

**Github Project Link:** <https://github.com/Exponential182/KSP-Mission-Website>

# DIGI PROJECT PLAN

## Initial Plan

Idea: A Web App for KSP missions, mission reports and mission infrastructure information.

## The Who, What, and How

### About

My project idea is to develop a web app which can store Kerbal Space Program (KSP) missions and provide information on the missions to the end user. I am primarily developing this tool for myself, as developing a system for a wide range of users would add extra complexity in the form of login systems and would require me to store identifying information without a proper security system because I have to code my own login system. This will be a Flask web app coded in Python and using an SQLite3 database.

### Development Philosophy

This project will be broken down into several sprints (3+) lasting ~20 weeks of the project timeframe. Feedback will be collected after each sprint from people who might use the tool, and the project will be stress-tested for issues with the data, code, or infrastructure. 5 Weeks of the project will be dedicated to testing to ensure that the application works in all reasonable cases. The major goals of testing are to hunt down any edge or invalid case issues and to ensure that the data and display are clear/understandable to the end user.

### Python

The Python code will be programmed according to PEP8 and PEP 20 style conventions. This database will use external file storage for large data formats, such as mission reports and images, to prevent database bloating. This is important as it minimises the query time for the database while allowing images and reports. There are two major challenges which the Python app will have to overcome: ensuring that data is extracted from the database accurately and sending correct data to the website in a consistent format.

### Interface/Website

The interface will be designed while considering Neilson's usability heuristics, with feedback about the interface gathered from people with experience in web design and standard users. Because the target audience for the website is gamers, the vast majority of users will be proficient in interacting with digital interfaces.

The websites will all be generated from layouts using Flask with Jinja variable integration to insert the data. Jinja code comments will be primarily used to ensure that the code is readable without preventing inquisitive users from learning too much about the functionality of the code. The CSS will follow modern web design conventions such as using flex boxes and grid structure as opposed to tables and floating objects. CSS will be commented around complex sections, such as the navbar or grid boxes, to indicate the purpose of the CSS. The website will also utilise internally and externally consistent interface elements, such as where the account information, search bar, and logo are. HTML comments will be avoided and only used at the end of sections or div elements to indicate the ID and class of an HTML object.

## **Database**

See the Entity Relationship Diagram Section.

## **Data Integrity**

To ensure that the data is reliable, I will be generating a diff between the data in the database and the document where the data is stored to ensure that the copying process worked correctly. I will also be diligent in the process of data collection to ensure that inaccurate information does not enter the database.

# Background Information

## What is Kerbal Space Program?

Kerbal Space Program (KSP) is a spaceflight simulation game where you build and fly spacecraft to complete missions such as travelling to distant worlds, colonising planets, or building space stations. The game normally takes place in a fictional solar system, which is about 1/10th of the size of our solar system, with invented planets and a limited selection of fictitious parts.

The installation of the game used for this database is significantly modified to remove the more comedic aspects of the game and make the game more realistic. A wide range of mods adds realistic engines, real fuels, life support, solar panel degradation, radiation belts, realistic contracts, and improved communication. This means that the target audience of the website is more narrowly focused on people who play with a similarly modded version of the game.

## Glossary of Technical Terms

### Orbital and Planetary Terms

**Primary Body:** The celestial body (star, planet, moon, etc) that has the largest gravitational influence on the spacecraft.

**Orbit:** A circular, or elliptical path around the primary body of the spacecraft; this is the result of moving fast enough that you fall and miss the Earth.

**Hyperbolic Trajectory:** A trajectory in which the spacecraft has enough energy to escape the gravitational influence of the primary body and enter the gravitational influence of the primary body's primary body (For the Earth, the primary body is the Sun. For the Moon, the primary body is the Earth.)

**Fundamental Orbital Parameters:** The Semi-Major Axis, Eccentricity, Inclination, Longitude of the Ascending Node, and the Argument of Periapsis are the fundamental orbital parameters which uniquely separate all possible orbits of a Primary Body. Along with the Planetary Characteristics, it uniquely determines any orbit from any other orbit.

**Apoapsis:** The largest distance from the primary body's surface in an orbit. (measured in meters)

**Periapsis:** The smallest distance from the primary body's surface in an orbit. (measured in meters)

**Semi-Major Axis:** Half the distance between the Periapsis and Apoapsis, this includes the diameter of the Primary body (While Apoapsis and periapsis do not) (measured in meters)

**Orbital Period:** The time taken to complete one full orbit of a celestial body. (measured in seconds)

**Eccentricity:** A measure of how circular the orbit is. At 0, it means a perfectly circular path. For values between 0 and 1, it represents an elliptical orbit, and for values above 1, it represents a hyperbolic trajectory.

**Inclination:** A measure of the tilt of an orbit, with 0 degrees being along the equator in the direction of rotation and 180 degrees being along the equator opposing the direction of rotation. It also indicates the maximum latitude that the satellite will fly over. (measured in degrees)

**Longitude of the Ascending Node:** The longitude of the point in an orbit when you pass the equator moving upwards at a fixed point in time. This is used to differentiate between the infinite range of orbits of a given inclination. (measured in degrees)

**Argument of Periapsis:** The angle between the longitude of the ascending node and the lowest point in the orbit. (measured in degrees)

**Attitude:** The direction of a spacecraft in 3d space.

### Rocket Science Terms

**Thrust:** The amount of force applied by an engine, measured in kilonewtons (kN)

**Specific Impulse:** A measure of the efficiency of a rocket engine and defined as the amount of time that an engine can produce 1kg of thrust from 1 kg of propellant. The greater the specific impulse, the greater the change in velocity that can be achieved for a certain mass of propellant. (measured in seconds)

**Engine:** Any system aboard a spacecraft which uses chemical, nuclear, or electrical reactions to affect the velocity of the spacecraft. This can include small thrusters called RCS engines (Reaction Control System), which are primarily used for changing the attitude of the spacecraft or stage.

**Launch Vehicle:** A composite vehicle designed to lift a payload into orbit around the Earth. This is often discarded after reaching orbit, but sometimes persists if the final stage of a launch vehicle is useful for further manoeuvres.

**Stage:** A part of a payload/launch vehicle that has engines and fuel. Stages are sequentially separated from the rest of the payload as it is more mass efficient to discard the weight of the control electronics, engines, and empty fuel tanks than to build a monolithic construction which has enough fuel to lift a payload to its destination.

**Payload:** The spacecraft, satellites, or crew capsules delivered somewhere by a vehicle

**Performance:** The performance of a vehicle or stage is an indicator of the amount of payload which can be delivered to a given location, this is often measured in mass to a given orbit such as Low Earth Orbit (a minimum energy orbit), Geostationary Earth Orbit (an orbit such that you remain stationary over a fixed point on the surface), Trans Lunar Injection (an orbit which will encounter the moon) or any other destination.

# Feature List

## Need

- Robust Infrastructure
- A Dataset of ~10 missions
- Genuine data produced by people to ensure that the designs would roughly work
- Functional Database Connections
- Search System
- Mission, Stage, and Engine Pages
- Mod License Page
- Glossary
- 

## Want

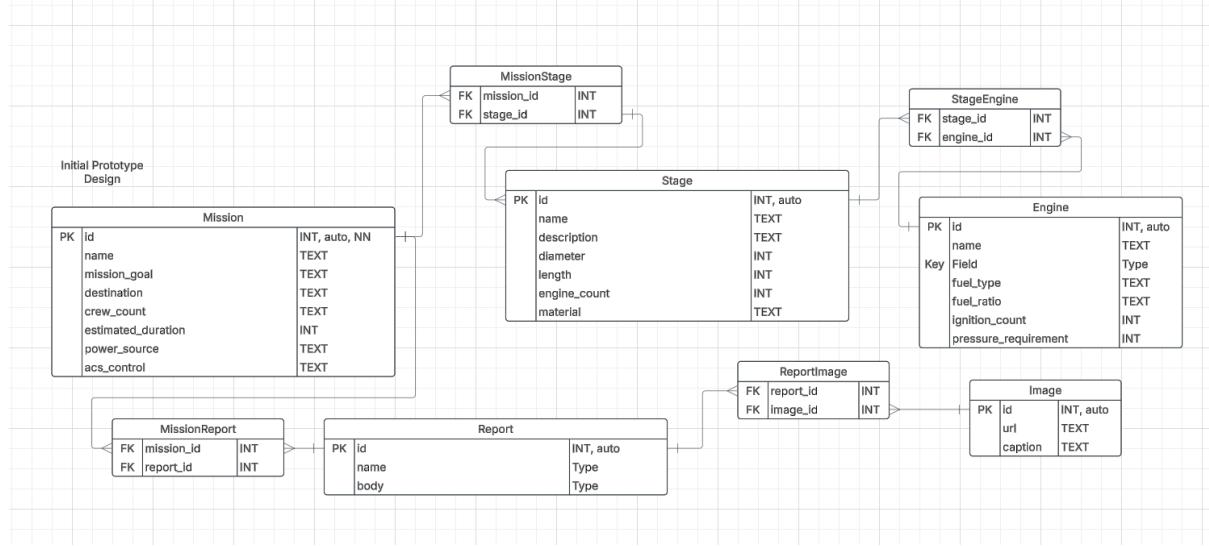
- Craft File Download
- Site Map
- A Dataset of ~50 missions
- Costs in Funds(the game's currency) of missions, stages, engines, etc
- Launch Vehicle Search Functionality

## If I have Time

- Web-based data addition, including images.
  - Using a flask library for images.
- Login System
  - Hashed and salted password storage.
  - Separate database (allows mission data to be released without compromising user security).
  - Newly developed system. (Ideally, this would be a preexisting system with proper cybersecurity experts involved in development. However, project requirements force an original system which will be less secure.)
  - 5 wrong login attempts will lock out the ability to try again for 1 hr. This will likely be vulnerable to new session attacks where all data about the site is cleared.
- The ability to search by more database columns
-

# ERD's

## Initial ERD



This is my initial database design that will be iterated on throughout planning and development as data is collected and goals are shifted. I am using several linking tables to connect data due to the overlap of various aspects of rocket design.

The Mission and Stage tables are linked through a linking table because a single mission will almost always contain several stages, and several missions can use the same stage either through a common launch vehicle or kick stage.

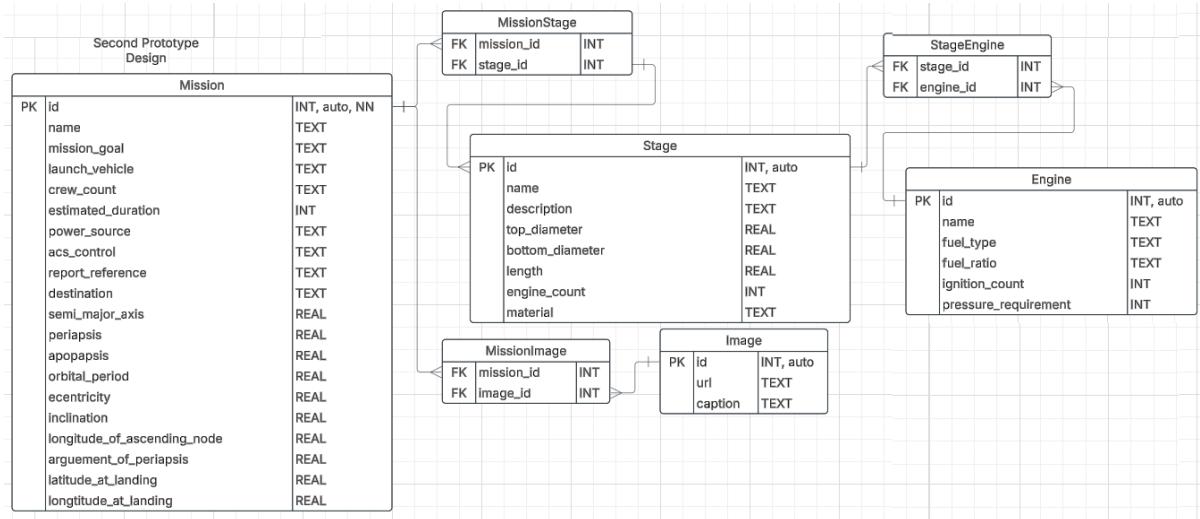
The Stage and Engine tables use a linking table because stages can use several types of engines in their design, and the same engine can be used on multiple stages.

The Mission and Report tables are connected with a linking table because more advanced missions, such as interplanetary missions or space stations, will generate several reports at different points in a mission. The same report can also have relevance to several missions, such as the report of a docking of two spacecraft is relevant to both missions.

The Report and Image tables are connected with a linking table because images can be relevant to several reports, such as a common image of a payload, a docking, a rendezvous or other events involving several spacecraft.

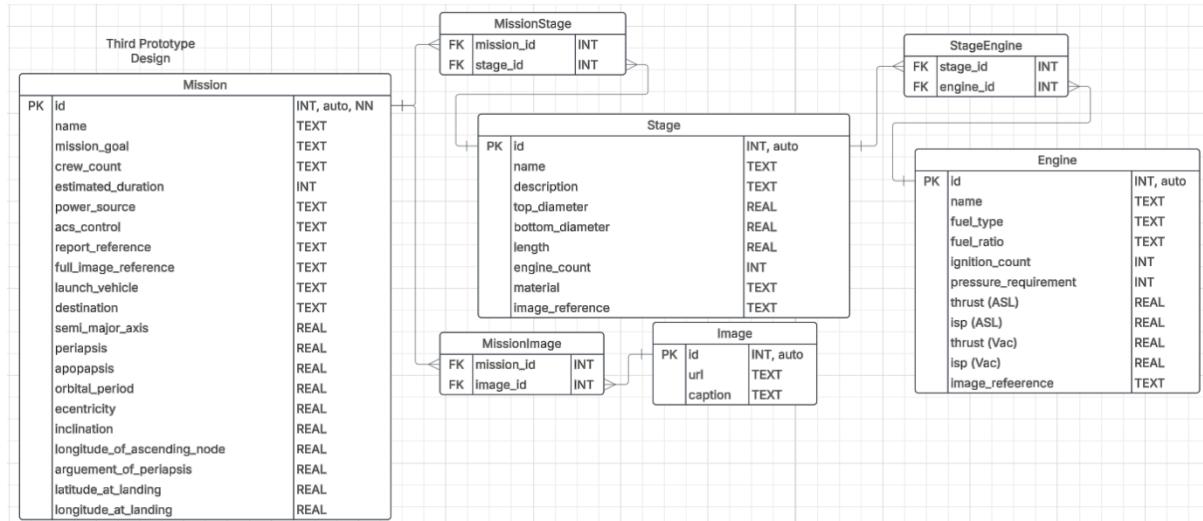
My primary reasoning behind selecting this design was what I thought would be most useful for me when I use this as a tool.

