

NavigateSLC - Process Book

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Link to repository: <https://github.com/dataviscourse2023/final-project-navigateslc>

Overview and Motivation:

As international students, we face difficulties moving into a new home and a new environment in another country. While numerous sites try to be helpful, there is a glaring gap: there isn't a single, all-inclusive website that can easily provide a comprehensive summary of crucial information.

Our goal is to create a web application that, in addition to filling the information gap, improves the educational experience for students by featuring an interactive map as its main feature. This interactive map will be a thorough resource, arming students with the information they need to choose a residence best suited to their unique needs and preferences.

By creating this website, we aim to:

1. Simplify Decision-Making: We have first-hand experience that selecting the ideal residence is a crucial task for us international students. Our website will provide a visual representation of the city, highlighting different areas and housing possibilities and essential information like the area's closeness to facilities like transportation hubs, the university, and other necessities.

2. Increase Convenience: We want to make getting important information easier. Our website will provide a one-stop solution for students during their settlement process in place of them having to navigate different sources, saving them time and effort.

In conclusion, we aim to develop a simple website that will ease the transition for international students and give them the power to choose their new home with knowledge and confidence, thereby raising their quality of life in the city.

Project objectives:

We will be focusing on:

1. **Population Map:** Providing a population map with concentrations of students and student-friendly neighborhoods helps newcomers connect with their peers, fostering a sense of community and making social integration easier.
2. **Local Stores:** For students, access to nearby grocery stores, bookshops, and other essential retail outlets is vital. Including information on the locations of these stores helps students settle into their new surroundings more comfortably.
3. **Public Transport:** Students rely heavily on public transportation. A comprehensive map featuring bus stops, TRAX stations, and their schedules enables them to navigate the city efficiently, especially when commuting to campus or exploring its attractions.
4. **Tourism Highlights:** While students primarily focus on their studies, they also seek opportunities for leisure and exploration. Highlighting local attractions, parks, museums, and entertainment venues allows newcomers to balance their academic pursuits and leisure activities.
5. **Safety and Emergency Services:** It's crucial to provide information on the locations of police stations, medical facilities, and other emergency services. This helps students feel secure and prepared in case of any unforeseen circumstances.
6. **Student Services:** New students require access to university offices, counseling services, and academic support centers. Including these on the map ensures students can easily find the resources they need to excel academically and adjust to campus life.

In essence, tailoring the city map to the needs of new students fosters a smoother transition into city life and university culture. It equips us with the information we require for everyday living, studying, and exploring the city, thereby enhancing our overall experience as students.

Related work:

- Visualizations discussed in class and used in assignments such as scatter plots, heatmaps, bar, line, and radar charts.
- Interactions present in the COVID dataset assignment also coincided with the underlying idea of our project.
- Transit app: <https://transitapp.com/>
- UofU Class Map: <https://myclassmap.utah.edu/>
- All trails app: <https://www.alltrails.com/>
- Google maps: <https://www.google.com/maps>

Questions:

We started the project with our motivation to help other students settle into a new city. We asked ourselves, what are the necessary features required to be developed and integrated on our website to help onboard students to the University of Utah and into Salt Lake City?

We delved into the topic and came up with the project's objectives.

We had to understand and think from the student's perspective to identify the essential features that would assist a student in going about their routines.

What are the necessities students require to settle into a new city?

With our objectives and features listed, our next big question was.

How do we acquire such relevant datasets?

We had already utilized all of the apps mentioned in the related work and wanted to bring all of those apps onto a single platform as a one-point solution for students.

We approached the GIS department at the UofU to understand the map layout that they were utilizing and acquire datasets that were available with them. This proved extremely helpful since the representative pointed us to the datasets that were publicly available and how to utilize the website to acquire the layers for the features that we were working on.

Now that we had collected the data and the necessary resources, we had to decide on the coding structure.

How do we manage the datasets, and what are the designs that are going to be utilized?

How do we develop informative, intuitive, and dynamic data visualization techniques on the acquired datasets, and how should they be presented?

What are the necessary features, and what are the optional features?

Data:

Datasets that were available online with public access:

- Parks: <https://opendata.utah.gov/Recreation/Map-of-Salt-Lake-City-s-Parks/>
- Public Transport: <https://gis.utah.gov/data/transportation/transit/>
- Topographical map: <https://gis.utah.gov/data/elevation-and-terrain/>
- Trails and Trailheads: <https://gis.utah.gov/data/recreation/trails/>

We have requested facilities@utah.edu to provide us with department-specific data. We have also requested the geography department to provide access to high-quality topographical maps of SLC, weather data, average block-wise rent data, and population density data.

We will update the list as we acquire them.

Data Processing:

Some of our data sources have overlapping information, such as transport routes of TRAX. We aim to pre-process the data and ensure data abstraction.

The multiple datasets that are being integrated have various differing columns and data types, which need to be unified by identifying the common data fields to be utilized optimally.

Then, develop a data integration strategy, which may involve merging, deduplicating, or aggregating overlapping data points. Data quality will be prioritized by cleansing and standardizing entries to ensure consistency, with an emphasis laid on helping students.

Since the visualization is essentially a map, the additional coordinates from the features must be superimposed, and they must be consistent with the underlying map coordinates, making the precise data pre-processing of coordinates a crucial component.

Exploratory Data Analysis:

From the data collected, we realized the following things:

The average block-wise data gave insights into how the students can utilize this information to find their community and figure out their living expenses and commutes.

The average block-wise rent data revealed the following tradeoff:

1. The locations that have a higher average rent have better accessibility to general amenities such as parks, grocery stores, and better connectivity with public transport, which is essential to help a student with setting up their routine.
2. The locations that have relatively lower average rent did not have the amenities that were easily accessible within walking distance in comparison to the higher average rent. The commute times to the university and the accessibility to public transport are much higher.

The weather dataset revealed following trends:

- The winters in Salt Lake City last long, from the months of November to March. The average temperatures in these months are in the range of 55°F to 27°F (13°C to -3°C).
- The dataset also revealed that the summers are the hottest in the months of June, July, and August, ranging from 90°F to 61°F (32°C to 14°C).

This data helps the students plan for their temperature-based clothing if they move into the city during the Fall or the Spring semesters to the University of Utah.

Visualization Design:

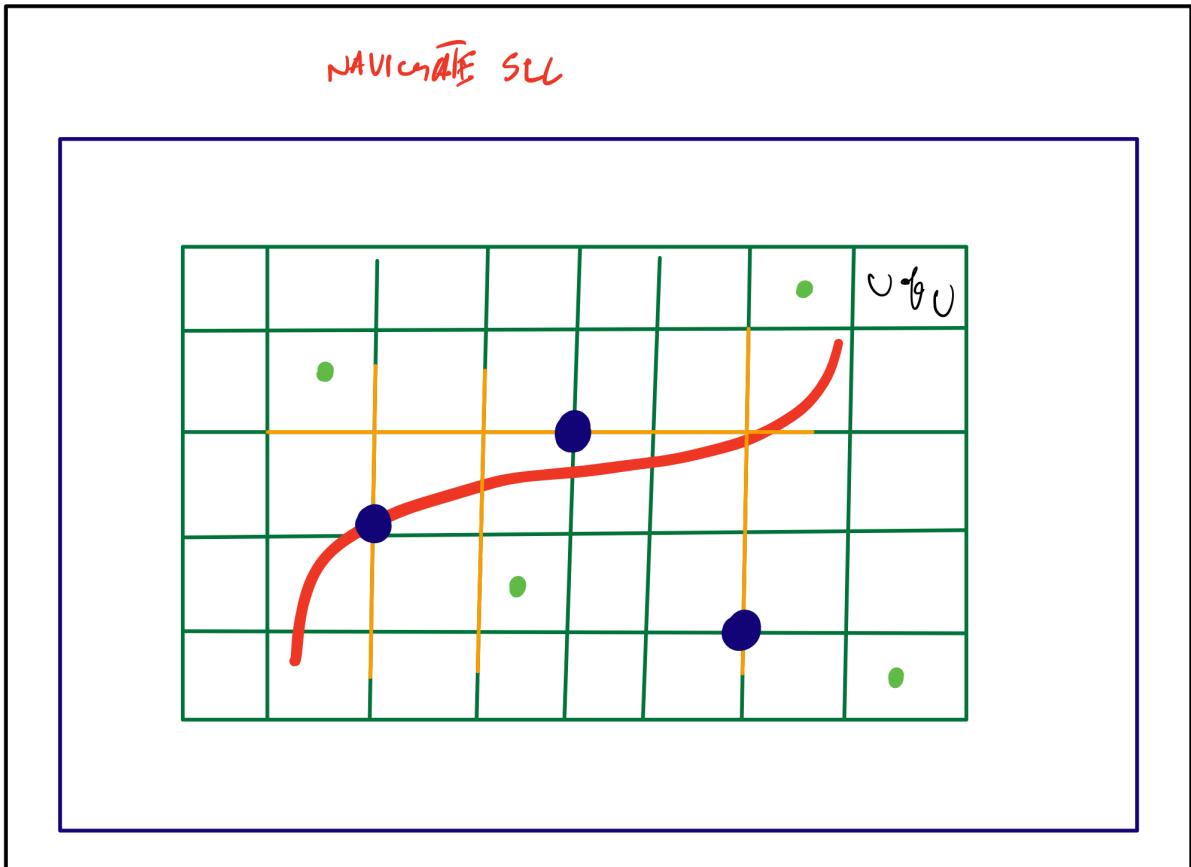
We start with a topological map. Over this, we intend to implement these filters:

1. **Block-wise visualization:** A menu option to select a particular block in SLC, which pops up the population density, average rent, convenience stores, and general recreational activities when the cursor hovers over it.
2. **Public transport route visualization:** This will explicitly highlight the bus routes. An option will be provided to select a particular bus route, which will be highlighted on the street map.
3. **Trail map:** Similar to the public transport route visualization, an option will be provided to select a particular trail/trailhead, which will be highlighted on the street map.
4. **University of Utah Visualization** - An option to particularly zoom into the campus will be incorporated. This will highlight all the buildings (along with historical information) and other places of significance on the campus.
5. **A macroscopic view:** of the entire city will be provided, and users will have the freedom to add and remove filters of their choice manually.

