CE 515: Genetic Algorithms

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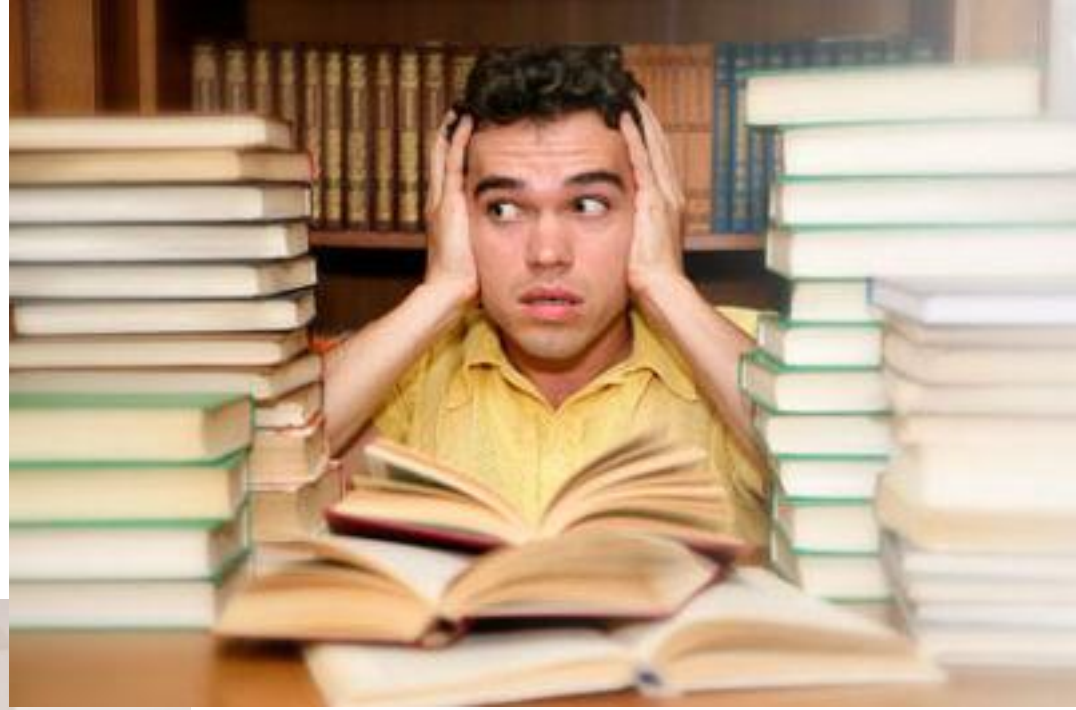
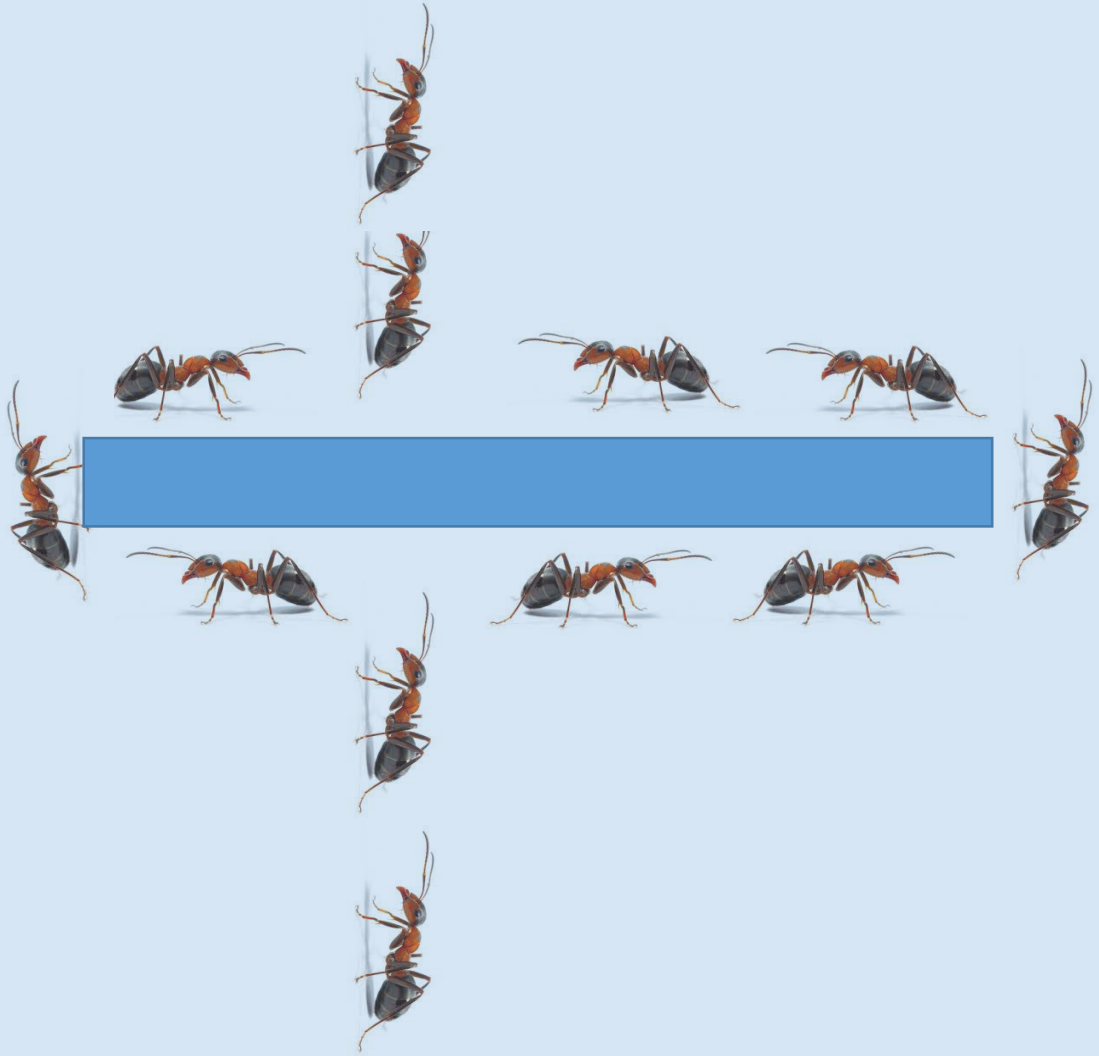


