Universidad de Puerto Rico
Recinto Universitario de Mayagüez
Departamento de Ingeniería de Eléctrica y Computadora

Artificial Intelligence Project Proposal

Grupo:
Julibert Díaz Collazo
Luis F. Quiles Ruiz
Manuel E Castañeda Neris

ICOM 5015/CIIC 5015 – 030
Fecha: 27 de abril de 2020

I. **Project Description**:

Map and GPS services typically incorporate a route optimization element to select the fastest routes to reach the user's selected destination. This element uses traffic, average velocity, distance and other real-time data to estimate travel times and dynamically change routes as the situation changes. The purpose of this project is to explore the route optimization element by designing and implementing agents with different search algorithms. Using recollected data to find the average of key properties relevant to this process, the agents will find the optimum route based on their corresponding criteria. Once the routes are found, the agents will be compared based on the travel time of those routes to conclude which algorithm yields the highest performance.

The graph shall be populated with locations, such as cities, stores or points of interest, with approximate distance information. For initial testing purposes small regions could be chosen, but the agent's capabilities will be able to scale to larger regions with more locations and routing alternatives. The stochastic elements mentioned, such as traffic, velocity and accidents, shall be obtained from online services, such as Google Maps, Apple Maps or Bing Maps, as historic data in order to approximate and store locally in CSV files. This data will then be used in the agent's functions to select the optimal routes.

One of the agents will use the A* algorithm to optimize the route.*"What A* Search Algorithm does is that at each step it picks the node according to a value-'**f**' which is a parameter equal to the sum of two other parameters – '**g**' and '**h**'. At each step it picks the node/cell having the lowest '**f**', and processes that node/cell.*

1. ***g** = the movement cost to move from the starting point to a given node.*
2. ***h** = the estimated movement cost to move from that given node on the grid to the final destination. **This is often referred to as the heuristic, which is nothing but a kind of smart guess**.* [1]*"*

The agent will use distance as its evaluation function to determine the best routes to take. Once it finds a route with minimum travel distance, a speed approximation will be used to

determine the route travel time. In order to validate that it is admissible and consistent, data from the previously mentioned online map services will be used to verify distance between locations and their approximations to the goal. The other agent will use the Simulated Annealing algorithm to optimize the route. "*The simulated annealing algorithm was originally inspired from the process of annealing in metal work… In simulated annealing we keep a temperature variable ... We initially set it high and then allow it to slowly 'cool' as the algorithm runs… This gives the algorithm the ability to jump out of any local optimums… allowing the algorithm to gradually focus in on an area of the search space in which hopefully, a close to optimum solution can be found.*[2]" In essence, simulating annealing progressively filters through local maxima testing out options until the agent finds an optimal or close to optimal solution. In this case, the temperature provides a means to determine stochastic elements.

The Simulated Annealing agent will use traffic, accident probability and velocity data, which could be incorporated into the A* agent's evaluation function, to search for routes with minimum travel time. These times will be used to compare the performance of the agents.

Performance measures:

1. *Estimated time*: the approximate time it'll take the agent to reach the destination given the weather and traffic density.
2. *Velocity*: the rate at which the agent moves from node to node.

Stochastic elements:

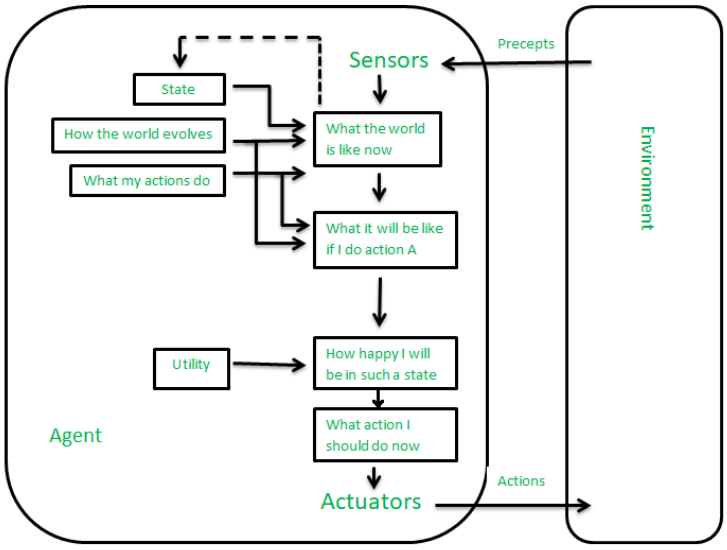
1. *Traffic*: Will influence the velocity at which the agent travels and the rate of accidents on route.
2. *Accidents*: Can either increase traffic on varying levels (mild, moderate, severely) or block a route altogether.