We came up with a few possible layouts for our website.

Initial Sketch:

- Overlay all the data and map layers onto one street view map with topographical information.
- The data consists of street view of roads, public transport routes, topography overlay, block-wise population density data, average rent prices, and a detailed map of departments in the University of Utah.
- In the sketch:
 - The red line corresponds to the TRAX routes.
 - The green grid corresponds to the city blocks, which contain block-wise data.
 - The orange lines are roads with street names.
 - The blue dots are bus stops.
 - The green dots are local landmarks.
 - The University of Utah has been included near the map's northeast as a detailed map overlay with links to departmental-specific data.

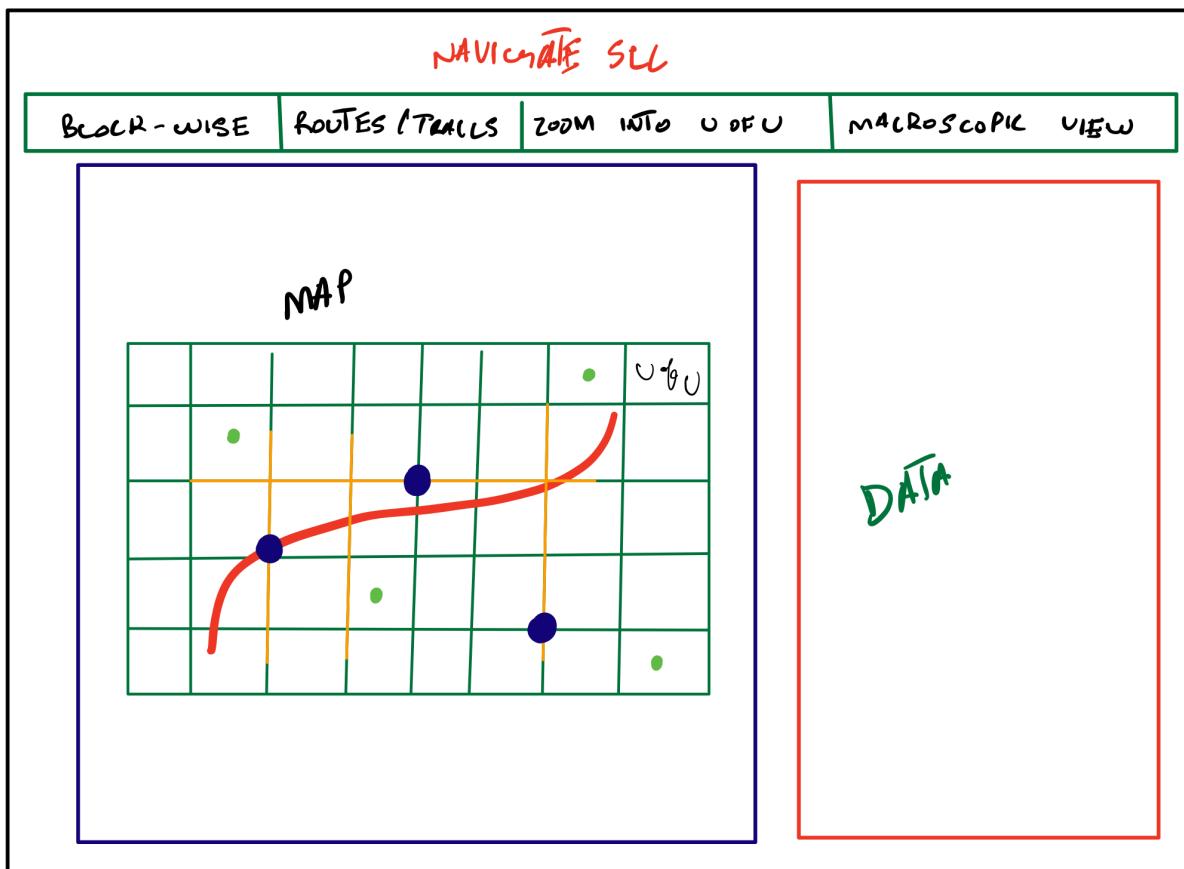


The above design has several issues:

1. There is a heap of information available, and understanding details becomes very difficult.
2. The entire visualization is cluttered due to multiple overlays of map layers and data layers.

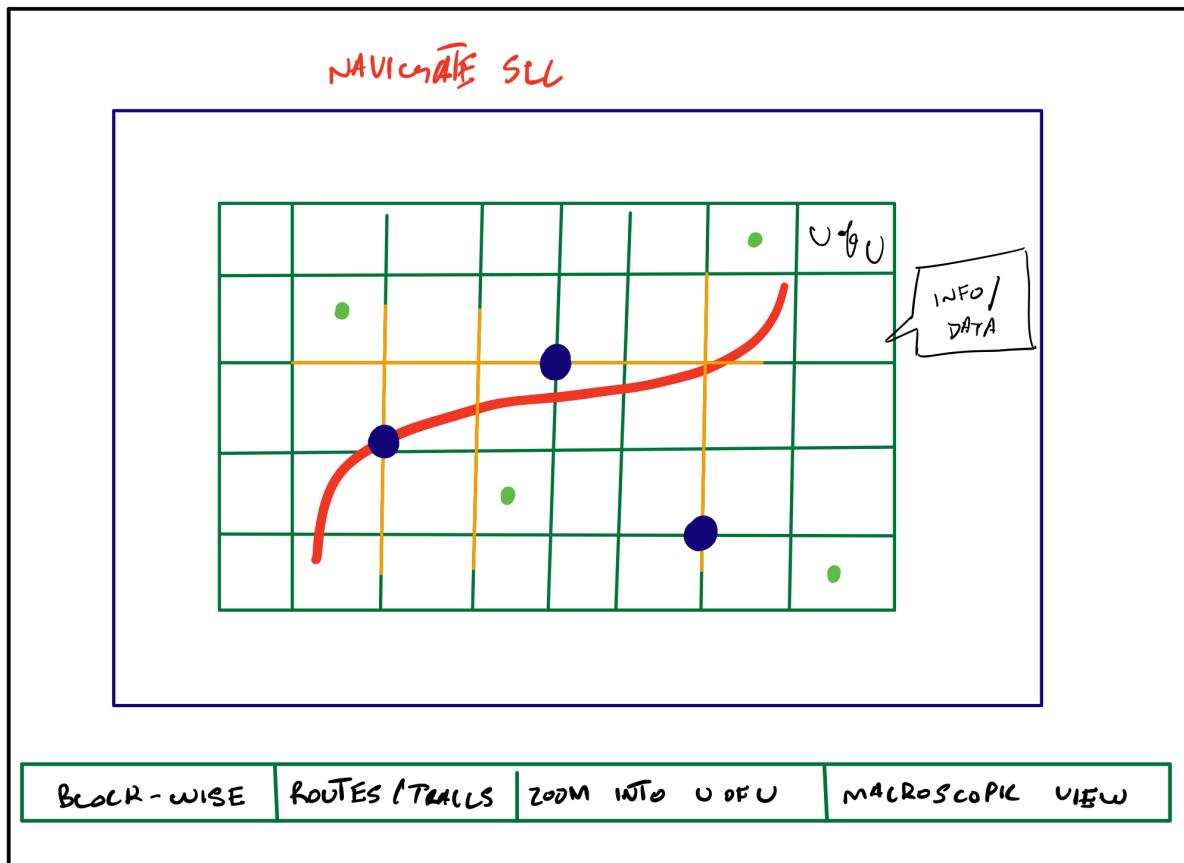
Improved Sketch:

- By utilizing filters for separating the overlays of different map layers.
- The data layer has been separated into a window that shows specific information about the selected filter.
- Filters: A block of buttons is present on the top of the page, and selecting the filter makes only data from that topic appear on the map section.
- Data Window: Selecting a particular element on the map will provide more information about that selection on the data window.



Final sketch:

- Since the data section is empty when there is no selection on the map, the size of the map on the screen can be maximized.
- The filters have been moved to the bottom of the page to provide more importance to the map.
- The design we have come up with is as follows:
 - A selection of the filter will overlay the map layer, which is filter specific to the street view map.
 - Each filter will have a drop-up, which provides a selection of features.
 - Upon selecting a feature, the map will be overlaid with a heat map (as applicable).
 - By hovering over a particular section with the cursor, a pop-up gets populated with the information related to the feature selected.



