Logistic Regression Project

In this project we will be working with a fake advertising data set, indicating whether or not a particular internet user clicked on an Advertisement. We will try to create a model that will predict whether or not they will click on an ad based off the features of that user.

This data set contains the following features:

- 'Daily Time Spent on Site': consumer time on site in minutes
- 'Age': cutomer age in years
- 'Area Income': Avg. Income of geographical area of consumer
- 'Daily Internet Usage': Avg. minutes a day consumer is on the internet
- 'Ad Topic Line': Headline of the advertisement
- 'City': City of consumer
- 'Male': Whether or not consumer was male
- 'Country': Country of consumer
- 'Timestamp': Time at which consumer clicked on Ad or closed window
- 'Clicked on Ad': 0 or 1 indicated clicking on Ad

Import Libraries

Import a few libraries you think you'll need (Or just import them as you go along!)

In [2]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

import warnings
warnings.filterwarnings('ignore')
```

Get the Data

Read in the advertising.csv file and set it to a data frame called ad_data.

In [13]:

```
ad_data=pd.read_csv("advertising (1).csv")
```

Check the head

In [16]:

```
ad_data.head()
```

Out[16]:

	Daily Time Spent on Site	Age	Area Income	Daily Internet Usage	Ad Topic Line	City	Male	Country	Timestamp	Clicked on Ad
0	68.95	35	61833.90	256.09	Cloned 5thgeneration orchestration	Wrightburgh	0	Tunisia	2016-03-27 00:53:11	0
1	80.23	31	68441.85	193.77	Monitored national standardization	West Jodi	1	Nauru	2016-04-04 01:39:02	0
2	69.47	26	59785.94	236.50	Organic bottom-line service-desk	Davidton	0	San Marino	2016-03-13 20:35:42	0
3	74.15	29	54806.18	245.89	Triple-buffered reciprocal time-frame	West Terrifurt	1	Italy	2016-01-10 02:31:19	0
4	68.37	35	73889.99	225.58	Robust logistical utilization	South Manuel	0	Iceland	2016-06-03 03:36:18	0

In [17]:

```
ad_data["Clicked on Ad"].value_counts()
```

Out[17]:

```
1    500
0    500
Name: Clicked on Ad, dtype: int64
```

Get the info

In [5]:

```
ad_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1000 entries, 0 to 999
Data columns (total 10 columns):
 #   Column                    Non-Null Count  Dtype  
---  ------                    --------------  -----  
 0   Daily Time Spent on Site  1000 non-null   float64
 1   Age                       1000 non-null   int64  
 2   Area Income               1000 non-null   float64
 3   Daily Internet Usage      1000 non-null   float64
 4   Ad Topic Line             1000 non-null   object 
 5   City                      1000 non-null   object 
 6   Male                      1000 non-null   int64  
 7   Country                   1000 non-null   object 
 8   Timestamp                 1000 non-null   object 
 9   Clicked on Ad             1000 non-null   int64  
dtypes: float64(3), int64(3), object(4)
memory usage: 62.6+ KB
```

Check for missing values

In [6]:

```
ad_data.isna().sum()
```

Out[6]:

```
Daily Time Spent on Site    0
Age                         0
Area Income                 0
Daily Internet Usage        0
Ad Topic Line               0
City                        0
Male                        0
Country                     0
Timestamp                   0
Clicked on Ad               0
dtype: int64
```

Get descriptive statistics

In [7]:

```
ad_data.describe()
```

Out[7]:

	Daily Time Spent on Site	Age	Area Income	Daily Internet Usage	Male	Clicked on Ad
count	1000.000000	1000.000000	1000.000000	1000.000000	1000.000000	1000.00000
mean	65.000200	36.009000	55000.000080	180.000100	0.481000	0.50000
std	15.853615	8.785562	13414.634022	43.902339	0.499889	0.50025
min	32.600000	19.000000	13996.500000	104.780000	0.000000	0.00000
25%	51.360000	29.000000	47031.802500	138.830000	0.000000	0.00000
50%	68.215000	35.000000	57012.300000	183.130000	0.000000	0.50000
75%	78.547500	42.000000	65470.635000	218.792500	1.000000	1.00000
max	91.430000	61.000000	79484.800000	269.960000	1.000000	1.00000

Exploratory Data Analysis

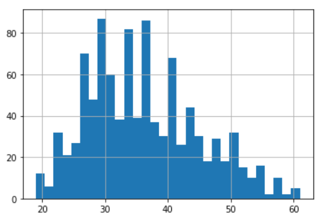
Let's use seaborn to explore the data!

Try recreating the plots shown below!

Create a histogram of the Age

In [8]:

```
plt.hist(ad_data["Age"],bins=30)
plt.grid(True)
plt.show()
```



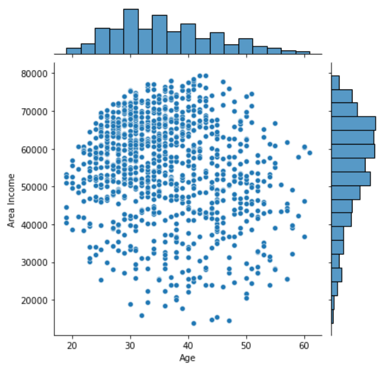
Create a jointplot showing Area Income versus Age.

In [9]:

```
sns.jointplot(x ='Age', y ='Area Income', data = ad_data)
```

Out[9]:

```
<seaborn.axisgrid.JointGrid at 0x9002838>
```



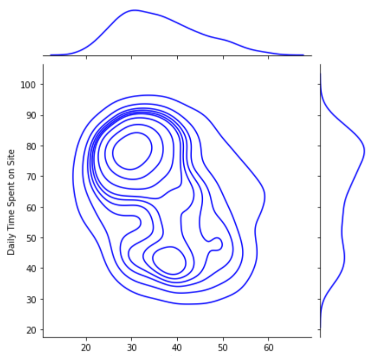
Create a jointplot showing the kde distributions of Daily Time spent on site vs. Age.

In [10]:

```
sns.jointplot(x="Age",y="Daily Time Spent on Site",data=ad_data,kind="kde",color="blue")
```

Out[10]:

```
<seaborn.axisgrid.JointGrid at 0x5e1c148>
```



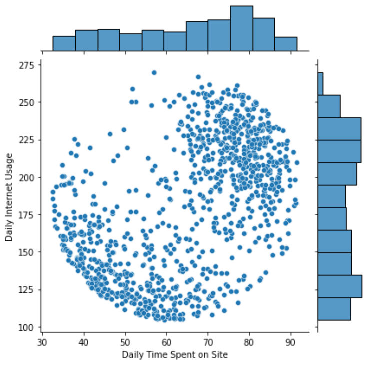
Create a jointplot of 'Daily Time Spent on Site' vs. 'Daily Internet Usage'

In [11]:

```
sns.jointplot(x="Daily Time Spent on Site",y="Daily Internet Usage",data=ad_data)
```

Out[11]:

```
<seaborn.axisgrid.JointGrid at 0x9624790>
```



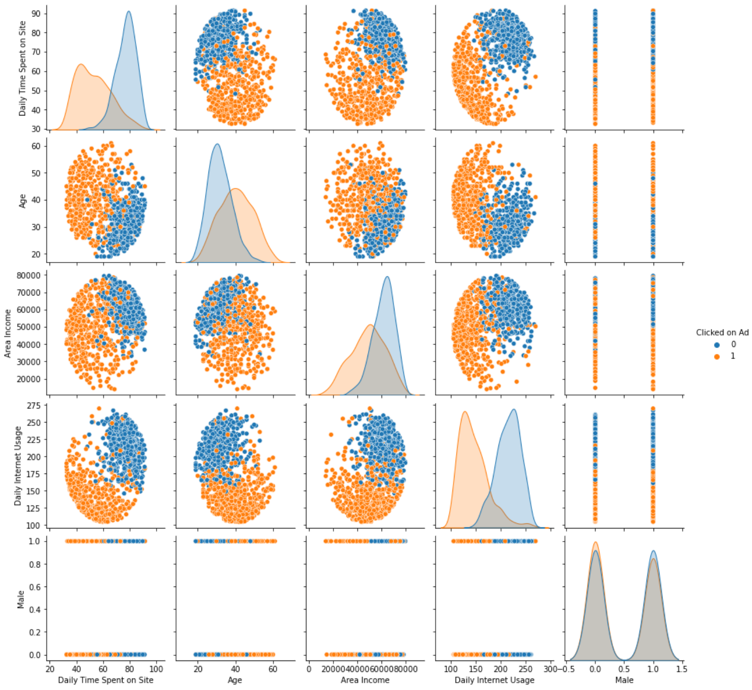
Finally, create a pairplot with the hue defined by the 'Clicked on Ad' column feature.

In [12]:

```
sns.pairplot(ad_data,hue="Clicked on Ad")
```

Out[12]:

```
<seaborn.axisgrid.PairGrid at 0x966b628>
```



Logistic Regression

Now it's time to do a train test split, and train our model!

You'll have the freedom here to choose columns that you want to train on!

Divide x & y

In [18]:

```
x=ad_data.iloc[:,[0,1,2,3,6]].values
y=ad_data.iloc[:,-1].values
```

In [19]:

```
x
```

Out[19]:

```
array([[6.895000e+01, 3.500000e+01, 6.183390e+04, 2.560900e+02,
        0.000000e+00],
       [8.023000e+01, 3.100000e+01, 6.844185e+04, 1.937700e+02,
        1.000000e+00],
       [6.947000e+01, 2.600000e+01, 5.978594e+04, 2.365000e+02,
        0.000000e+00],
       ...,
       [5.163000e+01, 5.100000e+01, 4.241572e+04, 1.203700e+02,
        1.000000e+00],
       [5.555000e+01, 1.900000e+01, 4.192079e+04, 1.879500e+02,
        0.000000e+00],
       [4.501000e+01, 2.600000e+01, 2.987580e+04, 1.783500e+02,
        0.000000e+00]])
```

Split the data into training set and testing set using train_test_split

In [32]:

```
from sklearn.model_selection import train_test_split
xtrain,xtest,ytrain,ytest=train_test_split(x,y,test_size=0.3,random_state=0)
```

Train and fit a logistic regression model on the training set.

In [33]:

```
from sklearn.linear_model import LogisticRegression
logreg = LogisticRegression()
logreg.fit(xtrain,ytrain)
```

Out[33]:

```
LogisticRegression()
```

In [34]:

```
ypred=logreg.predict(xtest)
```

Get the Confusion Matrix and Accuracy

In [35]:

```
from sklearn.metrics import confusion_matrix as cm,classification_report as cr,accuracy_score as acc
print(f"confusion matrix:-\n {cm(ytest,ypred)}")
print(f"\nAccuracy:- {acc(ytest,ypred)}")
```

```
confusion matrix:-
 [[155   9]
 [ 16 120]]

Accuracy:- 0.9166666666666666
```

Get the Classification Report

In [37]:

```
print(f"Classification Report:-\n {cr(ytest,ypred)}")
```

```
Classification Report:-
               precision    recall  f1-score   support

           0       0.91      0.95      0.93       164
           1       0.93      0.88      0.91       136

    accuracy                           0.92       300
   macro avg       0.92      0.91      0.92       300
weighted avg       0.92      0.92      0.92       300
```

Get the Mean Accuracy and Standard Deviation of the model

In [42]:

```
from sklearn.model_selection import cross_val_score
cvs=cross_val_score(logreg,xtrain,ytrain,cv=5,scoring="accuracy")
print(f"Accuracy:- {cvs.mean()*100}")
print(f"Standard Deviation:- {cvs.std()*100}")
```

```
Accuracy:- 90.99999999999999
Standard Deviation:- 2.539484119233024
```

In [ ]: