Assigment 3

This assigment focuses on getting comfortable with working with multidimensional data and linear regression. Key items include:

- Creating random n-dimensional data
- Creating a Model that can handle the data
- Plot a subset of the data along with the prediction
- Using a Dataset to read in and choose certain columns to produce a model
- Create several models from various combinations of columns
- Plot a few of the results

In [20]:

```
import numpy as np
import matplotlib.pylab as plt
%matplotlib inline
```

1. Create a 4 dimensional data set with 64 elements and show all 4 scatter 2D plots of the data x_1 vs. y, x_2 vs. y, x_3 vs. y, x_4 vs. y

In [51]:

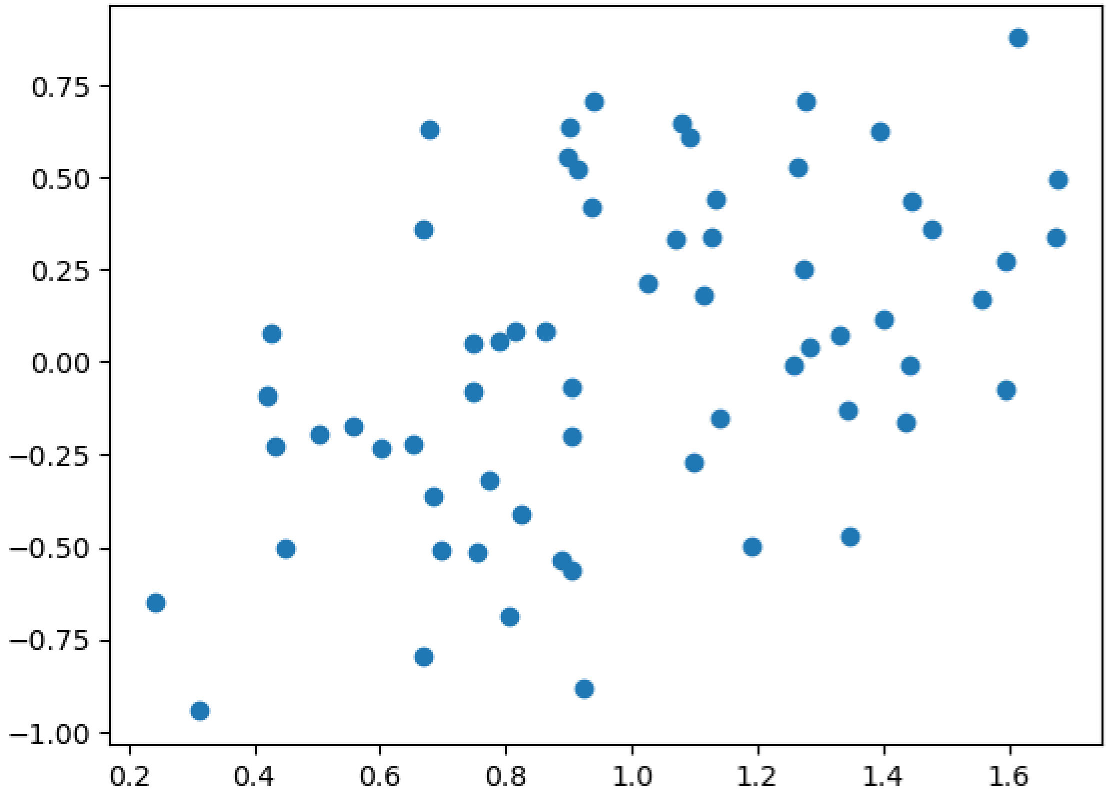
```
n = 64
x = np.linspace(0, 1, n) + np.random.rand(4, n)
x = np.vstack([x, np.ones(len(x.T))]).T
y = np.linspace(0, 1, n) + np.random.rand(n) - 1
```

In [52]:

```
plt.scatter(x.T[0], y)
```

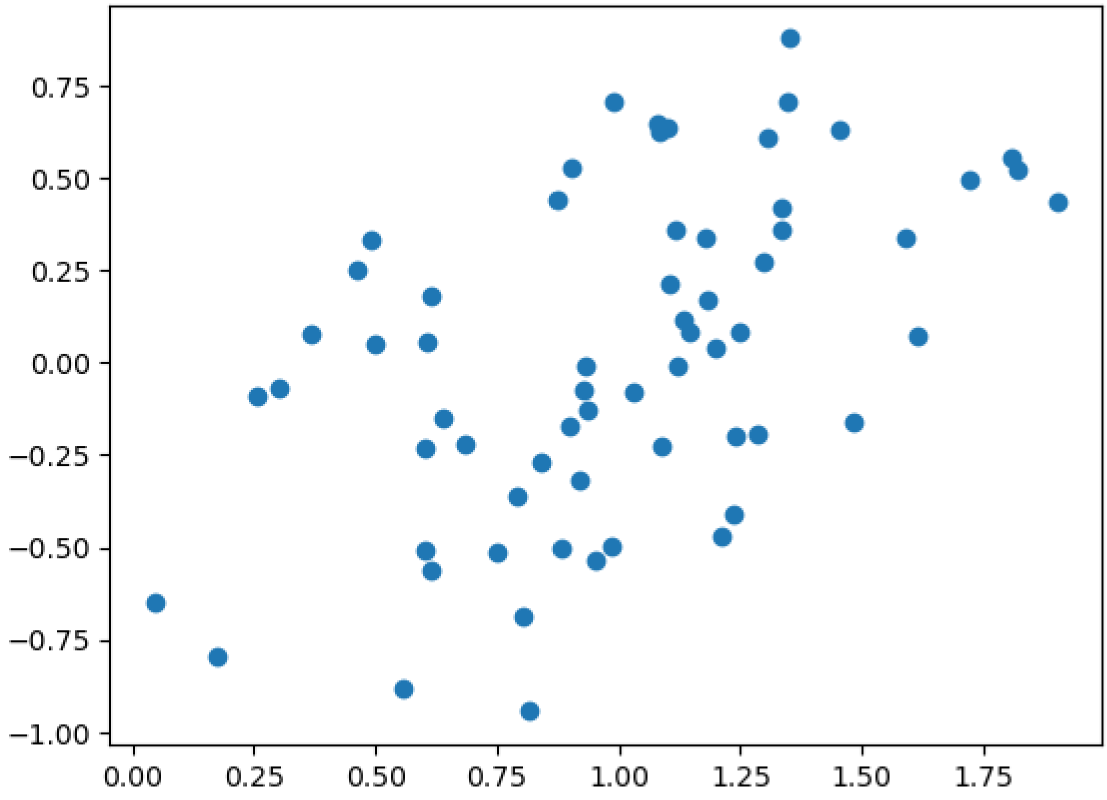
Out[52]:

```
<matplotlib.collections.PathCollection at 0x24dccae18a0>
```



