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 [1]:

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

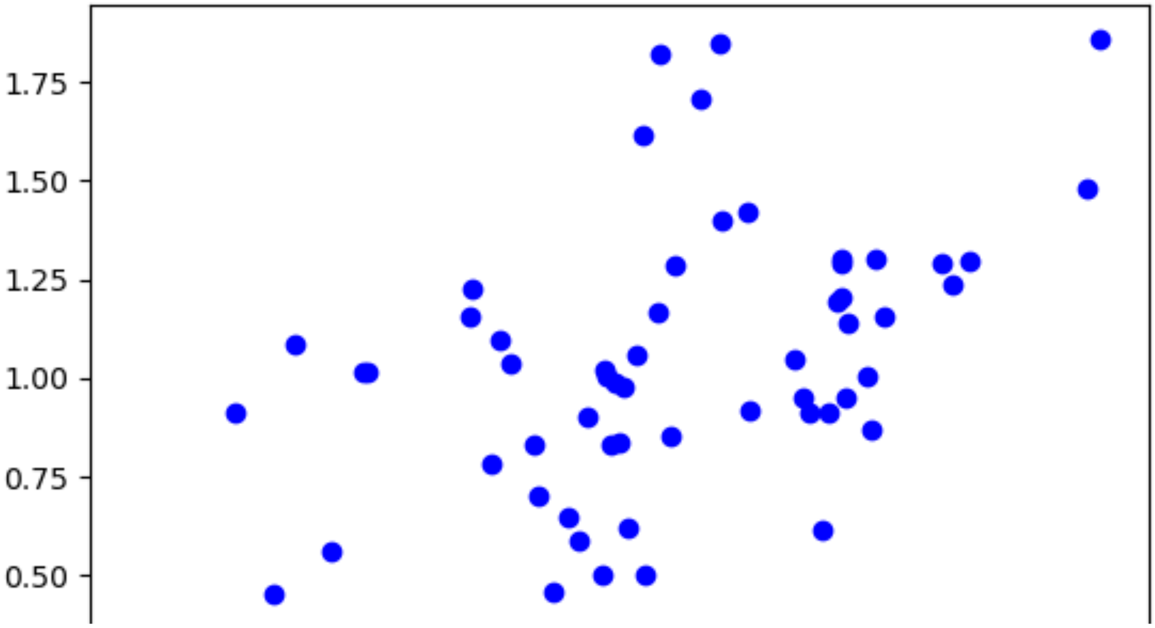
1. Create a 4 dimensional data set with 64 elements and show all 4 scatter 2D plots of the data x_1 vs. y, x_2 vs. y, x_3 vs. y, x_4 vs. y

In [4]:

```
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)
```

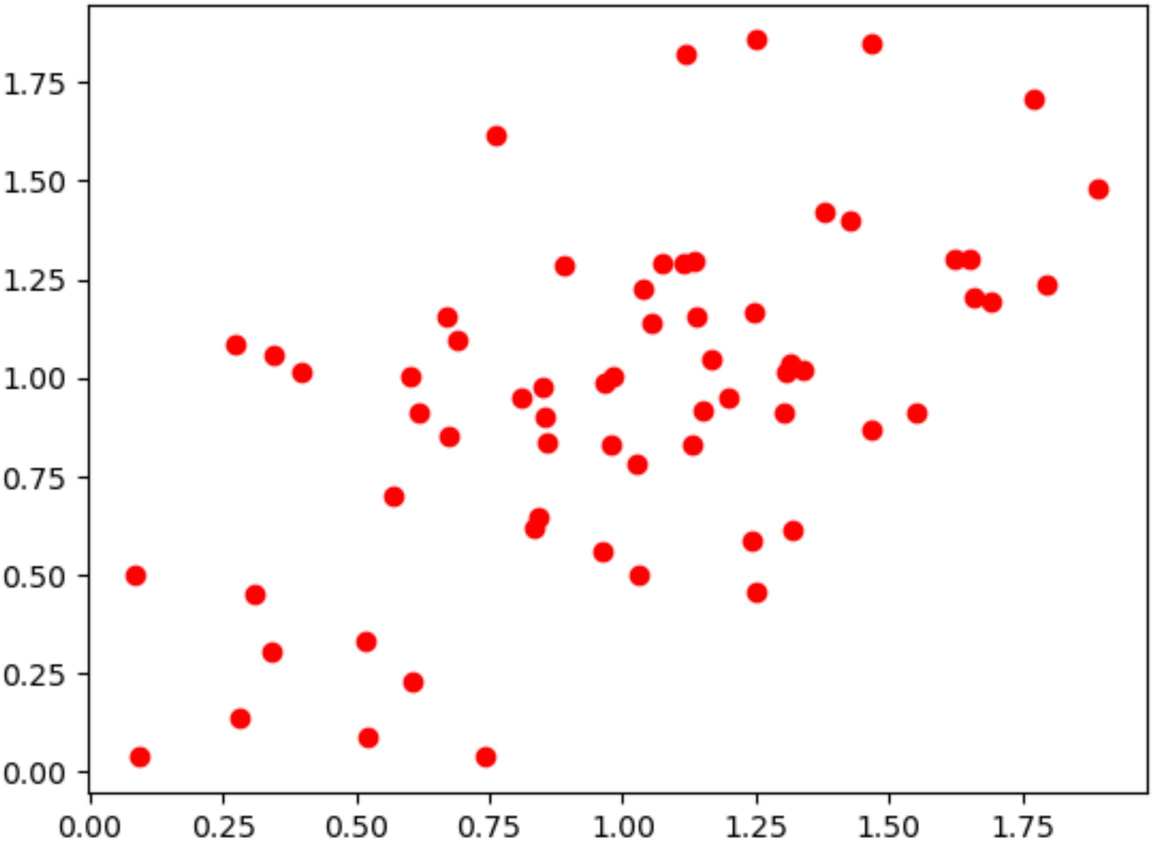
In [13]:
```
plt.scatter(x.T[0],y, c = "blue")
```

