Stories in Our Stars Process Book

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Overview

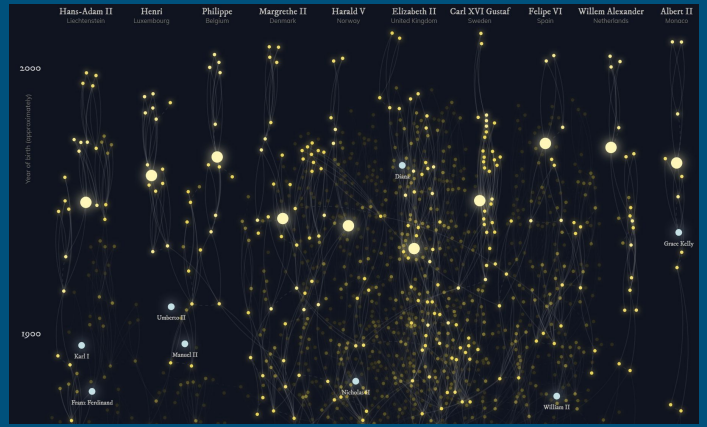
Stories in Our Stars is an astronomy based visualization that allows you to find and search for the constellations in our sky. Stories in Our Stars provides you with the name and a brief description of the background for each constellation.

Motivation

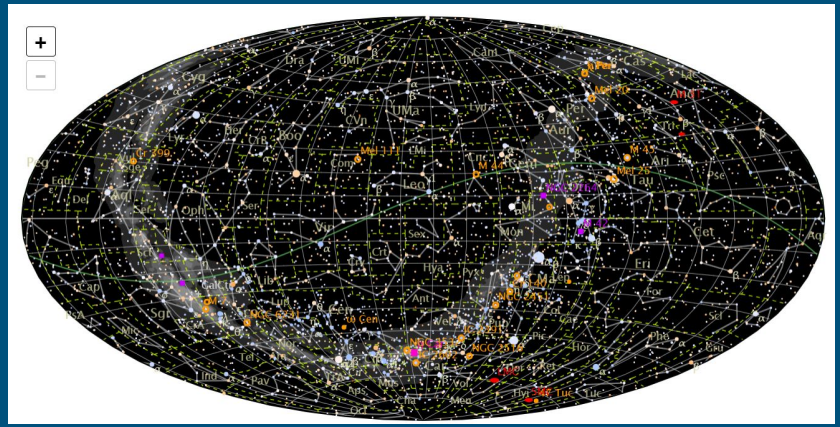
As a whole, our team has a large interest in viewing constellations as well as learning about what they represent. We noticed that there was a lack of visualizations that had all of the constellations as well as stories about them in one place. Thus, we created this visualization to provide fellow stargazers with an overview of constellations in a fun and efficient way.

Related Work

The in-class lecture on using d3 maps inspired us to create a visualization involving maps. Then our interest in constellations led us to view previous work involving stars and/or various constellations with and without using d3, some of which are pictured below.



Source: https://royalconstellations.visualcinnamon.com/



Source: https://armchairastronautics.blogspot.com/p/skymap.html

Questions

Our initial questions at the start of the project were:

- Can d3-geo-projection be applied to stars and constellations?
- What is the best way to display stars and their constellations on a map?

Later in the project once we had the map drawn, we had the following questions:

- How do we want to users to interact with the constellations?
- Where do we want to display the information about a constellation?

Data Preparation

While looking at related work, we found a similar project on GitHub that had JSON files here: https://github.com/ofrohn/d3-celestial. However, we ultimately decided to make our own dataset to gain experience with data scraping and processing. We used Python for these steps.

Step 1: Data Scraping

Using Beautiful Soup, we scraped data from two separate sources and saved them to CSV files.

Name	RA	Dec	vis. mag.
Rigel	$05^{h}\ 14^{m}\ 32.27^{s}$	−08° 12′ 05.9″	0.18

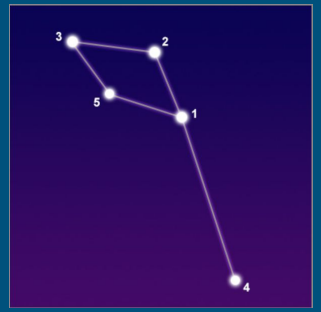
Source One: Wikipedia
https://en.wikipedia.org/wiki/Lists_of_stars_by_constellation
These tables contain the names of stars, right ascension and declination (which are the celestial equivalents of longitude and latitude), and the brightness of the stars.

