Proposal

Basic Information.

Title: "Traffic routes in the state of Utah" (may change at a later date).
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Project Repository link: https://github.com/xiaoyatang/Final-Project-VIS-2022.git
(Since our repository is private, I have added the TA account to collaborators.)

Background and Motivation.

Background:
Background work that was done on this subject is the reading of "Topological Analysis of the Evolution of Public Transport Networks". This article analyzed the topology of Stockholm's tram lines, calculated multiple metrics like the Pearson coefficient and closeness centrality, and visualized node charts with those metrics for coloring. This project showed that topological analysis describes the significance of important stations through the amount of their connections and age of creation, as the backbone of the network tends to be made first.

Motivation:
Topological Analysis is a powerful tool for understanding the relationships within complex data. Applying this to public transportation networks is useful for route planners and riders. An example is that route planners can analyze the connections of a traffic route with respect to how close it is to a core of the network. A dashboard for visualizing these properties could prove to be a powerful tool for better planning.

Milena:
What motivated me to do this project was the possibility of creating dynamic visualizations as well as the project's close connection to topology. I am currently working under Professor Bei Wang-Philips, who is known for her love for topology, so after learning many new things as her laboratory rotation student, I plan to implement them in this project. Creating a project using a programming language I have not used for projects before is very challenging but exciting at the same time, so I am looking forward to seeing how we all do our best to achieve set goals.

Tark:
I think this project will apply everything we've learned in this class so far while providing more challenges due to the preprocessing work. New techniques we will have to learn are how to zoom on maps, combine state and city views, and display routes onto maps.

Xiaoya:
I am thrilled to apply what I learn from this class to a truly meaningful project. The first idea came to us is to make a route map of the public transportation in Utah, especially in Salt Lake

City. Traffic routes on maps are often not intuitive. I think a nice-illustrated public transportation network can be truly helpful in route planning and time schedule, especially for newcomers like us. What we also want to do is to see the changes of traffic routes in this city during recent years, and to explore its connection with human and economic factors like population distribution or annual tourism revenue in a city. There are many fascinating visual analyses that can be done if we want to go further.

Project Objectives.

The most important entities for our project will be bus stops, railway stations and their connection to different routes in a large range of years (depending on how many datasets we can find). We hope users can choose the correct paths using our visualization and we can also see the obvious change of traffic routes in the state of Utah over the years from our visualization.

If we further find some dataset of on-board people during different time slots in one day, we will give a better and detailed transportation map for people who see our work. It will allow people to better schedule their time and to plan the routes. Besides, we may acquire some additional data like population distributions and apply it to the changes of traffic routes(to be determined). We plan to find some interesting connections between the public transportations and some human and economic factors in the city. Also the traffic routes may have some connections with some special facilities like schools, hospitals, supermarkets. We may give them highlights in the map, and we hope to do more fantastic interactions and explorations in our visualizations, besides just including the knowledge acquired from this class.

Some questions that our visualization would provide answers to:

1) How were the routes of different buses changing over the years, and why?
2) Which route (in a selected city) has the best availability? Which has the worst availability?
3) Is there a relationship between usage and number of stops?
4) Does usage of routes correspond to the number of other route connections?
5) What are the connections between most used traffic routes and the nearby facilities?
6) The busiest time slots of the public transportation(potentially).
7) Is there any chance of optimizing public transportations according to our findings?
8) What are the connections between the traffic network and the population distributions in the city, and is there any drawback of the route's design considering the distribution(potentially)?
9) Which city has the best bus transportation availability? (potentially)

Data.

One of the main resources our group is using to collect data is the UTA website: https://data-rideuta.opendata.arcgis.com/.

Routes Data URL:
https://data-rideuta.opendata.arcgis.com/datasets/rideuta::uta-routes-and-most-recent-ridership/about

Bus Stops Data URL:
https://data-rideuta.opendata.arcgis.com/datasets/rideuta::uta-stops-and-most-recent-ridership/about

Data Processing.

1) Traffic Routes.