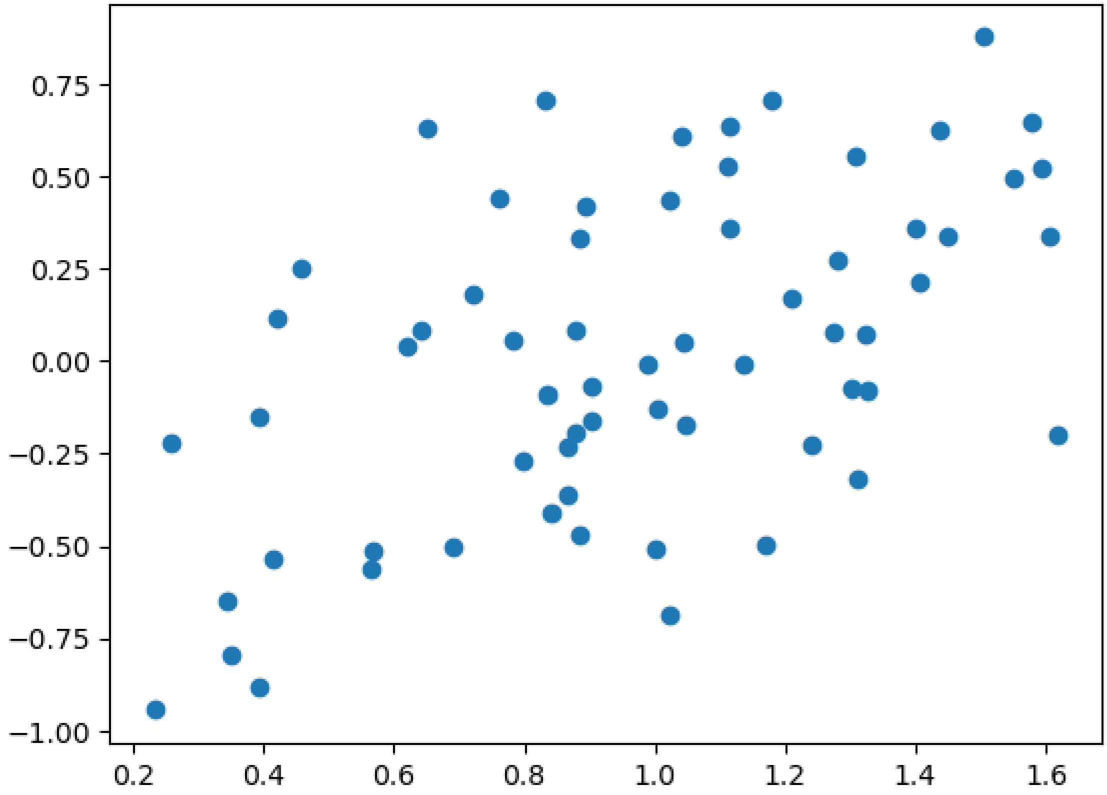
In [53]:
```
plt.scatter(x.T[1], y)
```

Out[53]:
```
<matplotlib.collections.PathCollection at 0x24dccf37c40>
```



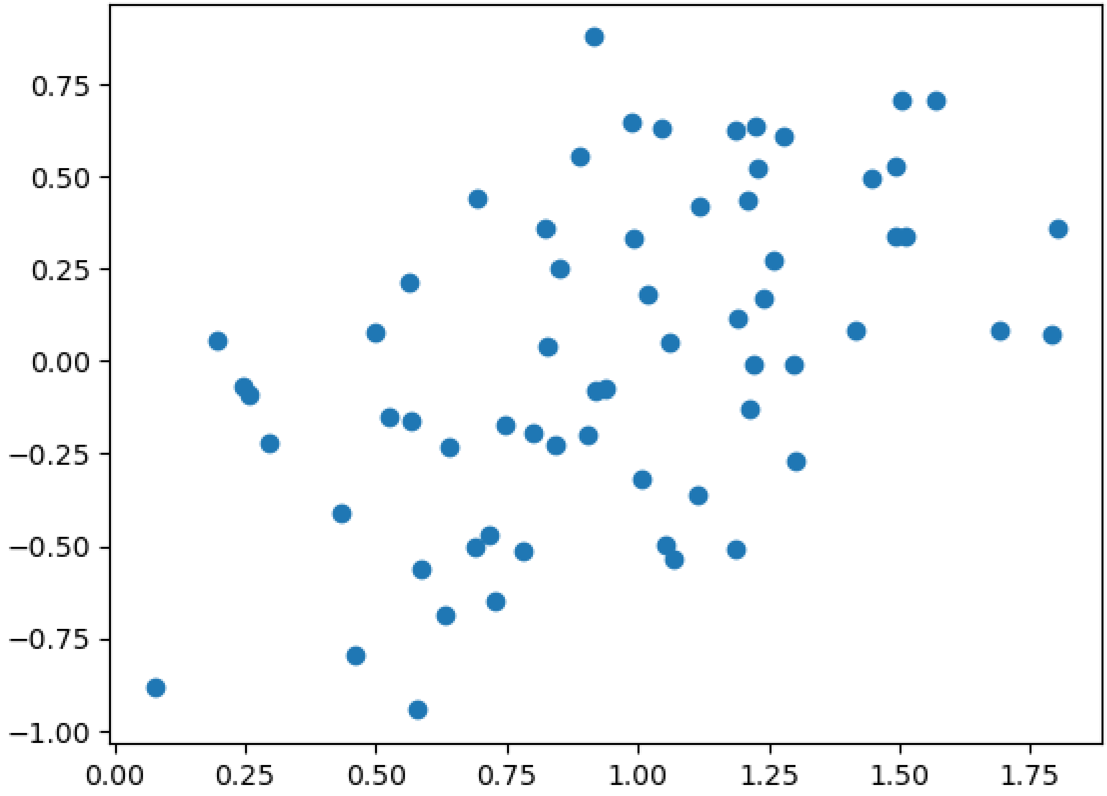
In [54]:
```
plt.scatter(x.T[2], y)
```

Out[54]:
```
<matplotlib.collections.PathCollection at 0x24dccfa2ef0>
```



In [55]:
```
plt.scatter(x.T[3], y)
```

Out[55]:
```
<matplotlib.collections.PathCollection at 0x24dcd16af80>
```



2. Create a Linear Regression model (LIKE WE DID IN CLASS) to fit the data. *Use the example from Lesson 3*

and DO NOT USE a library that calculates automatically. We are expecting 5 coefficients to describe the linear model.

After creating the model (finding the coefficients), calculate a new column $y_p = \Sigma\beta_n \cdot x_n$

In [70]:

```
beta = np.linalg.lstsq(x, y)[0]
beta
```

```
