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```
import os
os.environ['TF_CPP_MIN_LOG_LEVEL'] = '1'

import tensorflow.compat.v1 as tf
tf.disable_v2_behavior()
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import MinMaxScaler, Normalizer
from sklearn.decomposition import PCA as sklearnPCA
import warnings
warnings.filterwarnings("ignore")
```

```
WARNING:tensorflow:From /Users/sravya/anaconda3/lib/python3.10/site-
packages/tensorflow/python/compat/v2_compat.py:107:
disable_resource_variables (from tensorflow.python.ops.variable_scope)
is deprecated and will be removed in a future version.
Instructions for updating:
non-resource variables are not supported in the long term
```

```
wbcd = pd.read_csv("data.csv")
wbcd.head()
```

```
         id diagnosis  radius_mean  texture_mean  perimeter_mean  
area_mean  \
0    842302         M        17.99         10.38          122.80  
1001.0   
1    842517         M        20.57         17.77          132.90  
1326.0   
2  84300903         M        19.69         21.25          130.00  
1203.0   
3  84348301         M        11.42         20.38           77.58  
386.1   
4  84358402         M        20.29         14.34          135.10  
1297.0   

   smoothness_mean  compactness_mean  concavity_mean  concave 
points_mean  \
0          0.11840           0.27760          0.3001              
0.14710   
1          0.08474           0.07864          0.0869              
0.07017   
2          0.10960           0.15990          0.1974              
0.12790   
3          0.14250           0.28390          0.2414              
0.10520   
```

```
4           0.10030            0.13280           0.1980
0.10430

   ...  texture_worst  perimeter_worst  area_worst
smoothness_worst  \
0  ...          17.33           184.60      2019.0            0.1622

1  ...          23.41           158.80      1956.0            0.1238

2  ...          25.53           152.50      1709.0            0.1444

3  ...          26.50            98.87       567.7            0.2098

4  ...          16.67           152.20      1575.0            0.1374


   compactness_worst  concavity_worst  concave points_worst
symmetry_worst  \
0             0.6656           0.7119                0.2654
0.4601
1             0.1866           0.2416                0.1860
0.2750
2             0.4245           0.4504                0.2430
0.3613
3             0.8663           0.6869                0.2575
0.6638
4             0.2050           0.4000                0.1625
0.2364

   fractal_dimension_worst  Unnamed: 32
0                  0.11890          NaN
1                  0.08902          NaN
2                  0.08758          NaN
3                  0.17300          NaN
4                  0.07678          NaN

