Global Startup Funding

INFO 247 Final Project Report

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Table of Contents

1. Introduction **4**

2. Project Goals **4**

3. Related Work **5**

Global Entrepreneurship Monitor Report 5

State of Venture Capital in 2019 5

A City-Based Visualization of Funding Flows 6

Interactive Tableau Dashboard 7

Embroker Startup Infographic 8

Sequence Sunburst 9

Color Palette 10

4. Visualization Discussion **11**

Infographics 11

Tableau Dashboard: Who raises Unicorns? 13

Sunburst Diagram: How are Unicorns raised? 15

5. Approach **16**

Data 16

Tools 16

Steps 16

7. Usability Study **17**

Overview 17

Participants **18**

Method **18**

Results 18

6.1. Quantitative Results 18

6.2. Qualitative Results 19

Overall Usability Discussion **19**

Tableau dashboard 20

Animated bar chart with industry drill down 20

Sequence sunburst 20

8. Division of Labor **21**

9. Links and Sources **21**

Links 21

Sources 21

10. Appendix **22**

Figma Mockup 22

1. Introduction

Startup funding tends to be a good marker for innovation trends across the globe. While early stage funding tends to be bootstrapped or raised from friends and family, the main source of financing for growth is through external investments. A major area of interest is the rise of unicorns, i.e., startups that have attained the holy grail of more than $1B in valuation.

There have never been as many unicorn startups in the world as today. Armed with access to immense venture capital[1], more and more startups are choosing to stay private instead of filing for an IPO. With access to detailed funding data as recent as 2018 derived from Crunchbase, Pitchbook and other resources, we want to explore what unicorn funding trends look like.

2. Project Goals

There is extensive information about funding trends on startups in the US. However, there are a significant number of startups being formed outside the Bay Area and more so in other countries. Our final project intends to tell a story about how startups that go on to become unicorns are funded globally. This involves trying to answer the following questions:

- Where is the money going? (Location-wise and Industry-wise)
- Can we identify regions that have been drawing capital country-wise?
- For each startup, who are the investors that keep adding money into startups that go on to become unicorns?
- What does the funding cycle look like for unicorns industry-wise?

[1] https://news.crunchbase.com/news/q4-2018-closes-out-a-record-year-for-the-global-vc-market/

3. Related Work

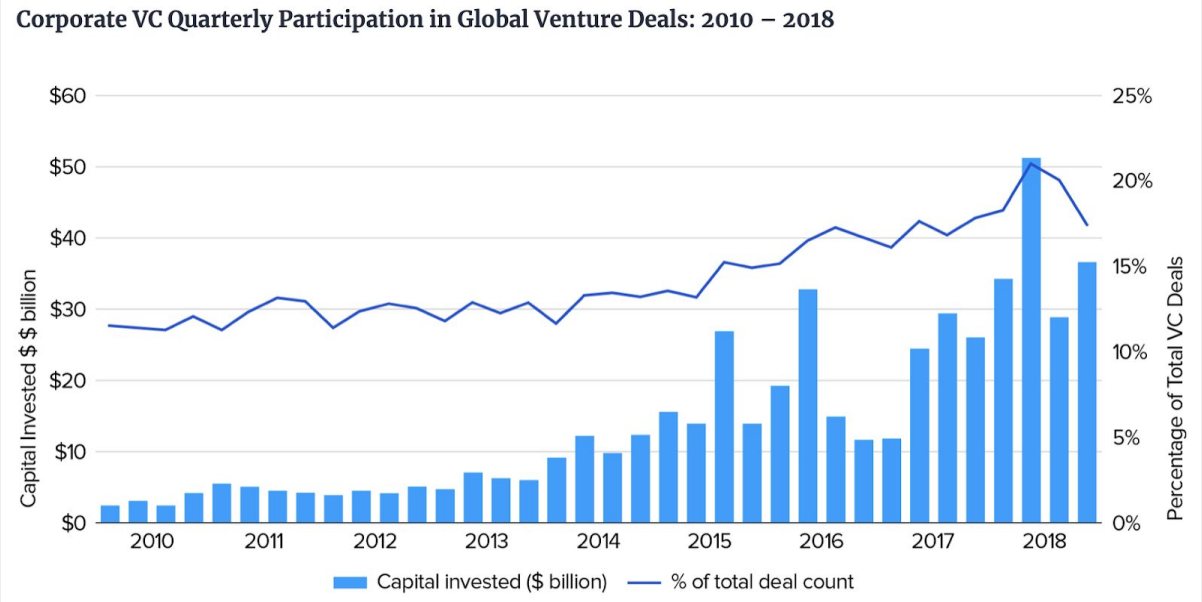
Global Entrepreneurship Monitor Report

Source

A detailed research report that summarized startup trends by industry, investment activity and the impact of the entrepreneurial ecosystem across various geographies globally. This information in this report [section 3, p. 36] drew our attention to the growing number of startups in countries like China, United Kingdom and India growing at an incredible pace. We used this to focus our research on country-specific investment trends.

State of Venture Capital in 2019

Source



While we focused on startup locations, a major area of study for us was to understand how major venture capital firms invest. There are just over a 1000 VC firms[2] in the US that are responsible for over 55% of global funding, it's a relatively exclusive club. This report helped us understand the large global impact of this small number of firms.