Object	Designation
1	M42
2	M43
3	M78
4	Betelgeuse
5	Rigel

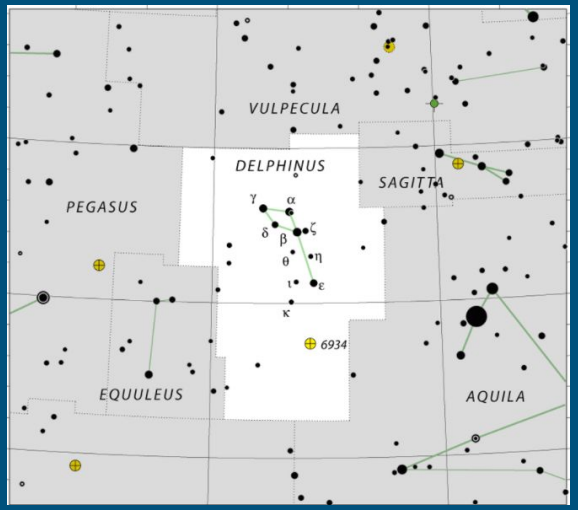
Source Two: Sea and Sky
http://www.seasky.org/constellations/constellations.html
These tables map the names of the stars to numbers.

Step 2: Constellation Paths

Using the diagrams from the Sea and Sky source, we manually created a third CSV that specifies the lines in constellations. The numbers that represent the endpoints of these lines map to the table on the previous slide.



Delphinus	4	1
Delphinus	1	2
Delphinus	2	3
Delphinus	3	5
Delphinus	5	1



We later changed some of the paths so they matched those on the website of the International Astronomical Union.

https://www.iau.org/public/themes/constellations/

Step 3: Data Processing

Finally, we used the pandas library to combine the information in the CSVs we created in previous steps. We converted right ascension and declination to longitude and latitude and mapped the numbers in the paths to the coordinates of the stars. We then created two final files: a GeoJSON containing the constellation paths and a CSV containing star locations.

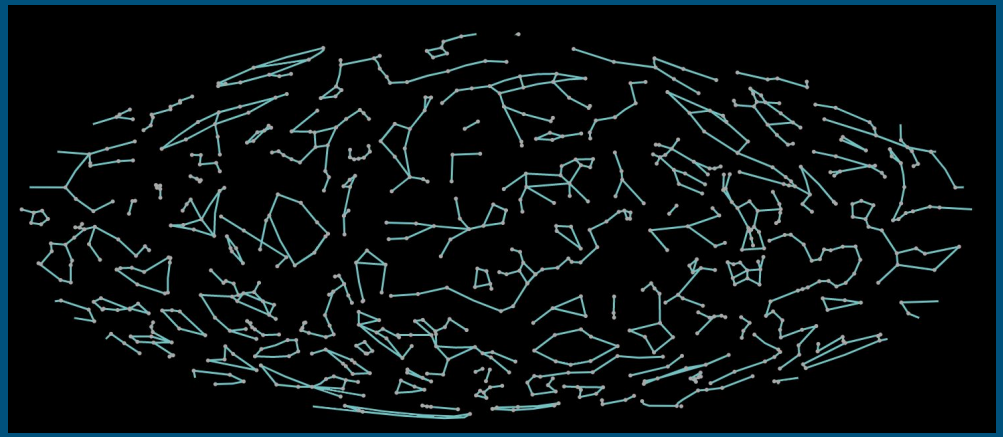
Step 4: Gathering Constellation Histories

After processing the star paths so we could display the constellations correctly, we decided that we wanted to show more information about these constellations. Thus, we collected some information about the history of these constellations from Sea and Sky, which we used previously to make the paths. We put these descriptions into another csv with name and description columns so we could connect these descriptions back to their paths.

