Assignment 1 (CS 747): Building FeedForward classifiers for images

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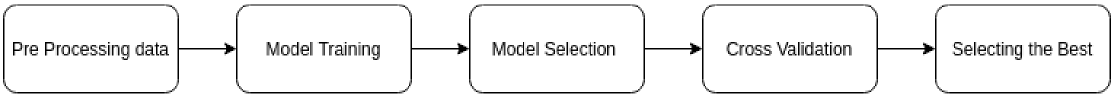
Goal:

This assignment consists of building, validating, and testing feed forward binary classifiers for the same repository of images you used in Assignment 0.

Approach:

I followed the below diagram step to solve this assignment.



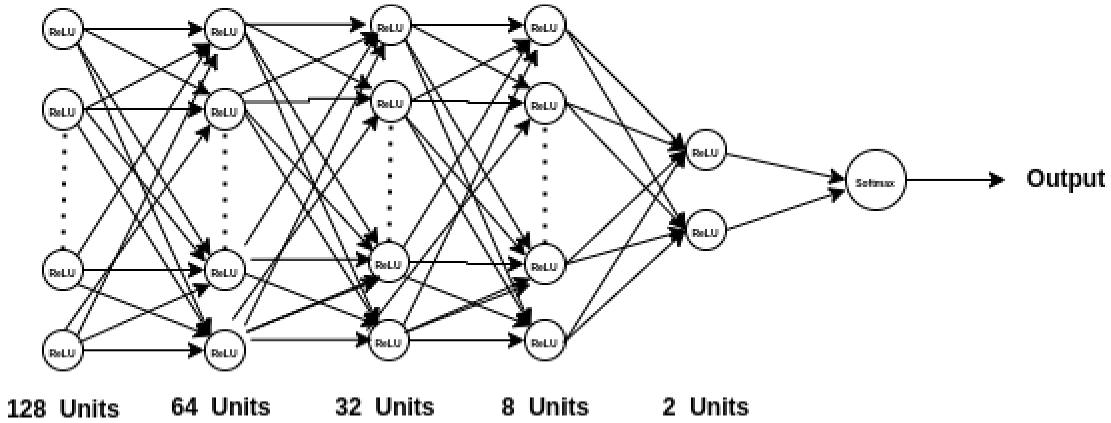
Pre-Processing of Data:

Below are the steps taken to pre-process that data.

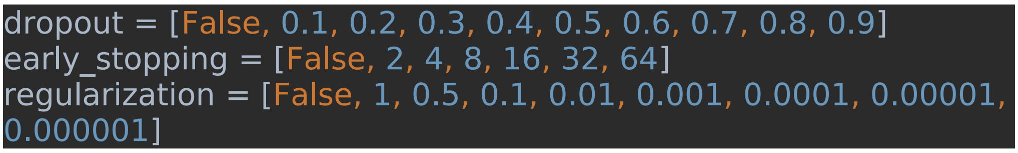
1. Standardized to the same size of all the image and converted to 1D vectors. So that each image will have same dimension and same cost function can be applied to all images.
2. Save the 1-D Images Vector and Labels to npy file for training, validation and evaluation files. So that I can avoid preprocessing each time.

Model Training:

The model include 5 hidden layer with different number of units which are 128, 64, 32, 8, 2. Below is the fast forward neural network model architecture.



For models trining I have used the tensorflow library and below are the parameter for used in model training.