[5 rows x 33 columns]
```

```
print("This WBCD dataset is consisted of",wbcd.shape)
```

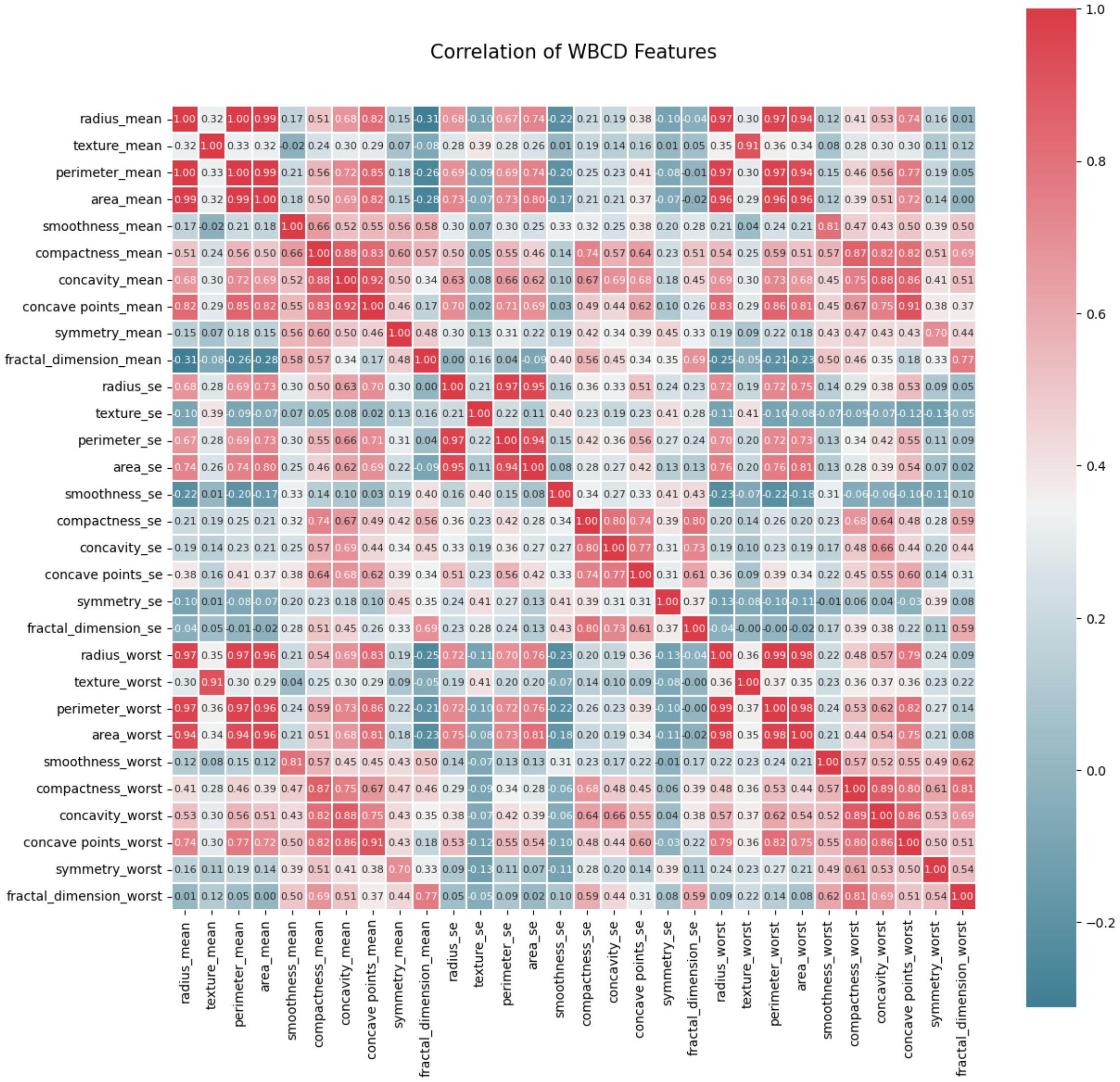
```
This WBCD dataset is consisted of (569, 33)
```

```
wbcd = wbcd.iloc[:,:-1]
print("This WBCD dataset is consisted of",wbcd.shape)
```

```
This WBCD dataset is consisted of (569, 32)
```

```
corr = wbcd.iloc[:,2:].corr()
colormap = sns.diverging_palette(220, 10, as_cmap = True)
plt.figure(figsize=(14,14))
sns.heatmap(corr, cbar = True,  square = True, annot=True, fmt=
'.2f',annot_kws={'size': 8},
            cmap = colormap, linewidths=0.1, linecolor='white')
plt.title('Correlation of WBCD Features', y=1.05, size=15)

Text(0.5, 1.05, 'Correlation of WBCD Features')
```



```
train,test = train_test_split(wbcd, test_size=0.3, random_state=42)
print("Training Data :",train.shape)
print("Testing Data :",test.shape)

Training Data : (398, 32)
Testing Data : (171, 32)
```

```
train_id = train['id']
test_id = test['id']

train_data = train.iloc[:,1:]
test_data = test.iloc[:,1:]

print("Training Data :",train_data.shape)
print("Testing Data :",test_data.shape)
```

```
Training Data : (398, 31)
Testing Data : (171, 31)
```

```
# Training Data
train_x = train_data.iloc[:,1:]
train_x = MinMaxScaler().fit_transform(train_x)
print("Training Data :", train_x.shape)

# Testing Data
test_x = test_data.iloc[:,1:]
test_x = MinMaxScaler().fit_transform(test_x)
print("Testing Data :", test_x.shape)
```

```
Training Data : (398, 30)
Testing Data : (171, 30)
```

```
# Training Data
train_y = train_data.iloc[:,:1]
train_y[train_y=='M'] = 0
train_y[train_y=='B'] = 1
print("Training Data :", train_y.shape)

# Testing Data
test_y = test_data.iloc[:,:1]
test_y[test_y=='M'] = 0
test_y[test_y=='B'] = 1
print("Testing Data :", test_y.shape)
```