Out[13]:
```
<matplotlib.collections.PathCollection at 0x7fc3c396df00>
```



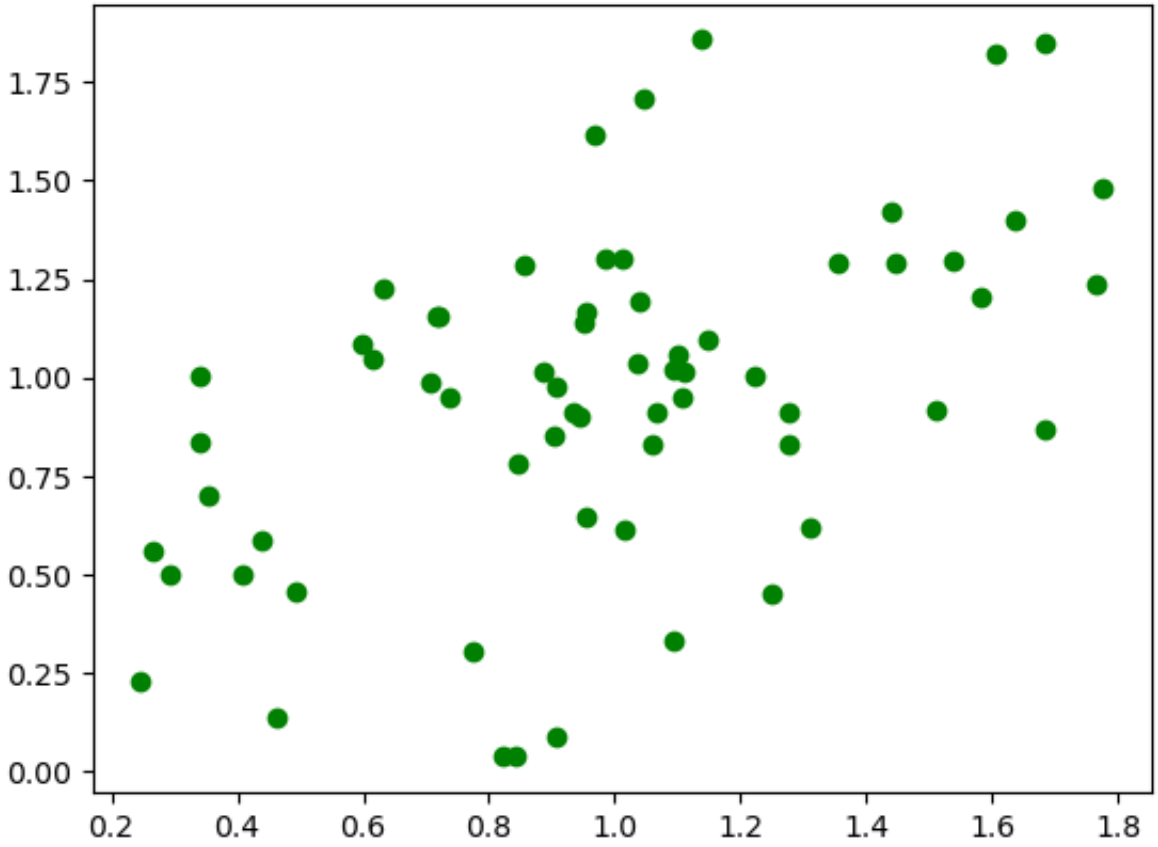
```
In [14]: plt.scatter(x.T[1],y, c = "red")
```

```
Out[14]: <matplotlib.collections.PathCollection at 0x7fc3c3bf4250>
```



