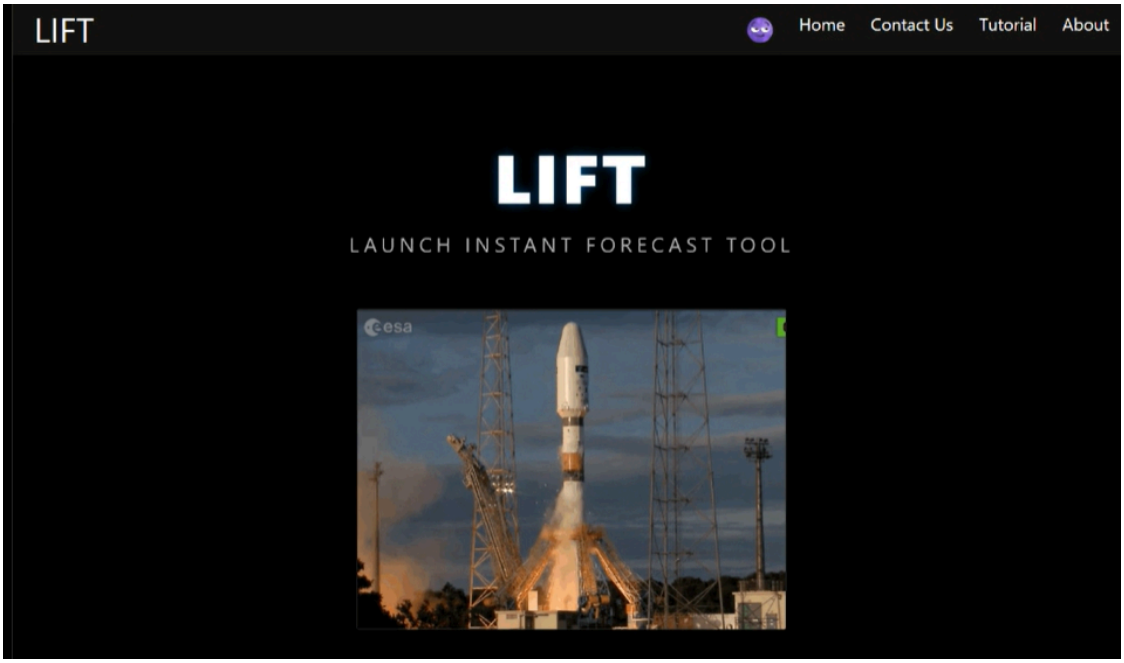
LIFT Launch Planner: User Manual



1. Introduction

LIFT Launch Planner is a web application built for hobby rocketeers to find their most suitable launch sites.

1.1: LIFT Launch Planner

One of the strengths of a small rocket is that you can choose where to launch it. In fact, choice of launch site is crucial. Outside of the safe wind speed, cloud cover, or wind direction envelope a launch at a particular location must be scrubbed. What some may not know is that there are many registered launch sites within driving distance in the USA, and their weather conditions can vary widely. How can the rocketeer efficiently time and locate launches amidst unpredictable weather?

LIFT (Launch Instant Forecast Tool) Launch Planner matches the best available launch conditions with the user's sounding rocket launches. LIFT has a list of registered launch sites in the USA current to May of 2025. The app is also connected to NOAA's weather forecast database. These two sources of information are merged via LIFT's unique launch site ranking algorithm to recommend appropriate launch sites and windows to the rocketeer. At time of writing, it is believed that no other product exists to provide this function.

1.2: The LIFT Team

LIFT was developed for the course CS 330: Intro to Software Engineering at West Virginia University. It is the result of a semester-long group project with 7 collaborators. The team was instructed in the Agile methodology and continued to scrum three times a week until the end of development.

LIFT Roster:

- Shelby Hansen, *manager*
- Lucian Baumgartner, *product owner*
- Bryson Herron, *front end dev*
- Michael Kaulfuss, *scrum master*
- Rex Mcallister, *subject matter expert*
- Greyson Meares, *back end dev*
- Noah Yoak, *reviewer, back end dev*

The LIFT team wishes you clear skies and safe flights!

