Intelligent systems - Laboratory 6
Neural Networks
13 - 11 - 2018
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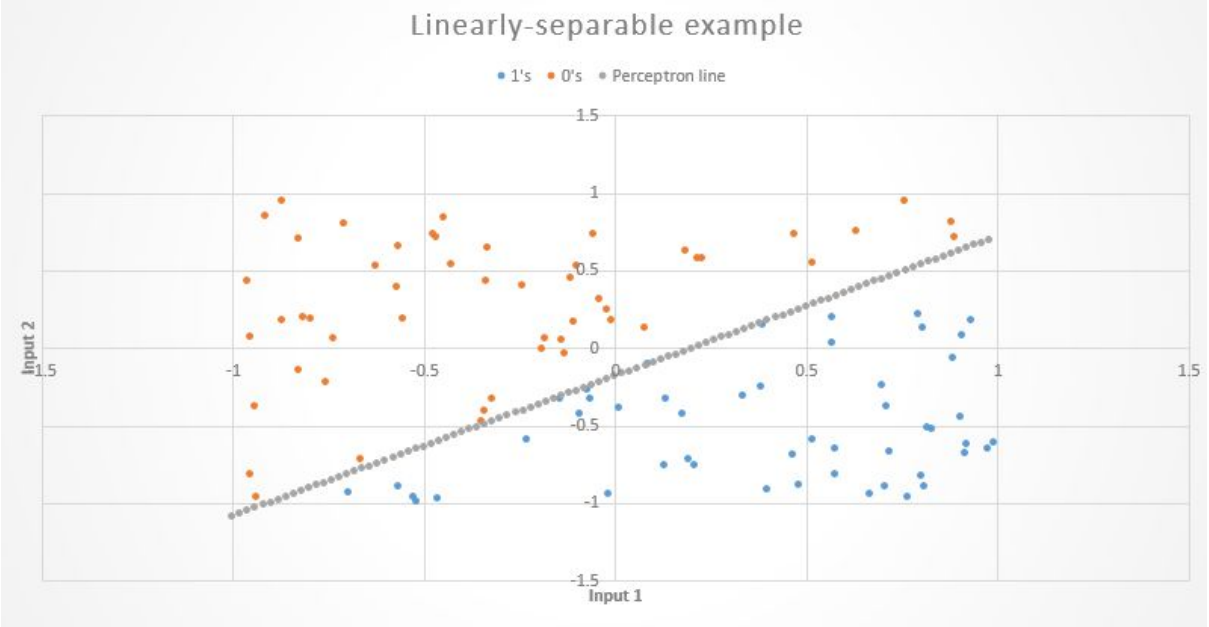
Part 1



The function that describes the perception line is given as:

$$Weight1 * Input1 + Weight2 * Input2 + WeightBias = Threshold$$

Where:

- $Weight1 = 0.319$
- $Weight2 = -0.354$
- $WeightBias = 0.934$
- $Bias = 1$
- $Threshold = 1$

Therefore

$$0.319 * Input1 - 0.354 * Input2 + 0.934 = 1$$

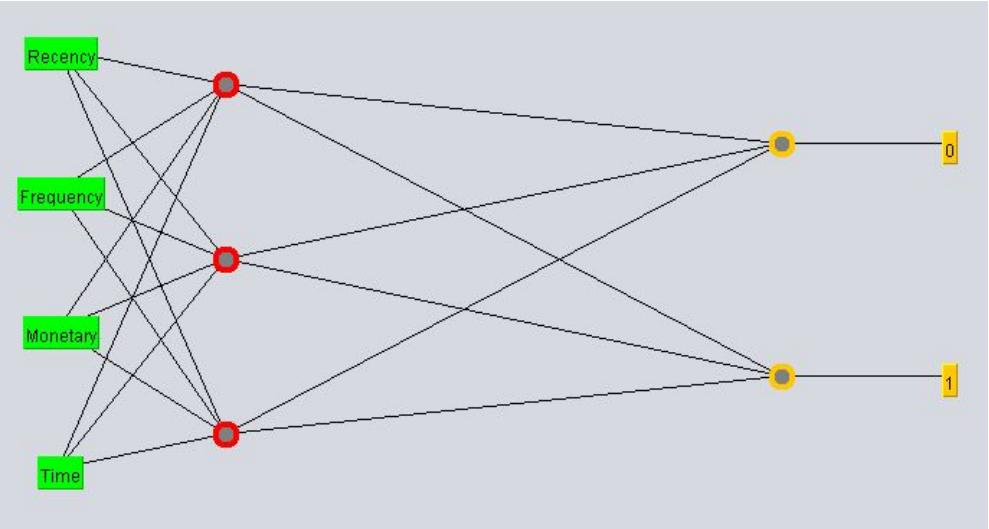
Part 2

For every network, three parameters were changed in order to observe how the result changes . For the first network:

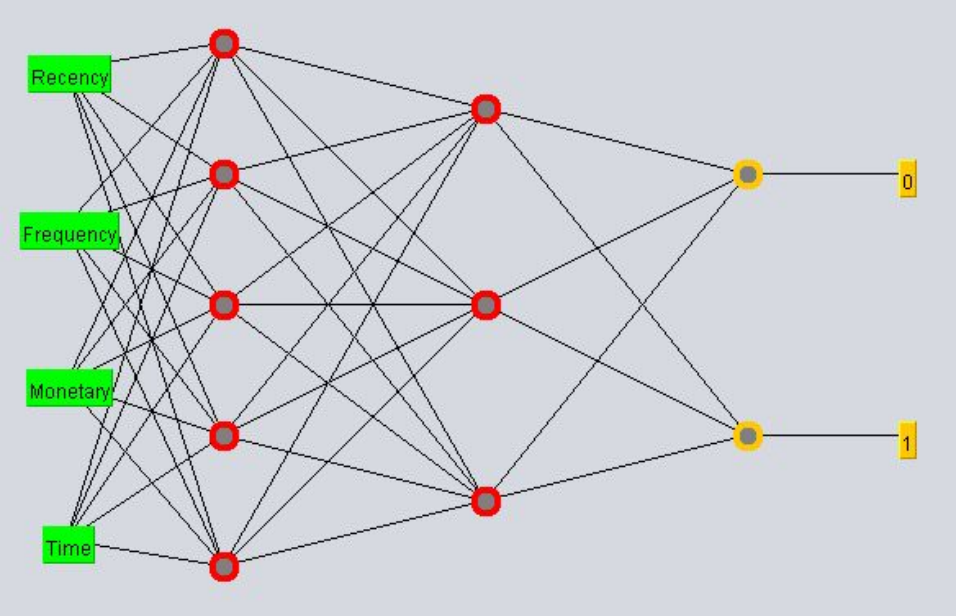
Parameters:

Hidden layers	Learning Factor	Epochs	Correctly	Learning time

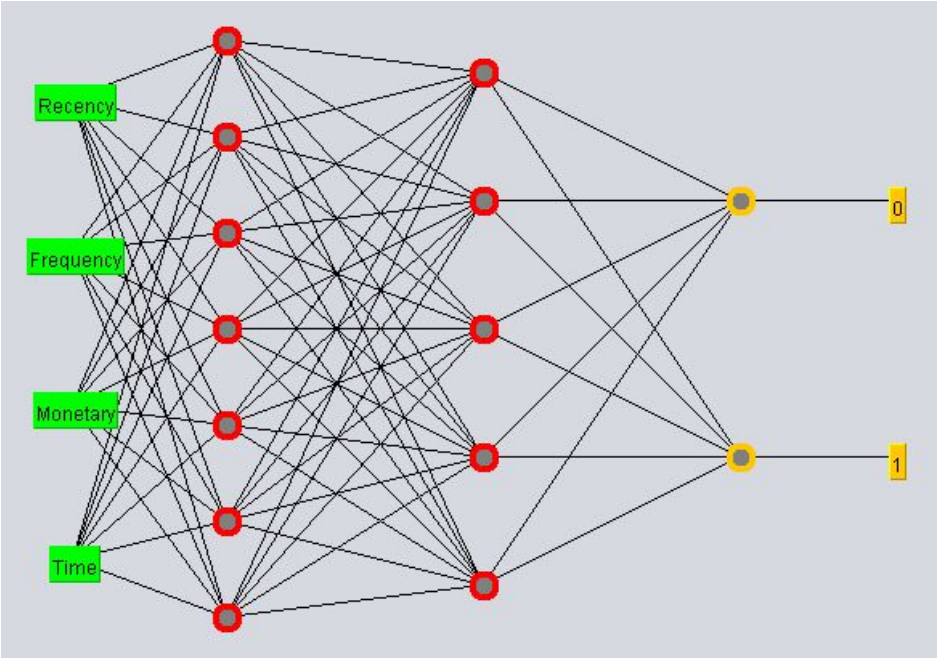
			classified instances	
3 (Default)	0.3	5000	76.666%	14.55 sec.
5, 3	0.2	5000	81.33%	14.93 sec.
7, 4	0.2	3000	78%	13.29 sec