## ERD Revision 1



I changed my ERD after a preliminary test of collecting data and concluded that the design of the database was not conducive to data collection because the process of collecting data required too much creative energy to populate a useful dataset. It also lacked any information about the orbital parameters of deployed spacecraft. This is useful data to sort by because it is numeric and provides more information about the mission to an informed user. The data will be of the spacecraft at the destination, so a crewed mission to lunar orbit will use the lunar orbit it achieves for its orbital parameters. A landing mission will use the position it lands in. I also changed the stage table to include a top and bottom diameter to account for the tapered nature of stages to the stage table. A launch vehicle column has been added to the mission table because it provides me with a reference for which stages are used.

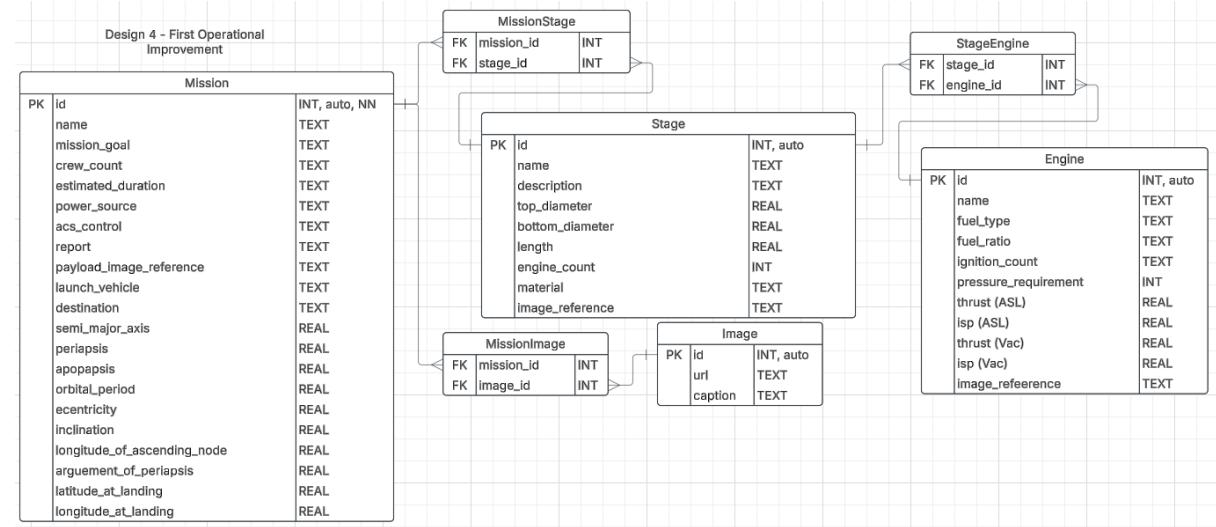
## ERD Revision 2



This revision of the ERD adds 4 new columns to the engine table: the thrust and efficiency (isp/specific impulse) of the engine. This is useful as it expands the potential of the engine table to function as its page to allow users to look at the engine and its performance. It also adds references for the images of stages and engines. I also added the

full\_image\_reference column to the mission table. This allows for an image to be displayed when the user searches for a specific mission as opposed to a list of mission names. This provides the user with a visual reference of the mission's payload before interacting with a mission. I also fixed incorrect relational notation between the MissionStage and Stage tables. The line between them was reversed(one to many as opposed to many to one). I also added a column to the mission table to indicate the launch vehicle used in the mission.

## ERD Revision 3 - First Development Changes



The ERD has been revised to change the estimated duration to be text to allow for descriptors such as weeks, months, or years to be useful. Full\_image\_reference was also replaced with payload\_image\_reference, as the image of the payload will be more useful than an image which mostly contains the launch vehicle. The report\_reference column has been replaced with the report column because I decided that it would be easier to store the text in the database, as it is relatively short.

# Aesthetics

## Colour Scheme

<https://coolors.co/0d0d0d-162654-2e573a-f5f5f5-f9d7aa>

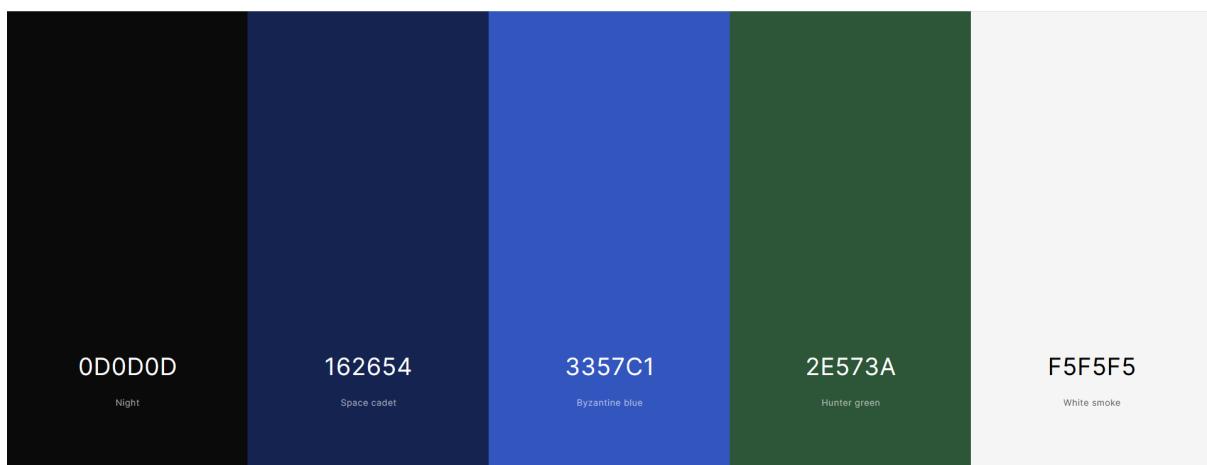


#000 and #fff to be used for text to ensure good contrast

The contrast of the website doesn't notably shift for most forms of colourblindness, which makes the website more accessible to people because the text should still be readable.

While the colour palette is less symbolic and looks worse with colour blindness, I believe that this is a small concession which needs to be made to ensure that the project is achieved in a reasonable amount of time because finding a visually optimal colour palette for all forms of colour blindness would be incredibly time-consuming and outside of the scope of the project.

<https://coolors.co/0d0d0d-162654-3357c1-2e573a-f5f5f5>



I have changed my colour palette to remove the yellow/gold colour as I think it has too much contrast, and I found myself not using it because it looked bad. I've replaced it with a different shade of blue to further complement the blue being used as a symbol of oceans. I think that this new colour palette will see more use as it lacks the jarring contrast of the yellow/gold.

## Colour Palette on Template



## Fonts

### Header Font

Space Mono - <https://fonts.google.com/specimen/Space+Mono>

License - <https://fonts.google.com/specimen/Space+Mono/license>

### Body Font

Open Sans - <https://fonts.google.com/specimen/Open+Sans>

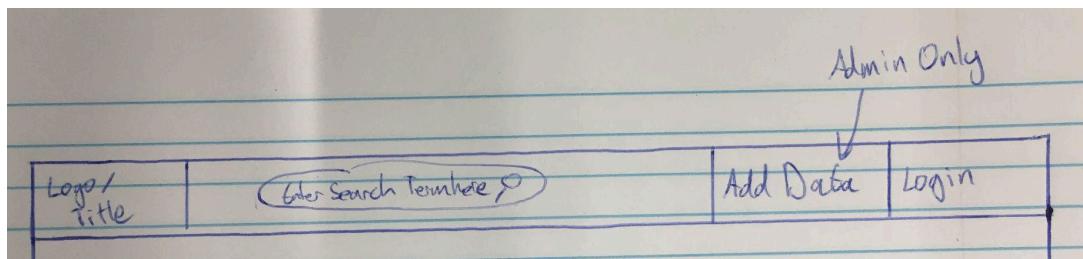
License - <https://fonts.google.com/specimen/Open+Sans/license>

## Functions, URLs, SQL Queries, and Layouts

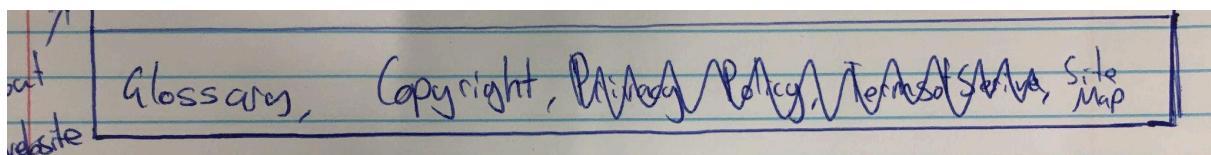
All SQL Queries will be properly escaped when implemented in Python, and f"{{variable}} notation is being used as a substitute for proper formatting in the Python module, as demonstrated below.

```
Database_Connection.execute("SELECT * FROM Mission WHERE name LIKE ?",
(f'{search_term}%'))
```

### Common Nav Bar Sketch



### Common Footer



### Colour Palette + Font Design

A wireframe of a web page titled "Search Results" with a subtitle "Search term was Luna 14". The page features a grid of six placeholder cards, each containing an image placeholder and the text "Lorem ipsum dolor sit amet,". At the bottom, there is a footer with links: "Site Map", "Glossary", "Licenses", and "©Matthew Thomas". The design uses a dark blue background with orange and white accents for the header and footer.

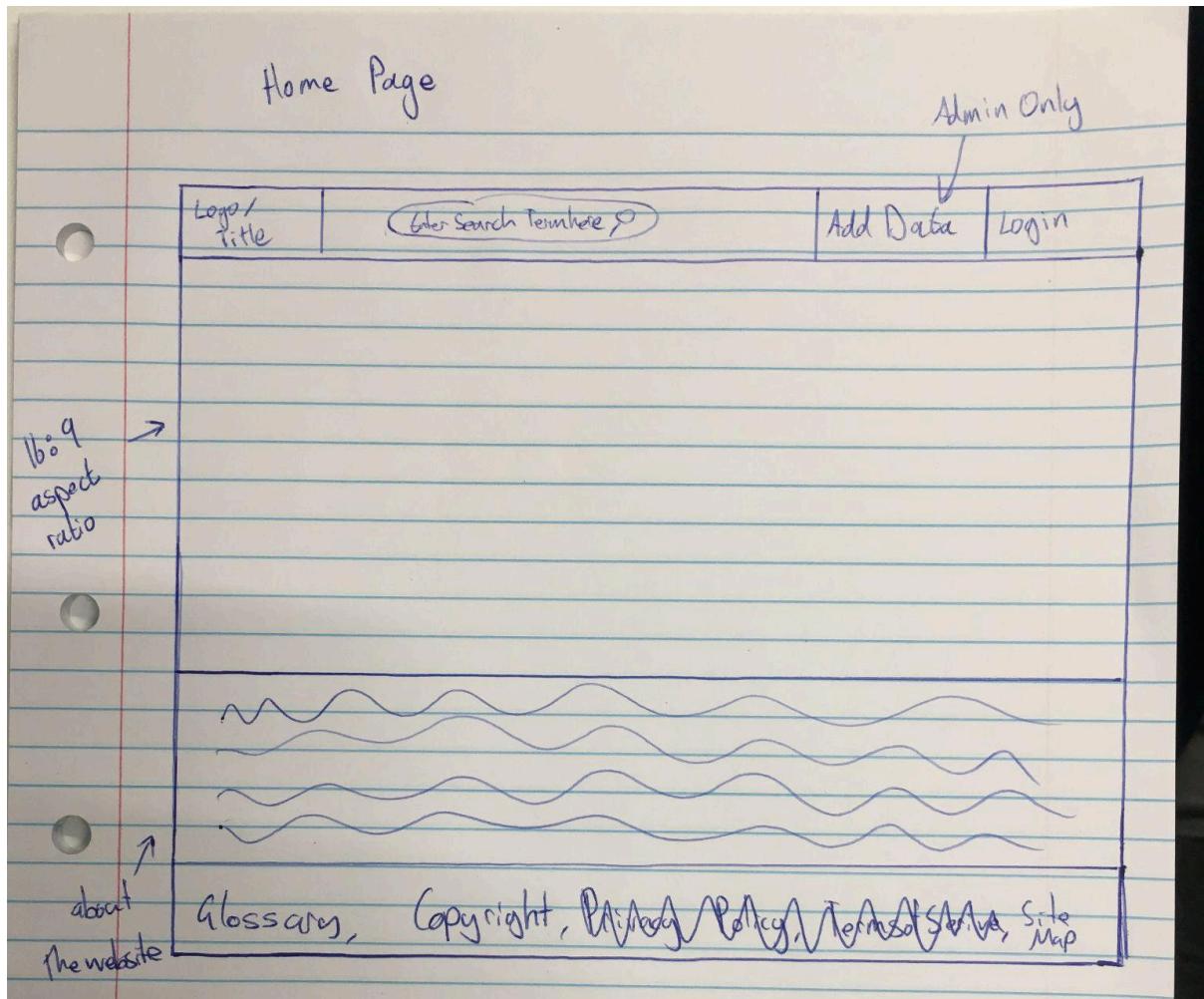
## Home Page

```
@app.route('/')
def home():
```

### Pseudocode

Render the page from the template.

