Operations Research Models and Algorithms

Transportation – Hungarian algorithm

- Subtract min value from all values in **row**
- Subtract min value from all values in **column**
- Zero assignment (select unique cell with zero)
- Calculate cost
- Source

Simplex

- Steps

I. Standard form
II. Introducing slack variables
III. Creating the tableau
IV. Pivot variables
V. Creating a new tableau
VI. Checking for optimality
VII. Identify optimal values

Branch and Bound

- It recursively splits the feasible search space into smaller spaces, then minimizing $f(x)$ on these smaller spaces; the splitting is called *branching*.
- Branching alone would amount to brute-force enumeration of candidate solutions and testing them all. To improve on the performance of brute-force search, a B&B algorithm keeps track of *bounds* on the minimum that it is trying to find, and uses these bounds to "prune" the search space, eliminating candidate solutions that it can prove will not contain an optimal solution

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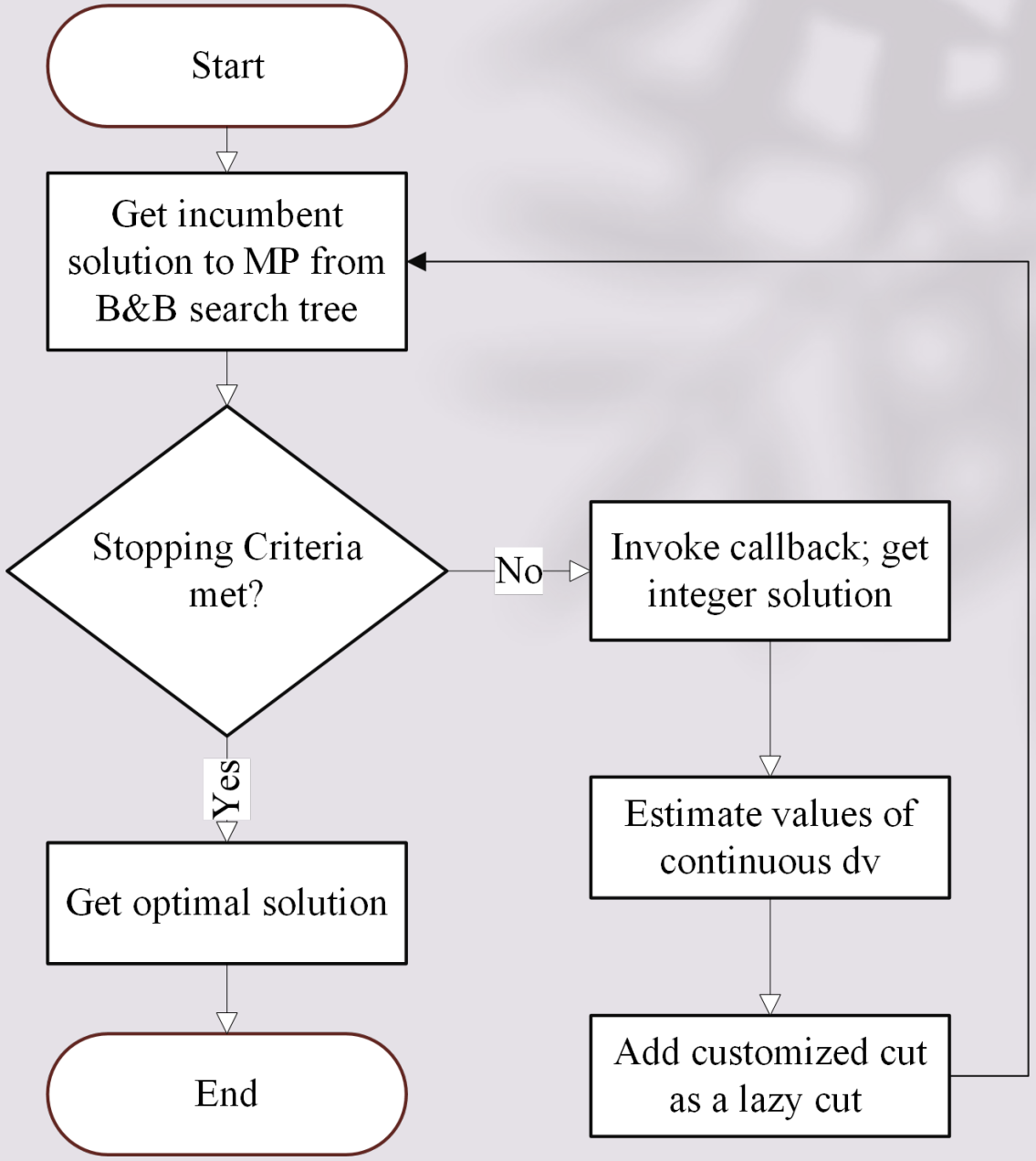
B&C

