Assignment 5

1. Choose a REGRESSION dataset (reusing bikeshare is allowed), perform a test/train split, and build a regression model (just like in assignment 3), and calculate the errors

In [11]:
```
import matplotlib.pyplot as plt
%matplotlib inline
plt.rcParams['figure.figsize'] = 20, 10
import pandas as pd
import numpy as np
from sklearn import linear_model, metrics

state_crime = pd.read_csv("../data/state_data.csv")
```

In [4]:
```
state_crime
```

Out[4]:

	Unnamed: 0	state_name	state_initial	state_num	year	poverty_rate	unemploy_rate	justice_rate	violent_rate	property_rate	welfare_povcap	welfare_
0	0	Alabama	AL	1	2010	19.0	7.0	2.140814	0.377311	3.512574	6.634749	1.
1	1	Alaska	AK	2	2010	9.9	6.6	1.789721	0.635514	2.837753	25.466003	2.
2	2	Arizona	AZ	3	2010	17.4	7.2	2.299276	0.407122	3.525627	8.262792	1.
3	3	Arkansas	AR	4	2010	18.8	5.8	2.086791	0.504284	3.551550	7.810438	1.
4	4	California	CA	5	2010	15.8	8.2	1.913700	0.439805	2.631169	10.828264	1.
...	...	...	...	...	...	...	...	...	...	...	...	
430	445	Virginia	VA	47	2018	10.7	2.7	1.560287	0.200346	1.668983	12.844782	1.
431	446	Washington	WA	48	2018	10.3	2.7	1.585951	0.311967	2.950756	16.505352	1.
432	447	West Virginia	WV	49	2018	17.8	3.1	1.178324	0.290197	1.486844	14.336538	2.
433	448	Wisconsin	WI	50	2018	11.0	2.1	1.479784	0.295760	1.561558	17.473126	1.
434	449	Wyoming	WY	51	2018	11.1	2.5	1.687603	0.212257	1.785489	13.313502	1.

435 rows × 12 columns

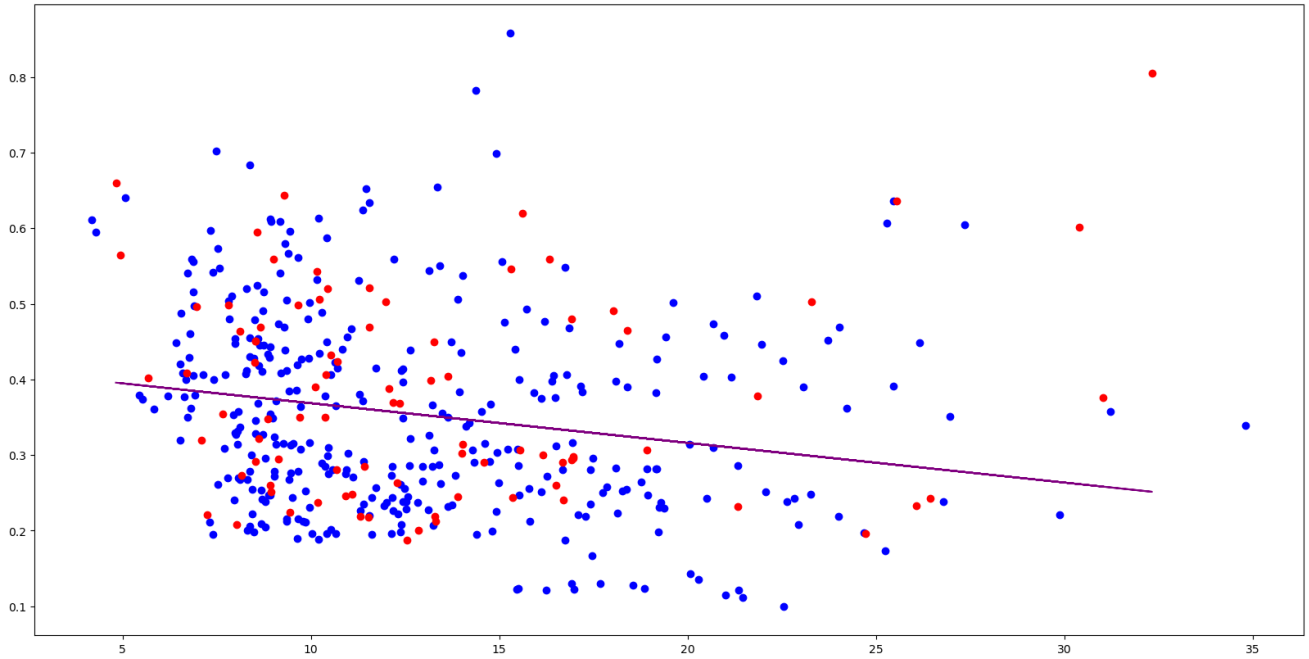
In [27]:
```
from sklearn.model_selection import train_test_split
(crimex_train, crimex_test, crimey_train, crimey_test) = train_test_split(state_crime["welfare_povcap"].values, state_crime["viole
```

In [28]:
```
crime_linear = linear_model.LinearRegression()
crime_linear.fit(crimex_train.reshape(-1,1), crimey_train)
(crime_linear.coef_, crime_linear.intercept_)
```

Out[28]:
```
(array([-0.00524724]), 0.42104625281593266)
```

In [29]:
```
plt.scatter(crimex_train, crimey_train, c="b")
plt.scatter(crimex_test, crimey_test, c="r")
plt.plot(crimex_test, crime_linear.predict(crimex_test.reshape(-1,1)), c="purple")
# welfare_povcap is the amount of dollars a state spends on welfare (including medicaid) per state resident in poverty
# violent_rate is the number of violent crimes in a single year over state population
```