### Sketch



## Search Result Page

```
@app.route('/search/<str:search_type>/<str:search_term>/',  
methods=[ 'GET' ])  
def search_result(search_type, search_term):
```

### Pseudo Code

- Check if the search type is valid (mission, engine, stage)
- Connect the Database to the code, then run the relevant query and collect the results.
- Pass the data to the template.
- Render the Template

For Mission Searches (id, name, destination, goal, full image)

For Engine Searches (id, name, image)

For Stage Searches (id, name, engine count, image)

### SQL Queries

Mission: SELECT name, destination, mission\_goal, full\_image\_reference FROM Mission  
WHERE name LIKE f'{search\_term}%';

Expected Result

name	destination	mission_goal	full_image_reference
Luna 14	The Moon	Lunar Landing	Luna-14-full.png
Luna 15	The Moon	Lunar Landing	Luna-15-full.png
Svet 15	Earth	Commercial Communications	Svet-15-full.png

Stage: SELECT name, engine\_count, image FROM Stage WHERE name LIKE f'{search\_term}%';

Expected Result

name	engine_count	image_reference
URS-100-1A	2	URS-100-1A.png
URS-350-3A	5	URS-350-3A.png
URS-200-2A	5	URS-200-2A.png

In the results, the string "static/images/stages/" must be placed before the image reference to attain the correct path.

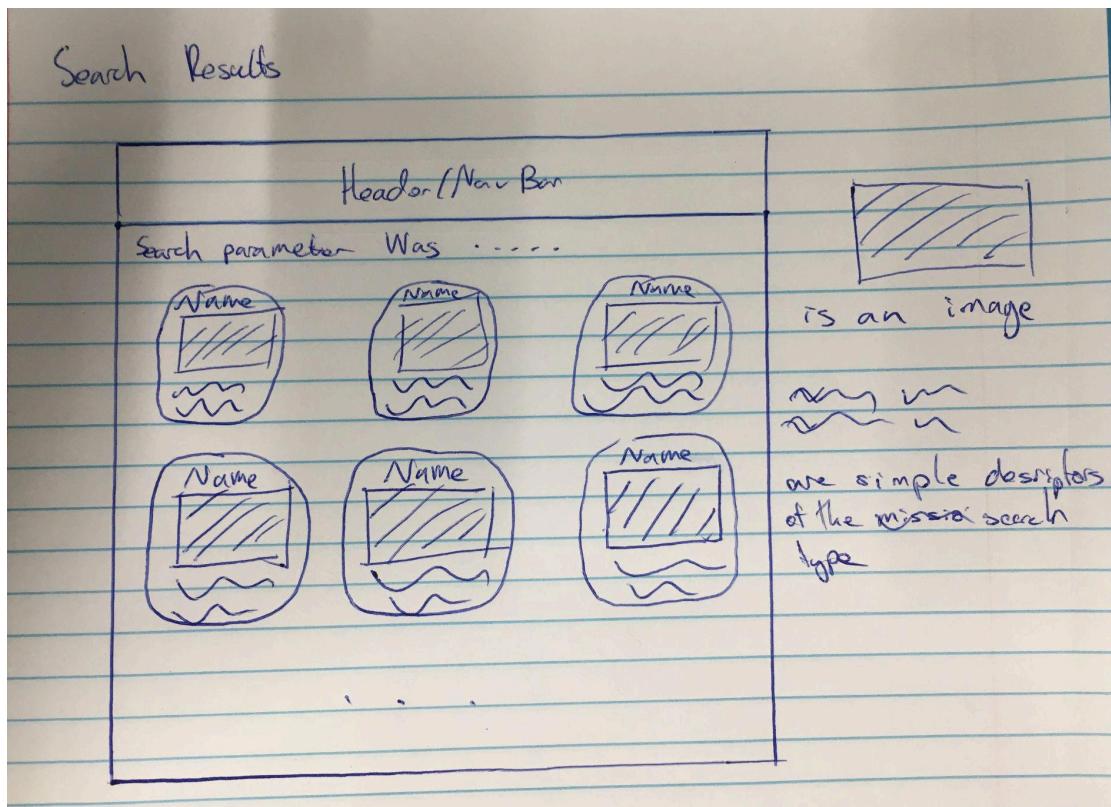
Engine: SELECT name, fuel\_type, ignition\_count, image\_reference FROM Engine WHERE name LIKE f'{search\_term}%';

Expected Result

<b>name</b>	<b>fuel_type</b>	<b>igniton_count</b>	<b>image_reference</b>
RD-0203	UDMH/NTO	1	RD-0203.png
RD-253	UDMH/NTO	1	RD-253.png
S1.5400-11D33M	Kerosene/Liquid Oxygen	1	S1.5400-11D33M.png

In the results, the string "static/images/engines/" must be placed before the image reference to attain the correct path.

### Sketch



## Mission Specific Page

```
@app.route('/mission/<int:mission_id>/')
def mission(mission_id):
```

### Pseudo Code

- Connect the database to the function.
- Run queries to gather all the data on a mission.
- Format the Results.
- Pass the Results to the HTML template.
- Render the template

### SQL Queries

#### Primary Data Query

```
SELECT * FROM Mission WHERE id = f'{mission_id}';
```

#### Sample Results

<b>id</b>	3	<b>full_image_reference</b>	static/images/full-vehicles/Svet-15-full.png	<b>eccentricity</b>	0.838
<b>name</b>	Svet 15	<b>launch_vehicle</b>	UR-200A	<b>inclination</b>	116.689
<b>mission_goal</b>	Commercial Communications	<b>destination</b>	Earth	<b>longitude_ofAscending_node</b>	264.3019
<b>estimated_duration</b>	5 Years	<b>semi-major-axis</b>	42423100	<b>argument_of_periapsis</b>	90.2
<b>power_source</b>	Solar Panels	<b>periapsis</b>	483382	<b>latitude_at_landing</b>	
<b>acs_control</b>	Spin Stabilisation	<b>apoapsis</b>	71620871	<b>longitude_at_landing</b>	
<b>report_reference</b>	static/reports/svet-15.txt	<b>orbital_period</b>	86959.09		

Empty boxes will be stored as null because there is no relevant data in that field for a mission. This is caused by the fact that KSP missions can have different outcomes. Some will be aiming to land on planetary surfaces, others will be targeting specific orbits, and others will be aiming to fly by planets/moons.

#### Image Gallery Data Query

```
SELECT url, caption FROM Image WHERE id = (
```

```
SELECT image_id FROM MissionImage WHERE mission_id = f'{mission_id}'
```

#### Sample Results

url	caption	url	caption
luna-17/Luna-17-breaking-maneuver.png	The Luna 17 spacecraft screaming to a halt above the lunar surface, it will reduce its velocity to 0 m/s at an altitude of 1400m.	luna-16/Luna-16-deployment.png	The Luna 16 spacecraft and its transfer stage flying free of the third stage, an issue with the vernier engines caused the stage to enter an uncontrolled spin, effectively ending the mission.
svet-15/Svet-15-payload-deploy.png	The spacecraft, gently spinning to maintain stability, is separated from the transfer stage to begin its on-orbit operations.	luna-15/Luna-15-payload-deploy.png	The Luna 15 payload separates from its upper stage over South America.

Note: images need the string “static/images/inflight-images/” added to the front of them.  
Writing these as shown helps to simplify the data entry process.

#### Stage Data Query

```
SELECT * FROM Stage WHERE id = (
SELECT stage_id FROM MissionStage WHERE mission_id = f'{mission_id}' )
```

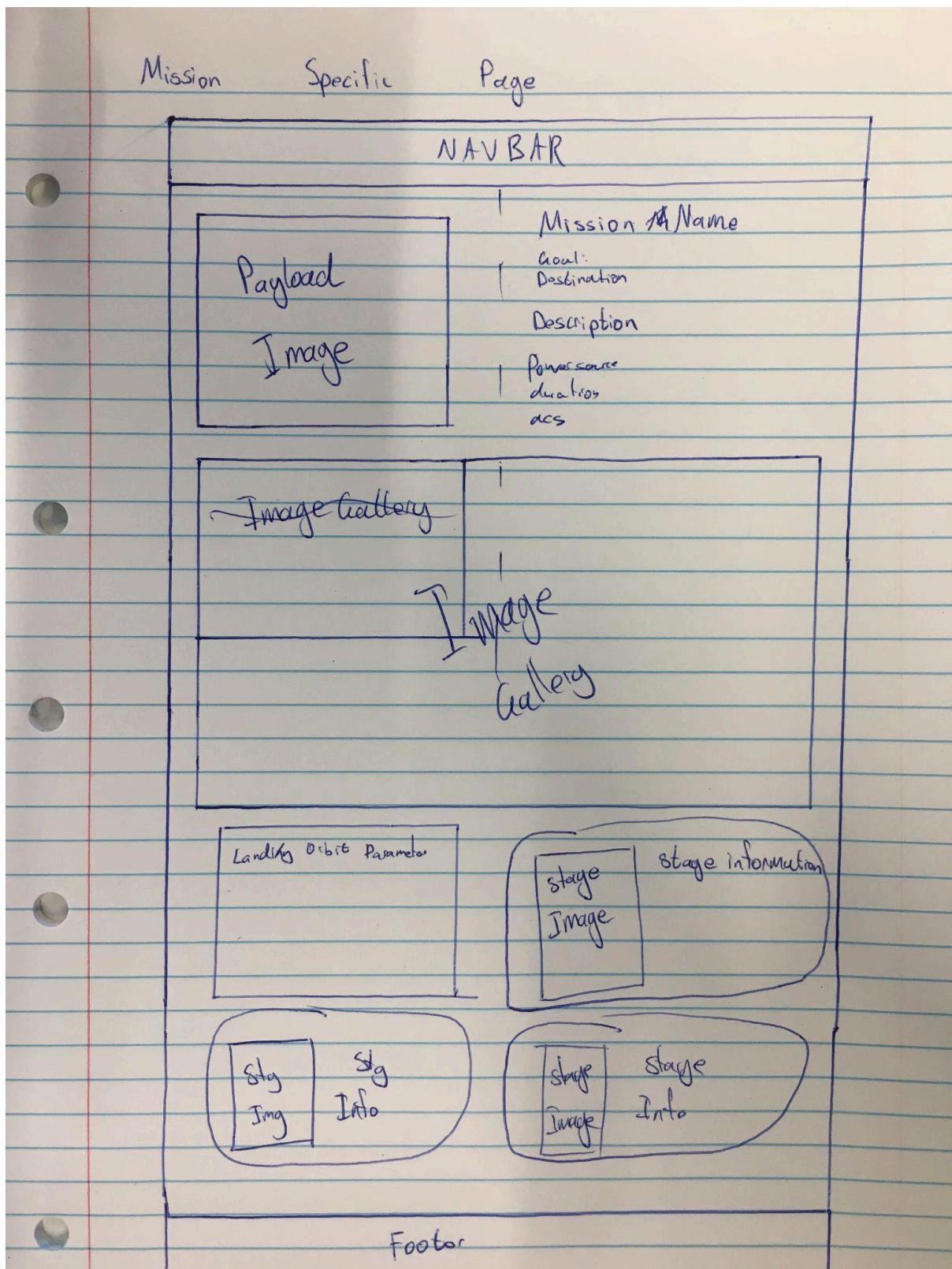
#### Sample Results

<b>id</b>	0	1	2	9
<b>name</b>	URS-350-1A	URS-350-2A	URS-350-3A	Pegasus-C
<b>description</b>	The first stage of the UR-350A, utilising 3 RD-253 engines. Fueled by unsymmetric dimethyl hydrazine and	The second stage of the UR-350A, utilising 3 RD-0203. Fueled by unsymmetric dimethyl hydrazine and	The third stage of the UR-350A, utilising 1 RD-0206 main engine and 4 RD-0207 vernier engines. Fueled by unsymmetric dimethyl hydrazine and	A kick stage used for the second generation of lunar landers (Luna 14 through 19). Powered by the S1.5300 engine

	hydrazine and nitrogen tetroxide propellants, these engines were historically used on the first stage of the UR-500 (Proton) rocket developed in the Soviet Union.	nitrogen tetroxide propellants, these engines were historically used on the first stage of the UR-200, an ICBM developed by the Soviet Union in the 1960s.	dimethyl hydrazine and nitrogen tetroxide propellants, these engines were historically used on the third stage of the UR-500 (Proton) rocket developed in the Soviet Union.	in its 11D33M configuration, it performs the TLI and breaking burns in lunar missions but could be applied to heavy commercial payloads.
<b>top_diameter</b>	4	3	3	1.5
<b>bottom_diameter</b>	4	4	3	1.5
<b>length</b>	11	7	3.3	3
<b>engine_count</b>	3	3	5	1
<b>material</b>	Isogrid - Al Gridded	Isogrid - Al Gridded	Isogrid - Al Gridded	Isogrid - Al Gridded
<b>image_reference</b>	URS-350-1A.png	URS-350-2A.png	URS-350-3A.png	Pegasus-C.png

Note: images need the string “static/images/stages/” added to the front of them, writing these as shown helps to simplify the data entry process.

Sketch



## Stage Page

```
@app.route('/stage/<int:stage_id>/')
def stage(stage_id):
```

### Pseudo Code

- Connect the database to the function.
- Run queries to gather all the data on a mission.
- Format the Results.
- Pass the Results to the HTML template.
- Render the template

### SQL Queries

#### Stage Data Query

```
SELECT * FROM Stage WHERE id = f'{stage_id}'
```

#### Sample Results

<b>id</b>	0
<b>name</b>	URS-350-1A
<b>description</b>	The first stage of the UR-350A, utilising 3 RD-253 engines. Fueled by unsymmetric dimethyl hydrazine and nitrogen tetroxide propellants, these engines were historically used on the first stage of the UR-500 (Proton) rocket developed in the Soviet Union.
<b>top_diameter</b>	4
<b>bottom_diameter</b>	4
<b>length</b>	11
<b>engine_count</b>	3
<b>material</b>	Isogrid - Al Gridded
<b>image_reference</b>	URS-350-1A.png

Note: images need the string "static/images/stages/" added to the front of them, writing these as shown helps to simplify the data entry process.