```
Training Data : (398, 1)
Testing Data : (171, 1)
```

```
X = tf.placeholder(tf.float32, [None,30])
Y = tf.placeholder(tf.float32, [None, 1])

# weight
W = tf.Variable(tf.random_normal([30,1], seed=0), name='weight')

# bias
b = tf.Variable(tf.random_normal([1], seed=0), name='bias')

logits = tf.matmul(X,W) + b
```

```
hypothesis = tf.nn.sigmoid(logits)

cost_i =
tf.nn.sigmoid_cross_entropy_with_logits(logits=logits,labels=Y)
cost = tf.reduce_mean(cost_i)
# cost = -tf.reduce_mean(Y * tf.log(hypothesis) + (1 - Y) * tf.log(1 -
hypothesis))

train =
tf.train.GradientDescentOptimizer(learning_rate=0.1).minimize(cost)

prediction = tf.cast(hypothesis > 0.5, dtype=tf.float32)
correct_prediction = tf.equal(prediction, Y)
accuracy = tf.reduce_mean(tf.cast(correct_prediction,
dtype=tf.float32))

with tf.Session() as sess:
    sess.run(tf.global_variables_initializer())
    for step in range(10001):
        sess.run(train, feed_dict={X: train_x, Y: train_y})
        if step % 1000 == 0:
            loss, acc = sess.run([cost, accuracy], feed_dict={X:
train_x, Y: train_y})
            print("Step: {:5}\tLoss: {:.3f}\tAcc: {:.2%}".format(step,
loss, acc))

    train_acc = sess.run(accuracy, feed_dict={X: train_x, Y: train_y})
    test_acc,test_predict,test_correct =
sess.run([accuracy,prediction,correct_prediction], feed_dict={X:
test_x, Y: test_y})
    print("Model Prediction =", train_acc)
    print("Test Prediction =", test_acc)
```

```
Step:     0     Loss: 0.848     Acc: 39.70%
Step:  1000     Loss: 0.238     Acc: 91.21%
Step:  2000     Loss: 0.180     Acc: 94.72%
Step:  3000     Loss: 0.154     Acc: 96.23%
Step:  4000     Loss: 0.138     Acc: 96.98%
Step:  5000     Loss: 0.128     Acc: 97.49%
Step:  6000     Loss: 0.120     Acc: 97.74%
Step:  7000     Loss: 0.114     Acc: 97.99%
Step:  8000     Loss: 0.110     Acc: 98.24%
Step:  9000     Loss: 0.106     Acc: 98.24%
Step: 10000     Loss: 0.102     Acc: 98.24%
Model Prediction = 0.98241204
Test Prediction = 0.94736844
```

```
def ann_slp():
    print("===========Data Summary===========")
    print("Training Data :", train_x.shape)
    print("Testing Data :", test_x.shape)

    X = tf.placeholder(tf.float32, [None,30])
    Y = tf.placeholder(tf.float32, [None, 1])

    W = tf.Variable(tf.random_normal([30,1], seed=0), name='weight')
    b = tf.Variable(tf.random_normal([1], seed=0), name='bias')

    logits = tf.matmul(X,W) + b
    hypothesis = tf.nn.sigmoid(logits)

    cost_i =
tf.nn.sigmoid_cross_entropy_with_logits(logits=logits,labels=Y)
    cost = tf.reduce_mean(cost_i)

    train =
tf.train.GradientDescentOptimizer(learning_rate=0.1).minimize(cost)

    prediction = tf.cast(hypothesis > 0.5, dtype=tf.float32)
    correct_prediction = tf.equal(prediction, Y)
    accuracy = tf.reduce_mean(tf.cast(correct_prediction,
dtype=tf.float32))

    print("\n============Processing============")
    with tf.Session() as sess:
        sess.run(tf.global_variables_initializer())
        for step in range(10001):
            sess.run(train, feed_dict={X: train_x, Y: train_y})
            if step % 1000 == 0:
                loss, acc = sess.run([cost, accuracy], feed_dict={X:
train_x, Y: train_y})
                print("Step: {:5}\tLoss: {:.3f}\tAcc:
{:.2%}".format(step, loss, acc))

        train_acc = sess.run(accuracy, feed_dict={X: train_x, Y:
train_y})
        test_acc,test_predict,test_correct =
sess.run([accuracy,prediction,correct_prediction], feed_dict={X:
test_x, Y: test_y})

        print("\n============Results============")
        print("Model Prediction =", train_acc)
        print("Test Prediction =", test_acc)

        return train_acc,test_acc

ann_slp_train_acc, ann_slp_test_acc = ann_slp()
```

```
===========Data Summary===========
Training Data : (398, 30)
```

```
Testing Data : (171, 30)

