## Question 4:

### Genetic Algorithm Pseudocode

A screenshot of a computer program

Description automatically generated

## Question 5:

### Box Plots

A diagram of a graph

Description automatically generatedA diagram of a box

Description automatically generated

Time Budget: {20, 60}

Mutation Rate: [0.01, 0.2]

A diagram of a box diagram

Description automatically generatedA diagram of a box plot

Description automatically generated

Population Size: {20, 200}

Treedepth: {3,10}

A diagram of a box

Description automatically generatedA diagram of a box plot

Description automatically generated

Penalty Weight: [1,4] 

Treedepth: {3,10}

The above boxplots show the distribution of fitness results when tuning a given parameter. The captions contain the ranges tested: {} denotes an Integer range and [] a Real range. From these results we can determine which parameters have the highest effect on the quality of the final solution. For example, *time\_budget* has a very flat box, meaning the results were mainly very similar, suggesting that this parameter has less impact on the final result than others. On the other end of the spectrum, *offspring\_size, tree\_depth* and *penalty\_weight* have a wider spread of results, suggesting that these parameters have a greater effect on the results. Another interesting observation is the mean value is always towards the higher end of the interquartile range and approximately 2400~. This is most likely an indicator of the effectiveness of my genetic algorithm with the default values of the parameters not being tuned.

From my tuning process the final values I got for the parameters were:

* Time Budget: 20
* Population Size: 118
* Penalty Weight: 1.1
* Mutation Rate 0.14
* Offspring Size: 16
* Tree Depth: 5