#### Engine Data Query

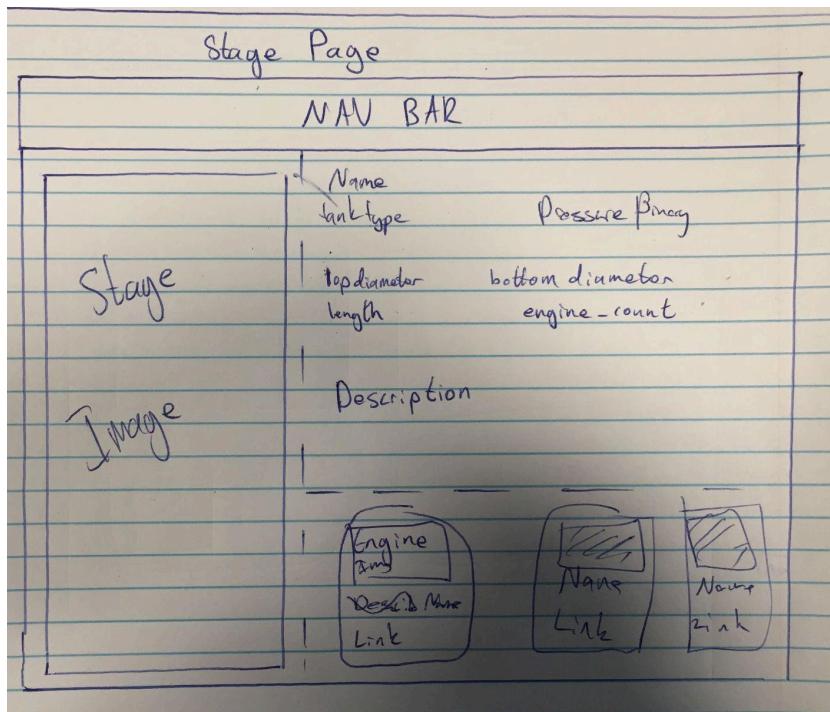
```
SELECT * FROM Engine WHERE id =
SELECT engine_id FROM StageEngine WHERE stage_id = f'{stage_id}';
```

<b>id</b>	0
<b>name</b>	S1.5400/11D33M
<b>fuel_type</b>	Kerosene/Liquid Oxygen

<b>fuel_ratio</b>	1:1.684
<b>ignition_count</b>	5
<b>pressure_requirement</b>	0
<b>thrust (ASL)</b>	33
<b>isp (ASL)</b>	168
<b>thrust (Vac)</b>	67.3
<b>isp (Vac)</b>	342.2
<b>image_reference</b>	S1.5400-11D33M.png

Note: images need the string “static/images/engines/” added to the front of them, writing these as shown helps to simplify the data entry process.

## Sketch



## Engine Page

```
@app.route('/engine/<int:engine_id>')
def engine(engine_id):
```

### Pseudocode

- 
- Render the website from the template.

### Pseudo Code

- Connect the database to the function.
- Run queries to gather all the data on a mission.
- Format the Results.
- Pass the Results to the HTML template.
- Render the template

### Engine Data Query

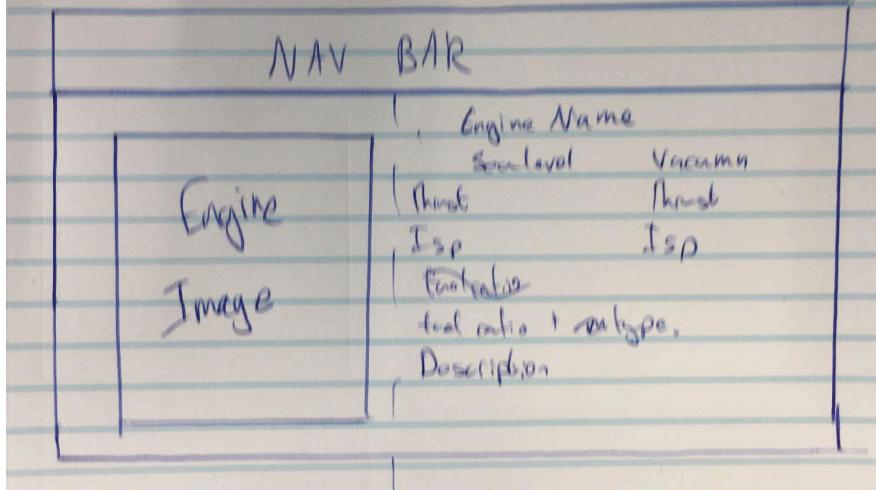
```
SELECT * FROM Engine WHERE id = f'{engine_id}'
```

<b>id</b>	0	1	2
<b>name</b>	S1.5400/11D33M	RD-253	RD-0206
<b>fuel_type</b>	Kerosene/Liquid Oxygen	UDMH/NTO	UDMH/NTO
<b>fuel_ratio</b>	1:1.684	1:1.477	1:1.402
<b>ignition_count</b>	5	1	1
<b>pressure_requirement</b>	0	0	0
<b>thrust (ASL)</b>	33	1393.2	425.4
<b>isp (ASL)</b>	168	284.5	241
<b>thrust (Vac)</b>	67.3	1545	575.5
<b>isp (Vac)</b>	342.2	315.5	326
<b>image_reference</b>	S1.5400-11D33M.png	RD-253.png	RD-0206.png

Note: images need the string “” added to the front of them, writing these as shown helps to simplify the data entry process.

### Sketch

## Engine Page



## Sitemap Page

```
@app.route('/sitemap/')
```

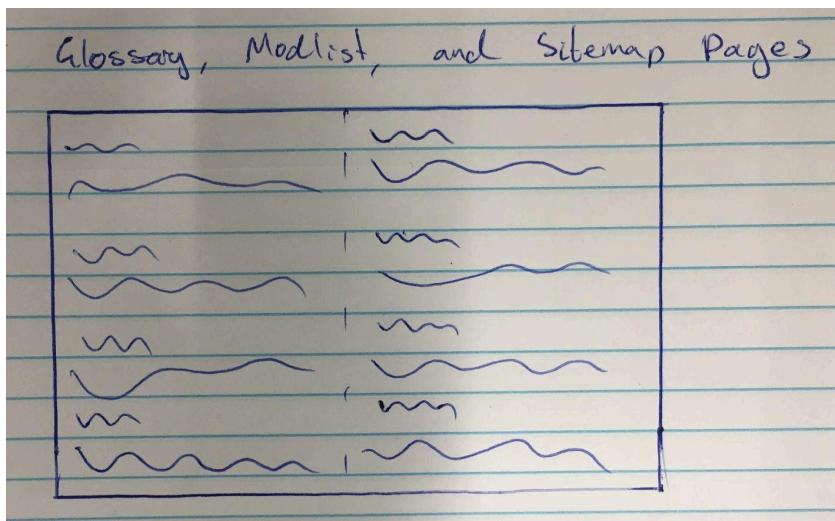
```
def sitemap():
```

A compilation of all the site links which require no dynamic input, useful for any user who is looking to see if the website supports some functionality or has some information.

### Pseudocode

Render the website from the template.

### Sketch



## Modlist Page

```
@app.route('/mod_list/')
```

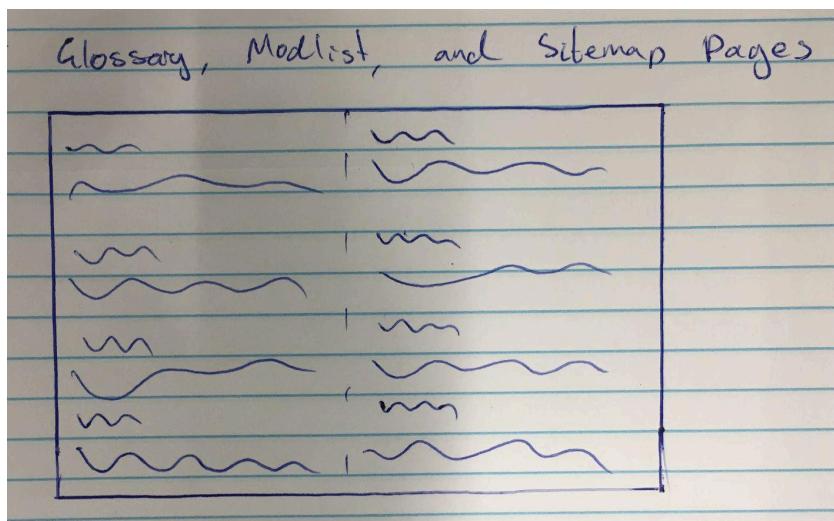
```
def mod_list():
```

### Pseudocode

Render the website from the template.

This page is intended for referencing all of the mods used in my installation of Kerbal Space Program. This provides the end user with knowledge of how to create a similar installation of the game. This also covers the potential legal issue of mod authors claiming copyright to any media produced by me on the site on the basis of failing to credit their work. This is unlikely to be an issue because the screenshots used on the website are my original work, most licenses talk about distributing software, and many creators post YouTube videos of them playing a similarly modded instance of the game without providing a modlist.

### Sketch



## Glossary Page

```
@app.route('/glossary/')
```

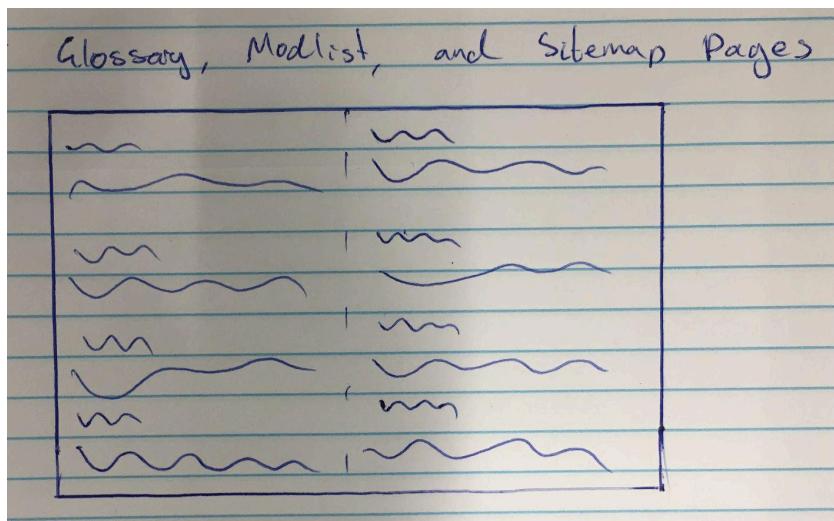
```
def glossary():
```

### Pseudocode

Render the website from the template.

A Glossary of subject-specific terms relating to astrodynamics, orbital mechanics, and rocket design. Intended for people unfamiliar with the vast array of technical terms which are frequently used throughout the website, this is the website's version of the glossary at the top of this document..

### Sketch



# Development Log/Notes

## Sprint Notes

### Sprint 1

#### Goals

- Populated the database with sample data writer
- Static HTML layout complete
- Display pages for all data of a type (All Missions Page, All Stages Page, All Engines Page)
- HTML/CSS and Python Completion

#### Data collection and population methodology.

I decided to change my approach to data collection to make it more conducive to the automatic database creation process and improve the reliability of data transfer. I did this by changing from collecting data in a Word document then transferring it directly to the database using spreadsheets. This allows me to export CSV files and use these to compose a database automatically. It also allows for the data to be stored in a git repo in the form of JSON files to show iteration in the database design process.

This increases the complexity of the project as a script or method to convert CSV files into database information will be needed, but this allows for easier database recreation in development, in case a process causes damage to the database.

#### Aesthetic Changes

I have changed my colour palette to remove the yellow/gold colour as I think it has too much contrast, and I found myself not using it because it looked bad. I've replaced it with a different shade of blue to further complement the blue being used as a symbol of oceans.

#### Database Changes

I changed the method of storing images as paths in the database to be less reliant on string concatenation. The image path is now stored directly as the path of the image in the Flask app directory. This means that the system is more robust, as all paths are now relative to the root repository provided that the scripting remains in its current location. This requirement is already established because of how Flask's image, CSS, and script referencing system works.

#### Sprint 1 Feedback

(Note: SW indicates experience in software development)

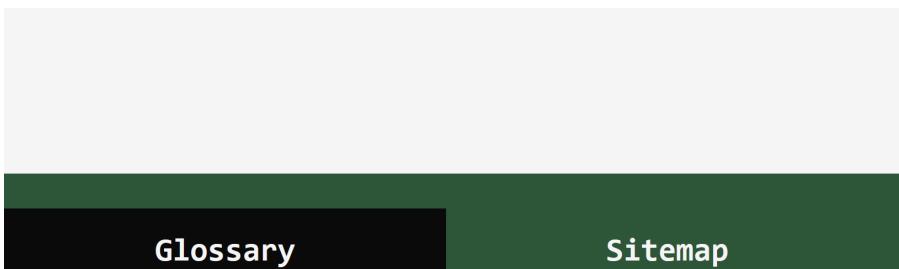
Name	Feedback	Changes/My Thoughts
Ben (SW)	I think the text is too big on the home page and glossary, which makes the page look	I agree with the text being too large and will make changes to

	<p>zoomed in. On the missions page, I don't like that all the boxes aren't the same size. The engines page has misaligned boxes that look unsatisfying. I think you should add box shadows to make everything pop out more, for instance, the nav bar, to make it look like it's above the rest of the page. Fix the weird stitching on the footer on the home page.</p>	<p>fix this issue. I understand the potential for dislike in the inconsistency of the boxes having different sizes/misaligned boxes, and will endeavour to fix this if I have time before the end of the project. I agree that box shadows should be implemented to add more contrast and depth to the website and that the background issue needs to be fixed.</p>
Benjamin (SW)	<p>Change home page outline colour, add a box shadow, Navbar text too big, Less green, More clarity/space filling by images, Glossary text too big.</p>	<p>I agree that there is too much green on the all missions, stages, and engines pages with the entire used colour palette being green, causing there to be no contrast. I agree that the glossary text is too big and will make it smaller. I also agree that box shadow should be added for more contrast.</p>
Finn	<p>The buttons are good, make all the links work, it doesn't break, but it lacks features. Put the glossary in alphabetical order for increased clarity.</p>	<p>I've decided to not change the order of the glossary as I specifically ordered so that terms used in the definition of other terms are introduced first. This means that alphabetical order makes it less effective as a glossary, as definitions will be reliant on undefined technical terms. I am planning to implement functionality for all of the links over the next two sprints therefore, this feedback is irrelevant.</p>
Minjun	<p>It looks very 2000s, incomplete design. Too much green.</p> <p>The all missions page looks like it's lacking something, not enough information.</p> <p>False information should not be conveyed in the navbar, only real links should be visible.</p> <p>The website lacks the ability to convey all the information on a mission/stage/engine,</p>	<p>I agree that there is too much usage of green in the colour scheme of my website and I will change this in the next sprint. I agree that the all missions page looks as though it lacks contrast and am aiming to fix this with more contrast between the boxes and the background. I will also make it more informative by implementing a page to show more in depth information on</p>

	<p>making it not useful if the desired information is not in the brief summary.</p>	<p>each mission. I agree that links to incomplete pages should not be shown in the navbar/footer and will be addressing this in sprint 2 and sprint 3 by implementing all of the pages referenced or removing the buttons from the navbar/footer.</p> <p>I agree that the websites lack of ability to convey all of the information stored about a mission/stage/engine is a flaw and will be aiming to fix this in sprint 2 and 3.</p>
--	---	---

Highlight active Page in navbar.