============Processing============
Step:     0     Loss: 0.848     Acc: 39.70%
Step:  1000     Loss: 0.238     Acc: 91.21%
Step:  2000     Loss: 0.180     Acc: 94.72%
Step:  3000     Loss: 0.154     Acc: 96.23%
Step:  4000     Loss: 0.138     Acc: 96.98%
Step:  5000     Loss: 0.128     Acc: 97.49%
Step:  6000     Loss: 0.120     Acc: 97.74%
Step:  7000     Loss: 0.114     Acc: 97.99%
Step:  8000     Loss: 0.110     Acc: 98.24%
Step:  9000     Loss: 0.106     Acc: 98.24%
Step: 10000     Loss: 0.102     Acc: 98.24%

============Results============
Model Prediction = 0.98241204
Test Prediction = 0.94736844

def ann_slp_pca():
    sklearn_pca = sklearnPCA(n_components=10)

    print("===========Data Summary===========")
    pca_train_x = sklearn_pca.fit_transform(train_x)
    print("PCA Training Data :", pca_train_x.shape)

    pca_test_x = sklearn_pca.fit_transform(test_x)
    print("PCA Testing Data :", pca_test_x.shape)

    X = tf.placeholder(tf.float32, [None,10])
    Y = tf.placeholder(tf.float32, [None, 1])

    W = tf.Variable(tf.random_normal([10,1], seed=0), name='weight')
    b = tf.Variable(tf.random_normal([1], seed=0), name='bias')

    logits = tf.matmul(X,W) + b
    hypothesis = tf.nn.sigmoid(logits)

    cost_i =
tf.nn.sigmoid_cross_entropy_with_logits(logits=logits,labels=Y)
    cost = tf.reduce_mean(cost_i)

    train =
tf.train.GradientDescentOptimizer(learning_rate=0.2).minimize(cost)

    prediction = tf.cast(hypothesis > 0.5, dtype=tf.float32)
    correct_prediction = tf.equal(prediction, Y)
    accuracy = tf.reduce_mean(tf.cast(correct_prediction,
dtype=tf.float32))

    print("\n============Processing============")
    with tf.Session() as sess:
        sess.run(tf.global_variables_initializer())
        for step in range(10001):
            sess.run(train, feed_dict={X: pca_train_x, Y: train_y})
            if step % 1000 == 0:
                loss, acc = sess.run([cost, accuracy], feed_dict={X:
pca_train_x, Y: train_y})
                print("Step: {:5}\tLoss: {:.3f}\tAcc:
{:.2%}".format(step, loss, acc))

        train_acc = sess.run(accuracy, feed_dict={X: pca_train_x, Y:
train_y})
        test_acc,test_predict,test_correct =
sess.run([accuracy,prediction,correct_prediction], feed_dict={X:
pca_test_x, Y: test_y})

        print("\n============Results============")
        print("PCA Model Prediction =", train_acc)
        print("PCA Test Prediction =", test_acc)

        return train_acc, test_acc

ann_slp_pca_train_acc, ann_slp_pca_test_acc = ann_slp_pca()

===========Data Summary===========
PCA Training Data : (398, 10)
PCA Testing Data : (171, 10)

============Processing============
Step:     0     Loss: 0.701     Acc: 54.52%
Step:  1000     Loss: 0.142     Acc: 96.23%
Step:  2000     Loss: 0.117     Acc: 96.98%
Step:  3000     Loss: 0.106     Acc: 97.49%
Step:  4000     Loss: 0.100     Acc: 97.74%
Step:  5000     Loss: 0.095     Acc: 97.74%
Step:  6000     Loss: 0.092     Acc: 97.74%
Step:  7000     Loss: 0.089     Acc: 97.74%
Step:  8000     Loss: 0.087     Acc: 97.99%
Step:  9000     Loss: 0.086     Acc: 97.99%
Step: 10000     Loss: 0.084     Acc: 97.99%

