Basic Info

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Project Repo: https://github.com/DuffinCover/D3finite

Background and Motivation

This specific dataset presents both an interesting and informative insight into a subject that appeals to several different fields. There are general scientific, physics-related, economic-related, and politically-related implications in the satellite dataset. And this specific selection was based on both prior knowledge of the physics/orbital mechanics as well as the many possible visualization options and focuses/comparisons possible. Our team composition is made up of two data-science undergraduates and one physics alum. Of the data that we examined for possible study in this project, satellites are both ubiquitous among our group as well as most of our possible audience (being other classmates or possibly the general public). We did give some consideration to the appeal and relevance for our group as well as our audience. Although this does not directly correlate to any of the group's member's research or field of study, it does relate to our more general interests.

One of the interesting pieces, the accurate orbital data, makes it possible to simulate and/or visualize the actual orbiting speed and location of the satellites. From the political aspect, both country of origin/owner as well as the usage (whether commercial or military) present interesting questions that could be examined with this dataset. Many portions of the data involve classifications and distinctions that we found interesting to learn more about and investigate correlations with the more familiar metrics. Finally, while mentioned elsewhere, this dataset in particular presented few challenges in the data processing stage while also providing many possibilities for challenging and interesting visualization with the many tools learned in class.

Project Objectives (Provide the primary questions you are trying to answer with your visualization. What would you like to learn and accomplish? List the benefits.)

The Dataset that we have found covers numerous aspects of these satellites, like who made them or when and how they were launched. We would like to explore the dataset, and potentially find relationships between data points. We have data for the apogee, perigee, and period for most satellites, which means we could explore the "band" around the earth that satellites reside in, as well as how frequently they orbit. Other interesting variables that are worth comparing are eccentricity and the inclination. While most satellites have a relatively low eccentricity, type of orbit, and the inclinations and types of orbits do vary which might have some

correlation to the intended purpose or some other factor. There is likely a standard that most satellites fall into, but the outliers would be interesting to explore, if only because they may have differing purposes or origins from the standard.

Some questions we could ask are:

- Do origin countries and purposes relate? - e.g. are most of the USA's satellites commercial on purpose?
- Purpose vs. Expected Lifetime.
- Where are satellites launched from?
- What are the most common launch vehicles?
- What is the relationship between the angle, type, and speed of orbit, and the stated purpose or the owner?
- Where do most satellites reside? Is there a visual "band" that we could explore showing the bulk of most of them?

Generally speaking, once something makes its way out of our atmosphere, it sort of dissipates into the ether and out of public consciousness. Our dataset has nearly 6000 rows of satellites launched over the past 20 years or so, and that is truly a staggering amount. We would like to take a deep dive into that ether and gain an understanding of what is hanging out above us. We wanted to see if it was possible to create a visualization that showed a handful of the satellites "orbiting" the world. Perhaps that visualization could change based on satellite class, or the "band" between the apogee and perigee.
Digging into the above questions gives us plenty of ways to build out visualizations. We could produce heat maps based on satellite launch location or country of origin. We could create more abstract bubble plots of the various makers of satellites. Either way, we want to make interesting, interactive visualizations.

