EleNA: Elevation-Based Navigation App

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The Problem

We all have had moments where we wished we had a system that could tell us the **optimal path to our destination** but, **taking altitude into consideration**. Not every time the the shortest lateral distance between two points is the best route in a terrain. This is exactly what EleNA tries to solve. **EleNa is an altitude-aware program** which can take elevation gain or loss into account when planning routes between two points. Unlike traditional mapping applications, EleNA **allows users to specify a threshold distance** that will search for the maximal or minimal elevation gain or loss.

Guiding Principles

Functional Requirements

- Authentication
- Map API Connection
- Efficient Pathfinding Algorithm

Non-Functional Requirements

- Usability
- Testability
- Privacy

Full requirements document available here: [link]
(must use UMass account to view)

Project Design/Architecture

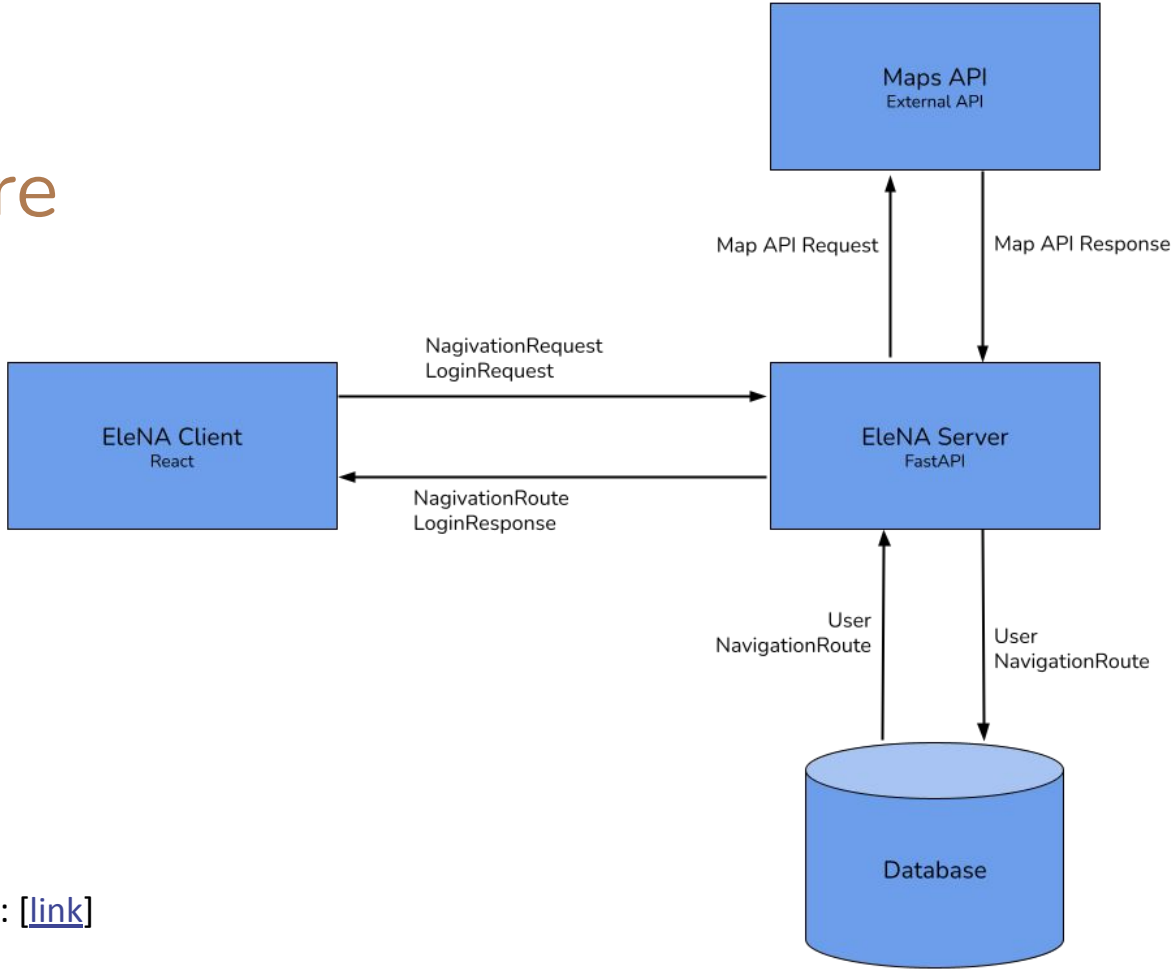
Backend

- Python
- FastAPI
  - Integrates well with OAuth
  - Easy to build
  - Performant
- MongoDB
  - Easy serialization/deserialization
  - Free cloud hosting
  - Flexible schema

