Genetic Algorithms & Evolutionary Principles

- **Evolutionary Forces in Populations:**
  - **Mutations:** Random genetic changes due to environmental factors.
  - **Gene Flow:** Introduction of new genes into a population.
  - **Genetic Drift:** Random loss of alleles in small populations.
  - **Natural Selection:** Survival of the fittest individuals for reproduction.

- **What is a Genetic Algorithm (GA)?**
  - Inspired by **natural selection**, GAs optimize solutions by evolving a population over generations.
  - Developed by **John Holland (1975)**, popularized by **David Goldberg (1989).**

- **Key Advantages of GA:**

✔ Works with **complex cost surfaces** and **large variable spaces**
✔ Suitable for **parallel computing**
✔ Finds **multiple optimal solutions**, not just one
✔ Doesn’t need derivatives like calculus-based methods

- **Limitations:**
  - Not always the fastest; **quick analytical methods** may be better for simple problems.
  - Slower on **serial computers** since each solution must be evaluated.