Routes JSON file:
https://services.arcgis.com/5QAphMT1g51Tw2X4/arcgis/rest/services/UTA_Routes_0419/FeatureServer/0/query?outFields=*&where=1%3D1&f=geojson

Attributes: route abbreviation, route name, frequency(minutes), route type, city, county, most recent average weekday boardings, shape_length.

Data cleanup: We have concluded that substantial data cleanup is not required, except for adding some "NaN" instead of missing data for certain columns, if we see fit.

2) Bus and rail stops.

Stops JSON file:
https://services.arcgis.com/5QAphMT1g51Tw2X4/arcgis/rest/services/UTA_Stops_and_Most_Recent_Ridership/FeatureServer/0/query?outFields=*&where=1%3D1&f=geojson

Attributes: stop name, city, zip code, county, routes served, stop number (integer), stop abbreviation (text), mode (bus or rail), average weekday boardings and alightings, latitude, longitude.

Data cleanup: We have concluded that we might require some substantial data cleanup but due to the fact that this dataset is secondary, we have not proceeded with it yet.

Visualization Design.

We are planning on creating a dynamic map of the state of Utah state, which, by zooming in, will provide the information about different routes used in that city. The interface will be interactive, so clicking on each route will provide the information about the traffic route itself. We also plan on showing filters for the map on the left side of the map, so the user can "filter" the output for the map at their own discretion. The attributes we plan on using for filters are the following: route type, frequency, city, route.

Another visualization will show some kind of graph of comparison of selected routes based on different attributes stored for each of them. So far we are thinking about comparing routes with different frequencies in comparison to their weekday ridership values. This visualization will be placed on one of the sides of the main map, [Figure 2]. Our choice of marks and channels will be based on what attributes we decide to compare, so we have not decided on something specific just yet.

Previous prototype is illustrated in [Figure 1] and shows a previous version of the final visualization design while we were still brainstorming.

Another sketch also shows the current final layout of our visualization [Figure 3]. We also left some extra space for potential other implementations in case we needed to. If we end up not

using it, we can just fix margins of the map and graph spaces, or potentially move the description there.

We also plan to add another dataset for bus stops and overlay the existing routes to the acquired bus stops data in the same area. If we succeed in doing that, then we plan to derive some kind of correlation between the stops and route’s variables.

