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Design Document

A. A description of the data. Report where you got the data. Describe the variables. If you had to reformat the data or filter it in any way, provide enough details that someone could repeat your results. If you combined multiple datasets, specify how you integrated them. Mention any additional data that you used, such as shape files for maps. Editing is important! You are not required to use every part of the dataset. Selectively choosing a subset can improve usability. Describe any criteria you used for data selection. (10 pts)

All of the data we used was pulled from NASA's NeoWs online api available at https://api.nasa.gov/api.html#demo_key-rate-limits.

Screenshot of api description:

Asteroids - NeoWs

NeoWs (Near Earth Object Web Service) is a RESTful web service for near earth Asteroid information. With NeoWs a user can: search for Asteroids based on their closest approach date to Earth, lookup a specific Asteroid with its NASA JPL small body id, as well as browse the overall data-set.

Data-set: All the data is from the NASA JPL Asteroid team (<http://neo.jpl.nasa.gov/>).

This API is maintained by [SpaceRocks Team](#): [David Greenfield](#), [Arezu Sarvestani](#), [Jason English](#) and [Peter Baunach](#).

NEO FEED

Retrieve a list of Asteroids based on their closest approach date to Earth. GET https://api.nasa.gov/neo/rest/v1/feed?start_date=START_DATE&end_date=END_DATE&api_key=API_KEY

QUERY PARAMETERS

Parameter	Type	Default	Description
start_date	YYYY-MM-DD	none	Starting date for asteroid search
end_date	YYYY-MM-DD	7 days after start_date	Ending date for asteroid search
api_key	string	DEMO_KEY	api.nasa.gov key for expanded usage

EXAMPLE QUERY

https://api.nasa.gov/neo/rest/v1/feed?start_date=2015-09-07&end_date=2015-09-08&api_key=DEMO_KEY

Each NASA api request returns a JSON file with a list of asteroid objects for a particular week of the year. Each asteroid object returns a diameter, magnitude, velocity, miss distance, approach date, and name. Since each file represents one week of the year, we iterated through all 53 weeks in order to get all of the data for 2016. In our graphs, we only referenced the relative velocities, distances from Earth, and diameters of each asteroid. We chose those criteria because they seemed most relevant for visualizing the potential threat a near-earth object may pose towards people on planet Earth.

B. A description of the mapping from data to visual elements. Describe the scales you used, such as position, color, or shape. Mention any transformations you performed, such as log scales. (10 pts)

The first 3 graphs are polar with polar coordinates and each dot represents a unique asteroid, each with a unique name. The dot's location on the angular axis represents the time after January 1st 2016 and extends counterclockwise until December 31st 2016. The dot's location on the radial axis represents the asteroid's nearest distance to Earth in passing. The size of each circle directly corresponds to the asteroid's diameter. Each dot's color is indicative of the asteroid's relative velocity, with light yellow being slowest and dark red being fastest. The green dot in the very center of the graph represents Earth. However, please note that due to the minuscule sizes of the near earth objects relative to Earth, Earth is not drawn to scale.

The second graph is identical to the first, except this time, the radial axis (distance from Earth) is scaled logarithmically. The log scale for distance allows you to visualize all the actual distance between the Earth and the asteroids. On the linear scale, you cannot see the orbit of the moon because it is much too small compared to the max distance of an asteroid; however in the log scale, the orbit of the moon and even the orbit of the average satellite is easily visible.

The third graph is generated in the same way as the second graph, however here we highlight 6 specific asteroids, based on descriptive statistics (minimum/maximum miss distance, minimum/maximum velocity, and minimum/maximum diameter). The highlighted asteroids are colored normally and moved to the front, while the rest are colored in light gray.

The fourth graph (the heat map) we created shows frequencies of miss distances (grouped by million) by week. Here's an example: a box located at week 2 and a miss distance of 0 shows the frequency of miss distances between 0 and 1,000,000 miles for week 2. The blue line shows the day we obtained our data, meaning that all boxes to the left depict observed miss distances, while boxes to the right are predicted. This graph was created by gathering counts for each 1,000,000-mile group for each week. The boxes were plotted to the graph by using our xScale function for the 'week' parameter and the yScale function for the '1,000,000-mile group' parameter. The color for each box was assigned by colorScale, which ranged from frequency 0 (light yellow) to frequency 8 (red).

C. The story. What does your visualization tell us? What was surprising about it? (5 pts)

Polar Graphs:

From our first graph, it looks like the distribution of asteroids is random within 60,000,000 miles of Earth, which makes sense since asteroids are flying randomly in space. The only part of this graph that does not look random is in the observed section, within 10,000,000 miles of Earth. Here, there is a large cluster points, which is more dense than any other cluster in the graph. While it is not clear why this occurs, we believe it is because NASA does not usually predict asteroids flying close to Earth (because, generally, they do not).

The second graph gives the user a better view of outer space, by using a log scale and including circles for the orbit of the moon and the average satellite. It allows the user to see that barely any asteroids passed Earth at a distance closer than the moon and that none passed at a distance closer than the average satellite.

Heat Map:

In the observed section of the heat map (to the left of the blue line), it is clear that the highest frequency of asteroids are observed between 0 and 10,000,000 miles. This makes it seem like asteroids are only flying close to Earth. However, this is most likely not the case. We assume that observed asteroids close to Earth

will always have higher frequencies than those that are farther away from Earth because it is easier for NASA to get readings on these asteroids (as evidenced by the fact that there were no readings above 50,000,000 miles). The prediction side of the heat map was also interesting. From about 10,000,000 to 45,000,000 miles, there is a band of light-red boxes that stretch across the whole map (including the observed side). However, whereas there are a high amount of readings between 0 and 10,000,000 miles in the observed section, there are almost none being predicted. It is not clear why NASA does not predict asteroids to fly close to Earth, but it is possible that there have been more close fly-bys in 2016 than average.