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Genetic Algorithms

1. Written Exercises
   1. TEXT EXERCISE 5: Explain the genetic operator: selection, crossover, and mutation used in GA.
      1. Selection is the process where individual genomes are selected for further breeding.
      2. Crossover is the process where two individual’s genes are combined to have a new combination of these parent genes.
      3. Mutation is the process where sometimes an individual’s genes are slightly changed to see if this will produce a better fitness.
   2. TEXT EXERCISE 10: What is the major distinction between GA and GP?
      1. Genetic algorithms have a fixed complexity and work by changing some variables inside the algorithm, but not the length of the algorithm or the complexity.
      2. Genetic programs do not have a fixed complexity and may change their entire structure. They have a tendency to gradually increase in complexity over the generations.
   3. GA FITNESS FUNCTIONS:
      1. A moon landing -- cost of mission, number of times a rocket could be reused, least distance, most likely to increase future budgets, most likely to succeed.
      2. TSP -- least total distance, total profit, densest population path, most likely to maintain a sustainable trip, cheapest route.
2. Design Exercise
   1. TEXT EXERCISE 6 (page 395): How would you formulate a GA that is capable of playing tic-tac-toe?
      1. The objective should be to create an algorithm that never loses tic tac toe. Its fitness function will be the percentage of games that the algorithm does not lose. There are only 827 base cases for potential boards in tic tac toe according to a [paper from Stanford University](http://www.genetic-programming.org/sp2003/Hochmuth.pdf) (this includes equivalent cases where the board is mirrored or rotated). All of these base cases can be placed in a queue so that the algorithm traverses the queue looking for the next base case it can recreate on the board with one move. It does that move. Also, when breeding, the queue is what gets crossed over with another parent’s queue.
3. Programming Exercise
   1. Robotic navigation problem (Refer to Example 12.1 in the text). Expand search space.
      1. [Link to Github](https://github.com/timothybruggeman/Robot-Navigation)