The Genetic Algorithm - a brief overview

Before you can use a genetic algorithm to solve a problem, a way must be found of *encoding* any potential solution to the problem. This could be as a string of real numbers or, as is more typically the case, a binary bit string. I will refer to this bit string from now on as the chromosome. A typical chromosome may look like this:

100101011101010010100111011011101111111101

(Don't worry if non of this is making sense to you at the moment, it will all start to become clear shortly. For now, just relax and go with the flow.)

At the beginning of a run of a genetic algorithm a large population of *random* chromosomes is created. Each one, when decoded will represent a different solution to the problem at hand. Let's say there are N chromosomes in the initial population. Then, the following steps are repeated until a solution is found

- Test each chromosome to see how good it is at solving the problem at hand and assign a *fitness score* accordingly. The fitness score is a measure of how good that chromosome is at solving the problem to hand.

- Select two members from the current population. The chance of being selected is proportional to the chromosomes fitness. *Roulette wheel* selection is a commonly used method.

- Dependent on the *crossover rate* crossover the bits from each chosen chromosome at a randomly chosen point.

- Step through the chosen chromosomes bits and flip dependent on the *mutation rate*.

- Repeat step 2, 3, 4 until a new population of N members has been created.

Tell me about Roulette Wheel selection

This is a way of choosing members from the population of chromosomes in a way that is proportional to their fitness. It does not guarantee that the fittest member goes through to the next generation, merely that it has a very good chance of doing so. It works like this:

Imagine that the population's total fitness score is represented by a pie chart, or roulette wheel. Now you assign a slice of the wheel to each member of the population. The size of the slice is proportional to that chromosomes fitness score. i.e. the fitter a member is the bigger the slice of pie it gets. Now, to choose a chromosome all you have to do is spin the ball and grab the chromosome at the point it stops.

What's the Crossover Rate?

This is simply the chance that two chromosomes will swap their bits. A good value for this is around 0.7. Crossover is performed by selecting a random gene along the length of the chromosomes and swapping all the genes after that point.

e.g. Given two chromosomes

10001001**110010010**
01010001**001000011**

Choose a random bit along the length, say at position 9, and swap all the bits after that point

so the above become:

10001001101000011
01010001010010010

What's the Mutation Rate?

This is the chance that a bit within a chromosome will be flipped (0 becomes 1, 1 becomes 0). This is usually a very low value for binary encoded genes, say 0.001

So whenever chromosomes are chosen from the population the algorithm first checks to see if crossover should be applied and then the algorithm iterates down the length of each chromosome mutating the bits if applicable.