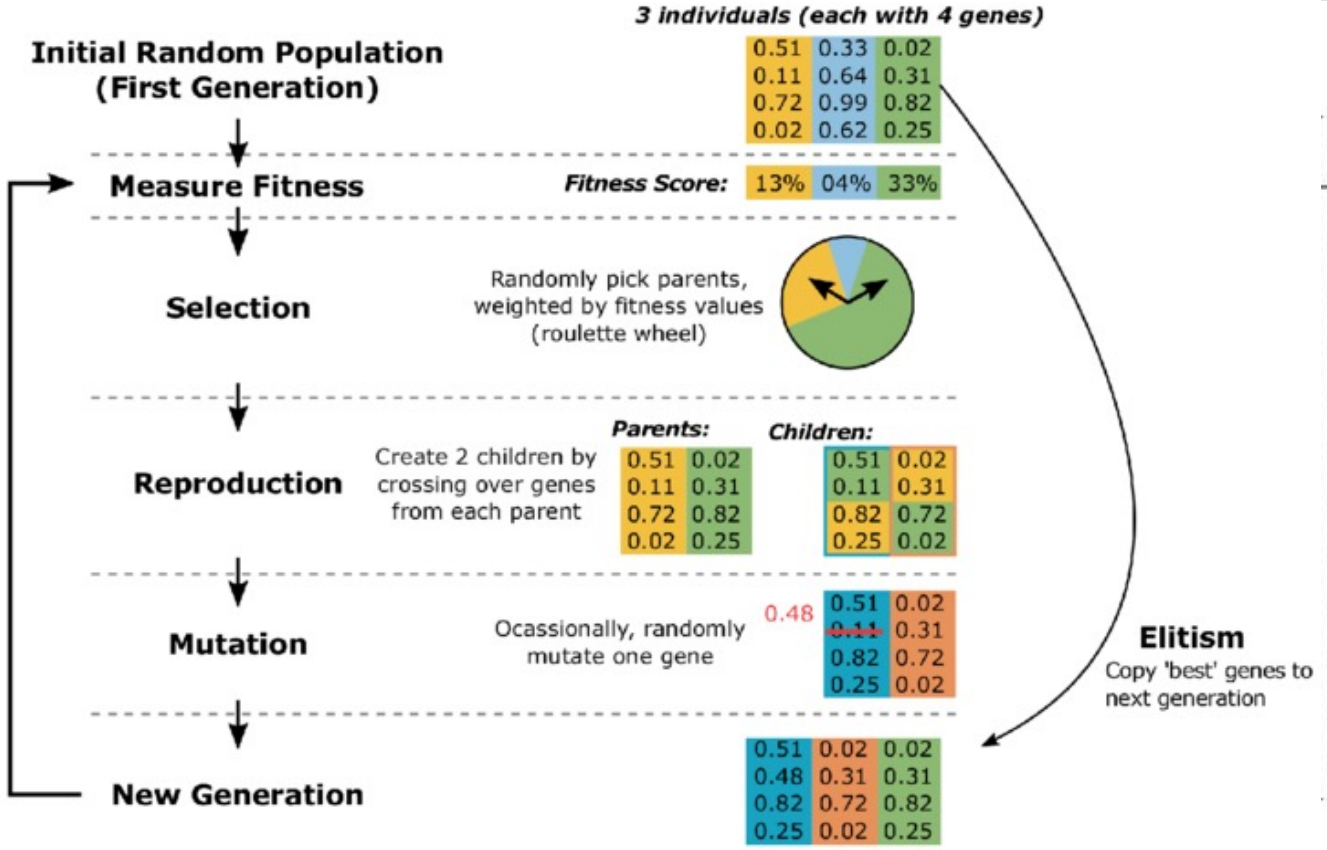

Start
Get incumbent solution to MP from B&B search tree
Stopping Criteria met?
No
Invoke callback; get integer solution
Yes
Estimate values of continuous dv
Get optimal solution
Add customized cut as a lazy cut
End

