PROGRAM 7: PANDAS IN PYTHON

University of Anybody Can Learn Datascience - ABCLD

Requirement

Description:

Given dataset is a dummy dataset containing infor related to Grades from a PG course at ABCCD University.

Attributes:

There are total 5 attributes Sem_enrolled,Tests,Coursera,GroupActivity and FinalExam.
FinalExam is the target variable.

The recorded values are the average of sub-components:

e.g The Tests, coursera and group activity variables are the average of all tests, coursera courses and gro
up activities taken by students.
The FinalExam variable is the average of all questions in the final, written exam.

The Sem_enrolled column is the year in which the student first enrolled at the university and is a crude approxi
mation of the student's age (maturity).

This particular course permitted students to work in groups for assignments, tutorials and the take-home exam. T
he groups were self-selected, and varied during the semester.

Of interest is whether the assignments, tutorials, midterms or take-home exam are a good predictor of the studen
t's performance in the final exam.
Also, findout whether the sem_enrolled variable show any promise as a prediction variable?

- Data shape: 100 rows and 5 columns
- Missing Values: YES
- Task to be performed: Missing value imputation and Regression.

IMPORTING PACKAGES

In [1]:
```
import pandas as pd
import numpy as np
import seaborn as sns

import matplotlib.pyplot as plt
from matplotlib import style

import sklearn
from sklearn import linear_model
from sklearn.utils import shuffle
import pickle
```

Academic score of the University of Anybody Can Learn Datascience - ABCLD

In [2]:
```
D= pd.read_excel('AcademicScoreDataset.xlsx')
Data =pd.DataFrame(D)
e = Data[(Data['Final'] >= 100) | (Data['Final'] <= 0)]
outlier =pd.DataFrame(e)
outlier
```

Out[2]:

	Sem_enrolled	Tests	Coursera	GroupActivity	Final
33	2	85.42	91.03	NaN	107.78

In [3]:
```
Data.drop(Data[(Data['Final'] >= 100) | (Data['Final'] <= 0)].index, inplace = True)
```

In [4]:
```
e = Data[(Data['Final'] >= 100) | (Data['Final'] <= 0)]
outlier =pd.DataFrame(e)
outlier
```

Out[4]:

Sem_enrolled	Tests	Coursera	GroupActivity	Final

Type *Markdown* and LaTeX: α^2

Understanding and examine the given academic dataset to perform the effective 'EDULYTICS'

In [5]:
```
AcademicScoreDataset= Data
AcademicScoreDataset
```

Out[5]:

	Sem_enrolled	Tests	Coursera	GroupActivity	Final
0	5	95.05	34.09	51.48	52.50
1	1	83.70	100.00	99.07	68.33
2	1	81.22	83.17	63.15	48.89
3	2	91.32	96.06	100.00	80.56
4	1	95.00	93.64	100.00	73.89
...	...	...	...	...	...
95	2	89.94	80.54	93.70	39.72
96	1	95.60	100.00	90.74	87.78
97	2	63.40	76.13	99.81	85.56
98	1	75.35	97.37	72.78	77.22
99	5	NaN	63.39	93.70	50.83

99 rows × 5 columns

As per the above table, It clearly shows that this dataset conatins 5 different type of attributes which is related to University Academic. Such like consolidated Test marks, Coursera marks, Group Activity marks and respective Final marks.

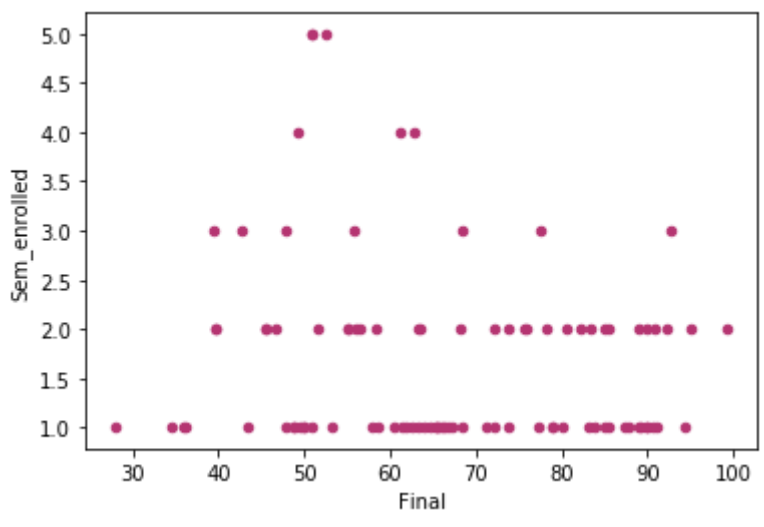
In [6]:
```
AcademicScoreDataset.describe()
```

Out[6]:

	Sem_enrolled	Tests	Coursera	GroupActivity	Final
count	99.000000	96.000000	96.000000	93.000000	93.000000
mean	1.707071	85.081146	88.188646	78.777957	66.520215
std	0.961000	15.038993	14.004583	22.984082	17.278241
min	1.000000	0.000000	34.090000	16.910000	28.060000
25%	1.000000	81.047500	83.170000	63.890000	51.670000
50%	1.000000	90.135000	92.840000	87.590000	65.280000
75%	2.000000	95.012500	99.000000	97.410000	82.220000
max	5.000000	100.000000	100.000000	100.000000	99.170000

In [7]:
```
# Weightage of Semester enrollment distribution
AcademicScoreDataset.plot(x = 'Final', y = 'Sem_enrolled', kind = 'scatter',color="#B53471")
```

Out[7]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x2070f20abc8>
```



Above plotted graph clearly shows the number of students endrolled on semester bases

Note:- Higher enrollment in 1st sem 2nd higher enrollment in 2nd sem Lower enrollment in 5th sem

Return a copy of the dataset with missing values filled, replaced or imputed

Since as per our initial analysis, we found that some of the Tests, coursera and group activity fields holding blank or missing data. Which could misleading our EDULYTICS interpretation.

In order to quick fix that we should use missing value imputation technique in Python.

Below here, the above dataset carries 3 different missing value imputation technique.

In [8]:
```
Replace_DataFrame      = AcademicScoreDataset.fillna(0)
ForwardFill_DataFrame  = AcademicScoreDataset.fillna(method = 'ffill')
BackwardFill_DataFrame = AcademicScoreDataset.fillna(method = 'bfill')
```

Method 1 - replacing null by zero

- In method one we're making sure that every Tests, coursera and group activity fields NaN values get replaced by ZERO.
- LinearRegression to find the highest accuracy

In [9]:
```
Replace_DataFrame[Replace_DataFrame.notnull()]
```

Out[9]:

	Sem_enrolled	Tests	Coursera	GroupActivity	Final
0	5	95.05	34.09	51.48	52.50
1	1	83.70	100.00	99.07	68.33
2	1	81.22	83.17	63.15	48.89
3	2	91.32	96.06	100.00	80.56
4	1	95.00	93.64	100.00	73.89
...	...	...	...	...	...
95	2	89.94	80.54	93.70	39.72
96	1	95.60	100.00	90.74	87.78
97	2	63.40	76.13	99.81	85.56
98	1	75.35	97.37	72.78	77.22
99	5	0.00	63.39	93.70	50.83

99 rows × 5 columns

In [10]:
```
style.use("ggplot")

# Import dataset with student's data
data = Replace_DataFrame

# Select the value we want to predict
predict = "Final"

# List the variables we want to use for our predictions in this model
data = data[[ 'Tests','Coursera','GroupActivity','Final']]
data = shuffle(data)

x = np.array(data.drop([predict], 1))
y = np.array(data[predict])

x_train, x_test, y_train, y_test = sklearn.model_selection.train_test_split(x, y, test_size = 0.1)

# Train model multiple times to find the highest accuracy
best = 0
for _ in range(10):
    x_train, x_test, y_train, y_test = sklearn.model_selection.train_test_split(x, y, test_size = 0.1)

    linear = linear_model.LinearRegression()

    linear.fit(x_train, y_train)
    acc = linear.score(x_test, y_test)
    print("Accuracy: " + str(acc))

    # Save the highest accuracy
    if (acc > best):
        best = acc
        with open("studentgrades.pickle", "wb") as f:
            pickle.dump(linear, f)
print("")
print("Highest Accuracy: ", best)

# Load model
pickle_in = open("studentgrades.pickle", "rb")
linear = pickle.load(pickle_in)

print("-------------------------")
print('Coefficient:  \n', linear.coef_)
print('Intercept: \n', linear.intercept_)
print("-------------------------")
print("")
predictions = linear.predict(x_test)

# Print the predictions, the variables we used and the actual final grade
for x in range(len(predictions)):
   print("Predicted Final grade: ", predictions[x])
   print("Data:", x_test[x])
   print("Final grade:", y_test[x])
   print("")
```

```
Accuracy: 0.10844137293154033
Accuracy: -0.8145768276011798
Accuracy: -0.035500920649660817
Accuracy: -0.10636161063030936
Accuracy: -0.2891070128025601
Accuracy: 0.03737249875069015
Accuracy: 0.27352549843545637
Accuracy: -0.0664506987530884
Accuracy: -0.0426523918474635
Accuracy: -0.11991328950721325

Highest Accuracy:  0.27352549843545637
-------------------------
Coefficient:
 [-0.04714049  0.02102377  0.1250936 ]
Intercept:
 55.36240646550149
-------------------------

Predicted Final grade:  64.9937945378385
Data: [87.93 61.4  99.81]
Final grade: 42.78

Predicted Final grade:  63.0932585980695
Data: [86.29 92.93 78.7 ]
Final grade: 73.89

Predicted Final grade:  58.78461422461769
Data: [81.22 93.68 42.22]
Final grade: 61.39

Predicted Final grade:  66.34394937748662
Data: [ 71.79  88.3  100.  ]
Final grade: 99.17
```

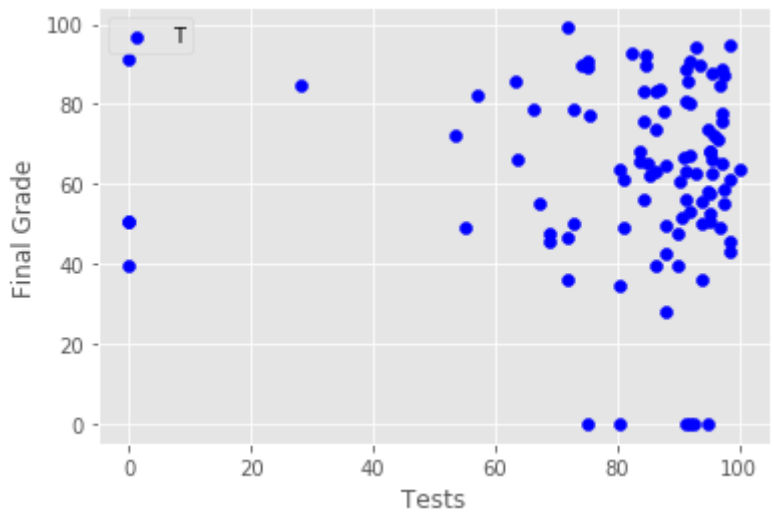
```
Predicted Final grade:  65.454519145218
Data: [83.7  88.11 97.41]
Final grade: 65.56

Predicted Final grade:  62.960349783936515
Data: [90.74 57.97 85.19]
Final grade: 51.67

Predicted Final grade:  64.86055274315694
Data: [ 91.28 100.    93.52]
Final grade: 63.33

Predicted Final grade:  68.41637365675439
Data: [ 0.   63.39 93.7 ]
Final grade: 50.83

Predicted Final grade:  65.37774785412233
Data: [ 97.   100.    99.81]
Final grade: 88.89

Predicted Final grade:  65.05973542273453
Data: [95.05 92.58 97.78]
Final grade: 68.06
```

Final Interpretation of Method 1

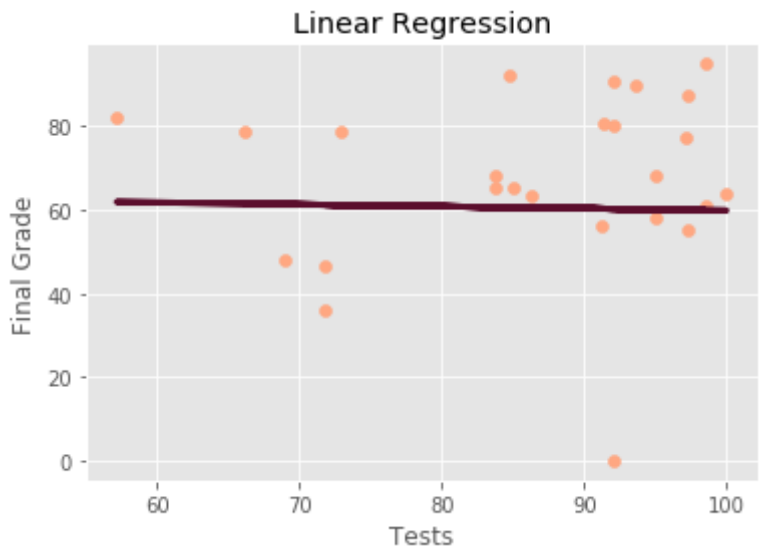
Tests

In [11]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
from sklearn.metrics import mean_squared_error
from sklearn import metrics
from sklearn.metrics import r2_score

X = Replace_DataFrame[['Tests']]
y = Replace_DataFrame["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "Tests"
plt.scatter(data[plot], data["Final"],color="blue")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('Tests')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

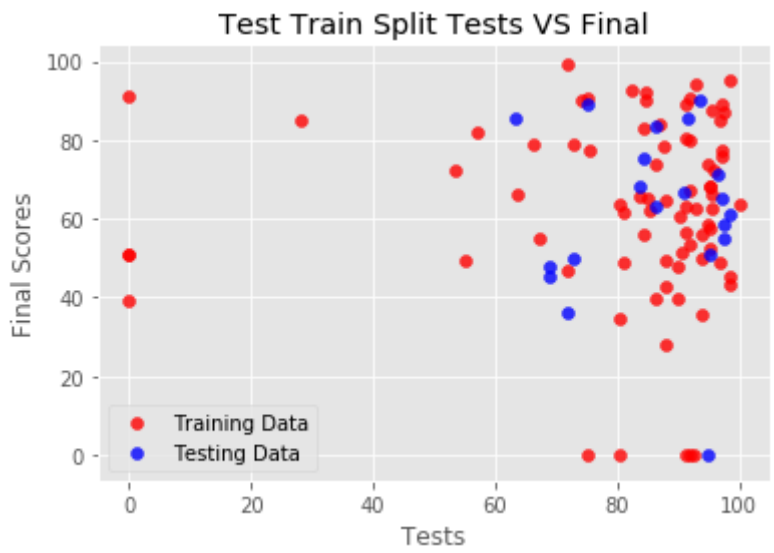
```
The Mean square error is:  472.9745614904693
R squared value is  -0.12413234184058508
```

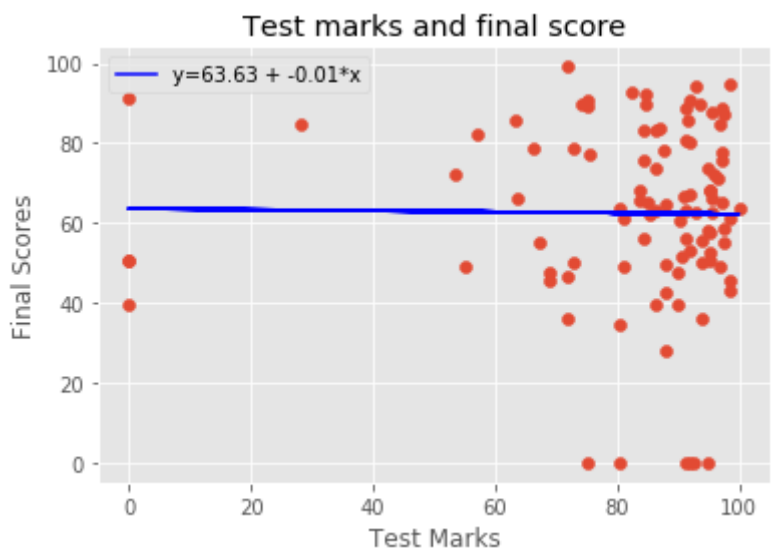


Out[11]: Text(0.5, 1.0, 'Linear Regression')



In [12]:
```
X = Replace_DataFrame[["Tests"]]
y = Replace_DataFrame["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("Tests")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Tests VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Tests Marks")
plt.ylabel("Final Scores")
plt.legend()
plt.show()

reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("Test Marks")
plt.ylabel("Final Scores")
plt.title("Test marks and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```





Out[12]:

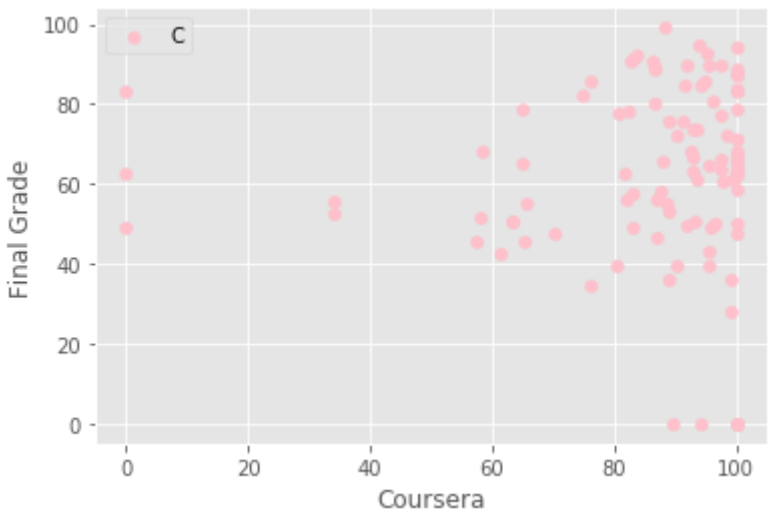
	Actual	Predicted
0	52.50	62.314706
1	68.33	62.472088
2	48.89	62.506476
3	80.56	62.366427
4	73.89	62.315399
...	...	...
95	39.72	62.385562
96	87.78	62.307079
97	85.56	62.753573
98	77.22	62.587871
99	50.83	63.632694

99 rows × 2 columns

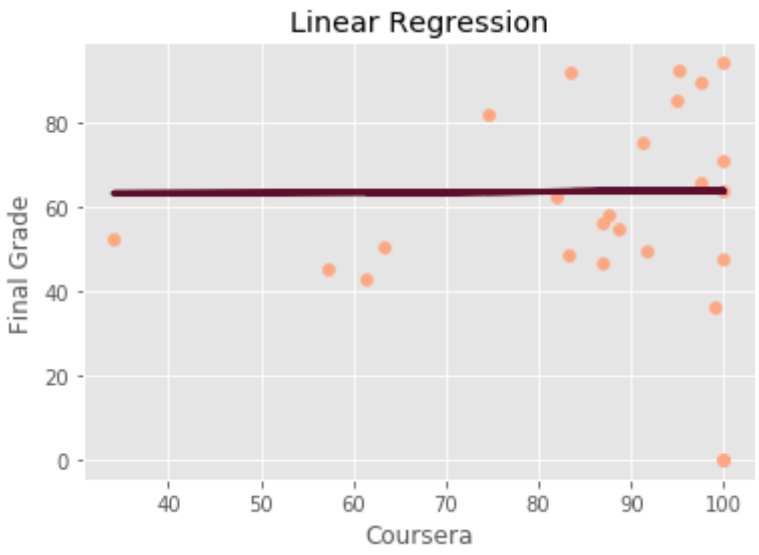
Coursera

In [13]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = Replace_DataFrame[['Coursera']]
y = Replace_DataFrame["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "Coursera"
plt.scatter(data[plot], data["Final"],color="pink")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('Coursera')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

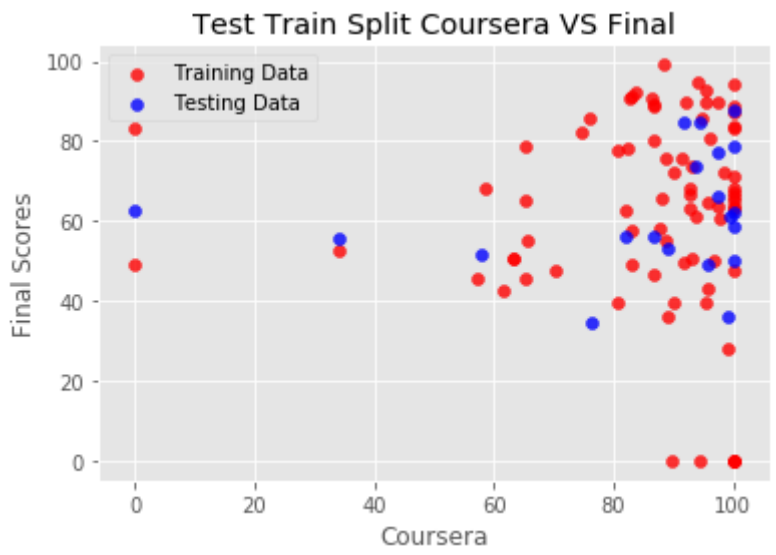
```
The Mean square error is:  615.8382748256361
R squared value is  -0.04408503782720241
```

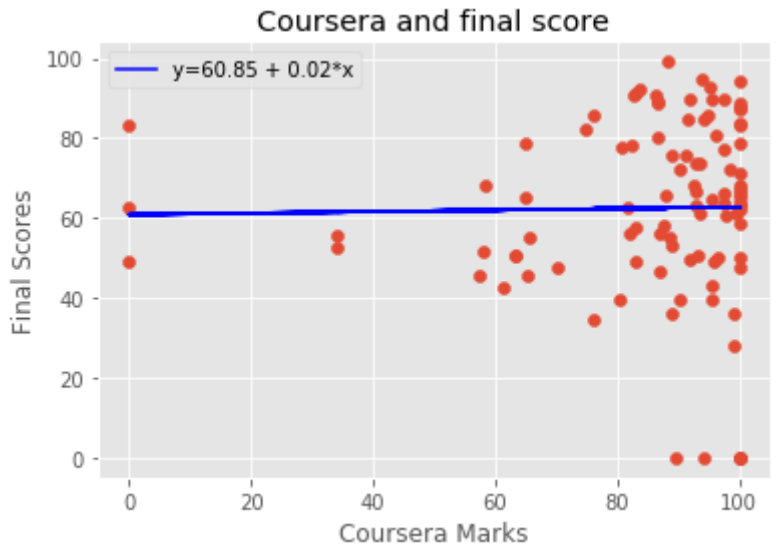


Out[13]: Text(0.5, 1.0, 'Linear Regression')



In [14]:
```
X = Replace_DataFrame[["Coursera"]]
y = Replace_DataFrame["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("Coursera")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Coursera VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Coursera")
plt.ylabel("Final Scores")
plt.legend()
plt.show()

reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("Coursera Marks")
plt.ylabel("Final Scores")
plt.title("Coursera and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```





Out[14]:

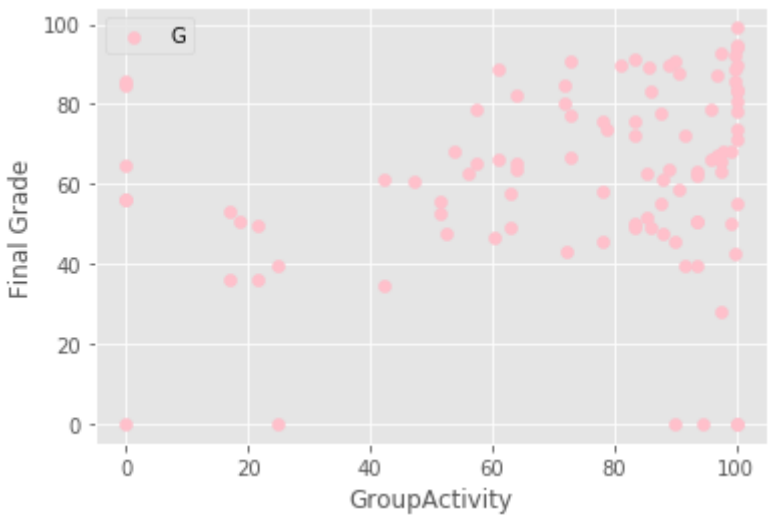
	Actual	Predicted
0	52.50	61.502553
1	68.33	62.766423
2	48.89	62.443696
3	80.56	62.690870
4	73.89	62.644465
...	...	...
95	39.72	62.393264
96	87.78	62.766423
97	85.56	62.308699
98	77.22	62.715991
99	50.83	62.064400

99 rows × 2 columns

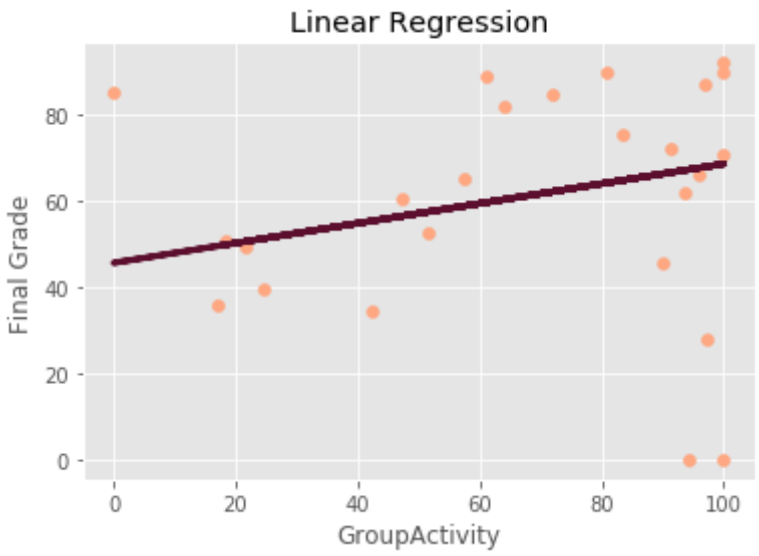
GROUP ACTIVITY

In [15]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = Replace_DataFrame[['GroupActivity']]
y = Replace_DataFrame["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "GroupActivity"
plt.scatter(data[plot], data["Final"],color="pink")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('GroupActivity')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

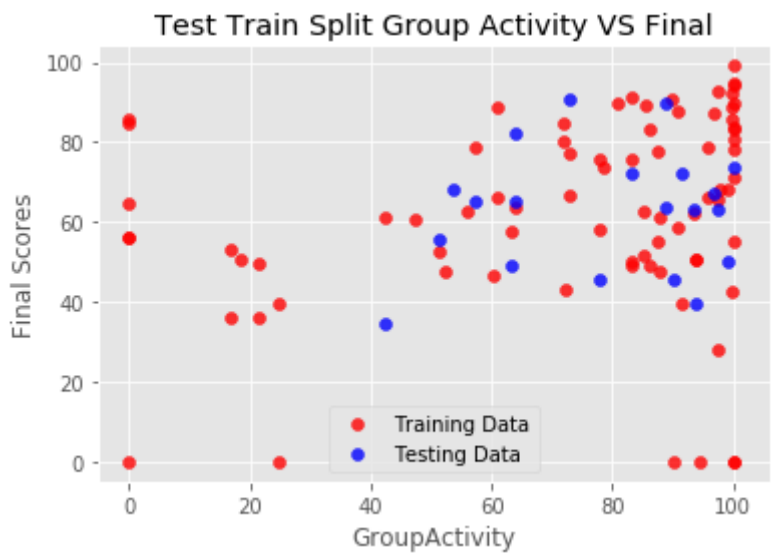
```
The Mean square error is:  712.4523427290154
R squared value is  -0.04099311985552956
```

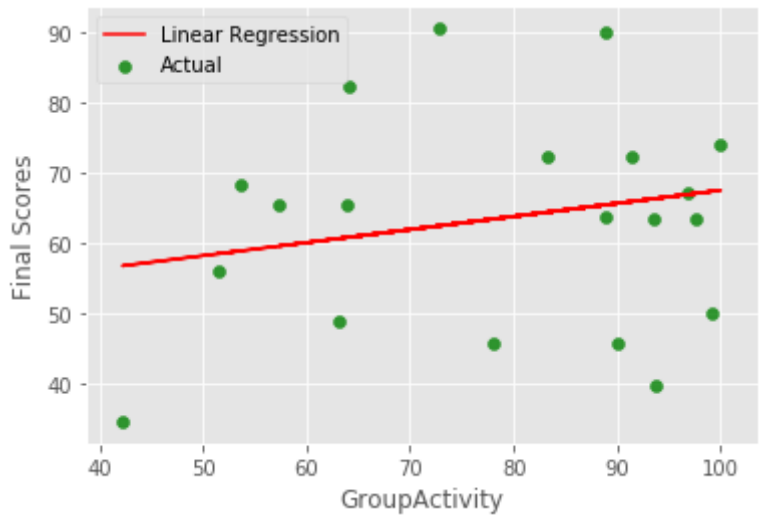


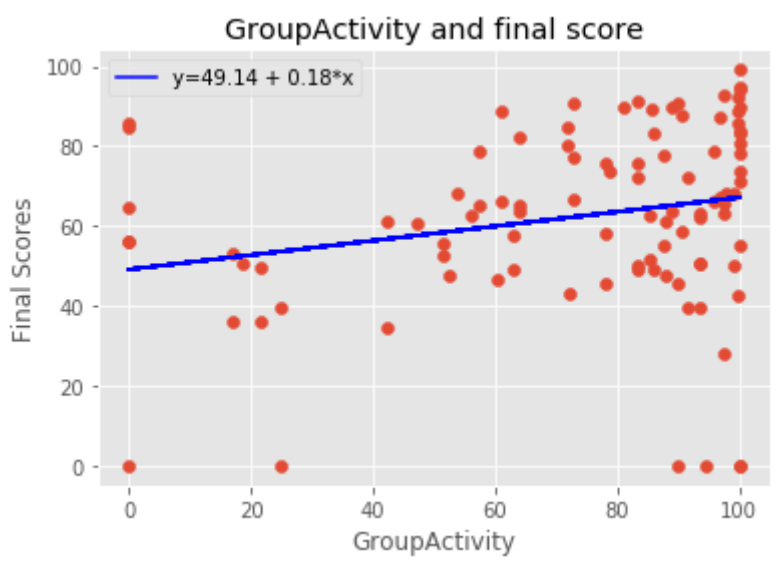
Out[15]: Text(0.5, 1.0, 'Linear Regression')



In [16]:
```
X = Replace_DataFrame[["GroupActivity"]]
y = Replace_DataFrame["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Group Activity VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.legend()
plt.show()

reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.title("GroupActivity and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```







Out[16]:

	Actual	Predicted
0	52.50	58.426873
1	68.33	67.009084
2	48.89	60.531399
3	80.56	67.176797
4	73.89	67.176797
...	...	...
95	39.72	66.040677
96	87.78	65.506881
97	85.56	67.142533
98	77.22	62.268039
99	50.83	66.040677

99 rows × 2 columns

Method 2A - forward fill imputation

- In method two - forward fill imputation, we're filling our NaN value by propagated last valid entry from respective columns Tests, coursera and group activity.
- NOTE: For the very 1st row, NaN values remains unchange.

In [17]:
```
ForwardFill_DataFrame[ForwardFill_DataFrame.notnull()]
```

Out[17]:

	Sem_enrolled	Tests	Coursera	GroupActivity	Final
0	5	95.05	34.09	51.48	52.50
1	1	83.70	100.00	99.07	68.33
2	1	81.22	83.17	63.15	48.89
3	2	91.32	96.06	100.00	80.56
4	1	95.00	93.64	100.00	73.89
...	...	...	...	...	...
95	2	89.94	80.54	93.70	39.72
96	1	95.60	100.00	90.74	87.78
97	2	63.40	76.13	99.81	85.56
98	1	75.35	97.37	72.78	77.22
99	5	75.35	63.39	93.70	50.83

99 rows × 5 columns

In [18]:
```
style.use("ggplot")

# Import dataset with student's data
data = ForwardFill_DataFrame

# Select the value we want to predict
predict = "Final"

# List the variables we want to use for our predictions in this model
data = data[[ 'Tests','Coursera','GroupActivity','Final']]
data = shuffle(data)

x = np.array(data.drop([predict], 1))
y = np.array(data[predict])

x_train, x_test, y_train, y_test = sklearn.model_selection.train_test_split(x, y, test_size = 0.1)

# Train model multiple times to find the highest accuracy
best = 0
for _ in range(10):
    x_train, x_test, y_train, y_test = sklearn.model_selection.train_test_split(x, y, test_size = 0.1)

    linear = linear_model.LinearRegression()

    linear.fit(x_train, y_train)
    acc = linear.score(x_test, y_test)
    print("Accuracy: " + str(acc))

    # Save the highest accuracy
    if (acc > best):
        best = acc
        with open("studentgrades.pickle", "wb") as f:
            pickle.dump(linear, f)
print("Highest Accuracy:", best)

# Load model
pickle_in = open("studentgrades.pickle", "rb")
linear = pickle.load(pickle_in)

print("-------------------------")
print('Coefficient: \n', linear.coef_)
print('Intercept: \n', linear.intercept_)
print("-------------------------")

predictions = linear.predict(x_test)

# Print the predictions, the variables we used and the actual final grade
for x in range(len(predictions)):
   print("Predicted Final grade: ", predictions[x])
   print("Data:", x_test[x])
   print("Final grade:", y_test[x])
   print("")
```

```
Accuracy: -0.34328924654630777
Accuracy: 0.12180894057740321
Accuracy: -0.6526758225862714
Accuracy: 0.2800888934575929
Accuracy: 0.07136039449723242
Accuracy: 0.06072737905147774
Accuracy: -0.1458422859151316
Accuracy: 0.3003968607572872
Accuracy: 0.12199351728877195
Accuracy: -0.24286555657181652
Highest Accuracy: 0.3003968607572872
-------------------------
Coefficient:
 [-0.04395735  0.14703592  0.2506458 ]
Intercept:
 37.26760796451037
-------------------------
Predicted Final grade:  59.506667366833895
Data: [90.33 97.76 47.22]
Final grade: 60.56

Predicted Final grade:  70.98714585612828
Data: [ 68.95 100.    87.96]
Final grade: 47.78

Predicted Final grade:  61.313991421253924
Data: [91.32 86.67 61.11]
Final grade: 88.89

Predicted Final grade:  64.49006446943173
Data: [96.73 91.58 71.85]
Final grade: 85.0

Predicted Final grade:  66.76154067730636
```

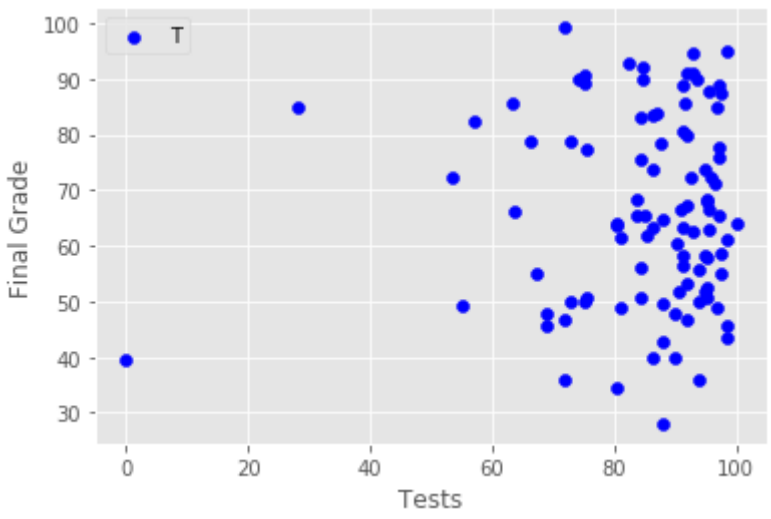
```
Data: [75.35 63.39 93.7 ]
Final grade: 50.83

Predicted Final grade:  62.50943948908162
Data: [91.62 94.89 61.11]
Final grade: 85.56

Predicted Final grade:  70.95912073777785
Data: [83.7  88.11 97.41]
Final grade: 65.56

Predicted Final grade:  56.780431763088465
Data: [89.89 70.24 52.41]
Final grade: 47.78

Predicted Final grade:  69.7768994516326
Data: [93.59 97.55 88.89]
Final grade: 90.0

Predicted Final grade:  71.81332964080937
Data: [ 95.6  100.    95.93]
Final grade: 66.39
```

Final Interpretation of Method 2A

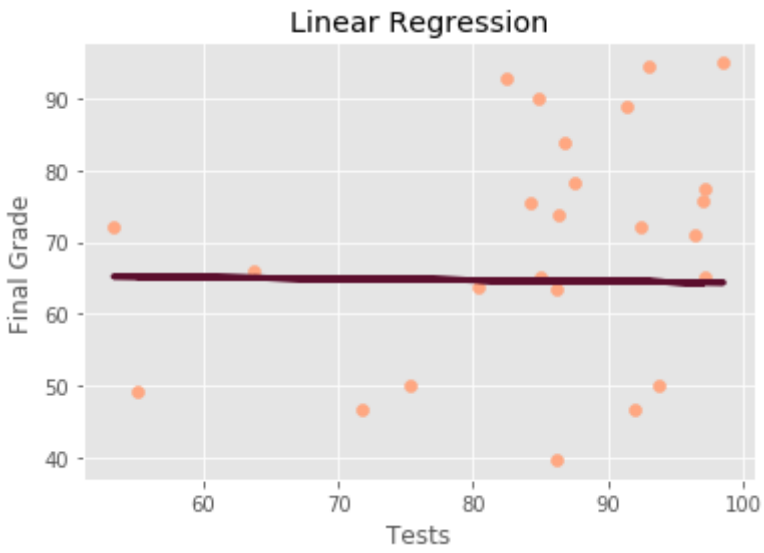
TESTS

In [19]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = ForwardFill_DataFrame[['Tests']]
y = ForwardFill_DataFrame["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "Tests"
plt.scatter(data[plot], data["Final"],color="blue")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('Tests')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

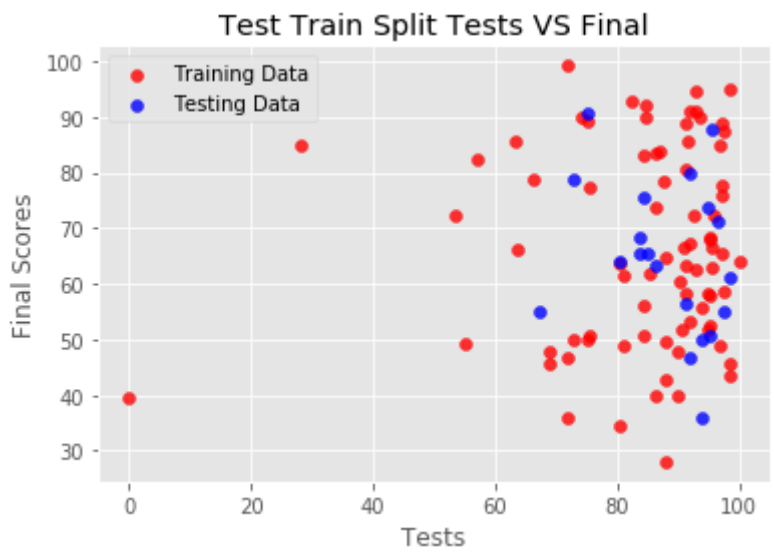
```
The Mean square error is:  281.90008865669114
R squared value is  -0.12009596257898103
```

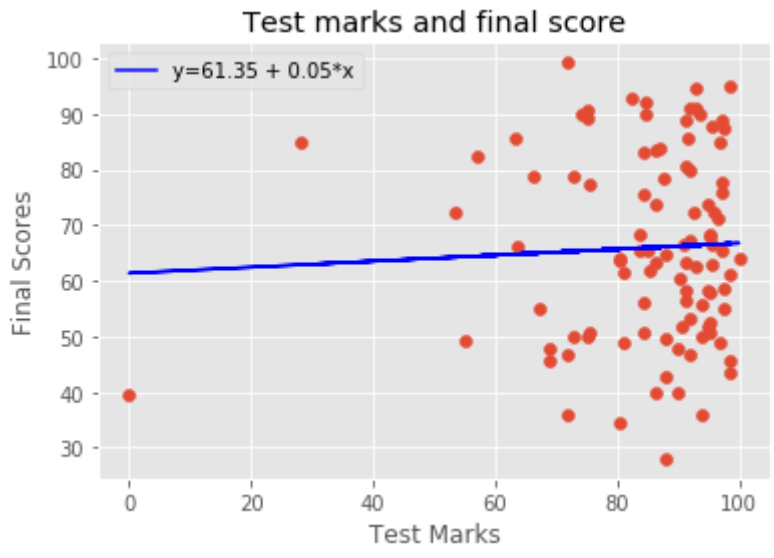


Out[19]: Text(0.5, 1.0, 'Linear Regression')



