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Problem Set #3, Genetic Algorithms
The Backpack Problem

Discussion

Clarification by the instructor on Piazza stated that we are to solve the problem such that each box can be used only a single time. The weight is the top number in each box, the importance the bottom number.

We define the problem as a genetic algorithm.

- Fitness Function
  - directly proportional the total importance value of boxes in the backpack, while trials that go over the weight limit are heavily penalized

- Genome
  - each individual (trial) is represented by a string (mask) of 1's and 0's, which determines whether or not a particular box is included in the backpack for that trial

- Random Selection
  - crossover at a single random point in the binary string

- Mutation
  - mutation rate (chosen by user) defines the probability that a bit will flip in an individual's genome

The user can also choose the number of states in the initial population, the number of iterations (generations), the cull rate, the max weight the backpack can hold, and the initial probability of a 1 existing in the initial binary string.

The default values for parameters that quickly solved the backpack problem are the following:

Variable Description	Variable Name	Default Value
Number of Generations	`maxNumGenerations`	1000
Number of Individuals in Population	`numHypotheses`	10
Cull Rate	`cullRate`	0.5
Mutation Rate	`mutationRate`	0.01
Probability of 1 Existing in the Initial Binary String	`initRate`	0.5
Maximum Weight Allowed in the Backpack	`maxWeight`	120

Instructions

1. Make sure that the two files required for this assignment, backpackGA_01.m and objects.mat are in your Matlab path.
2. Type into the Matlab command prompt the following command.

solution = backpackGA_01(10, 1000, 0.5, 0.01, 0.5, 120, ‘objects.mat')

This will call the function with the default parameters listed above and quickly find the optimal solution.

The variable “solution” is a structure with the following fields and statistics:

solution.genome: binary string representing which boxes were used in the solution
solution.fitness: the total fitness of the solution
solution.total_weight: the total weight used for the solution
solution.importance: importance used for the solution; 0 means box not used
solution.weight: the weights used for the solution; 0 means box not used