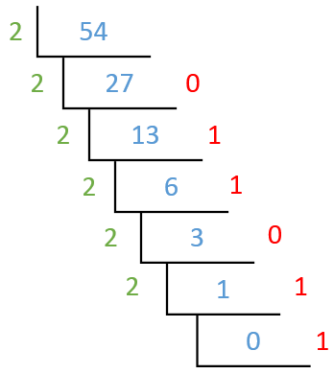
Genetic Algorithm
For the Absolute Beginner

Cheat Sheet:

1. **Converting decimal to binary**
   Successively divide the decimal number by 2, the remainders of the process taken in reverse order gives the binary form of the number. In the following example we try to find the binary equivalent of the decimal number 54. The process of successive division is shown below.



   The Binary equivalent is 110110

2. **Converting binary to decimal**
   The following formula can be used to convert the binary form of a number into its decimal form

$$D = (b_0 \times 2^0) + (b_1 \times 2^1) + \cdots + (b_n \times 2^{n-1})$$

   To convert 110110 to decimal form, first we identify the bs and n

   n+1 = number of bits = 6 => n = 5
   $b_0 = 0$
   $b_1 = 1$
   $b_2 = 1$
   $b_3 = 0$
   $b_4 = 1$
   $b_5 = 1$

   Applying the formula,

$$D = (b_0 \times 2^0) + (b_1 \times 2^1) + \cdots + (b_n \times 2^{n-1})$$
$$D = (0 \times 2^0) + (1 \times 2^1) + (1 \times 2^2) + (0 \times 2^3) + (1 \times 2^4) + (1 \times 2^5)$$
$$D = 54$$

3. **How to select the number of bits to represent a variable?**

$$n = \log_2\left(\frac{x_{\max} - x_{\min}}{p}\right)$$
$$p = \text{precision required}$$

4. Finding the variable value from the decimal value

Use the following formula to find the variable value x from the decimal value D

$$x = x_{\min} + \frac{x_{\max} - x_{\min}}{2^n - 1} \times D$$

5. Some mutation and cross over schemes

Cross- over

a. Single Point cross over <- Discussed in the talk
b. Multi point cross over <- Similar but splicing happens at more than one location on the chromosome

Mutation

a. Fixed bit mutation <- Mutation always happens on a fixed bit position
b. Random bit mutation <- Discussed in the talk

6. How do I create random numbers?

Random number generators are already available in the literature. Based on the programming language you are using, you can find pre-written codes for random number generation online.

I recommend that you use a random number generator which takes **Time** as the seeding input.

7. Some test functions that you can use to test your GA code

a. Kursawe function
b. Mishra's Bird function – constrained
c. Rosenbrock function constrained with a cubic and a line
d. Rosenbrock function constrained to a disk
e. Zitzler–Deb–Thiele's function

These are some of the standard functions available in the literature, you can google the names of the functions and you will get the functionality and the constraints.

8. How can I use GA in my field?

a. Identify an optimization problem
b. Write down the problem in mathematical form
c. Identify the objectives and the variables
d. Find the constraints of the variables
e. Fix the precision level you want for your answer, find the number of bits required to achieve this precision
f. Solve your problem using GA