Data

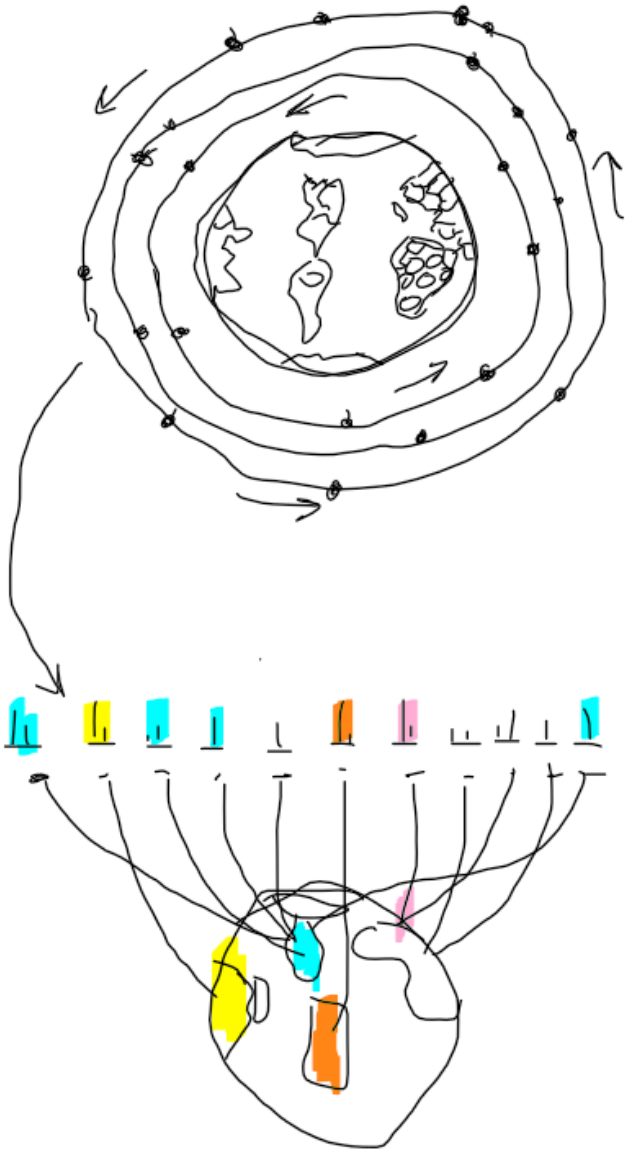
We will be collecting our data from the Union of Concerned Scientists of the United States of America's (UCSUSA) website which can be found here: Satellite Database | Union of Concerned Scientists (ucsusa.org). UCSUSA is a non-profit organization that works on independent studies, and reports their findings. The specific dataset we will use contains information about satellites that are currently in orbit, including launch information and the entity that operates the satellite. The dataset contains 5466 different satellite listings, with 28 fields. The fields give quantitative, (ranging and two comment-type fields). The data can be downloaded as both an excel sheet and as a text file.

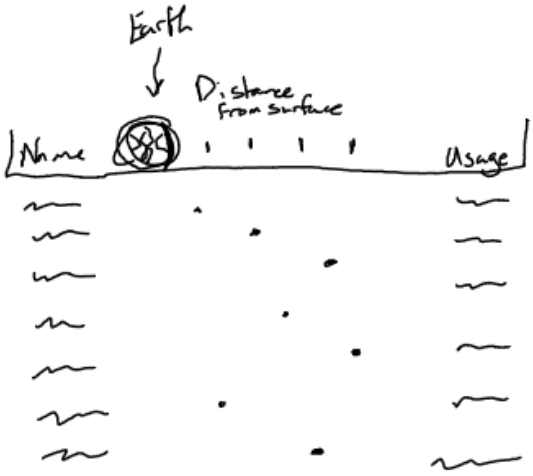
Data Processing

We expect moderate data cleanup. Some of the columns do not have values, either because they are not applicable or because they are not public record. We will need to replace these empty spaces with some placeholder indicating a missing value. Fortunately, almost all the values in the dataset do not need any additional parsing/formatting except the date column which will need to be converted from character to datetime data. The data processing will be completed via Python scripts to gracefully handle missing values and convert the dataset from table format to JSON objects.