C:\Users\jorda\AppData\Local\Temp\ipykernel_48204\4087615102.py:1: FutureWarning: `rc
ond` parameter will change to the default of machine precision times ``max(M, N)`` wh
ere M and N are the input matrix dimensions.
To use the future default and silence this warning we advise to pass `rcond=None`, to
keep using the old, explicitly pass `rcond=-1`.
  beta = np.linalg.lstsq(x, y)[0]
```

Out[70]:

```
array([ 0.22729526,  0.18837653,  0.33780781,  0.23293845, -0.94804625])
```

In [57]:

```
pred = np.dot(x, beta)
```

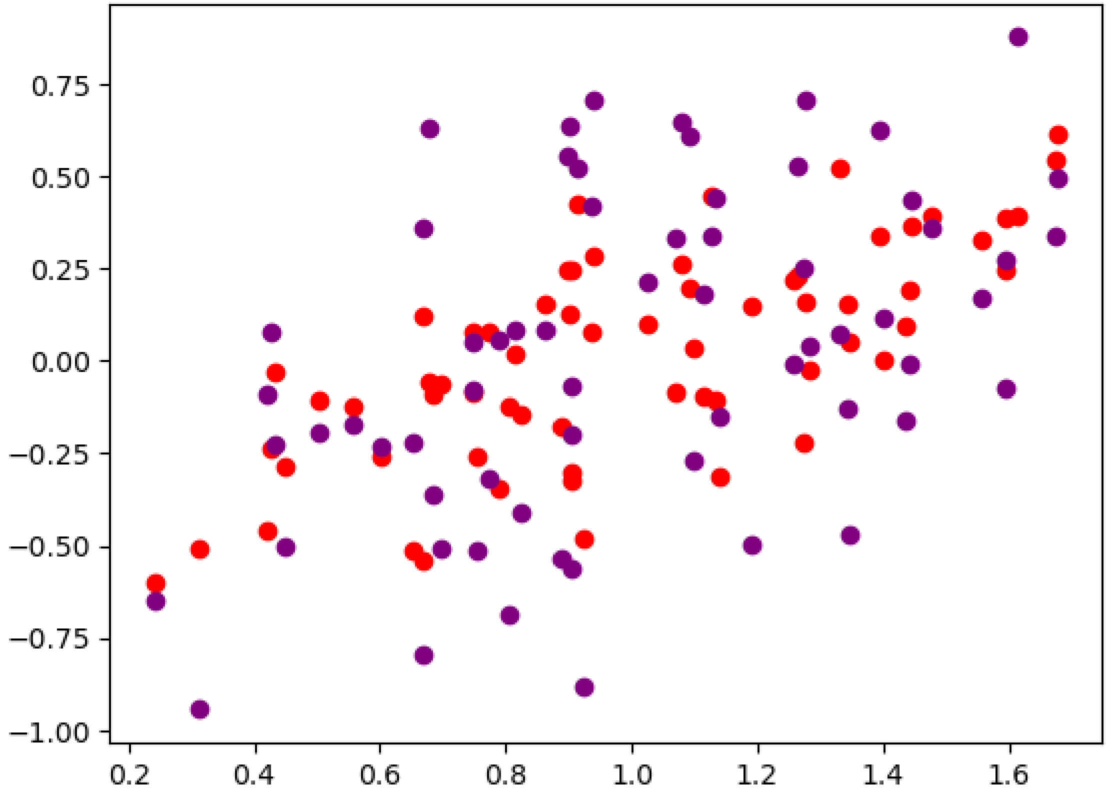
3. Plot the model's prediction as a different color on top of the scatter plot from Q1 in 2D for all 4 of the dimensions ($x_1 \rightarrow y_p, x_2 \rightarrow y_p, x_3 \rightarrow y_p, x_4 \rightarrow y_p$)

In [58]:

```
plt.scatter(x.T[0], pred, c = 'red')
plt.scatter(x.T[0], y, c = 'purple')
```