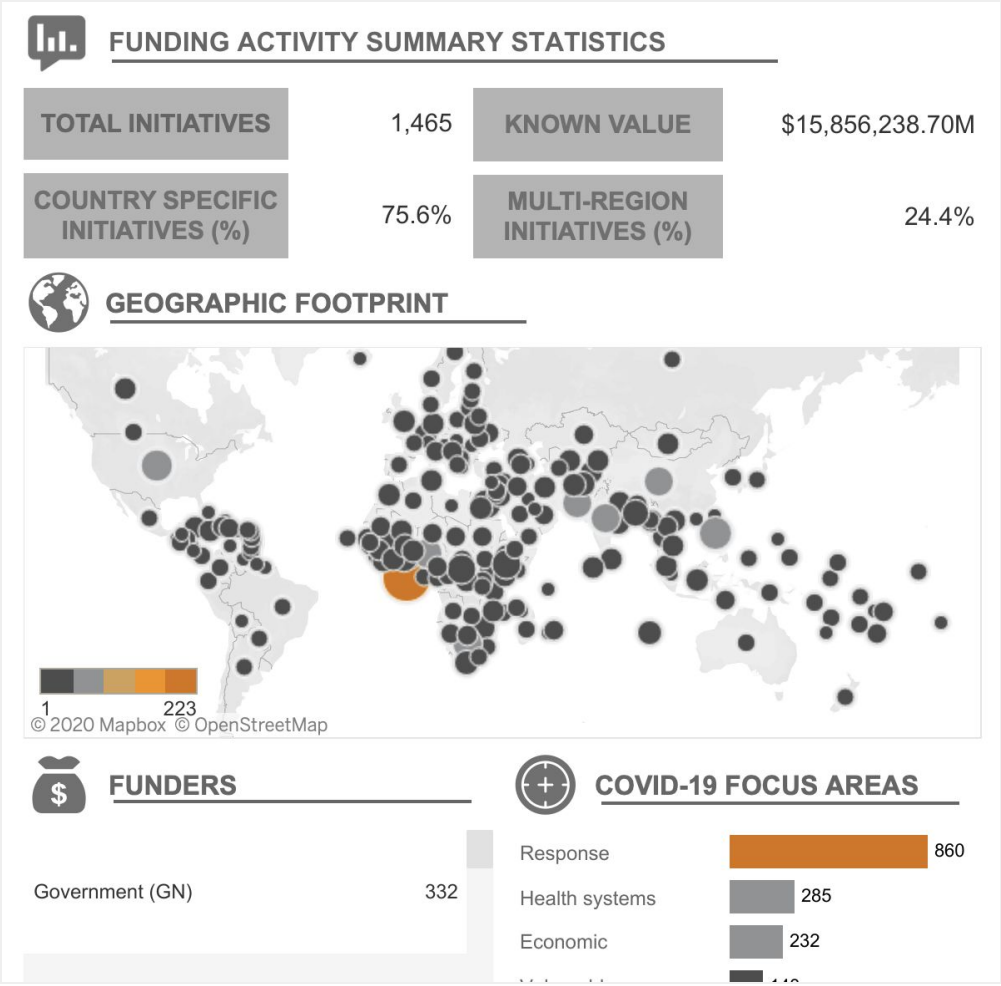
[2]https://nvca.org/pressreleases/latest-nvca-yearbook-highlights-record-levels-reached-u-s-venture-ecosystem-2018/

A City-Based Visualization of Funding Flows

Source

This article is a summary of the research conducted by a team of researchers at Harvard that analysed over a decade of funding data to spatially visualize funding flows on the basis of each city. It was very close to our original motivation of being able to track funding flows. While the website that hosted this research has been down for a few years, it served as a very good point of inspiration even if we eventually ended up dropping the map part of out design.

Interactive Tableau Dashboard



[Source]

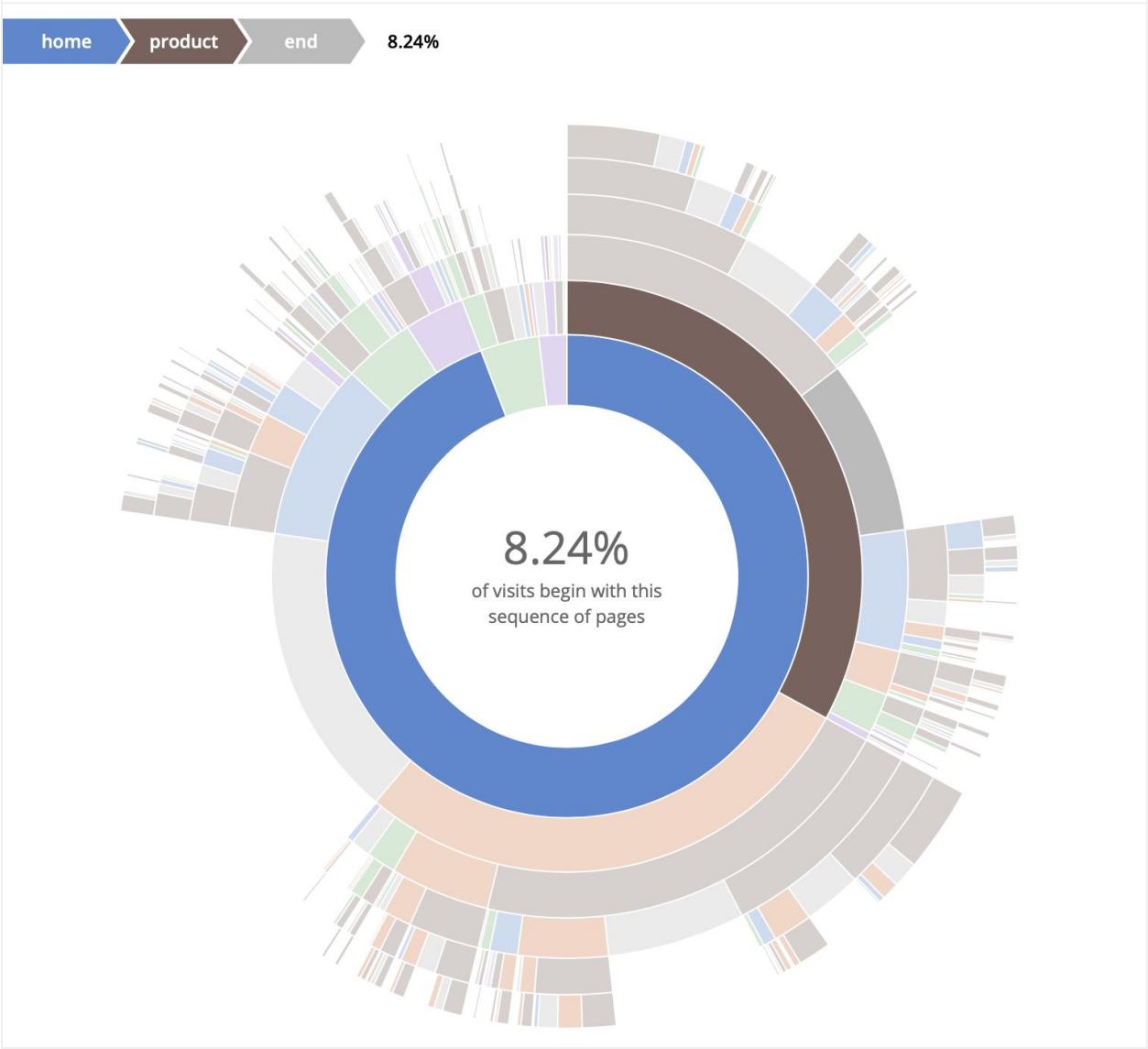
We had always considered that a simple, yet intuitive Tableau dashboard would be the most effective way for a user to explore the funding sources for each startup. The article stated here by Lisa Cornish for Devex uses a comprehensive Tableau dashboard to track global funding for the covid-19 reponse. We decided to link the country, industry and company name for our dashboard such that selection of one would apply stacked filters allowing the user to explore using any dimension as they wished.

