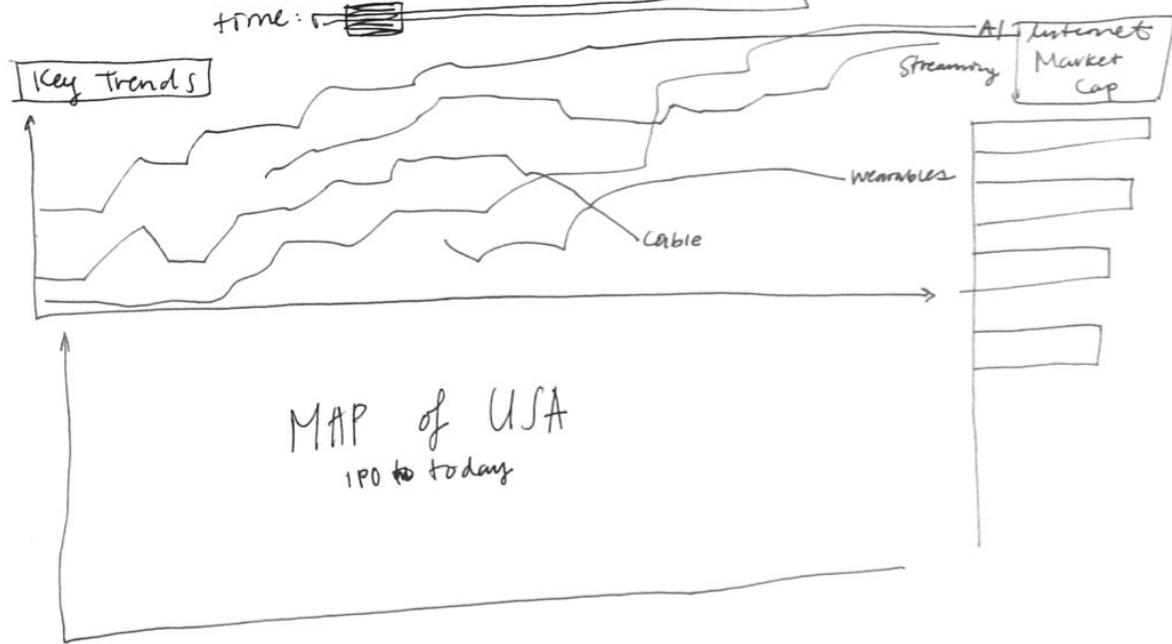
Lawsuits: Problems:

cybersecurity

Ads, Data breaches

How did today's 10 tech giants rise into power?

+ time:



Text:

Choose company: ~~2010-2015~~

All M&A time

key reasons for M&A:

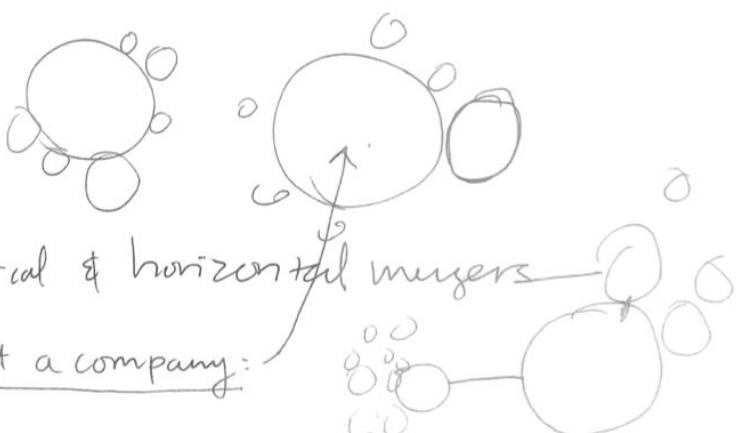


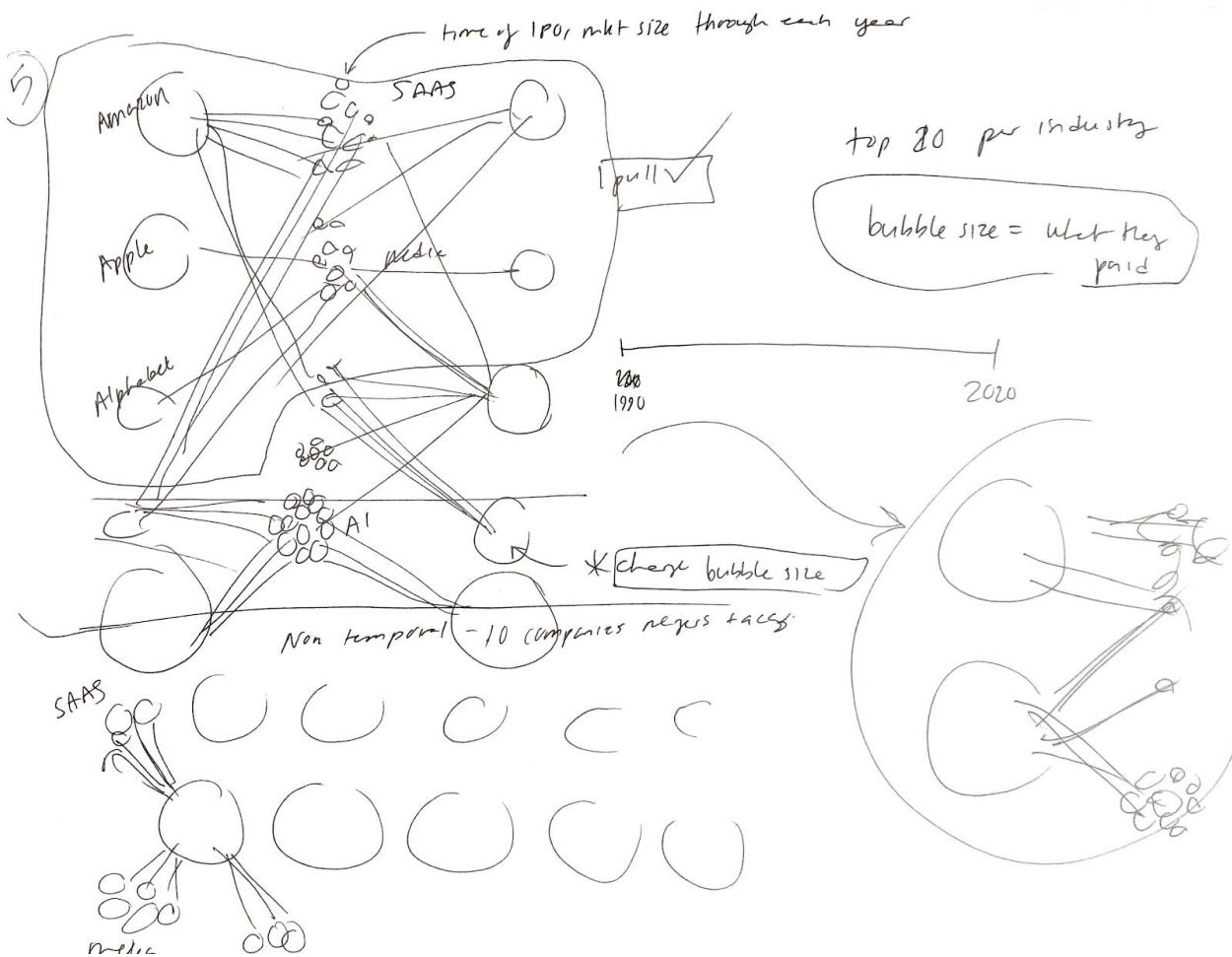
Volume:
put in



Vertical & horizontal mergers

Select a company:





Website storyline:

Website template + placeholders: [Lin](#)

Key question/title: How did today's 5 biggest tech giants come into power?