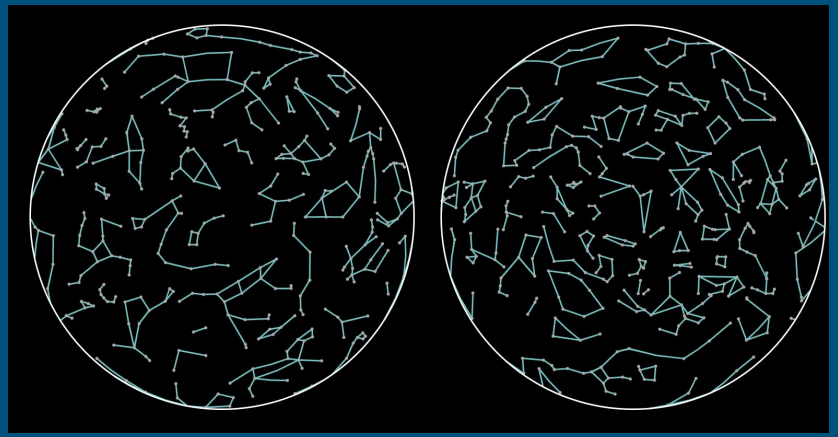
Design Evolution

Geographic Projections

We experimented with different projections in d3-geo-projection. Originally, we had a single elliptical projection that showed all the constellations on one map. However, we later decided to switch to two spherical projections split between the northern and southern celestial hemispheres. These projections better reflect how the stars look in the sky.



Bromley Projection



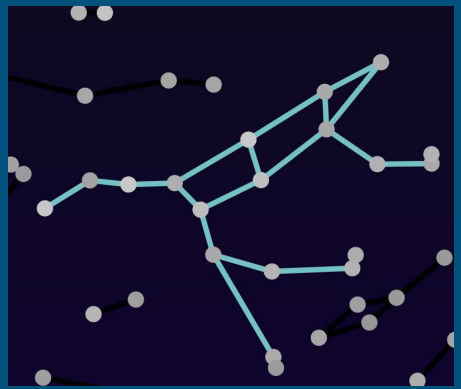
Azimuthal Equal-Area Projection

Magnitude Mappings

The data we scraped had a column for the magnitude (brightness) of the stars. We decided to incorporate this into our visualization to add more variety to the stars. In class we discussed different ways to represent a range of numerical variables, such as area and color. We chose to use size instead of color because having different colored stars made the visualization look too chaotic. We tried reducing the range of the color scale but then the difference between the stars was hard to distinguish, whereas size differences are very easy to see.