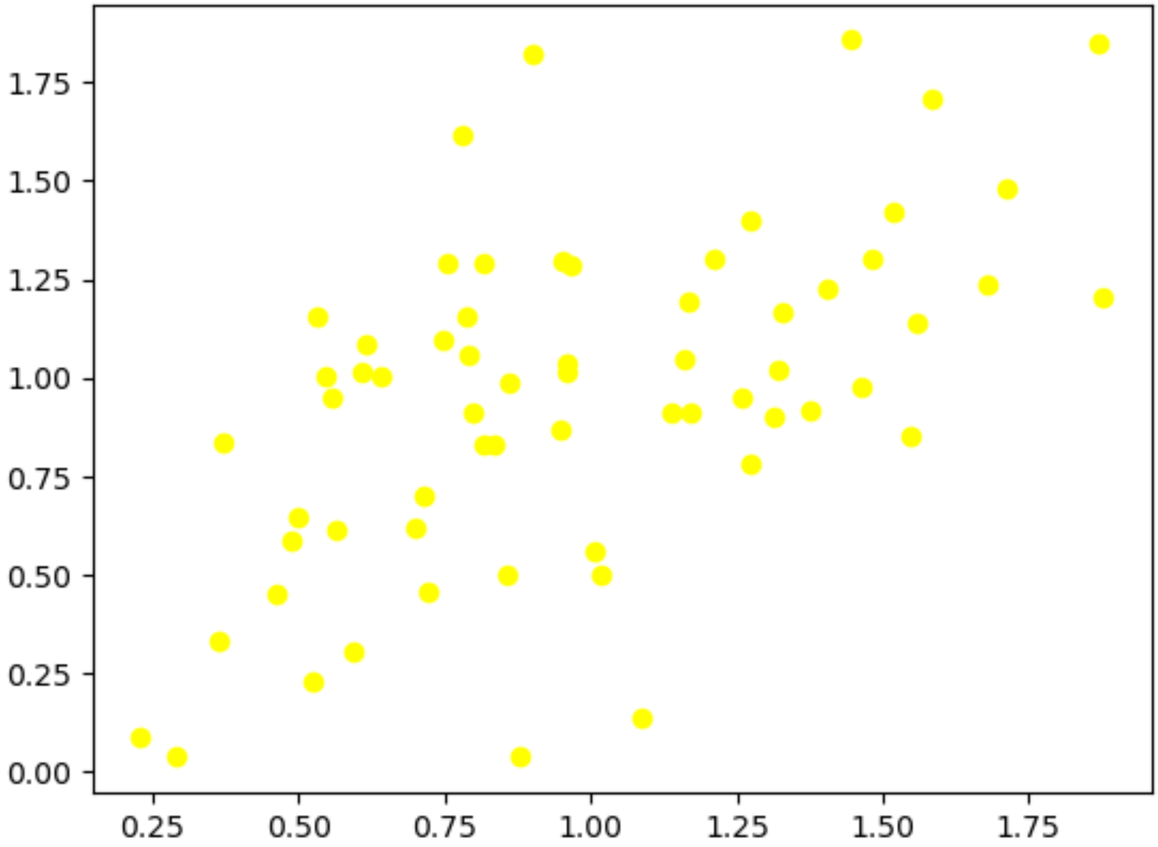
```
In [15]: plt.scatter(x.T[2],y, c = "green")

Out[15]: <matplotlib.collections.PathCollection at 0x7fc3c3c5e470>
```



```
In [16]: plt.scatter(x.T[3],y, c = "yellow")
```

```
Out[16]: <matplotlib.collections.PathCollection at 0x7fc3c4207580>
```



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 $y_p = \Sigma\beta_n \cdot x_n$

$\beta = (X^TX)^{-1}Y^TX$

```
In [22]: left  = np.linalg.inv(np.dot(x.T, x)) # Just showing the by hand metho
         right = np.dot(y.T, x)
         np.dot(left, right)

Out[22]: array([0.26360319, 0.13727859, 0.24396712, 0.26238594, 0.04789135])
```

```
In [23]: beta = np.linalg.lstsq(x,y,rcond=None)[0] # Got a warning that didn't
         beta

Out[23]: array([0.26360319, 0.13727859, 0.24396712, 0.26238594, 0.04789135])
```