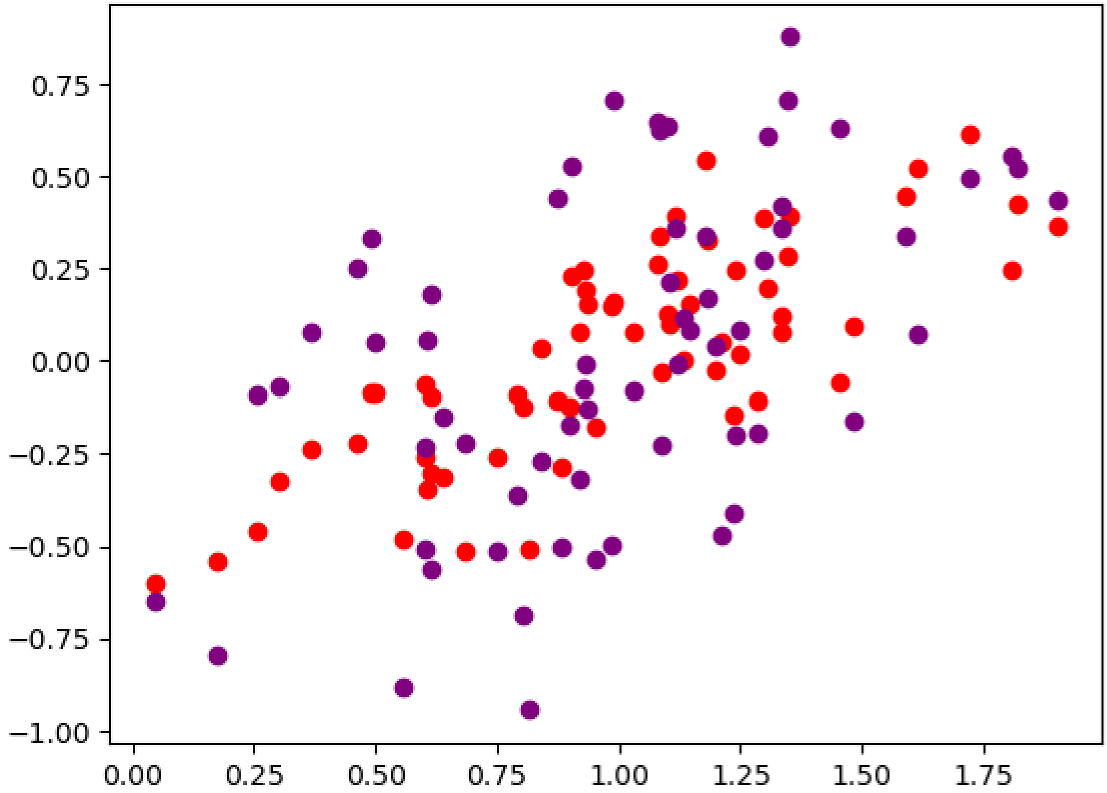
Out[58]:

```
<matplotlib.collections.PathCollection at 0x24dcd1f22c0>
```



In [59]:
```
plt.scatter(x.T[1], pred, c = 'red')
plt.scatter(x.T[1], y, c = 'purple')
```

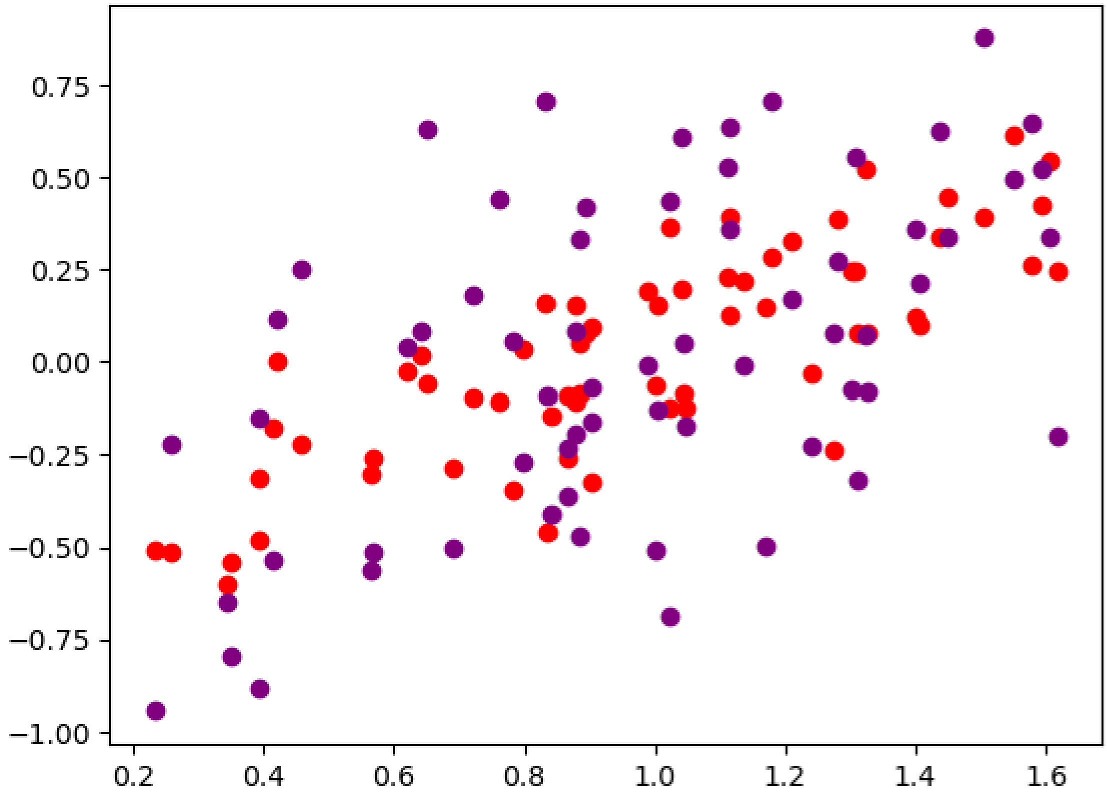
Out[59]:
```
<matplotlib.collections.PathCollection at 0x24dcd2825c0>
```



In [60]:
```
plt.scatter(x.T[2], pred, c = 'red')
plt.scatter(x.T[2], y, c = 'purple')
```

