Bet-Based Learning Idea

Instead of directly learn how to solve problems, learn on which solver you should place a bet.

Bet-Based EA

- Target: Constraint minimisation problem on function \( f: \mathbb{R}^d \rightarrow \mathbb{R} \)
- Self-controlling betting strategy to optimise the evolution of individuals over successive generations
- Two approaches:
  1. Self-betting EA (Self BEA)
  2. External betting EA (External BEA)

Self BEA

Fitness

- Fitness \( F^{t+1}(x_i) \) is influenced by positive or negative outcome of bet
  
  \[ F^{t+1}(x_i) = F^t(x_i) + \pi(x_i) \]
  
  \[ \pi(x_i) = c_{global} \cdot f(x_i) \cdot \text{sgn}(\Delta f(x_i)) \cdot \left( F^t(x_i) \cdot c_{wager} \cdot (\Delta f(x_i) \cdot c_{influence} + 1) \right) \]

- Bet outcome \( \pi(x_i) \) depends on sign of \( \Delta f(x_i) \) \( \Delta f(x_i) \) function value increase/decrease after one generation

- Bet outcome magnitude is influenced by:
  - Individual bet control parameters: \( c_{wager} \) proportion of fitness, \( c_{influence} \) proportion of \( \Delta f(x_i) \)
  - Global bet parameter \( c_{global} \) globally controls bet intensity

Crossover

• Separately applying uniform-split crossovers on bet parameters and problem parameters

External BEA

Fitness of bet population

\[ F^{\text{bet}}(b_j) = \sum_{i=1}^{N_{\text{main}}} b_j[i] \cdot \Delta f(x_i) \]

→ Individuals of external population \( b_j \) place bets on all individuals of main population \( x_i \)

Standard EA vs. Self BEA vs. External BEA

• Test over 22 functions
• Number of wins after 500 Generations

External BEA 12
Self BEA 6
Standard EA 4