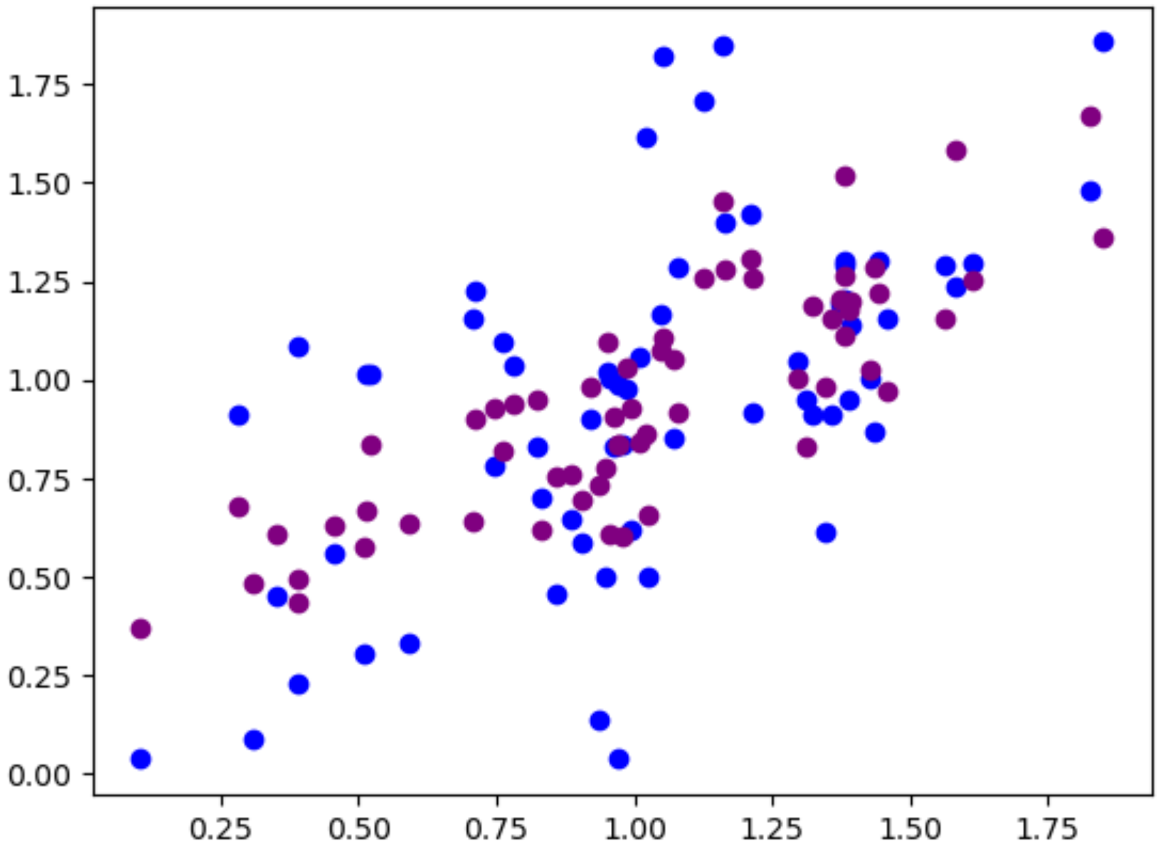
```
In [28]: y_pred = np.dot(x, beta) # I know the question implies a single column
         y_pred

Out[28]: array([0.36952917, 0.83677403, 0.77686919, 0.65430735, 0.60382323,
                0.4822258 , 0.62880784, 0.76118452, 0.7315866 , 0.4315507 ,
                0.83790944, 0.82024312, 0.63613028, 0.57367806, 0.90819419,
                0.49570087, 0.67750482, 0.60820225, 0.75519312, 0.61900206,
                0.60941138, 0.83260192, 0.66774922, 0.64009178, 0.95067922,
                1.00381411, 0.69162493, 0.9278044 , 0.91733898, 0.90061287,
                1.07651445, 0.97998747, 1.11082255, 0.92644363, 0.83044965,
                0.93829559, 1.09601861, 1.30534116, 1.02593861, 1.20055023,
                1.0497504 , 0.86340068, 0.8346136 , 0.97149528, 1.25596771,
                0.98276486, 1.18550525, 1.15650348, 1.25302432, 1.02901105,
                1.20221377, 1.21995515, 1.15361967, 1.28726524, 1.26442715,
                1.10639379, 1.58258207, 1.17895158, 1.45583387, 1.67127802,
                1.25825194, 1.36388241, 1.51754147, 1.28272578])
```

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 ($x_1 \rightarrow y_p, x_2 \rightarrow y_p, x_3 \rightarrow y_p, x_4 \rightarrow y_p$)

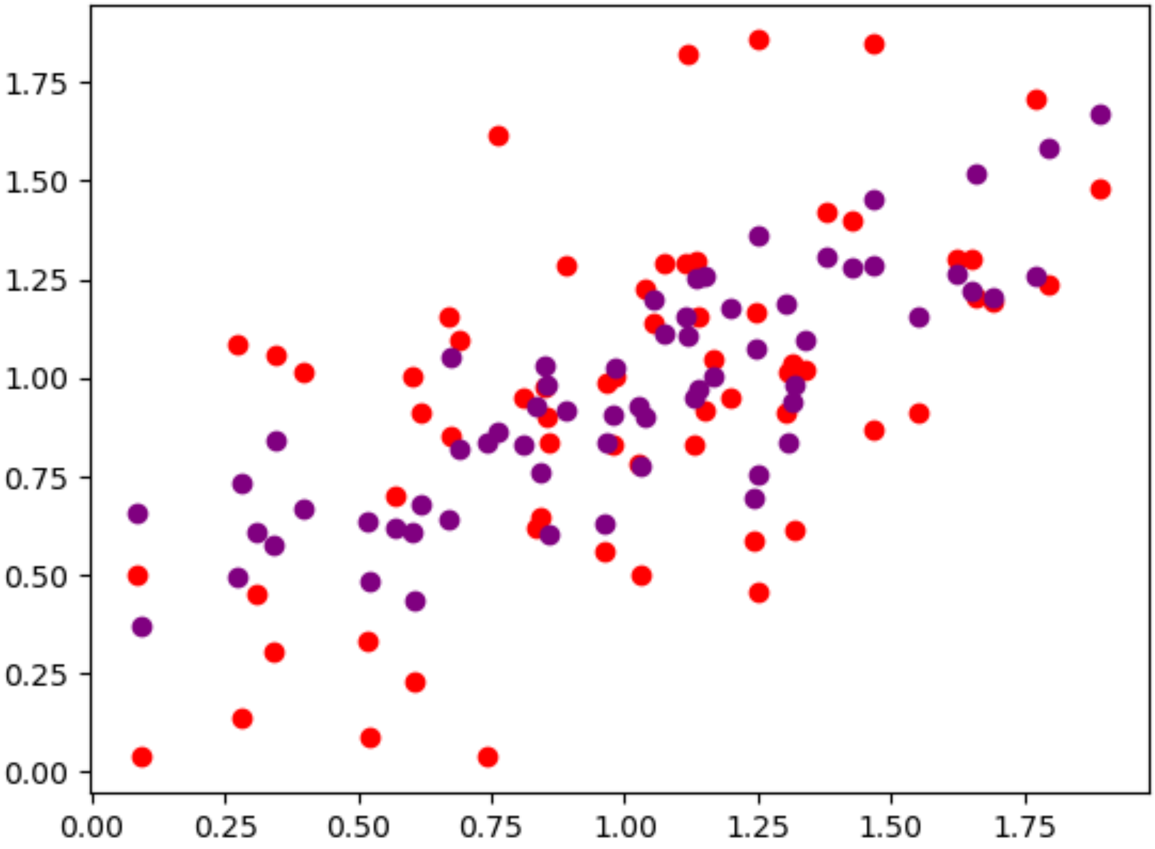
In [29]:
```
plt.scatter(x.T[0], y, c = "blue")
plt.scatter(x.T[0], y_pred, c = "purple")
```