Embroker Startup Infographic

[Source]

The infographic/web page curated and collected by Embroker depicts key information about startup funding and statistics in a detailed manner. This allowed us to structure our page such that we use a combination of interactive visualizations and static content utilizing iconography to showcase key insights.

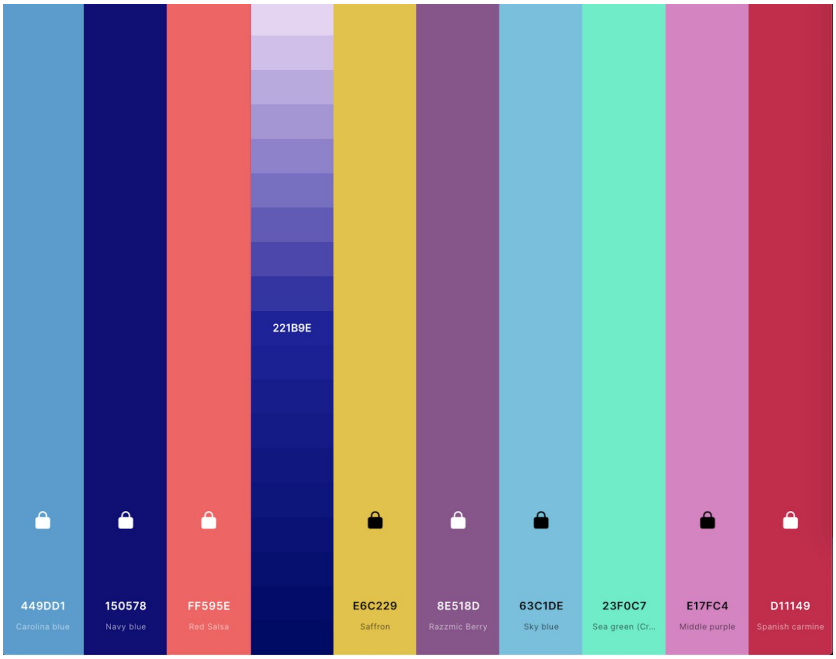
Sequence Sunburst



Source

The sequence sunburst is a good example to summarize navigation paths. We were looking at ways to visualize funding pathways and considering that with nearly 16 funding types, there were too many permutations to showcase this flow linearly. The sequence sunburst provides an interactive pathway for a user to explore this. When Kerry Rodden, the author of this Observable notebook serendipitously turned up as a guest lecturer for class, we had little reason not to be inspired by this choice.

Color Palette



We wanted to make sure that we had a limited color palette for the overall design language of our webpage. We found this fantastic image by Wilmer Matinez on Unsplash[3] that showcased a street in Chinatown, NY with a unicorn figure floating. We extracted a color palette from that image.

For the sunburst however, with over 16 types in funding, we needed a much more distinct, yet complementary set of colors. This was done by matching the primary color palette on coolors.co. For VC series funding, we used the hue variations from a single color (Fourth from left in second figure) to show visual transition.