============Results============
PCA Model Prediction = 0.9798995
PCA Test Prediction = 0.9649123

def ann_mlp():
    print("===========Data Summary===========")
    print("Training Data :", train_x.shape)
    print("Testing Data :", test_x.shape)
    X = tf.placeholder(tf.float32, [None,30])
    Y = tf.placeholder(tf.float32, [None, 1])

    # input
    W1 = tf.Variable(tf.random_normal([30,60], seed=0),
name='weight1')
    b1 = tf.Variable(tf.random_normal([60], seed=0), name='bias1')
    layer1 = tf.nn.sigmoid(tf.matmul(X,W1) + b1)

    # hidden1
    W2 = tf.Variable(tf.random_normal([60,60], seed=0),
name='weight2')
    b2 = tf.Variable(tf.random_normal([60], seed=0), name='bias2')
    layer2 = tf.nn.sigmoid(tf.matmul(layer1,W2) + b2)

    # hidden2
    W3 = tf.Variable(tf.random_normal([60,90], seed=0),
name='weight3')
    b3 = tf.Variable(tf.random_normal([90], seed=0), name='bias3')
    layer3 = tf.nn.sigmoid(tf.matmul(layer2,W3) + b3)

    # output
    W4 = tf.Variable(tf.random_normal([90,1], seed=0), name='weight4')
    b4 = tf.Variable(tf.random_normal([1], seed=0), name='bias4')
    logits = tf.matmul(layer3,W4) + b4
    hypothesis = tf.nn.sigmoid(logits)

    cost_i =
tf.nn.sigmoid_cross_entropy_with_logits(logits=logits,labels=Y)
    cost = tf.reduce_mean(cost_i)

    train =
tf.train.GradientDescentOptimizer(learning_rate=0.001).minimize(cost)

    prediction = tf.cast(hypothesis > 0.5, dtype=tf.float32)
    correct_prediction = tf.equal(prediction, Y)
    accuracy = tf.reduce_mean(tf.cast(correct_prediction,
dtype=tf.float32))

    print("\n============Processing============")
    with tf.Session() as sess:
        sess.run(tf.global_variables_initializer())
        for step in range(10001):
            sess.run(train, feed_dict={X: train_x, Y: train_y})
            if step % 1000 == 0:
                loss, acc = sess.run([cost, accuracy], feed_dict={X:
train_x, Y: train_y})
                print("Step: {:5}\tLoss: {:.3f}\tAcc:
{:.2%}".format(step, loss, acc))
```

```
        train_acc = sess.run(accuracy, feed_dict={X: train_x, Y:
train_y})
        test_acc,test_predict,test_correct =
sess.run([accuracy,prediction,correct_prediction], feed_dict={X:
test_x, Y: test_y})

        print("\n============Results============")
        print("Model Prediction =", train_acc)
        print("Test Prediction =", test_acc)

        return train_acc,test_acc

ann_mlp_train_acc, ann_mlp_test_acc = ann_mlp()
```

```
===========Data Summary===========
Training Data : (398, 30)
Testing Data : (171, 30)

============Processing============
Step:     0     Loss: 2.073     Acc: 37.44%
Step:  1000     Loss: 0.335     Acc: 89.95%
Step:  2000     Loss: 0.266     Acc: 92.71%
Step:  3000     Loss: 0.226     Acc: 93.72%
Step:  4000     Loss: 0.199     Acc: 93.97%
Step:  5000     Loss: 0.180     Acc: 95.23%
Step:  6000     Loss: 0.166     Acc: 95.98%
Step:  7000     Loss: 0.155     Acc: 96.23%
Step:  8000     Loss: 0.147     Acc: 96.73%
Step:  9000     Loss: 0.139     Acc: 96.98%
Step: 10000     Loss: 0.133     Acc: 96.98%

============Results============
Model Prediction = 0.9698492
Test Prediction = 0.9298246
```

```
def ann_mlp_pca():
    sklearn_pca = sklearnPCA(n_components=10)

    print("===========Data Summary===========")
    pca_train_x = sklearn_pca.fit_transform(train_x)
    print("PCA Training Data :", pca_train_x.shape)

    pca_test_x = sklearn_pca.fit_transform(test_x)
    print("PCA Testing Data :", pca_test_x.shape)