Out[29]:
```
[<matplotlib.lines.Line2D at 0x233d01f91f0>]
```



In [30]:
```
#Training Error (MSE, MAE)
(
    metrics.mean_squared_error(crimey_train, crime_linear.predict(crimex_train.reshape(-1,1))),
    metrics.mean_absolute_error(crimey_train, crime_linear.predict(crimex_train.reshape(-1,1)))
)
```

Out[30]:
```
(0.016738983568976403, 0.10619273291473316)
```

In [31]:
```
#Testing Error (MSE, MAE)
(
    metrics.mean_squared_error(crimey_test, crime_linear.predict(crimex_test.reshape(-1,1))),
    metrics.mean_absolute_error(crimey_test, crime_linear.predict(crimex_test.reshape(-1,1)))
)
```

Out[31]:
```
(0.019886768837576625, 0.1113128582597789)
```

2. Choose a CLASSIFICATION dataset (not the adult.data set, The UCI repository has many datasets as well as Kaggle), perform test/train split and create a classification model (your choice but DecisionTree is fine). Calculate

In [97]:
```
resume = pd.read_csv("../data/resume.csv",index_col=False)
resume = resume[resume["resume_quality"] == "high"]
non_numeric_columns = ['job_ad_id', 'job_city', 'job_industry', 'job_type', 'job_fed_contractor', 'job_ownership',
                       'resume_quality','job_req_min_experience', 'job_req_school', 'firstname', 'race', 'gender']
resume = resume.copy().drop(non_numeric_columns, axis=1)
resume
```

Out[97]:

	job_equal_opp_employer	job_req_any	job_req_communication	job_req_education	job_req_computer	job_req_organization	received_callback	years_cc
1	1	1	0	0	1	0	0	
3	1	1	0	0	1	0	0	
4	1	1	0	0	1	1	0	
6	1	0	0	0	0	0	0	
7	1	1	0	0	1	1	0	
...	...	...	...	...	...	...	...	
4860	0	1	0	0	0	0	0	
4863	0	1	0	0	1	0	0	
4864	0	1	0	0	1	0	0	
4867	0	0	0	0	0	0	0	
4868	0	0	0	0	0	0	0	

2446 rows × 18 columns

In [54]:
```
resx_train, resx_test, resy_train, resy_test = train_test_split(resume.drop(['received_callback'], axis=1),resume.received_callbac
```

In [59]:
```
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.metrics import (accuracy_score, classification_report, confusion_matrix, auc, roc_curve)
```

In [56]:
```
res_model = DecisionTreeClassifier(criterion='entropy')
res_model.fit(resx_train,resy_train)
```

Out[56]:
```
DecisionTreeClassifier(criterion='entropy')
```

In [58]:
```
predict_test = res_model.predict(resx_test)
predict_train = res_model.predict(resx_train)
```

In [60]:
```
#Accuracy
accuracy_score(resy_test, predict_test)
```

Out[60]:
```
0.9
```

In [61]:
```
#Confusion Matrix
confusion_matrix(resy_test, predict_test)
```

Out[61]:
```
array([[438,  16],
       [ 33,   3]], dtype=int64)
```

In [63]:
```
#Classifcation Report
print(classification_report(resy_test, predict_test))
```

```
              precision    recall  f1-score   support

           0       0.93      0.96      0.95       454
           1       0.16      0.08      0.11        36

    accuracy                           0.90       490
   macro avg       0.54      0.52      0.53       490
weighted avg       0.87      0.90      0.89       490
```

3. (Bonus) See if you can improve the classification model's performance with any tricks you can think of (modify features, remove features, polynomial features)

In [598…
```
# there doesn't seem to be much of a benefit to dropping any columns (though admittedly I did not try every combination)
drop_columns = [
                'has_email_address','honors','volunteer','military'
                ]
resume_new = resume.copy().drop(drop_columns, axis=1)
resume_new
```

Out[598]:

	job_equal_opp_employer	job_req_any	job_req_communication	job_req_education	job_req_computer	job_req_organization	received_callback	years_c
1	1	1	0	0	1	0	0	
3	1	1	0	0	1	0	0	
4	1	1	0	0	1	1	0	
6	1	0	0	0	0	0	0	
7	1	1	0	0	1	1	0	
...	...	...	...	...	...	...	...	
4860	0	1	0	0	0	0	0	
4863	0	1	0	0	1	0	0	
4864	0	1	0	0	1	0	0	
4867	0	0	0	0	0	0	0	
4868	0	0	0	0	0	0	0	

2446 rows × 14 columns

In [599…
```
newx_train, newx_test, newy_train, newy_test = train_test_split(resume_new.drop(['received_callback'], axis=1),resume_new.received
```

In [600…
```
new_model = DecisionTreeClassifier(criterion='entropy')
new_model.fit(newx_train,newy_train)
```

Out[600]:
```
DecisionTreeClassifier(criterion='entropy')
```

In [601…
```
predict_new = new_model.predict(newx_test)
```

In [602…
```
#Accuracy
accuracy_score(newy_test, predict_new)
```

Out[602]:
```
0.8979591836734694
```

In [603…
```
#Confusion Matrix
confusion_matrix(newy_test, predict_new)
```

Out[603]:
```
array([[438,  13],
       [ 37,   2]], dtype=int64)
```

In [604…
```
#Classifcation Report
print(classification_report(newy_test, predict_new))
```

```
              precision    recall  f1-score   support

           0       0.92      0.97      0.95       451
           1       0.13      0.05      0.07        39

    accuracy                           0.90       490
   macro avg       0.53      0.51      0.51       490
weighted avg       0.86      0.90      0.88       490
```

In [ ]:
```

```