1st Network



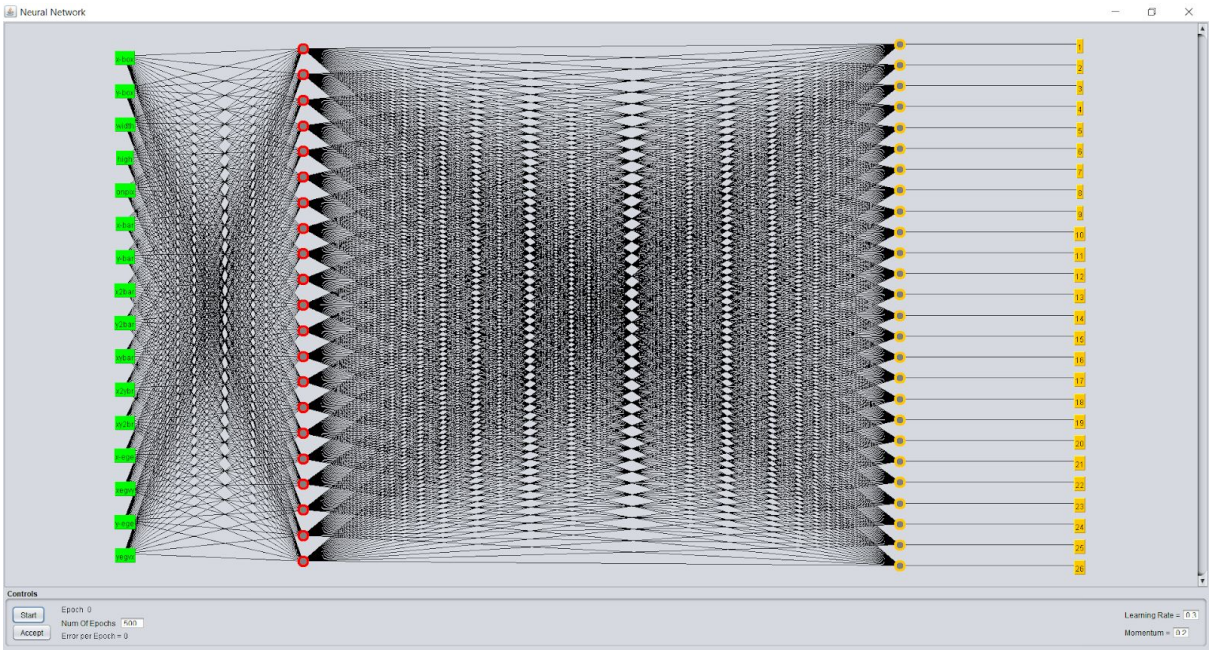
2nd Network



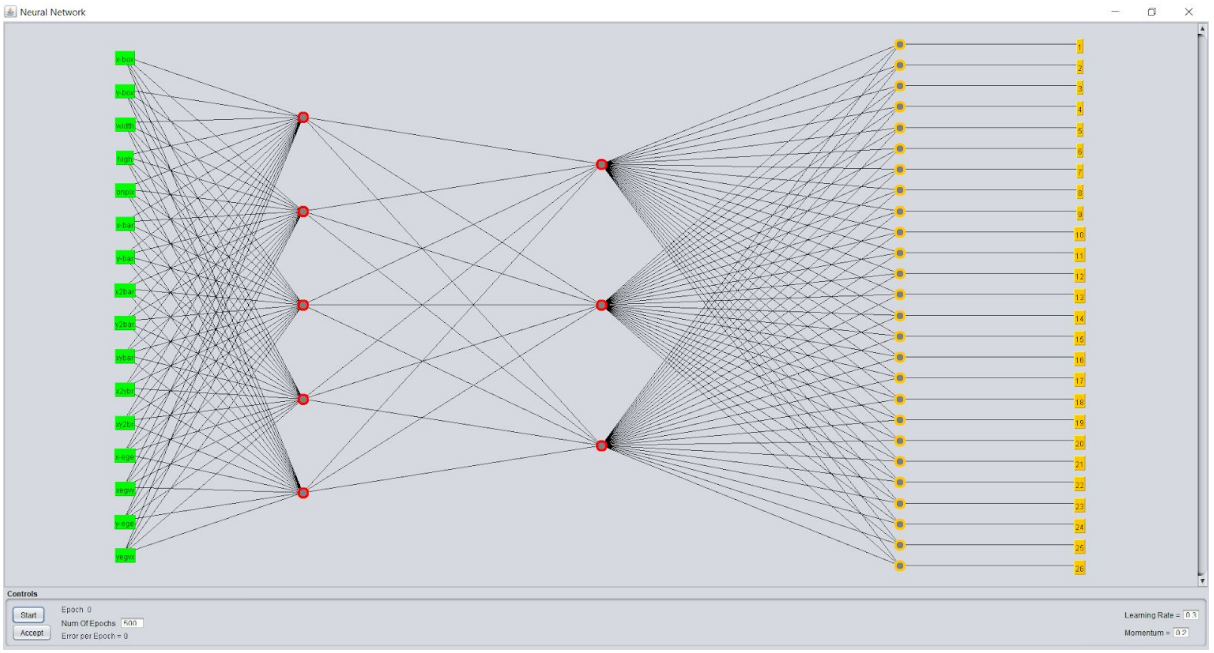
3rd Network

Second database

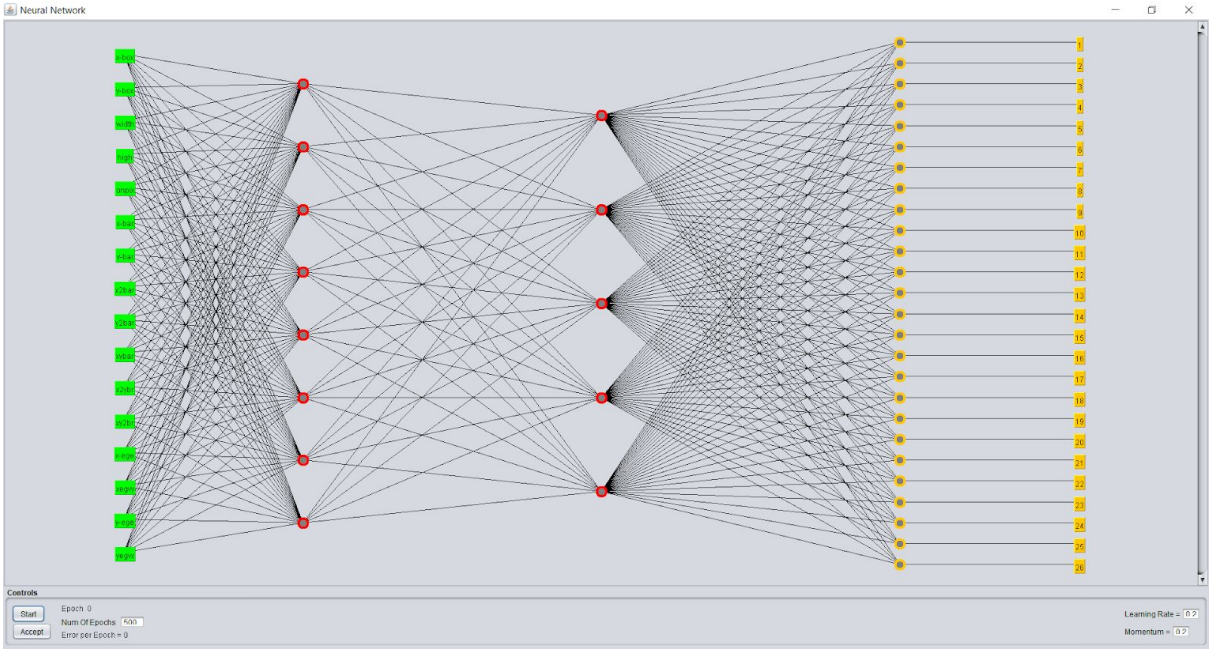
Hidden layers	Learning Factor	Epochs	Correctly classified instances	Learning time
21 (Default)	0.3	50	80.82%	41.15 sec.
5, 3	0.3	50	42.8%	22.64 sec.
8, 5	0.2	50	63.6%	61.7 sec



First Network



Second Network



Third Network

We can observe that more nodes per layer implies more training time (also this is because of a larger database), and that doesn't mean more precision, using more nodes per layer can lead us to overfitting. For the second database, even with more training time (third network) doesn't give a better result. Increasing the total connections give us the biggest training time. Each case is unique because of the database, giving that for every re-calculation we take in count the importance of the input, we cannot just take a model that works the best of one case and implement another neural network with the same parameters in another database and expect that is as good as it was for the first case.

Advantages of ANN:

- ANNs have the ability to learn and model non-linear and complex relationships, which is really important because in real-life, many of the relationships between inputs and outputs are non-linear as well as complex.
- ANN does not impose any restrictions on the input variables (like how they should be distributed). Additionally, many studies have shown that ANNs can better model heteroskedasticity i.e. data with high volatility and non-constant variance, given its ability to learn hidden relationships in the data without imposing any fixed relationships in the data. This is something very useful in financial time series forecasting (e.g. stock prices) where data volatility is very high.
- ANNs can generalize — After learning from the initial inputs and their relationships, it can infer unseen relationships on unseen data as well, thus making the model generalize and predict on unseen data

ANN cannot be used when the database is small, this will case overfitting or a bad prediction, because it doesn't have enough material to learn. Another disadvantage is their "black box" nature, where it is kind of uncertainty the way the NN came up with a certain output.