2. Core Functions

LIFT combines user-supplied launch data with NOAA's weather data to recommend sites and launch windows.

2.1: LIFT's UI

At the top of the page is the Navigation Bar. The Nav Bar contains links to each of LIFT's pages: Home, Contact Us, About, and Tutorial. The Welcome page is accessible by clicking the logo. **Figure 1** shows LIFT's Home page, where the action happens..

On the right side of the Home page is the Directory Panel, where the lists of sites and launches are stored. The Directory Panel is split into two tabs, one for sites and one for launches. Lists that exceed the height of the panel are scrollable.

On the left side of the Home page is the Inspection Panel, where specific information about a selected site or launch can be viewed and edited, and where launches can be saved to and deleted from the directory. Once at least one launch is saved to the site the ranking function is made available.

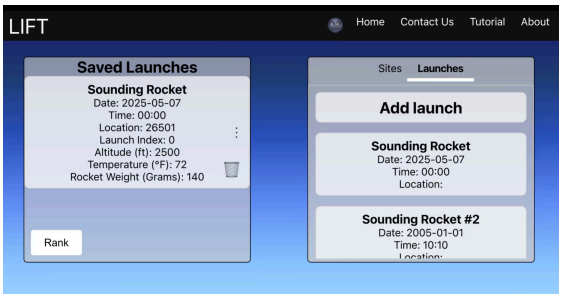


Figure 1: The LIFT UI in Light Mode. In the Directory Panel, the "*Launches"* tab is selected.

2.2: Launch Site Directory

LIFT's Launch Site Directory contains every registered launch site in the USA, for which useful data could be found. The list is found under the "*Sites*" tab of the Directory Panel, as shown in **Figure 2**. Sites in the Directory are clickable. Clicking on a site will bring it up into the Inspection Panel. **Figure 3** shows a launch site under inspection.l The Directory houses the following information about each site:

- state
- latitude
- longitude
- ZIP code
- maximum waiver altitude *(feet)*
    - This measure was not publicly available for every launch site.
- elevation *(feet)*
- website

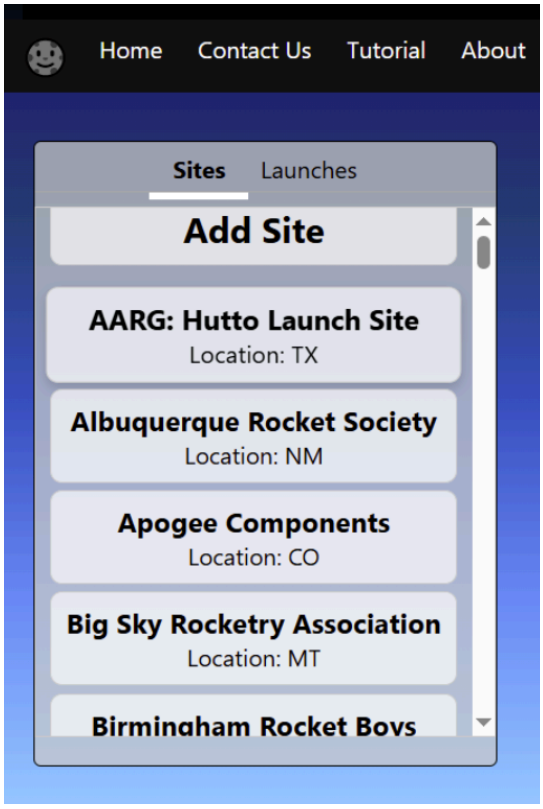


Figure 2: The Site Directory. Click on any of these sites to bring it into the Inspection Panel.