Out[29]:
```
<matplotlib.collections.PathCollection at 0x7fc3c2d5be20>
```



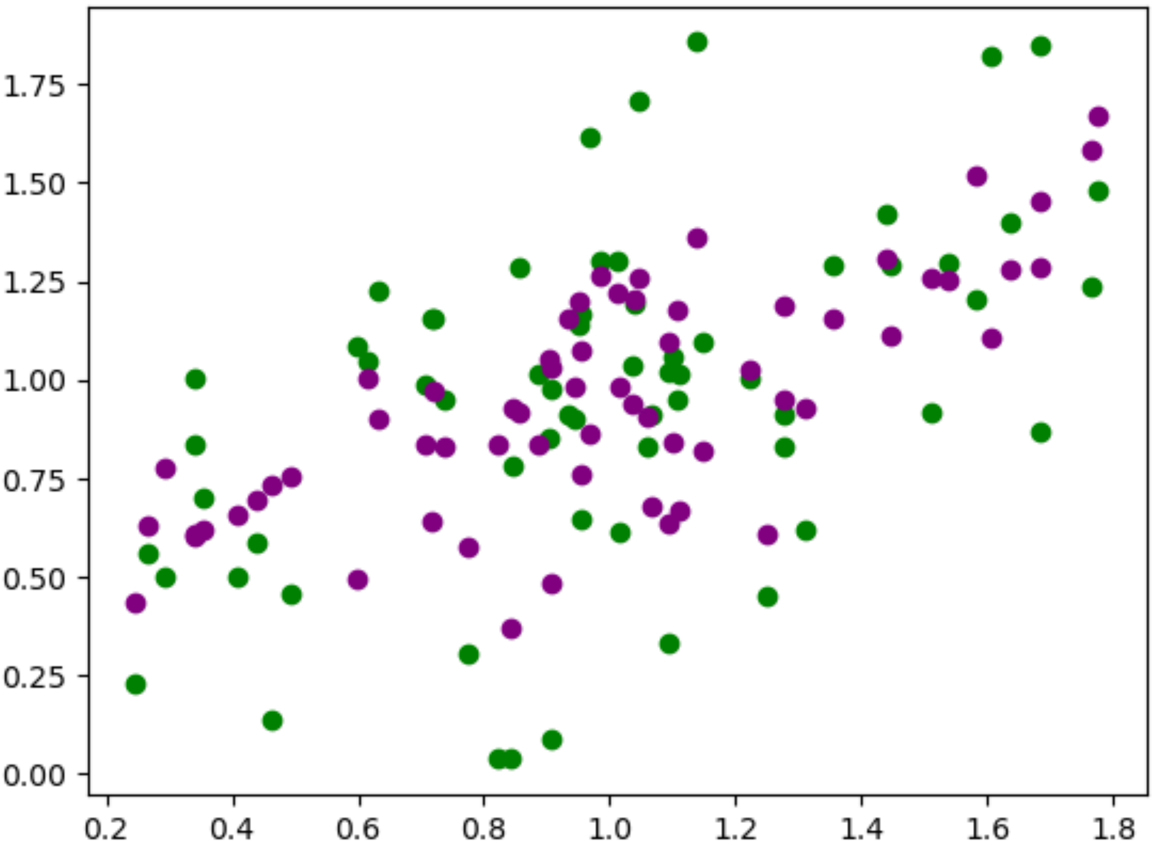
In [30]:
```
plt.scatter(x.T[1], y, c = "red")
plt.scatter(x.T[1], y_pred, c = "purple")
```