Out[60]:

```
<matplotlib.collections.PathCollection at 0x24dcd2c6b90>
```

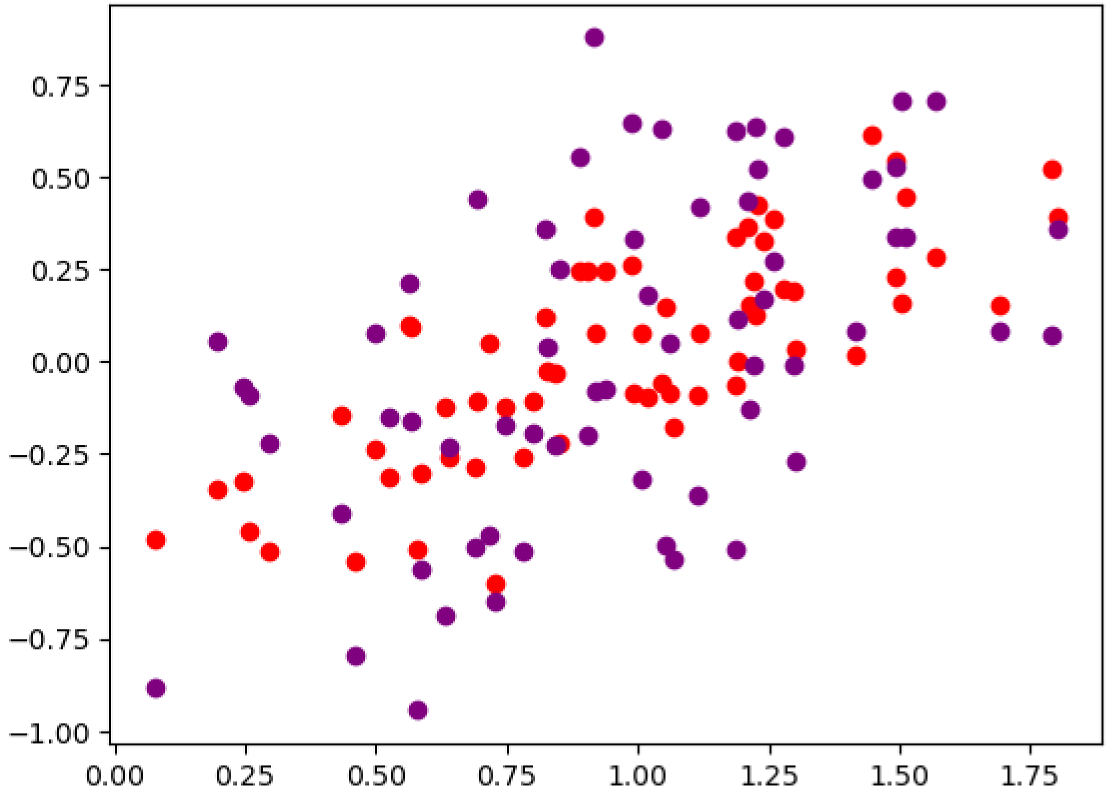


In [61]:

```
plt.scatter(x.T[3], pred, c = 'red')
plt.scatter(x.T[3], y, c = 'purple')
```

Out[61]:

```
<matplotlib.collections.PathCollection at 0x24dcd39d5a0>
```



4. Read in `mlnn/data/Credit.csv` with Pandas and build a Linear Regression model to predict Credit Rating (`Rating`). Use only the numeric columns in your model, but feel free to experiment which which columns you believe are better predicters of Credit Rating (Column `Rating`)

In [62]:

```python
import pandas as pd
import numpy as np
credit = pd.read_csv('Credit.csv')
credit.head()
```

Out[62]:

	Unnamed: 0	Income	Limit	Rating	Cards	Age	Education	Gender	Student	Married	Ethnicity
0	1	14.891	3606	283	2	34	11	Male	No	Yes	Caucasian
1	2	106.025	6645	483	3	82	15	Female	Yes	Yes	Asian
2	3	104.593	7075	514	4	71	11	Male	No	No	Asian
3	4	148.924	9504	681	3	36	11	Female	No	No	Asian
4	5	55.882	4897	357	2	68	16	Male	No	Yes	Caucasian

Choose multiple columns as inputs beyond `Income` and `Limit` but clearly, don't use `Rating`

In [87]:

```python
columns = ['Income', 'Limit', 'Cards', 'Age', 'Education', 'Balance']
x2 = credit[columns].values
x2 = np.vstack([x2.T, np.ones(len(x2))]).T
x2
```

Out[87]:

```
array([[1.48910e+01, 3.60600e+03, 2.00000e+00, ..., 1.10000e+01,
        3.33000e+02, 1.00000e+00],
       [1.06025e+02, 6.64500e+03, 3.00000e+00, ..., 1.50000e+01,
        9.03000e+02, 1.00000e+00],
       [1.04593e+02, 7.07500e+03, 4.00000e+00, ..., 1.10000e+01,
        5.80000e+02, 1.00000e+00],
       ...,
       [5.78720e+01, 4.17100e+03, 5.00000e+00, ..., 1.20000e+01,
        1.38000e+02, 1.00000e+00],
       [3.77280e+01, 2.52500e+03, 1.00000e+00, ..., 1.30000e+01,
        0.00000e+00, 1.00000e+00],
       [1.87010e+01, 5.52400e+03, 5.00000e+00, ..., 7.00000e+00,
        9.66000e+02, 1.00000e+00]])
```

In [88]:

```python
y2 = credit['Rating']
y2
```

Out[88]:

```
0      283
1      483
2      514
3      681
4      357
      ... 
395    307
396    296
397    321
398    192
399    415
Name: Rating, Length: 400, dtype: int64
```

In [89]:

```
beta2 = np.linalg.lstsq(x2, y2)[0]
beta2
```

```
C:\Users\jorda\AppData\Local\Temp\ipykernel_48204\1242549579.py:1: FutureWarning: `rc
ond` parameter will change to the default of machine precision times ``max(M, N)`` wh
ere M and N are the input matrix dimensions.
To use the future default and silence this warning we advise to pass `rcond=None`, to
keep using the old, explicitly pass `rcond=-1`.
  beta2 = np.linalg.lstsq(x2, y2)[0]
```

Out[89]:

```
array([ 9.48157743e-02,  6.42304413e-02,  4.67706085e+00,  8.06617460e-03,
       -2.30863025e-01,  8.18115721e-03,  3.10522106e+01])
```