Frontend

- React
- Material UI

Architecture



Data model details available here: [link]
(must use UMass account to view)

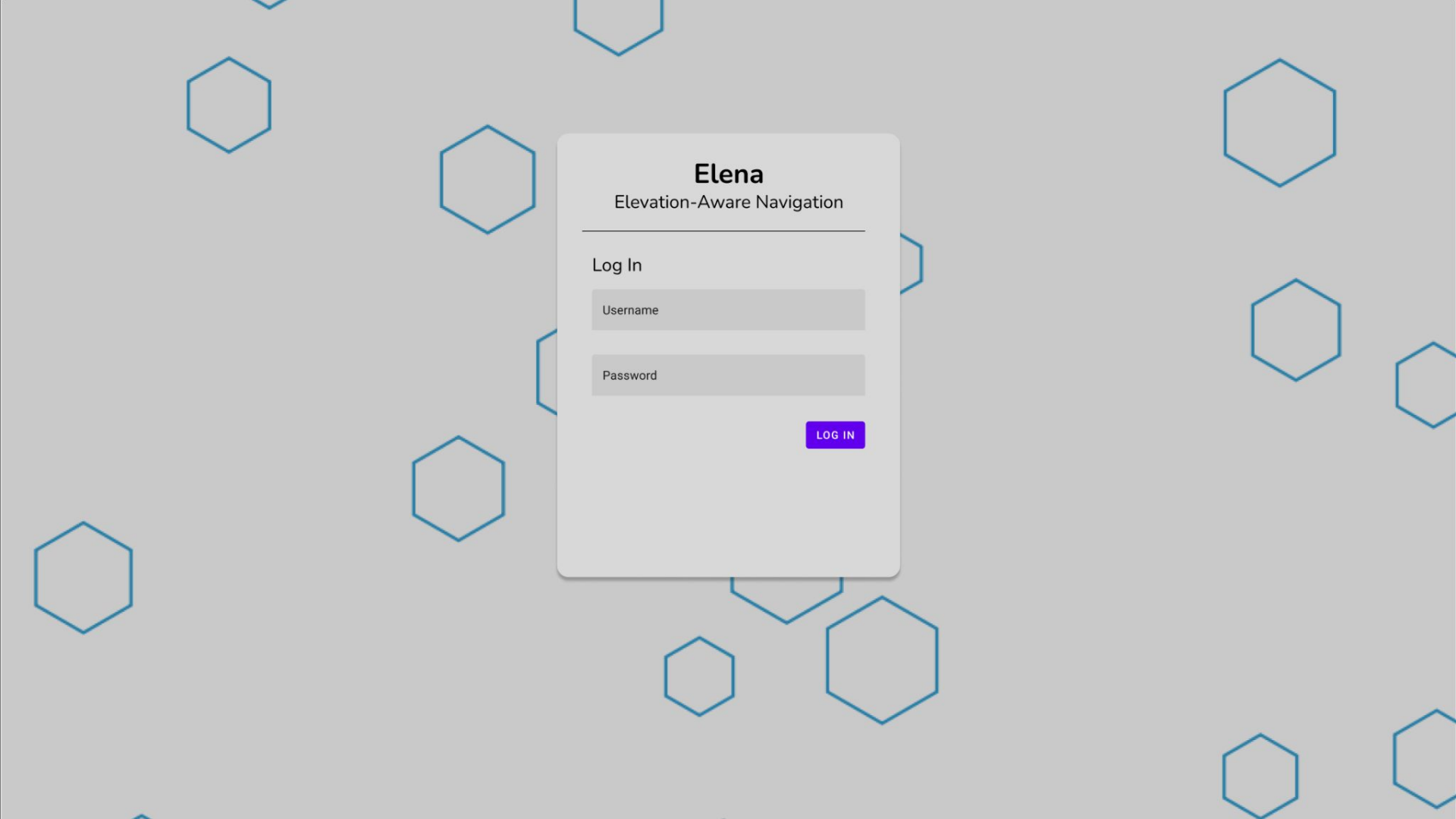
Scalability

- Containerization
  - All components of project self-contained and buildable from Dockerfiles.
  - Containerization of all services enables scalable cloud hosting
- Orchestration
  - Docker-compose used to manage multiple containers simultaneously, scalable in the future to large scale orchestration tools like Kubernetes
  - If large load on the system, can spin up additional containers to meet demand.
- Location-Independent Routing
  - Scalability of our system allows for routing in any geographic area, regardless of demand.

Pathfinding Algorithm/s

- A*
  - Easy to implement
  - Reasonably performant
  - Cost function allows us to handle the elevation preference directly in the algorithm
    - Edge weights must be positive
  - O(|E|)
- Bellman-Ford
  - Slower than A*
  - Allows negative edge weights
    - Useful if we want to insert elevation preference via subtraction
  - O(|V||E|)