Section 1: Key trends & history of the tech industry

1. (Key divisions of the industry over time) Temporal line graph of the market cap of the key divisions of the tech industry (AI, streaming, weables, cable, social networks, internet, etc) over time, with a scrollable time bar - [Lin](#)
2. Linked view of the market caps of our top 5 tech giants (dynamic horizontal bar charts) - [Rebecca](#)
3. Linked view of a map of the USA in which the 5 tech giants pop up on the US map when they IPO, with tooltips which give the company name, IPO, industry, etc - [Nick](#)

Section 2: M&A

1. M&A bubble chart over time - [Nick](#)
2. Key reasons for M&A (bar chart) - [Lin](#)
 - a. Tooltips of text box info & revenue over time bar/line chart for the company
3. Volume of M&As over time - [Lin](#)

4. M&A non-temporal bubble chart (5 tech companies connected to their acquisitions) -
Rebecca (dataset done)

Section 3: Moving forward

1. Lawsuits, Databreaches
2. How big tech has negatively impacted economic output

Top 5/10 tech giants:

1. Microsoft
2. Apple
3. Amazon
4. Facebook
5. Alphabet (Google)
6. Intel
7. IBM
8. Cisco Systems
9. Salesforce
10. Adobe

Top tech industry sectors: (Variable names for acquisitions.json)

1. saas (software as a service)
2. social (social media)
3. search
4. commerce
5. content (internet content)
6. media (media/entertainment)
7. hardware (hardware/iot)
8. chips (semiconductors)
9. ai (artificial intelligence)
10. analytics
11. security

Datasets

Task: Data scraping and cleaning complete (using the real data sets)

Our datasets are complete. We have included a list of links to Statista datasets below, and the rest of our datasets are included in the data folder of our code zip file. These datasets include data on the market caps of 10 tech giants over the past 20+ years (used in our dynamic bar chart visualization), data on the volume of tech mergers and acquisitions since 1985, and data on all of the acquisitions by Facebook, Apple, Google, Microsoft, and Amazon (to be used in two force diagram visualizations).

1. AdTech
 - a. <https://www-statista-com.ezp-prod1.hul.harvard.edu/statistics/455840/digital-advertising-revenue-format-digital-market-outlook-usa/>
2. AI/ML/Big Data
 - a. <https://www-statista-com.ezp-prod1.hul.harvard.edu/statistics/254266/global-big-data-market-forecast/>
3. Cybersecurity
 - a. <https://www-statista-com.ezp-prod1.hul.harvard.edu/statistics/595182/worldwide-security-as-a-service-market-size/>
4. Digital Health
5. E-Commerce
6. E-Sports
 - a. <https://www-statista-com.ezp-prod1.hul.harvard.edu/statistics/490522/global-esports-market-revenue/>
7. IoT/consumer electronics
 - a. <https://www-statista-com.ezp-prod1.hul.harvard.edu/statistics/272115/revenue-growth-ce-industry/>
8. Semiconductors
 - a. <https://www.statista.com/statistics/266973/global-semiconductor-sales-since-1988/>
9. SaaS
 - a. <https://www-statista-com.ezp-prod1.hul.harvard.edu/statistics/510333/worldwide-public-cloud-software-as-a-service/>
10. Media / Communications
 - a. telecoms:
<https://www-statista-com.ezp-prod1.hul.harvard.edu/statistics/185217/total-revenues-with-telecommunication-services-in-the-united-states-since-1998/>

Task: At least one D3 visualization already partly implemented, and drafts for 2 more visualizations

We have two D3 visualizations completely implemented, and are in the process of implementing more. Screenshots of the webpage are below, and a static image of the D3 visualization is included below.

Task: Rough webpage design and structure has to be done and implemented (placeholders for visualizations, text and images allowed). Storytelling clear.

How Today's Top 5 Tech Giants Rose Into Power

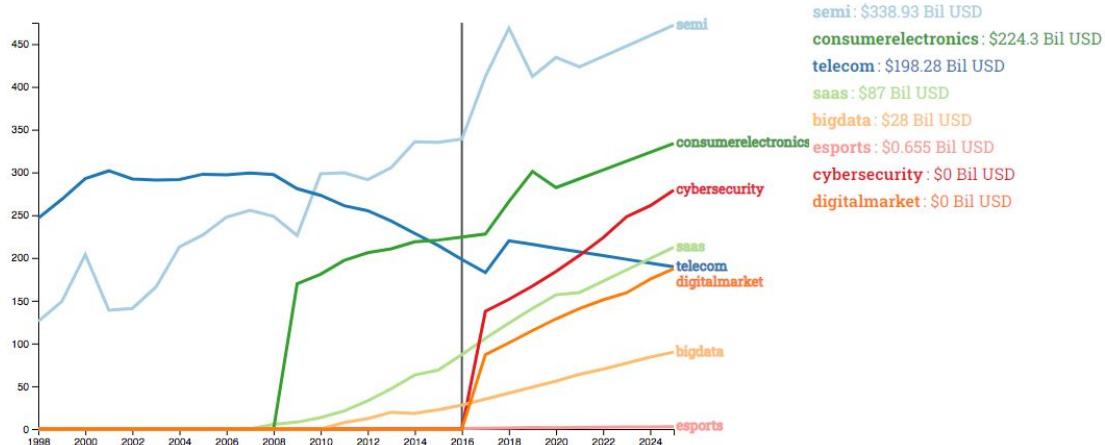
An Analysis Through the lens of Mergers & Acquisitions

Nicolas Lepore, Rebecca Lisk, Lin Zhu

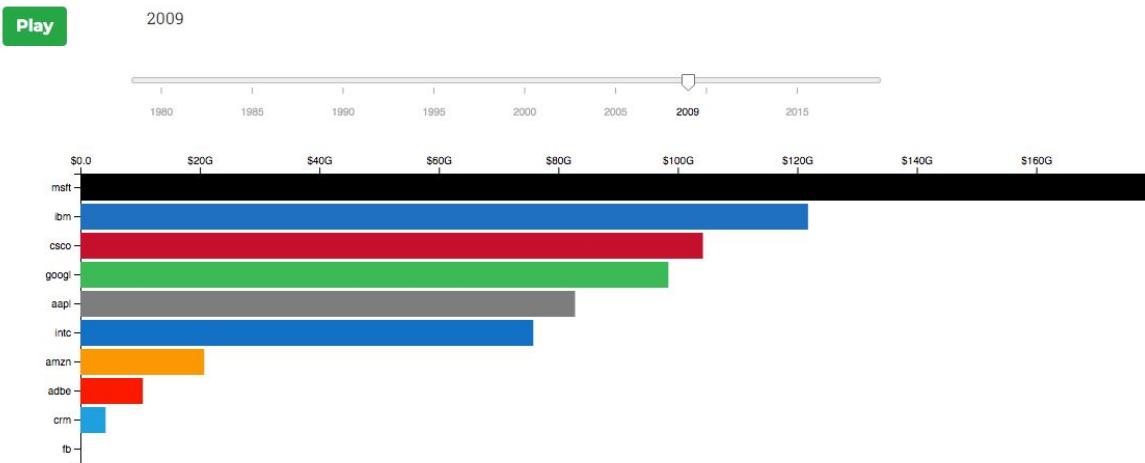
Learn More

THE RISE OF BIG TECH

Revenue (\$ Bil USD) of Tech Verticals Grows with Trends of Faster Computing Chip Technologies and Rise of Big Data



Today's big tech giants rise to market power as IBM's growth stagnates



The tech giants form their HQ's on the west and east coasts - click on a company and more info about the company will show up on display.

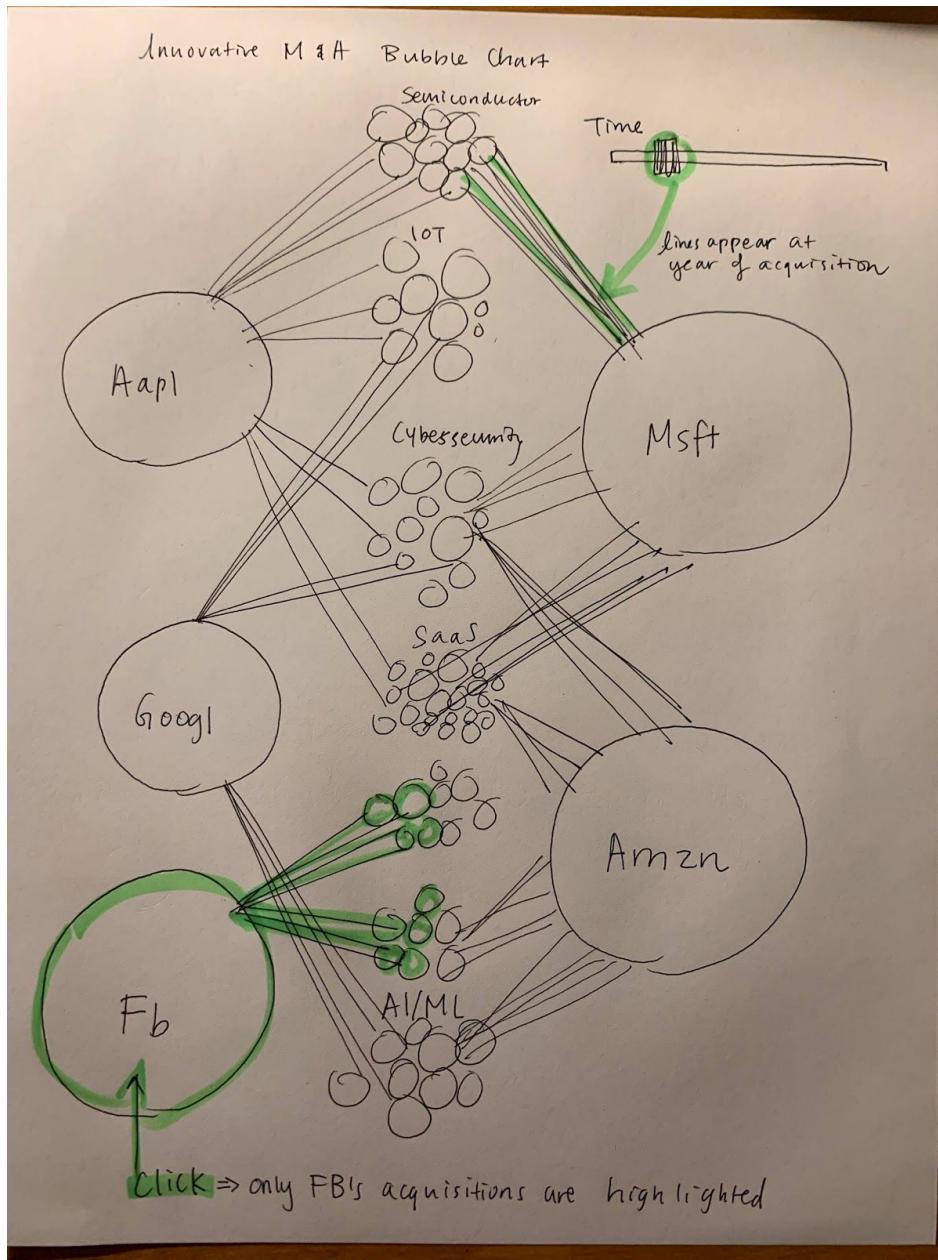


DEALS OF A LIFETIME

Key reasons for M&A

Volume of M&As over time

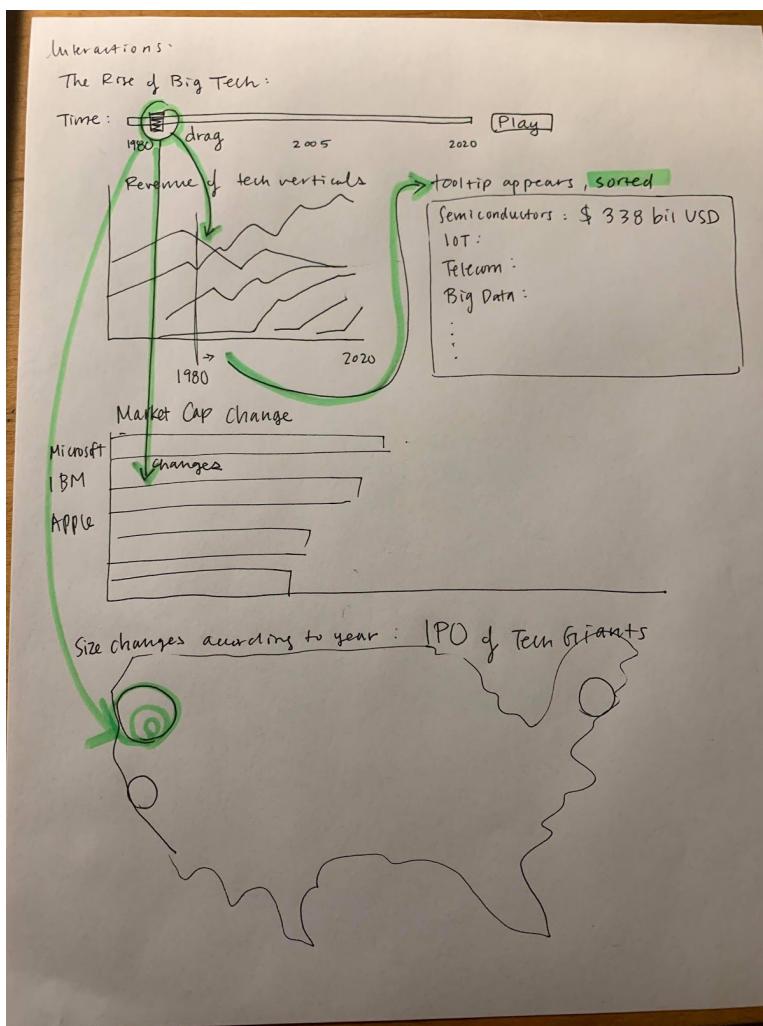
M&A bubble chart over time, showing the top 100 acquisitions made by the top 5 tech giants - Nick