In [90]:

```
pred2 = np.dot(x2, beta2)
```

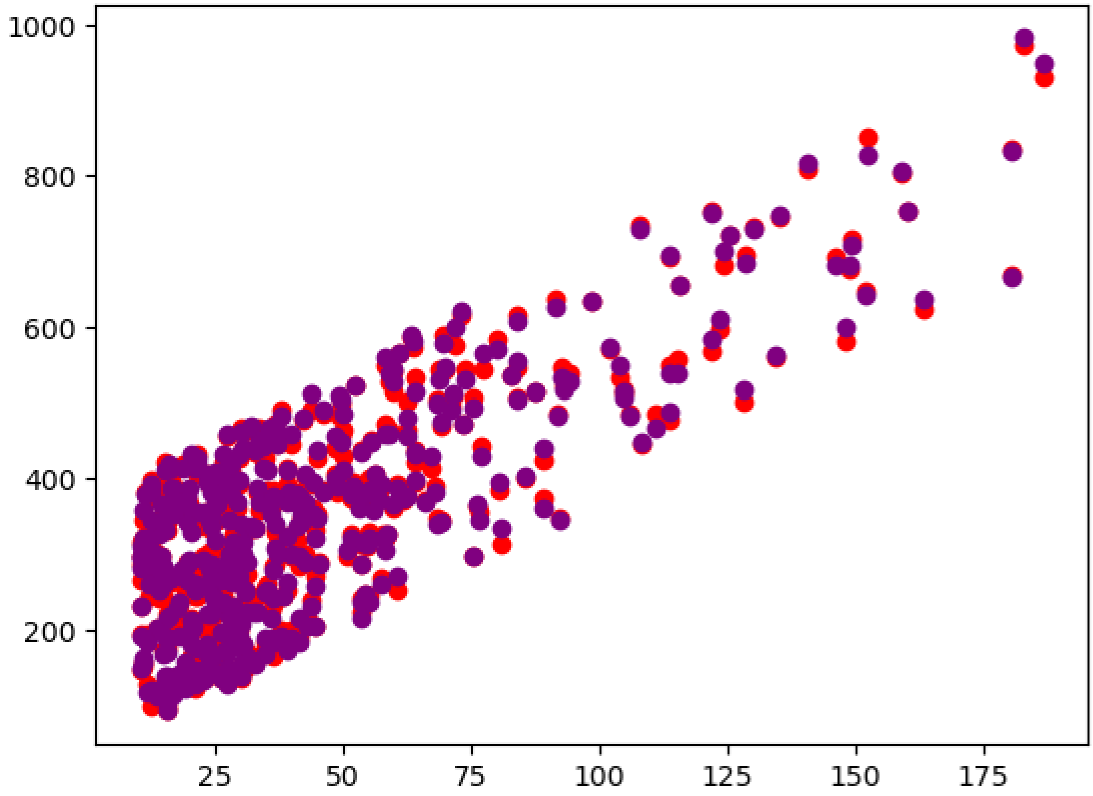
5. Plot your results using scatter plots (just like in class). Show as many of your columns vs. credit rating that you can.

In [92]:

```
plt.scatter(x2.T[0], pred2, c = 'red')
plt.scatter(x2.T[0], y2, c = 'purple')
```

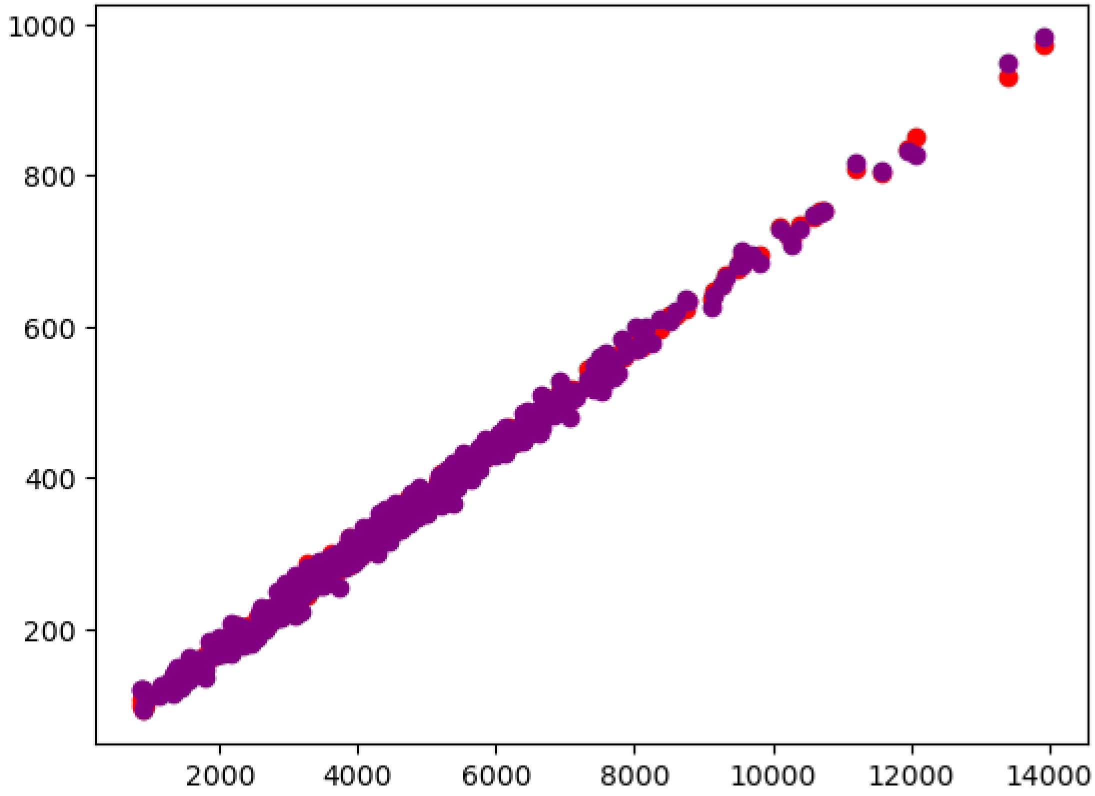
Out[92]:

```
<matplotlib.collections.PathCollection at 0x24dce7da6b0>
```



