# Problem Definition

## Input

The higher order system gives the neural network a set of weights to feed forward, along with the number of hidden nodes, encoded in a single chromosome. The artificial neural network takes this chromosome as input, along with values from the Pima Indians Diabetes Data Set. The dataset requires 8 input nodes and gives a binary output on 1 node.

## Output

Applying feed forward on this network allow us to calculate the accuracy of the network using the supplied weights on the input dataset, which is returned back to our global search as output of Neural Network. Genetic Algorithm uses this as a parameter to evaluate fitness, and continues this cycle to finally return the configuration of network which is best in terms of accuracy, i.e. the set of weights and number of hidden nodes in that network.

## Constraints

Since creating and training a very large population of networks repeatedly, can take up a huge chunk of memory, take a very long time and can sometimes just be redundant, we put some constraints on our operations and problem instance sizes.

In generating variable length chromosomes, the number of hidden nodes is set from 0 to 20, and 200 of such chromosomes are generated. This population pool is wide enough to incorporate all the variations, and make our search space truly global, as well as it allows us to reach an optimal solution in an appropriate time frame. Also, the number of hidden layers is set to 1 in all such genomes, as increasing hidden layers increases complexity significantly. The initial weights of network lie in the range which allows search algorithm to reach to optimal set of weights faster.

The probability of mutation is a very significant factor that generates all of the variety, required to reach the optimal point in search space and can also cause the algorithm to wander around it, never actually reaching the global solution. To address both of these, the probability of mutation is set to 0.2 in first 200 generations to allow greater variety and then reduced to 0.02 to let it converge on a single optimal result.

Similarly, the probability of crossover is set to 0.8 which allows some partners to not generate child chromosomes, and reproduce themselves into the next generation of population. This distinctively incorporates the ideology of elitism into search strategy.

Finally, a run lasts for 500 generations, ingeniously allowing the members of our genome to mature enough and produce a result that can get as close as it can, to the globally optimum result.