In [20]:
```
X = ForwardFill_DataFrame[["Tests"]]
y = ForwardFill_DataFrame["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("Tests")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Tests VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Tests Marks")
plt.ylabel("Final Scores")
plt.legend()
plt.show()

reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("Test Marks")
plt.ylabel("Final Scores")
plt.title("Test marks and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```





Out[20]:

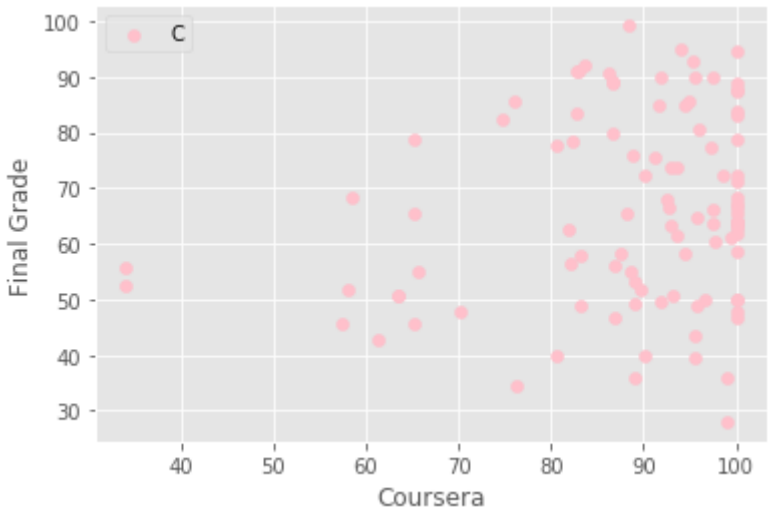
	Actual	Predicted
0	52.50	66.491673
1	68.33	65.877831
2	48.89	65.743706
3	80.56	66.289944
4	73.89	66.488969
...	...	...
95	39.72	66.215309
96	87.78	66.521419
97	85.56	64.779946
98	77.22	65.426238
99	50.83	65.426238

99 rows × 2 columns

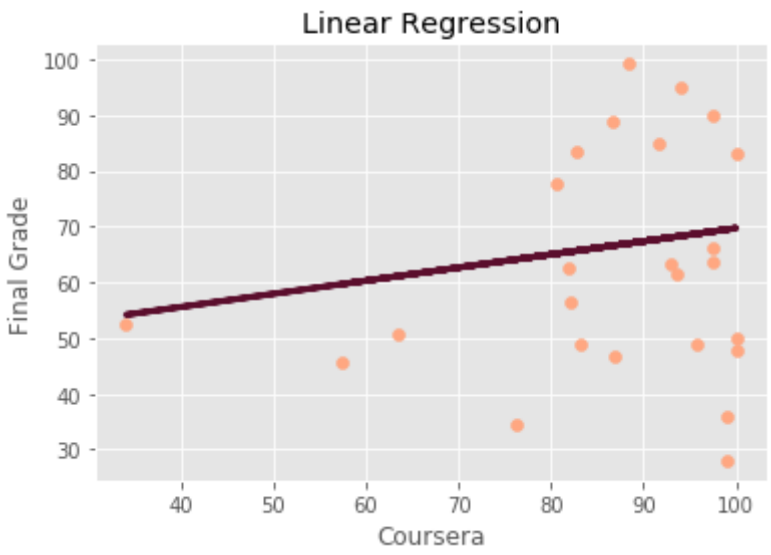
COURSERA

In [21]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error

X = ForwardFill_DataFrame[['Coursera']]
y = ForwardFill_DataFrame["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "Coursera"
plt.scatter(data[plot], data["Final"],color="pink")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('Coursera')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

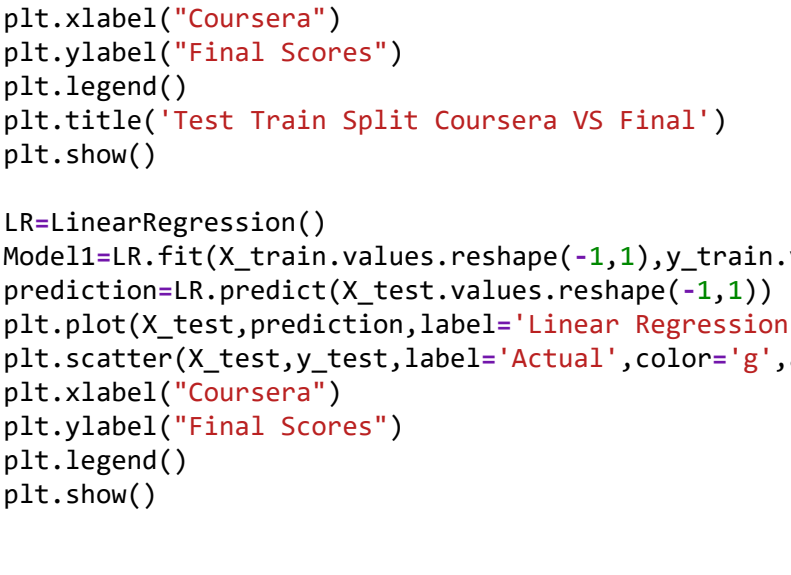
```
The Mean square error is:  391.3942981829368
R squared value is  -0.01064632084789463
```

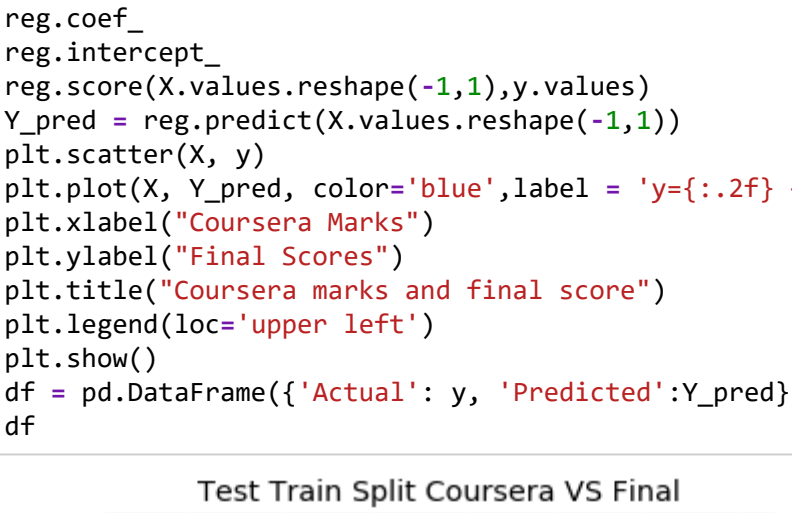


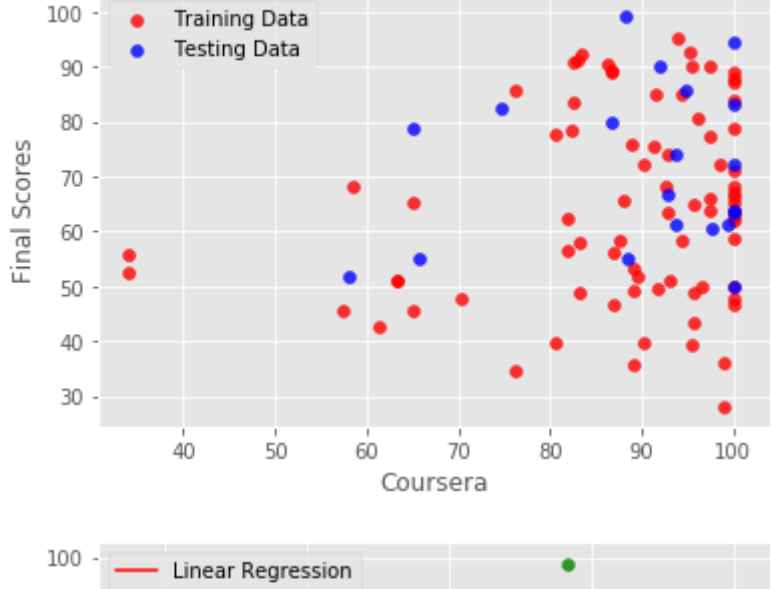
Out[21]: Text(0.5, 1.0, 'Linear Regression')



In [22]:
```
X = ForwardFill_DataFrame[["Coursera"]]
y = ForwardFill_DataFrame["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("Coursera")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Coursera VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Coursera")
plt.ylabel("Final Scores")
plt.legend()
plt.show()


reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("Coursera Marks")
plt.ylabel("Final Scores")
plt.title("Coursera marks and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```







Out[22]:

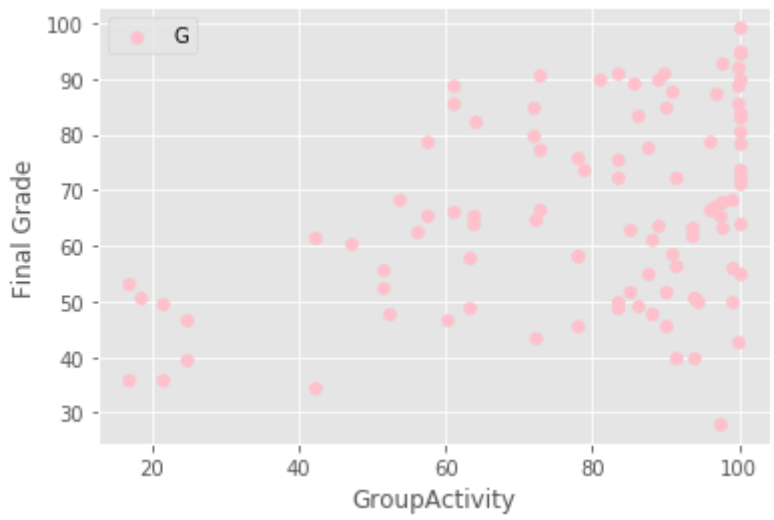
	Actual	Predicted
0	52.50	52.941327
1	68.33	68.770304
2	48.89	64.728403
3	80.56	67.824072
4	73.89	67.242883
...	...	...
95	39.72	64.096781
96	87.78	68.770304
97	85.56	63.037673
98	77.22	68.138682
99	50.83	59.978029

99 rows × 2 columns

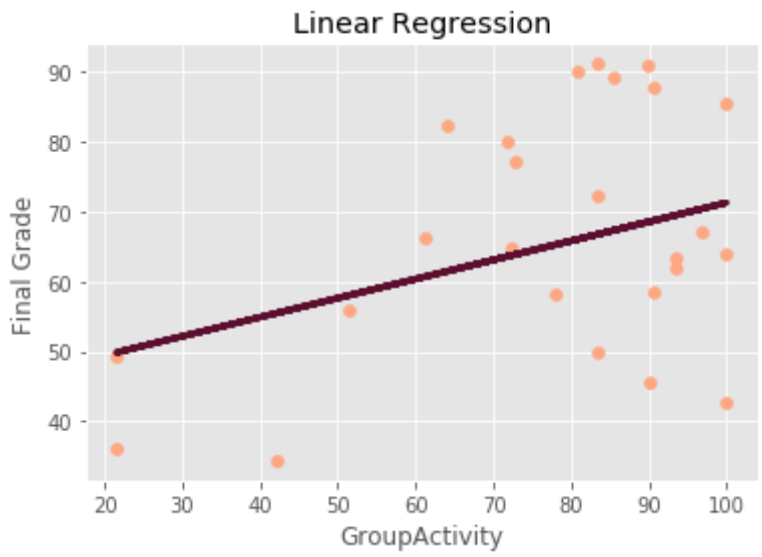
GROUP ACTIVITY

In [23]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = ForwardFill_DataFrame[['GroupActivity']]
y = ForwardFill_DataFrame["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "GroupActivity"
plt.scatter(data[plot], data["Final"],color="pink")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('GroupActivity')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

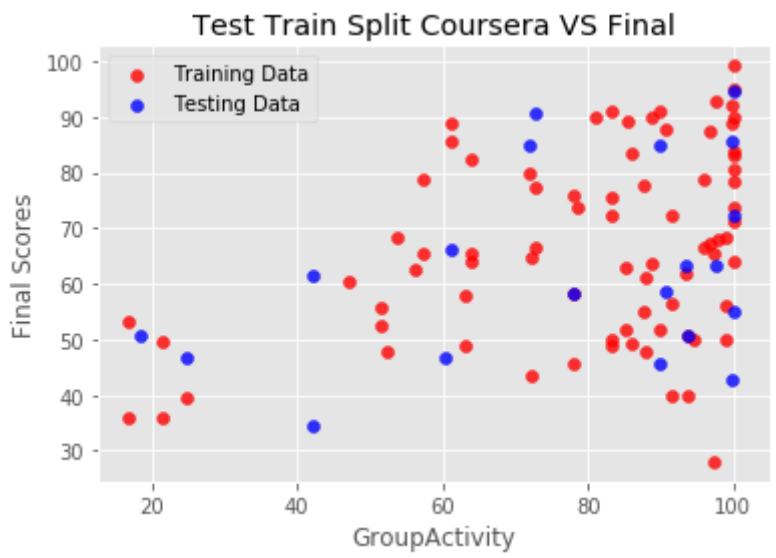
```
The Mean square error is:  248.6646873887786
R squared value is  0.1663284707405156
```

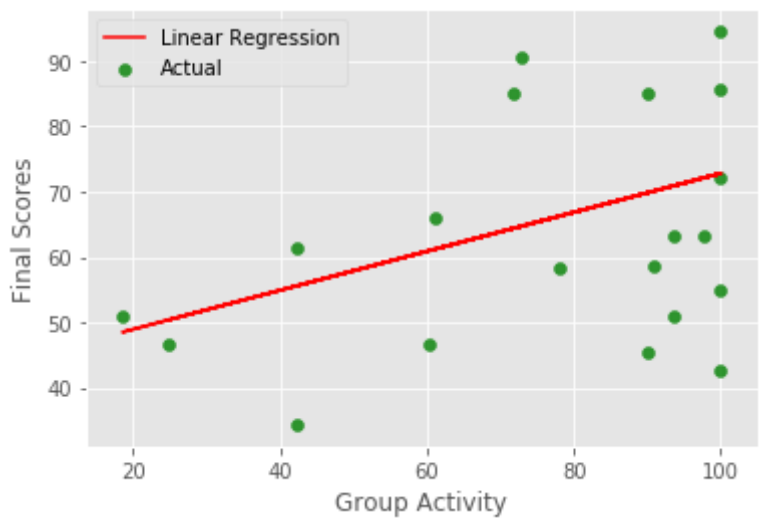


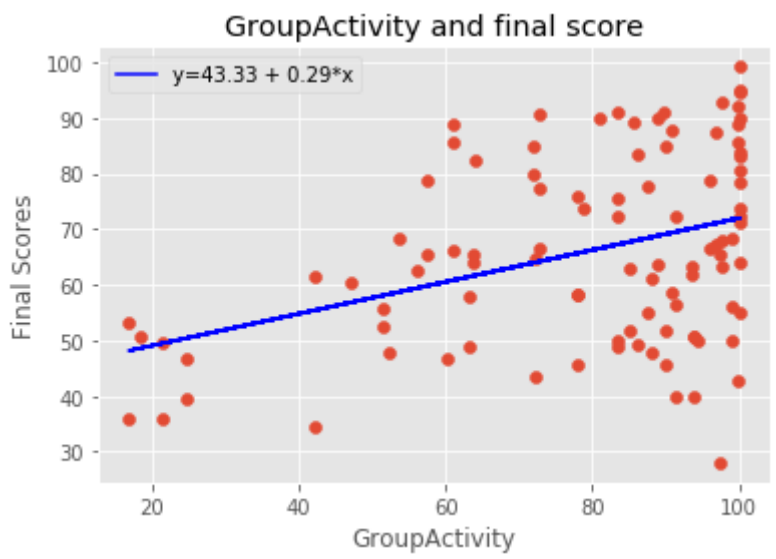
Out[23]: Text(0.5, 1.0, 'Linear Regression')