[3] https://unsplash.com/photos/8WR86Z_mLms

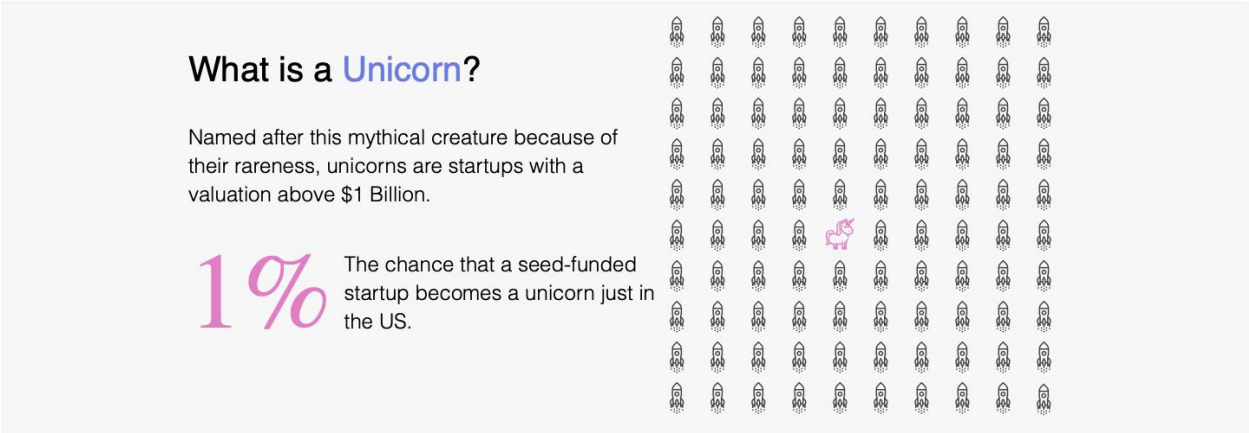
4. Visualization Discussion

We will discuss the different sections of our website and visualizations under the following headings:

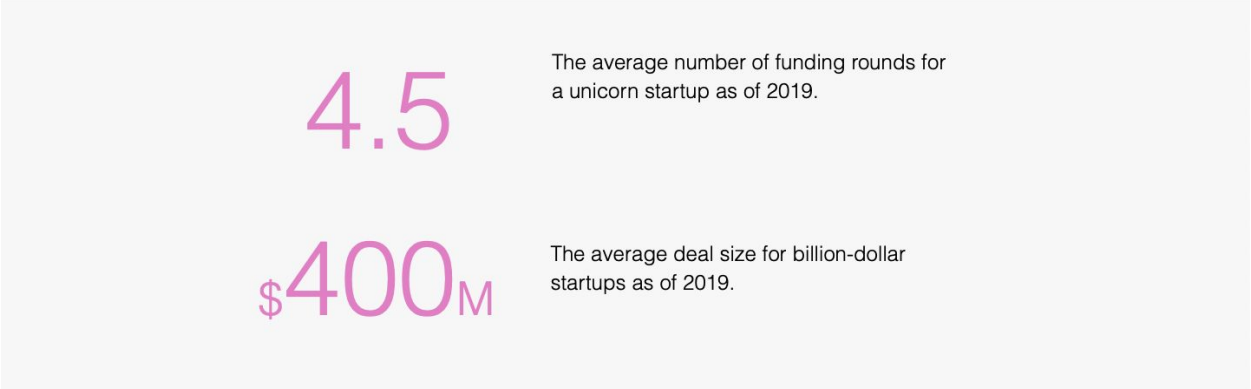
1. Infographics
2. Tableau Dashboard: Who raises Unicorns?
3. Sunburst Diagram: How are Unicorns raised?

Infographics

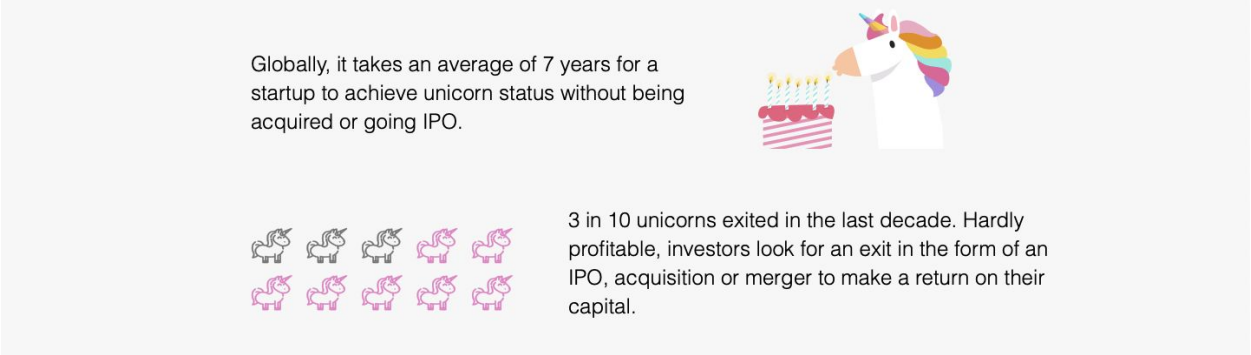
Along our main and interactive visualizations we decided to add static components, to minimize cognitive load for the user..



To introduce the reader to the overall topic we decided to go with the static visualization above. We explain what a unicorn startup is and why it is special by emphasizing it rareness using iconography. The icon of the unicorn next to all the other 99 icons represent the probability of a seed-funded US startup to become a Unicorn startup at some point. We had to go with this special subgroup (seed-funded US startup) to be able to visualize it with iconography as the probability of a startup in general is even lower (0.006%).

