IEEE CIS/SMC Challenge

Wen Dong #110057395 dong23@uwindsor.ca

Motivation

I have selected artificial neural network to solve the multi-label and multiclass classification challenge, the selection was due to the requirement of the Challenge and the nature of the dataset.

Algorithm

The algorithm employed in the solution is an artificial neural network with multiple hidden layers and a softmax output layer with 10 units. According to my analysis on the dataset, the multi-label problem can be safely converted to a single-label classification task as the two labels are highly correlated:

1. Label 1 is of 10 classes [1,2,3,4,5,6,7,8,9,10]
2. Label 2 is a binary [0,1]
3. Whenever label1 is 7 label2 is 0 and label2 is 1 if label1 is not 7 as below

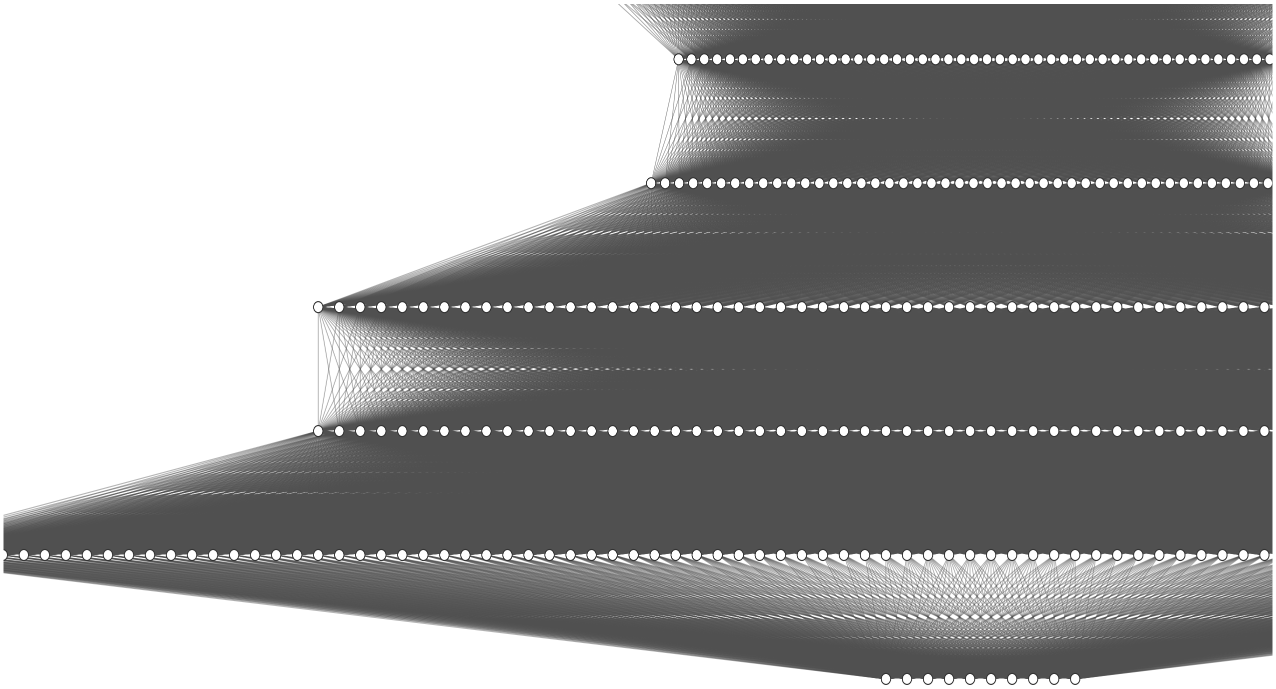
Label 1	Label 2
1	1
2	1
3	1
4	1
5	1
6	1
7	0
8	1
9	1
10	1

Architecture

Structure and characteristics of the neural network, concluded by keras tuner automatically searching and identifying the optimal parameters of the neural network

Layer	**Layer type**	**Units**	**Activation**
First layer	Dense	66	Relu
Hidden	Dense	48	Tanh
Hidden	Dense	48	Relu
Hidden	Dense	64	Relu
Hidden	Dense	64	Tanh
Hidden	Dense	108	Relu
Output	Dense	10	Softmax

Visualization of the neural network structure



Experimental Setting

there is no drop-out in layers.

learning rate is 0.001.

batch size is 128.

number of epochs is 40.

early stopping patience is 5.