Out[30]:
```
<matplotlib.collections.PathCollection at 0x7fc3c47219f0>
```



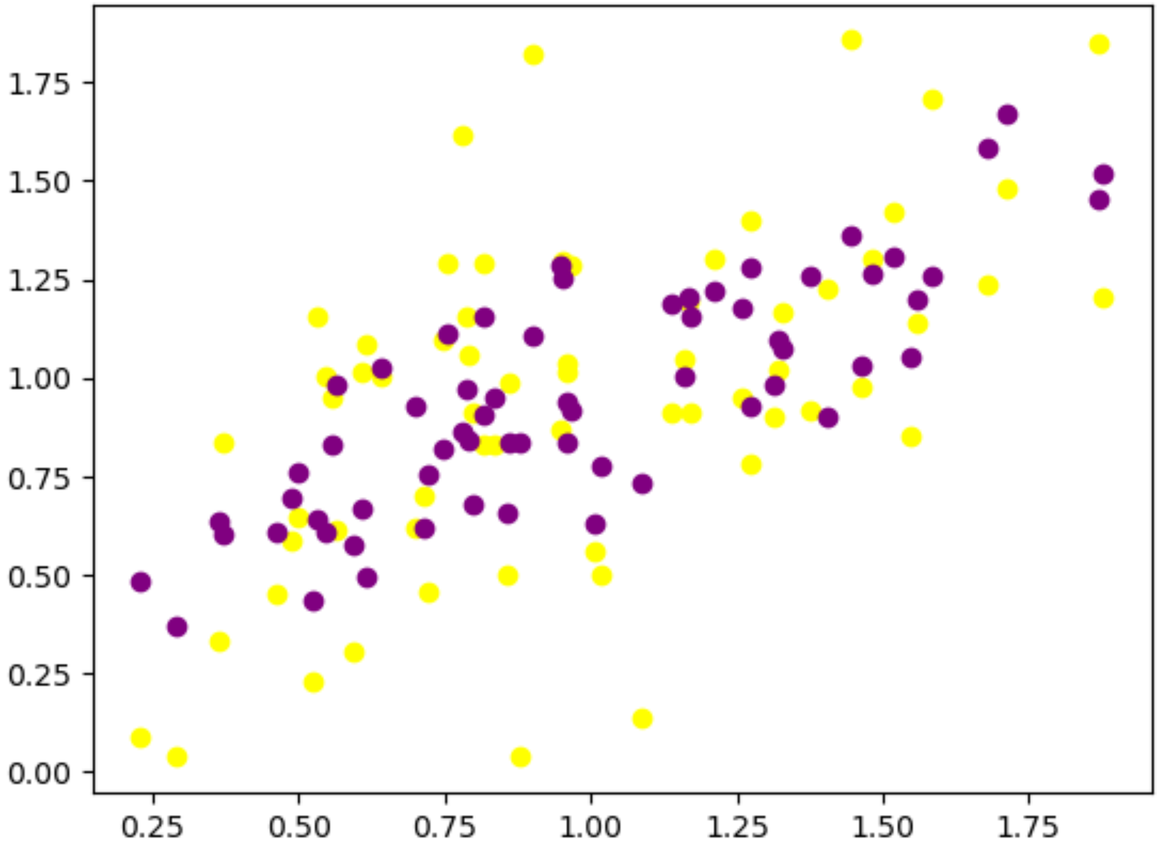
```
In [31]: plt.scatter(x.T[2], y, c = "green")
         plt.scatter(x.T[2], y_pred, c = "purple")

Out[31]: <matplotlib.collections.PathCollection at 0x7fc3c408b340>
```



In [32]:
```
plt.scatter(x.T[3], y, c = "yellow")
plt.scatter(x.T[3], y_pred, c = "purple")
```

Out[32]:
```
<matplotlib.collections.PathCollection at 0x7fc3c46463e0>
```



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 [33]:

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

Out[33]:

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

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

In [44]:

```
columns = ['Income', 'Limit', "Balance", "Education"]
X = credit[columns].values

X = np.vstack([X.T, np.ones(len(X))]).T
X
```

Out[44]:

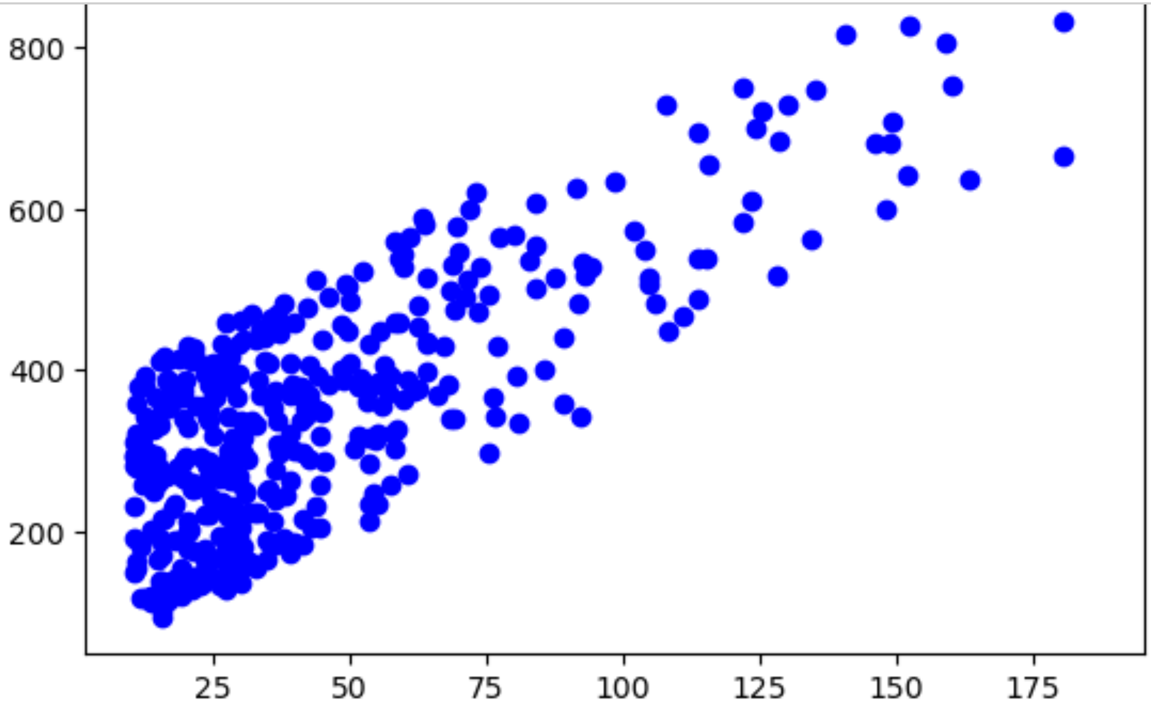
```
array([[1.48910e+01, 3.60600e+03, 3.33000e+02, 1.10000e+01, 1.00000e+
00],
       [1.06025e+02, 6.64500e+03, 9.03000e+02, 1.50000e+01, 1.00000e+
00],
       [1.04593e+02, 7.07500e+03, 5.80000e+02, 1.10000e+01, 1.00000e+
00],
       ...,
       [5.78720e+01, 4.17100e+03, 1.38000e+02, 1.20000e+01,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