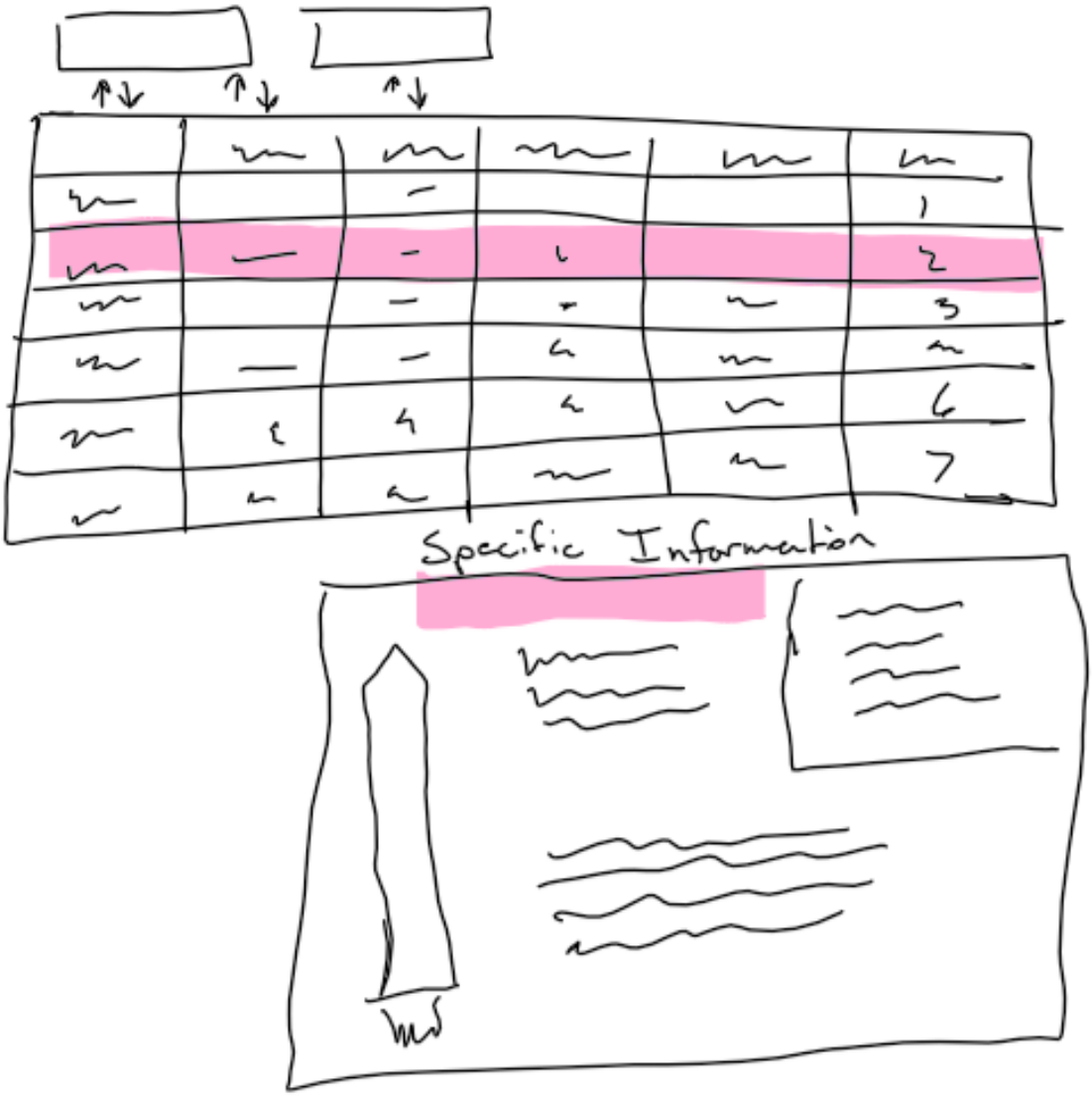
Quantities of particular interest to us are: Name of satellite, country of origin, name of company currently operating the satellite, use type (i.e. military, commercial, scientific), date of launch, launch site, and a comments column which yields specific details about a particular satellite. Some numerical quantities provided by this dataset that we will use are the longitude, apogee, pedigree, inclination, longitude, and period. These will be used for plotting the satellite locations on a map, and providing the future trajectory path of the satellites.

