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Project Report

Due: 04/26/2017

Design a rational problem-solving agent for an interesting application. Two algorithms – genetic algorithm (GA) and simulated annealing (SA) – should be used independently to solve the problem. In the project report, include the following:

What is your application problem?

Initial State:

The predator spawns in the upper-leftmost corner of the grid, the prey spawn randomly throughout the grid.

Actions (ACTION(s)) and Transition Models (RESULT(s, a)):
The predator has a set of actions that it can carry out every tick:
- Move: Moves one tile adjacent of current position of the predator.

    Formal Action: Position(GridTile), {Move(NeighboringGridTile)}

    Formal Result: Position (GridTile), Move(NeighboringGridTile) = Position(NeighboringGridTile)

- Drink: Only usable on water tiles; predator drinks to relieve thirst value.

    Formal Action: Position(GridTileNeighboringWaterTile), {Drink()}

    Formal Result: Position(GridTile), Drink() = (self.thirst = 100.0)

- Attack: If at least one prey exists in an adjacent tile, predator attacks prey, prey disappears, and predator moves to prey's previous location.

    Formal Action: Position(GridTileNeighboringPrey), {Attack()}

    Formal Result: Position(GridTileNeighboringPrey), Attack() = (prey.removed , Move(prey.position)

The prey's actions:
- Move: Moves one tile adjacent of current position of the predator.

    Formal Action: Position(GridTile), {Move(NeighboringGridTile)}

    Formal Result: Position (GridTile), Move(NeighboringGridTile) = Position(NeighboringGridTile)

Goal Test:
Has the predator kept his hunger and thirst bars above 0% for the duration of the program?

Path Cost:
The number of ticks spent for the action taken to reach the next node/state.

Describe the representation of your problem that is used to solve the problem using GA.

I use the genetic algorithm when the predator must decide which path to take to get to a water tile in the grid. Using the genetic algorithm in this way returns an entire path, which the predator can then use to travel efficiently to the closest water source.

Describe the representation of your problem that is used to solve the problem using SA.

I use simulated annealing when the predator must decide which path to take to get to a prey object in the grid. Since the prey are constantly changing location, I have the simulated annealing algorithm simply return the best possible move *towards* the prey, so that the path is updated after every move by the predator.

Mathematically define the fitness function for your problem for GA.

In code, it is represented as:

```
-SimulatedAnnealing.distanceFormula(finalLoc, this.goal)-(this.maxDistance/100);
```

Now to break it down:

- First, we take the distance between the final location of the path and the goal location as a negative value (distance)
- Then, we take the maximum number of moves allowed for a population and divide that by 100, so that we can have a more precise fitness value for use in comparisons (maxDistance/100)

Mathematical Representation:

-distance – (maxDistance/100)

Mathematically define the objective function for your problem for SA.

In code, it is represented as:

```
Math.exp( (currentEnergy - newEnergy) / temperature );
```

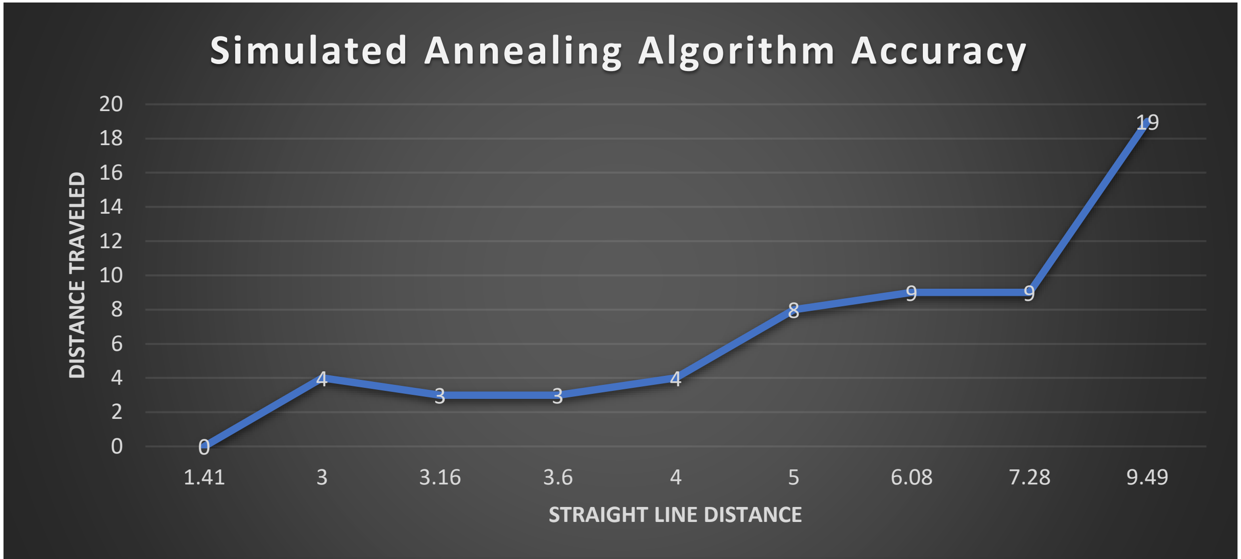
Now to break it down:

