



Roads of the Sea

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Problems

- Navigation through the ocean is not a simple linear process
 - No true “road-like” routes defined
 - Multiple routing/traffic separation schemes for navigation
- Accidents can take place when a ship takes a route for the first time/changes course
- Ship paths are hard to predict so collisions can occur

Solutions

- Ships utilize an automatic tracking system known as the Automatic Identification System (AIS)
 - AIS reports ship IDs (MMSI), coordinates, headings, sizes, etc.
 - Analysing this data can help us understand ship navigation tendencies

MMSI	LAT	LON	DRAFT
366976870	47.35679	-122.4145	4.9
375903000	38.72557	-73.25068	6.3
366760650	41.05959	-69.29142	4.3
367005130	57.78607	-152.41035	3.3
316013397	18.17757	-64.93496	5

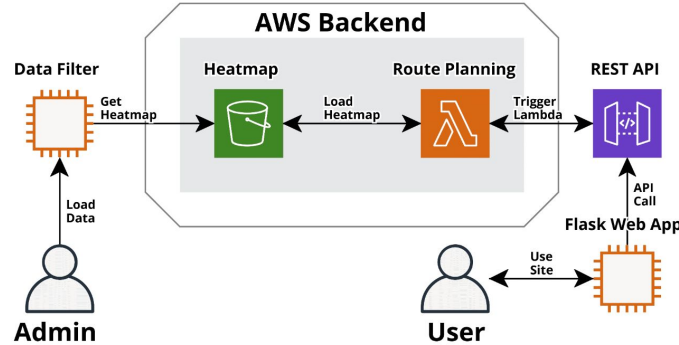
Subset of AIS Data

Background

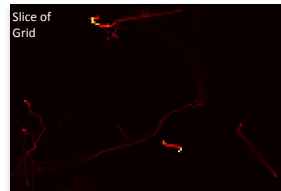
Three main requirements:

- Shows the activity of ships as a heatmap and groups major activity “paths”
- Assists in navigating a user from one port to another
- All aspects of the tool can be used through a web interface

Design

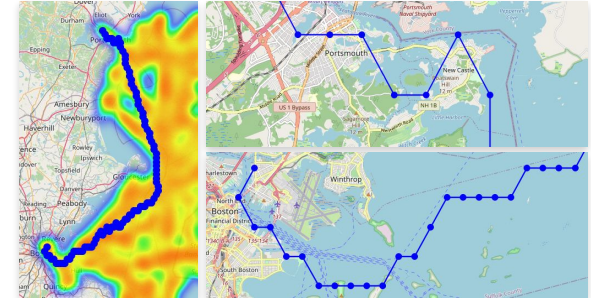


- API deployed on AWS with a serverless architecture
- Data stored in grid-based heatmap using Lambert Cylindrical Equal-Area Projection
 - Each grid square is $0.01^\circ \times 0.01^\circ$ and stores the count of ships grouped by size that have travelled through that area
- Filter automatically uploads data to existing heatmap
- User interaction through API/web interface
- Pathfinding with A* over grid-based heatmap of ship traffic
 - Finds best route of least cost by incorporating path traffic density



Results

- Constructed Heat maps tracking major ship activities and implemented pathfinding algorithm
- Pathfinding constructs a path that follows previous traffic even avoiding a straight path through land
- Each “dot” in the path refers to the center of a corresponding grid square so some accuracy is lost in favor of a general route



Future Work

- Refine route creation through more robust coordinate validation
- Implementation and refinement of ship route prediction system
- Implementation of machine learning techniques to solve issues in historical AIS data
 - Ex: Classifying idling ships obscuring routes
- Interpolating missing data
- Implementation of real-time data usage
- Update ship characteristics database with confirmed accurate data

References

Office for Coastal Management. National Oceanic and Atmospheric Administration, 2020, <https://coast.noaa.gov/>. Accessed 15 Mar. 2021.