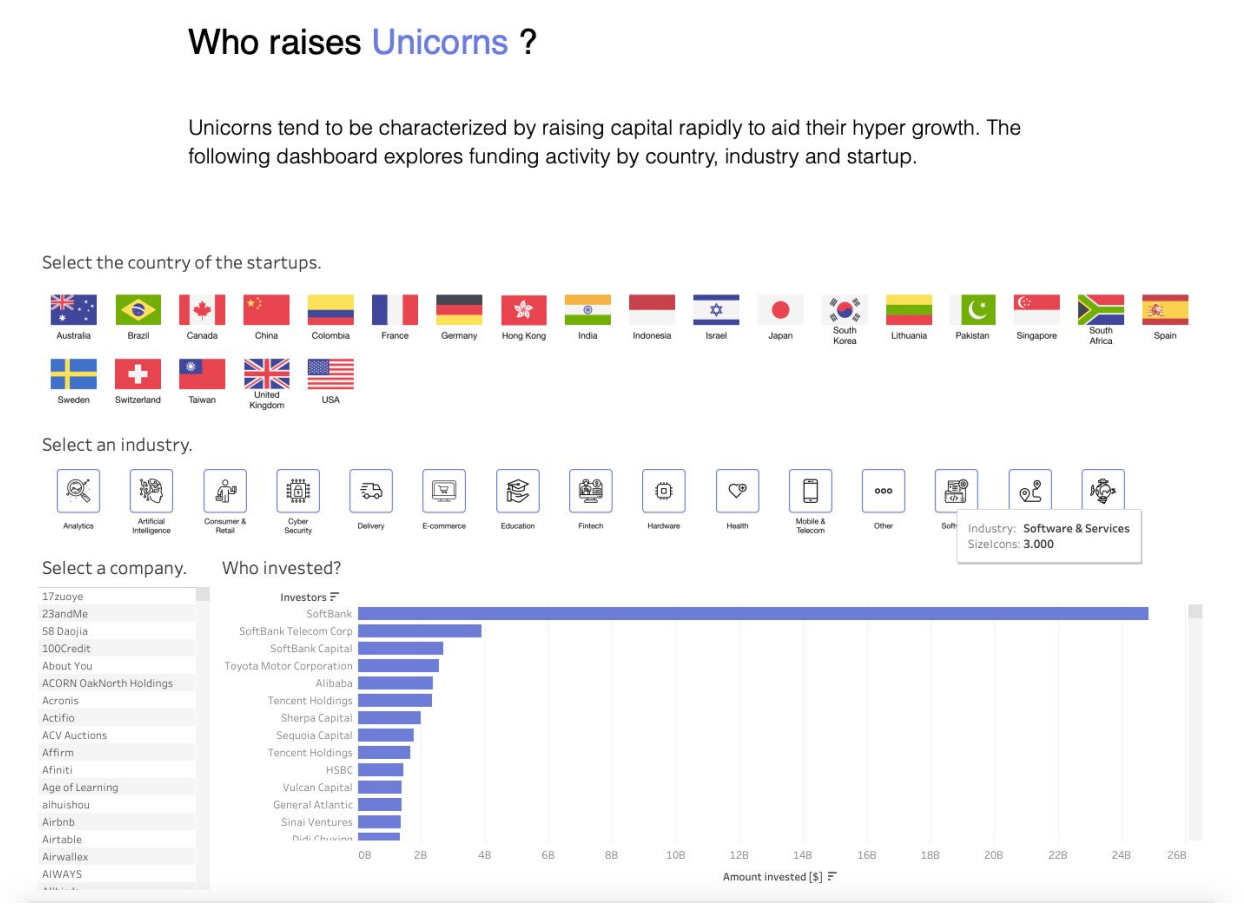


The second static visualization just includes two numbers accompanied by text. It shows the average number of funding rounds and average deal size a unicorn receives. The idea here was to give the user some background information before they are looking at the funding cycle in the sunburst diagram.



The last visualization is supposed to end the story about unicorns telling the reader, how long it takes most of them to get an exit as well as how many unicorn startups are still waiting for their exit option. This time, we are using an illustration as well as iconography to visually emphasize the messages.

Tableau Dashboard: Who raises Unicorns?



The tableau dashboard is one of the main visualizations on our website and was iterated a lot. Starting off with the idea to show where the funding comes from that the unicorns raise, the first intuition was to use a map to depict locations. However, thanks to a lot of feedback, we learned that the sparsely populated map is not visually appealing and neither engaging. In addition, we got feedback from some users saying they would like to be able to filter for a certain country or industry they are interested in. Even the possibility to select that in advance to not be forced to handle all the data was mentioned. Thus, we concluded that a more guided and customizable visualization would be valuable.

We chose icons plus text to visualize the countries as well as the industries, because the icons for industries could be ambiguous and people might not remember every country flag. However, the icons aid some visual encoding and hence enrich the dashboard and help the reader.

