Selection

CS 5764
Evolutionary Computation
Hod Lipson
Approaches

- Generational (classic GA)
- Steady state (unsynchronized)
- Distributed (parallel)
Steady State

1. Choose parent(s) at random
2. create offspring
3. Choose someone in population
4. If child better than selected individual, replace it

Produces races on multi-processor architectures
Distributed
Selection
Approaches

- Fitness proportionate
- Rank
Roulette

Total fitness = $F$

0

A B C D E F G
SUS

Total fitness = $F$

| A | B | C | D | E | F | G |

0 to $F$
Challenges

• Signal to noise
  – Small variations in large fitnesses matter
  – $103\,101\,102$
Normalization

- Gaussian
  - subtract mean, divide by stdev

- Linear
  - Bring min-max to [0-1]

- Nonlinear
  - Boltzmann selection \( F = \exp(f/T) \)
Replacement

- Random
- Worst (Inverse Boltzman)
- Parent
- Most similar $\leftarrow$ Diversity
Rank based methods

- **Truncation**: top k% are replicated and replace bottom 100-k% with variation.
- **Tournament**: Select random k, among those select top for variation.
- \((\mu, \lambda)\) generates \(\lambda\) new offspring and uses top \(\mu\) to populate the next generation.
- **Elitism**: Keep the best \(k\) solutions around unmodified.
Sexual Selection
Sexual Selection
Fitness evaluation is costly

- Internal error correction
- Natural selection (expensive)
- Culling at all levels
  - Sperm competition
  - Sibling rivalry
  - Male competition
The role of males

• Males are often smaller and have a shorter life span
• Males are put through more testing: competition with each other, thrown out of family younger, placed at (otherwise unnecessary) risk
• Males are more fragile: susceptible various illnesses
• Males have less error correction mechanisms: Haplodiploidy
• Errors are visible (eg. Via intelligence) to allow sexual culling be females
Diversity

• Adapt fitness by similarity
• Adapt selection by similarity