Name: Chih-Feng Lin
Andrew ID: chihfenl
Evolutionary Algorithm in Engineering Optimization

Homework 2

1. According to the description of question, I think the **original interpretation is incorrect**. N(0, σ) means choose a variable within the normal distribution, where 0 means this distribution's mean is 0 and standard deviation σ. And the characteristic of normal distribution is symmetry distributed based on mean value. Therefore, adding a number from N(0, σ) will have chance to add a negative number.

2. During the starting period, we should increase mutation strength. Because we have to expand our search space to find out more feasible solution or possibilities. After that period, we should start to narrow down our search scope (i.e. decreasing mutation strength) to focus on possible solutions.

3. Take evolutionary strategy as a example, the representation of individual with n step size is $(x_1 x_2 x_3 \ldots \ldots x_n, \sigma_1 \sigma_2 \sigma_3 \ldots \ldots \sigma_n)$. If we use self-adaptation technics at whole population level, we cannot focus on individually variation and it leads to our searching space too narrow during whole running phase. Conversely, using self-adaptation operation at individual level can make individual step size coevolve during running phase and make broader searching space. This has better chance to find out target optimal solution.

4. *S1 = *0**11***0***   *S2 = *****0*1*****

   A. Order of S1 = number of fixed positions = o(S1) = 4
   Order of S2 = number of fixed positions = o(S2) = 2
   Defining length of S1 = distance between 1st & last fixed position = 8
   Defining length of S1 = distance between 1st & last fixed position = 2

   B. $p_{survive} \geq 1 - p_{crossover} \cdot \frac{\delta(H)}{l-1}$

   For S1, $p_{crossover} = p_c, \ \delta(S1) = 8, \ l = 12$

   So $p_{survive} \geq 1 - p_{crossover} \cdot \frac{\delta(H)}{l-1} = 1 - p_c * 0.727$

   For S2, $p_{crossover} = p_c, \ \delta(S1) = 2, \ l = 12$

So $p_{survive} \geq 1 - p_{crossover} \cdot \frac{\delta(H)}{l-1} = 1 - p_c * 0.1818$

C. $(1 - p_{mutation})^{o(H)}$

For S1, $p_{mutation} = p_m$, $o(S1) = 4$

So $p_{survive} \geq (1 - p_{mutation})^{o(H)} = (1 - p_m)^4 \approx 1 - 4p_m$

For S2, $p_{mutation} = p_m$, $o(S2) = 2$

So $p_{survive} \geq (1 - p_{mutation})^{o(H)} = (1 - p_m)^2 \approx 1 - 2p_m$

D. For S1

$p_{survive} \geq 1 - 0.727p_c - 4p_m$

For S2

$p_{survive} \geq 1 - 0.1818p_c - 2p_m$

E. S2 can be seen as "Building Block."

Because it meets the definition of Building Block Hypothesis : **short defining length** and **lower-order schema**. This kind of schema has greater chance of being transmitted to the next generation than longer and higher order schema.