Food

Nest

Food



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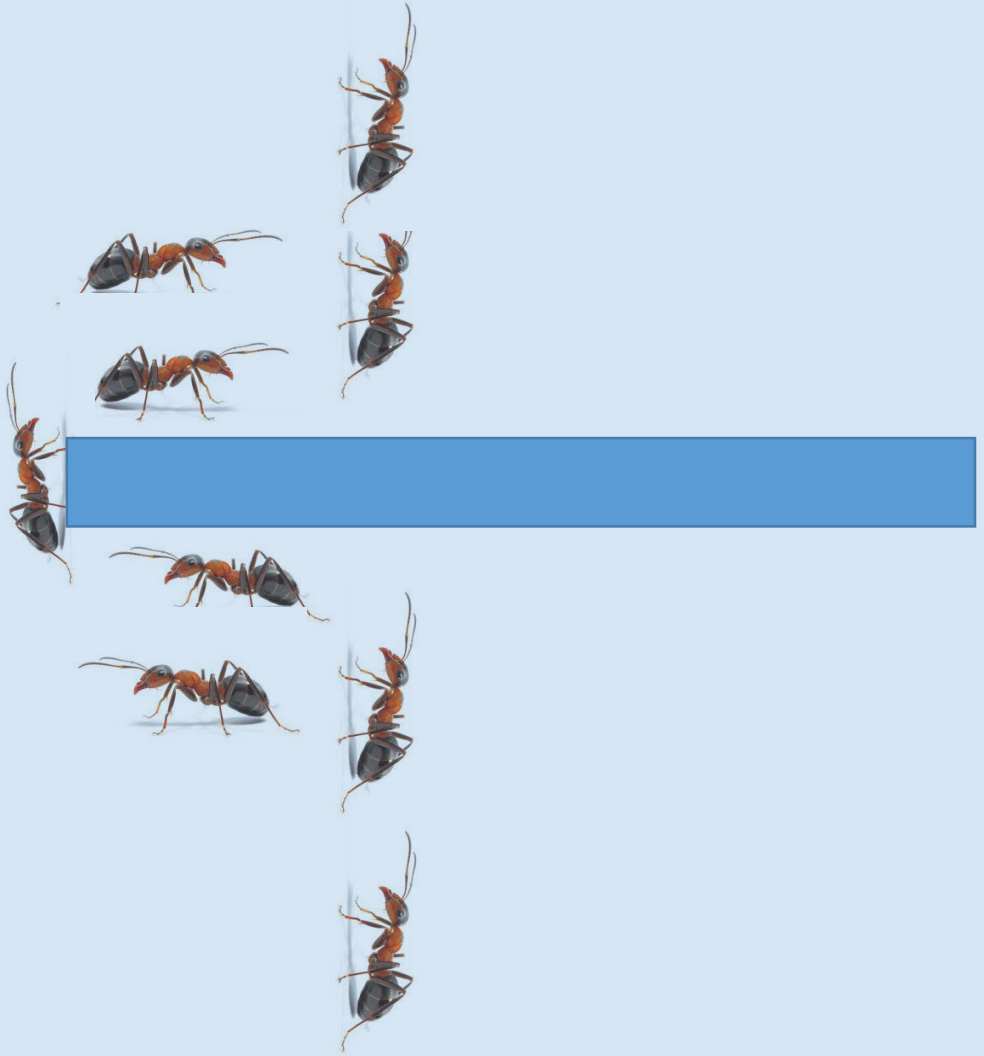