## Sprint 1 Changes from Feedback

Before:		A repeated piece of feedback was frustration with the size green background going beyond the bounds of the footer. This was caused by
After:		
Before:	<p><b>Orbital and Planetary Terms</b></p> <p><b>Primary Body:</b> The celestial body (star, planet, moon, etc) that has the largest gravitational influence on the spacecraft.</p> <p><b>Orbit:</b> A circular, or elliptical path around the primary body of the spacecraft; this is the result of moving fast enough that you fall and miss the Earth.</p> <p><b>Hyperbolic Trajectory:</b> A trajectory in which the spacecraft has enough energy to escape the gravitational influence of the primary body and enter the gravitational influence of the primary body's primary body (For the Earth, the primary body is the Sun. For the Moon, the primary body is the Earth.)</p> <p><b>Rocket Science Terms</b></p> <p><b>Thrust:</b> The amount of force applied by an engine, measured in kilonewtons (kN)</p> <p><b>Specific Impulse:</b> A measure of the efficiency of a rocket engine and defined as the amount of time that an engine can produce 1kg of thrust from 1 kg of propellant. The greater the specific impulse, the greater the change in velocity that can be achieved for a certain mass of propellant. (measured in seconds)</p> <p><b>Engine:</b> Any system aboard a spacecraft which uses chemical, nuclear, or electrical reactions to affect the velocity of the spacecraft, this sometimes</p>	Ben felt that the text in the glossary was too large, leading to the page feeling zoomed in and I agree with this. As a result, I've reduced the size of the text and added in some line spacing for clarity.

<p><b>Orbital and Planetary Terms</b></p> <p><b>Primary Body:</b> The celestial body (star, planet, moon, etc) that has the largest gravitational influence on the spacecraft.</p> <p><b>Orbit:</b> A circular, or elliptical path around the primary body of the spacecraft; this is the result of moving fast enough that you fall and miss the Earth.</p> <p><b>Hyperbolic Trajectory:</b> A trajectory in which the spacecraft has enough energy to escape the gravitational influence of the primary body and enter the gravitational influence of the primary body's primary body (For the Earth, the primary body is the Sun. For the Moon, the primary body is the Earth.)</p> <p><b>Fundamental Orbital Parameters:</b> The Semi-Major Axis, Eccentricity, Inclination, Longitude of the Ascending Node, and the Argument of Periapsis are the fundamental orbital parameters which uniquely separate all possible orbits of a Primary Body. Along with the Planetary Characteristics, it uniquely determines any orbit from any other orbit.</p>	<p><b>Rocket Science Terms</b></p> <p><b>Thrust:</b> The amount of force applied by an engine, measured in kilonewtons (kN)</p> <p><b>Specific Impulse:</b> A measure of the efficiency of a rocket engine and defined as the amount of time that an engine can produce 1kg of thrust from 1 kg of propellant. The greater the specific impulse, the greater the change in velocity that can be achieved for a certain mass of propellant. (measured in seconds)</p> <p><b>Engine:</b> Any system aboard a spacecraft which uses chemical, nuclear, or electrical reactions to affect the velocity of the spacecraft, this sometimes includes small engines called RCS engines (Reaction Control System) which are primarily used for changing the attitude of the spacecraft or stage.</p> <p><b>Launch Vehicle:</b> A composite vehicle designed to lift a payload into orbit around the Earth. This is often discarded after reaching orbit, but sometimes persists if the final stage of a launch vehicle is useful for further manoeuvres.</p>
<p>Before:</p>  <p>Name: <b>Explorer 4</b></p> <p>Launch Vehicle: <b>UR-100A</b></p> <p>Mission Goal: <b>Scientific Orbiter</b></p> <p><a href="#"><u>More Details</u></a></p> <p>After:</p>	<p>Many people felt that the lack of box shadow led to the page lacking depth and I agree, as a result I've implemented box shadow around the boxes on the all missions, stages, and engines pages which, in my opinion, makes the page look better because of the increase in depth.</p>



**Name:**  
**Explorer 4**

**Launch Vehicle:**  
**UR-100A**

**Mission Goal:**  
**Scientific Orbiter**

[More Details](#)

## Sprint 1 Testing

Test Subject	Test Method	Expected Result	Actual Result	Notes + Pass/Fail
Sample Data Writer - Data Integrity	Exporting Data from the database and comparing file diffs.	No difference in the content of all columns not related to the linking table and linking table data matching.	No difference in the contents of the exported CSV except for the linking tables, which were manually confirmed to be accurate.	A very slow process. Could be optimised for future testing.
Sample Data Writer - Bad Data	Placing data of the incorrect type into the data writer	The assembler script should crash, this is an acceptable outcome as it is a development tool.	The bad data is entered into the table without restriction.	The tables should be replaced with STRICT tables or the backend should prevent shoddy data input.  Could write the insert statements / backend to force accuracy.

				<p>The issue is that blank info in the CSV file is an empty string and not None.</p> <p>Strict tables have been implemented to prevent bad data from entering the database and the sample data writer has been changed to replace empty strings with None so.</p>
Nav Bar	Clicking all of the buttons on the navbar.	The buttons redirect to the indicated pages	The buttons redirect to the indicated pages. The Search page returns the 404 page as it has no route.	<p>Navbar support for the search bar may negatively impact aesthetics. Potentially remove the search button and replace with a search bar.</p>
Footer	Clicking all of the buttons on the footer.	The buttons redirect to the indicated pages.	The buttons redirect to the indicated pages but the sitemap and mod license pages do not have content so they return the header and footer	<p>Add mod licensing and sitemap pages in the next sprint.</p> <p>Slight size error in the dimensions of the footer on the home page, to be fixed.</p> <p>Changed the default margin to prevent empty space from overflowing between sections. Excess green background was caused by HTML default to prevent excess scrolling having a jarring colour transition.</p>
Data Lookup Accuracy (All data Pages)	Checking the information displayed on the website against the database and sample data set	The data on the website aligns with the data in the database and in the sample data csv file.	The data on the website aligns with the data in the database and in the sample data csv file.	Test Passes

Aspect Ratio Javascript	Manually calculating the aspect ratios to ensure accuracy.	That the assigned classes based on the aspect ratio of the image is correct.	That the assigned classes baseRd on the aspect ratio of the image is correct.	<b>Test Passes</b>
Buttons on All Data Pages	Checking all of the URL's for the missions/stages/engines against the data in the database	That for any given mission, the url is <code>“./mission/{id}”</code> , for any stage <code>“./stage/{id}”</code> , and for any engine <code>“./engine/{id}”</code> . This should target the 404 page as these routes are yet to be defined. (Sprint 2)	This worked for the missions and stages pages but the engines linked to the individual stage url.  <b>RETEST:</b> The engines linked to the individual engine url.	Failed due to incorrect url.  Missions and Stages have correct links.  After changing the HTML, the link works correctly for all missions, stages, and engines.

## Sprint 1 Reflection

Overall, I think that this sprint was relatively successful as it laid the framework to quickly develop other static pages and established the sample data and a method to quickly construct the database, and built the navigation infrastructure. I also completed the 404 page so that bad links or unimplemented pages cause the website to fail gracefully instead of crashing/returning a browser default 404 page.

## Sprint 2

### Goals

- Mission/Stage/Engine Specific pages
- Last of the Static Supporting Pages
- Add 500 error handler
- More redundant data validation on the backend

### Technical Changes

- Added functions for running queries with internally produced queries based on url inputs such as id's. This doesn't require parameterised queries as the infrastructure forces valid data types.
- Written a function to format the data for the mission to include descriptive strings, allowing templates to render data based on its presence in the database.
- Written descriptive docstrings for all of the functions in the database for the project specific applications of the function, general summaries are unneeded as the code will not be packaged as a module or be used beyond the project.

- Added code to the assembler script to ensure that any occurrence of a column in the database not being applicable leads to an empty cell in the database as opposed to an empty string, allowing strict tables to be used and the type of an output of the database to be known with certainty.
- Changed the absolute database path to locate an instance of the database with the correct name within the working directory to prevent crashes from the database not loading correctly.

## Data Changes

- Added more data to the database as part of the sample dataset.
- Fixed some typographical errors in the data.

## Website/Aesthetic Changes

- Added the page for a specific mission to display the information relevant to a mission including its stages and the images related to it.
- Added a dynamic image gallery
- Added a 500 error page to render whenever an internal server error occurs.
- Tweaked 404 page to allow for a wider range of errors to use it such as page not found, id not present in the database,
- Added Links on the home page to the missions, stages, and engines pages including sample images.
- Started on the page for the mod licenses.

## Sprint 2 Testing

Test Subject	Test Method	Expected Result	Actual Result	Notes + Pass/Fail
New query executor	Checking if the same query returns the same result.	The query returns the same result.	The query returns the same result	Test Passes
Mission data formatter - column data zipping	Comparing the produced array to the database	The data should zip to the column it links to in the database	The data is associated with the correct column from the database	Test Passes
Mission data formatter - column display flag	Checking all of the columns with names are displayed and those without are not displayed.	Data should only be shown in the summary of stats if the column name is	Only column-data pairs which have a column name and data are displayed in	Test Passes

		specified and the data exists.	the summary.	
Mission data display - valid name and value	Checking if the data is displayed as per the template.	The data should exist in the list and website.	The data exists in the list and website	Test Passes
Mission data display - valid name and invalid value	Checking if the data is displayed as per the template.	The data should exist in the list but not be displayed on the website.	The data exists in the list but is not displayed on the website.	Test Passes
Mission data display - invalid name and valid value	Checking if the data is displayed as per the template.	The data should exist in the list but not be displayed on the website.	The data exists in the list but is not displayed on the website.	Test Passes
Mission data display - invalid name and value	Checking if the data is displayed as per the template.	The data should exist in the list but not be displayed on the website.	The data exists in the list but is not displayed on the website.	Test Passes
Assembler Script/Sample Data	Check if empty values from the CSV files are transferred to null values in the database instead of empty strings	Empty values in the database should be Null.	Empty values in the database are Null.	Test Passes
Database path generator	Check if the path produced by the database path assembler matches the absolute system path	The absolute path generated should coincide with the absolute path of the database.	The absolute path generated coincides with the absolute path of the database.	Test Passes
Mission Page linking accurately	Check if the name for both the all missions page	Both pages have the same data and that the	Both pages have the same data and the data	Test Passes

	instance of the mission and the mission specific page of the mission have the same data.	data matches the id in the link	matches the id in the link.	
Image Gallery - 16:9 Aspect Ratio Images	Check if the image neatly fills the container.	The image should neatly fill the container	The image neatly fills the container	Test Passes
Image Gallery - non 16:9 aspect ratio images	Check how the container responds to an image which does not fit the expected aspect ratio. (These are present but rare)	The container should not be able to become taller than a 16:9 image would allow to ensure the controls for the gallery are usable.	The image expands the container vertically, creating extremely tall images when the image is narrower than 16:9. If the image is wider than 16:9, the gallery shrinks in height.	<p>Partial Failure</p> <p>When an image wider than 16:9 is required, the gallery becomes shorter as expected. When an image narrower than 16:9 is displayed, it stretches vertically, making it harder to use the controls for the gallery.</p> <p>Retest</p> <p>After changing the CSS, the image slide scales as expected with different image aspect ratios.</p> <p>Test Succeeds</p>
Image Carousel Slide Index - 0 (minimum)	Directly calling the function which controls the carousel to show the first image in the carousel.	The first image should show and only have a right arrow	The first image shows and the left arrow is missing(only right arrow showing)	Test Succeeds
Image Carousel Slide Index - -1 (below lower bound)	Directly calling the function which controls the carousel for an index below the lower bound of the number of images	The code should detect the invalid index and adjust to show the first image	The image goes to the first image as the value goes beyond the lower bound.	Test Succeeds
Image	Directly calling	The carousel	The carousel	Test Succeeds

Carousel Slide Index - Maximum	the function to change which image is shown at the upper bound for the image carousel for a specific image	should display the last image without a right arrow to signify the upper limit of the display.	displays the last image and doesn't show the right arrow	
Carousel Slide Index - Maximum + 1	Directly calling the function to change the slide for the index one above the upper bound	The carousel should display the last image.	The carousel displays the last image.	Test Succeeds
Mission Specific Page - lower boundary	Run the route with the id equal to the lower bound of the existing data (1)	The page renders for the mission with id 1.	The page renders for the mission with id 1.	Test Succeeds
Mission Specific Page - below lower boundary	Run the route with the id below the lower bound of the existing data (-3)	The 404 page renders the url for the mission page with id -3 and a message saying the mission doesn't exist.	The 404 page renders the url for the mission page with id -3 and a message saying the mission doesn't exist.	Test Succeeds
Mission Specific Page - upper boundary	Run the route with the id at the upper bound of the existing data (14)	The mission specific page renders for the mission with id 14.	The mission specific page renders for the mission with id 14.	Test Succeeds
Mission Specific Page - above lower boundary	Run the route with the id above the upper bound of the existing data (15)	The 404 page renders with the url for the mission page with id 15 and a message saying the mission does not exist.	The 404 page renders with the url for the mission page with id 15 and a message saying the mission does not exist.	Test Succeeds

Mission Specific Page - massive id	Enter a very large number >10^100 as the id for the mission page.	The 404 page renders and the invalid url wraps to fit on the screen	The 404 page renders but the text goes off the screen without wrapping	<b>Test Fails</b>  Set the overflow-wrap attribute in CSS anywhere, causing text moving over the end of the screen to wrap around.  <b>Test Succeeds</b>
Mission Specific Page - non integer id	Enter a string like "bob" as the input for the id on the mission page	The 404 page renders because the "bob" or any other text input cannot be parsed as an integer.	The 404 page renders, stating that the page does not exist.	<b>Test Succeeds</b>