In [24]:
```
X = ForwardFill_DataFrame[["GroupActivity"]]
y = ForwardFill_DataFrame["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Coursera VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Group Activity")
plt.ylabel("Final Scores")
plt.legend()
plt.show()

reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.title("GroupActivity and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```







Out[24]:

	Actual	Predicted
0	52.50	58.074958
1	68.33	71.709155
2	48.89	61.418330
3	80.56	71.975594
4	73.89	71.975594
...	...	...
95	39.72	70.170688
96	87.78	69.322669
97	85.56	71.921160
98	77.22	64.177257
99	50.83	70.170688

99 rows × 2 columns

Method 2B - backward fill imputation

- In method three - backward fill imputation, we're filling our NaN value by propagated next valid entry from respective columns Tests, coursera and group activity.
- NOTE:

```
- For the last row, NaN values remains unchange.
- In order to handle that, we're using the convenience methods,
      -> dropna() (which removes NA values)
```

In [25]:
```
BackwardFill_DataFrame[BackwardFill_DataFrame.notnull()]
```

Out[25]:

	Sem_enrolled	Tests	Coursera	GroupActivity	Final
0	5	95.05	34.09	51.48	52.50
1	1	83.70	100.00	99.07	68.33
2	1	81.22	83.17	63.15	48.89
3	2	91.32	96.06	100.00	80.56
4	1	95.00	93.64	100.00	73.89
...	...	...	...	...	...
95	2	89.94	80.54	93.70	39.72
96	1	95.60	100.00	90.74	87.78
97	2	63.40	76.13	99.81	85.56
98	1	75.35	97.37	72.78	77.22
99	5	NaN	63.39	93.70	50.83

99 rows × 5 columns

In [26]:
```
# calculating correlation
BackwardFill_DataFrame = BackwardFill_DataFrame.dropna()
```

In [27]:
```
style.use("ggplot")

# Import dataset with student's data
data = BackwardFill_DataFrame

# Select the value we want to predict
predict = "Final"

# List the variables we want to use for our predictions in this model
data = data[[ 'Tests','Coursera','GroupActivity','Final']]
data = shuffle(data)

x = np.array(data.drop([predict], 1))
y = np.array(data[predict])

x_train, x_test, y_train, y_test = sklearn.model_selection.train_test_split(x, y, test_size = 0.1)

# Train model multiple times to find the highest accuracy
best = 0
for _ in range(50):
    x_train, x_test, y_train, y_test = sklearn.model_selection.train_test_split(x, y, test_size = 0.1)

    linear = linear_model.LinearRegression()

    linear.fit(x_train, y_train)
    acc = linear.score(x_test, y_test)
    print("Accuracy: " + str(acc))

    # Save the highest accuracy
    if (acc > best):
        best = acc
        with open("studentgrades.pickle", "wb") as f:
            pickle.dump(linear, f)
print("Highest Accuracy:", best/2)

# Load model
pickle_in = open("studentgrades.pickle", "rb")
linear = pickle.load(pickle_in)

print("-------------------------")
print('Coefficient: \n', linear.coef_)
print('Intercept: \n', linear.intercept_)
print("-------------------------")

predictions = linear.predict(x_test)

# Print the predictions, the variables we used and the actual final grade
for x in range(len(predictions)):
   print("Predicted Final grade: ", predictions[x])
   print("Data:", x_test[x])
   print("Final grade:", y_test[x])
   print("")
```

```
Accuracy: -0.1266368691011297
Accuracy: -0.2751628671870958
Accuracy: 0.17958398904099349
Accuracy: 0.06829264054238082
Accuracy: -0.002547601431938107
Accuracy: 0.062455694232286585
Accuracy: -0.006700355213627773
Accuracy: 0.15483487506388083
Accuracy: 0.3692663973669711
Accuracy: -0.22693086491992798
Accuracy: 0.27757113131986577
Accuracy: -0.4584687784955308
Accuracy: -0.025750351127683535
Accuracy: 0.1667038434769047
Accuracy: -1.5433501496472037
Accuracy: 0.15953401100484166
Accuracy: -0.3562913101011487
Accuracy: -0.024465060116457993
Accuracy: -0.21120472229598963
Accuracy: 0.1636743764902815
Accuracy: -0.04034440350607249
Accuracy: -0.2899427536178538
Accuracy: 0.16134207549378843
Accuracy: -0.011233674824955298
Accuracy: -0.580013243107377
Accuracy: 0.04037823653755568
Accuracy: 0.06666392653649256
Accuracy: 0.00271305126933552
Accuracy: 0.09278924446814074
Accuracy: 0.02907844644062363
Accuracy: 0.31746043454531636
Accuracy: 0.09776555208028537
Accuracy: 0.39302386020024793
```

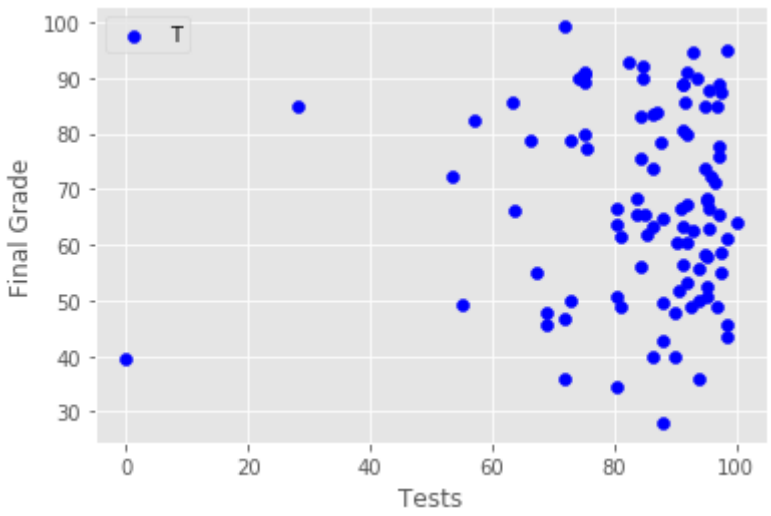
```
Accuracy: -0.13631479190848883
Accuracy: -0.1557694870806785
Accuracy: -0.23426226921319326
Accuracy: 0.09944634194468993
Accuracy: 0.021159535808465524
Accuracy: -0.016950091144520174
Accuracy: 0.2545848753399669
Accuracy: 0.2010734011379508
Accuracy: 0.057897591587885655
Accuracy: 0.2557490367609423
Accuracy: -0.11891452028627136
Accuracy: -0.47331153580577223
Accuracy: -0.544810788999063
Accuracy: 0.2975706542800346
Accuracy: 0.21619723637432853
Accuracy: 0.2578580161288927
Accuracy: 0.3712384456344463
Highest Accuracy: 0.19651193010012397
-------------------------
Coefficient:
 [-0.03461221  0.16040037  0.26522438]
Intercept:
 35.30031514765864
-------------------------
Predicted Final grade:  71.21973023563231
Data: [91.62 94.89 90.  ]
Final grade: 85.56

Predicted Final grade:  74.07002615277013
Data: [ 91.32  96.06 100.  ]
Final grade: 80.56

Predicted Final grade:  52.68869070585791
Data: [87.93 91.78 21.53]
Final grade: 49.44

Predicted Final grade:  62.578530195190154
Data: [81.22 83.17 63.15]
Final grade: 48.89

Predicted Final grade:  74.94636582004244
Data: [ 84.26 100.   100.  ]
Final grade: 83.06

Predicted Final grade:  51.22661828840376
Data: [84.26 86.85 18.52]
Final grade: 56.11

Predicted Final grade:  62.29099146041196
Data: [57.14 74.66 64.07]
Final grade: 82.22

Predicted Final grade:  54.72494482907412
Data: [ 92.02 100.    24.77]
Final grade: 60.56

Predicted Final grade:  74.64350898684073
Data: [ 93.01 100.   100.  ]
Final grade: 94.44

Predicted Final grade:  74.49303745600203
Data: [ 66.17 100.    95.93]
Final grade: 78.89
```

Final Interpretation of Method 2B

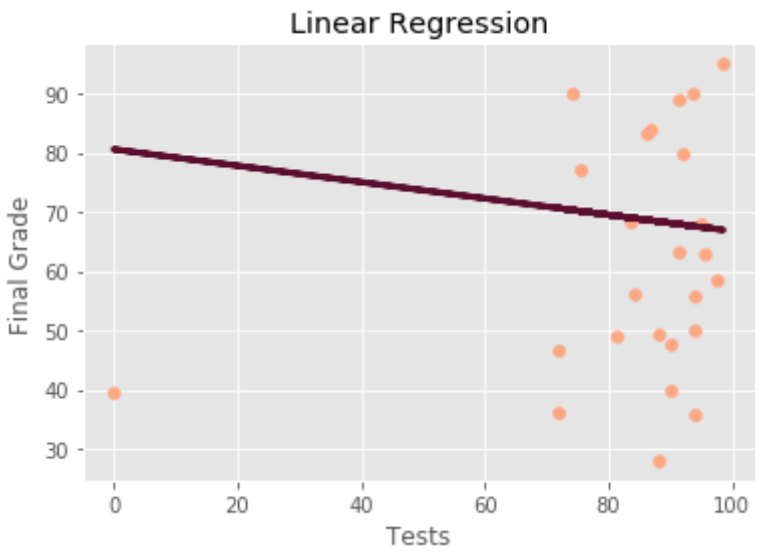
TESTS

In [28]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = BackwardFill_DataFrame[['Tests']]
y = BackwardFill_DataFrame["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "Tests"
plt.scatter(data[plot], data["Final"],color="blue")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('Tests')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

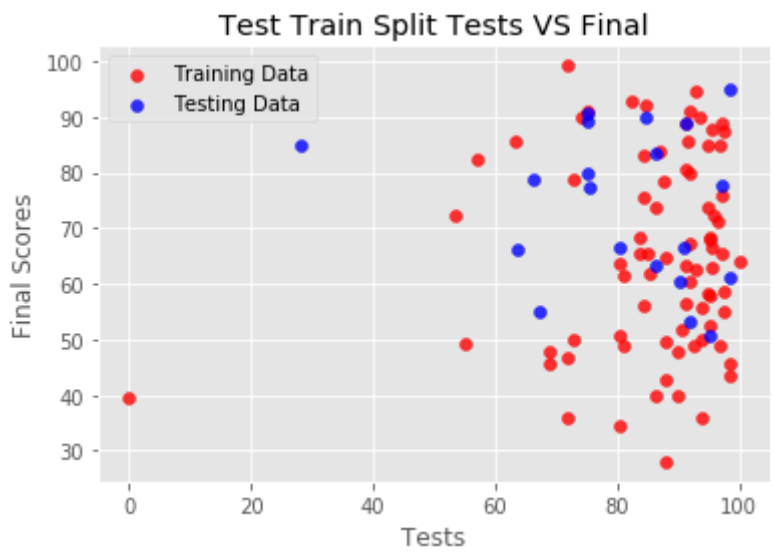
```
The Mean square error is:  463.4909992340656
R squared value is  -0.22554687459059242
```

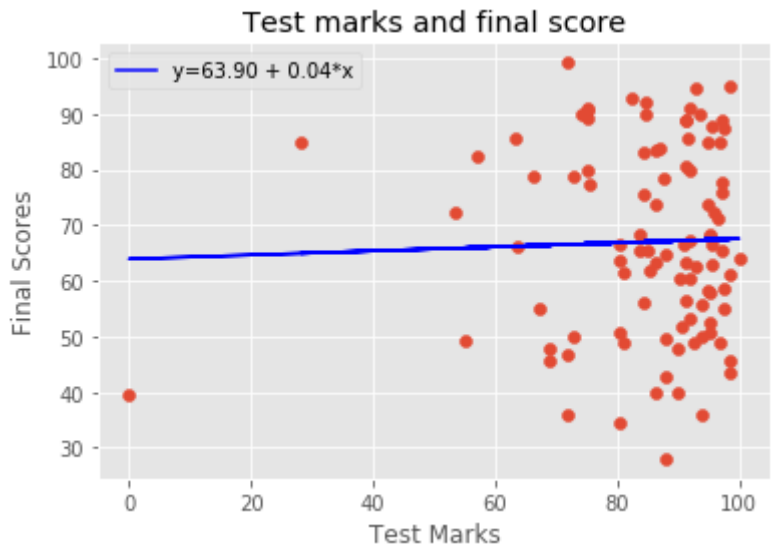


Out[28]: Text(0.5, 1.0, 'Linear Regression')



In [29]:
```
X = BackwardFill_DataFrame[["Tests"]]
y = BackwardFill_DataFrame["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("Tests")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Tests VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Tests Marks")
plt.ylabel("Final Scores")
plt.legend()
plt.show()

reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("Test Marks")
plt.ylabel("Final Scores")
plt.title("Test marks and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```





Out[29]:

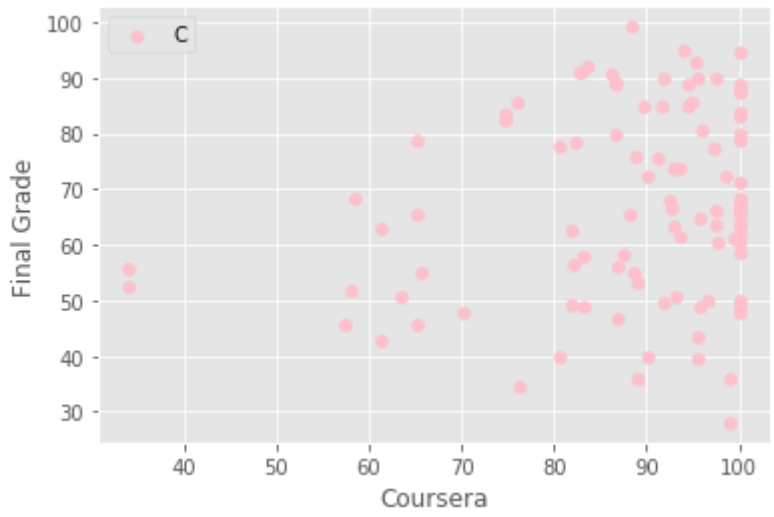
	Actual	Predicted
0	52.50	67.363851
1	68.33	66.950592
2	48.89	66.860293
3	80.56	67.228040
4	73.89	67.362030
...	...	...
94	61.94	67.010305
95	39.72	67.177793
96	87.78	67.383876
97	85.56	66.211458
98	77.22	66.646564