- First, the current energy of the best solution (distance)
- Then, we take the maximum number of moves allowed for a population and divide that by 100, so that we can have a more precise fitness value for use in comparisons (maxDistance/100)

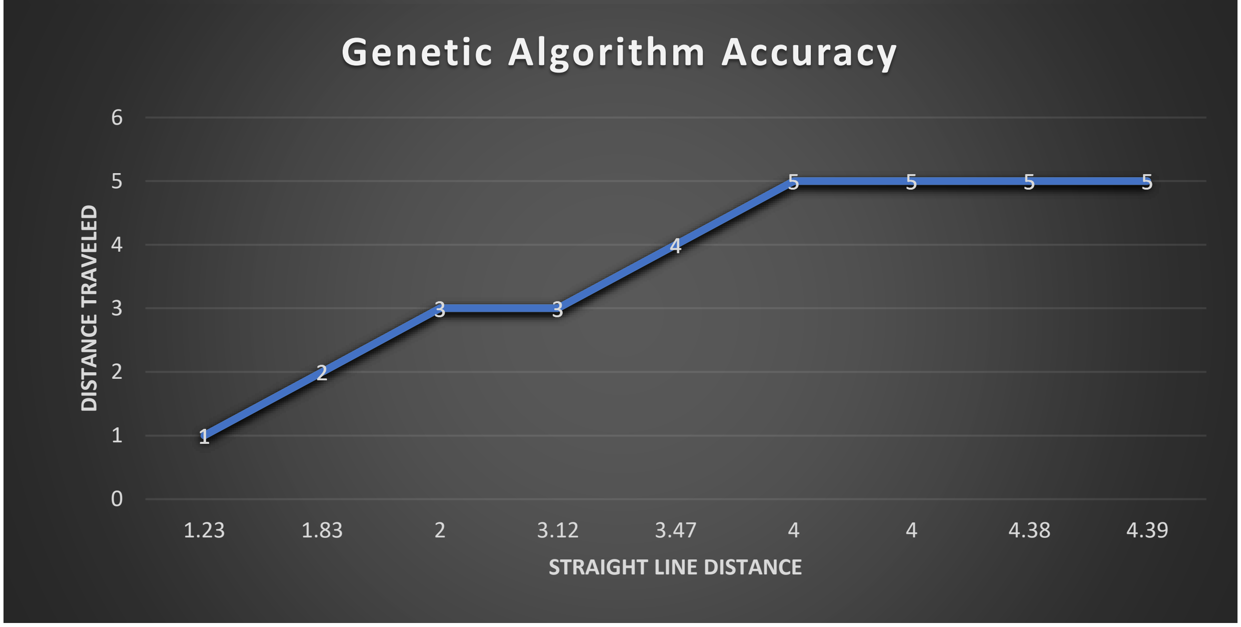
Mathematical Representation:

-distance – (maxDistance/100)

Compare the two algorithms using the accuracy of your solution.

