CSE/ECE 848
Introduction to
Evolutionary Computation

Module 3 - Lecture 12 - Part 2
Differential Evolution:
Performance

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The DE Algorithm

Initialization: # Population, # Generations, F and CR

    Evaluate the fitness values of all population individuals

while the terminate criteria is not met

    Pick individuals from the population

    Building a donor vector for each

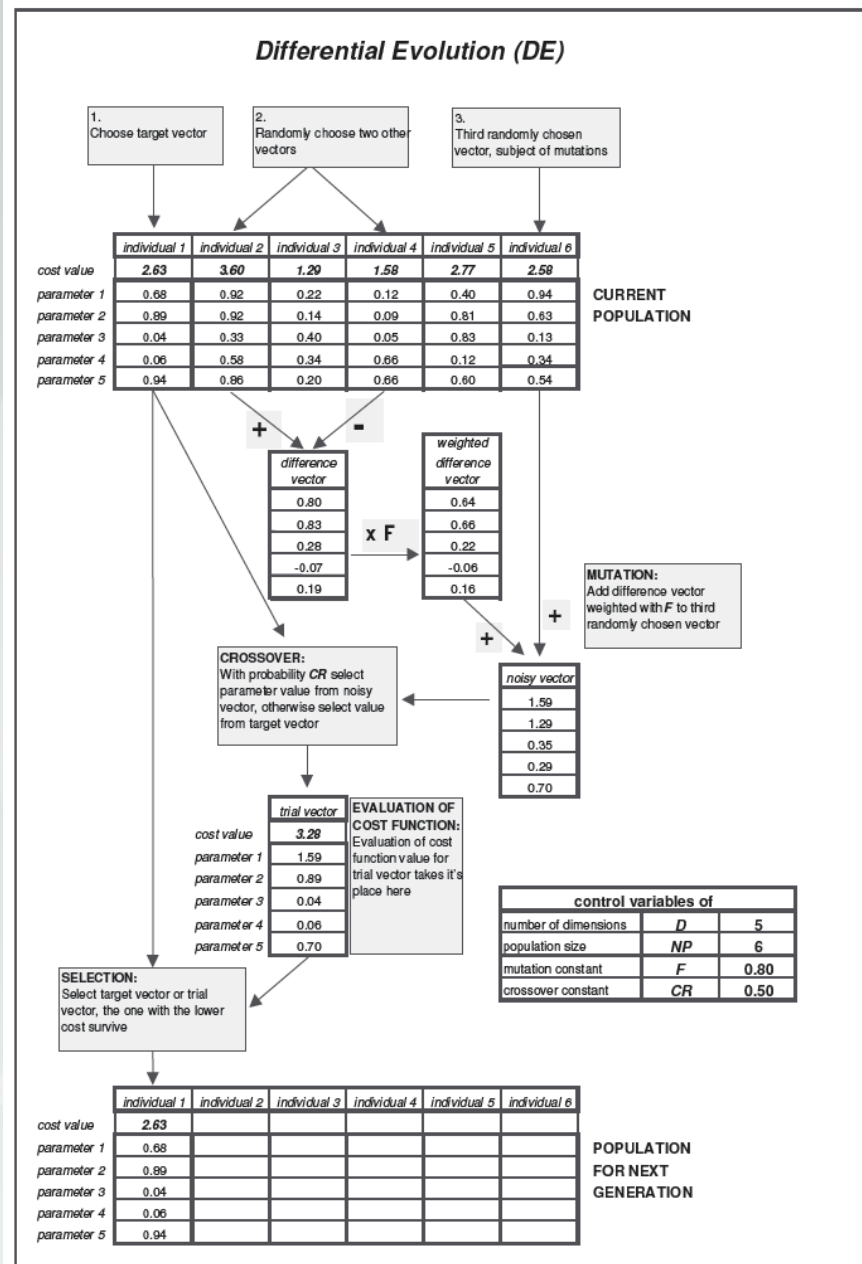   Making a trial vector using the parent and the donor

    Evaluate the fitness values of new individuals (children)

    Replace the child with the parent if it is better

end while

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Performance

- No convergence proof

- However, shown to be effective on a large range of optimization problems

- 2004 paper by Lampinen and Storn demonstrated its power

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Differential Evolution (DE)

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DE Variations

- DE/x/y/z
  - x: base vector of donor
  - y: # of vectors considered for perturbation of x
  - z: type of crossover (exp: exponential; bin: binomial)