Data preprocessing steps:

1. Removed redundant highly correlated features with correlation rate greater than 94%
2. Selected from the remaining columns the most important 21 features by ExtraTreesRegressor to enhance prediction and reduce the chance of over fitting
3. Standardized and normalized the features
4. Convert label1 from [1,2,3,4,5,6,7,8,9,10] to [0,1,2,3,4,5,6,7,8,9] by subtracting 1 to fit it better to the output softmax layer

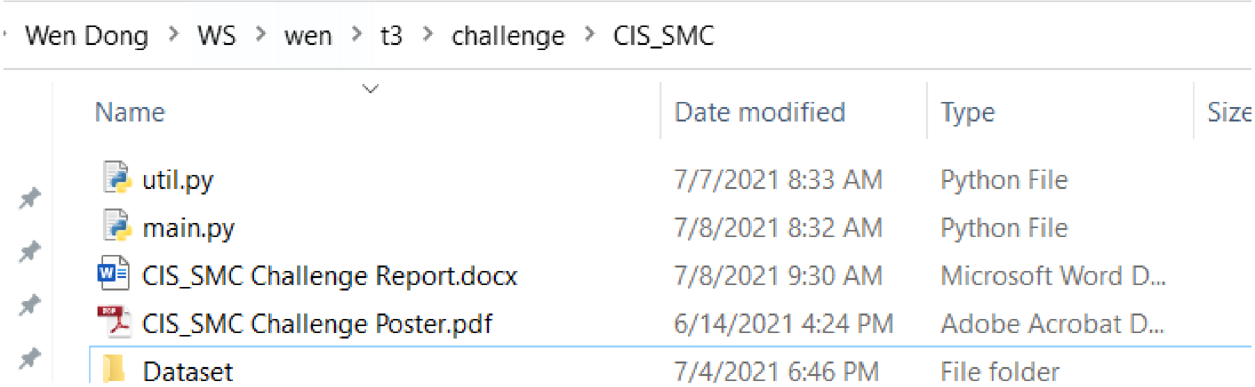
Analysis

Evaluation

Model	Exact Match Loss	Exact Match Accuracy	Hamming Loss	Hamming Accuracy
1	0.542	77.47%	0.168	83.19%
2	0.563	76.19%	0.178	82.18%
3	0.567	74.33%	0.198	80.18%
4	0.550	77.08%	0.172	82.82%
5	0.532	78.07%	0.160	84.00%
6	0.556	76.39%	0.177	82.26%
7	0.534	78.03%	0.162	83.84%
8	0.530	77.49%	0.168	83.15%
9	0.561	75.06%	0.191	80.90%
10	0.538	77.36%	0.169	83.07%
Mean	0.547	76.75%	0.174	82.56%
Standard derivation	1.314%	1.186%	1.159%	1.159%

How to run the script

1. download the source code and dataset and layout them like this:
   a. unzip source code & dataset package
   b. change current working directory to CIS_SMC as below
   c. execute python3 script file main.py



Wen Dong › WS › wen › t3 › challenge › CIS_SMC

Name	Date modified	Type	Size
util.py	7/7/2021 8:33 AM	Python File	
main.py	7/8/2021 8:32 AM	Python File	
CIS_SMC Challenge Report.docx	7/8/2021 9:30 AM	Microsoft Word D...	
CIS_SMC Challenge Poster.pdf	6/14/2021 4:24 PM	Adobe Acrobat D...	
Dataset	7/4/2021 6:46 PM	File folder	

   d. it takes approximately an hour to run, in the end, predictions of Test.csv will be saved in 'predictions.csv' and following evaluation results will be in the console output

```
[(0.5420660972595215, 0.7747412919998169, 0.16810596123014143, 0.8318940387698586),
(0.5634239912033081, 0.7619273066520691, 0.17819924209298932, 0.8218007579070107),
(0.5672074556350708, 0.7433197498321533, 0.198173249769227, 0.801826750230773),
(0.5503278374671936, 0.7708181738853455, 0.17175581790798233, 0.8282441820920177),
(0.532231867313385, 0.7806563377380371, 0.15996210464946803, 0.840037895350532),
(0.5560332536697388, 0.7639435529708862, 0.17740368265073114, 0.8225963173492689),
(0.5343391299247742, 0.7803284525871277, 0.1616443181266093, 0.8383556818733907),
(0.5301542282104492, 0.7749113440513611, 0.16847033960064128, 0.8315296603993587),
(0.5608804821968079, 0.7506073117256165, 0.19102536073458676, 0.8089746392654132),
(0.538071870803833, 0.7735509872436523, 0.16930233687994944, 0.8306976631200506)]
```

```
std_variation [0.01314313 0.01185915 0.01159284 0.01159284]
```

```
mean [0.54747362 0.76748045 0.17440424 0.82559576]
```

Thank you for reviewing my anwsers, you comments and advice is apprecaited especailly on how to improve accuracy.