Shallow_Neural_Nets

December 4, 2017

Instructions: 1) Put the training data and the test data in a folder name "data". Place this folder in the same folder from where you run the jupyter notebook. 2) To get the score for the test data, upload the CSV file "SNN_cont.csv" generated to this competition: "https://www.kaggle.com/c/porto-seguro-safe-driver-prediction/submit".

```
In [10]: # Let us load in the relevant Python modules
    import pandas as pd
    import numpy as np
    import seaborn as sns
    import matplotlib.pyplot as plt
    %matplotlib inline
    import plotly.offline as py
    py.init_notebook_mode(connected=True)
    import plotly.graph_objs as go
    import plotly.tools as tls
    import warnings
    from collections import Counter
    from sklearn.feature_selection import mutual_info_classif
    warnings.filterwarnings('ignore')
```

0.1 Dropping columns which have many missing values and rows which have any missing at all

```
In [11]: train = pd.read_csv('data/train.csv')
         test = pd.read_csv('data/test.csv')
In [12]: (train==-1).sum()
Out[12]: id
                                 0
                                 0
         target
         ps_ind_01
                                 0
         ps ind 02 cat
                              216
         ps_ind_03
                                 0
         ps_ind_04_cat
                               83
         ps_ind_05_cat
                             5809
         ps_ind_06_bin
                                 0
         ps_ind_07_bin
                                 0
         ps_ind_08_bin
                                 0
```

| ps_ind_09_bin | 0 |
|----------------------------------|--------|
| ps_ind_10_bin | 0 |
| ps_ind_11_bin | 0 |
| ps_ind_12_bin | 0 |
| ps_ind_13_bin | 0 |
| ps_ind_14 | 0 |
| ps_ind_15 | 0 |
| ps_ind_16_bin | 0 |
| ps_ind_17_bin | 0 |
| ps_ind_18_bin | 0 |
| ps_reg_01 | 0 |
| ps_reg_02 | 0 |
| ps_reg_03 | 107772 |
| ps_car_01_cat | 107 |
| ps_car_02_cat | 5 |
| ps_car_03_cat | 411231 |
| ps_car_04_cat | 0 |
| ps_car_05_cat | 266551 |
| ps_car_06_cat | 0 |
| ps_car_07_cat | 11489 |
| ps_car_08_cat | 0 |
| ps_car_09_cat | 569 |
| ps_car_10_cat | 0 |
| ps_car_11_cat | 0 |
| ps_car_11 | 5 |
| ps_car_12 | 1 |
| ps_car_13 | 0 |
| ps_car_14 | 42620 |
| ps_car_15 | 0 |
| ps_calc_01 | 0 |
| ps_calc_02 | 0 |
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| ps_calc_19_bin | 0 |
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ps_calc_20_bin
                                 0
         dtype: int64
In [13]: skip_columns = ['ps_ind_05_cat', 'ps_reg_03', 'ps_car_03_cat', 'ps_car_05_cat', 'ps_c
In [14]: train = train.drop(skip_columns, axis = 1)
         test = test.drop(skip_columns, axis = 1)
In [15]: rows_drop = train[(train.T==-1).sum()!=0].index.tolist()
In [16]: train = train.drop(rows_drop, axis = 0)
In [17]: train.head()
Out [17]:
                target
                        ps_ind_01 ps_ind_02_cat ps_ind_03 ps_ind_04_cat
            id
             7
                                                             7
         1
             9
                      0
                                 1
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         2
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            ps_ind_06_bin ps_ind_07_bin ps_ind_08_bin ps_ind_09_bin
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            ps_calc_11 ps_calc_12 ps_calc_13 ps_calc_14 ps_calc_15_bin
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            ps_calc_16_bin ps_calc_17_bin ps_calc_18_bin ps_calc_19_bin
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            ps_calc_20_bin
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[5 rows x 53 columns]

0.1.1 Check to make sure no missing values left:

| In [18]: | (train==-1).sum() | |
|----------|--------------------------|---|
| Out[18]: | id | 0 |
| | target | 0 |
| | ps_ind_01 | 0 |
| | ps_ind_02_cat | 0 |
| | ps_ind_03 | 0 |
| | ps_ind_04_cat | 0 |
| | ps_ind_06_bin | 0 |
| | ps_ind_07_bin | 0 |
| | ps_ind_08_bin | 0 |
| | ps_ind_09_bin | 0 |
| | ps_ind_10_bin | 0 |
| | ps_ind_11_bin | 0 |
| | ps_ind_12_bin | 0 |
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| | ps_ind_17_bin | 0 |
| | ps_ind_18_bin | 0 |
| | ps_reg_01 | 0 |
| | ps_reg_02 | 0 |
| | ps_car_01_cat | 0 |
| | ps_car_02_cat | 0 |
| | ps_car_04_cat | 0 |
| | ps_car_06_cat | 0 |
| | ps_car_08_cat | 0 |
| | ps_car_09_cat | 0 |
| | ps_car_10_cat | 0 |
| | ps_car_11_cat | 0 |
| | ps_car_11 | 0 |
| | ps_car_12 | 0 |
| | ps_car_13 | 0 |
| | ps_car_15 | 0 |
| | ps_calc_01 | 0 |
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| | ps_calc_03 | 0 |
| | ps_calc_04 | 0 |
| | ps_calc_05 | 0 |
| | ps_calc_06 ps_calc_07 | 0 |
| | ps_calc_07 ps_calc_08 | 0 |
| | ps_calc_00 | 0 |
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| | ps_calc_11 ps_calc_12 | 0 |
| | P5_0010_12 | J |