98 rows × 2 columns

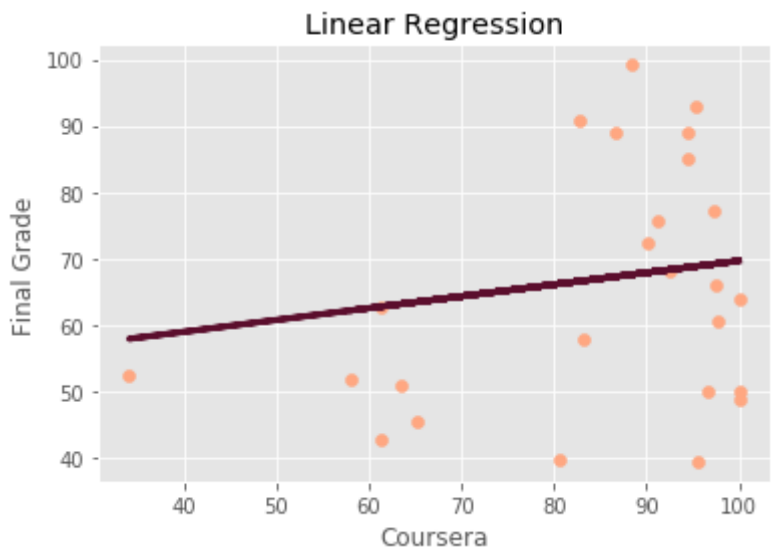
COURSERA

In [30]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = BackwardFill_DataFrame[['Coursera']]
y = BackwardFill_DataFrame["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "Coursera"
plt.scatter(data[plot], data["Final"],color="pink")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('Coursera')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

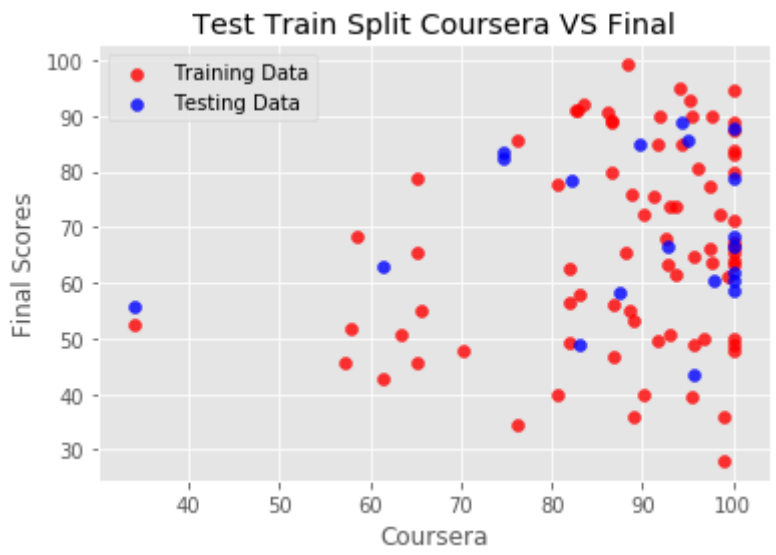
```
The Mean square error is:  295.90703678758274
R squared value is  0.07032065623392103
```

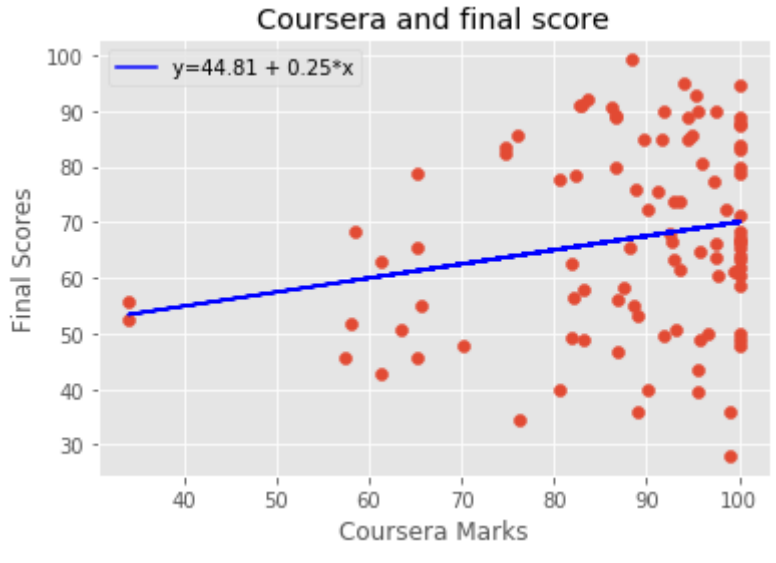


Out[30]: Text(0.5, 1.0, 'Linear Regression')



In [31]:
```
X = BackwardFill_DataFrame[["Coursera"]]
y = BackwardFill_DataFrame["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("Coursera")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Coursera VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Coursera")
plt.ylabel("Final Scores")
plt.legend()
plt.show()


reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("Coursera Marks")
plt.ylabel("Final Scores")
plt.title("Coursera and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```





Out[31]:

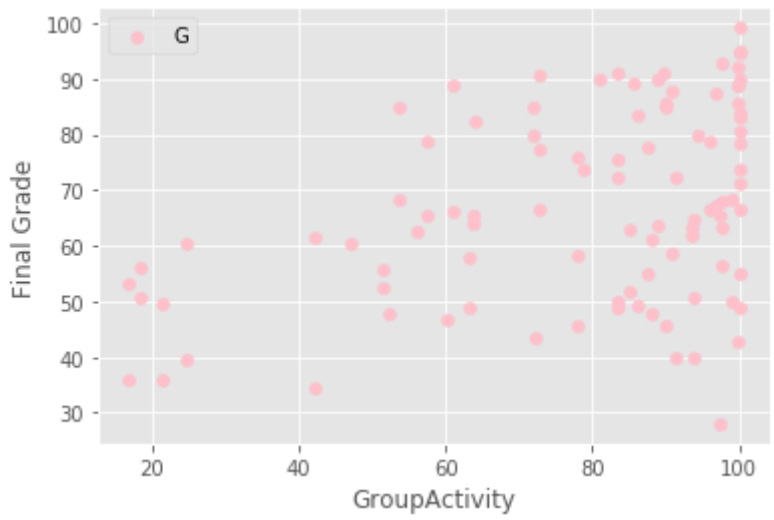
	Actual	Predicted
0	52.50	53.405633
1	68.33	70.031130
2	48.89	65.785839
3	80.56	69.037283
4	73.89	68.426849
...	...	...
94	61.94	70.031130
95	39.72	65.122433
96	87.78	70.031130
97	85.56	64.010031
98	77.22	69.367724

98 rows × 2 columns

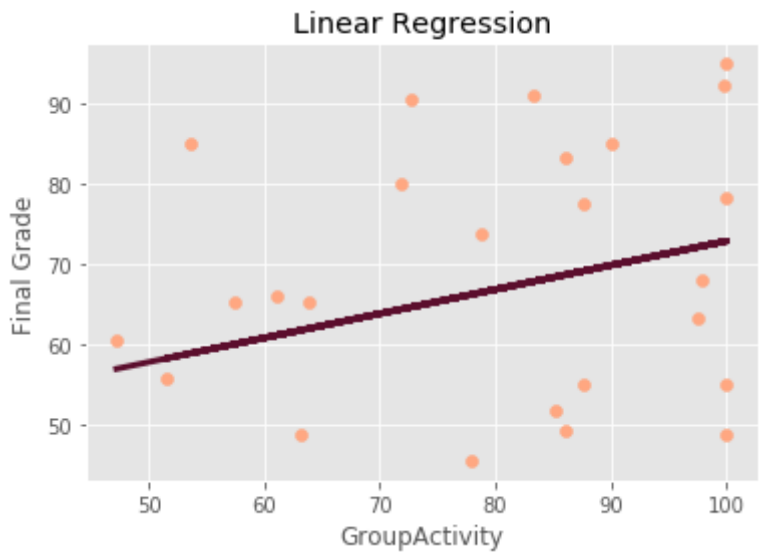
GROUP ACTIVITY

In [32]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = BackwardFill_DataFrame[['GroupActivity']]
y = BackwardFill_DataFrame["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "GroupActivity"
plt.scatter(data[plot], data["Final"],color="pink")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('GroupActivity')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

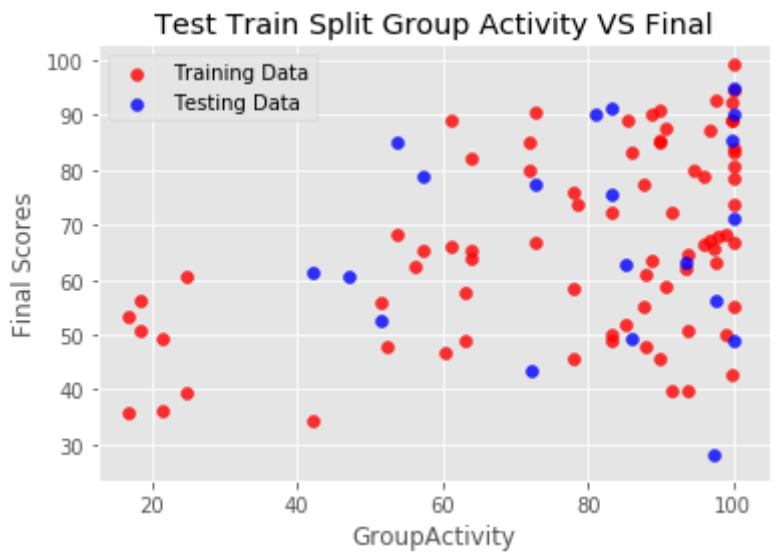
```
The Mean square error is:  244.92910012714063
R squared value is  -0.02975320332707021
```

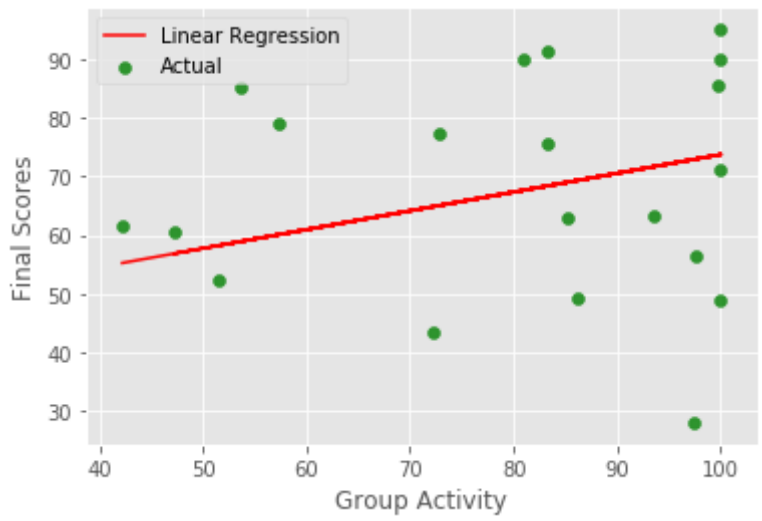


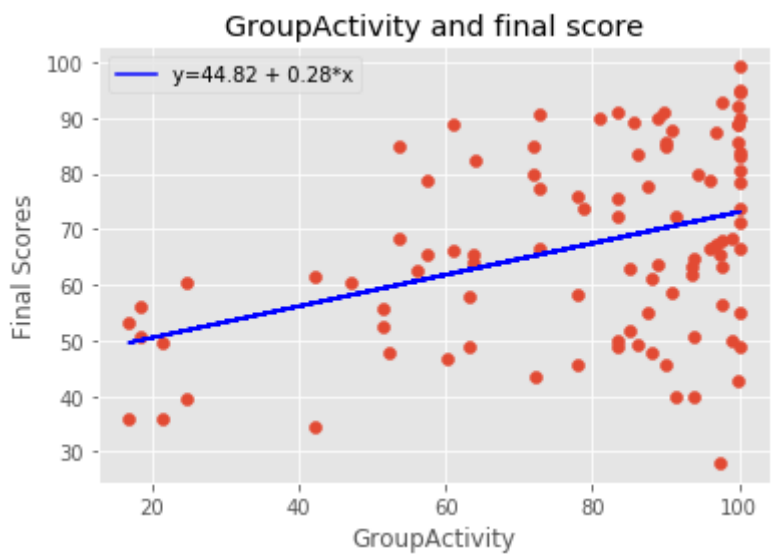
Out[32]: Text(0.5, 1.0, 'Linear Regression')



In [33]:
```
X = BackwardFill_DataFrame[["GroupActivity"]]
y = BackwardFill_DataFrame["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Group Activity VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Group Activity")
plt.ylabel("Final Scores")
plt.legend()
plt.show()

reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.title("GroupActivity and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```







Out[33]:

	Actual	Predicted
0	52.50	59.376225
1	68.33	72.831703
2	48.89	62.675772
3	80.56	73.094649
4	73.89	73.094649
...	...	...
94	61.94	71.262510
95	39.72	71.313402
96	87.78	70.476499
97	85.56	73.040929
98	77.22	65.398534

98 rows × 2 columns

Method 3 - KNN sklearn

In [34]:
```
import sklearn
from sklearn.impute import SimpleImputer

imputer = SimpleImputer(missing_values=np.nan, strategy='mean')
sklearn_Data = imputer.fit_transform(AcademicScoreDataset)
sklearn_DataFrame = pd.DataFrame(sklearn_Data, columns = ['Sem_enrolled','Tests','Coursera','GroupActivity','Final'])
sklearn_DataFrame
```

Out[34]:

	Sem_enrolled	Tests	Coursera	GroupActivity	Final
0	5.0	95.050000	34.09	51.48	52.50
1	1.0	83.700000	100.00	99.07	68.33
2	1.0	81.220000	83.17	63.15	48.89
3	2.0	91.320000	96.06	100.00	80.56
4	1.0	95.000000	93.64	100.00	73.89
...	...	...	...	...	...
94	2.0	89.940000	80.54	93.70	39.72
95	1.0	95.600000	100.00	90.74	87.78
96	2.0	63.400000	76.13	99.81	85.56
97	1.0	75.350000	97.37	72.78	77.22
98	5.0	85.081146	63.39	93.70	50.83