## Sprint 2 Feedback

(Note: SW indicates experience in software development)

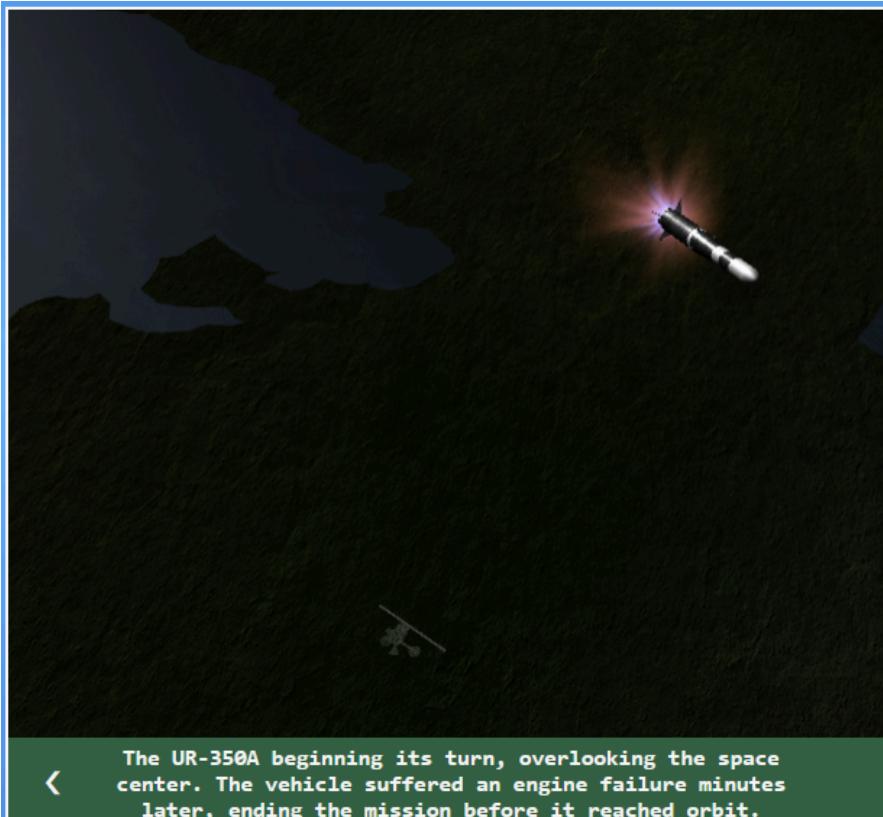
Name	Feedback	Changes/My Thoughts
Ben (SW)	<p>Ugly anti-aliasing in the box shadows. Try to make the boxes for engines, stages, and missions a consistent size to make the grid look nicer.</p> <p>The borders not having a circular corner because looks bad, em/rem on border radius instead of %. Fix buttons existing which lead to undeveloped pages.</p> <p>The Navbar lacks clarity, could be improved with box shadow. Complete the licensing page so make it much more readable.</p> <p>On the mission page, change the border colour and add box shadow around the summary, change background colour. Add rounded edges to the mission image.</p> <p>The slideshow looks good. In the data summary emphasise the descriptors to make the data more clear, maybe a 2 column summary.</p>	<p>I agree that the inconsistent size of boxes makes the website look worse but I don't have time to change the design to deal with the inconsistently sized images. If I had more time, I would attempt to fix this.</p> <p>I agree that the borders should have circular corners as opposed to rounded corners and will change this.</p> <p>I think that the navbar has decent clarity because I've used gradients to gently fade between the nav bar and body text. This would be ruined by adding box shadow so I won't act on this feedback.</p> <p>The licensing page looks awful and is yet to be formatted, this is planned to be part of Sprint 3.</p>

		<p>I agree that changing the border and font colour to increase contrast is a good idea and that adding box shadow would improve the contrast. I also agree that adding rounded edges to the mission image would make the design look better.</p> <p>I agree that adding emphasis to the mission data columns by making them bold would improve the clarity of the mission data.</p>
Benjamin (SW)	<p>The unbalanced container size looks bad. Some of the rounded edges have inconsistent scales because of percentage, it looks odd/rastery.</p> <p>Change the colour of the font on the mission summary to improve contrast. The link font doesn't look interactive. The box shadow doesn't create a 3D effect. The inconsistent images leading to inconsistent box sizes looking bad. Maybe fix this with flex rows and a maximum height?</p> <p>The gradient backgrounds look nice. The image slideshow is good but would benefit from rounded corners.</p>	<p>While I agree that the inconsistent container sizes look bad, the development time required to implement a consistent scaling system with minimal white space for an inconsistent image size is beyond the scope of the time I have left in the project.</p> <p>I agree that I should change the colour of the font to increase contrast and have done so. I disagree with the complaint about the effect of the box shadows as I feel it adds depth to the page and adds contrast. I tried changing it but decided that I like the effect of light shining at an angle onto the boxes as opposed to a shadow in all directions.</p> <p>The comment on the backgrounds looking nice is good because it was a step I took during this iteration to improve the quality of the outcome. I disagree with the comment that the slideshow would benefit from rounded corners because I think that the sharp edges help to draw the users attention towards the image gallery due to the contrast it creates with the rounded edges used</p>

		throughout the page.
Finn	<p>The image carousel and home page look good.</p> <p>Maybe have the blue background gradient fade into a photo of earth as a footer.</p> <p>The arrows on the gallery are quite small and fiddly, maybe make them bigger.</p> <p>It's unclear when you reach the end of a gallery, it should indicate this or loop.</p> <p>Make the mod licensing page readable by formatting it properly.</p>	<p>I appreciate the positive feedback because I believe I made substantial improvements to the quality of the home page and am proud of how the image carousel looks.</p> <p>I don't think that fading into the image of the earth around the footer is a good idea because I don't think it will look good and would be really difficult to implement. I think that expanding the arrows to take a larger area would be beneficial for making the gallery easier to use. I believe that the gallery clearly communicates that it has reached the end by causing the cursor to change back to a normal cursor and the arrow used to change slides disappearing.</p> <p>I agree that I should format the mod licensing page properly to make it more readable, this is a sprint 3 goal.</p>
Minjun	It's perfect.	While I disagree with this feedback as the website is still not complete. It is good to see that some people like the website.

## Changes from Testing/Feedback

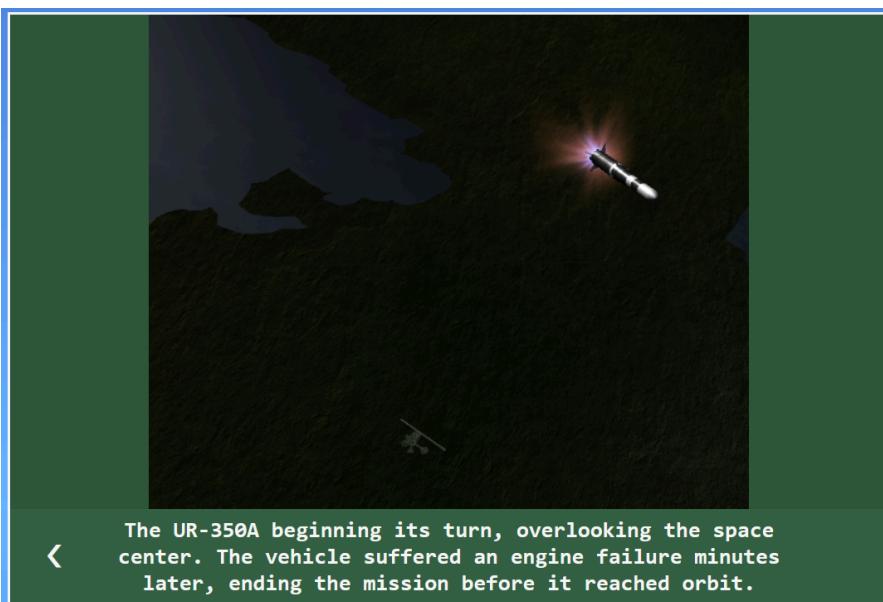
Before:	I noticed during testing that the image gallery stretched vertically when images had an aspect ratio lower than 16:9 (such as 4:3). This led to increased spacing between the stages related to a mission and
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made the image gallery much harder to use.

I changed the constraint of the slide size regulator class for the slideshow to cap based on height, not width. I also centred the image so that it sits in the middle of the gallery and added a background to ensure that the image gallery feels distinct from the rest of the page. This made the rest of the page much more readable

After:



Before:

After:

In response to a bug I found during testing, I changed the url in the 404 page to wrap if it goes off the page, this allows a long link to be shown on a single page

		as opposed to requiring a lot of scrolling.
Before:	<p><b>Mission Report:</b></p> <p>The Explorer 5 mission follows the same flight plan as Explorer 4, launching into a 180km polar parking orbit on the 8th of February 1964 before boosting into an eccentric orbit to gather information on the infrared spectrum, magnetosphere, and micrometeorite concentrations. During ascent, the second stage of the UR-100A suffered a minor failure of its main engine, reducing its thrust output. However, the mission successfully concluded with the deployment of the satellite into its target orbit using the Pegasus-B parking stage.</p>  <p style="text-align: center;">Explorer 5</p>	Several People said that there was a distinct lack of contrast between the background and the text which made it difficult to read.
After:	<p><b>Mission Report:</b></p> <p>The Explorer 5 mission follows the same flight plan as Explorer 4, launching into a 180km polar parking orbit on the 8th of February 1964 before boosting into an eccentric orbit to gather information on the infrared spectrum, magnetosphere, and micrometeorite concentrations. During ascent, the second stage of the UR-100A suffered a minor failure of its main engine, reducing its thrust output. However, the mission successfully concluded with the deployment of the satellite into its target orbit using the Pegasus-B parking stage.</p>  <p style="text-align: center;">Explorer 5</p>	To address this common concern, I changed the colour of the fonts and borders to white. This improved the contrast of the page and made it more readable (in my opinion).
Before:		Several people's feedback said that I should change the border radius value from % to em/rem to have more consistent and nicer looking circular arcs. I agreed with this feedback and have changed the border radii causing the effect on the left.
After:		
Before:		Based on feedback that the info list lacked clarity between the data being displayed and the column names

```

Mission Goal: Scientific Orbiter
Crew Count: 0
Estimated Mission Duration: 5 Years
Power Source: Solar Panels
Axial Control System: Spin Stabilised
Launch Vehicle: UR-100A
Destination: Earth
Semi Major Axis (km): 39362.0
Periapsis (km): 2107.44
Apoapsis (km): 63874.651
Orbital Period: 21h 35m 19.05s
Eccentricity: 0.785
Inclination (deg): 89.852
Longitude of the Ascending Node (deg):
101.3386
Argument of Periapsis (deg): 352.6

```

describing the data, make the column names bold to increase the clarity of the information.

After:

```

Mission Goal: Scientific Orbiter
Crew Count: 0
Estimated Mission Duration: 5 Years
Power Source: Solar Panels
Axial Control System: Spin Stabilised
Launch Vehicle: UR-100A
Destination: Earth
Semi Major Axis (km): 39362.0
Periapsis (km): 2107.44
Apoapsis (km): 63874.651
Orbital Period: 21h 35m 19.05s
Eccentricity: 0.785
Inclination (deg): 89.852
Longitude of the Ascending Node (deg):
101.3386
Argument of Periapsis (deg): 352.6

```

## Sprint 2 Reflection

This sprint was cut short a little before all of its goals were completed as I underestimated the amount of work required to learn the javascript used on the Missions page and the time required to complete the feedback for Sprint 1. As such, the last of the supporting static pages as well as the all Stages and all engines Pages will be pushed to sprint 4, following the attempt at CSS rewrite (changing to % and em/rem from vh/vw for all dimensions). I'm happy with the progress I've made on the all Missions page and the related CSS and JS which allows for the final pages to be quickly implemented. I'm also happy with the work I've done of gathering the information for the mod license page

## Sprint 3

### Goals

- Stage and Engine Specific Pages
- Finish Static Pages
- Ensure PEP 8 compliance

## Technical Changes

- Ensured PEP8 compliance
- Rewritten docstrings so they align to be descriptive and explain why something is being done
- Wrote descriptive code comments which explain why code works the way it does.

## Website Changes

- Formatted the Mod licenses page to make it usable and accessible.
- Removed Sitemap
- Implemented the stage specific page
- Implemented the engine specific page
- Increased contrast between some text elements and the background.
- Removed buttons for removed/cancelled features from the codebase (some were commented, some were uncommented)
- Changed 404/500 pages to extend the layout, adding the navbar and footer to them.