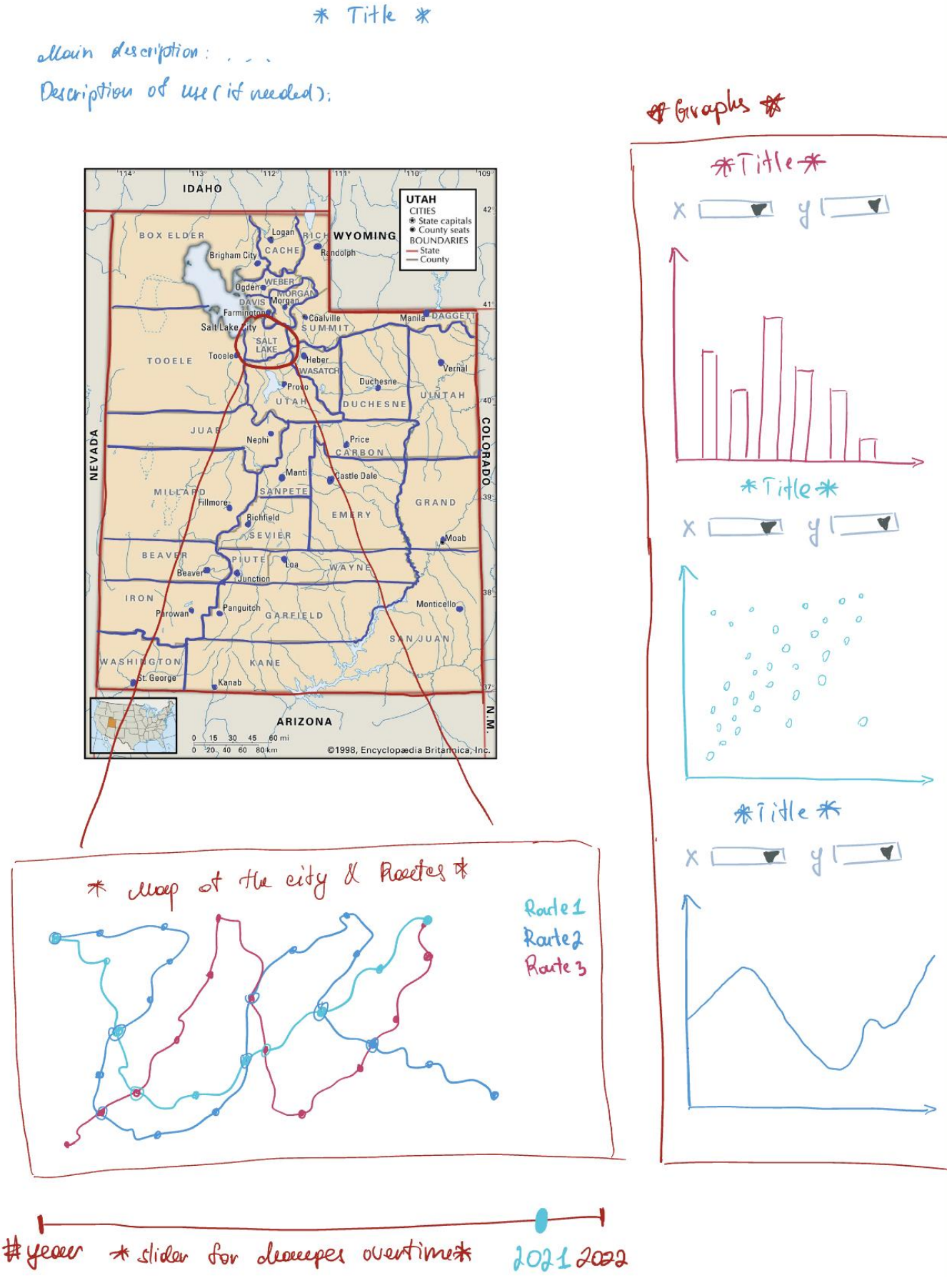

Figure 1: *Initial Sketch*

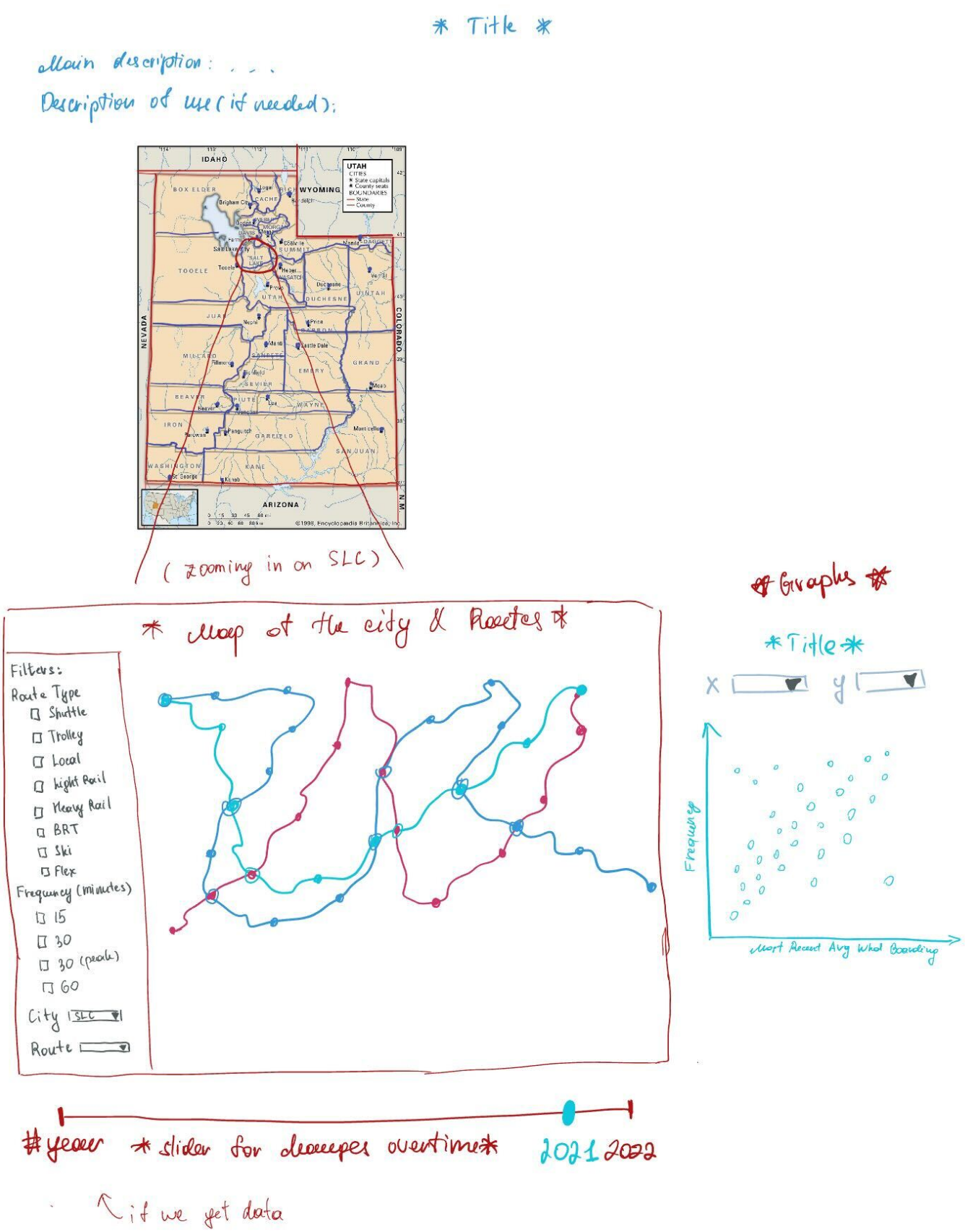

Figure 2: Final Sketch

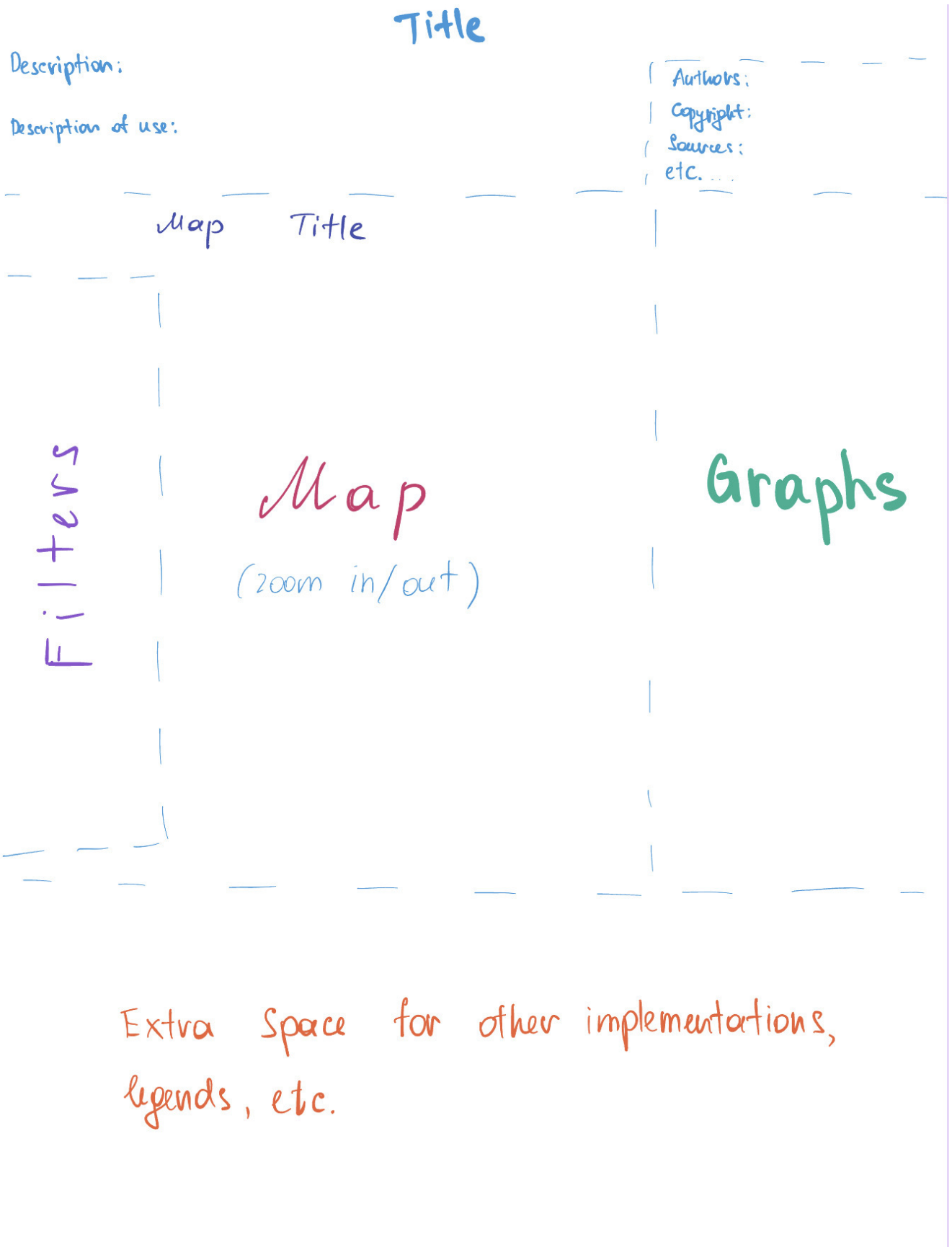

Figure 3: Layout

Must-have Features.
Correct data application and processing, correct map about traffic routes, correct add-on map (layer) about bus and rail stops, implemented map filters on the side, drop-down selectors/sliders for year switch (if we acquire data), map zoom from the state to city view and back, some kind of graphs on the side for attribute comparisons, …

Optional Features.
Highlighted special locations, district borders, population distributions in the state, tooltips for each route/stop, interactive popout when you choose some "connection" buttons (besides the tooltips), search bar for routes/stops, …