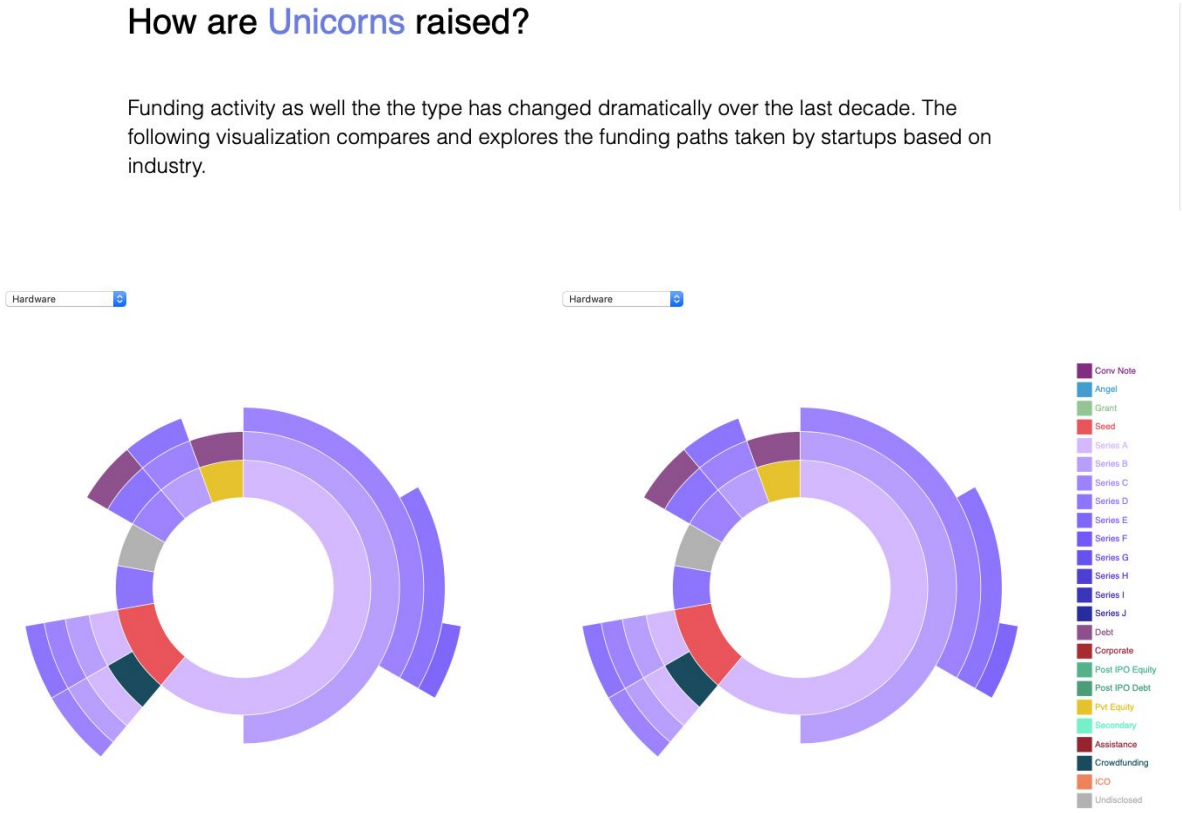
The company names are displayed in a column next to the actual visualization, the bar chart. Due to the large number of startups, there was no better way in this setting than displaying them in a

column. We wanted to have the column on the left, as the natural flow of reading goes from left to right and the company name might be used as an input to filter the bar graph.

The bar graph itself shows the investors on the y-axis and the amount invested on the x-axis. We chose it to be a horizontal bar graph to have the investor names readable. Also, even though the space for the bar graph might seem small, the idea is that the user filters down to the company level so that the number of investors displayed is limited.

Last but not least, we added some interactivity and tool tips. Selecting a country for example, filters the industries as well as the company names. That on one hand conveys information about the industry-country connection but also avoids that the user selects country-industry combinations that do not exist. The tooltip, finally, offers more information on demand: the country of origin of the investor, the precise amount invested and the number of investments the investor made.

Sunburst Diagram: How are Unicorns raised?



As mentioned in section 3, we were inspired by Kerry Rodden's diagram for sequences of user visits on the youtube homepage to use a sunburst diagram to show the different funding cycles companies go through. The great interactivity in her implementation is engaging and enables the user to get information on demand. We added a legend to help the user locate certain funding types they are interested in. We first created the counts of the certain funding cycles/sequences based on the different years of founding. However, we realized that that might not be meaningful and would not aid the story. Thus we pivoted and decided to create one sunburst diagram for every of the 15 industry sectors we distinguish. This enables the user to look at funding trends within a certain industry in the first place but due to our layout with two diagrams next to each other, the user can also compare industries. With the idea in mind of creating small multiples, we had to reassess when we realized that 15 sunburst diagrams would not aid the comparison as they would have to be too big to be readable and thus would force the user to scroll up and down to compare industries that are not side by side. That said, the layout we chose seemed to be a valid compromise.

5. Approach

Data

The primary source of our data came from a Github repository attributed to Crunchbase. This dataset contained detailed company, investor and funding data till Nov 2018. We also augmented this dataset with sources such as Pitchbook, CB Insights and investment reports mentioned under related work in section 3.

Tools

To implement our visualizations and the website as a whole we applied different technologies. For the visualizations themselves we used Tableau, D3.js and Illustrator. For the data cleaning and organization we implemented scripts in R and Python but also used the power of Microsoft Excel. Various elements of the mockup were planned using a combination of Photoshop and created a high-fidelity mockup in Figma.

This served as the guideline for implementing the website with HTML and CSS which was finally deployed using Github Pages.

Steps

1. **Data Cleaning and Organization**

   We spent several hours on cleaning and organizing our data. As stated above the main resource was a thorough dataset which was retrieved from crunchbase. However, narrowing it down to unicorns forced us to include more data sources. A detailed list of current unicorns was found on CB Insights[4] and cross-referenced against our main dataset. Unfortunately, several companies had names that did not match, changed due to acquisitions and mergers. This was manually fixed and matched by checking each domain and the history of each company on Wikipedia, Crunchbase and Pitchbook.

   The funding rounds data had multiple investors for a single investment record. To gain information for individual investors, we used python to generate a new csv file that contained one row per investor. The amount each investor invested was estimated by dividing the total funding amount by the number of investors. Lastly, the sunburst diagram required a special data structure as well, which was generated using another python script.

[4] https://www.cbinsights.com/research-unicorn-companies

2. **Creating separate visualizations and user testing**

   We started off without a webpage and just created individual visualizations first on scratch paper and later using Tableau and D3. Our usability test was conducted using links to these individual visualizations too, which is one reason why we missed testing our creations in the actual context.

   Thanks to the feedback from our professor, our GSI and friends and colleagues, we were able to iterate a lot and continue to improve our designs. The most important decision was to drop a Tableau world map, we were attached to for a while.

3. **Frontend design and implementation**

   As described under Tools, we used the design software Figma to create the outline of our final webpage. The frontend look was refined while the actual website was implemented and deployed.