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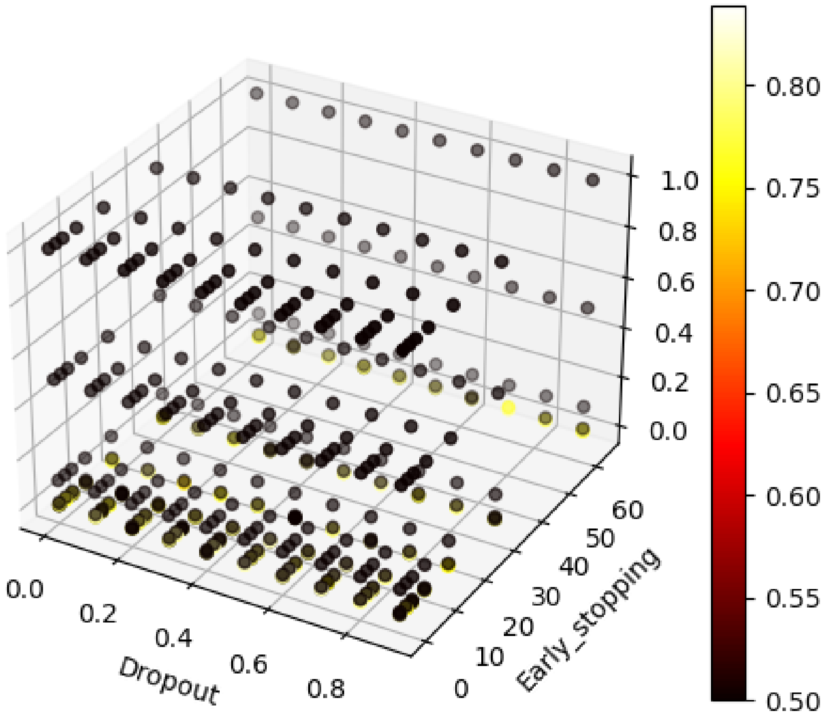
dropout = [False, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9]
early_stopping = [False, 2, 4, 8, 16, 32, 64]
regularization = [False, 1, 0.5, 0.1, 0.01, 0.001, 0.0001, 0.00001,
0.000001]
```

Model Selection(Results):

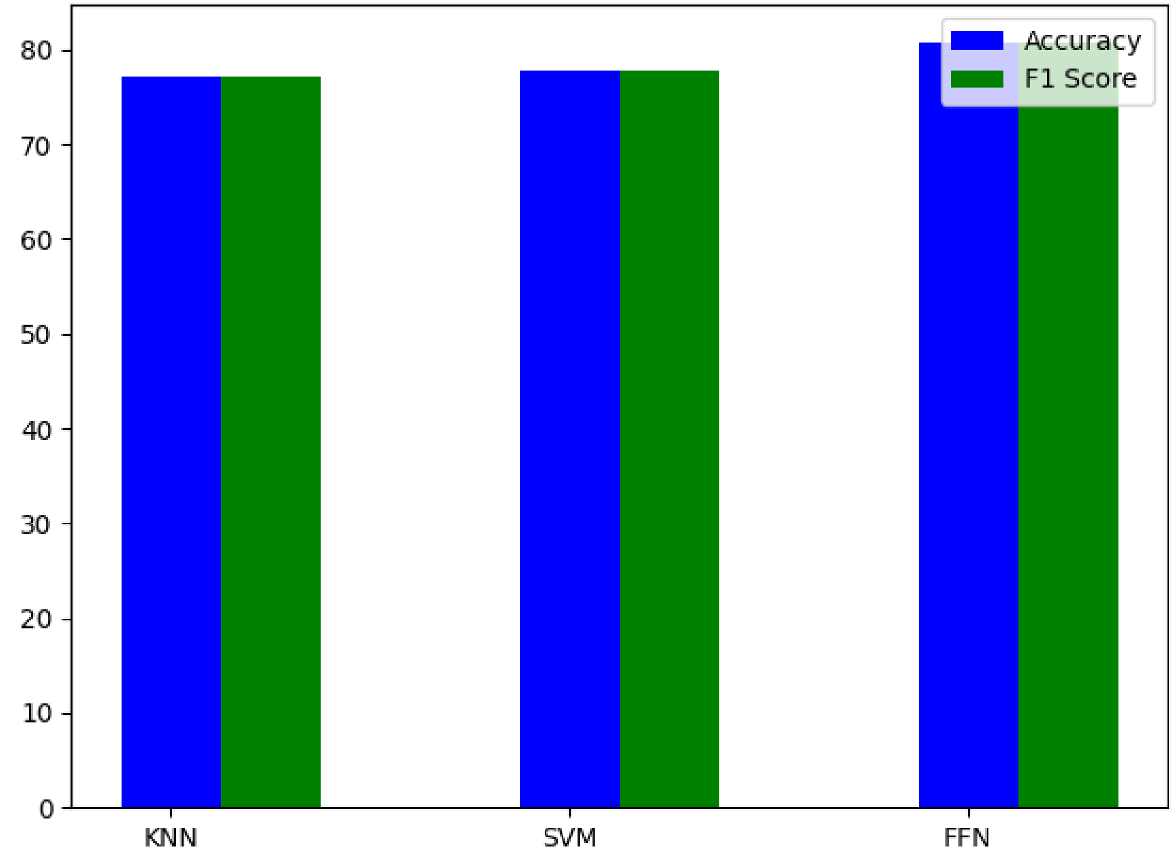
The model selection is done by selecting the best performing model on different hyperparameter(dropout, early stopping and regularization value) on validation data. The maximum accuracy was 83.7 on validation data using 0.8 dropout, 64 early dropping and 1e-06 regularzation value.

Below is the plot for the same. Also same values can be find on miscellaneous folder as the CSV file.



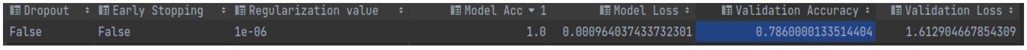
Resuls Comparison:

Feed forward binary classifiers outperform the svm and knn and give the best accurary on evaluation data which is 80.7 percent.



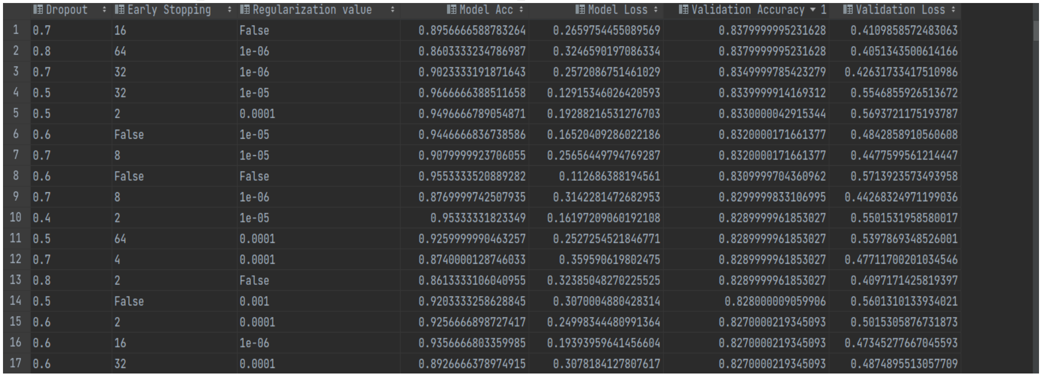
Conclusion:

1. Model with max traning accuray does not perform well on validation data which mean that model was simply highly biased on training data.



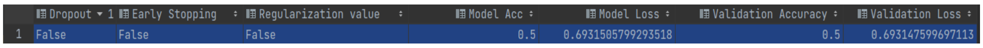
Dropout	Early Stopping	Regularization value	Model Acc ▾ 1	Model Loss	Validation Accuracy	Validation Loss
False	False	1e-06	1.0	0.000964037433732301	0.7860000133514404	1.612904667854309

2. Dropout helped to come over the problem overfitting. As we can see in bleow screenshot that top results came with a dropout.



	Dropout	Early Stopping	Regularization value	Model Acc	Model Loss	Validation Accuracy ▾ 1	Validation Loss
1	0.7	16	False	0.8956666588783264	0.2659754455089569	0.8379999995231628	0.4109858572483063
2	0.8	64	1e-06	0.8603333234786987	0.3246590197086334	0.8379999995231628	0.4051343500614166
3	0.7	32	1e-06	0.9023333191871643	0.2572086751461029	0.8349999785423279	0.42631733417510986