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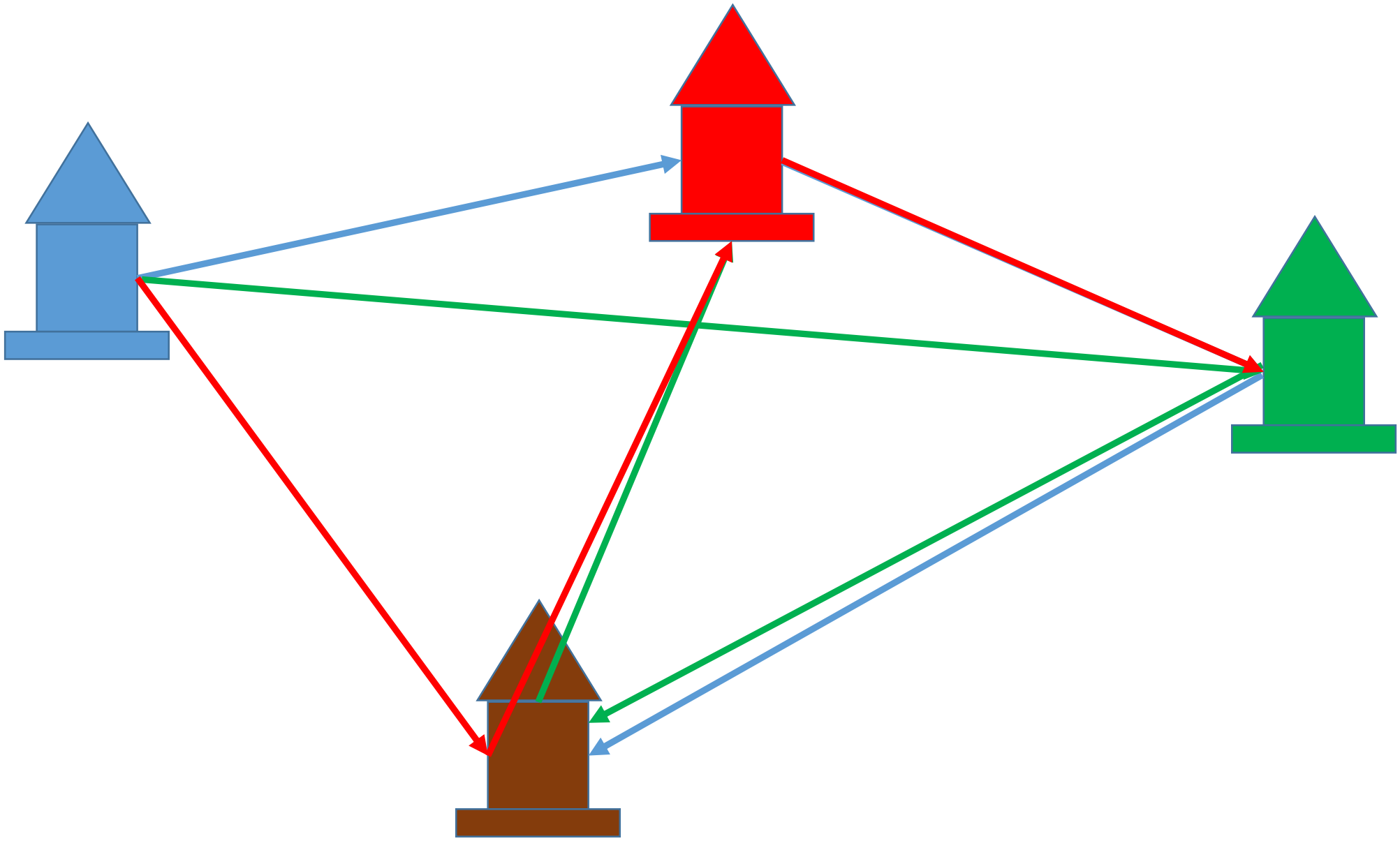
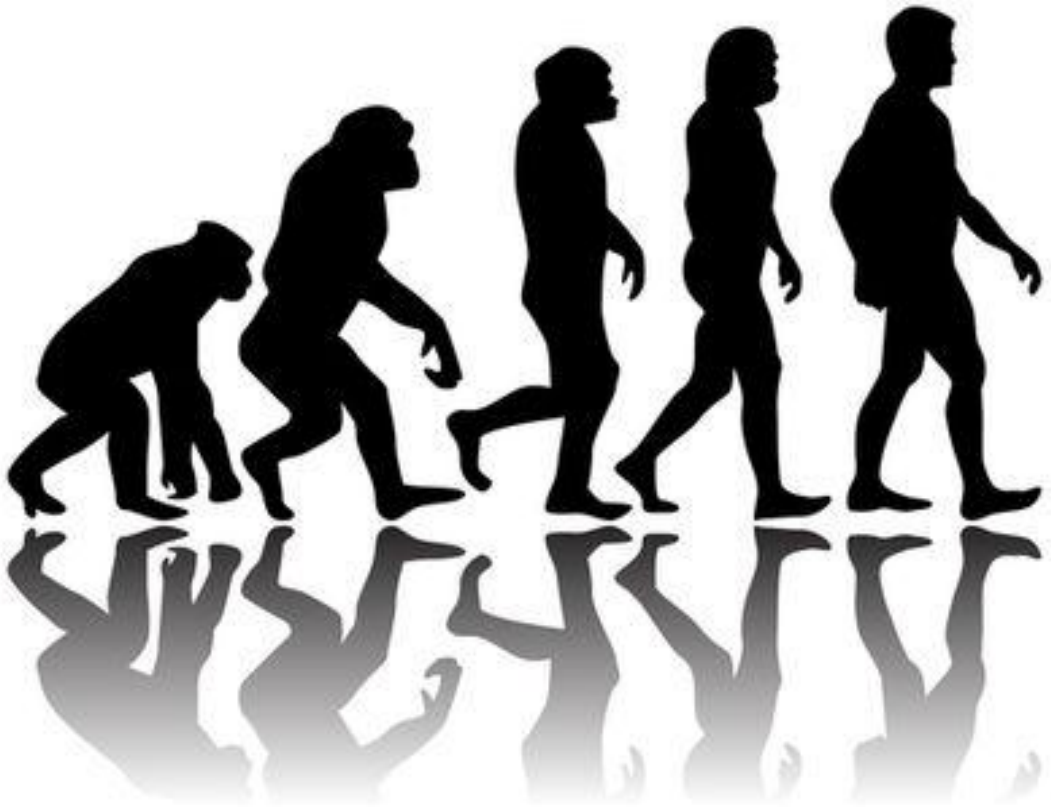