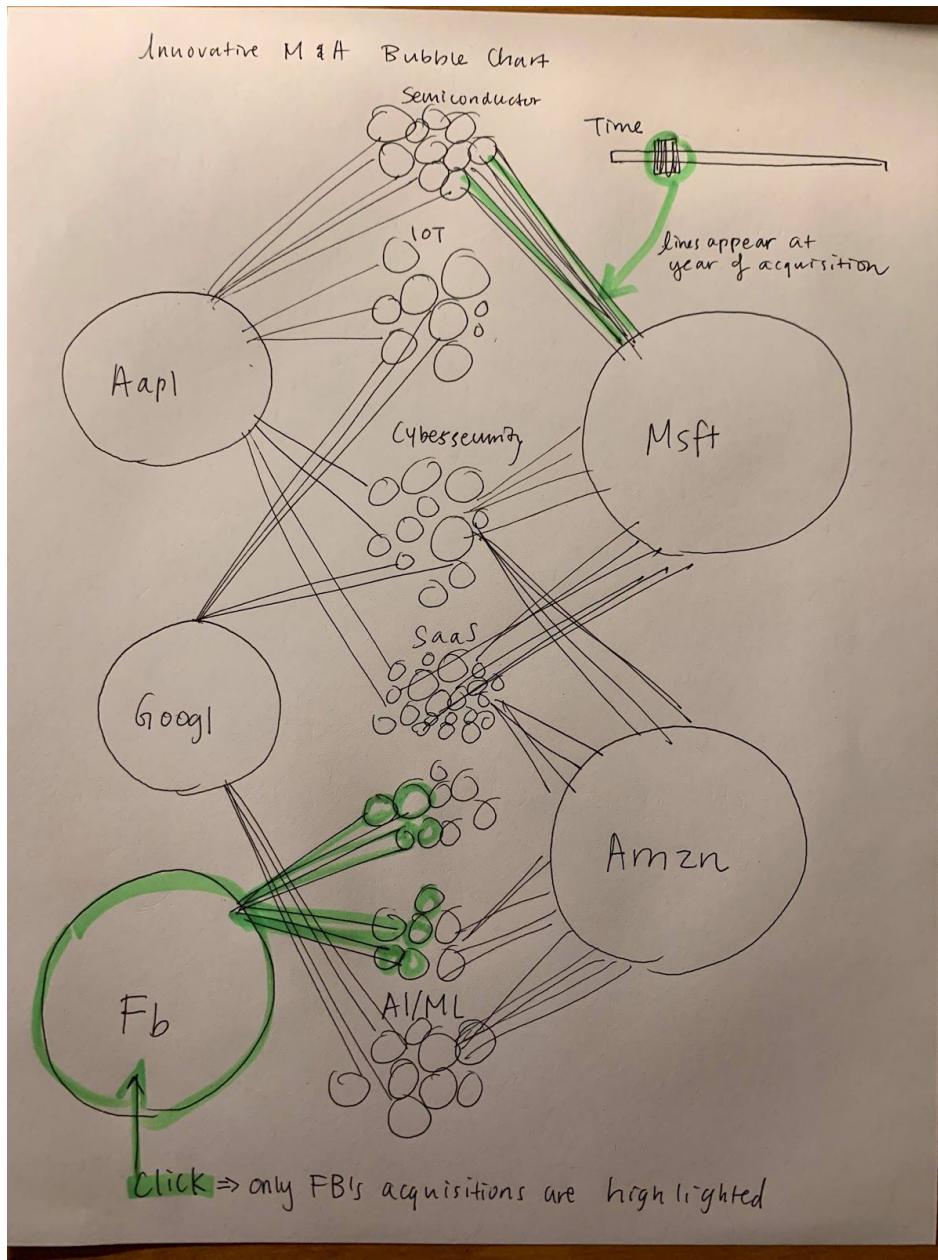


Upon clicking a specific company or deal, a tooltip will pop up detailing the deal data as well as the market conditions that prompted the deal.

Interaction Storyboard

Task: Interactions (e.g., filtering, brushing, etc.) have to be designed (either in an interaction storyboard, or in a textual description and some sketches)





In general, most of our visualizations will be linked through time, as the different data changes over time and are updated. Upon clicking a company, all relevant information will be highlighted.

11/24/2019: Prototype V2

This week, our team completed a working prototype for our website. Each section below details our progress:

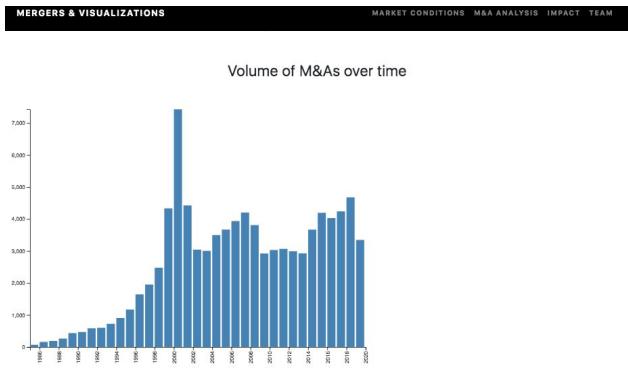
Background & Market Conditions

- Edited the landing page to include information about each of the 5 tech giants and focused on visual design to tell a clear message
- Changed layout and colors of the Verticals Trend chart to match design principles
- Changed layout and colors of the company market cap chart to match design principles



M&A Deal volume bar chart

- Bar chart with tooltips shows the deal volume and value of all tech M&A deals from the 1980s
- This serves as a contextualizing background that M&A activity over the years is on average the same volume, but has volatility every few years



M&A Force Layout with Time Slider

- Shows the acquisition of companies over time by the big tech companies
- Size denotes the size of the deal
- Lots of private or missing data as far as prices, so we made this clear with our choice of color
- Can separate or center the companies as an added feature
- Can hit the play button and see the companies get acquired through the years
- Shows the collection of 750 companies (a lot!) by big tech



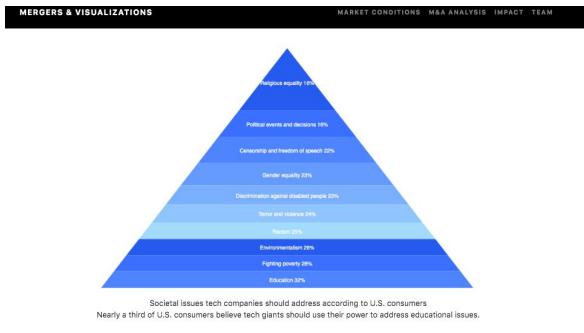
Perception of big tech companies stacked bar chart

- stacked bar chart shows that the public perceives these tech companies are very positive, despite the potential misalignment of values and harm they cause



Social Issues Pyramid

- Shows what people wish tech companies focused on in a hierarchical manner



To do's Next Week

- Add 2 more innovative views
- Complete claims and storytelling element, do research and conclude from our data
- Focus on design of website and chart elements
- Link more views together
- Review with Staff
- Get feedback from our tests and improve from suggestions

11/25/2019: Think-Aloud Study

Notes on Ethan's experience:

- Make the links to page sections actually connect to where they are on the page
- We should put the timeline right next to the interactive bar chart because or else
- If you play the bar chart and it completes and then you click play again, it breaks (you have to drag the slider back to the start)
- Or, get rid of the timeline and make the bar chart connected to the tooltip for the industry chart, and add text next to the bar chart that changes based on the year that the tooltip is in.
- Slider head should move on the 1st timeline
- Ethan is colorblind; we should change the color scheme from blue -- change to a different color scheme
- Change the sidebar labels of the bar chart to larger font and the actual names of the companies
- Add text to make the story more clear
- First time clicking the bubble chart play button nothing happened -- play button doesn't work
- Also the big bubbles are moving across the page
- Can't see the year on the bubble chart if you have the viz centered
- Small bubbles are too small to mouse over to see the company names
- Forces seem super strong -- maybe make the circles larger and decrease the force (because the tiny circles are zipping all over the place)
- Group small bubbles by acquisition type in the center to see more trends
- Tooltips for Tech Giants and Society are not in the correct place
- Ethan understood what the triangle meant to communicate BUT it is not intuitive due to the different areas of the top and bottom (top area seems like its most important)

Feedback:

https://docs.google.com/document/d/1snFqghvRVUzgVM9XIYH60IHEiD1HWDOkWm_xrzfFh9U/edit

Images of feedback forms: (see larger versions in the feedback document)

CS 171 Project Presentations

(Give the completed form to the team you gave feedback on. They will have to scan it in and attach it to their final submission.)

Your Names: Estefania Lohara

Your E-mail: elohara@college.harvard.edu

Name of group you evaluated:

Mergers + Visualization

What is good about the group's visualization?

- Creative visualization
 - like their merger one
 - like the side description of line plot

What could be improved?

Sun Chart

- needs axis labels
- would move next to play button
- going to need detailed description because business stuff not common knowledge
- I wonder if map takes away from story

Is the message clear? What is the message?

- background
 - merging over time
 - acquisitions
 - impact on perception society
- } could be more clearly emphasized

CS 171 Project Presentations

(Give the completed form to the team you gave feedback on. They will have to scan it in and attach it to their final submission.)

Your Names: Nate Hollenberg

Your E-mail: nhollenberg@college.harvard.edu

Name of group you evaluated: Mergers + Visualization

What is good about the group's visualization?

- Very innovative visualizations, especially the ones that you can press play and updates.
- Really good data on the companies and good, unique visualizations.
- Most of the visualizations are very similar.
- Super interactive and fun of tool tips

What could be improved?

- A lot of it still needs to be implemented!
- More text and flow of how each visualization connects to each other
- Screen size issues as some visualizations did not all fit on the same screen

Is the message clear? What is the message?

- The message is somewhat clear, definitely clear that it is about tech companies, and seems like an exploratory dashboard
- Maybe want to focus a little more on telling a story!

CS 171 Project Presentations

(Give the completed form to the team you gave feedback on. They will have to scan it in and attach it to their final submission.)

Your Names: Risan Cui

Your E-mail: tcui@college.howard.edu

Name of group you evaluated: Mergers & Visualizations

What is good about the group's visualization?

The group has two innovative figures (correspondence between timeline and map of tech companies) and the bubble chart shows acquisitions. I felt very engaged with these two visualizations.

What could be improved?