Mockups


Elena
Elevation-Aware Navigation
Log In
Username
Password
LOG IN

Route Selection

Origin

Select the starting point of your journey

Destination

Select the end point of your journey

Navigation Mode

Minimize Elevation | Most Direct | Maximize Elevation

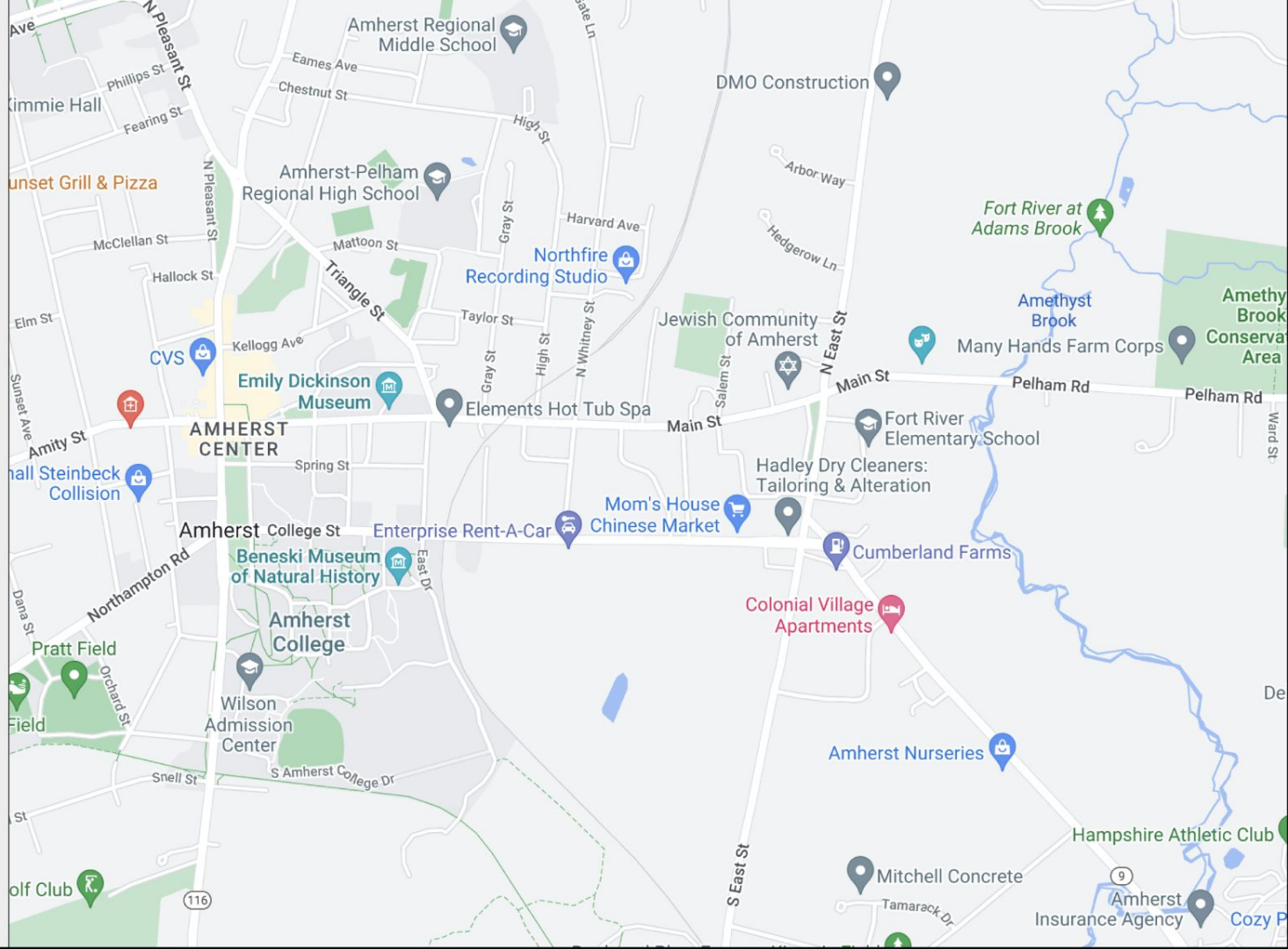
Maximum Route Distance

1x — 10x

9x

Your route can be this many times longer than the most direct path to meet your criteria

