CSE/ECE 848 Introduction to Evolutionary Computation

Module 3 - Lecture 15 - Part 2

Extended Compact GA and the Bayesian Optimization Algorithm

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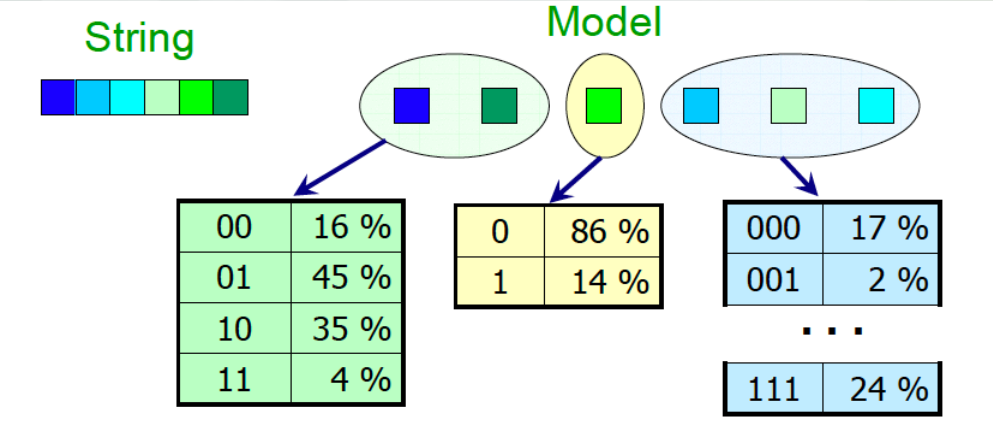
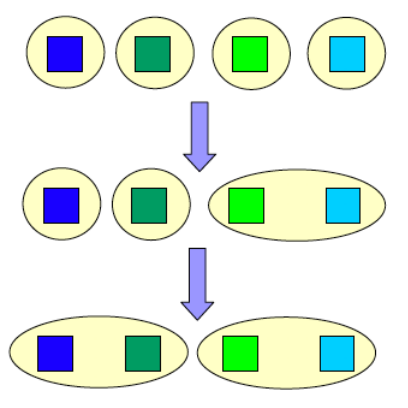
The Extended Compact GA

- ECGA: Harik and Goldberg, 1999
- Considers groups of string positions



The Extended Compact GA II

- Learn by starting with each bit in a separate group
- Iteratively merge groups for best improvement



- Model quality is judged by minimum description length + D_{Data}

$$MDL(M,D) = D_{Model}$$

MDL

- N: Population size, g: group of bits, X: bitstring

$$D_{Model} = \sum_{g \in G} 2^{|g|-1} \log N \qquad D_{Data} = -N \sum_{X} p(X) \log p(X)$$

Sampling in ECGA

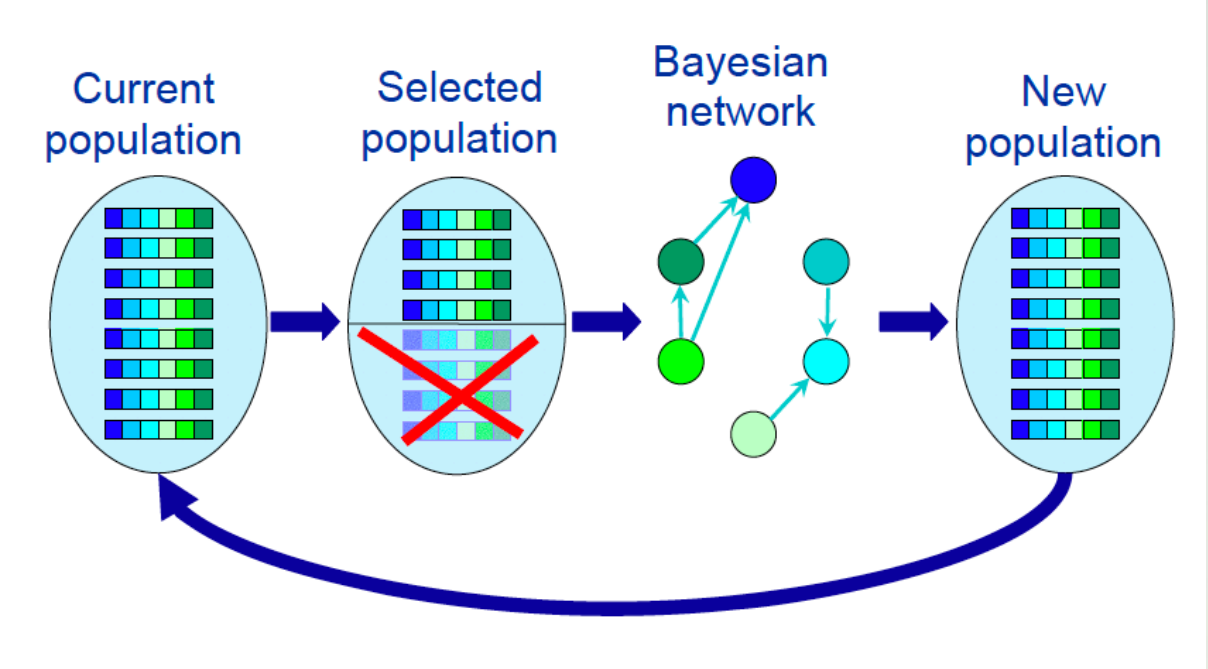
- Sample groups of bits at a time
- Based on the observed probabilities

Bayesian Optimization Algorithm

- Pelikan, Cantu-Paz, Goldberg 1998
- Uses a Bayesian Network as the probabilistic model
- Bayesian network:
  - Acyclic directed graph
  - Nodes are variables (string positions)
  - Edges are conditional dependencies

Bayesian Optimization Algorithm II

- Main problem now: Learning the BN
- Quality of a BN: Minimum description length metric is the Bayesian Information Criterion (BIC)



Learning the BN

- Start with an empty network
- Use a primitive operator that improves the model most
- Iterate until no more improvements possible
- Primitive operators:
  - Addition of edge
  - Removal of edge
  - Reversal of edge