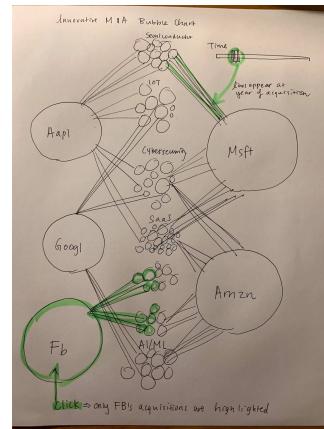
The first two visualizations could be better linked together. Also with the bubble chart the group could consider implementing a flow diagram alongside it.

Is the message clear? What is the message?

I understand the group is trying to relate tech and society, but the exact relationship could be made more clear.

To do's for next week:

1. Fix title/landing page & change template (Lin)
2. Gather story/background text and insert into website, both for tooltips as well as background info, make claims and give clear conclusions
 - a. Add axis and chart titles for all charts (Lin)
 - b. Market Conditions (Lin)
 - c. M&A (Lin)
 - d. Tech Giants and society (Rebecca)
 - e. Conclusion (Rebecca)
3. Link trend and market cap graph (Nick)
4. Finish Map (Lin)
5. Revise M&A volume chart (Rebecca)
6. Fix M&A bubble chart (no force, add lines), add sectors & adjust circle radius (Nick)



7. Fix Company Perception chart (Nick)
8. Fix Pyramid (Lin)
9. Add the percentage circle charts (Rebecca)
10. Add 1 more creative visual (up 4 grabz)
11. Link Views, clickable, highlight (up 4 grabz)
12. Set up meeting with TF (Lin)
13. Draft Video Plan (All)

12/3/2019: Fixing Visualizations, Design, Storytelling Implementation

This week, we took into consideration the following forms of feedback:

1. Feedback of Prototype V2 from Alain (mentor TF)
2. Think-Aloud studies

Feedback from Prototype V2:

- I like that the title of the story is now focused.
- I would help to have a paragraph or some text to segue between the lead-in title and the beginning of the market conditions' visualizations.
- For the line graph, I recommend using divergent colors for the different categories (e.g. semiconductor, consumer electronics, etc.). It currently feels like the lines are representing ordinal data, which I don't feel it is what you are trying to convey.
- For the details on demand of the line graph, I recommend you move it a tad to the right for better visual grouping. Also, you may want to decrease line spacing in that section.
- The market conditions play bar corresponds to the bar chart, and should therefore be moved near the bar chart.
- I take it that the map is still a work in progress?
- For the "Volume of M&As over time" bar chart, I recommend having the x-axis labels be slanted diagonally.
- The second play bar does not appear to be connecting to the near visualizations.
- The grouped scatterplot has a lot of appeal to it. However, I don't think the end user has enough instructions to use and understand what is being conveyed. Here, I recommend that you add tooltips or even just regular text stating what the viz is about and how to navigate it.
- For the "Tech Giants and Society" stacked bar chart, hovering over the different bar areas results in displacement of the value label into the white space of the webpage in many cases. Also, the y axis needs to be labeled in terms of what it is measuring.
- The topical pyramid looks cool; though, how does it relate to the theme of mergers and acquisitions? Also, what are the different hues of blue encoding? A legend here would be helpful.
- In summary, I would like you to improve the following areas for your final submission:
 - Fixes to existing visualizations.
 - Implementing the visualizations in lieu of placeholders, and completing the in-progress visualizations.
 - Adding instructions/tips where how to use the visualizations is not intuitive.
 - Writing the story that you are trying to tell, and reflecting it in both prose and through the use of visualizations to achieve high coherence.

We made the following adjustments:

1. **Added background text and explanations:** text [here](#)
2. **Fixed M&A acquisition graph**
3. **Fixed stacked bar chart:** *How do you feel about this company?*
4. **Added double layer pie chart:** *How do you feel about the digital sector being dominated by just a few tech companies?*
5. **Added multi-bar charts:** *Would you support or oppose a policy breaking up big tech companies by undoing recent mergers (such as Facebook buying Instagram) in order to increase competition in the future?*
6. **Fixed Pyramid chart:** *Societal issues tech companies should address according to U.S. consumers?*
 - a. now includes legend and tooltips
7. **Finished adding titles, legends, axis-labels**
8. **Focused on color and design**
 - a. Market trend data now has divergent colors
 - b. Changed overall layout to encapsulate visualizations in card divs to make more visual coherence
9. **Video Plan** [here](#)

Questions for Zoom call with Alain on 12/5:

1. Is the story clear, effective, and engaging? Is it reflected through both prose and the use of visualizations to achieve coherence?
2. Does the text effectively guide you through the website? Are the transitions between the sections clear?
3. Is the pyramid better related to the theme of M&A? (based on a previous comment)
4. Are the instructions on how to use the non-intuitive visualizations clear?
5. Do we have enough visualizations and enough unique visualizations?
6. Quality of website design elements?
7. What can we improve between now and the deadline?

Notes from Zoom call on 12/5:

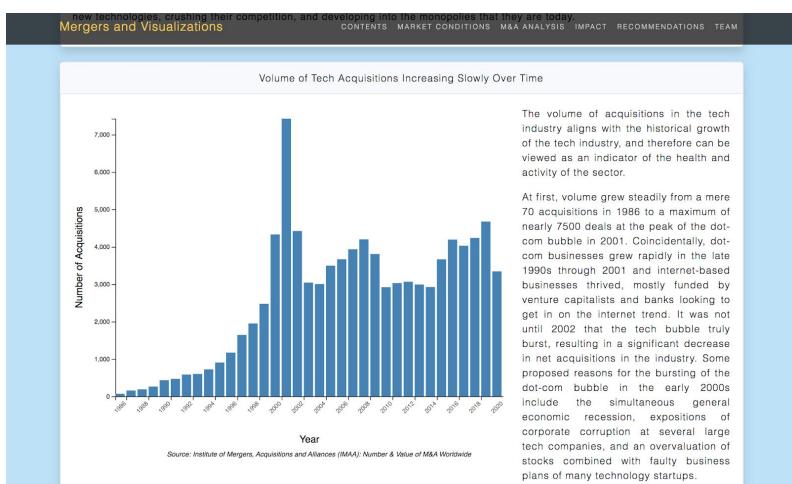
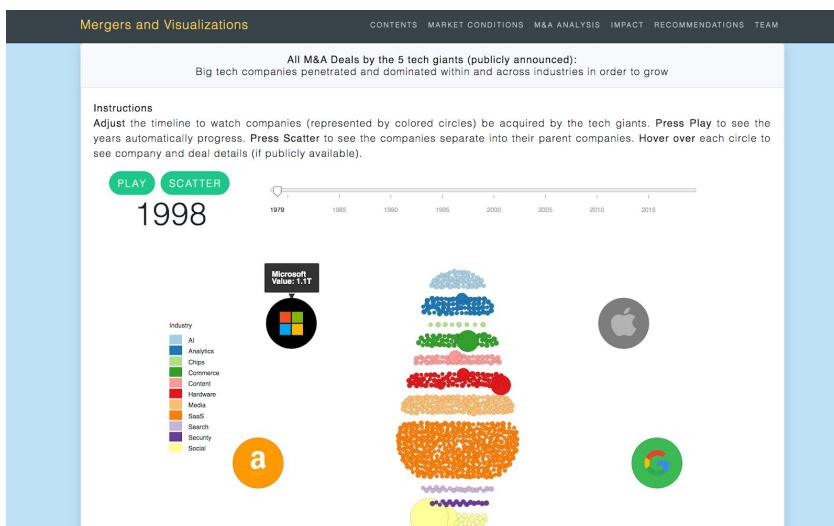
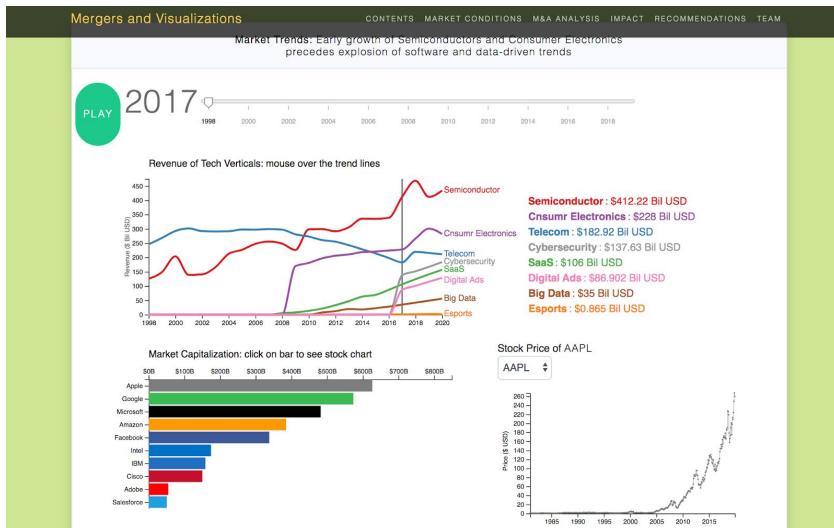
- Add a linked view (link two visualizations) -- click on a company in the bar graph & the stock price chart appears
- Bold section titles in the contents section
- “Click through the menu options...” are instructions: move on top of the graph
- Match the content titles to the section titles
- Re: grouping of companies -- group companies by their industries
- Fix nodes getting stuck