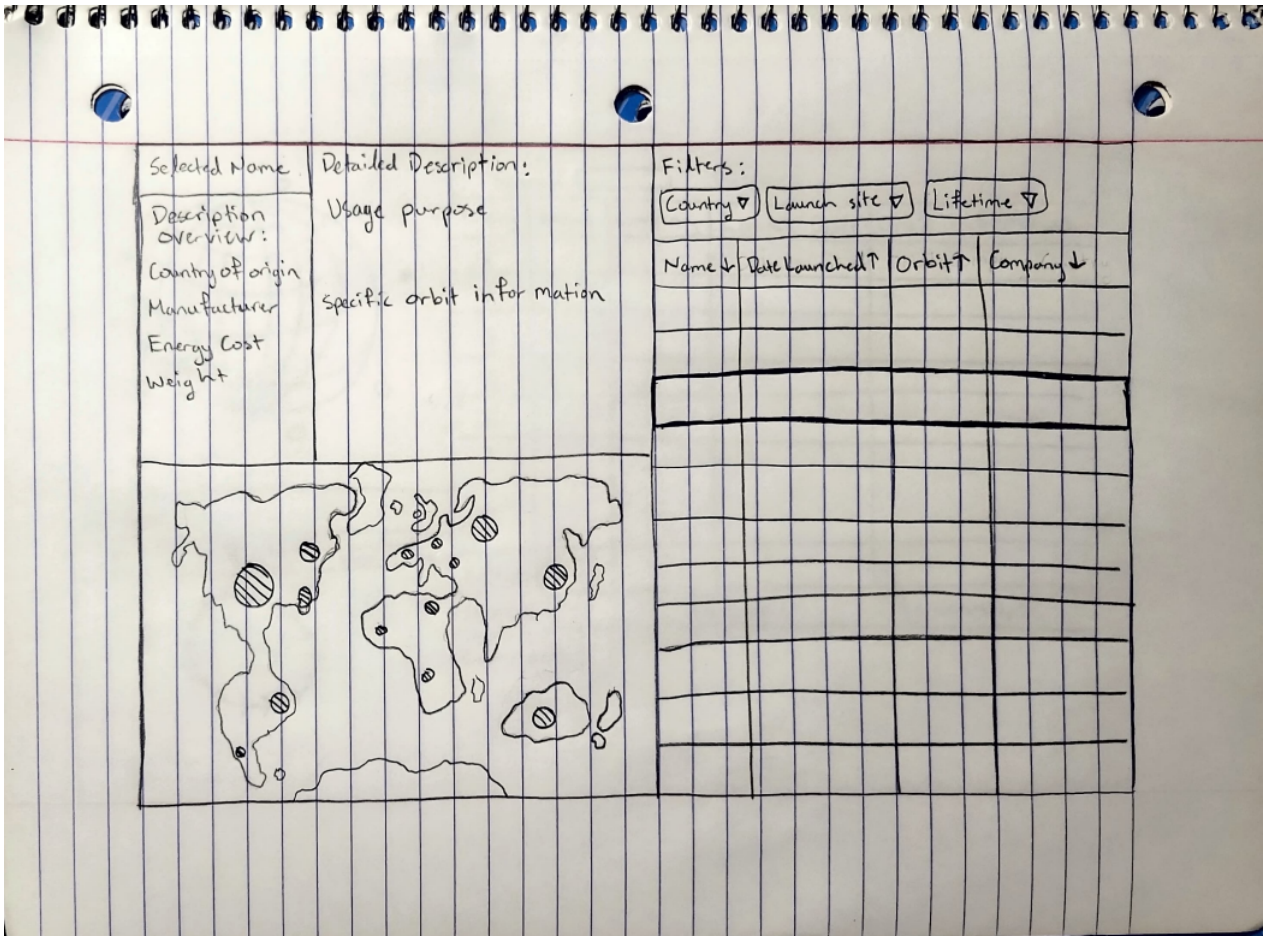
Visualization Design

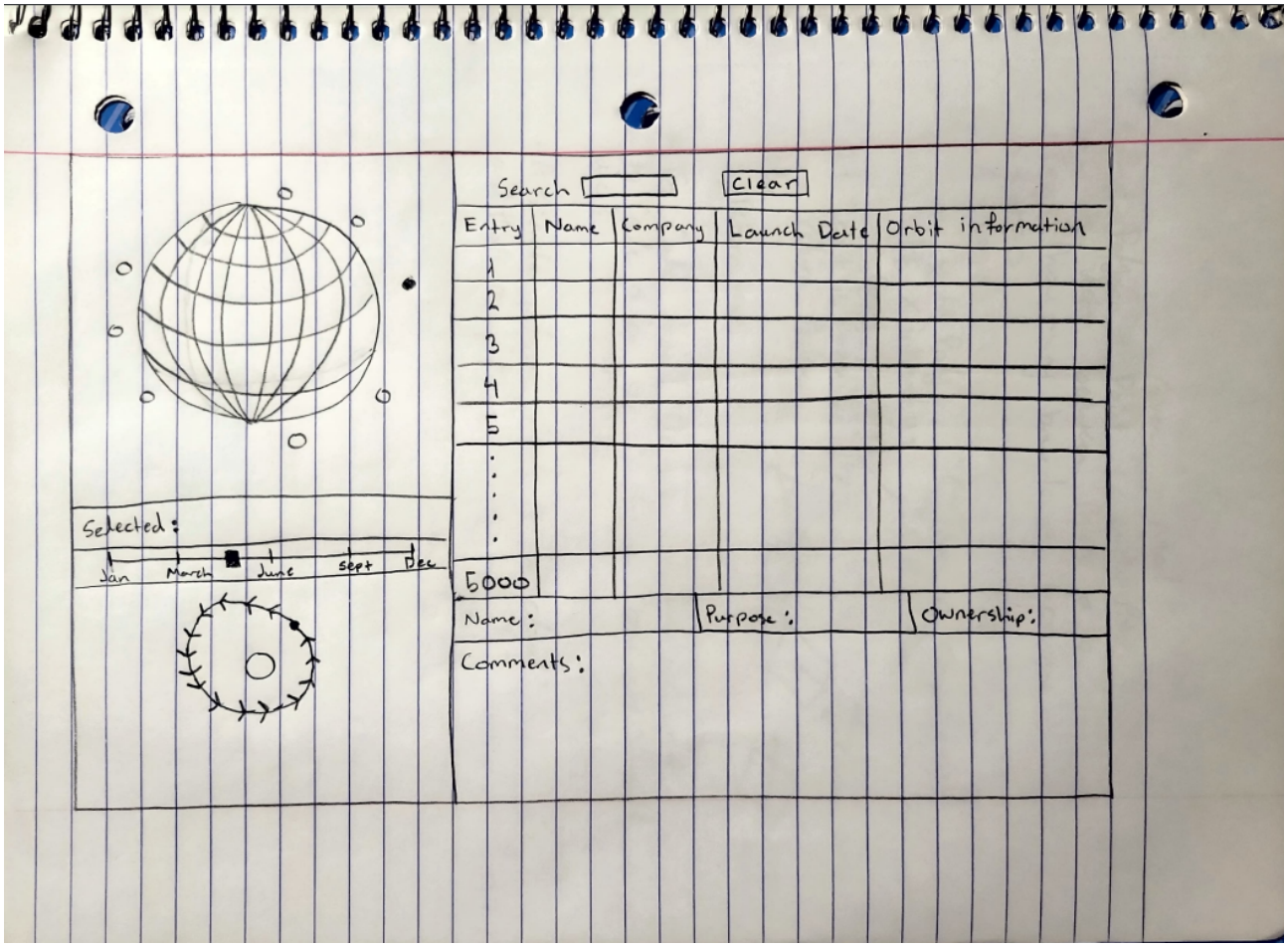


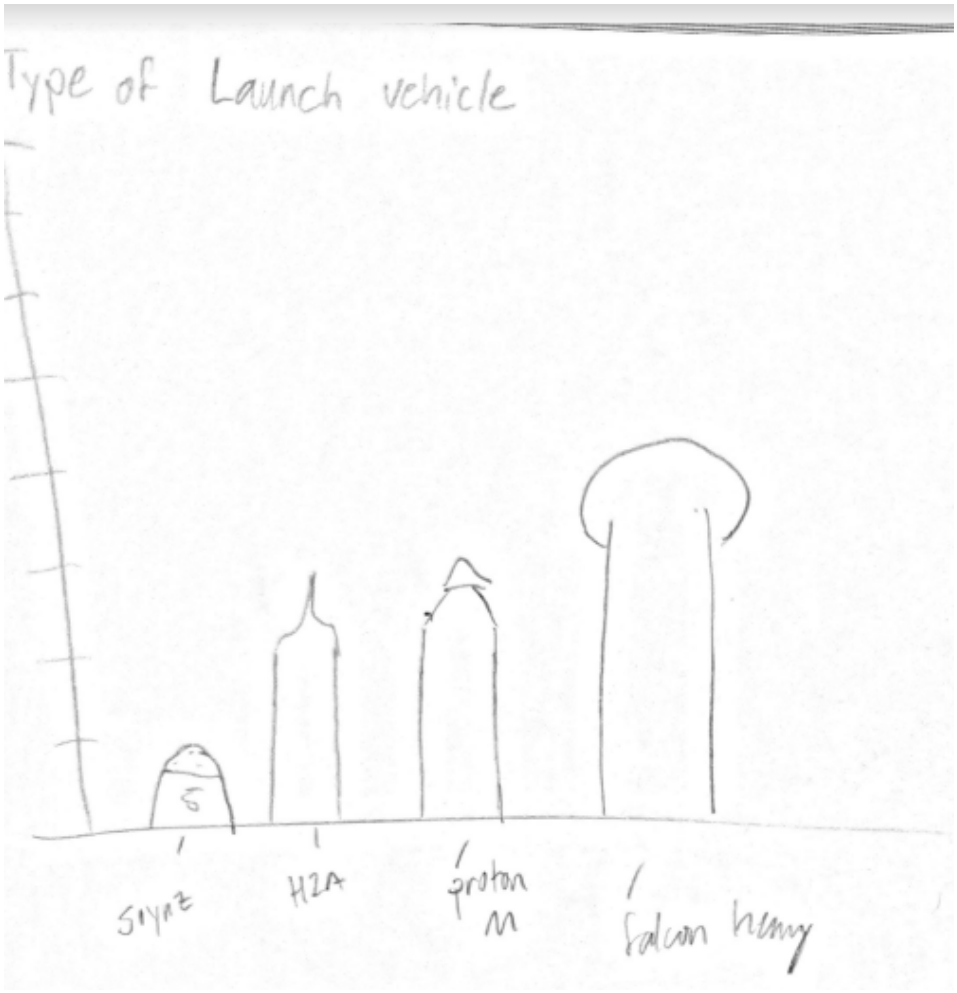


Vehicle used to deliver:


Specific Information


Selected Name
Detailed Description:
Description overview:
Usage purpose
Country of origin
Manufacturer
specific orbit information
Energy Cost
Weight
Filters:
Country
Launch site
Lifetime
Name
Date Launched
Orbit
Company

