LECTURE 7

Topic Coverage Tags: Genetic Algorithm Example Problems

Problem1:

Design a Cylindrical can using two parameters: diameter d and height h.Consider a case that the can needs to have a volume of at least 300ml and the objective of the design is to minimize the cost of can material.

Answer:

Step1:

Encode the Objective Function:

$$Minimize \;\; f(\mathrm{d},\mathrm{h}) = \mathrm{c}\left(\frac{\pi \mathrm{d}^2}{2} + \pi \mathrm{dh}\right)$$

C=> cost of can material per square cm.

Constraint

$$Subject\ to\ g(d,h) = \frac{\pi d^2 h}{4} \geq 300$$

Variable bound

$$dmin \leq d \leq dmax$$
$$hmin \leq h \leq hmax$$

Step2: Chromosome representation and design space generation

To find optimal parameter value of d, h. parameter d, h value should satisfy constraint g and minimize f(d,h).

Represent parameter value in binary string. Assume, chromosome is designed using 5 bits of code. So, overall length for d and h = 10 bits.

d = | 0 | 1 | 0 | 0 | 0 | = 8

h = | 0 | 1 | 0 | 1 | 0 | =10

(d,h) = (8,10)

Chromosome = 0100001010

5 bits mean there will be 2^5=32 different solutions

Lower bound and upper bound of both d and h is [0, 31]

Step 3: Assign fitness to a solution

Evaluate solution in context of objective function and constraints for c=0.654

F(s) =0.654($\pi(8)^2/2$ + $\pi(8)(10)$ = 23

And also g(s) > 300

Objective: we need to find out smaller fitness value and find out other better solutions

Initial Population (Random): **Population Size=6**

23 24 30 26 11 9

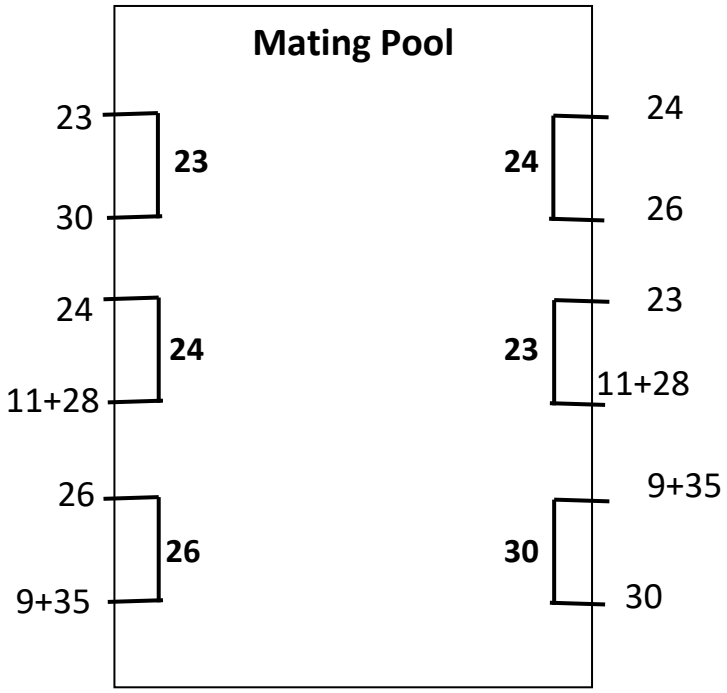
11 and 9 does not satisfy constraint g (300 ml volume) so penalized by 'Artificial cost'

23 24 30 26 11+28 9+35

Step 4: Reproduction/ Selection

Objective is to emphasis is to achieve good solution and eliminate bad solution. Reproduction does not generate any new population

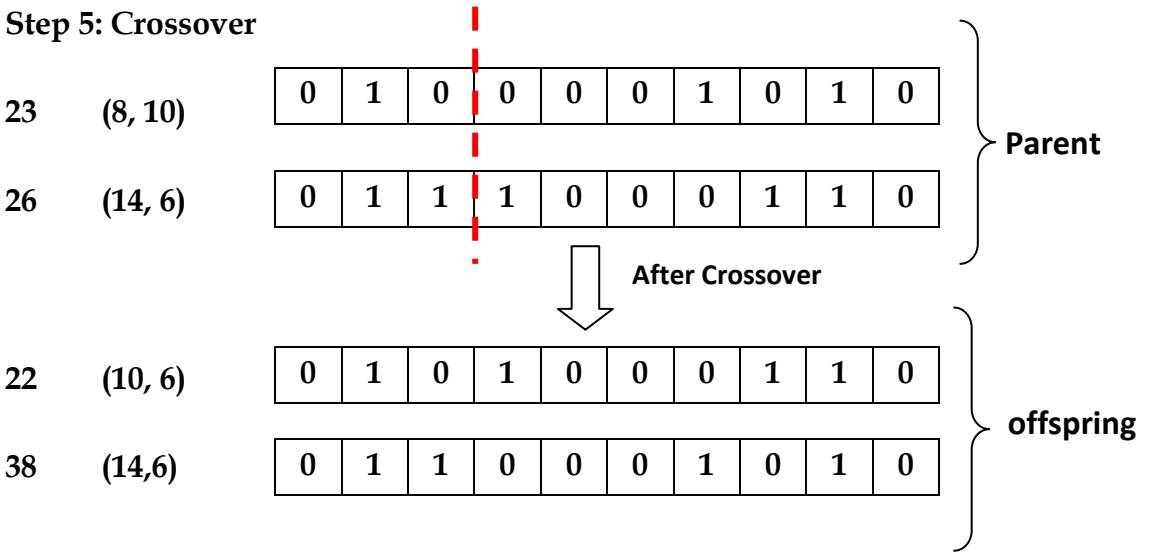
- Identify good solution
- Make multiple copies of good solution
- Eliminate bad solution



Good Solution: 23, 24, 26, 30

Eliminated: 30, 9+35, 11+38

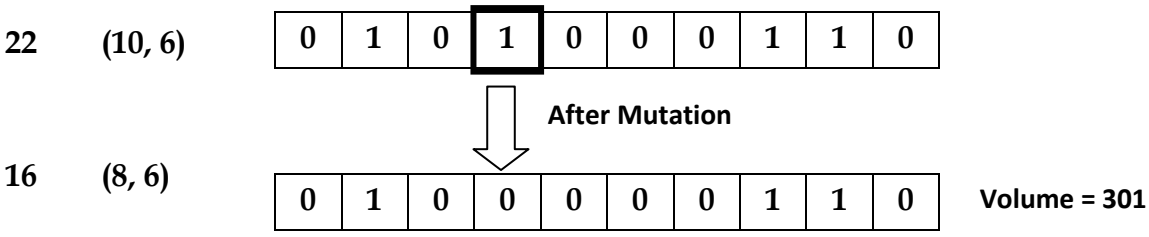
Step 5: Crossover



Always Children solution is not better than parent solution but at least better than random selection.

Step 6: Mutation

To keep diversity in the population



Assignment1:

Suppose there is equality

a+ 2b+3c+4d =30

Use Genetic Algorithm to find the value of A, B, C, D that satisfy the above equation. Objective function is minimizing the value of function

f(a,b,c,d) = a+ 2b+3c+4d-30

and a,b,c,d cannot be zero.