Size Mapping

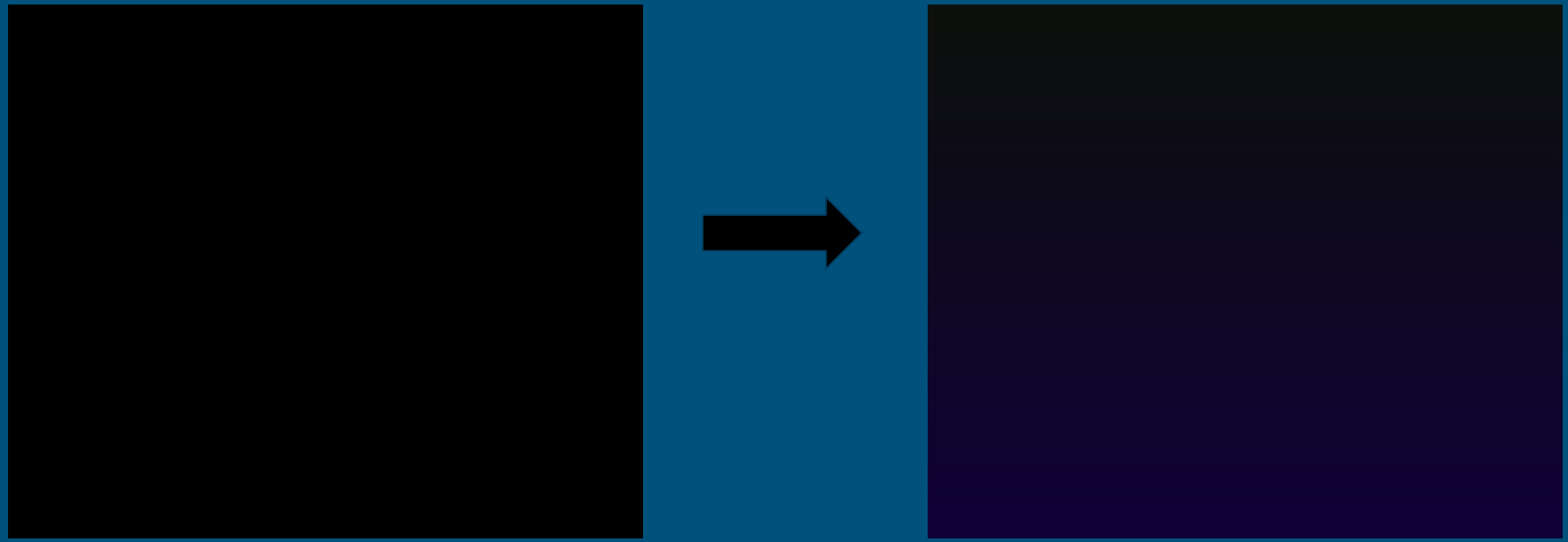
Color Mapping



Color Mapping (subtler)

Aesthetic Design: Background

To give the feel of constellations, we opted for a background with a subtle blue-black gradient.



Aesthetic Design: Constellation Colors

The selection cycle of a constellation includes four different colors.

Black unexplored → Orange selected → Yellow is just active → Cyan is explored

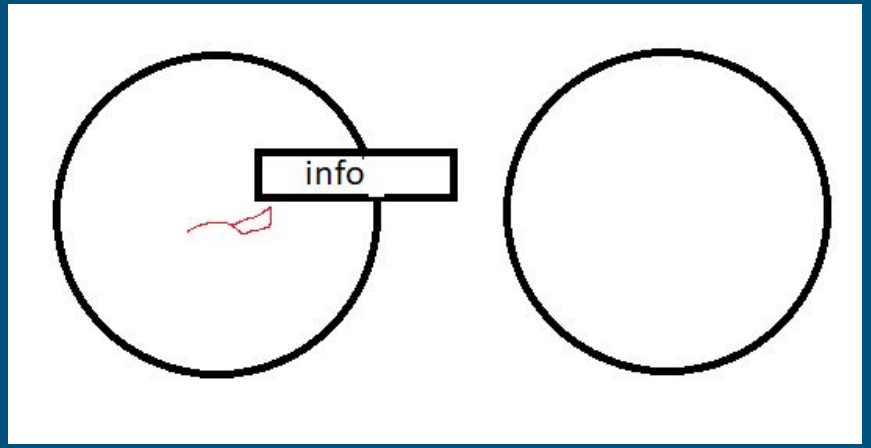
This allows users to enter the vis with an “unexplored sky”, and allows them to visually see which constellations they’ve explored. Warm colors were used to communicate active or recently active constellations, while the cyan is more passive and communicates an already explored constellation.

Aesthetic Design: Glow

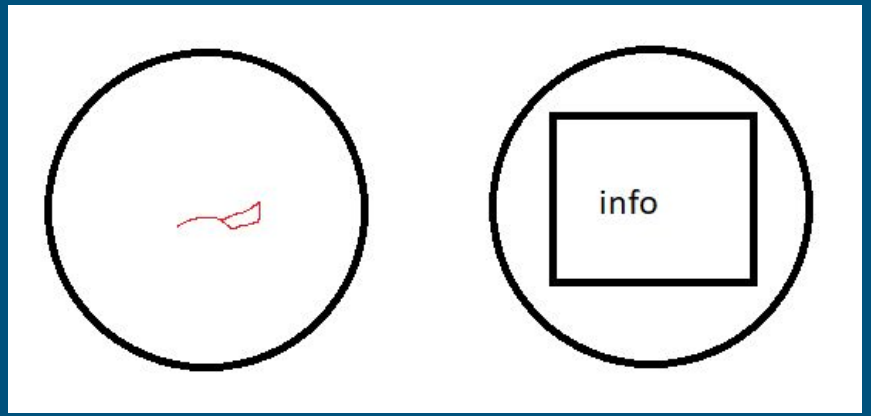
To add a softer glow to the stars and constellations, we added a glow effect to every “path” element of the visualization. This was done by pulling and modifying some code from Visual Cinnamon.

