ASSIGNMENT 3

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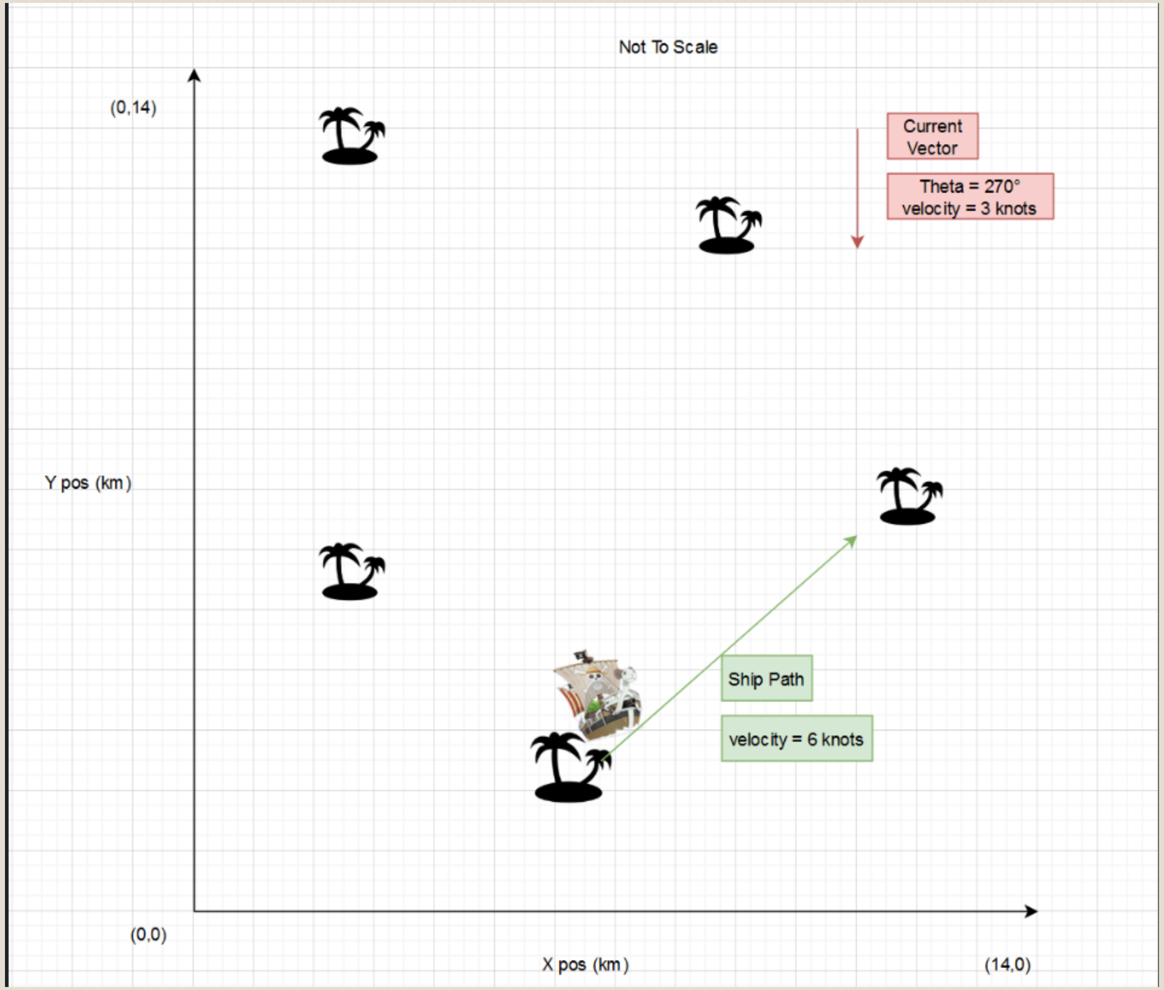
Report Table

Base Model	Travelling Sales Person, used to compute the shortest path between n points
Extension Assumptions	Consider Travelling sales person as a ship navigating islands. Introduce a known current which will either speed up / not affect / slow down the ship, depending on the angle between them. Now we seek to minimise total travel time of the ship between the islands. Finally, introduce an unknown stochastic current.
Techniques showcased	Simulated Annleaing & Monte Carlo Simulation.
Modelling question 1	How does a constant current impact our ship's ability to navigate the ocean?
Modelling question 2	How does an unknown stochastic current impact our ship's ability to navigate the ocean?

Introduction

- Optimal tour vs shortest tour
- Consider a ship moving between Islands
- Introduce a current
- Minimise total travel time

Example Visualisation



Key Questions

- 1. How does a constant current impact our ship’s ability to navigate the ocean?
  - 1.1 Is there a connection between angle and magnitude of the current and solution path shape?
  - 1.2 Does the optimal route differ from the shortest?
  - 1.3 What happens to the total travel time of our ship? Increase / decrease / variable?
- 2. How does an unknown stochastic current impact our ship’s ability to navigate the ocean?
  - 2.1 Is Monte Carlo simulation useful for finding a "good path" (relative to the true optimal on the given day)?
  - 2.2 Are there any trends in the optimal paths across the simulations?
  - 2.3 Are there any limitations to Monte Carlo simulation that impact our ability to find a close to optimal path?