- Use a sequential or diverging (not red-to-green) color scheme for pie chart; change pie chart to bar chart
- Match the order on the pie chart legend to the bar chart legend (green on top, etc)
- Add tooltips to pyramid viz and look into making all areas the same or make the pyramid stacked boxes

Some screenshots below:

The screenshot shows the homepage of the "Mergers and Visualizations" website. The main title is "The Rise of Today's Tech Giants: An Analysis of Mergers and Acquisitions". Below the title, there is a brief text: "Microsoft, Amazon, Apple, Google, and Facebook represent the world's largest, most valuable companies. How did these tech companies rise to market power and domination in just over ten years? What can we learn from their growth and expansion strategies?" A "GET STARTED" button is visible at the bottom left. In the center, there is a video player showing a video titled "Mergers&Visualizations.com - The Impact of Tech Giants on the Stock Market". The video interface includes a play button, a progress bar at 0:43 / 1:59, and social sharing icons for YouTube, Facebook, and Twitter.

The screenshot shows the "Contents" page of the "Mergers and Visualizations" website. The main title is "Contents". Below it, there are four sections listed in boxes: "Market Conditions: Analysis of historical market trends within the tech industry that incubated growth conditions", "M&A Analysis: Analysis of strategic merger and acquisitions (M&A) deals that allowed vertical and horizontal industry penetration and gain of market share", "Impact: Analysis of public sentiment of the 5 tech giants and monopolization of the industry", and "Recommendations: Data driven recommendations and conclusions based off of market conditions, strategic M&A trends, and public values".





Screencast Script

Background music: <https://www.youtube.com/watch?v=J0BPoofmPkw>

Hook intro: (10 seconds) Mark Zuckerberg and Facebook at senate hearing:

<https://www.youtube.com/watch?v=jyxS2bvQGxc>

Lin Nick Rebecca

Over the last decade, tech giants Microsoft, Amazon, Apple, Google, and Facebook rose to power and have become some of the world's most valuable companies.

Today, we analyze how they rose to power, through the lens of Merger and Acquisition Deals.

First, what market conditions incubated such growth conditions?

- From the late 90's to the early 2000's, the Semiconductor and Telecom sectors boomed, followed by the recent growth of Big Data, SaaS, and Cybersecurity.
- The tech giants market caps have grown significantly in just a few years.
- Here we can compare individual stock prices and indices.

Next, what M&A deals did these companies close?

- The circles represent companies as they are acquired. Microsoft and Apple are the two main pre-2000 acquirers, then they are joined by the others. These acquisitions have been key to their success in penetrating new markets and gaining market power
- We see that the volume of Tech Acquisitions is Increasing Slowly Over Time.

Lastly, what is the public perception of these tech giants?

- There is an overall positive view of big tech.
- Yet there is a majority negative feeling toward the tech sector being monopolized.
- A significant majority supports undoing recent mergers, regardless of political leaning.
- This visualization demonstrates that the public believes the most powerful companies should use their power to address social issues.

Given our data analysis, We recommend tech companies to pursue M&A where the market trend is growing, as well as invest in social impact driven companies to align corporate missions with public values.

Visit our website to learn more!!!!

12/7/2019: The Final Chapter

Overview and Motivation: *Provide an overview of the project goals and the motivation for it. Consider that this will be read by people who did not see your project proposal.*

Our overall goal for this project was to create a visual story of the tech giants' rise to power and the public perception of them, in a digestible and interactive format for the general public to consume. To achieve this broader goal, we set additional, smaller goals, including using visualizations to describe the trajectory of the tech industry's sectors, depicting the acquisitions that the big 5 tech companies made during their rise to dominance, communicating the general public perception of the big tech companies, and linking views together to create a complete picture of the rise of the big 5 tech companies to industry monopolization. In terms of our website design goals, we wanted to create an intuitive, easily-digestible website with an engaging story and a few unique visualizations.

The members of this project are all studying computer science or applied math and two are working in software and data science roles at big tech companies and the other is working in banking. Thus, the rise of big tech through the lens of their acquisitions was intriguing to each of the group members, and we wanted to use this project as an opportunity to better understand the growth of both the tech industry and the major companies within it, as well as understand the public perception of big tech and the implications of the views of the general public.

Related Work: Anything that inspired you, such as a paper, a website, visualizations we discussed in class, etc.

Although we were initially inspired by Marian Dork's EdgeMaps visualization ([HERE](#)) for our acquisitions force diagram, we ended up moving away from it in favor of a dynamic visualization in which small bubbles representing companies travel to their parent company as they acquired, allowing us to show acquisitions as they occur over time. We were also inspired by [this](#) dynamic bar chart of the biggest tech companies' market caps, which is an important part of our final website. Aside from these visualizations, we were generally most inspired to pursue this topic by our involvement in the tech and finance industries, because looking at acquisition deals within this specific industry was an excellent combination of our skills and interests.

Questions: What questions are you trying to answer? How did these questions evolve over the course of the project? What new questions did you consider in the course of your analysis?

When we first began our project, we knew that we wanted to focus on the tech industry, but planned to focus on merger & acquisition deal data and trends. Therefore, our primary questions were "What are the important M&A trends in the tech sector?" "What are the implications of these trends?" "What companies are being acquired, and what companies are doing the acquiring?" However, we later decided that this was too broad of a topic and did not lend itself to storytelling, as it was a broad view of the deals going on in the industry and was not focused enough. Our next idea was to focus in on the 5 tech giants and use our project to argue that they have gotten too large and should be broken apart. However, we soon realized our mistake of building the story around the conclusion that we wanted instead of building our story and conclusion around the data that we found, and switched our focus onto the 5 tech giants and the story of their rise to power. Our questions then changed accordingly, and are as follows:

Our key question is: *How did today's 5 biggest tech giants come into power?*

Additional questions include:

- *What are the historical trends in the tech industry which provided the perfect growth conditions for Apple, Amazon, Microsoft, Google, and Facebook?*
- *What are the strategic acquisitions that each company made to allow them to penetrate new areas of the industry, eliminate competition, and gain market share?*
- *What is the public perception of the tech giants' monopolization of the industry?*

- *What recommendations can be made for these companies in terms of how they should proceed?*

Data: *Source, scraping method, cleanup, etc.*

We previously included links to almost all of our Statista datasets in the Process Book, so we will not include links here for the sake of avoiding repetition. For the force diagram acquisitions visualization, the data was sourced from Wikipedia's lists of company acquisitions on each company's page, and then cleaned and categorized manually. That was the only dataset that had to be manually cleaned, as the rest of the datasets were found fully cleaned and only had to be cut down or combined with other datasets. Though we primarily used Statista to find our datasets, the stock price data was downloaded from Wolfram Alpha and the volume of tech industry acquisitions dataset was found on the Institute for Mergers, Acquisitions, and Alliances (IMAA) website.

