# Selection and Crossover of Variable Length Chromosomes

Genetic Algorithms work on one basic principle of searching a truly global search space and optimizing the results in each subsequent generation to reach a global optimal value. In our problem, we are using this fundamental concept related to GA to train our neural networks faster and better. Only one hidden layer is taken in account in the model for simplicity and efficiency. Encoding the chromosomes of a genome with Neural Networks incorporates number of hidden nodes in the one hidden layer, which then determines the number of weights in the network (also the length of the chromosome). This seems fitting, as then only we are using a global search space. But the problem arises during crossover; as networks with different number of hidden units can’t be crossed over with each other.

To solve this problem, different selection techniques are incorporated. One of them finding both parents that satisfy the condition of having equal number of hidden units, resulting in no anomaly during crossover. This requires alteration of the used selection procedure.

Selection gives two parents, a father and a mother. The father is selected using the normalized rank based selection from the population. The ranks evaluated according to fitness returned by the artificial neural network, i.e. the accuracy of the feed forward training of said network. The number of hidden nodes in the first parent, father is used to find suitable match in a subset of the original population which satisfy , where is a procedure that gives the no of hidden nodes in the given chromosome. If the population contains elements having number of hidden nodes varying from 1 to n, total number of such subsets come out to be n, labeled , which are mutually exclusive and exhaustive. If , then we apply our normalized rank roulette wheel selection procedure on the set . And the result is selected as the second parent, the mother. This allows us to apply crossover on both parents with ease.