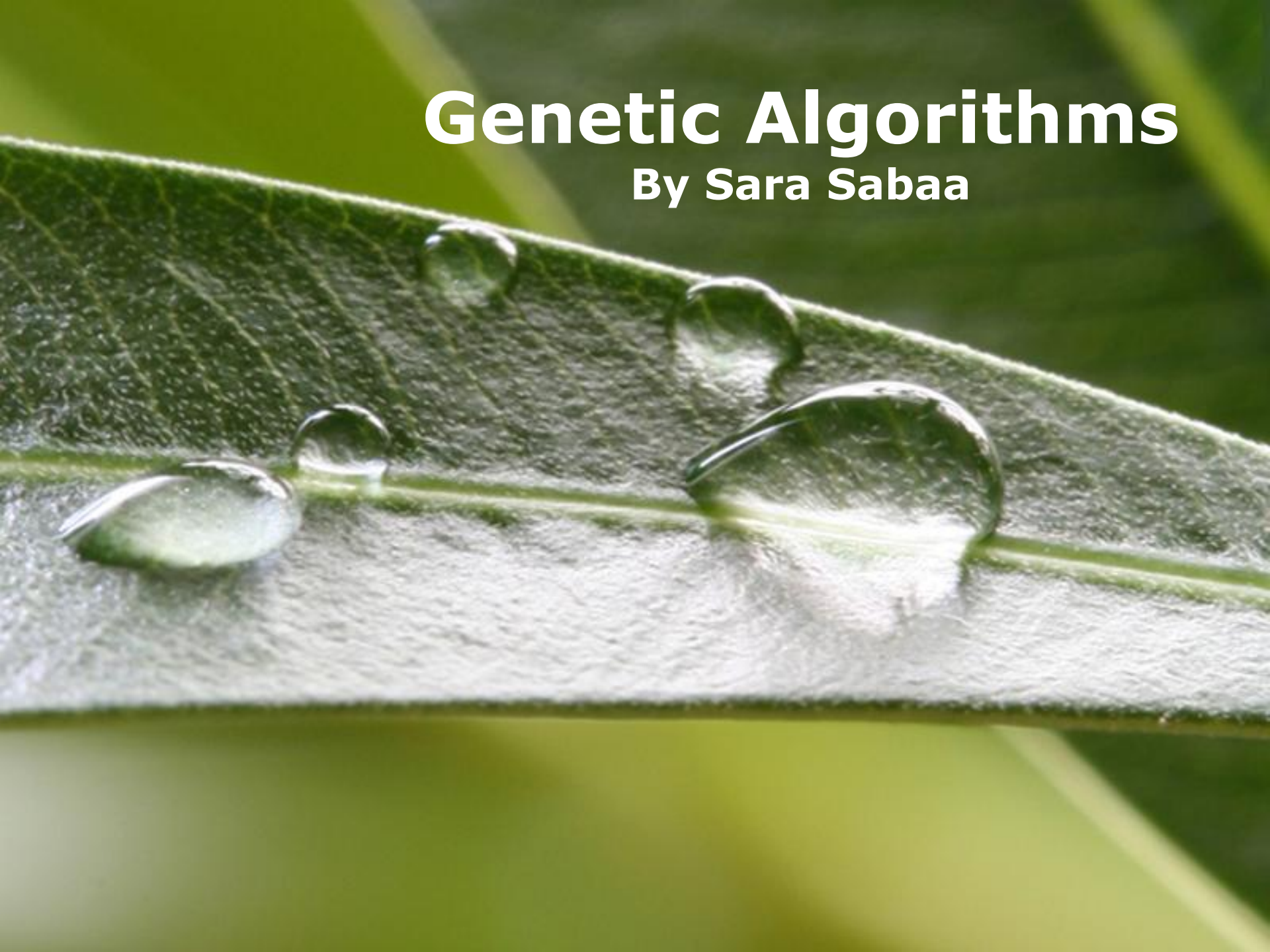
Genetic Algorithms
By Sara Sabaa

Genetic Algorithms:

- Genetic algorithms are examples of *evolutionary computing* methods and are optimization-type algorithms. Given a population of potential problem solutions (individuals), evolutionary computing expands this population with new and potentially better solutions.

Genetic Algorithms

- The basis for evolutionary computing algorithms is biological evolution, where over time evolution produces the best or “fittest” individuals.

Genetic Algorithms

- In Data mining, genetic algorithms may be used for clustering, prediction, and even association rules.

Genetic Algorithms

- When using genetic algorithms to solve a problem, the first thing, and perhaps the most difficult task, that must be determined is how to model the problem as a set of individuals. In the real world, individuals may be identified by a complete encoding of the DNA structure.
- An individual typically is viewed as an array or tuple of values. Based on the recombination (crossover) algorithms, the values are usually numeric and maybe binary strings.

Genetic Algorithms

- These individuals are like a DNA encoding in the structure for each individual represents an encoding of the major features needed to model the problem. Each individual in the population is represented as a string of characters from the given alphabet.

Genetic Algorithms

Definition:

- Given an alphabet A, an **individual** or **chromosome** is a string $I = I1, I2, \ldots, In$ where $Ij \in A$. Each character in the string, Ij, is called a gene. The values that each character can have are called the alleles. A populations, P, is a set of individuals.

Genetic Algorithms

- In genetic algorithms, reproduction is defined by precise algorithms that indicate how to combine the given set of individuals to produce new ones. These are called “crossover algorithms”.

For example:

- Given two individuals; parents from a population, the crossover technique generates new individuals (offspring or children) by switching subsequences of the string.

Genetic Algorithms

A =	1	1	1	|	1	1	1	1	1	|	1	1	1
B =	0	0	0	|	0	0	0	0	0	|	0	0	0
a =	1	1	1	|	0	0	0	1	1	|	0	0	0
b =	0	0	0	|	1	1	1	0	0	|	1	1	1

Genetic Algorithms

- As in nature, mutations sometimes appear, and these also may be present in genetic algorithms. The mutation operation randomly changes characters in the offspring and a very small probability of mutation is set to determine weather a character should change.

Genetic Algorithms

- Since genetic algorithms attempts to model nature, only the strong survive. When new individuals are created, a choice must be made about which individuals will survive. This may be the new individuals, the old ones, or more likely a combination of the two. It is the part of genetic algorithms that determines the best (or fittest) individuals to survive.

Genetic Algorithms

- To sum up all these information, Margaret Dunham defines a genetic algorithm (GA) as a computational model consisting of five part:

- Starting set of individuals.
- Crossover technique.
- Mutation algorithm.
- Fitness function (survivor of the strongest)
- Algorithms that applies the crossover and mutation to P iteratively using the fitness function to determine the fitness function to determine the best individuals in P to keep.

Genetic Algorithms

❖ References:

- Data Mining, introduction and Advanced Topics by Margaret H. Dunham.