```
In [45]: Y = credit['Rating']
         Y
```

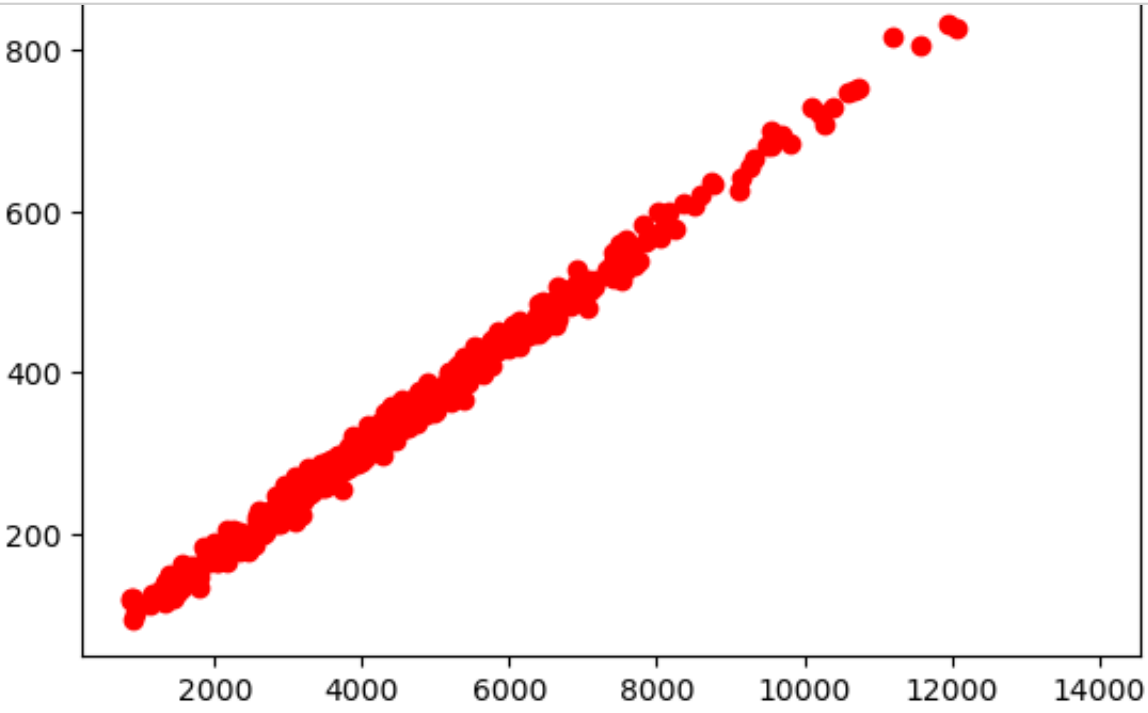
```
Out[45]: 0      283
         1      483
         2      514
         3      681
         4      357
               ...
         395    307
         396    296
         397    321
         398    192
         399    415
         Name: Rating, Length: 400, dtype: int64
```

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

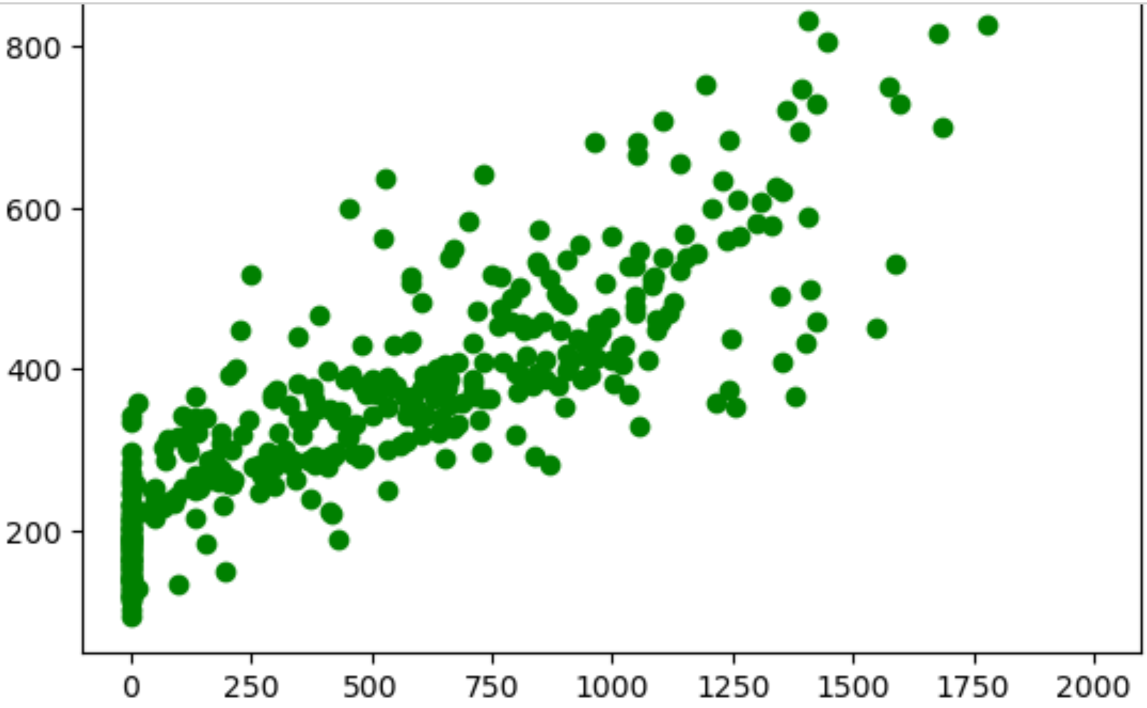
```
In [46]: plt.scatter(X.T[0], Y, c = "blue")