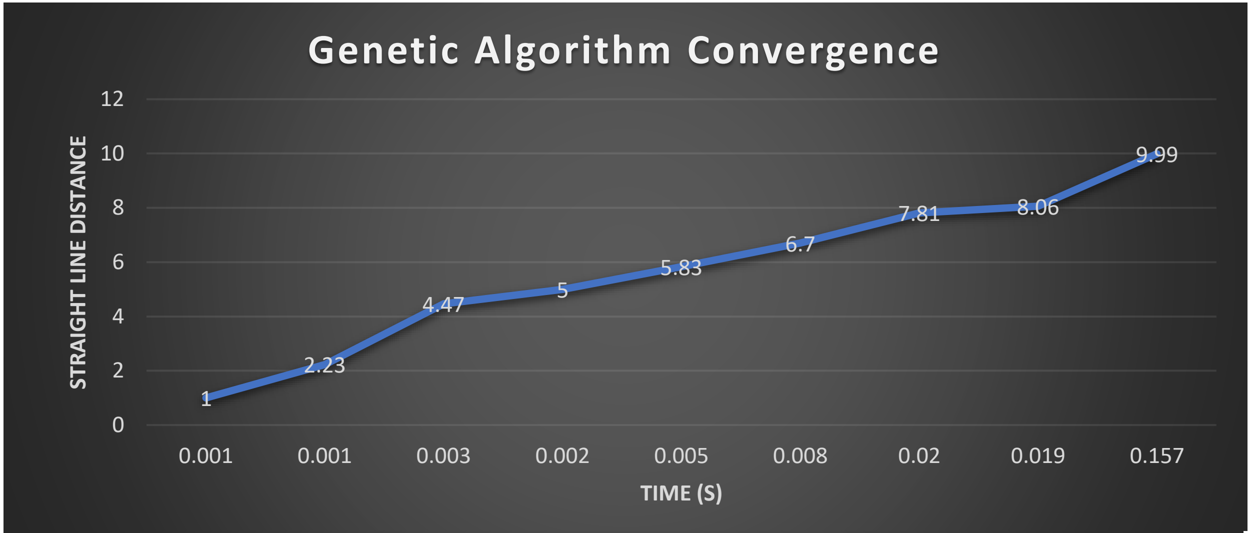


Simulated Annealing Algorithm Accuracy

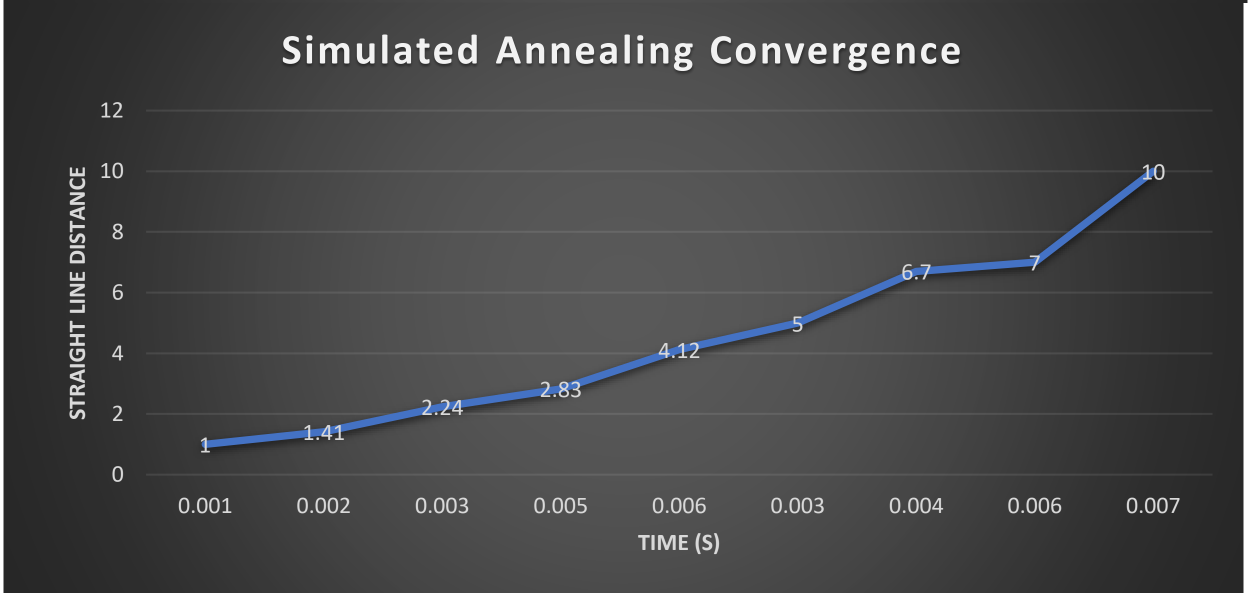


Genetic Algorithm Accuracy

Compare the two algorithms using the time (in seconds) required to reach convergence. Show convergence plot for each algorithm. Calculate time taken as discussed in class today (4/21/2017).



Genetic Algorithm Convergence



Simulated Annealing Convergence