Tooltips

When a user mouses over a constellation, we wanted to bring up a tooltip giving the story behind that constellation. We considered several different designs on where to put the tooltip. We chose not to use options 1 and 2 because we did not want the tooltip to cover the star charts.



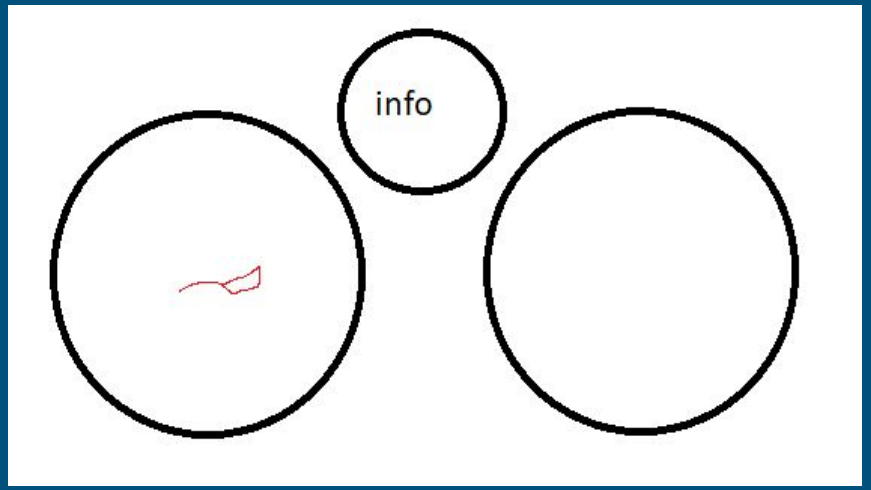
Option 1: Bring up tooltip at location of mouseover.



Option 2: Overlay tooltip on opposite hemisphere.

Tooltips

We then considered a third option of putting another container in between the hemispheres for the tooltip so it would not overlap. We ultimately settled on a variation of this where the information goes in a side panel.



Option 3: Show tooltip in separately view.

Side panel tooltip.

Implementation

Implementation- Mouseover

- At first, the star map hides the constellation paths
- The user can hover over the stars to display the constellations
- Once they hover over the constellation, the tooltip will pop up on the left side, providing more information about the constellation

Implementation- Search

- On the left hand side of the screen, the user can scroll through the list of constellations or search for a specific one
- As the user searches, the results automatically adjust to match what they type, referenced from [w3schools]

Implementation- Select

- Once a user selects the constellation they want to see, the tooltip will appear and the constellation will be highlighted in red

Implementation- Color changes

- When the user hovers over or selects a constellation, it turns orange
- Then when they go to another constellation, the color turns to yellow
- The yellow then fades to blue, which represents the constellations that have been viewed

Evaluation

Evaluation- What we learned from our data

- Where the constellations are located within the northern and southern hemispheres
- Each constellation has its own story to tell

Evaluation- Answers to previous questions

- Can d3-geo-projection and maps be applied to stars and constellations?
  - Since d3-geo-projection uses geoJSON with latitude and longitude, we were able to create a geoJSON for stars based on the converted right ascension and declination
- What is the best way to display stars and their constellations on a map?
  - We displayed the constellations in two graphs representing the north and south hemispheres
- How do we want to users to interact with the constellations?
  - We thought that allowing the user to find the constellations by hovering over them created a fun way to interact with our visualization. We also added a search option so other people with specific motives could get the information they want quickly
- Where do we want to display the information about a constellation?
  - We decided to put the constellation information in a side panel

Evaluation- How well does it work?

- We accomplished everything we wanted to include in our visualization
- It works the way we imagined it would

Evaluation- Improvements

- Linking constellation names in the tooltips to other tooltips
- 3D rotation for the constellation maps
- Expand the search to include the constellations’ nicknames