Assignment 3

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Part I
Architecture

We used a 1-layer (1 input layer, 1 output layer, and 1 hidden layer) neural network with 2 hidden nodes for our network architecture. 1 input, 1 hidden, and 1 output layer is sufficient for most applications of neural network because this type of network is able to map any 1-to-1 function. The function of most applications represent a 1-to-1 mapping, thus we concluded we only need 1 layer of each node type for the problem of gender recognition through facial image analysis. We decided on 2 hidden nodes through trial and error. We concluded the reason this works is because we are dealing with two different types of images: male and female. For input nodes, we used the number of pixels in an image file for complete information assurance. Once the input reached the hidden layer it was converted to a sigmoid unit and then multiplied by a weight and sent to the output node. Since the network contained two output nodes each hidden node had two weights associated to it. Depending on this output, the network was able to make a decision as to wether the image was of a male or female. In our network an output of a 0 coressponded to a male and a value of 1 represented a female. For output nodes, we used 2 nodes again for the reason of the dichotomy between male and female images. The network was fully connected in order to propogate our results correctly. Our implementation can be found in the following files : Main.java , Image. java , NeuralNetwork.java .

Part II
Cross Validation

Below is an estimation of our mean and standard deviation through various trials. Needless to say, there was something wrong with our folding function.

Run #	Mean	Standard Deviation
1	.99	0
2	.99	0
3	.99	0
4	.99	0
5	.99	0
6	.99	0
7	.99	0
8	.99	0
9	.99	0
10	.99	0

Part III
Confidence

To calculate the confidence in our prediction, we used the ouput of the neural network and determined whether it was more likley to be male or female. After we had our prediction we divided our output by the value of our guess (1 for female, 0 for male). In most cases, this would have been a good confidence meter, however as a result of being unable to properley train our network, the output values were often too strong (1 or 0 - overtraining), leading to overly confident predictions. The output file will be saved as the following : `AI_Am_Boss.predictions`.

Part IV
Network Behavior

$$h_1 = i_1 \cdot w_{r(1)} + i_2 \cdot w_{r(2)} + \ldots + i_{128 \cdot 120} \cdot w_{r(128 \cdot 120)}$$

$$h_2 = \overline{i_1} \cdot w_{r(1)} + \overline{i_2} \cdot w_{r(2)} + \ldots + \overline{i}_{128 \cdot 120} \cdot w_{r(128 \cdot 120)}$$

The above formulae represents the values of the two hidden nodes. The weights are different for the two hidden nodes because these weights are what are refined in the training phase. We suspect that the network is acting on information in the image that indicates the placement and amount of hair. For example, facial hair indicates a male. Long head hair usually indicated a female. We believe our neural network is using this criterion as a major focus in its decision making process. Using back propagation a decision is made in the network by first propogating through the network until the output nodes are reached. The output nodes are where the actual decision is made.

Appendix

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Usage

`java Main -train -test` where Male, Female, and Test are default directories. `java Main -train dir1 dir2 -t` specified directories.