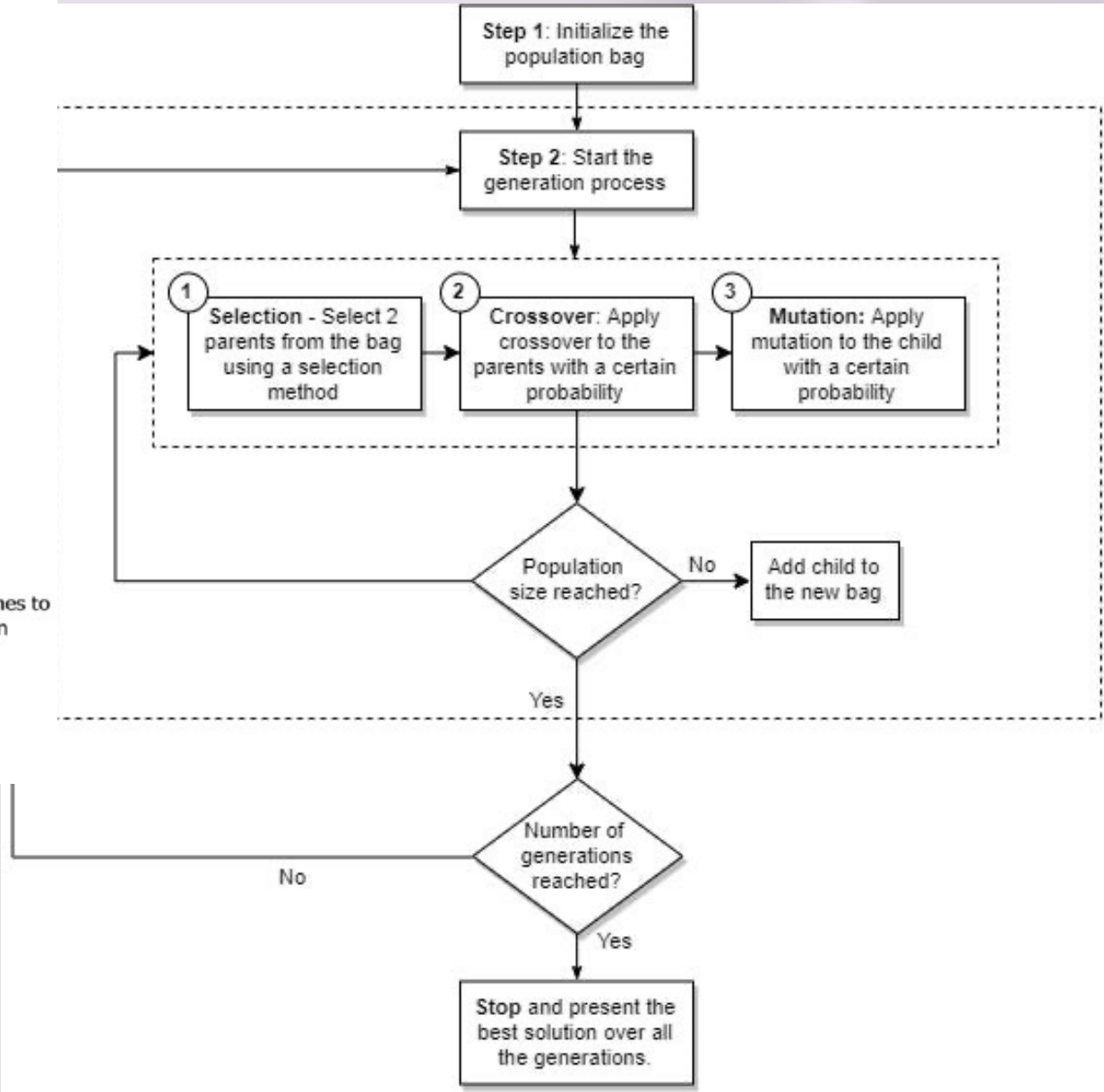
Genetic Algorithm

- **Step 1-** Choose an encoding technique, a selection operator, and a crossover operator
- **Step 2-** Choose a population size
- **Step 3-** Randomly choose the initial population
- **Step 4-** Select parental chromosomes
- **Step 5-** Perform Crossover (random crossover points)
- **Step 6-** Evaluation of offsprings
- **Step 7-** Repeat the process

- From Scratch

GA


3 individuals (each with 4 genes)
Initial Random Population
(First Generation)
0.51 0.33 0.02
0.11 0.64 0.31
0.72 0.99 0.82
0.02 0.62 0.25
Measure Fitness
Fitness Score:
13% 04% 33%
Selection
Randomly pick parents, weighted by fitness values (roulette wheel)
Reproduction
Create 2 children by crossing over genes from each parent
Parents:
0.51 0.02
0.11 0.31
0.72 0.82
0.02 0.25
Children:
0.51 0.02
0.11 0.31
0.82 0.72
0.25 0.02
Mutation
Ocassionally, randomly mutate one gene
0.48
0.51 0.02
0.11 0.31
0.82 0.72
0.25 0.02
Elitism
Copy 'best' genes to next generation
0.51 0.02 0.02
0.48 0.31 0.31
0.82 0.72 0.82
0.25 0.02 0.25
New Generation


Step 1: Initialize the population bag
Step 2: Start the generation process
1
Selection - Select 2 parents from the bag using a selection method
2
Crossover: Apply crossover to the parents with a certain probability
3
Mutation: Apply mutation to the child with a certain probability
Population size reached?
No
Add child to the new bag
Yes
Number of generations reached?
No
Yes
Stop and present the best solution over all the generations.