## Sprint 3 Testing

Test Subject	Test Method	Expected Result	Actual Result	Notes + Pass/Fail
New query structure	Check the data displayed by the website is the same as in Sprint 2 after changing how the queries are declared.	The data displayed is the same despite the change in how the queries are declared in python.	The data is the same.	Test Passes
PEP 8 Compliant Assembler Script	Compare the data dumped from the database into json files before and after restructuring the queries to be over multiple lines	The json files show no change and the queries work as they did before the update.	The json files show no change.	Test Passes
Stage Specific Page linking correctly	Check if the data for the stages align between both pages	The data on both pages is consistent and is taken correctly from	The data on both pages is consistent and is taken correctly from	Test Passes

	and is correct to the database.	the database.	the database.	
Stage Specific Page - lower boundary	Run the route with the is equal to the lower bound of the existing data (1)	The page renders for the stage with id 1.	The page renders for the stage with id 1.	Test Succeeds
Stage Specific Page - below lower boundary	Run the route with the id below the lower bound of the existing data (-3)	The 404 page renders the url for the stage page with id -3 and a message saying the stage doesn't exist.	The 404 page renders the url for the stage page with id -3 and a message saying the stage doesn't exist.	Test Succeeds
Stage Specific Page - upper boundary	Run the route with the id at the upper bound of the existing data (9)	The stage specific page renders for the stage with id 9.	The stage specific page renders for the stage with id 9.	Test Succeeds
Stage Specific Page - above lower boundary	Run the route with the id above the upper bound of the existing data (10)	The 404 page renders with the url for the stage page with id 10 and a message saying the stage does not exist.	The 404 page renders with the url for the stage page with id 10 and a message saying the stage does not exist.	Test Succeeds
Stage Specific Page - massive id	Enter a very large number >10^100 as the id for the stage page.	The 404 page renders and the invalid url wraps to fit on the screen	The 404 page renders but the text goes off the screen without wrapping	Test Succeeds
Stage Specific Page - non integer id	Enter a string like "bob" as the input for the id on the	The 404 page renders because the "bob" or any other text input	The 404 page renders, stating that the page	Test Succeeds

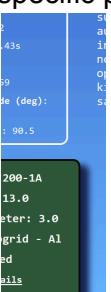
	stage page	cannot be parsed as an integer.	does not exist.	
Engine Specific Page linking correctly	Check if the data for the engines align between both pages and is correct to the database.	The data on both pages is consistent and is taken correctly from the database.	The data on both pages is consistent and is taken correctly from the database.	Test Passes
Engine Specific Page - lower boundary	Run the route with the id equal to the lower bound of the existing data (1)	The page renders for the engine with id 1.	The page renders for the engine with id 1.	Test Succeeds
Engine Specific Page - below lower boundary	Run the route with the id below the lower bound of the existing data (-3)	The 404 page renders the url for the engine page with id -3 and a message saying the engine doesn't exist.	The 404 page renders the url for the engine page with id -3 and a message saying the engine doesn't exist.	Test Succeeds
Engine Specific Page - upper boundary	Run the route with the id at the upper bound of the existing data (5)	The engine specific page renders for the engine with id 5.	The engine specific page renders for the engine with id 5.	Test Succeeds
Engine Specific Page - above lower boundary	Run the route with the id above the upper bound of the existing data (6)	The 404 page renders with the url for the engine page with id 6 and a message saying the engine does not exist.	The 404 page renders with the url for the engine page with id 6 and a message saying the engine does not exist.	Test Succeeds
Engine Specific Page -	Enter a very large number	The 404 page renders and the invalid url	The 404 page renders but the text	Test Succeeds

massive id	>10^100 as the id for the engine page.	wraps to fit on the screen	goes off the screen without wrapping	
Engine Specific Page - non integer id	Enter a string like "bob" as the input for the id on the engine page	The 404 page renders because the "bob" or any other text input cannot be parsed as an integer.	The 404 page renders, stating that the page does not exist.	Test Succeeds
404 Error Page - layout extension	Render the 404 page and check if the navbar and footer work correctly.	The navbar and footer work correctly on the 404 page.	The navbar and footer work correctly on the 404 page.	Test Succeeds
500 Error Page - layout extension	Render the 500 page and check if the navbar and footer work correctly.	The navbar and footer work correctly on the 500 page.	The navbar and footer work correctly on the 500 page.	Test Succeeds
Numerical Type Function - Integer	Run the numerical type function with an integer as an input.	The function returns True.	The function returns True.	Test Succeeds
Numerical Type Function - Float	Run the numerical type function with a float as an input.	The function returns True.	The function returns True.	Test Succeeds
Numerical Type Function - not a float or integer	Run the numerical type function with a list as an input	The function returns False.	The function returns False.	Test Succeeds
Stage Data Formatter - column zipping	Compare the output of the function to the database and its	The database columns and name value pairs from the function are the	The database columns and name value pairs from the function are	Test Succeeds

	columns.	same.	the same.	
Engine Data Formatter - column zipping	Compare the output of the function to the database and its columns.	The database columns and name value pairs from the function are the same.	The database columns and name value pairs from the function are the same.	Test Succeeds
Stage Page - No relevant engines	Manually changing the input for related engines to an empty list.	A card should appear saying there are no relevant engines in the database.	A card appears saying there are no relevant engines in the database.	Test Succeeds

## Sprint 3/End of Project Feedback

(Note: SW indicates experience in software development)

Name	Feedback	Changes/My Thoughts
Ben (SW)	<p>Glossary page font sizes are wrong, header is same size as less impactful headers</p> <p>The font is basic.</p> <p>Items in details page need to be separated more, more padding on each box in details page (vertical and horizontal)</p> <p>The boxes don't line up on the mission specific page.</p> 	<p>I agree that the font sizes look comparatively wrong, I've addressed this by rebalancing the font sizes to use scale to emphasise importance more. I think the glossary looks better as a result of this change</p> <p>I disagree that the font is basic and like how it works with my design.</p> <p>I think that the amount of padding is good and have received no other feedback to this effect, I am not going to change this.</p> <p>I think that the boxes lining up would increase the clarity of the web page. However, because the grids have different fractional percentages, getting the gap sizes to line up was very difficult and I eventually decided not to.</p>

	<p>The stage and engine pages have a big empty space which looks a bit off.</p> <p>I like the box Shadows.</p> <p>The 404 page includes layout, this is good.</p> <p>Add a way to submit data to the database for display in the library.</p> <p>Add search box to search for engine, stage, or mission to find specific one</p> <p>On mission id 2 the slideshow images are much different sizes so it's annoying to click through the slide show.</p> <p>The image on the stage has a different colour border.</p> <p>Home page images are different sizes, it would look better if they were the same size.</p>	<p>I agree that this looks strange and have changed the grid layouts to prevent columns from existing without any content, reducing white space and centering content.</p> <p>I also like the box shadows, however I've decided that the box shadows being offset from the boxes as if there is a light source on the screen only works if it is applied to every element. Because some aspects of the page wouldn't work with that, I've changed the box shadows to be centered on the box preventing this inconsistency.</p> <p>If I had more time to work on the project and continue it according to my original plan, a search system and data submission system would have been implemented however due to time constraints these ideas cannot be completed.</p> <p>This was a problem with the website that I addressed by changing the image gallery to constrain the size of images such that the ratio of the box never gets smaller than 16:9 (such as 1:1). This effectively locks the buttons to click through the slideshow in place.</p> <p>I agree that this doesn't look good and have changed the colour to white to match with the rest of the borders.</p> <p>I agree that this makes the home page look worse, I've changed the images so they each have the same aspect ratio to fix this.</p>
Benjamin (SW)	I don't like the title, too many big words	The title accurately describes the project using the smallest words

	<p>Home page grid, box shadows broken, alignment is centered vertically, which makes everything seem different as the images are different sizes. Box shadows are all broken on mission elements</p> <p>You should add some sort of KSP related thing on home page, eg Kerbal</p> <p>Make nav bar elements more spaced out, on big words like missions it feels cramped on hover</p> <p>All missions page elements don't have to say name: every time, it's obvious that the name is the name</p> <p>The all missions page elements vertically center aligned. Tall images make massive gaps and everything feels slightly off as images are different sizes. To fix could vertically align everything to the top of the row, so the top of each element is in a row, or add max height and scroll for large elements.</p> <p>On mission more details could add different background colour behind text, feels a little hard to read</p> <p>On the mission specific page some boxes have border radius some don't</p>	<p>possible.</p> <p>The box shadows being offset was originally a design choice based on an off centre light source but that didn't make sense so I've changed the shadows to be centred on the box. I agree that the images should be the same size and have changed the images to have a consistent aspect ratio.</p> <p>KSP's IP is owned by a big corporate company who I cannot easily get a license from and I'm not willing to take a copyright risk.</p> <p>I agree that increasing the spacing on nav bar elements would be good and have increased the amount of space allocated to each.</p> <p>I agree that this is completely superfluous and have removed this. The first and largest element in a box is obviously the title or name.</p> <p>Because the boxes do not have a consistent size in either dimension, collaging the boxes together is very difficult and I think that the current gaps are better than there being gaps between different elements in the same line.</p> <p>I agree that the text is a little hard to read and that a background which guarantees more contrast would improve the readability of the text. I've made this change and I think it looks much better.</p> <p>Only the image carousel lacks rounded borders and this is a deliberate design choice to increase the contrast between the</p>
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	 <p>The mission specific page could somehow have the whole description be more compact, you have to scroll a lot to see the images, which are the main feature of the page.</p> <p>Stages page: same issues with grid vertical alignment as before</p> <p>Stage more details not sure why everything is aligned to the left.</p>	<p>carousel and the rest of the page.</p> <p>I disagree that the images are the main feature of the page because I believe that the main feature of the page is the stats and the images so having the images lower down after the explanatory context and report makes the page easier to understand.</p> <p>Like the Missions page, the challenge of overcoming the inconsistent dimensions is not feasible in the time remaining on the project and I believe the current layout is better than causing all of the boxes in a row to have the same start point.</p> <p>This was caused by an empty column in a grid, the layout has since been changed to prevent empty grid columns.</p>
Nicola	<p>Text on the Home page has good clarity on the image.</p> <p>Occasional grammatical errors are present in the data.</p> <p>What various elements of the mission specific page are unclear. This could be improved by adding more titles.</p> <p>The box of stats and information before showing images and stages related to the image is a good layout which helps to explain the context of the mission before showing specifics.</p> <p>The image gallery is easy to miss and</p>	<p>This would be good to fix if I had more time but this is a low priority as the spelling/grammatical errors are easy to read around.</p> <p>I've added headings to the sections on the mission, engine, and stage specific stages to help clarify the page structure.</p> <p>Adding a heading has made this</p>

	<p>isn't obviously interactable, you could emphasise this by making it take the whole width of the page or put the arrows outside the box</p> <p>The stage and engine specific pages are cool and the glossary is a useful resource. The project as a whole is cool.</p>	more clear.
Logan	<p>The blue backgrounds might disrupt people's circadian rhythms if they use the site at night, could change the colours to be more yellow/orange at late times.</p> <p>Text with background on the mission specific page looks weird.</p> <p>The boxes look weird being different sizes, could be changed to give a consistent scale.</p> <p>Basic details on the missions page is good because it allows you to get a brief summary without clicking into a mission.</p>	<p>This is a good point however it would require me to be somewhat invasive into the user (check their local time, narrowing their location to a time zone), and would require a complete colour palette rewrite so this is impractical.</p> <p>I agree and have changed this to have a dark green background.</p> <p>This would be very difficult to do as discussed in the last two sets of feedback.</p>

# Project Overview

## Tools Used in Development

### Media Outcome

- Visual Studio Code
- Inspector Tool in Firefox
- Mozilla Developer Network
- W3schools
- ChatGPT

### Database Outcome

- Lucid Chart (Digital ERD Tool)
- SQLite3 Studio
- SQLite3 Editor (VS Code Extension)
- Code Spell Checker (VS Code Extension)

### Programming Outcome

- Visual Studio Code
- Python Docs
- Flask Docs
- Flake 8 (VS Code Extension)
- Pylance (VS Code Extension)
- Code Spell Checker (VS Code Extension)
- ChatGPT

## Relevant Implications

### Database

#### Intellectual property

A relevant implication for databases is intellectual property because databases could store fragments, sections, or all of a work which is held under some copyright license. This is important when developing a database because storing material without complying with its license agreements is a violation of the initial producer's intellectual property rights.

In my project, I've addressed this by providing a list of all of the mods used and the link to their development/release repositories categorised by license. This means that the data in the database and images externally stored by referenced by the database which are based on a version of the game visually and mechanically changed by the mods attribute the effects of those changes to the mods. By fulfilling the obligations of the mod licenses, the images and data I've generated for usage in the database is not in violation of copyright law.

### Future Proofing

A relevant implication for databases in future-proofing because a database being accessible and maintainable can be important for a user or company who has integrated the database into their workflow after active development has been completed. It is also significant when a database is used beyond its size design constraints where the database and the time it takes to query the database scales with an increasing dataset. For instance, if Facebook decided to store all of the images in their posts directly in the database then tried to search for a keyword in a post, storing a 1 MB image in a 1000 character post increases the size of the message you have to search from ~1 KB using UTF-8 encoding to 1 MB. Turning a 1 second search into a ~17 minute search. (assuming linear search time)

In my project, I've addressed this by storing the paths to images in the repository instead of storing the images directly to allow the database to scale to larger datasets without bloating the size of the database and reducing the execution time of queries. Part way through development, the images for the website, most of which are stored in the database as file paths, have a file size of 127 MB while the database has a file size of 72 KB. The project as a whole, excluding the .git folder, has a file size of 127 MB so storing the images outside of the database has made using and sharing the database faster and easier by reducing the size of the file by a factor of ~2000. It also reduces the demand on the version control system as a change to the database if it stored 100+ MB of images could add a 100 MB .git folder whereas storing images as images in a folder reduces the demand on the version control system to the size of the image file.

## **Website**

### **Aesthetics**

When designing a website, it is important to consider the aesthetics of the website because it affects how the website is used, perceived, and influences people's opinion of the website. An example of where this is relevant is in ecommerce websites, if the website looks unprofessional or unpolished, people may become distrustful of the website, while an ecommerce website which looks overly jokey or satirical people may not take it seriously. It is important when designing a website to ensure that the aesthetics of the website align with the focus of the website and aim to support that focus.

In my website, I've addressed this by ensuring that aspects of the website look good so that using it is convenient while maintaining some degree of space theming by using the green, blue, and white tones commonly associated with photographs of the Earth taken from space. I've done this by ensuring that my colours are complementary and contrasting colours to draw the users attention to key aspects of the page such as the boxes containing information and ensuring there is sufficient contrast between backgrounds and text so that any text is easy to read. This improves the quality of the outcome as it uses the visual aspect of the website to focus the users attention away from the blank space on the page and towards while improving the users experience.

## **End-user Considerations**

When designing a website, it is important to consider how the website's design affects the end-users experience. It is important that websites prioritise the end user's experience, especially in ecommerce where poor design choices negatively impact the users ability to interact with the website and the service it provides. An example of why end user considerations are important is on websites which are primarily used by older people or mobile phones, increasing the font and button size would make it easier for the end user to interact with the website where a technologically proficient person on a desktop may be able to easily use the website. By considering who will use the website, we can produce a website which provides a better experience for a wide range of users.

In my website, I've considered the end user and added a glossary of terms to my website to improve the end users experience by ensuring that any requisite technical terms have their definition in the glossary. This consideration benefits the end user as many technical terms are used in the website without definition because they are routinely used among players of KSP or people who work with orbital mechanics and spacecraft but are unknown to the average internet user. This allows the intended user base to refresh their memory of the definition of technical terms while allowing new users to become familiar with the technical terms without having to stagger through finding the correct definition.