Must-Have Features:

- Topographical and street map
- UoU department and student services buildings with general and historical information.
- Population density with emphasis on student-friendly neighborhoods.
- The average rent across areas.
- Public transportation with stops, routes, and timings.
- Convenience Stores - with emphasis on cuisines
- Recreational Activities - including parks, theaters, tourism highlights, etc

Optional Features:

- Trails map overlay
- Live events notice board with information about local and state-level events.
- Past weather map overlay

Project Schedule:

Sep 15 - Submit the proposal

Sep 22 - Complete data collection and processing

Sep 29 - Have a primitive working visualization model - trying to incorporate all the collected data on the must-have features

Oct 6 - Collect feedback based on the primitive model - and incorporate suggestions in the visualization

Oct 13 - Improve on the primitive model and make a version dealing with the addressed issues

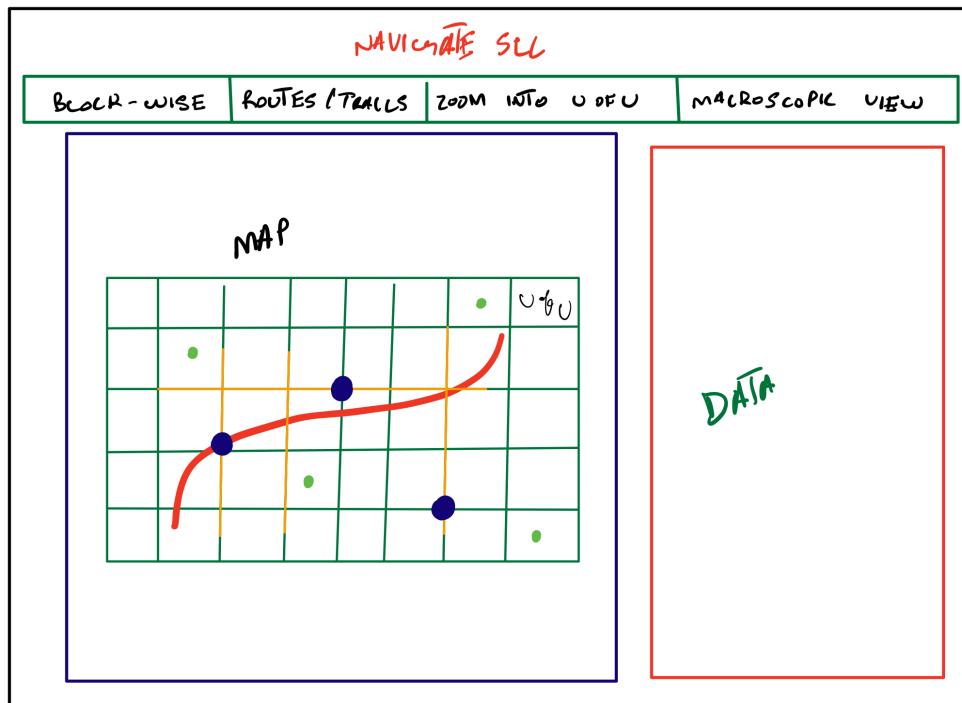
Oct 20 - Collect feedback based on the improved model - and incorporate suggestions in the visualization

Oct 27 - Improve on the final model and make a version dealing with the addressed issues

Nov 3 - If everything goes according to schedule, we can include our optional features in the remaining time.

Updated information:

We have decided to go ahead with this layout based on the TA's recommendation to display more visualizations:



We also have a few additional visualizations planned:

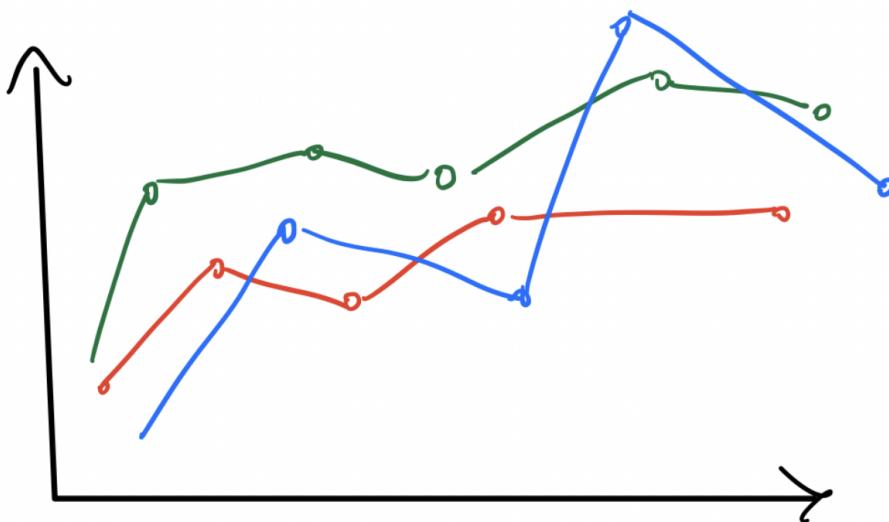
A radar chart to represent the block-wise data which contains multiple attributes:



The above graph is inspired by the game Fifa. Instead of the player stats on the edges of the circle, our visualization will have per-block attributes such as rent, population density, utilities, crime, altitude, and tourist attractions.

There will also be a list of all the bus routes in a block of the map. We also plan on adding a visualization overlay on the map that shows the route of the bus of the selected bus route (From the list).

In the macroscopic view, we have planned to add a line chart with information about the entire city as shown:



Here, the x-axis is the time in years, and the y-axis is the increase/decrease of the particular feature.

The lines in the line chart represent the Rainfall in Salt Lake City averaged monthly throughout the year and average Rent in Salt Lake City measured over a period of time.

Additionally, we will add a bar chart for average rent in Salt Lake City over the prominent areas in Salt Lake City and the temperature averaged monthly measured throughout the year.



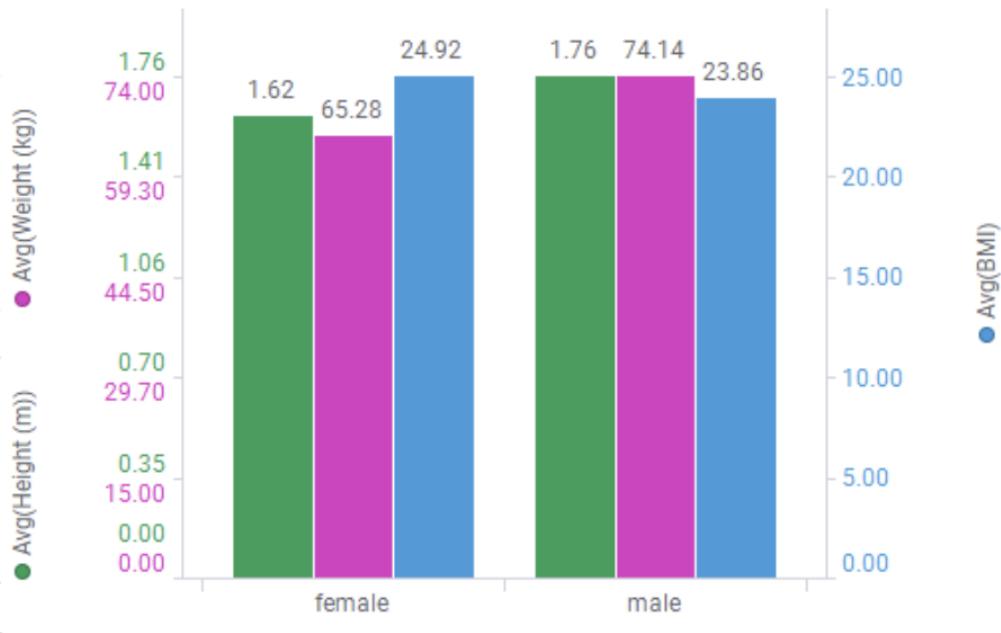
The bars on the bar chart will represent the average rent for the area so that the students will be able to prioritize their preferences while looking for a place to live.

The temperature bar chart and the rainfall line chart gives the students a generic idea about the weather they can expect throughout the year in Salt Lake City. This helps them plan their choice of clothing and travel accordingly.

UofU data:

Department specific data - number of students, number of programs offered, funding, number of faculties.

For this information, we plan to make a bar chart for each department. The different department attributes (mentioned above) will be color-coded on the scales so we can incorporate more data in one graph as shown below:



The above mentioned was part of the initial design process, however as we progressed we were not able to collect all the relevant data. As a result, we had to incorporate the bar chart elsewhere and change functionality of the Zoom into U of U filter.

Final Implementation

The final implementation includes certain features which were added on top of the initial proposal. These were added since they seem to enhance the utility of the work. At the same time, certain features mentioned previously have been removed due to lack of availability of data or lack of possibly meaningful visualizations.

As a result, before moving forward onto the details of the final implementation, the revised objectives are presented in this section.

Revised Objectives

1. **Locality Selection:** Helps students identify their desirable place of residence by providing them various relevant details about every locality in Salt Lake City. Some of these relevant details may include - Total Population, Rent etc.
2. **Connectivity:** Convenience in terms of commute is a major necessity for students. As a result, an extremely important objective of this work is to provide students with an intuitive way of assessing the connectivity of every locality with public transport.
3. **Leisure Activities:** Salt Lake City is regarded as a great outdoor location and many students may look to explore this aspect of the city. As a result, this work particularly aims to show the enormous number of trails present in SLC.
4. **Weather:** For many international students, winter may be unknown. This work aims to depict the weather trends of SLC to help students plan their clothing etc appropriately.
5. **Dynamic Trends:** Many students who plan to stay in SLC for an extended period of time may be interested to know certain trends across time. This work tries to provide this information for the limited data available.

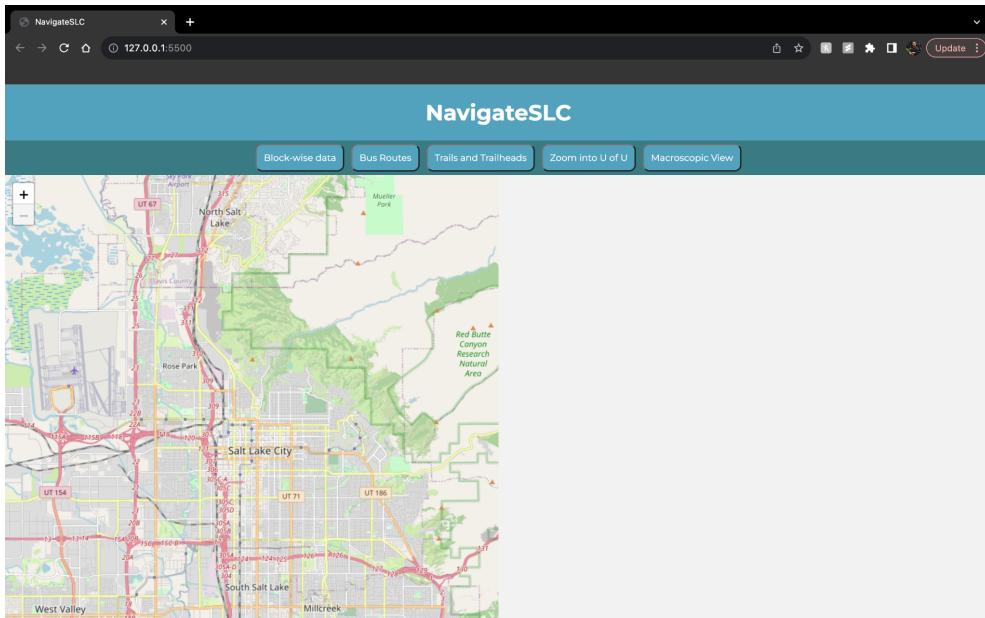
Feature Implementation and Visual Design

The final features of our work have been discussed in detail below.

1. [The home page:](#)

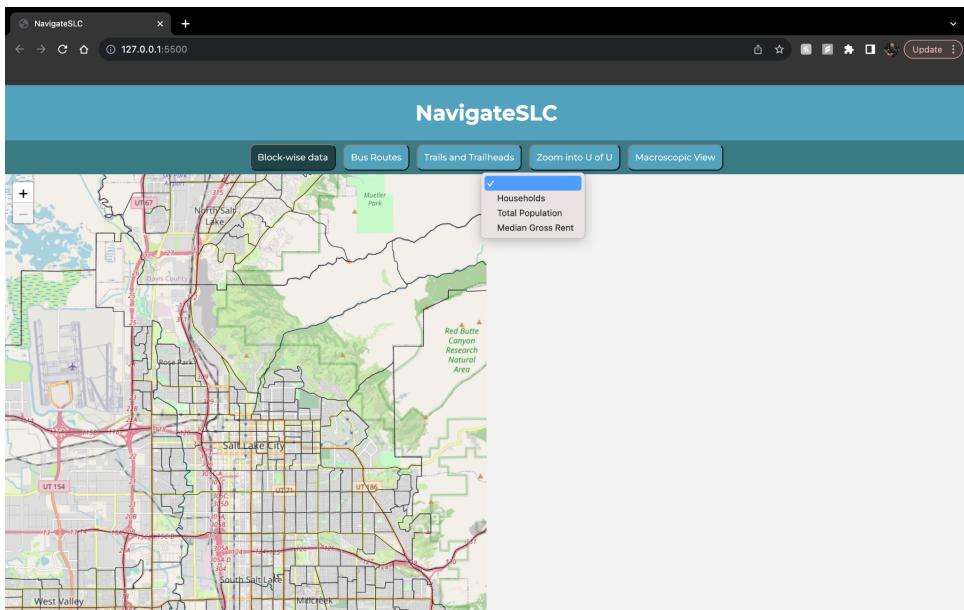
The website - Navigate SLC's home page depicts a map of Salt Lake City with an option to zoom in and out. It also has 5 buttons that describe the

functionality of each button.



2. Block Wise data:

The block wise data button overlays a block wise partition of all blocks present in SLC over the map of Salt Lake City and the cursor highlights the block over which it hovers. The dropdown shows 3 options for heatmap overlays over the blocks - Households, Total Population and Median Gross Rent.

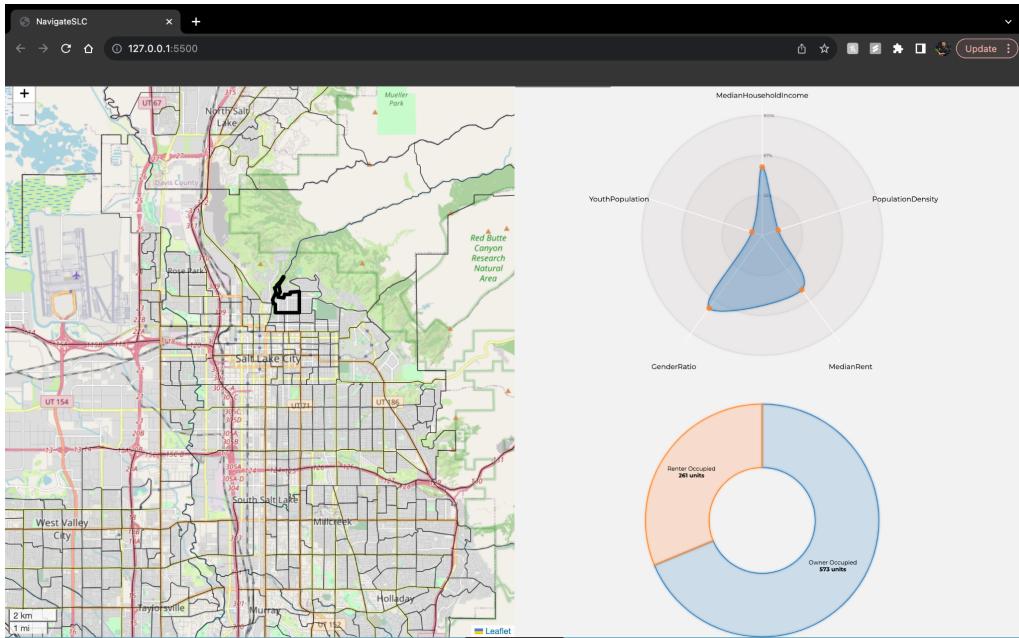


3. Block selection:

Upon selecting a particular block the the radar chart and donut chart for that block appears.

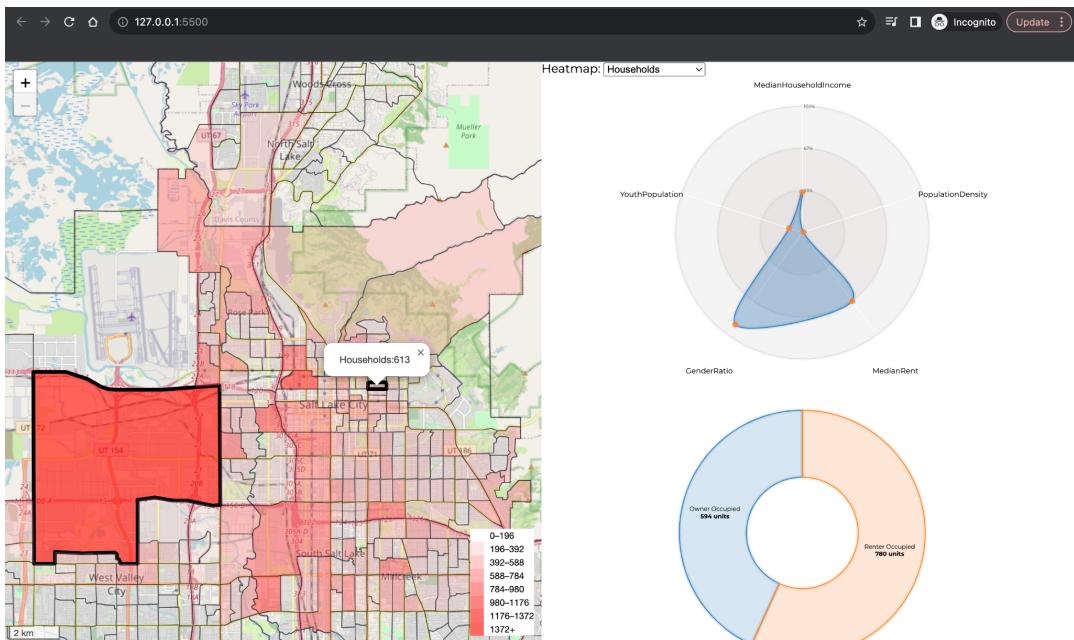
The radar chart depicts 5 attributes: Median Household Income, Youth Population, Gender Ratio, Median Rent and the Population Density. These attributes depict the values which are specific to that block. This feature helps in comparing multiple features present in each block with ease.

The donut chart depicts the number of households in that block that are occupied by the owners and those which are occupied by renters.



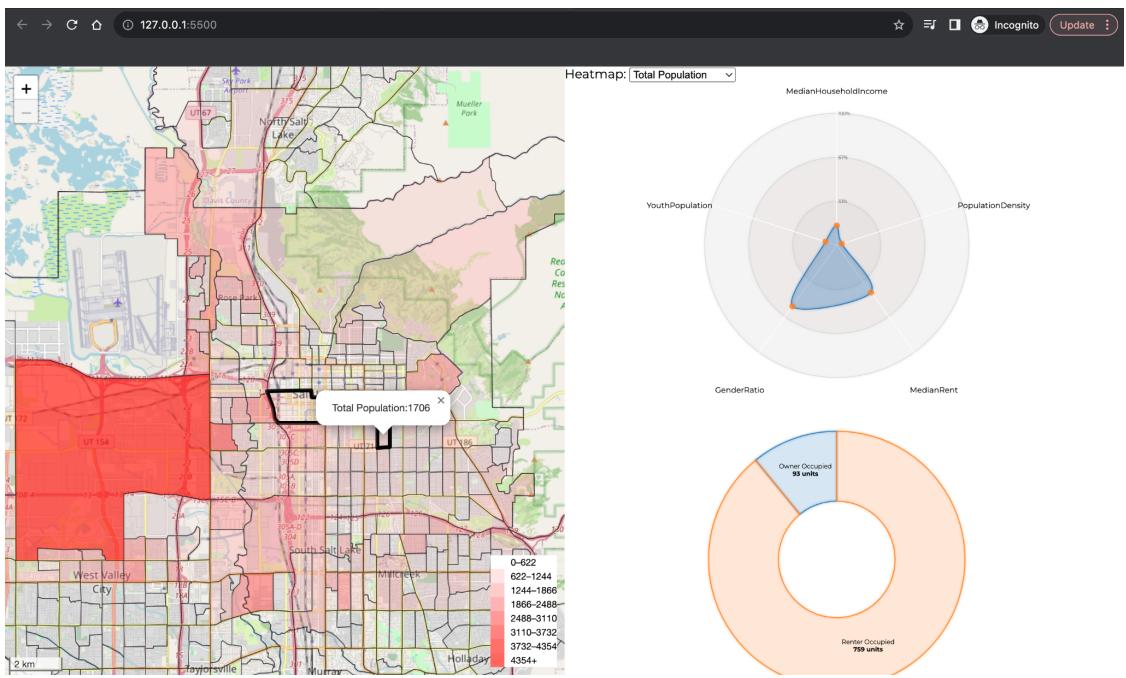
4. Households Heatmap:

On choosing the households option, the map of SLC is overlaid with the heatmap depicting the total number of households in each block. A popup depicts the value when the cursor is hovered on a specific block.



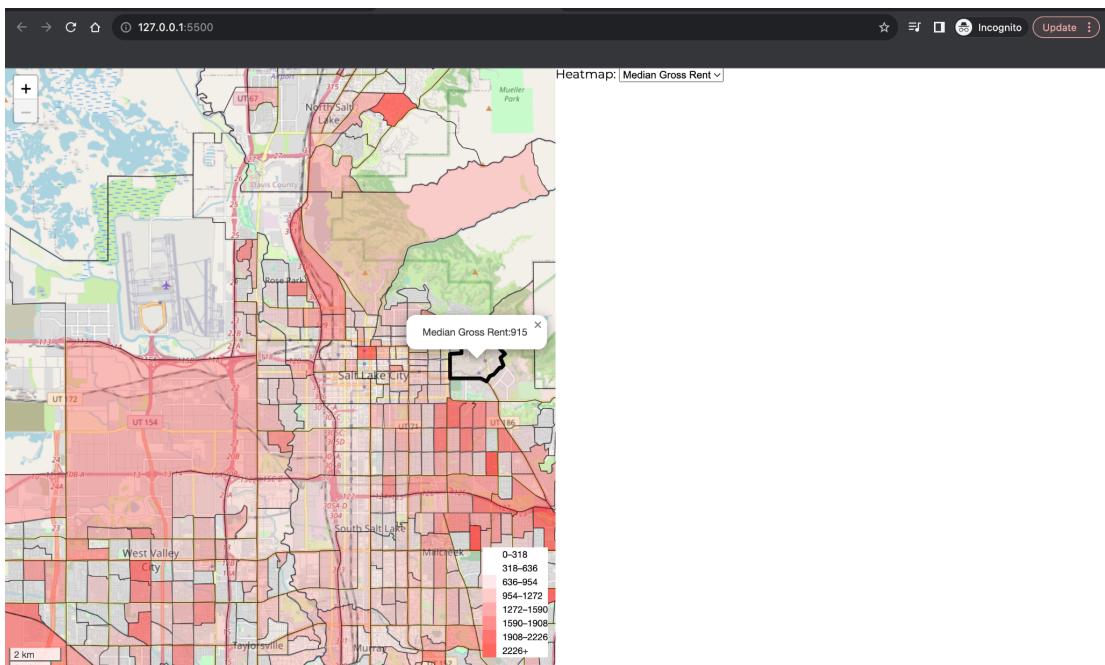
5. Total Population Heatmap:

Similar to the households heatmap, on choosing the total population option the corresponding heatmap is overlaid on the map of SLC. On hovering the cursor over a block the total population value for that specific block is displayed in the popup.



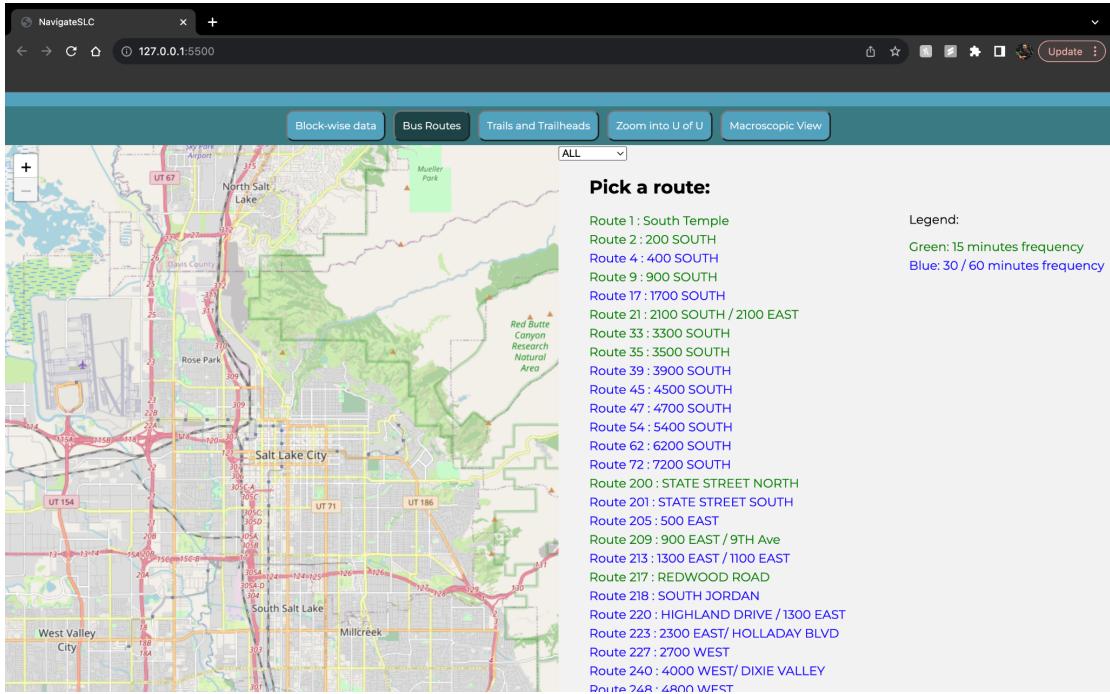
6. Median Gross Rent heatmap:

Similar to the above 2 heatmaps, the Median Gross Rent heatmap depicts the rent for a particular block. This feature is specifically useful to new incoming students trying to find housing in SLC.



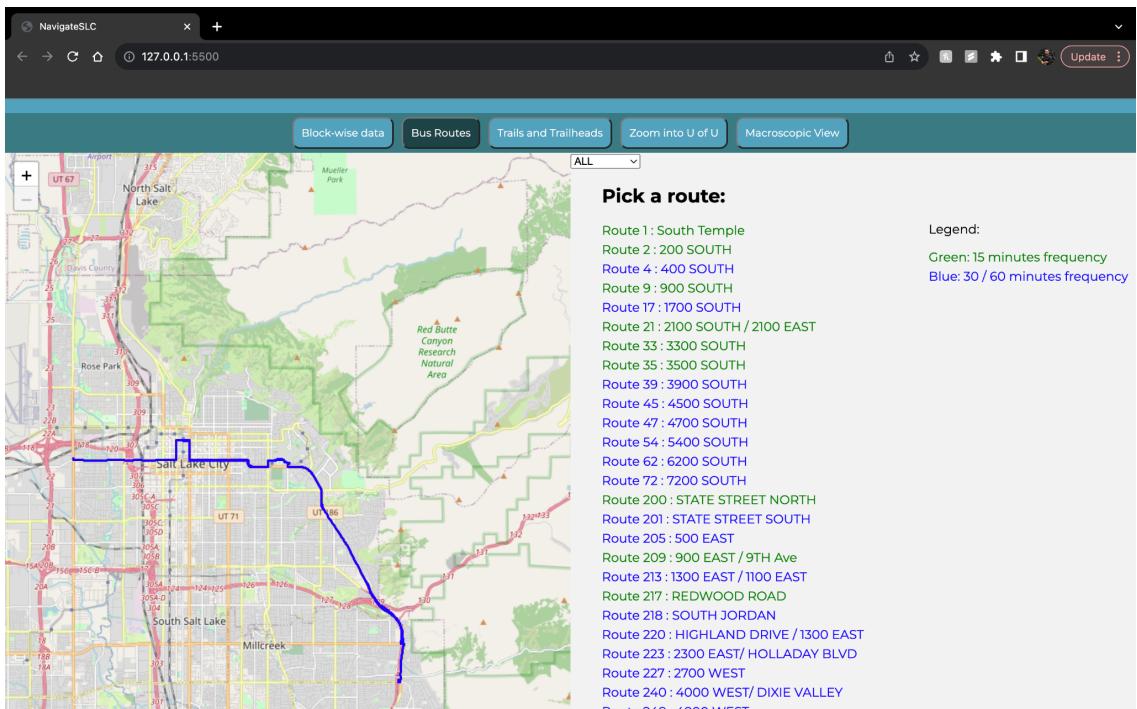
7. All Bus Routes:

The bus routes feature displays a list of ALL bus routes that run within SLC. The frequency of the bus along a particular route is depicted in the legend.



8. Bus Route Selection:

On selecting a particular bus route, the route that the bus follows is overlaid on the map of SLC. The bus stops along this route are present on the map which can be seen upon zooming in.

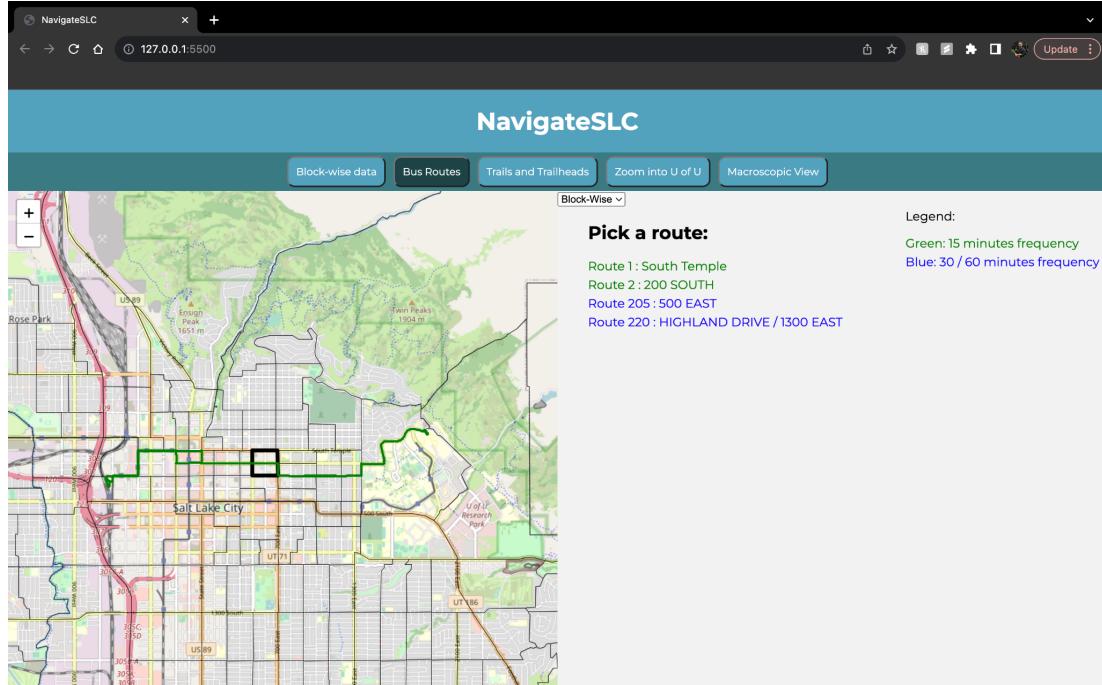


9. Block wise bus routes:

On choosing the block wise option, the blocks partition is overlaid onto the map of SLC. Upon selecting a particular block the bus routes that pass

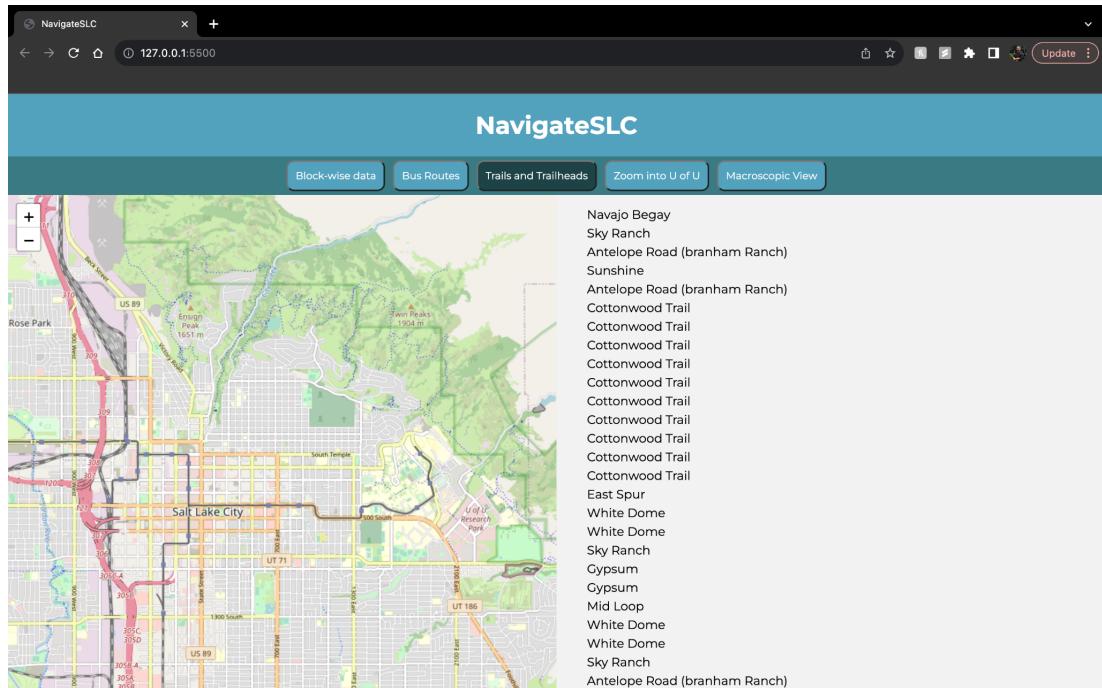
through the block are listed and on choosing a particular route the bus route is overlaid on the map of SLC that passes through the block.

This feature is built specifically to help new incoming students to navigate through SLC and gain better understanding of their choice of commutes to their destinations.



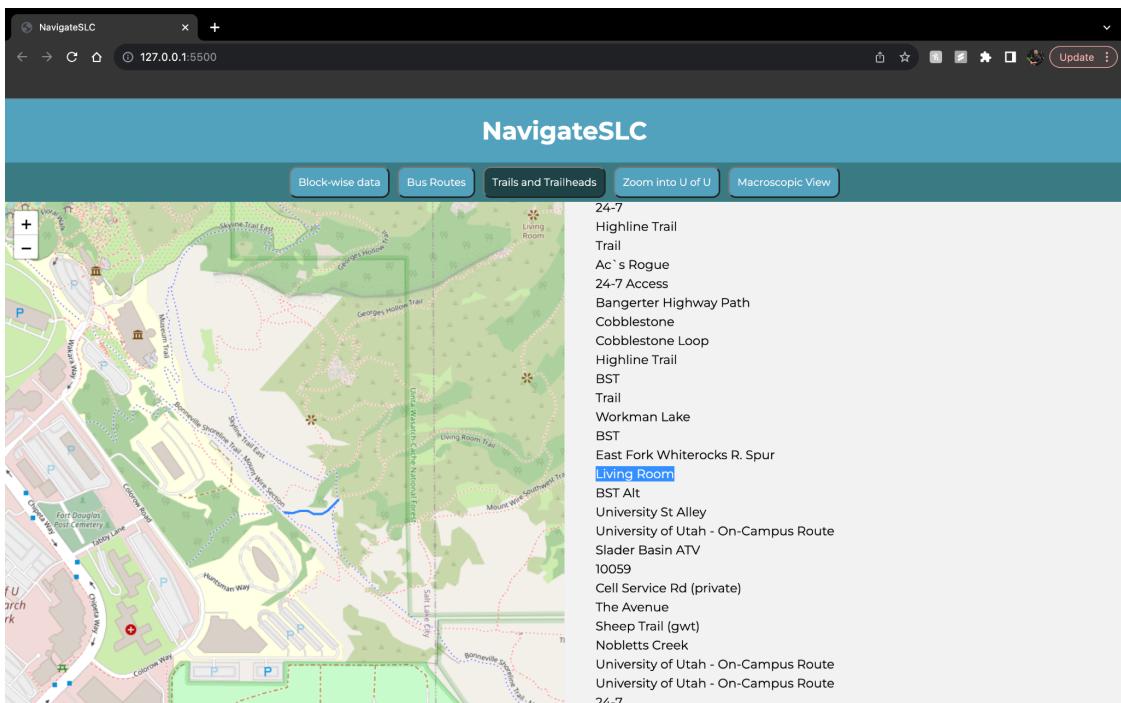
10. Trails and trailheads:

The trails feature lists all the hiking trails in and around SLC.



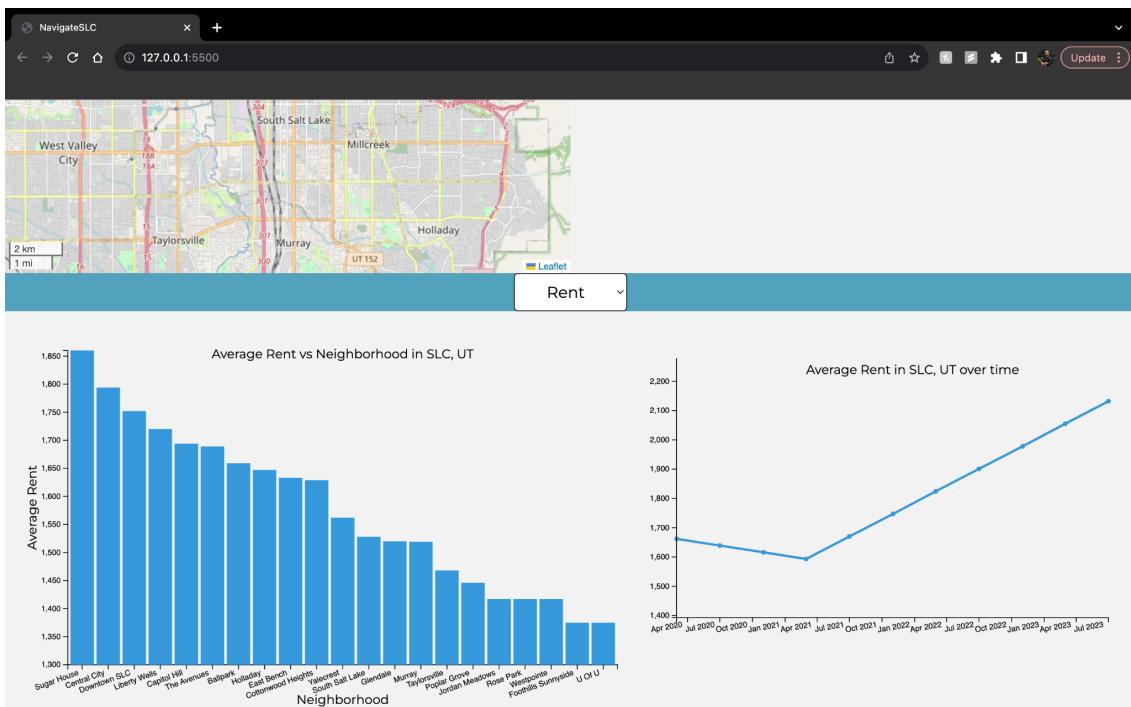
11. Trail selection:

On choosing a particular trail, the path for the chosen trail is overlaid on the map of SLC. Here we can see the depiction of living room trail.



12. Macroscopic View:

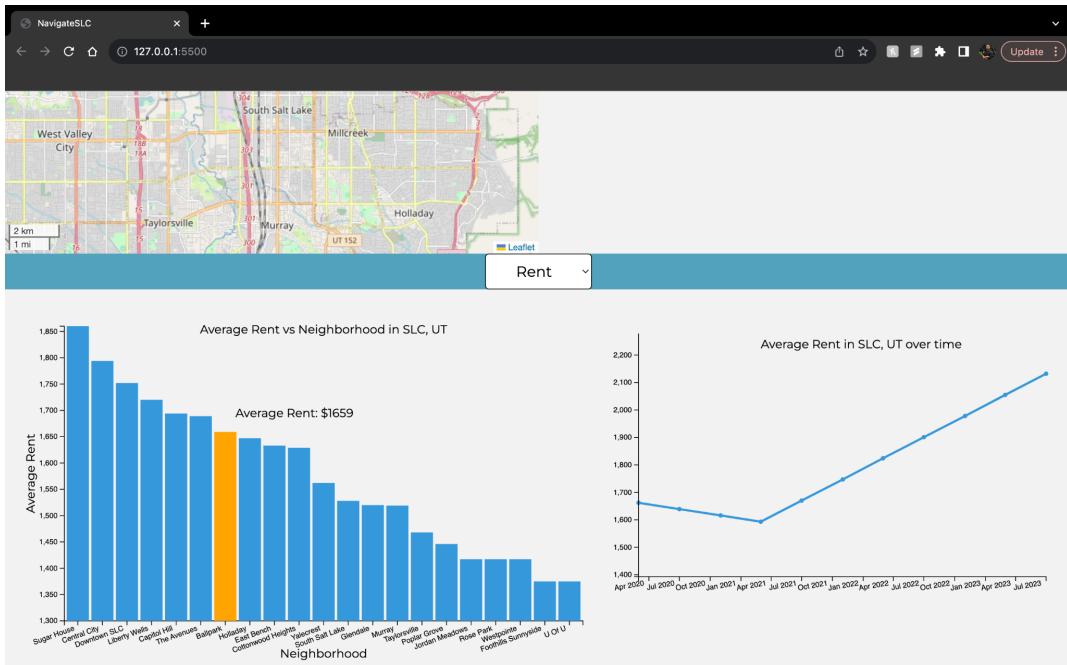
The purpose of the macroscopic view feature is to depict the Rent and Weather for the entirety of SLC. On selecting the macroscopic view button two charts depicting the information related to rent are presented.



13. Macroscopic View - Rent - Area wise:

In the macroscopic view for rent, a bar chart represents the average rent across the areas of SLC and on hovering over a particular block the exact

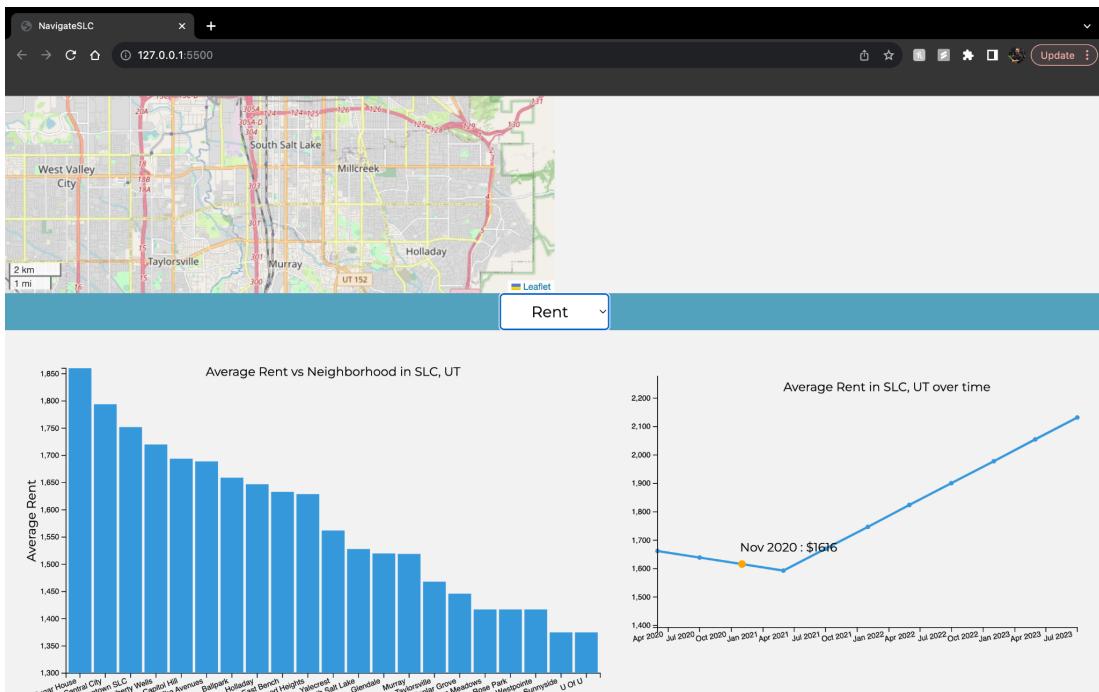
value is presented as a popup.



14. Macroscopic View - Rent - Over Time:

The line chart depicts the trend in the average rent in SLC over time - from April 2020 to July 2023.