Agent Description:

1. *Agent type:* Single Agent
2. *Fully* observable : The agent has all data in the CSV.
3. *Sequential* : The next action or state of the agent depends on the previous actions or state reached by the agent.
4. *Static* : The conditions of the state do not change while the agent deliberates.

5. *Discrete* : The agent has only a finite number of options to choose for the next state.
6. *Known* : The agent knows its function, data and goal, it does not need to learn from scratch or from an external source.

Both agents can be considered utility based. "*...They choose actions based on a* ***preference (utility)*** *for each state. Sometimes achieving the desired goal is not enough. We may look for a quicker, safer, cheaper trip to reach a destination. Agent happiness should be taken into consideration. Utility describes how* ***"happy"*** *the agent is....*[3]" For our purposes, "happiness" will be measured with the time achieved.



Legend:

Environment: current location.

Precepts: distance, time, weather, traffic status.

State : It will change until it reaches the desired state.

Actions: Selection of the next state.

Utility: It will be the time it takes to reach the desired state.

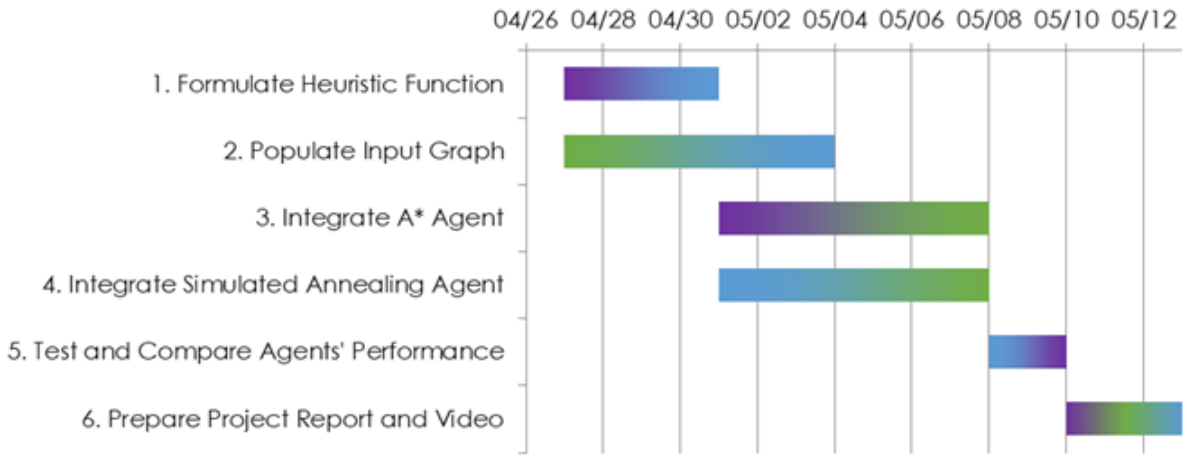
II. Objectives

1. To design agents that maximize their utility.
2. To implement search algorithms (A*, Simulated Annealing) to optimize routes.
3. To compare the performance of different agents based on their travel time.

III. Tasks and Schedule

Julibert Diaz	Dates

• Formulate relationship between parameters for heuristic function • Integrate A* agent • Test and compare the agents' performance • Prepare Project Report and Video	4/27 - 5/01 5/02 - 5/08 5/08 - 5/10 5/10 - 5/13
Luis F. Quiles	Dates
• Formulate relationship between parameters for heuristic function • Populate input graph with selected cities with CSV files • Integrate Simulated Annealing agent • Test and compare the agents' performance • Prepare Project Report and Video	4/27 - 5/01 4/27 - 5/01 5/02 - 5/08 5/08 - 5/10 5/10 - 5/13
Manuel E. Castaneda	Dates
• Populate input graph with selected cities with CSV files • Integrate A* agent • Integrate Simulated Annealing agent • Prepare Project Report and Video	4/27 - 5/01 5/02 - 5/08 5/02 - 5/08 5/10 - 5/13



6. **Bibliographic references**:

[1] "A* Search Algorithm," *GeeksforGeeks*, 07-Sep-2018. [Online]. Available: https://www.geeksforgeeks.org/a-search-algorithm/. [Accessed: 25-Apr-2020].

[2] "Agents in Artificial Intelligence," *GeeksforGeeks*, 06-Aug-2019. [Online]. Available: https://www.geeksforgeeks.org/agents-artificial-intelligence/. [Accessed: 25-Apr-2020].

[3] "Simulated Annealing for beginners," *The Project Spot*. [Online]. Available: http://www.theprojectspot.com/tutorial-post/simulated-annealing-algorithm-for-beginners/6. [Accessed: 25-Apr-2020].