- DE/rand/1 $\qquad v_i = x_{r1} + F(x_{r2} - x_{r3})$

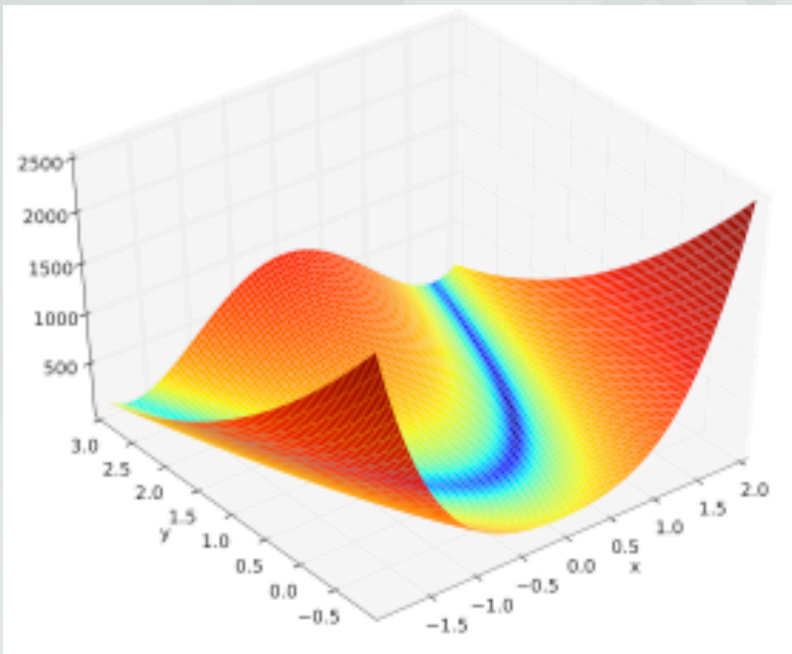- DE/best/1 $\qquad v_i = x_{best} + F(x_{r2} - x_{r3})$

- DE/rand/2 $\qquad v_i = x_{r1} + F(x_{r2} - x_{r3} + x_{r4} - x_{r5})$

- DE/best/2 $\qquad v_i = x_{best} + F(x_{r2} - x_{r3} + x_{r4} - x_{r5})$

- DE/rand to best/1 $\qquad v_i = x_{r1} + F_1(x_{r2} - x_{r3}) + F_2(x_{best} - x_{r1})$

- DE/curr. to best/1 $\qquad v_i = x_i + F_1(x_{r2} - x_{r3}) + F_2(x_{best} - x_i)$
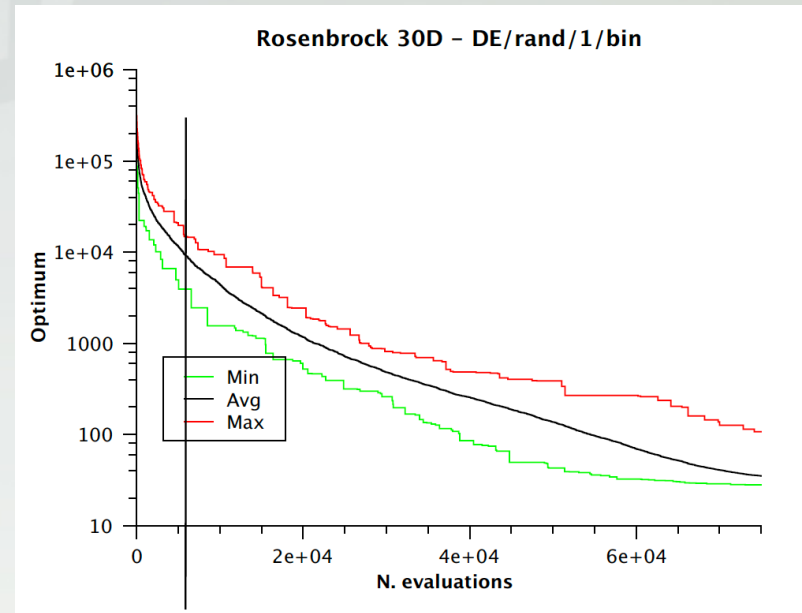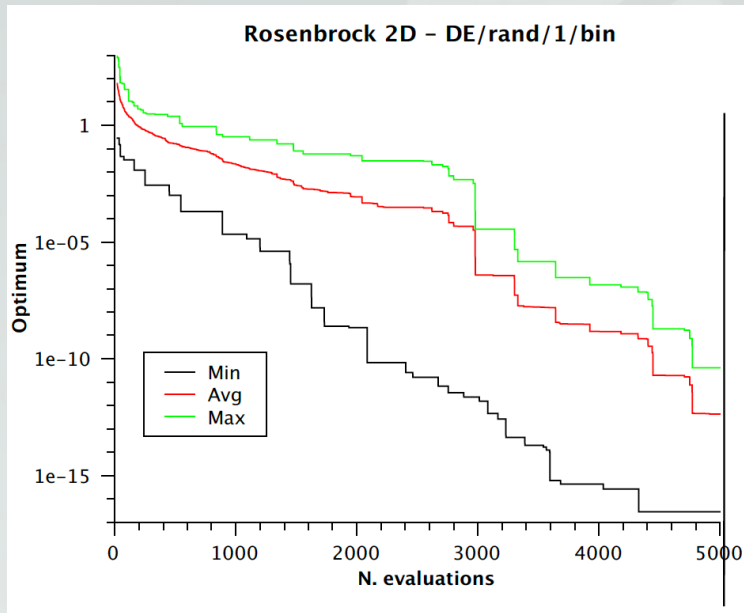
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Example - DE Performance on Rosenbrock Function