Techniques

- Simulated Annealing

- Monte Carlo Simulation

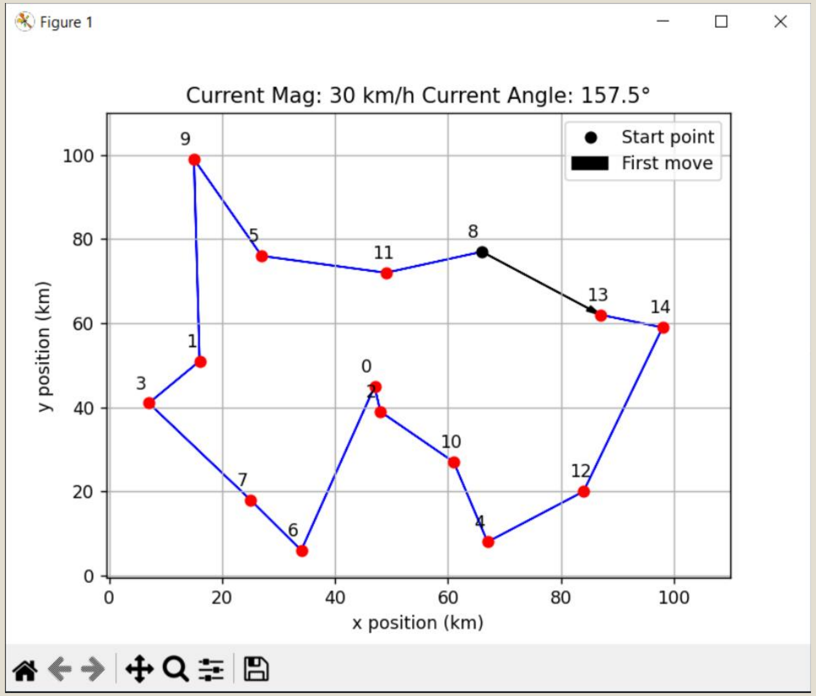
Base Model Assumptions

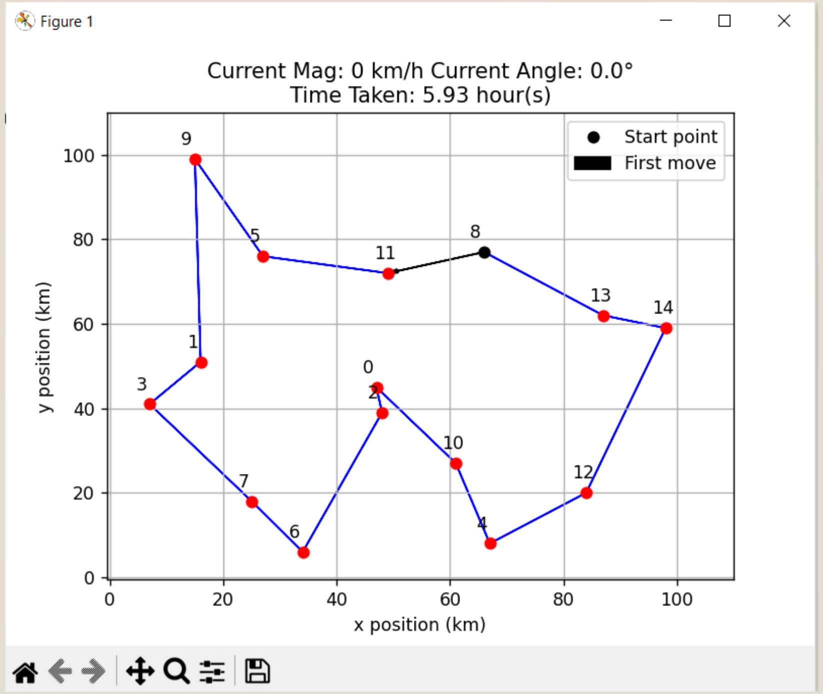
- Instead of a Travelling salesperson we now consider a ship that must Travel between N islands.
- All islands must be visited once.
- Islands cannot be revisited.
- Each island exists at some point (x_i,y_i).
- The ship starts at an island (x_0,y_0).

Extended Model Assumptions

- The ship now moves at a constant velocity v.
- There exists a vector S, which describes the velocity and direction of the ship moving between two islands.
- For any day there exists a constant current C, which is comprised of a magnitude M and a direction θ.
- Given a path for our ship between any two islands. Our ship will either be sped up, slowed down or unaffected by the current C
- We now seek to optimise the total time taken for our ship to complete the voyage between all islands.

Initial Model Failure





Results

- Optimal path differs from shortest
- Relationship between current angle and optimal path
- Two new algorithm behaviours
- On average travel time increased
- Monte Carlo was effective at estimating, <10 % difference
- Key limitation is island number