

## Evolutionary Machine Learning – HW1

**HW1:** Train a shallow feedforward neural network (with sigmoidal node functions and one hidden layer with twice as many nodes as the input dimensionality) for a 2-class classification task using a Genetic Algorithm; compare the results with backpropagation.

**Dataset:** Bank Marketing Dataset

Link: - <https://www.kaggle.com/chaithanya96/train-cc>

### Code execution steps:

Genetic Algorithm

1. GeneticNeuralNetwork class is defined by specifying the sequential model as the argument. If there are no weights specified, then one hidden layer and one output layer will be created by taking the sigmoid activation. The Genetic Neural Network is being created in such manner.
2. Different methods have been defined for mutation and forward propagation.
3. Maximum fitness is being set as 0.9 and for the number of generations as 250 till which the program will be executed.
4. The obtained Max fitness is 0.88.

```
Generation: 1
Max Fitness: 0.8840707964601769
[array([[ 0.13318026,  0.1603396 ,  0.02078304, -0.30280423, -0.35221553,
          0.03362378,  0.13438094,  0.34500313, -0.25380635, -0.2603329 ,
          0.37509078, -0.1704962 ,  0.3816538 ,  0.22451192,  0.42015797,
         -0.09756175,  0.23120302, -0.19912656,  0.02710906,  0.14633828],
        [ 0.02724329,  0.11032677,  0.00284281,  0.10588813, -0.35592902,
         -0.2865877 ,  0.07846856,  0.28864145,  0.15698832,  0.3745911 ,
         -0.23784664, -0.10857034, -0.29291007, -0.38541567,  0.09456825,
          0.12792718, -0.27768874,  0.29161257,  0.00475767,  0.4460271 ],
        [ 0.21324432,  0.00135499,  0.37498635, -0.04907617, -0.19480306,
          0.24257147,  0.3180967 , -0.20143987,  0.07098109, -0.35472512,
          0.22094482, -0.04530048,  0.18020356,  0.25437486, -0.08060318,
         -0.308841 , -0.31239676,  0.37906933, -0.05382189, -0.22148477],
        [ 0.23079753,  0.12943274, -0.06678364, -0.29206774,  0.38609564,
          0.3652935 , -0.34149736, -0.28231505,  0.42921853,  0.3961779 ,
         -0.3380214 , -0.24298134,  0.2993123 , -0.41771337,  0.08385265,
         -0.38627946,  0.2432642 , -0.08515623, -0.38763356,  0.17344594],
        [-0.00534922, -0.1216656 ,  0.43156767, -0.33802813,  0.17426836,
          0.41757125,  0.17141175, -0.3010569 , -0.13802415, -0.42393565,
          0.360592 , -0.199916 ,  0.23454738,  0.2488336 ,  0.13543642,
          0.40955633, -0.34663963, -0.08801344,  0.01969719,  0.36727864],
        [-0.06975579,  0.00319424,  0.01488972,  0.3666649 ,  0.1701442 ,
```

5.

Backpropagation

1. Dividing the available dataset as train data and test data.
2. Creating one hidden layer with twice as many nodes as the input i.e. 10 layers and 20 perceptron.
3. Applying sigmoid function to the 20 hidden layers.
4. Training the data model.
5. Evaluation of the model.

```
Epoch 1/10
3390/3390 [=====] - 1s 428us/step - loss: 0.3818 - accuracy: 0.8794
Epoch 2/10
3390/3390 [=====] - 1s 326us/step - loss: 0.3495 - accuracy: 0.8841
Epoch 3/10
3390/3390 [=====] - 1s 328us/step - loss: 0.3362 - accuracy: 0.8841
Epoch 4/10
3390/3390 [=====] - 1s 326us/step - loss: 0.3271 - accuracy: 0.8841
Epoch 5/10
3390/3390 [=====] - 1s 331us/step - loss: 0.3252 - accuracy: 0.8841
Epoch 6/10
3390/3390 [=====] - 1s 326us/step - loss: 0.3263 - accuracy: 0.8841
Epoch 7/10
3390/3390 [=====] - 1s 326us/step - loss: 0.3273 - accuracy: 0.8841
Epoch 8/10
3390/3390 [=====] - 1s 321us/step - loss: 0.3256 - accuracy: 0.8876
Epoch 9/10
3390/3390 [=====] - 1s 327us/step - loss: 0.3224 - accuracy: 0.8861
Epoch 10/10
3390/3390 [=====] - 1s 331us/step - loss: 0.3288 - accuracy: 0.8817
```

```
Test accuracy: 0.889478325843811
```

```
Test loss: 0.3081013898897972
```

## Conclusion:

The **Genetic Neural Network** resulted in a test accuracy of 0.89 The **Sequential Neural Network** resulted in a test accuracy of 0.88

## References

- 1) <https://towardsdatascience.com/neural-net-from-scratch-using-numpy-71a31f6e3675>
- 2) <https://machinelearningmastery.com/implement-backpropagation-algorithm-scratch-python/>
- 3) Discussed with classmates.

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