$$f(x) = \sum_{i=1}^{N-1} [(1 - x_i)^2 + 100(x_{i+1} - x_i^2)]$$

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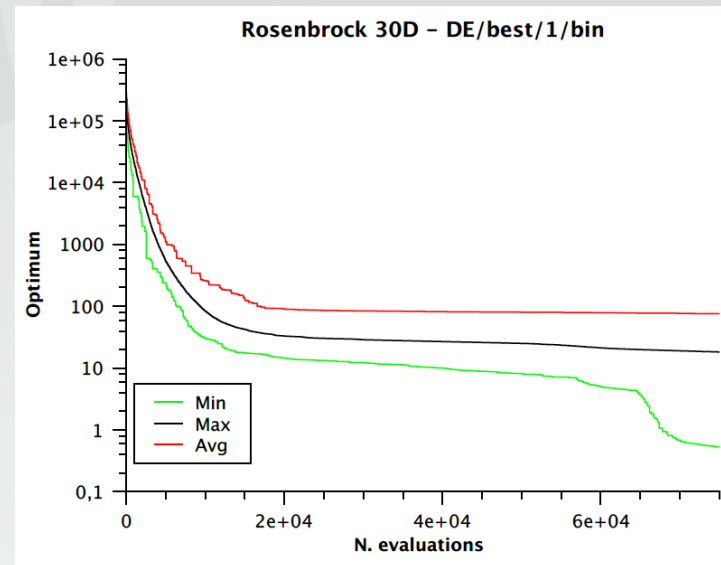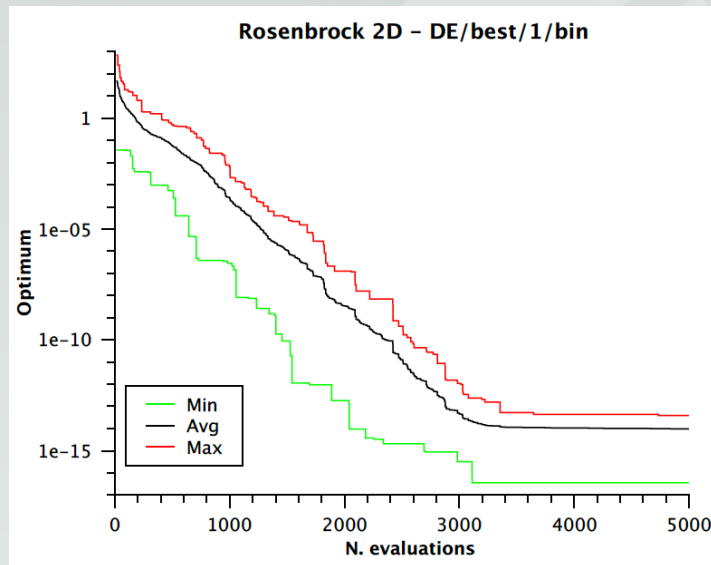
DE/rand/1/bin

$$v_i = x_{r1} + F_1(x_{r2} - x_{r3})$$

Comparison for different dimensionality

Curse of dimensionality

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DE/best/1/bin

$$v_i = x_{best} + F_1(x_{r2} - x_{r3})$$

- Much faster convergence
- Stagnation?

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