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ps_calc_13
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         ps_calc_16_bin
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         ps_calc_18_bin
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         ps_calc_19_bin
                            0
         ps_calc_20_bin
                            0
         dtype: int64
In [19]: X = train.drop(['id', 'target'], axis = 1).as_matrix()
         Y = train['target'].as_matrix()
In [20]: X_test = test.drop(['id'], axis = 1).as_matrix()
In [21]: print(X.shape)
         print(Y.shape)
(594444, 51)
(594444,)
```

1 Perceptron - Logistic Regression

Using TensorFlow backend.

Epoch 3/150

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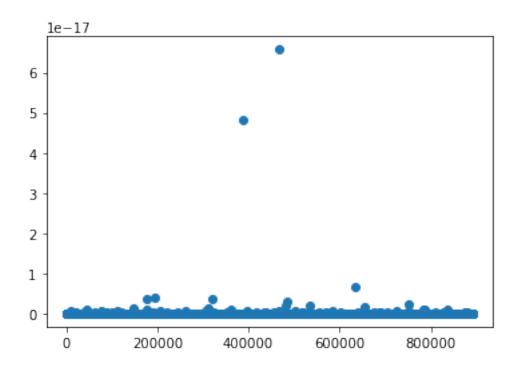
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Out[26]: <keras.callbacks.History at 0x11685f780>

In [27]: predics = model.predict(X_test)



```
In [29]: test['predic'] = predics
In [30]: test[['id','predic']].to_csv('perceptron.csv', index = False)
```

1.0.1 Does worse than random!

2 Let's add some layers

```
model.add(Dense(5, kernel_initializer = 'uniform', activation = 'sigmoid'))
  #model.add(Dense(30, kernel_initializer = 'uniform', activation = 'sigmoid'))
  #model.add(Dense(10, kernel_initializer = 'uniform', activation = 'sigmoid'))
  #model.add(Dropout(0.3))
  model.add(Dense(1, activation = 'sigmoid'))
In [32]: optimizer = keras.optimizers.adam(lr=0.005)
  model.compile(loss='binary_crossentropy', optimizer=optimizer, metrics=['accuracy'])
In [230]: model.fit(X,Y, validation_split=0.3, epochs = 1500, batch_size=10000)
Train on 416110 samples, validate on 178334 samples
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Traceback (most recent call last)
    KeyboardInterrupt
    <ipython-input-230-0b623299a98d> in <module>()
  ----> 1 model.fit(X,Y, validation_split=0.3, epochs = 1500, batch_size=10000)
    /anaconda3/lib/python3.6/site-packages/keras/models.py in fit(self, x, y, batch_size,
    865
                        class_weight=class_weight,
    866
                        sample_weight=sample_weight,
  --> 867
                        initial_epoch=initial_epoch)
    868
    869
         def evaluate(self, x, y, batch_size=32, verbose=1,
    /anaconda3/lib/python3.6/site-packages/keras/engine/training.py in fit(self, x, y, bat
                        initial_epoch=initial_epoch,
    1596
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                        steps_per_epoch=steps_per_epoch,
  -> 1598
                        validation_steps=validation_steps)
    1599
    1600
         def evaluate(self, x, y,
    /anaconda3/lib/python3.6/site-packages/keras/engine/training.py in _fit_loop(self, f,
                       val_outs = self._test_loop(val_f, val_ins,
    1195
    1196
                                       batch_size=batch_size,
  -> 1197
                                       verbose=0)
    1198
                       if not isinstance(val_outs, list):
    1199
                         val_outs = [val_outs]
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/anaconda3/lib/python3.6/site-packages/keras/engine/training.py in _test_loop(self, f,
       1335
                                ins_batch = _slice_arrays(ins[:-1], batch_ids) + [ins[-1]]
       1336
                            else:
    -> 1337
                                ins_batch = _slice_arrays(ins, batch_ids)
       1338
       1339
                            batch_outs = f(ins_batch)
        /anaconda3/lib/python3.6/site-packages/keras/engine/training.py in _slice_arrays(arrays
        404
                        if hasattr(start, 'shape'):
        405
                            start = start.tolist()
                        return [None if x is None else x[start] for x in arrays]
    --> 406
        407
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                        return [None if x is None else x[start:stop] for x in arrays]
        /anaconda3/lib/python3.6/site-packages/keras/engine/training.py in <listcomp>(.0)
                        if hasattr(start, 'shape'):
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                            start = start.tolist()
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                        return [None if x is None else x[start] for x in arrays]
    --> 406
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                        return [None if x is None else x[start:stop] for x in arrays]
        KeyboardInterrupt:
In [217]: predics = model.predict(X_test)
In [218]: test['predic'] = predics
          test[['id','predic']].to_csv('2layer.csv', index = False)
```

2.1 We get a score of 0.211.

One issue is that we are passing categorical variables as is, however we should use some kind of one-hot encoding or other equivalent methods before passing it to the nerual network.

2.1.1 Repeating the experiments with only continuous variables! We will get to handling categorical/ordinal in the next notebook

