GENETIC ALGORITHM

Reproduction Operators

Genetic operators are applied to chromosomes that are selected to be parents, to create offspring

Basically of two types: Crossover and Mutation

Crossover operator create offspring by recombining the chromosomes of selected parents

Mutation is used to make small random changes to a chromosome in an effort to add diversity to the population

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Reproduction Operators: Crossover

Crossover operation takes two candidate solutions and divides them, swapping components to produce two new candidates

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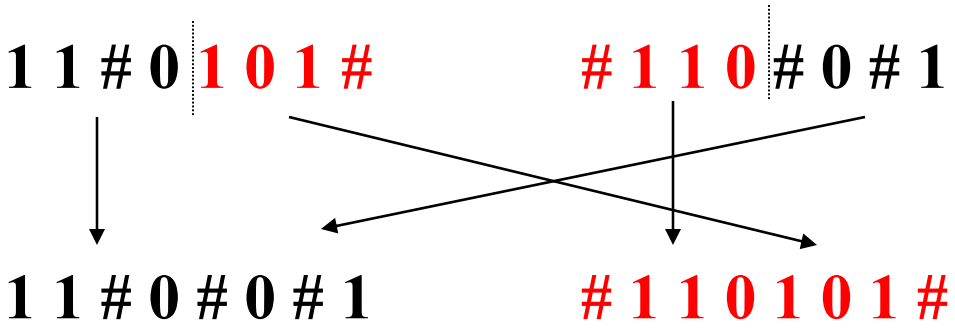
Reproduction Operators: Crossover

Figure illustrates crossover on bit string patterns of length 8

The operator splits them and forms two children whose initial segment comes from one parent and whose tail comes from the other

Input Bit Strings

Resulting Strings



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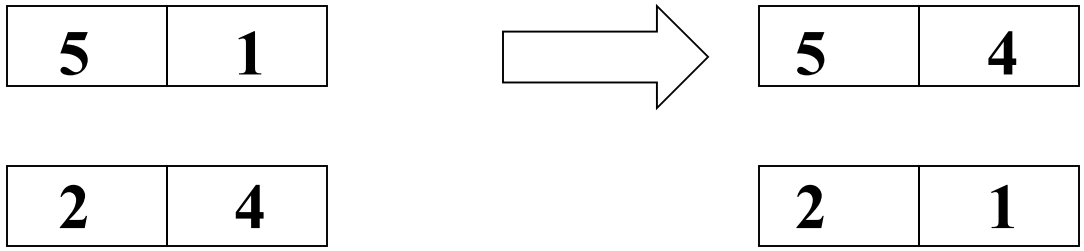
Reproduction Operators: Crossover

Two genes sugar and flour (in kgs)
Crossover operation on chromosomes



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Reproduction Operators: Crossover

The place of split in the candidate solution is an arbitrary choice. This split may be at any point in the solution

This splitting point may be randomly chosen or changed systematically during the solution process

Crossover can unite an individual that is doing well in one dimension with another individual that is doing well in the other dimension

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Reproduction Operators: Crossover

Two types: Single point crossover & Uniform crossover

Single type crossover

This operator takes two parents and randomly selects a single point between two genes to cut both chromosomes into two parts (this point is called cut point)

The first part of the first parent is combined with the second part of the second parent to create the first child

The first part of the second parent is combined with the second part of first parent to create the second child

1000010 1000001

1110001 1110010

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Reproduction Operators: Crossover

Uniform crossover

The value of each gene of an offspring's chromosome is randomly taken from either parent

This is equivalent to multiple point crossover

1000010
1110001 1010010

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Reproduction Operators: Crossover (Variable size chromosomes)

Suppose crossover points (1, 3) happen to be chosen for the 2nd parent

1st parent **10 01 1 11 10 0**
2nd parent **01 11 0 10 01 0**

The resulting two offspring would be

11 10 0

and

00 01 1 11 11 0 10 01 0

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Reproduction Operators: Mutation

Mutation is another important genetic operator

Mutation takes a single candidate and randomly changes some aspect (gene) of it

For example, mutation may randomly select a bit in the pattern and change it, switching a 1 to a 0 or to # (don't care)

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Reproduction Operators: Mutation

Mutation is important in that the initial population may exclude an essential component of a solution

For example, if no member of the initial population has a 1 in the first position, then crossovers cannot produce a child that could become a solution

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Reproduction Operators: Mutation

Each gene of each offspring is mutated with a given mutation rate p_μ (say 0.01)

It is hence possible that no gene may be mutated for many generations. On the other hand more than one gene may be mutated in the same generation (or even in the same chromosome)

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Reproduction Operators: Mutation

For real valued genes, the value is selected randomly from the alleles

If the rate is too low, new traits will appear too slowly in the population. If the rate is too high, each generation will be unrelated to the previous generation