99 rows × 5 columns

In [35]:
```
style.use("ggplot")

# Import dataset with student's data
data = sklearn_DataFrame

# Select the value we want to predict
predict = "Final"

# List the variables we want to use for our predictions in this model
data = data[[ 'Tests','Coursera','GroupActivity','Final']]
data = shuffle(data)

x = np.array(data.drop([predict], 1))
y = np.array(data[predict])

x_train, x_test, y_train, y_test = sklearn.model_selection.train_test_split(x, y, test_size = 0.1)

# Train model multiple times to find the highest accuracy
best = 0
for _ in range(10):
    x_train, x_test, y_train, y_test = sklearn.model_selection.train_test_split(x, y, test_size = 0.1)

    linear = linear_model.LinearRegression()

    linear.fit(x_train, y_train)
    acc = linear.score(x_test, y_test)
    print("Accuracy: " + str(acc))

    # Save the highest accuracy
    if (acc > best):
        best = acc
        with open("studentgrades.pickle", "wb") as f:
            pickle.dump(linear, f)
print("Highest Accuracy:", best)

# Load model
pickle_in = open("studentgrades.pickle", "rb")
linear = pickle.load(pickle_in)

print("-------------------------")
print('Coefficient: \n', linear.coef_)
print('Intercept: \n', linear.intercept_)
print("-------------------------")

predictions = linear.predict(x_test)

# Print the predictions, the variables we used and the actual final grade
for x in range(len(predictions)):
   print("Predicted Final grade: ", predictions[x])
   print("Data:", x_test[x])
   print("Final grade:", y_test[x])
   print("")
```

```
Accuracy: -0.6259646078727692
Accuracy: 0.006196324273112563
Accuracy: 0.049733756546105456
Accuracy: -0.5137057494880457
Accuracy: 0.3377942577631585
Accuracy: -0.20401729633383314
Accuracy: 0.002508683254307642
Accuracy: -0.01877301536513798
Accuracy: -0.3096551331775499
Accuracy: 0.057600871437630485
Highest Accuracy: 0.3377942577631585
-------------------------
Coefficient:
 [-0.01062128  0.1892344   0.24891728]
Intercept:
 31.233793091725204
-------------------------
Predicted Final grade:  72.52955655692926
Data: [ 85.34 100.    93.52]
Final grade: 61.94

Predicted Final grade:  55.3102579847112
Data: [80.44 76.21 42.22]
Final grade: 34.44

Predicted Final grade:  62.44519894648195
Data: [90.74 57.97 85.19]
Final grade: 51.67

Predicted Final grade:  64.8644261329282
Data: [75.27 86.21 72.78]
Final grade: 90.55

Predicted Final grade:  65.02859390823967
```

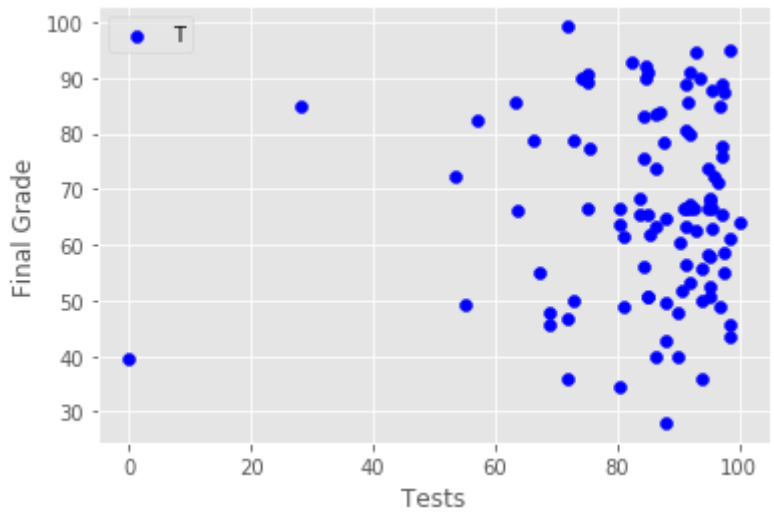
```
Data: [ 97.16 100.    63.89]
Final grade: 65.28

Predicted Final grade:  69.59140005865753
Data: [95.9  98.47 83.33]
Final grade: 72.22

Predicted Final grade:  65.54335770992638
Data: [95.05 63.39 93.7 ]
Final grade: 50.83

Predicted Final grade:  67.82631784295064
Data: [91.62       94.89       78.77795699]
Final grade: 85.56

Predicted Final grade:  64.92360020237915
Data: [98.58 65.18 90.  ]
Final grade: 45.56

Predicted Final grade:  72.46646612464181
Data: [ 91.28 100.    93.52]
Final grade: 63.33
```

Final Interpretation of Method 3

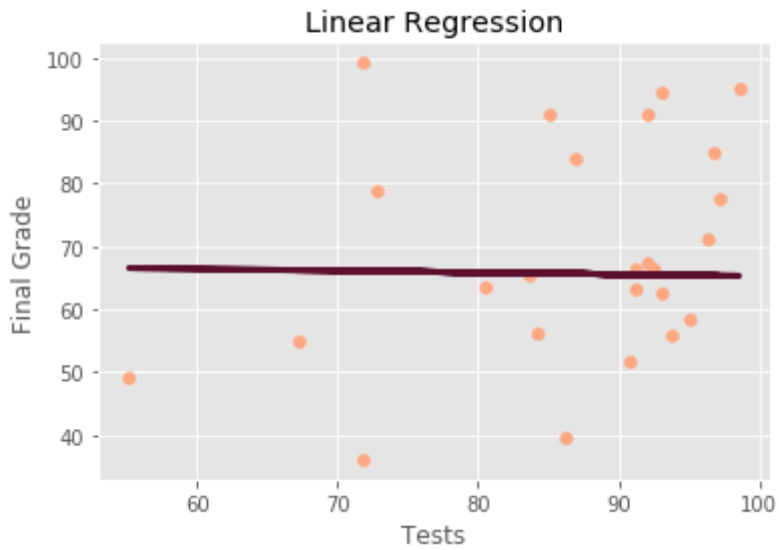
TESTS

In [36]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = sklearn_DataFrame [['Tests']]
y = sklearn_DataFrame ["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", -1*metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "Tests"
plt.scatter(data[plot], data["Final"],color="blue")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('Tests')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

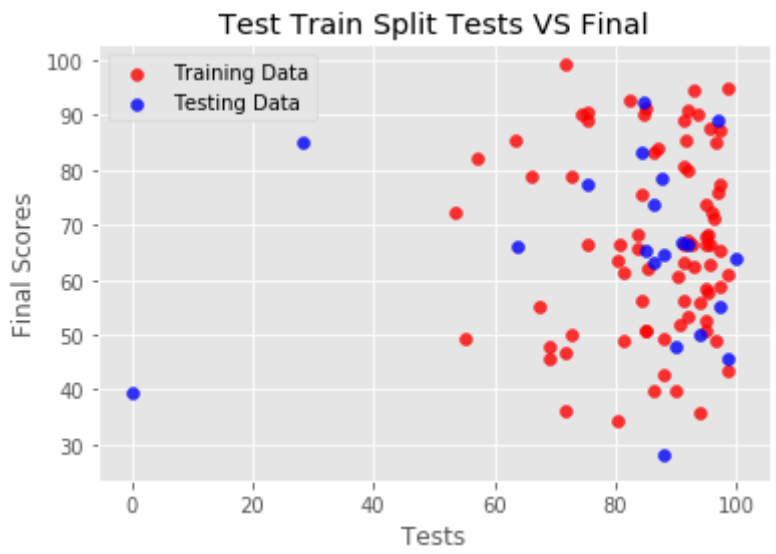
```
The Mean square error is:  304.7705788113988
R squared value is  0.048929197663077906
```

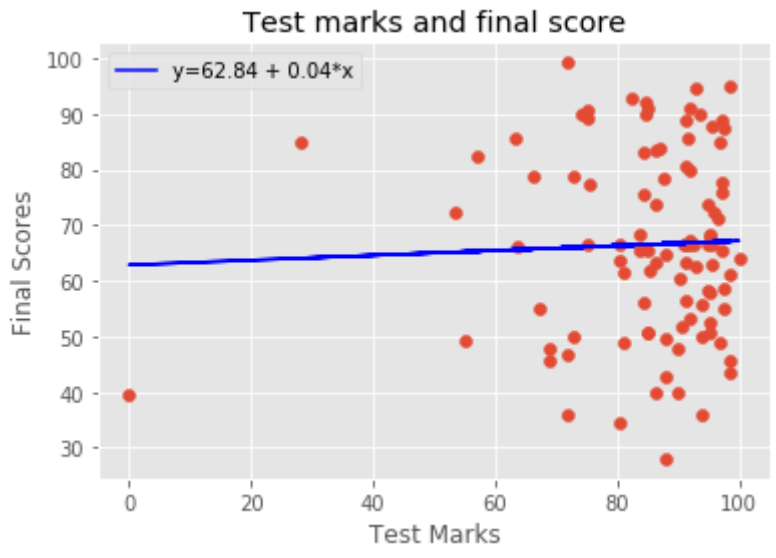


Out[36]: Text(0.5, 1.0, 'Linear Regression')



In [37]:
```
X = sklearn_DataFrame [["Tests"]]
y = sklearn_DataFrame ["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("Tests")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Tests VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Tests")
plt.ylabel("Final Scores")
plt.legend()
plt.show()

reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("Test Marks")
plt.ylabel("Final Scores")
plt.title("Test marks and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```





Out[37]:

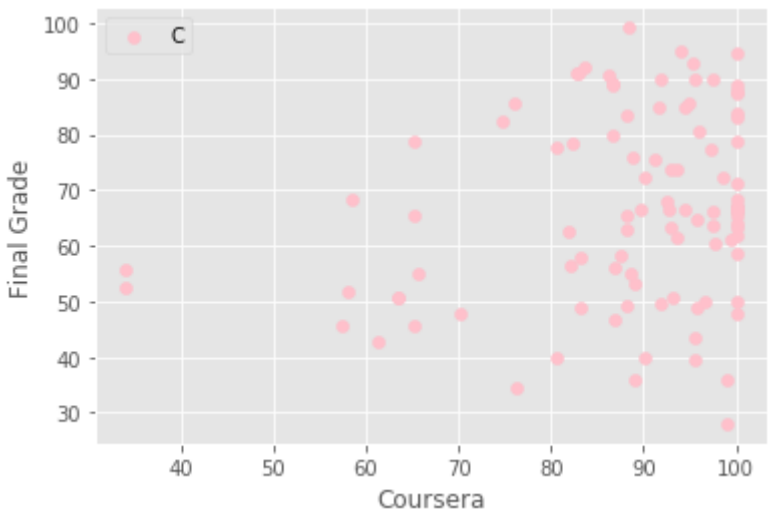
	Actual	Predicted
0	52.50	66.951942
1	68.33	66.460401
2	48.89	66.352998
3	80.56	66.790405
4	73.89	66.949776
...	...	...
94	39.72	66.730640
95	87.78	66.975761
96	85.56	65.581258
97	77.22	66.098783
98	50.83	66.520215

99 rows × 2 columns

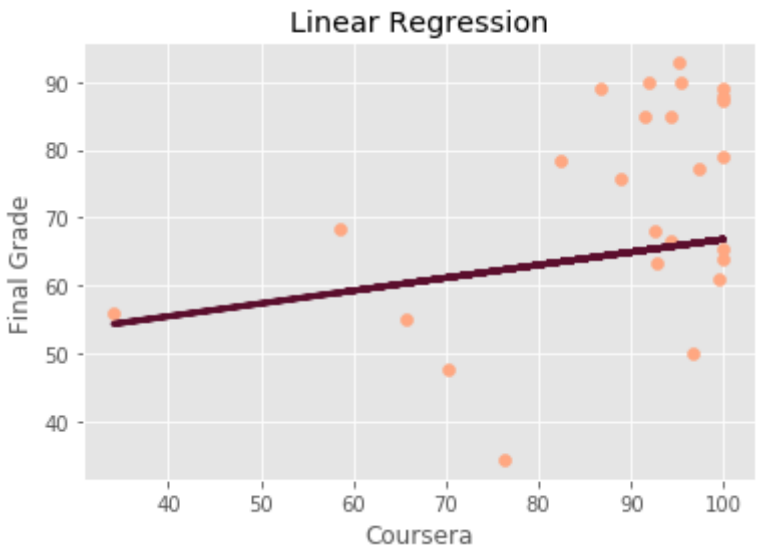
COURSERA

In [38]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = sklearn_DataFrame [['Coursera']]
y = sklearn_DataFrame ["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "Coursera"
plt.scatter(data[plot], data["Final"],color="pink")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('Coursera')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

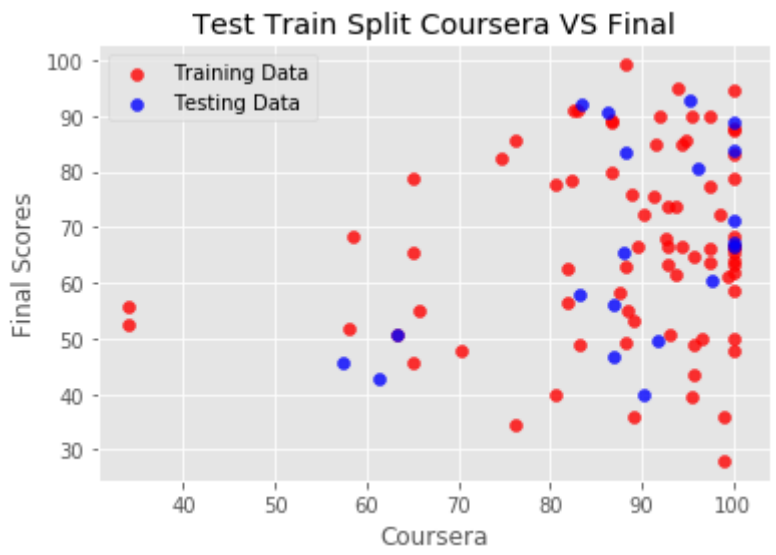
```
The Mean square error is:  265.2622818231509
R squared value is  -0.10484392988177471
```

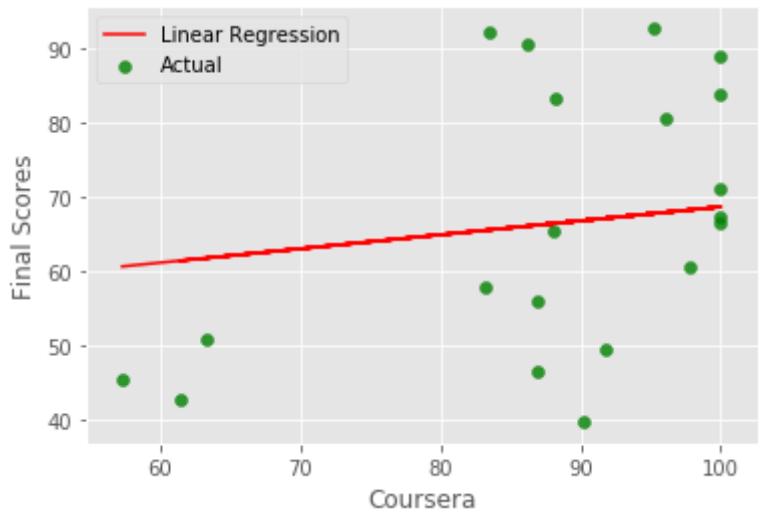


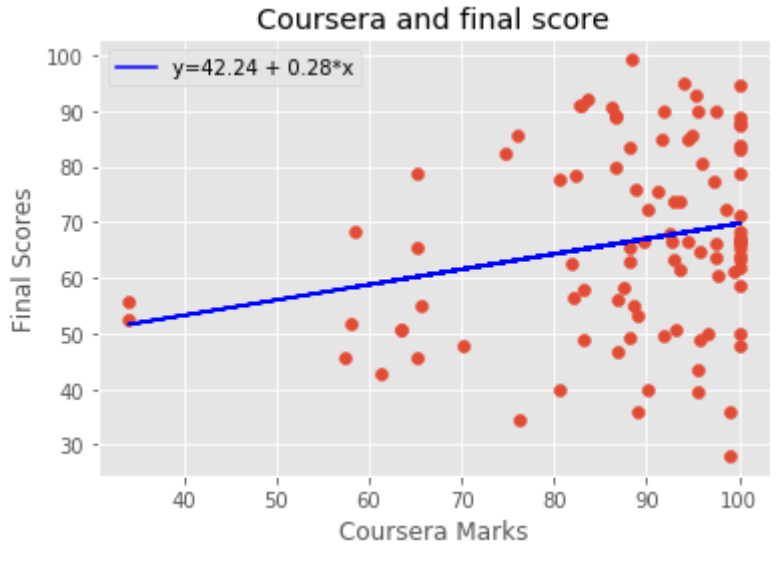
Out[38]: Text(0.5, 1.0, 'Linear Regression')



In [39]:
```
X = sklearn_DataFrame [["Coursera"]]
y =sklearn_DataFrame ["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("Coursera")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Coursera VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("Coursera")
plt.ylabel("Final Scores")
plt.legend()
plt.show()


reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("Coursera Marks")
plt.ylabel("Final Scores")
plt.title("Coursera and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```







Out[39]:

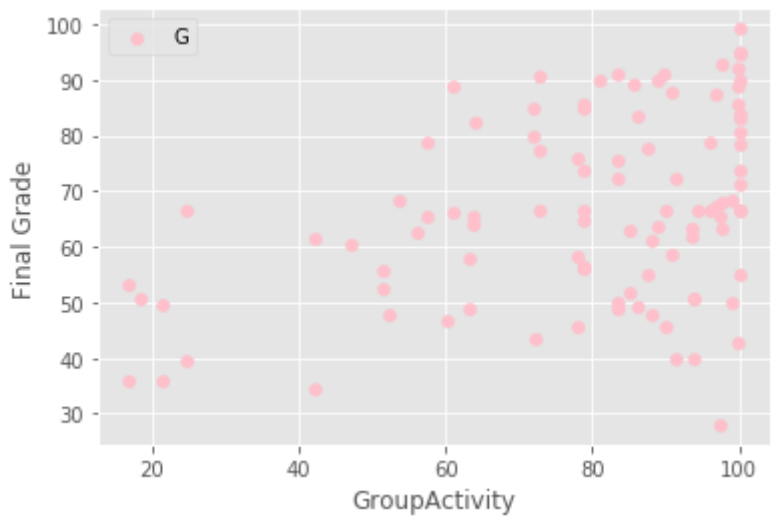
	Actual	Predicted
0	52.50	51.626970
1	68.33	69.771856
2	48.89	65.138592
3	80.56	68.687183
4	73.89	68.020962
...	...	...
94	39.72	64.414559
95	87.78	69.771856
96	85.56	63.200495
97	77.22	69.047823
98	50.83	59.693199

99 rows × 2 columns

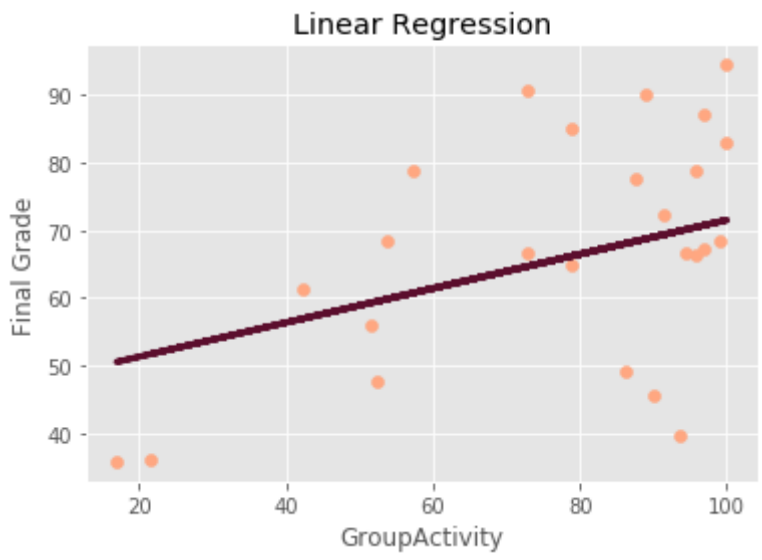
GROUP ACTIVITY

In [40]:
```
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import mean_squared_error
import math

X = sklearn_DataFrame [['GroupActivity']]
y = sklearn_DataFrame ["Final"]
train_X, val_X, train_y, val_y = train_test_split(X, y)
model = LinearRegression()
model.fit(train_X, train_y)
val_predictions = model.predict(val_X)
mse = mean_squared_error(val_y, val_predictions)
print("The Mean square error is: ",mse)
print("R squared value is ", metrics.r2_score(val_y,val_predictions))

# Create visualisation of the model
plot = "GroupActivity"
plt.scatter(data[plot], data["Final"],color="pink")
plt.legend(plot)
plt.xlabel(plot)
plt.ylabel("Final Grade")
plt.show()

plt.scatter(val_X, val_y, color="#FFA781")
plt.plot(val_X, val_predictions, color="#5B0E2D", linewidth=3)
plt.xlabel('GroupActivity')
plt.ylabel('Final Grade')
plt.title('Linear Regression')
```

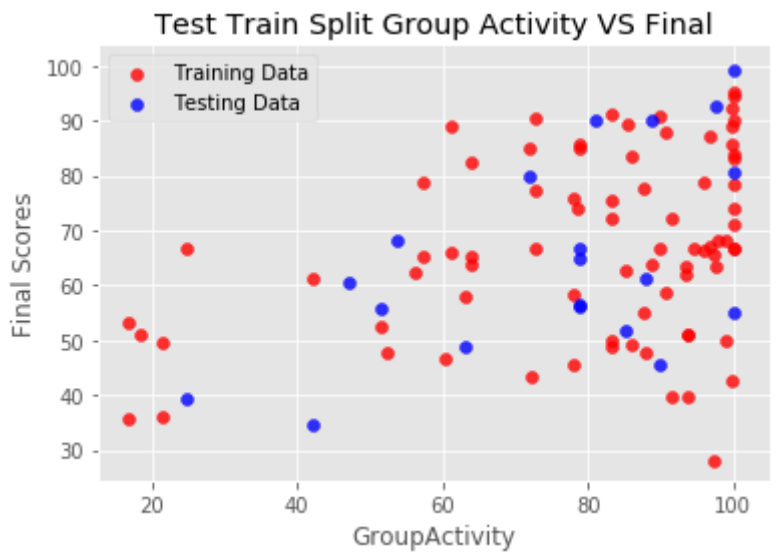
```
The Mean square error is:  219.02240496701842
R squared value is  0.24266517384488495
```

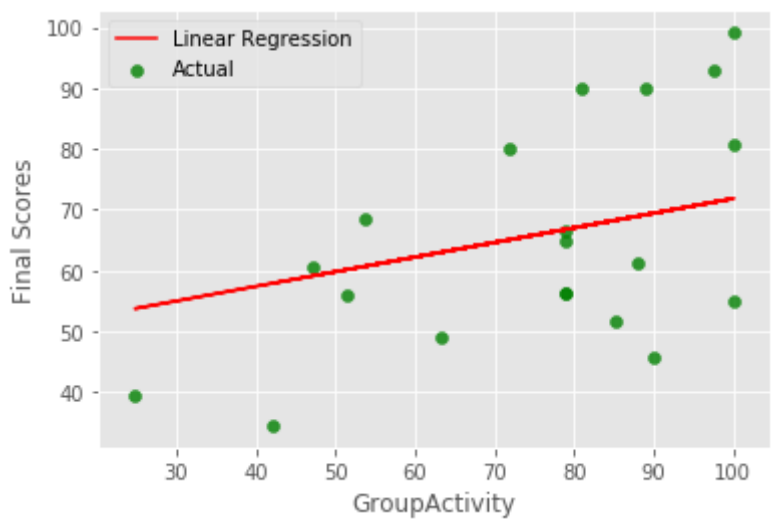


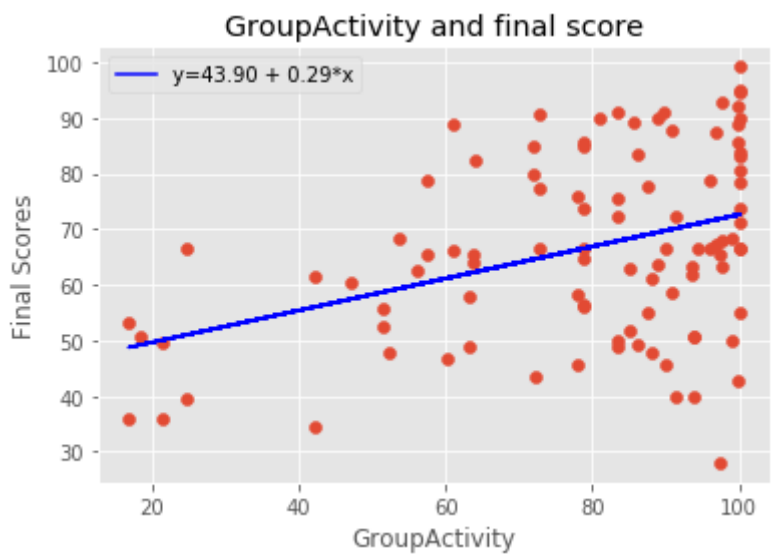
Out[40]: Text(0.5, 1.0, 'Linear Regression')



In [41]:
```
X = sklearn_DataFrame [["GroupActivity"]]
y = sklearn_DataFrame ["Final"]
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.2)
from matplotlib import pyplot as plt
plt.scatter(X_train,y_train,label='Training Data',color='r',alpha=0.8)
plt.scatter(X_test,y_test,label='Testing Data',color='b',alpha=0.8)
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.legend()
plt.title('Test Train Split Group Activity VS Final')
plt.show()

LR=LinearRegression()
Model1=LR.fit(X_train.values.reshape(-1,1),y_train.values)
prediction=LR.predict(X_test.values.reshape(-1,1))
plt.plot(X_test,prediction,label='Linear Regression',color='r')
plt.scatter(X_test,y_test,label='Actual',color='g',alpha=0.8)
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.legend()
plt.show()

reg=LR.fit(X.values.reshape(-1,1),y.values)
reg.coef_
reg.intercept_
reg.score(X.values.reshape(-1,1),y.values)
Y_pred = reg.predict(X.values.reshape(-1,1))
plt.scatter(X, y)
plt.plot(X, Y_pred, color='blue',label = 'y={:.2f} + {:.2f}*x'.format(reg.intercept_,reg.coef_[0]))
plt.xlabel("GroupActivity")
plt.ylabel("Final Scores")
plt.title("GroupActivity and final score")
plt.legend(loc='upper left')
plt.show()
df = pd.DataFrame({'Actual': y, 'Predicted':Y_pred})
df
```







Out[41]:

	Actual	Predicted
0	52.50	58.683343
1	68.33	72.345785
2	48.89	62.033641
3	80.56	72.612775
4	73.89	72.612775
...	...	...
94	39.72	70.804131
95	87.78	69.954355
96	85.56	72.558229
97	77.22	64.798283
98	50.83	70.804131

99 rows × 2 columns

R-squared is a goodness-of-fit measure for linear regression models.

HOW TO CONCLUDE ON R squared Values:

- The negative R-squared value means that your prediction tends to be less accurate that the average value of the data set over time
- R-squared is always between 0 and 100%:

  -> 0% represents a model that does not explain any of the variation in the response variable around its mean. The mean of the dependent variable predicts the dependent variable as well as the regression model.

  -> 100% represents a model that explains all of the variation in the response variable around its mean.

Usually, the larger the R2, the better the regression model fits your observations.

HOW TO CONCLUDE ON MSE VALUES:

- The value which is Less fits good model

METHOD 1 : Replacing Null by Zero

- TESTS:
  - MSE: 472.97
  - R2 value: -0.124
- COURSERA:
  - MSE: 615.838
  - R2 value: -0.044
- GROUP ACTIVITY:
  - MSE: 712.452
  - R2 value: -0.040

METHOD 2A : Forward Fill Imputation

- TESTS:
  - MSE: 281.900
  - R2 value: -0.120
- COURSERA:
  - MSE: 391.394
  - R2 value: -0.010
- GROUP ACTIVITY:
  - MSE: 248.664
  - R2 value: 0.166

METHOD 2B : Backward Fill Imputation

- TESTS:
  - MSE: 463.490
  - R2 value: -0.225
- COURSERA:
  - MSE: 295.907

    - R2 value: 0.070

- GROUP ACTIVITY:
    - MSE: 244.929
    - R2 value: -0.029

METHOD 3 : KNN sklearn

- TESTS:
    - MSE: 304.770
    - R2 value: 0.048

- COURSERA:
    - MSE: 265.262
    - R2 value: -0.104

- GROUP ACTIVITY:
    - MSE: 219.022
    - R2 value: 0.242