```
In [303]: continuous = [col for col in train.columns if 'bin' not in col and 'cat' not in col]
    train = train[continuous]
    continuous = [col for col in test.columns if 'bin' not in col and 'cat' not in col]
    test = test[continuous]
In [304]: X = train.drop(['id', 'target'], axis = 1).as_matrix()
    Y = train['target'].as_matrix()
In [261]: X.shape
Out[261]: (594444, 24)
In [316]: model = Sequential()
    model.add(Dense(10, input_dim = 24, kernel_initializer = 'uniform', activation = 'si
    model.add(Dense(10, kernel_initializer = 'uniform', activation = 'sigmoid'))
     #model.add(Dense(5, kernel_initializer = 'uniform', activation = 'sigmoid'))
    model.add(Dense(1, activation = 'sigmoid'))
In [321]: optimizer = keras.optimizers.adagrad(lr=0.01)
    model.compile(loss='binary_crossentropy', optimizer=optimizer, metrics=['accuracy'])
In [322]: model.fit(X,Y, validation split=0.3, epochs = 1500)
Train on 416110 samples, validate on 178334 samples
Epoch 1/1500
Epoch 2/1500
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2.1.2 We get a lower error than previously but the score is much worse....this means we are overfitting with 100 nodes in the hidden layer.

Repeating the experiment with just 10 neurons in the hidden layer, and adding one additional layer (2 hidden layers)

The best score we get using this 0.200. Probably we need to add categorical features etc. to get better results...

Update - Another thing we should try before adding additional data (~categorical) is to give the neural network more balanced data (compared to ~95% 0's and 5% 1's that we are giving it right now)

```
In [348]: train = pd.read_csv('data/train.csv')
                          test = pd.read_csv('data/test.csv')
                          train = train.drop(skip_columns, axis = 1)
                          test = test.drop(skip_columns, axis = 1)
                          rows_drop = train[(train.T==-1).sum()!=0].index.tolist()
                          train = train.drop(rows_drop, axis = 0)
                          continuous = [col for col in train.columns if 'bin' not in col and 'cat' not in col]
                          train = train[continuous]
                          continuous = [col for col in test.columns if 'bin' not in col and 'cat' not in col]
                          test = test[continuous]
In [340]: no_ones = train[train['target'] == 1].shape[0]
                         train = train[train['target'] == 0].sample(n = p*no_ones).append(train[train['target'] == 0].sample(n = p*no_ones).append(train['target'] == 0].sample(n = p*no_one
In [341]: X = train.drop(['id', 'target'], axis = 1).as_matrix()
                          Y = train['target'].as_matrix()
                          X_test = test.drop(['id'], axis = 1).as_matrix()
In [364]: model = Sequential()
                          model.add(Dense(25, input_dim = 24, kernel_initializer = 'uniform', activation = 'signal's
                          model.add(Dense(20, kernel_initializer = 'uniform', activation = 'sigmoid'))
                          #model.add(Dense(5, kernel_initializer = 'uniform', activation = 'sigmoid'))
                          model.add(Dense(1, activation = 'sigmoid'))
In [365]: optimizer = keras.optimizers.adam(lr=0.01)
                          model.compile(loss='binary_crossentropy', optimizer=optimizer, metrics=['accuracy'])
```

```
In [366]: model.fit(X,Y, validation_split=0.2, epochs = 10000, batch_size=1000)
Train on 34595 samples, validate on 8649 samples
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Out[366]: <keras.callbacks.History at 0x140bdef98>
In [362]: predics = model.predict(X_test)
In [363]: test['target'] = predics
  test[['id','target']].to_csv('SNN_cont.csv', index = False)
  test = test.drop(['target'], axis = 1)
```