NAVIGATE



Route Selection

The Halal Cart

Select the starting point of your journey

Cumberland Farms

Select the end point of your journey

Navigation Mode

Minimize Elevation | Most Direct | Maximize Elevation

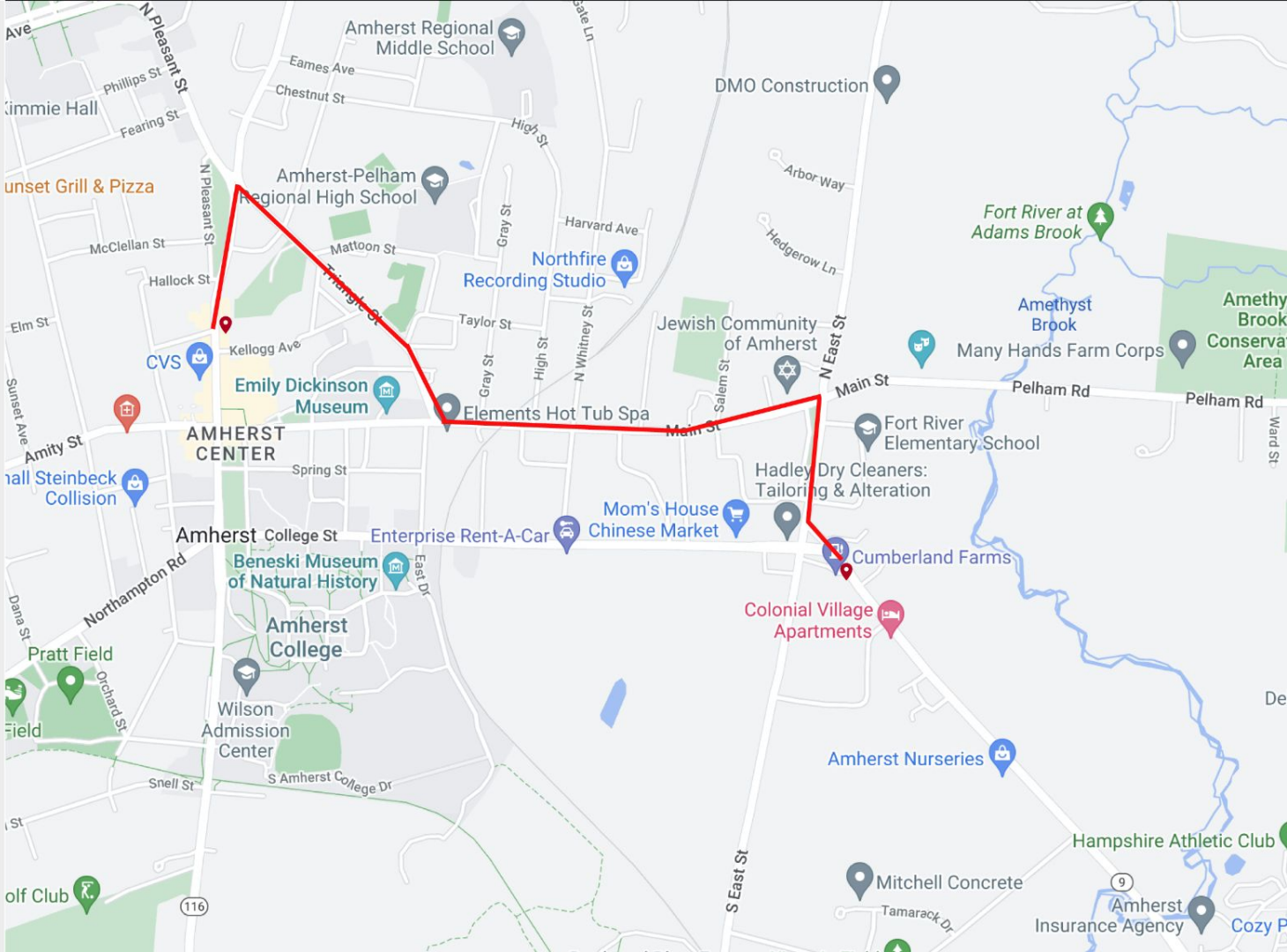
Maximum Route Distance

1x — 10x

9x

Your route can be this many times longer than the most direct path to meet your criteria

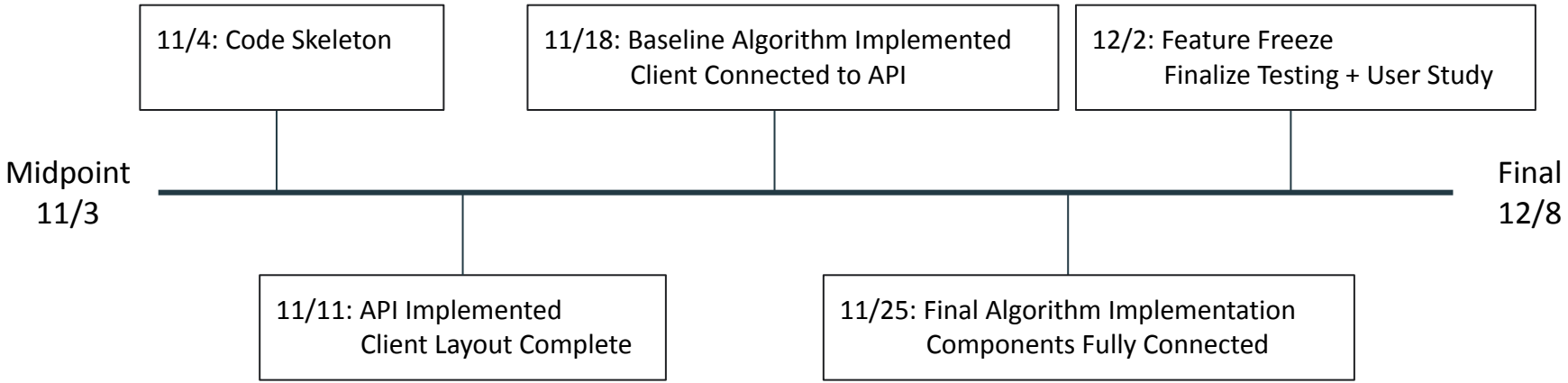
NAVIGATE



Testing Plan

- pytest Python testing framework
  - Integration with FastAPI, our backend framework
  - Run tests in parallel
- Unit testing
  - Will compare to hardcoded ground truths
- High Code Coverage
- React Component Tests
  - Can use snapshot testing to ensure functionality
- User testing at end of project

Planned Timeline



Division of Work

- Casey Ryan
  - Algorithm Focus
  - Backend Secondary
- Cody Richter
  - Frontend Focus
  - Backend Secondary
  - Devops Tertiary
- Sohan Show
  - Backend Focus
  - Frontend Secondary

Thank you!

We are happy to answer any questions