4	0.5	32	1e-05	0.9666666388511658	0.12915346026420593	0.8339999914169312	0.5546855926513672
5	0.5	2	0.0001	0.9496666789054871	0.19288216531276703	0.8330000042915344	0.5693721175193787
6	0.6	False	1e-05	0.9446666836738586	0.16520409286022186	0.8320000171661377	0.4842858910560608
7	0.7	8	1e-05	0.9079999923706055	0.25656449794769287	0.8320000171661377	0.447759961214447
8	0.6	False	False	0.9553333520889282	0.112686388194561	0.8309999704360962	0.5713923573493958
9	0.7	8	1e-06	0.8769999742507935	0.3142281472682953	0.8299999833106995	0.44268324971199036
10	0.4	2	1e-05	0.95333331823349	0.16197209060192108	0.8289999961853027	0.5501531958580017
11	0.5	64	0.0001	0.9259999990463257	0.2527254521846771	0.8289999961853027	0.5397869348526001
12	0.7	4	0.0001	0.8740000128746033	0.359590619802475	0.8289999961853027	0.47711700201034546
13	0.8	2	False	0.8613333106040955	0.32385048270225525	0.8289999961853027	0.4097171425819397
14	0.5	False	0.001	0.9203333258628845	0.3070004880428314	0.828000009059906	0.5601310133934021
15	0.6	2	0.0001	0.9256666898727417	0.24998344480991364	0.8270000219345093	0.5015305876731873
16	0.6	16	1e-06	0.9356666803359985	0.19393959641456604	0.8270000219345093	0.47345277667045593
17	0.6	32	0.0001	0.8926666378974915	0.3078184127807617	0.8270000219345093	0.4874895513057709

3. Model does not perform best with deafult values either.



	Dropout	Early Stopping	Regularization value	Model Acc	Model Loss	Validation Accuracy	Validation Loss
1	False	False	False	0.5	0.6931505799293518	0.5	0.693147599697113

4. I have also notice that while training model. The same model gives different accuracy. And the reason is that the multi layer nural network is non-convex. Duo to non-convexity the model reach to local(not global) minima and its always depents on starting point for reaching the minima. And duo it changes every time. The model also gives different accurary for same hpyerparameters.