# Genetic Algorithms

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ML 2 BDA3321

# Some Definitions

## Current Population

Collection of hypotheses being used at the current step (or iteration)

## Best Hypothesis

It is defined as the hypothesis that optimizes a *predefined numerical measure*.

## Hypothesis Fitness

The predefined numerical measure used to to define a best hypothesis (or judge/compare hypothesis).

## Fitness

A function that assigns an evolution score, given a hypothesis.

# Some Definitions

## Contd

### Fitness Threshold

A threshold specifying the termination criterion.

### f

The number of hypotheses to be included in the population.

### r

The fraction of population the population to be replaced by crossover at each step.

### m

The mutation rate.

# General structure of the algorithm

## GA(Fitness, Fitness Threshhold, p, r, m)

1. Initialize Population:
   Generate $p$ hypotheses at random $\rightarrow P$
2. Evaluate:
   For each $h \in P$, compute Fitness($h$)
   while $max_h$(Fitness($h$)) $<$ Fitness Threshold do:
   Create a new generation $\rightarrow P_s$
3. Return hypothesis that has the highest fitness.

# General structure of the algorithm

## GA(Fitness, Fitness Threshhold, p, r, m);Creating a new generation

1. Select:
   Probabilistically select $(1 - r)p$ members of $P$ to add to $P_s$.

$$P_r(h_i) = \frac{\text{Fitness}(h_i)}{\sum_{j=1}^{p} \text{Fitness}(h_j)}$$

2. Crossover:
   Probabilistically select $\frac{r \times p}{2}$ pairs from $P$ according to $P_r(h_i)$.
   $\forall(h_i, h_j)$, produce two offsprings. Add all offsprings to $P_s$.
3. Mutate:
   Choose $m$ percent members of $P_s$ uniformly and mutate them.
4. Update:

$$P_s \rightarrow P$$

5. Evaluate:
   $\forall h \in P$ compute Fitness$(h)$

# References I


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