    X = tf.placeholder(tf.float32, [None,10])
    Y = tf.placeholder(tf.float32, [None, 1])

    # input
    W1 = tf.Variable(tf.random_normal([10,64], seed=0),
name='weight1')
    b1 = tf.Variable(tf.random_normal([64], seed=0), name='bias1')
    layer1 = tf.nn.sigmoid(tf.matmul(X,W1) + b1)

    # hidden1
    W2 = tf.Variable(tf.random_normal([64,128], seed=0),
name='weight2')
    b2 = tf.Variable(tf.random_normal([128], seed=0), name='bias2')
    layer2 = tf.nn.sigmoid(tf.matmul(layer1,W2) + b2)

    # hidden2
    W3 = tf.Variable(tf.random_normal([128,128], seed=0),
name='weight3')
    b3 = tf.Variable(tf.random_normal([128], seed=0), name='bias3')
    layer3 = tf.nn.sigmoid(tf.matmul(layer2,W3) + b3)

    # output
    W4 = tf.Variable(tf.random_normal([128,1], seed=0),
name='weight4')
    b4 = tf.Variable(tf.random_normal([1], seed=0), name='bias4')
    logits = tf.matmul(layer3,W4) + b4
    hypothesis = tf.nn.sigmoid(logits)

    cost_i =
tf.nn.sigmoid_cross_entropy_with_logits(logits=logits,labels=Y)
    cost = tf.reduce_mean(cost_i)

    train =
tf.train.GradientDescentOptimizer(learning_rate=0.01).minimize(cost)

    prediction = tf.cast(hypothesis > 0.5, dtype=tf.float32)
    correct_prediction = tf.equal(prediction, Y)
    accuracy = tf.reduce_mean(tf.cast(correct_prediction,
dtype=tf.float32))

    print("\n============Processing============")
    with tf.Session() as sess:
        sess.run(tf.global_variables_initializer())
        for step in range(10001):
            sess.run(train, feed_dict={X: pca_train_x, Y: train_y})
            if step % 1000 == 0:
                loss, acc = sess.run([cost, accuracy], feed_dict={X:
pca_train_x, Y: train_y})
                print("Step: {:5}\tLoss: {:.3f}\tAcc:
{:.2%}".format(step, loss, acc))

        train_acc = sess.run(accuracy, feed_dict={X: pca_train_x, Y:
train_y})
        test_acc,test_predict,test_correct =
sess.run([accuracy,prediction,correct_prediction], feed_dict={X:
```

```
pca_test_x, Y: test_y})

        print("\n============Results============")
        print("PCA Model Prediction =", train_acc)
        print("PCA Test Prediction =", test_acc)

        return train_acc,test_acc

ann_mlp_pca_train_acc, ann_mlp_pca_test_acc = ann_mlp_pca()
```

```
===========Data Summary===========
PCA Training Data : (398, 10)
PCA Testing Data : (171, 10)

============Processing============
Step:     0     Loss: 2.958     Acc: 62.56%
Step:  1000     Loss: 0.109     Acc: 97.74%
Step:  2000     Loss: 0.086     Acc: 98.24%
Step:  3000     Loss: 0.075     Acc: 98.24%
Step:  4000     Loss: 0.068     Acc: 98.49%
Step:  5000     Loss: 0.063     Acc: 98.74%
Step:  6000     Loss: 0.059     Acc: 98.99%
Step:  7000     Loss: 0.055     Acc: 98.99%
Step:  8000     Loss: 0.053     Acc: 98.99%
Step:  9000     Loss: 0.051     Acc: 98.99%
Step: 10000     Loss: 0.049     Acc: 98.99%

============Results============
PCA Model Prediction = 0.98994976
PCA Test Prediction = 0.9532164
```

```
sub = pd.DataFrame()
sub['id'] = test_id
sub['Predict_Type'] = test_predict.astype(int)
sub['Origin_Type'] = test_y
sub['Correct'] = test_correct
sub.head(10)
```

```
          id  Predict_Type Origin_Type  Correct
204    87930             1           1     True
70    859575             0           0     True
131     8670             0           0     True
431   907915             1           1     True
540   921385             1           1     True
567   927241             0           0     True
369  9012000             0           0     True
29    853201             0           0     True
81   8611161             0           1    False
477   911673             1           1     True
```