7. Usability Study

Overview

The participants were selected to be representative of our target audience (briefly described in the next section). Our goal was to test the effectiveness and impact of our design choice. The primary intention was to -

1. Evaluate if the audience found our choice of visualizations engaging.
2. Whether it intuitively allowed the users' to explore funding trends and relationships between startups and investors.
3. Understand if the users enjoyed each visualization.

We received valuable feedback as a result of the exercise that led us to make significant changes not including:

1. Removal of the map component of the Tableau dashboard as it was sparsely populated.
2. Redesign of the Tableau dashboard such that it aided country and industry specific exploration.
3. As a result of the above point, we ended up dropping the animated bar graph because the Tableau dashboard made it redundant.
4. Modified sunburst to allow for comparison.

Participants

The usability test was conducted with 3 primary users via a formal interview. The primary participants were two Masters of Engineering students and one MBA student at UC Berkeley with backgrounds in finance, venture capital and data science between them. The target audience were also avid enthusiasts of the startup ecosystem and had experience with entrepreneurship as well as fund-raising.

Apart from the above, we conducted ad-hoc interviews at various stages of the design process with 2 additional users.

Method

In order to conduct the usability test we devised a test setup that collected user feedback via a survey, observation through screen-sharing and a free-form exit interview. Each section in the survey linked to a single visualization. This was followed by two questions that required the user to answer a specific query by interacting with the visualization followed by general feedback on its effectiveness in being engaging.

Results

6.1. Quantitative Results

In the following table, the accuracy for every question will be displayed, indicating what questions were answered correctly and which not.

Question	Average
Do you know what a unicorn is?	100%
Outside of the US, which country do most unicorns come from?	100%
In the UK which industry do most of the unicorns operate in?	100%
How many companies/investors invested in BlaBlaCar?	100%
How much did Bridgepoint invest in Deliveroo?	66.7%
In 2000, what percentage of startups started with a "series A" funding?	100%

What is that percentage (startups that started with series A) in 2008?	100%

6.2. Qualitative Results

In addition to the questions on a likert scale (see table below), the observations we made and the things our users mentioned while navigating through the visualizations are an important part of the qualitative results.

Visualization	Question	Average
Bar graph	Did you find these engaging?*	5/5
	Was there anything confusing about the viz?+	No
Tableau world map	Did you find these engaging?*	3.66/5
	Was there anything confusing about the viz?+	Yes
Sunburst	Did you find these engaging?*	3.66/5
	Was there anything confusing about the viz?+	Yes

Note : *This was a likert scale question from 1-5

Overall Usability Discussion

We realised that our questions on engagement were structured such that it led to forming a biased opinion as well as the technical tasks did not explore all the visualization features effectively. We decided to leave the usability test results as is for the report and would like to discuss the significant changes we undertook over in this section. However, we conducted informal interviews with friends and colleagues repeatedly all the way till the end of our project.

Tableau dashboard

The original world map view was sparsely populated and did not allow for a detailed exploration of the relationships between countries and investors. Based on the feedback, we dropped the map component of the dashboard and re-designed it to allow the user to filter for country, industry and startup to analyse investor funding trends.

Animated bar chart with industry drill down

While the bar chart turned out to be the most well-liked visualization amongst our users. However, the animation did not add meaningful value and the redesigned Tablaeu dashnaopde made this visualization redundant. As a result we opted to omit it from the final design.

Sequence sunburst

For the sunburst diagram, nearly all the participants took a while to understand the intended goal of the visualization. The pain points amongst them can be summarized as follows:

1. The exact quantity or unit being displayed on mouseover was not obvious. One user assumed it was the percentage of the total funding amount and not the number of startups being displayed.
2. The drop-down year was not intuitively placed and the assumption was that this was the year of funding. Our drop-down filter was actually the year of founding of the startup and we realised that the false assumption was justified considering our description was lacking.
3. The color-coding was inconsistent and a lack of a legend forced the users to constantly memorize each pathway on mouse-over.

A key change we did after the feedback was to drop the year based dropdown filter and switch it to industry. We also decided to place two diagrams side-by-side to allow for comparison along with better color coding and legend markings we agreed with the feedback we got on our usability test that we could have asked more and better questions, we continued asking colleagues and friends for feedback to be able to improve our visualizations, pivot if necessary and serve a user demand.

8. Division of Labor

Task	Details	Henny	Johnson
Data Preparation	Data Sourcing	10%	90%
	Data Wrangling	50%	50%
	EDA	50%	50%
Visualizations	Infographics	10%	90%
	Tableau Dashboard	90%	10%
	Sequence Sunburst	90%	10%
Design	Layout Design	10%	90%
	Webpage Content	50%	50%
	Webpage Implementation	90%	10%
Others	Usability Study	50%	50%
	Report	50%	50%

9. Links and Sources

Links

Github Link: https://github.com/Henny2/StartUpFunding

Website: https://henny2.github.io/StartUpFunding/

Observable Notebooks:
https://observablehq.com/@henny2/funding-cycle-by-industry;
https://observablehq.com/@henny2/embed_left
Mockup - Here

Sources

Below are the sources that were not mentioned in the report itself.