## **Ensuring the Program works in expected cases.**

Because this isn't covered by the 5 column tests present in each of the sprints, I've put it here. This is me recounting going through the entire website and ensuring that nothing breaks.

Starting on the home page, I checked that all of the links in the navbar and footer all link correctly which they do without causing any errors or crashes. The links on the home page to the all missions, all stages, and all engines pages also work. On the all missions page, the links to the pages for the individual missions all work without error. On the all stages page, all of the links to the pages for the individual stages work without error. On the all engines page, all of the links to the pages for the individual engines work without error.

On the mission specific page, the image carousel does not allow the user to go beyond the constraints of the number of images by repeatedly pressing the button by hiding the button by default and preventing the script from going to a negative index in the list of slides. The links to the stages used in each mission all work without error. On the stage specific page, the links to the engines used on the stage work without error.

If the user does not actively try to disrupt the website by modifying urls, entering large amounts of data, or any other nefarious activity. The database will not crash or cause any errors.

## Data and Web Integrity Testing

### Mission/Missions Pages

The images below show the data presented by the website for mission id 14 as indicated in the images below, the link from the first image is caused by hovering over the more detailed link (not captured in screenshot).



**Name:**  
**Explorer 5**

**Launch Vehicle:**  
**UR-100A**

**Mission Goal:**  
**Scientific Orbiter**

[More Details](#)

<http://127.0.0.1:5000/mission/14>

http://127.0.0.1:5000/mission/14

# Explorer 5

**Mission Goal:** Scientific Orbiter

**Crew Count:** 0

**Estimated Mission Duration:** 5 Years

**Power Source:** Solar Panels

**Axial Control System:** Spin Stabilised

**Launch Vehicle:** UR-100A

**Destination:** Earth

**Semi Major Axis (km):** 39362.0

**Periapsis (km):** 2107.44

**Apoapsis (km):** 63874.651

**Orbital Period:** 21h 35m 19.05s

**Eccentricity:** 0.785

**Inclination (deg):** 89.852

**Longitude of the Ascending Node (deg):** 101.3386

**Argument of Periapsis (deg):** 352.6

**Mission Report:**

The Explorer 5 mission follows the same flight plan as Explorer 4, launching into a 180km polar parking orbit on the 8th of February 1964 before boosting into an eccentric orbit to gather information on the infrared spectrum, magnetosphere, and micrometeorite concentrations. During ascent, the second stage of the UR-100A suffered a minor failure of its main engine, reducing its thrust output. However, the mission successfully concluded with the deployment of the satellite into its target orbit using the Pegasus-B parking stage.



**Explorer 5**

Within the database, the data is stored as shown below, this is the same as the data shown in the database with a few transformations made as expected by the code. The name, mission goal, crew count, estimated duration, power source, Axial Control System (acs control), report, and destination, eccentricity, inclination, longitude of the ascending node and argument of periapsis are exact copies of the database. The values for semi-major axis, periapsis, and apoapsis values are 1000 times larger in the database than on the website, this is because the data in the database is stored in metres but is displayed in km so this is accurate. The value for orbital period in the database is 77719.05 seconds which converts to 21 hours, 35 minutes, and 19.05 seconds as displayed on the page. The correct is being displayed because the displayed image has the same file path (/static/images/payloads/Explorer-5.png) as accessed by inspector tools the path in the database (static/images/payloads/Explorer-5.png). This means that the data has been transferred from the database to the website while maintaining the integrity of the data, ensuring data integrity.

<code>id INTEGER PRIMARY KEY AUTOINCREMENT</code>	<code>name TEXT</code>	<code>mission_goal TEXT</code>	<code>crew_count TEXT</code>	<code>estimated_duration TEXT</code>	<code>power_source TEXT</code>	<code>acs_control TEXT</code>
14	Explorer 5	Scientific Orbiter	0	5 Years	Solar Panels	Spin Stabilised
	<code>report TEXT</code>	<code>payload_image_reference TEXT</code>	<code>launch_vehicle TEXT</code>	<code>destination TEXT</code>	<code>semi_major_axis REAL</code>	<code>periapsis REAL</code>
	The Explorer 5 miss...	static/images/payload...	UR-100A	Earth	39362000.0	210740.0
	<code>orbital_period REAL</code>	<code>eccentricity REAL</code>	<code>inclination REAL</code>	<code>longitude_ofAscending_node REAL</code>	<code>argument_of_periapsis REAL</code>	<code>latitude_of_landing REAL</code>
	77719.05	0.785	89.852	101.3386	352.6	NULL
						<code>longitude_of_landing REAL</code>
						NULL

The full report text is *The Explorer 5 mission follows the same flight plan as Explorer 4, launching into a 180km polar parking orbit on the 8th of February 1964 before boosting into an eccentric orbit to gather information on the infrared spectrum, magnetosphere, and micrometeorite concentrations. During ascent, the second stage of the UR-100A suffered a*

*minor failure of its main engine, reducing its thrust output. However, the mission successfully concluded with the deployment of the satellite into its target orbit using the Pegasus-B parking stage.* This is the same as what is displayed on the website.

To confirm that the data itself is accurate, I can go back to the instance of KSP which the data was gathered from. By looking at the craft file, I can see that the only power source on the spacecraft are solar panels and that the final payload has no thrusters which can control the orientation so it must have been spin stabilised. By looking at the description of the mission I wrote when I flew the mission, I wrote that it was a scientific orbiter with its target destination being an orbit of Earth with an estimated duration of 5 years before solar panel degradation prevented the spacecraft from getting power. I also wrote that it was being launched using the UR-100A launch vehicle. The orbital parameters of the spacecraft are accurate as shown by the image below.  $101^\circ, 20', 19''$  is 101.3386. This confirms that the data is accurate to the source material.

E C Orbit Info	
Orbital speed	2.954 km/s
Apoapsis	63.8747 Mm
Periapsis	2.10744 Mm
Orbital period	21h 35m 19.05s
Time to apoapsis	13h 50m 00.5s
Time to periapsis	3h 02m 21.0s
Semi-major axis	39.3620 Mm
Inclination	89.852 °
Eccentricity	0.785
Long. of ascending node	101° 20' 19"
Argument of periapsis	352.6 °
Angle to prograde	312.95 °
Relative inclination	N/A

## Stage/Stages Pages



Name: Pegasus-B

Length (metres):  
1.7

Average Diameter (metres):  
1.5

[More Details](#)

http://127.0.0.1:5000/stage/8

# Pegasus-B

Top Diameter: 1.5  
Bottom Diameter: 1.5  
Average Diameter: 1.5  
Length: 1.7  
Engine Count: 1  
Tank Material/Type: Isogrid - Al Gridded

**Stage Report:**  
A common kick stage used for commercial satellite missions and light lunar missions. Powered by the S1.5400 engine in its 11D33 configuration, it is primarily used for commercial satellite targeting tundra orbits launched on the UR-200A.

Within the database, the data stored is the same as the data shown on the page, with all mathematical values being transferred accurately. The image source in the HTML, /static/images/stages/Pegasus-B.png, is the same as the image source stored in the database. The report has also been copied accurately with there being no difference between the text stored in the database (*A common kick stage used for commercial satellite missions and light lunar missions. Powered by the S1.5400 engine in its 11D33 configuration, it is primarily used for commercial satellite targeting tundra orbits launched on the UR-200A.*) being the same in both the database and the website.

<code>id INTEGER PRIMARY KEY AUTOINCREMENT</code>	<code>name TEXT</code>	<code>description TEXT</code>	<code>top_diameter REAL</code>	<code>bottom_diameter REAL</code>	<code>length REAL</code>	<code>engine_count INTEGER</code>
8	Pegasus-B	A common kick stage...	1.5	1.5	1.7	1

<code>material TEXT</code>	<code>image_reference TEXT</code>
Isogrid - Al Gridded	static/images/stage...

The data stored within the database is accurate to the source material/ The dimensions of the cylindrical stage are shown in the image below and match with the data stored in the database and shown to the user. Because of the geometry of cylinders, this also shows that the average diameter is accurate, the average of the top and bottom diameters. The stage only visually has one engine and the source material confirms this with only one engine part being recognised on the stage.



## Engine/Engines Pages



**Name:**  
**RD-253**

**Fuel Type:**  
UDMH/NTO

**Fuel Ratio:**  
1:1.477

**Thrust (Sea Level):**  
1393.2 kN

**ISP (Vacuum):**  
315.5 seconds

**Ignitions:**  
1

[More Details](#)

<http://127.0.0.1:5000/engine/4>

**Fuel Type:** UDMH/NTO

**Fuel Ratio:** 1:1.477

**Ignitions:** 1

**Pressure Fed:** No

**Thrust (Sea Level) (kN):** 1393.2

**ISP (Sea Level) (s):** 284.5

**Thrust (Vacuum) (kN):** 1545.0

**ISP (Vacuum) (s):** 315.5



**RD-253**

The data displayed on the website is the same as the data stored within the database with one difference, the value of 0 for the pressure\_requirement column is being displayed as the string “No”. This is a deliberate transformation caused by the code pictured below to turn the integer representation of a binary value into a more human readable format.

<code>id INTEGER PRIMARY KEY AUTOINCREMENT</code>	<code>name TEXT</code>	<code>fuel_type TEXT</code>	<code>fuel_ratio TEXT</code>	<code>ignition_count TEXT</code>	<code>pressure_requirement INTEGER</code>	<code>thrust_ASL REAL</code>
4	RD-253	UDMH/NTO	1:1.477	1	0	1393.2

<code>isp_ASL REAL</code>	<code>thrust_Vac REAL</code>	<code>isp_Vac REAL</code>	<code>image_reference TEXT</code>
284.5	1545.0	315.5	static/images/engine...

```
# Converts if an engine is pressure fed from an integer to a word to make
# it more descriptive.
if data_row[5] == 0:
    data_row[5] = "No"
elif data_row[5] == 1:
    data_row[5] = "Yes"
```

As the image below which contains the statistics for this engine shows, the fuel mixture is accurate and the ratio is correct,  $172:254 = 1:1.477$ , and the engine thrust and ISP stats are the same as shown within the source material. The ignition count stored in the database is shown to be the same as the source material. This shows that the data stored within the database is both accurate to the source material and being accurately transferred to the website.

**Thrust (Vac):** 1545 kN (TWR 145.674), unthrottleable  
**Thrust (ASL):** 1393.2 kN (TWR 131.361), unthrottleable  
**Engine Isp:** 284.5 (ASL) - 315.5 (Vac.)  
Ignitions: 1, Subject to ullage

**Rated burn time:** 148s

**Propellants:**

- UDMH: 172 L/s - 136 kg/s

Drains evenly respecting crossfeed, per priority.

- NTO: 254 L/s - 363 kg/s

Drains evenly respecting crossfeed, per priority.

Total mass: 499 kg/s

**Variance:** 0.30 % Isp, 0.5 % flow, 0.50 % MR (stddev).

**Residuals:** min 0.4 % of propellant.

## Conventions of Web Design to improve the quality of the Outcome

### Planning

Throughout my website, I will be using Flex and Grid whenever several elements, such as cards for various missions, stages, or engines instead of older formats such as float or table. This makes the architecture of the website externally consistent with modern web design because of the shift away from older methods of organising collections of elements. This will improve the user's experience by forcing the design to follow similar patterns to most modern websites, allowing habits learned from other websites to make it easier to use my website. It would also make it easier for a new developer or maintainer of the project to work on the project because it follows the modern design conventions which developers are more familiar with as well as being easier to use.

I'm planning on adding a glossary to my website, this improves the quality of the website by providing the user with effective help and documentation for navigating the website and its wide range of subject specific technical terms which are commonly used in orbital mechanics, spacecraft design, and KSP missions but are never/rarely used in colloquial English. This design decision is based on the heuristic of help and documentation and is reactive help. If users are unfamiliar with technical terms but are interested in the website and its mission, they will draw on their intuition for where help documents often are on a website, the footer, and see the gallery which allows them to understand the technical terms used within the website. By placing the link to the gallery in the footer, my design also follows the heuristic of consistency and standards, being externally consistent with other websites' help systems.

### Development

During development, there are several times I applied the conventions of web design, often based on feedback, to improve the quality of the outcome.

One example of this was when I changed the colour of the text elements on the mission specific, and later stage and engine specific pages, from black to white. This improved design draws on the heuristic of aesthetics and minimalist design to improve the usability of the website. Because the text is sitting on a dark blue gradient background, it was somewhat

readable but had low contrast with the background. During the feedback I received for sprint 2, people said that the low contrast made it hard to read, something I hadn't fully processed as I'm used to picking text out of low contrast areas. By increasing the contrast, it improved the aesthetics, readability, and usability of the design because the contrasting colours look better for contrasting elements.

Another example of when I improved the design by following the conventions of web design was when I changed the error pages to be an extension of the default layout instead of being completely isolated from the rest of the website. This moved the interface to more fully consider the heuristics of consistency and standards and helped users recover from errors. The old design made it very difficult to go back to the functional part of the website if you accidentally ended up triggering a 404 error, either by deliberately tampering with the link or the occasional, now fixed, code error. This meant that it was hard for the user to recover from an error likely caused by the system, making the user's experience worse. By changing the error pages for 404 and 500 errors to be extensions of the default layout, all pages in the website have the header and footer, making the design internally consistent, and it is easier to recover from the error.

## Final Reflection

I think that this project was a moderate success. The scope of the project during planning was beyond what was reasonable and some unexpected technical issues caused the project to slow down during the middle of the project. This led to some systems, such as login, data addition, and a search system being too ambitious to complete as the project deadline and other exams stacked up. If I'd had more time, I would have first added a search system to search for a mission, stage, or engine of a given name then added a login system and data addition systems. I think that the project, while reduced in scope, does everything that it does relatively well. There are one or two outstanding changes I would have liked to make if I had time such as getting the info cards in all the missions, engines, and stages pages to tile properly but I am happy with the final project. General feedback on the project has been good with many small changes being suggested which I feel have improved the project.

If I was back at the start of the project again, I would have planned more carefully and tried to be more consistent with my workload on the project, avoiding throwing hours of work into it during the final weeks but instead consistently working on it for an hour a day, achieving a similar scope with less stress at the end of the project. I would have also chosen a different concept which had less names which sound similar and was understandable by a wider audience, allowing for more direct feedback based on personal experience.