

# mutation and its types

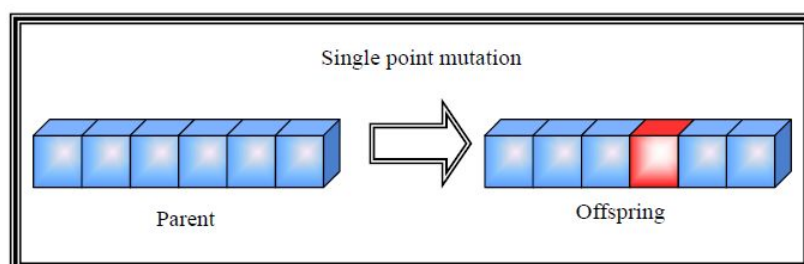
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## Mutation:

In GAs, mutation plays the role of a background operator which arbitrarily inverts one or more bits of a parent chromosome to increase the structural variability of the population. Mutation provides a means to restore lost or unexplored genetic material and prevent the GA from premature convergence to sub-optimal solutions. In this sense, mutation performs an exploration of the search space. Each bit of every chromosome in the population might become subject to an alteration according to a probability denoted by a mutation rate  $P_m$ . The mutation probability per bit is usually small, typical values for  $P_m$  lie in the interval  $[0.001, 0.02]$ . Therefore, the mutated chromosome is usually very similar to its parents.

### 1- 1M mutation:

Single gene (chromosome or even individual) is randomly selected to be mutated and its value is changed depending on the encoding type used, as shown in figure .



#### Algorithm 1M

Input : child, chromosome\_length, pm

Output : child with some change (may be)

Begin

  If flip(pm)

    Begin

$t \leftarrow \text{random}(\text{chromosome\_length}) + 1;$

      If child(t) = 0 then

        child(t)  $\leftarrow$  1;

      Else

        child(t)  $\leftarrow$  0;

      End;

  End;

## 2- 2M mutation:

Multi genes (chromosomes or even individuals) are randomly selected to be mutated and there values are changed depending on the encoding type used,



### Algorithm 2M

**Input :** child,chromosome\_length,pm  
**Output :** child with some change (may be)

**Begin**

**If flip (pm)**

**Begin**

**Repeat**

$t1 \leftarrow \text{random}$

$(\text{chromosome\_length})+1;$

$t2 \leftarrow \text{random}$

$(\text{chromosome\_length})+1;$

**Until**  $t1 \neq t2$

$x \leftarrow \text{child}(t1);$

$\text{child}(t2) \leftarrow \text{child}(t2);$

$\text{child}(t2) \leftarrow x;$

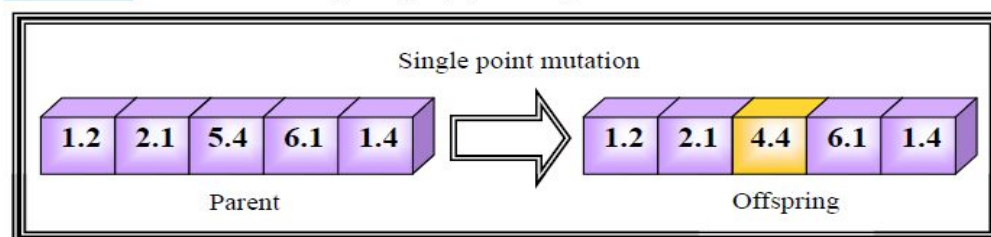
**End;**

**End:**

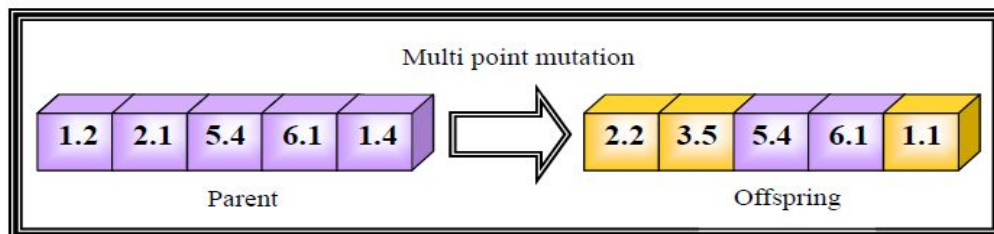
### 3- Mutation Of Real And Integer Encoding Chromosome:

In this type of encoding, there is several ways to implement mutation. This done, usually, by adding (or subtract) a random number to (or from) the mutated gene, but in another cases gene might by replaced by a new value generated randomly within the used real number limitation

□  
□  
□ fitness □



(a)



(b)

#### Reference:

S.N.Sivanandam · S.N.Deepa, 2008, Introduction to Genetic Algorithms, Springer