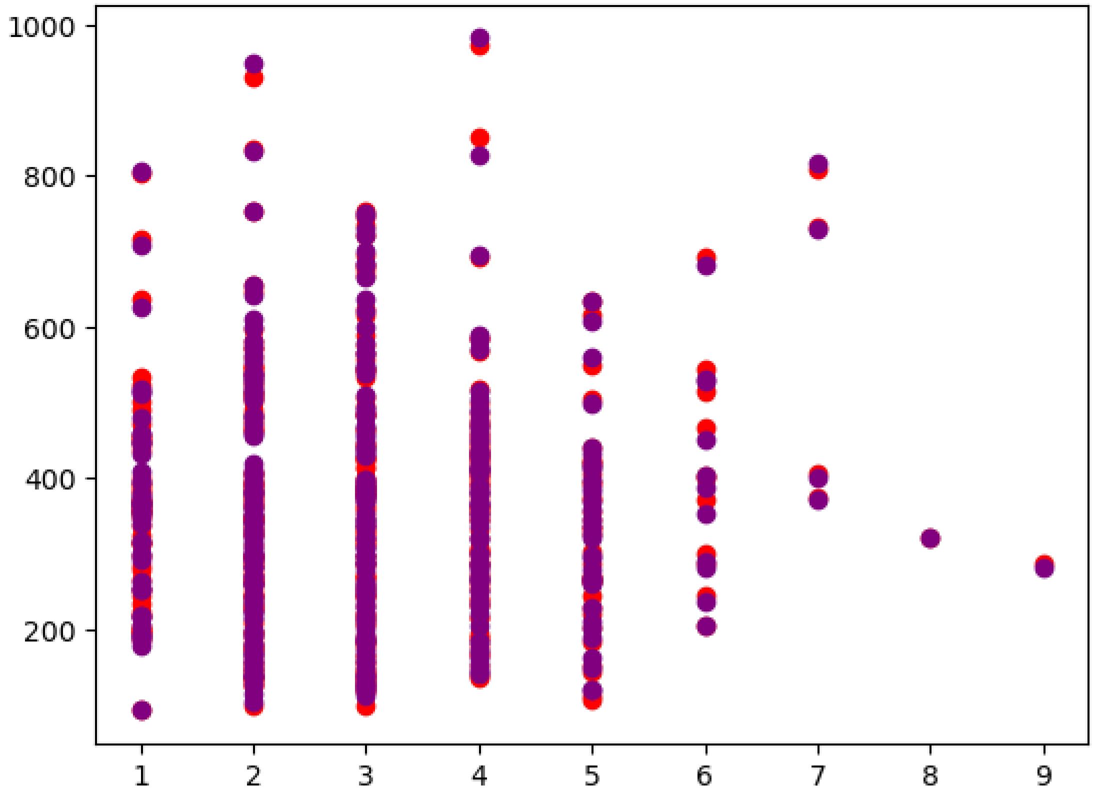
In [93]:
```
plt.scatter(x2.T[1], pred2, c = 'red')
plt.scatter(x2.T[1], y2, c = 'purple')
```

Out[93]:
```
<matplotlib.collections.PathCollection at 0x24dce77f640>
```



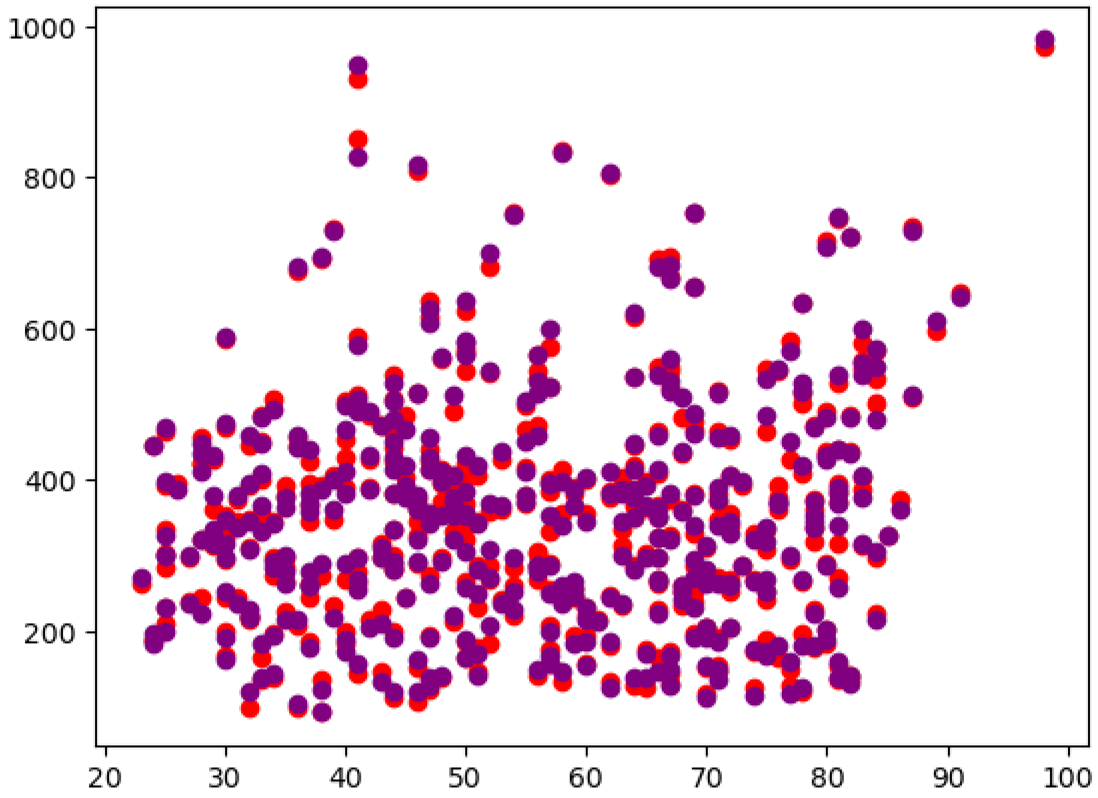
In [94]:
```
plt.scatter(x2.T[2], pred2, c = 'red')
plt.scatter(x2.T[2], y2, c = 'purple')
```

```
Out[94]: <matplotlib.collections.PathCollection at 0x24dce43c370>
```



```
In [95]: plt.scatter(x2.T[3], pred2, c = 'red')
         plt.scatter(x2.T[3], y2, c = 'purple')
```

```
Out[95]: <matplotlib.collections.PathCollection at 0x24dcfa03550>
```