Exploratory Data Analysis: *What visualizations did you use to initially look at your data? What insights did you gain? How did these insights inform your design?*

To initially look at our data and gain insights about potential paths, we visualized the market trends dataset with a line chart and looked at the publicly-available stock price charts for the big 5 tech companies. For all 5 companies, we observed sharp increases in stock price over the past decade, which pushed us to consider how, exactly, these companies achieved such fast, meteoric increases in value. This informed our overall question of "How did today's 5 biggest tech giants come into power?" We also examined the data on public perception and observed that there is a largely positive perception of the 5 tech giants, but that many people were concerned about their monopolization of the industry. This informed our "public perception" section, as we found these opinions interesting and influential on recommendations to the 5 companies.

Design Evolution: *What are the different visualizations you considered? Justify the design decisions you made using the perceptual and design principles you learned in the course. Did you deviate from your proposal?*

As briefly described above, our first idea was to focus on the tech industry and investigate the questions "What are the important M&A trends in the tech sector?" and "What are the implications of these trends?" Though many of our initial visualization

ideas for answering these initial questions made it to our final page, we also considered creating a dynamic map of the United States and using bubbles to represent when and where tech startups were founded over the years. However, once we implemented a U.S. map, we realized that it would not work as expected due to the high concentrations of tech startups in the Bay Area and the low concentrations of tech startups in other places across the country. By getting rid of the map, we also had to completely re-evaluate our plan for the linked view, and ended up making the one we have now by connecting a few visualizations that we did not initially intend to link.

We also significantly changed our design for the force-directed visualization, going back-and-forth between a visualization like the one we have now and a visualization in which the circles are stationary and lines are drawn between companies to represent acquisitions. However, we finally realized that as more and more lines are drawn it would become confusing, as our cleaned acquisitions dataset had over 750 acquisitions in it. We decided that moving circles rather than lines would be cleaner and more intuitive for the user, and liked how the area of the bubbles surrounding the Apple, Amazon, Microsoft, Facebook, and Google bubbles translated roughly to the volume of acquisitions each company made throughout the years.

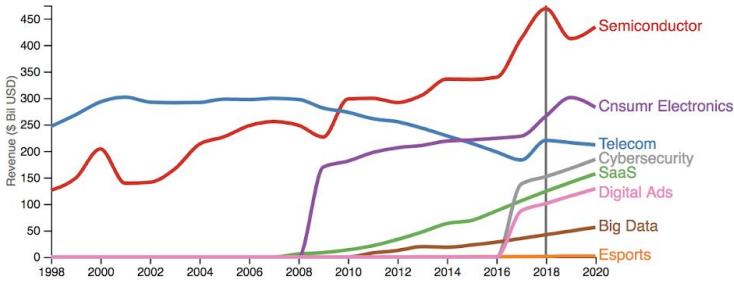
Implementation: *Describe the intent and functionality of the interactive visualizations you implemented. Provide clear and well-referenced images showing the key design and interaction elements. (See Below)*