```



In [47]:
```
plt.scatter(X.T[1], Y, c = "red")
```

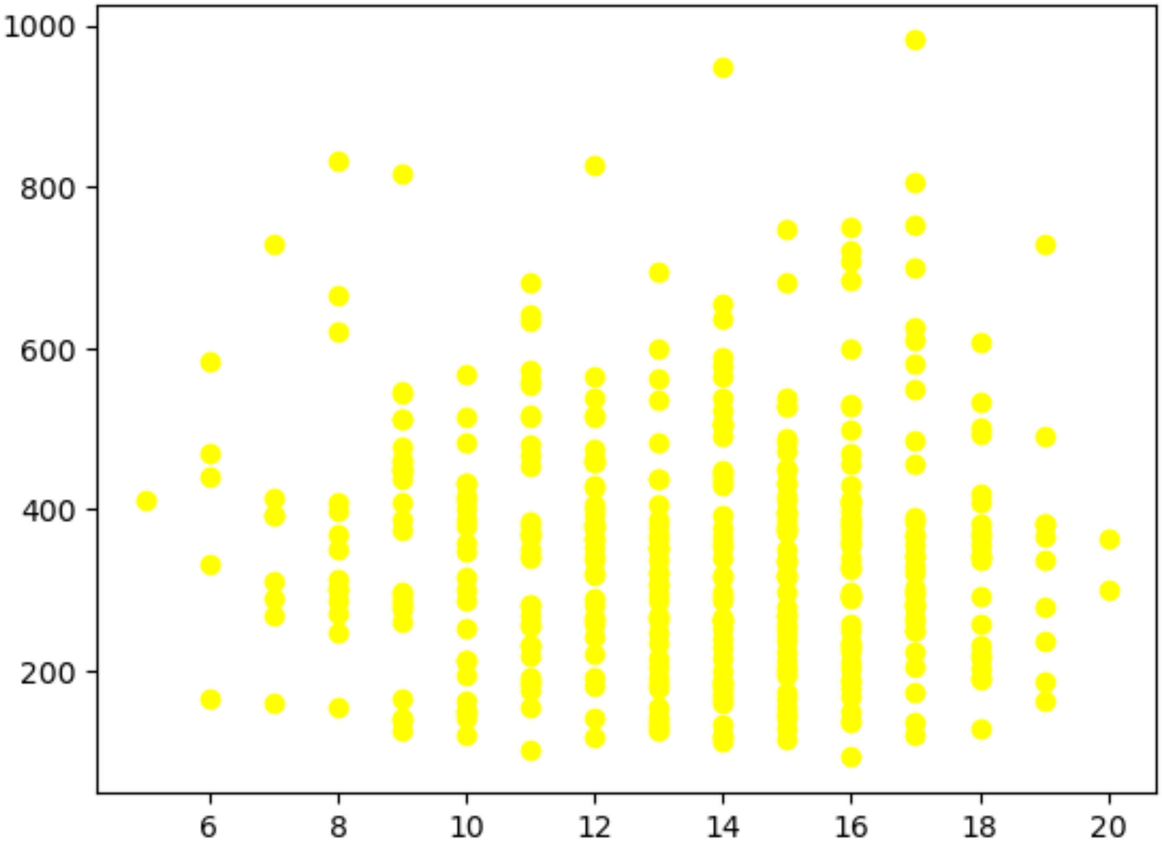


In [48]:
```
plt.scatter(X.T[2], Y, color = "green")
```



```
In [49]: plt.scatter(X.T[3], Y, color = "yellow")
```

```
Out[49]: <matplotlib.collections.PathCollection at 0x7fc3aafa9690>
```


1000
800
600
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200
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12
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