Natural evolution

It is a search for better individual

Question?

1. Is it a random search?

2. Guided search?

First Trial

Second Trial

Course Syllabus

Introduction to Evolutionary Computation: Biological and artificial evolution, evolutionary computation and AI, different historical branches of EC, a simple genetic algorithm.
Search Operators: Crossover, mutation, crossover and mutation rates, Crossover for real-valued representations, mutation for real-valued representations, combinatorial GA,
Selection Schemes: Fitness proportional selection and fitness scaling, ranking, tournament selection, selection pressure and its impact on evolutionary search.
Theoretical Analysis of Evolutionary Algorithms: Schema theorems, convergence of the algorithms, computational time complexity of the algorithms, no free lunch theorem.
Search Operators and Representations: Mixing different search operators, adaptive representations.
Niching and Speciation: Fitness sharing, crowding and mating restriction.
Constraint Handling: Common techniques, penalty methods, repair methods, Deb's penalty parameter method.
Multi-objective evolutionary optimization: Pareto optimality, multi-objective evolutionary algorithms: MOGA, NSGA-II, etc. Applications of GA in engineering problems, job-shop scheduling and routing problems

References

- D. E. Goldberg, ‘Genetic Algorithm In Search, Optimization And Machine Learning’, New York: Addison – Wesley (1989)
- John H. Holland ‘Genetic Algorithms’, Scientific American Journal, July 1992.
- Kalyanmoy Deb, ‘An Introduction To Genetic Algorithms’, Sadhana, Vol. 24 Parts 4 And 5.

References (contd.)

WEBSITES

- www.iitk.ac.in/kangal
- www.math.princeton.edu
- www.genetic-programming.com
- www.garage.cse.msu.edu
- www.aic.nre.navy.mie/galist

Assessment

- Assignment : 10
- Quiz : 15
- Mid semester exam : 25
- End semester exam : 40
- Project : 10

Darwin's Principle Of Natural Selection

- IF there are organisms that reproduce, and
- IF offsprings inherit character from their progenitors, and
- IF there is variability of character, and
- IF the environment cannot support all members of a growing population,
- THEN those members of the population with less-adaptive traits (determined by the environment) will die out, and
- THEN those members with more-adaptive character (determined by the environment) will flourish

The result is the evolution of species.

What Are Genetic Algorithms (GAs)?

Genetic Algorithms are *search* and *optimization* techniques based on Darwin's Principle of *Natural Selection*.

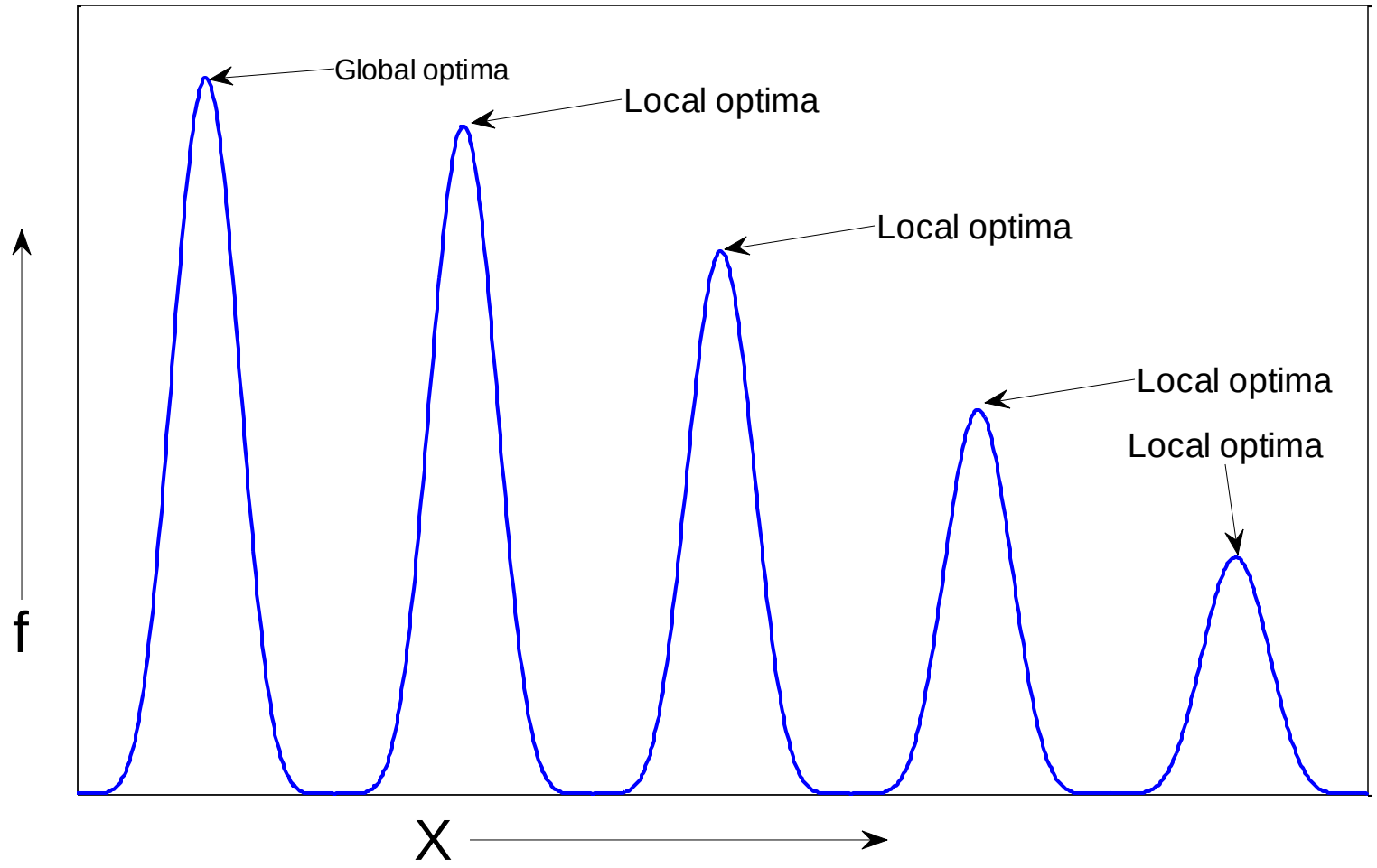
History Of Genetic Algorithms

- “Evolutionary Computing” was introduced in the 1960s by **I. Rechenberg**.

- John Holland wrote the first book on Genetic Algorithms ‘Adaptation in Natural and Artificial Systems’ in 1975.

- In 1992 **John Koza** used genetic algorithm to evolve programs to perform certain tasks. He called his method “Genetic Programming”.

Introduction to optimization



Are you using optimization?

The word “optimization” may be very familiar or may be quite new to you. But whether you know about optimization or not, you are using optimization in many occasions in your day to day life.

What is Optimization?

- Optimization is the act of obtaining the best result under a given circumstances.

- Optimization is the mathematical discipline which is concerned with finding the maxima and minima of functions, possibly subject to constraints.