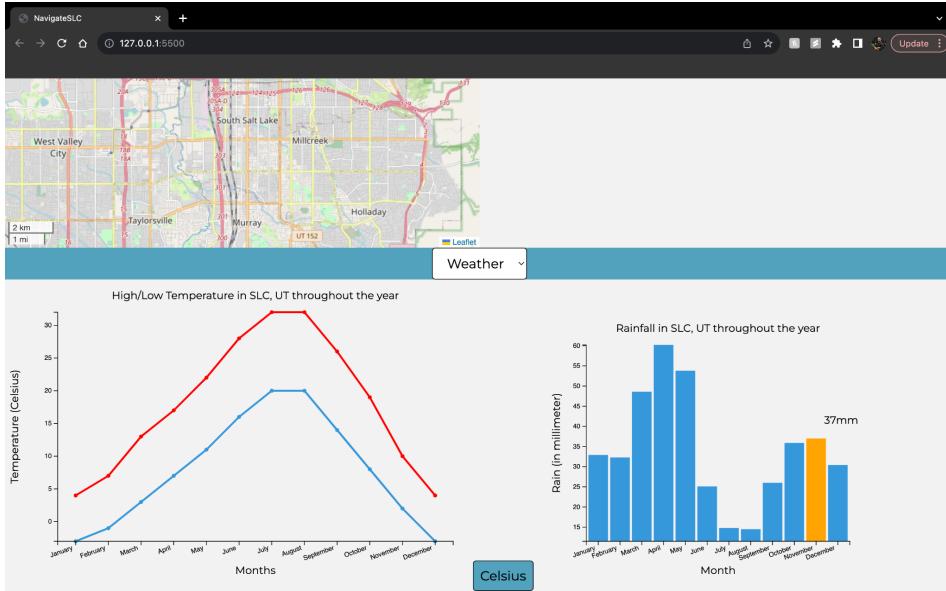
This feature helps student understand the general housing situation in SLC, giving them multiple options to choose from as per their requirements.



15. Macroscopic view - Weather - Rainfall:

The weather option in the macroscopic view depicts two charts - temperature line chart and rainfall bar chart. The rainfall chart depicts the average rainfall

(in mm) in SLC throughout the year. On hovering over a specific month the rainfall particular value is shown as a popup.

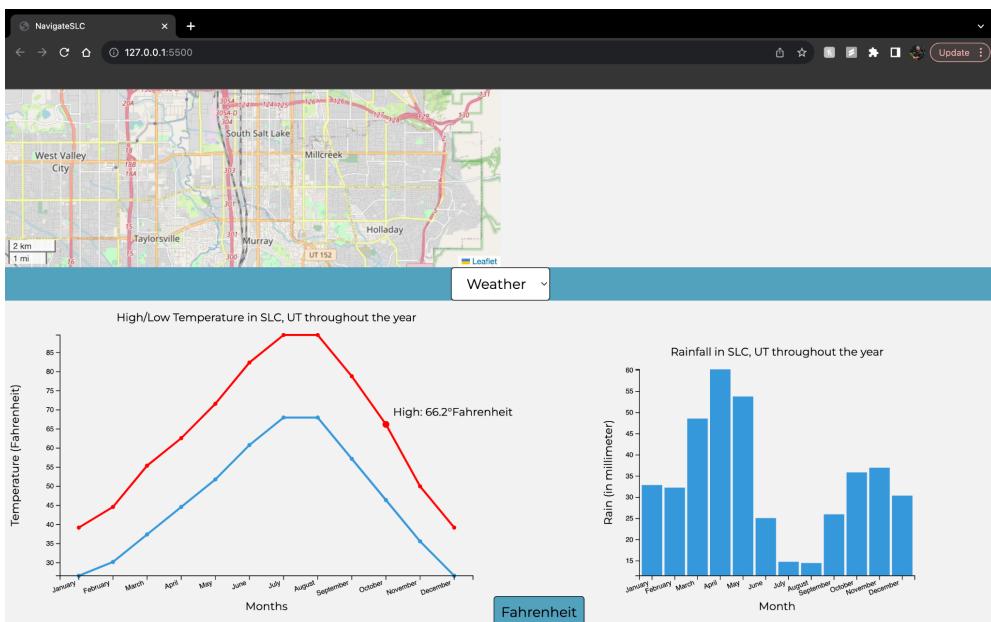


16. Macroscopic view - Weather - Temperature:

The temperature bar chart depicts the average high and low temperature monthly throughout a year in SLC. On hovering over a particular month the specific value of High or Low is shown as a popup.

The option to choose between Celsius and Fahrenheit is specifically useful to students to understand the metrics

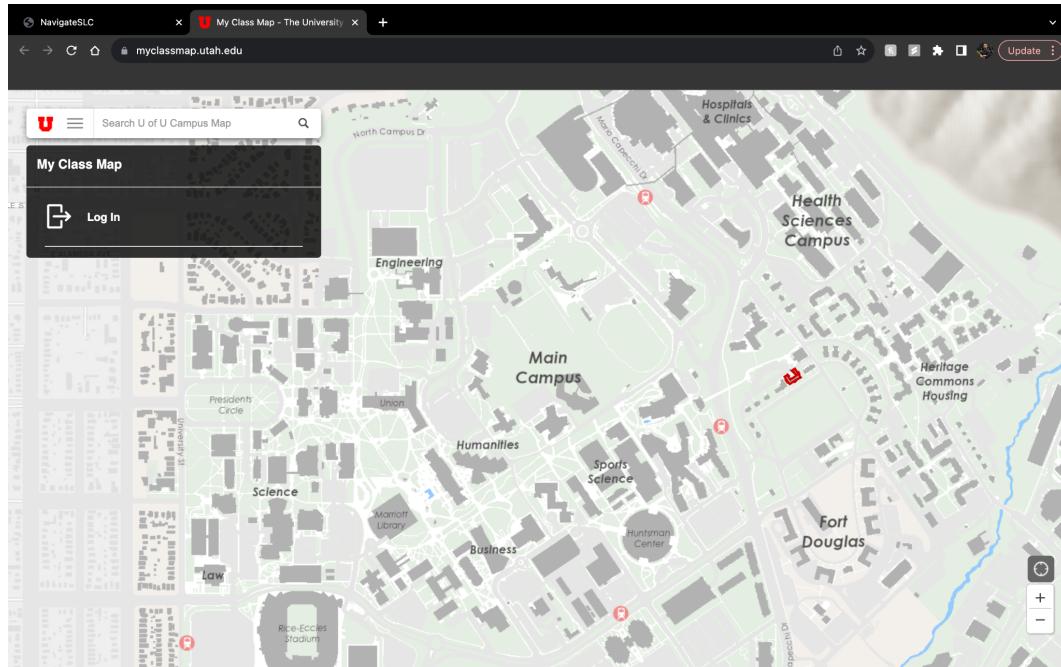
The weather throughout the feature helps students understand the climatic condition in SLC throughout the year.



17. Zoom into UofU:

The zoom into UofU feature is a hyperlink to the My Class Map website. This shows the map of the University of Utah with higher detail. It also allows the

students to login and access the exact location of their classes within the university, which helps them navigate through the university with ease.



Evaluation

What did you learn about the data by using your visualizations?

The visualizations collectively provide a comprehensive understanding of Salt Lake City's demographics, housing, transportation, and macroscopic trends, specifically targeted at students.

How did you answer your questions?

The visualizations effectively answer questions about Salt Lake City's spatial data, housing characteristics, public transportation network, city-wide rent trends, and the University of Utah campus layout. As mentioned earlier, users can explore and compare various aspects to make informed decisions.

How well does your visualization work, and how could you further improve it?

This is how the visualizations work and help the users:

Block-level visualizations

Here, two types of visualizations are shown - all attributes per block and one attribute for all blocks. As mentioned earlier, these attributes include the gross median rent, the median household income, the number of owner and renter owned houses, the gender ratio, the population density and the youth population. All of these undoubtedly play a significant role when it comes to a student looking for housing.

The selected visualizations in this section makes it extremely convenient for students to compare and contrast the different blocks of the city with respect to what the attribute(s) the student prioritizes.

Bus routes

This visualization shows the bus routes of Salt Lake City as an overlay on the interactive map, while also marking the bus stops.

The additional feature of filtering bus routes passing through a selected block further helps the student shortlist a place to live due to their close proximities to public transportation services.

Trails and Trailheads

These visualizations help students and any new-comers a list of all the trails and hikes in the proximity of the city for recreational purposes.

Macroscopic View

The macroscopic visualizations aim to show the users the trends in weather and rent prices throughout the years so they can be better prepared for the same in the future.

By addressing these points collectively, the visualizations offer a comprehensive tool for users to explore and understand Salt Lake City's diverse data sets.

Conclusions

We believe that our visualizations would be extremely useful for incoming students to Salt Lake City and hope that it would be used in the coming future. It provides an overall picture of all the important details regarding housing locations, commute, leisure activities and weather in Salt Lake City. These details will definitely aid students who are not from here, to make more well-informed decisions.

Finally, we hope that you enjoyed our visualization and functionalities and would like to thank Prof. Paul Rosen and the TA's for giving us this wonderful learning experience.