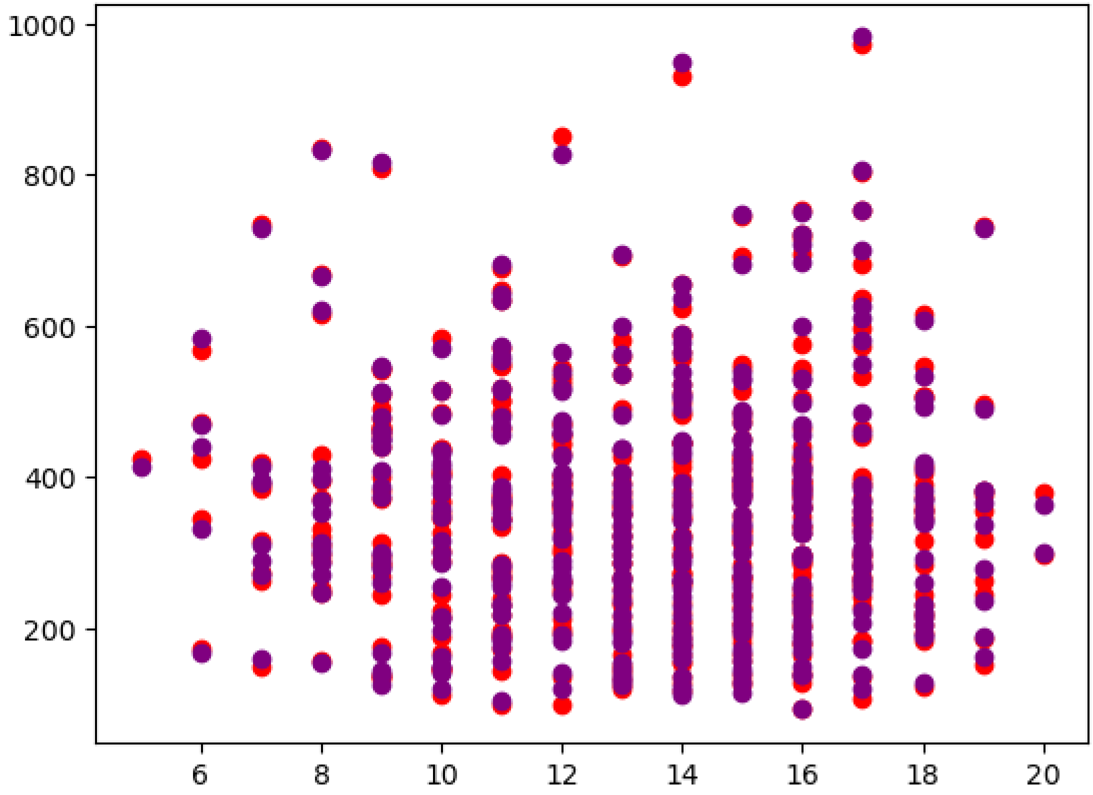


In [96]:

```
plt.scatter(x2.T[4], pred2, c = 'red')
plt.scatter(x2.T[4], y2, c = 'purple')
```

Out[96]:

```
<matplotlib.collections.PathCollection at 0x24dccf4c640>
```

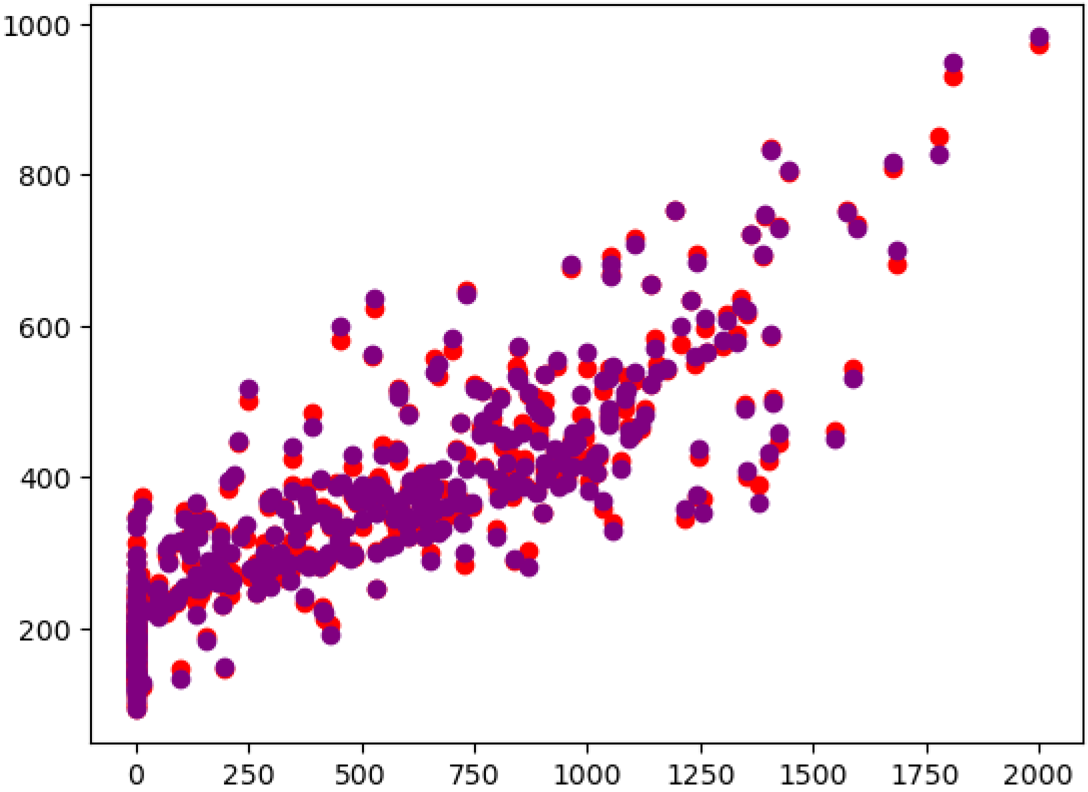


In [97]:

```
plt.scatter(x2.T[5], pred2, c = 'red')
plt.scatter(x2.T[5], y2, c = 'purple')
```

Out[97]:

```
<matplotlib.collections.PathCollection at 0x24dcd370700>
```


1000
800
600
400
200
0
250
500
750
1000
1250
1500
1750
2000