Project Schedule.

P.S. We plan to further separate duties weekly depending on everyone's availability.

Week	Milena's part	Tark's part	Xiaoya's part	End result for the week
Week 1 (fall break)	Send the request for data acquiring, document the progress. Work on the proposal, upload sketches.	~	Discussing the ideas. Work on the proposal.	Acquired data for traffic routes, proposal draft.
Week 2	Acquire data for bus stops, add files to the data folder on GitHub, upload the proposal.	Help with data preprocessing	Collaborating with the dataset preprocessing. Updating the repository.	Data processing, submit the proposal.
Week 3	Division of working space through different divs, data binding (routes).	Set up basic map view of Utah and cities	Collaborating with the map view.	Initial space division for the map and its extras.
Week 4 (Peer Review)	Data binding (routes) finish, extra features.	Add bus and rail stops	Add highlighted locations on the map.	Transit data added to views.
Week 5	Tooltips, graph ideas & some implementation	Add selecting cities from map vs	Collaborating with the interactivity for routes map and graphs.	Add interactivity for map routes and stops, add filters, add graphs.
Week 6 (Project Milestone)	TBD	Add info on route selection	Finishing the must-have visualizations.	Finish graphs and filters, debugging.
Week 7	TBD	TBD	Optimizing the vis. Add potential analysis.	Potential extra work for the visualization as described above.
Week 8	TBD	TBD	Collecting the required files.	Finalize the changes made, make the presentation video, combine all the required files for submission.