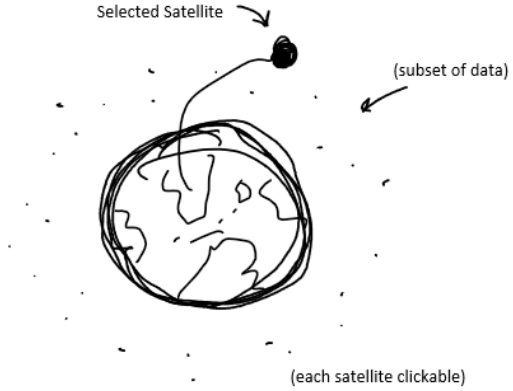

Search
Clear
Entry
Name
Company
Launch Date
Orbit information
1
2
3
4
5
5000
Selected:
Jan
March
June
sept
Dec
Name:
Purpose:
Ownership:
Comments:


Type of Launch vehicle
Soyuz
H2A
proton M
Falcon heavy


Owned / operator
chinese mining at debris
NASA
space X
chang gung

Final Design Prototype:

1



2

Satellites

Search _____ | Clear Selection

[Filter By]	[Filter By]	[Filter By]	[Filter By]	[Filter By]
Name ↕	Country ↕	Users ↕	Class of Orbit ↕	Period (minutes) ↕
Aalto-1	NR	Commercial	LEO	96.08
AAUSat-4	NR	Civil	LEO	94.7
ABS-2	USA	Civil	LEO	95.9
ABS-2A	USA	Commercial	GEO	1436.03
ABS-3A	USA	Commercial	GEO	1436.1
ABS-4	USA	Commercial	GEO	1436
ABS-6	USA	Commercial	GEO	1436.1
Adelis-Sampson 1	USA	Commercial	GEO	1436.08
Adelis-Sampson 2	USA	Government	LEO	95.5
Adelis-Sampson 3	USA	Government	LEO	95.5
USA 311	NR	Government	LEO	95.5
USA 139	USA	Military	GEO	1437.6
USA 171	USA	Military	GEO	1436.14
USA 202	USA	Military	GEO	1436.1
USA 223	USA	Military	GEO	1438.8
USA 237	ESA	Military	GEO	1436
AISTechSat-3	USA	Military	GEO	1436.1
Al Yah-3	USA	Military	GEO	1437.19
Alcomsat (Algerian Communications Satellite)	USA	Military	GEO	1436.1
ALE-2 (Astro Live Experiences-2)	USA	Military	GEO	1436.1
Alfa Crux	USA	Military	GEO	1436.1
Al-Farabi-2	USA	Military	GEO	1436.2

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Selected Satellite Details:

Launch Vehicle:

2021-022M

Contractor:

Asher Space Research Institute at Technion/Israeli Aircraft Industries

Launch Site:

Baikonur Cosmodrome

Comments:

Demonstrate long-term autonomous cluster flight of multiple satellites; determine the position of a cooperative terrestrial emitter.

Source:

http://www.absatellite.net/satellite-fleet/?sat=abs2

Source for Orbital Data

JMSatcat/5_21

Must-Have Features

- Window for displaying satellites descriptors like comments and purpose information
- Tabular view for displaying satellite entries
- Options to filter satellites by different attributes
- Options to sort satellites by attributes in ascending and descending order
- Satellite selection
- Updates across multiple views based on selection
- Color indicating selection/Data

Optional Features

- 3-D Rotating Globe
- Rapid scrolling
- Animated typing
- “Launching” selected satellite.

Project Schedule

- **Week 1**
  - Data chosen - columns picked out to visualize
  - Data added to an HTML
  - Basic elements of the page in HTML
- **Week 2**
  - Data Mapping - manipulate and explore
  - Develop a simple view
  - CSS decisions
- **Week 3 (Milestone)**
  - Visualizations chosen and statically displayed
  - Simplified versions of visualizations complete
- **Week 4**
  - Add interaction and manipulation
  - Figure out the “Moving Parts”
- **Week 5**
  - Transitions
  - Data Links
  - Updates (based on interaction)
  - All text/content added
- **Week 6 (Project Due Date)**
  - Final Polish
  - Create Video