July 14, 2021

ECE 457A: Assignment 3

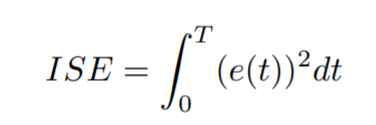
Daivik Goel, Bosco Han, Lichen Ma

# Question 1

### Suitable representation:

### Formulate a fitness function used to evaluate a solution

The fitness function used to evaluate a solution is the inverse of the integral squared error (ISE):



Where e(t) is the error signal in time domain.

Thus, to optimize the PID controller, we need to minimize the ISE value.

### Genetic Algorithm with population of 50, generations = 150, crossover probability = 0.6, mutation probability = 0.25

### with fitness proportionate selection and elitism survival selection to keep the best two individuals

### Plot of fitness of best solution in each generation

# Question 2

# Question 3

1. Using the NetLogo web interface we get to see the ANT model in action. For this question we will try varying the population size, diffusion rate and evaporation rate to see what effect it has on the time it takes to get the food from the piles.

Chart, line chart

Description automatically generatedThis is our base case with population set to 30, diffusion rate set to 40 and evaporation set to 10.

In increasing our population to 50 and keeping the rest of the parameters the same we see longer time for pile 2 and 3 to be destroyed. In fact, it almost looks like the time increase is directly proportional to the increase in population. As the population went up 1.6x the time for the piles to be finished also seemed to go up the same amount.

Chart, line chart

Description automatically generated

In increasing our population to 100 and keeping the rest of the parameters the same we get the following graph. The time for each of the piles drastically decreases.

Chart, line chart

Description automatically generatedIn increasing the diffusion rate to 80 while having a 100 population and the evaporation to 10 like was previously we get the following graph.

Chart, line chart

Description automatically generatedWith the diffusion rate increased we see the food in the piles overall decrease quicker with the exception pile 2 which takes longer.

Chart, line chart

Description automatically generatedIncreasing the evaporation rate from 10 to 20 while keeping all other parameters the same gives us the following graph.

The graph resembles the previous one but piles 3 takes around 3 times the amount of time to be fully eaten.

1. Below is the code implementation of the ACO algorithm.