PLAY

2018

1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018

Revenue of Tech Verticals: mouse over the trend lines



Semiconductor : \$468.78 Bil USD

Consumer Electronics : \$266 Bil USD

Telecom : \$220.1 Bil USD

Cybersecurity : \$151.67 Bil USD

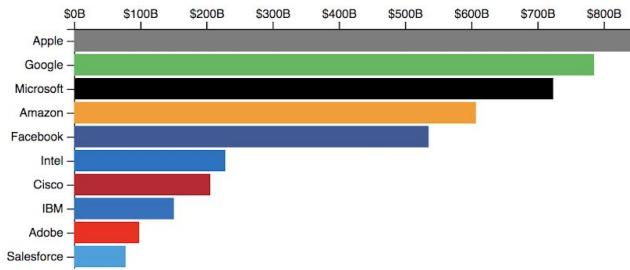
SaaS : \$124 Bil USD

Digital Ads : \$100.796 Bil USD

Big Data : \$42 Bil USD

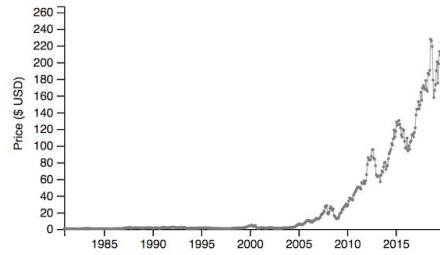
Esports : \$1.096 Bil USD

Market Capitalization: click on bar to see stock chart

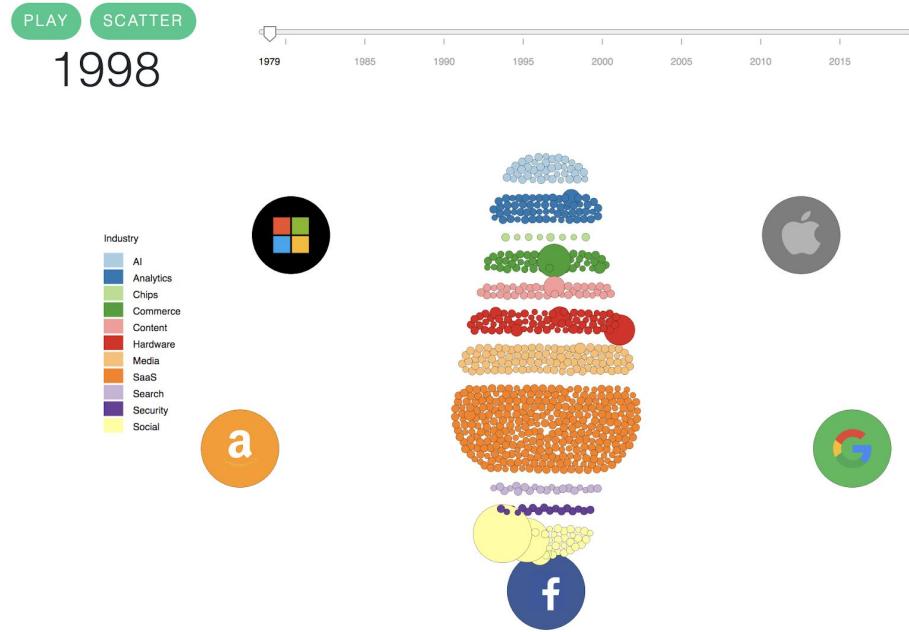


Stock Price of AAPL

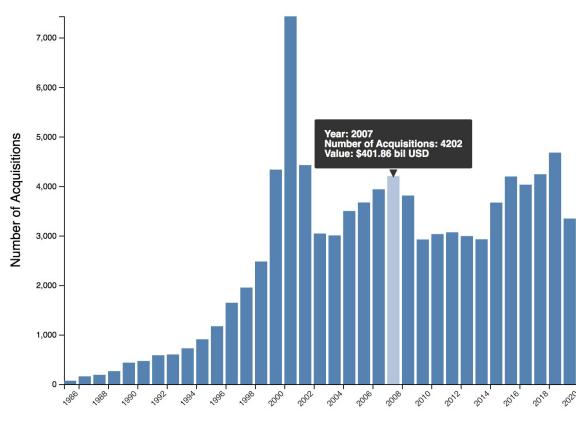
AAPL ▲



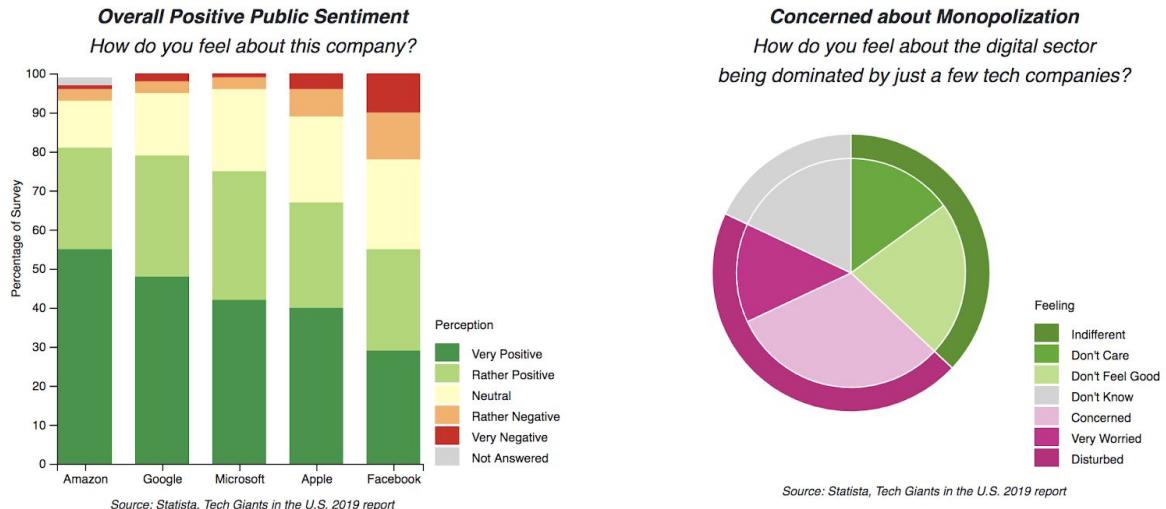
In this first panel of the website, we sought to use linked visualizations to connect industry context (sector trends) to the market capitalization growth patterns of the most significant tech companies. As you mouse over the “Revenue of Tech Verticals” line graph, the market cap bar chart changes with time, showing how the big 5 tech companies quickly dominated IBM and Intel and grew to dwarf their market caps. Furthermore, clicking any company’s bar in the bar chart shows their stock price chart, which provides additional information about each company’s path to becoming a “giant.”



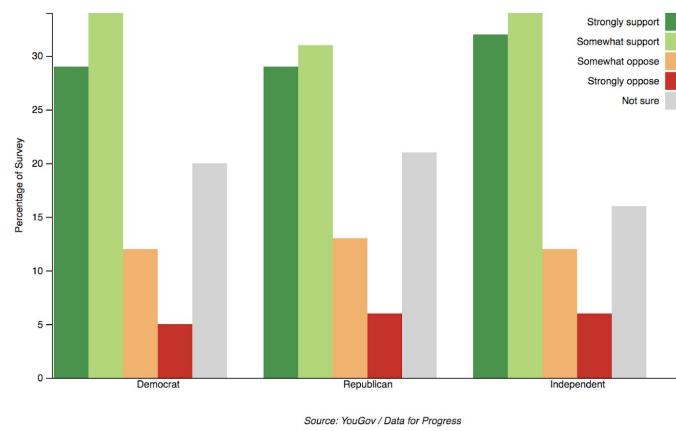
Next, the intent of this visualization is to show how the big 5 tech companies have used acquisitions as a tool to grow so large over the years. As each company acquires startups or established businesses, they can enter new sectors, crush their competition, and increase their market penetration and overall share. We tried to make the interface very simple, only requiring the user to press Play to watch the dynamic visualization and also providing the option to move the slider back and forth manually if they want to examine a certain time period.



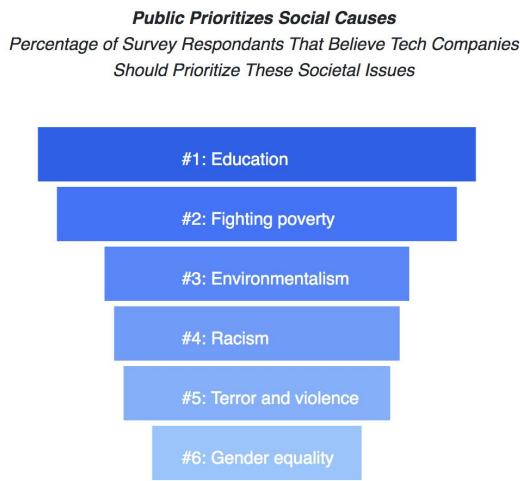
This visualization shows the increasing volume of acquisitions in the tech industry over the years, and shows how acquisition volume increased and decreased as the health of the sector changed. For example, volume was at an all-time high right before the dot-com bubble burst, and decreased during the Recession in 2008 and beyond. Users can mouse over each bar to see more details, but this visualization is not meant to be exceedingly complex.



Overwhelming Support to Break Up Big Tech
Would you support or oppose a policy breaking up big tech companies by undoing recent mergers (such as Facebook buying Instagram) in order to increase competition in the future?



These three visualizations are meant to depict the overall public sentiment regarding the big 5 tech companies and their monopolization of the industry. The data was best implemented as a stacked bar chart, a grouped bar chart, and a pie chart. Tooltips are fully implemented, but these are meant to be static visualizations that the user can quickly peruse to get a quick summary of public opinion of the companies.



Finally, this visualization is meant to depict the issues that the public feels that the big 5 tech companies should use their resources to tackle. This format is easily readable and the area of each rectangle shows which issues the survey respondents believed to take the highest priority. We used these results to make our final recommendations and as a reminder that the general public believes that the tech industry has a responsibility to enact social good, not just to make and sell technological innovations.

Evaluation: *What did you learn about the data by using your visualizations? How did you answer your questions? How well does your visualization work, and how could you further improve it?*

Throughout the process of brainstorming the site, analyzing the data, creating visualizations, and telling the story through a combination of data and text, we made the following takeaways:

1. The increase in SaaS, big data, and digital ads over the last decade combined with IBM and Intel's stagnation created excellent conditions for new companies (Apple, Amazon, Facebook, Google, and Microsoft), to rise to the top of industry.
2. The huge number of acquisitions made by the top 5 tech companies have allowed them to maintain their position on top. Given the diverse range of sectors that they have acquired from, the tech giants have been able to penetrate new sectors, acquire the technology and talent to make a wide array of products, and stifle competition before it is big enough to be worrisome. This is how they have developed such strong and worrisome monopolies in the tech industry.
 - a. Tech giants should focus on acquiring more AI and Analytics companies as there have been fewer acquisitions in these areas, and these areas have high future potential. Additionally, focus on acquiring Education and Social Justice oriented companies to align corporate missions with the public values.
3. The general public opinion of the big 5 tech companies is positive, but worried about the impact of their monopolies on society. They also think that tech

companies should use their resources and position to enact positive social good, especially in education, poverty, environmental issues, and racism.

How did we answer our questions? Next, we map our questions to the visualizations which best answer them.

- What are the historical trends in the tech industry which provided the perfect growth conditions for Apple, Amazon, Microsoft, Google, and Facebook?
 - Answered by the linked view including the line graph of revenue of tech verticals, bar graph of changing market caps, and the line graph of stock prices.
- What are the strategic acquisitions that each company made to allow them to penetrate new areas of the industry, eliminate competition, and gain market share?
 - Answered by the volume of acquisitions bar chart and, most significantly, the acquisitions bubble visualization
- What is the public perception of the tech giants' monopolization of the industry?
 - Answered by the three public sentiment charts (entitled "*Overall Positive Public Sentiment*", "*Concerned about Monopolization*", and "*Overwhelming Support to Break Up Big Tech*")
- What recommendations can be made for these companies in terms of how they should proceed?
 - Answered by the stacked pyramid chart with the different public priorities for tech companies (entitled "*Public Prioritizes Social Causes*")

Final reflection:

We are proud of our page, the work that went into creating it, and the story that it tells through both data and the accompanying text. We are especially proud of the creativity of the dynamic market cap bar chart and the bubble acquisition visualization, and the depth of information that each of these communicate to the viewer. We believe our visualization works well and have worked to ensure that the design of each visualization is intuitive and easy to use and understand. If we had more time, we would also like to create visualizations to answer questions such as "How much did acquisitions contribute to growth as compared to internal growth and development?" "How many of the acquisitions were of direct competitors to stifle competition (and overall, what is the distribution of the purposes of the acquisitions)?" "What was the impact on current events (the tech bubble bursting or the recession) on the growth of the tech giants?" "What were the most valuable acquisitions, what were the least valuable acquisitions, and how can we predict whether an acquisitions will be valuable or not?"