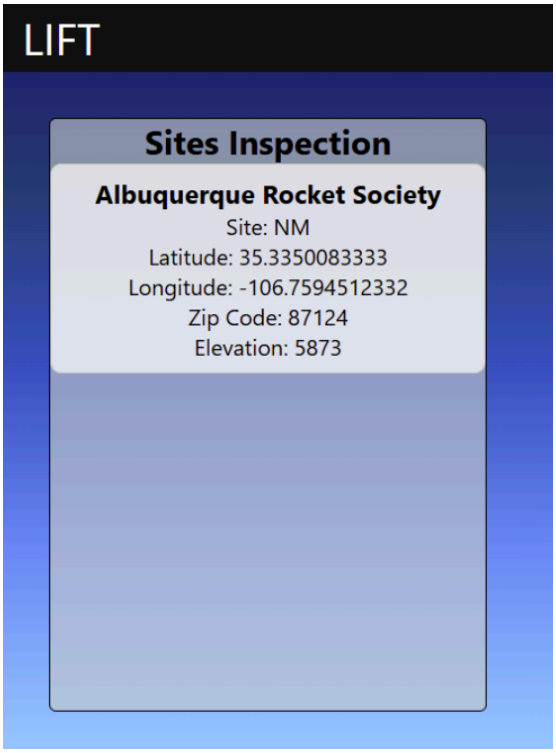


Figure 3: A launch site under inspection.

2.3: Launches

Create a new launch by clicking the "*Add Launch*" button, under the "*Launches*" tab in the Directory Panel. This will bring up a New Launch Form in the Inspection Panel, which is shown in **Figure 4.** LIFT collects the following information about each launch:

- Name
- Date
- Time
- Location (ZIP code)
- Target Altitude (feet)
- Desired Temperature (degrees F)
- Rocket Weight (Grams)

Once these parameters are entered, click the "*submit*" button under the New Launch Form to save the launch to LIFT. A newly saved launch should appear in the Directory Panel's list of launches. Saved launches are easily viewed by clicking the "*Launches*" tab in the Directory Panel and scrolling down if necessary. **Figure 5** shows this list. Any saved launch can be brought to the Inspection Panel for inspection by clicking on it, as shown in **Figure 6.**

Why LIFT collects ZIP code:

ZIP code is used to calculate which launch sites are closest to the user. Travel distance is an important factor in choosing a launch site, so it is part of the recommendation. ZIP code

is stored only with the other launch parameters submitted by the user, on the user's machine. Security minded users are advised to submit an adjacent ZIP code to their own. ZIP code is deleted when a launch is deleted.

Figure 4: The New Launch Form. Click "*Submit*" at the bottom of the form to save the launch.

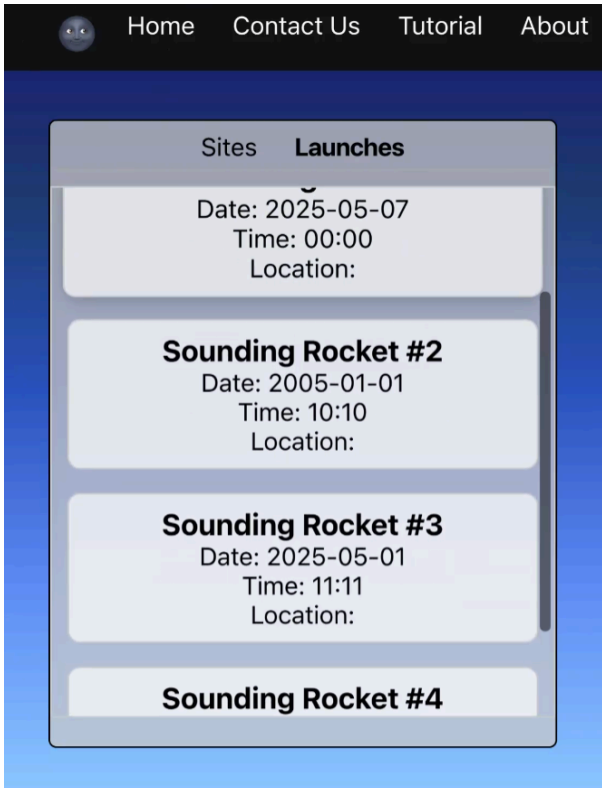


Figure 5: Saved launches in the Launch Directory. Clicking any one of these launches will highlight it in the Inspection Panel.

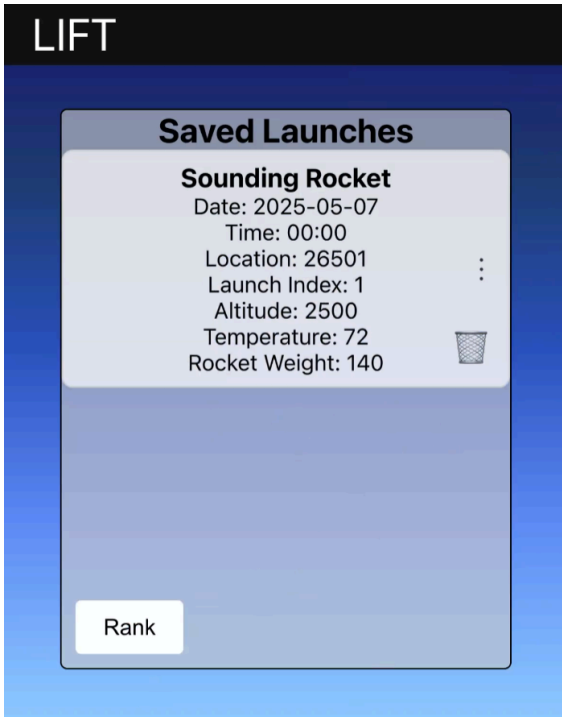


Figure 6: A launch in the Inspection Panel. Click "*Rank*" to bring up the Ranking Pop-Up.

2.4: Ranking Launch Sites

LIFT's unique ranking algorithm works by comparing the parameters of the user's launch to each of the launch sites in the directory. Weather data is pulled from the NOAA forecast database. Once each site's forecast is known the sites are ranked in order of suitability for the user. The following are the available parameters for ranking sites:

- Temperature
- Distance
- Wind speed
- Precipitation
- Waiver altitude

Each of these parameters can be weighted by the user. LIFT will analyze the user's weights of preference in order to provide the best ranking of launch sites for their purposes.

To obtain a recommendation from LIFT, there must be a launch in the Inspection Panel. Select one from the Directory Panel or, if none are yet saved to the site, make a new launch by following the instructions in *Launches (2.3)*. Once you are inspecting a launch click the *rank* button below the launch's displayed parameters. This will open the Ranking Pop-Up **(Figure 7.)**.

In the Ranking Pop-Up, each parameter is displayed to the left of its own drop down menu. These drop down menus are where parameter weights are inputted. A higher number for a weight indicates that the user values its parameter more.

For instance, consider two sites: A and B. Site A is closer to the user's ZIP code, but site B has less precipitation. With the *Distance* parameter weighted at 5 and the *Precipitation* parameter weighted at 1, LIFT will more likely recommend site A. With the *Precipitation* parameter weighted at 5 and the *Distance* parameter weighted at 1, LIFT will more likely recommend site B.

In order to proceed to the recommendation there is only one more step. A search radius must be entered at the bottom of the list of parameters in the Ranking Pop-Up. It is advised that the user input the maximum distance which they are willing to travel. This is measured in miles.

Once the user's preferences for parameter weights are indicated in the Ranking Pop-Up, the *Submit Weights* button will yield a list of the most suitable launch sites. For each site in the list, an optimal launch window will also be supplied.

Please note:

LIFT's launch site recommendations are based on forecast data. Weather forecasts are inconsistent and weather can change a lot in

little time. The closer to the launch date the more reliable the ranking will be, but always perform your due diligence before launch.

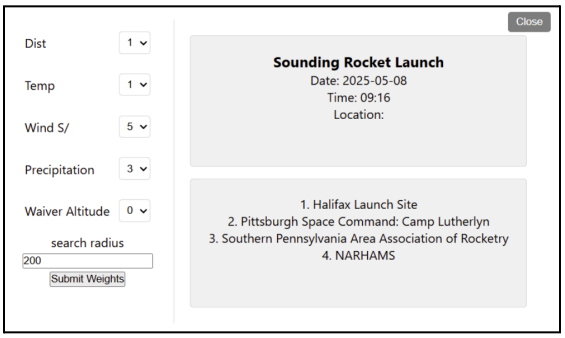


Figure 7: The Ranking Pop-Up. After selecting weights and entering your search radius, click "*Submit Weights*" to rank launch sites.

3. Auxiliary Functions

LIFT saves your launch data between sessions and offers Dark Mode.

3.1: Save Data Between Sessions

For the user's convenience, launches are saved between sessions. Saved launches previously entered by the user should be automatically displayed under the *Launches* tab of the Directory Panel. A launch that is deleted on the site will stay deleted during your next session.

Launches are saved in a pure data format to the user's machine in the browser's localStorage file, whose properties vary from browser to browser. **LIFT does not, and will never, store any executable code on the user's machine**. Since launch data is saved locally, user launches will only be available on the machine from which they were saved into LIFT.

3.2: Dark Mode

LIFT offers a user-toggleable Dark Mode. Dark Mode is controlled by a button in the Navigation Bar. Clicking the button once will switch to Dark Mode, and clicking the same button again will switch out of Dark Mode into Light Mode. **Figure 8** shows the Navigation Bar while in Light Mode, with a moon button signalling the transition to Dark Mode. **Figure 9** shows the Navigation Bar while in Dark Mode, with a sun button signalling the transition to Light Mode.

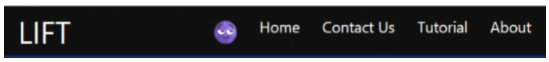


Figure 8: The Navigation Bar in Light Mode.

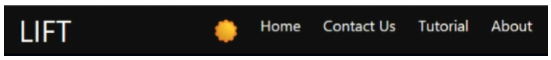


Figure 9: The Navigation Bar in Dark Mode.

4. Next Steps

Further work could improve the mobility and flexibility of LIFT.

4.1: Incomplete Features

Historical weather data:

Historical weather data may be useful to rank launch sites in the absence of reliable forecast data, or in highly unpredictable conditions. A developer familiar with LIFT's code base and NOAA APIs would be able to implement this without much trouble, since the API system within LIFT is abstracted and there is room for multiple API clients. This feature was cut from the final release.

Login and sync:

A login and data sync function would be useful for users who want to take their saved launches with them. This was considered as an auxiliary function. However, it was by far the heaviest weight auxiliary feature in consideration and provided marginal utility. It was ultimately considered out of scope.

User-submitted launch sites:

It would not be difficult to implement user-submitted launch sites, to accompany user-submitted launches. However it was considered unlikely that any user would know of a maintained sounding rocket launch site not already found within the LIFT site directory. It was also understood that sounding rockets cannot simply be launched from any old backyard, no matter how remote. As such this feature was discontinued while only half finished.

4.2: Recommended Expansion

Flagging unfavorable wind directions:

This would require a major update to LIFT's launch site data set, since each site would have its own favorable and unfavorable wind directions. It would also require front end modification. It would offer great utility to the user.

User submitted comparators:

LIFT's ranking comparators are simple and modular. The power of the app could be expanded by allowing users to upload their own comparators which the app could then use to rank launch sites. However, this represents an obvious security risk. Hazard management would make this difficult in practice.

Potential graphical improvements:

- Interactive maps
- Visual plotting of weather data
- Pictures of launch sites

5. Acknowledgements

5.1: WVU Experimental Rocketry

Members of the WVU Experimental Rocketry team provided valuable insight from the concept stage on and assisted in user testing. These members include:

- Jordan Herter

- Joseph Long
- Lucian Baumgartner
- Rex Mcallister
- Noah Yoak

5.2: Dr. Tom Devine

This CS330 course was administered by Dr. Tom Devine. Dr. Devine informed and advised LIFT from design to deployment. The LIFT team thanks him for his assistance and patience. All hail the Overlord!

5.3: NOAA

NOAA weather data is the pond on which LIFT's functionality floats. Without NOAA none of this would have been possible. The LIFT team hopes that NOAA will be around long enough that future generations might be able to benefit from their weather forecasts, which are so easily taken for granted.