Icons : https://thenounproject.com and https://www.flaticon.com/packs/international-flags

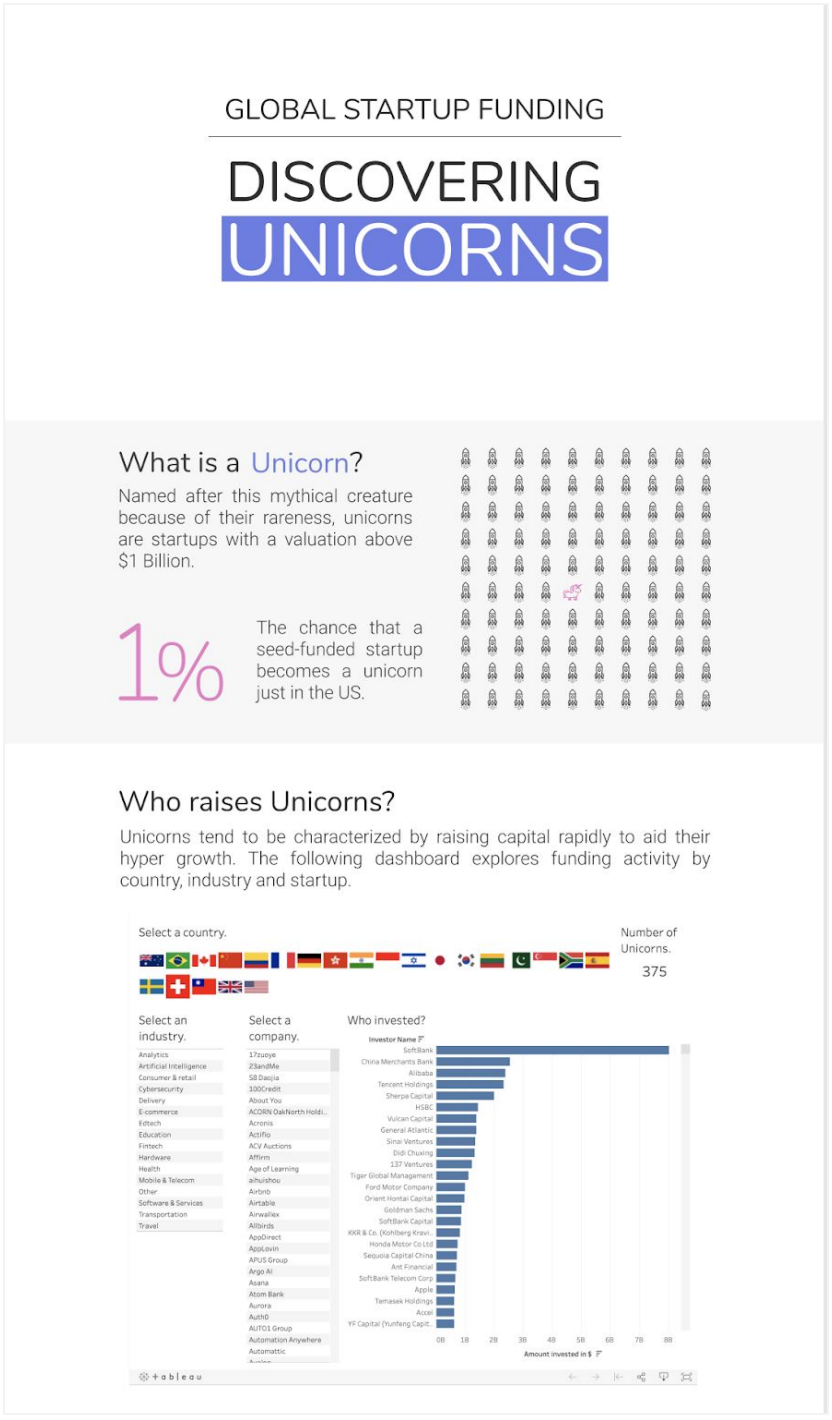
Code generator D3: https://observablehq.com/@jashkenas/handy-embed-code-generator

Legend for the sunburst diagram: https://www.d3-graph-gallery.com/graph/custom_legend.html

Information used for static visualizations:
https://pitchbook.com/news/articles/becoming-a-unicorn-is-more-expensive-than-ever

10. Appendix

Figma Mockup



4.5

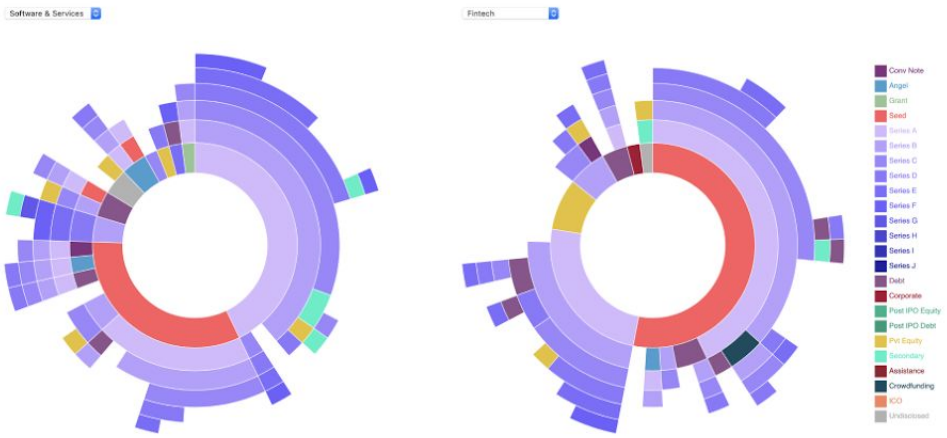
The average number of funding rounds for a unicorn startup as of 2019.

$400M

The average deal size for billion-dollar startups as of 2019.

How are Unicorns raised?

Funding activity as well the the type has changed dramatically over the last decade. The following visualization compares and explores the funding paths taken by startups based on industry.



Globally, it takes an average of 7 years for a startup to achieve unicorn status without being acquired or going IPO.

3 in 10 unicorns exited in the last decade. Hardly profitable, investors look for an exit in the form of an IPO, acquisition or merger to make a return on their capital.