Laptop-price-prediction-project

April 4, 2024

[159]:
```
import numpy as np
import pandas as pd
df = pd.read_csv("laptop_data.csv")
```

[160]:
```
df.head()    #To show the first 5 columns of the data set
```

[160]:

	Unnamed: 0	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price
0	0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8GB	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37kg	71378.6832
1	1	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8GB	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34kg	47895.5232
2	2	HP	Notebook	15.6	Full HD 1920x1080	Intel Core i5 7200U 2.5GHz	8GB	256GB SSD	Intel HD Graphics 620	No OS	1.86kg	30636.0000
3	3	Apple	Ultrabook	15.4	IPS Panel Retina Display 2880x1800	Intel Core i7 2.7GHz	16GB	512GB SSD	AMD Radeon Pro 455	macOS	1.83kg	135195.3360
4	4	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 3.1GHz	8GB	256GB SSD	Intel Iris Plus Graphics 650	macOS	1.37kg	96095.8080

[161]:
```
df.describe()    # This shows the stats of all the numerical values
```

[161]:

	Unnamed: 0	Inches	Price
count	1306.000000	1306.000000	1306.000000
mean	649.690658	15.013017	59912.258499
std	376.885737	1.424616	37304.220229
min	0.000000	10.100000	9270.720000
25%	323.250000	14.000000	31914.720000
50%	649.500000	15.600000	52054.560000
75%	975.750000	15.600000	79373.746800

```
max     1302.000000     18.400000  324954.720000
```

[162]:
```
df.shape
```

[162]: (1306, 12)

[163]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1306 entries, 0 to 1305
Data columns (total 12 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   Unnamed: 0        1306 non-null   int64  
 1   Company           1306 non-null   object 
 2   TypeName          1306 non-null   object 
 3   Inches            1306 non-null   float64
 4   ScreenResolution  1306 non-null   object 
 5   Cpu               1306 non-null   object 
 6   Ram               1301 non-null   object 
 7   Memory            1306 non-null   object 
 8   Gpu               1306 non-null   object 
 9   OpSys             1306 non-null   object 
 10  Weight            1306 non-null   object 
 11  Price             1306 non-null   float64
dtypes: float64(2), int64(1), object(9)
memory usage: 122.6+ KB
```

DATA CLEANING

[164]:
```
df.duplicated().sum() #To find the duplicate values
```

[164]: 9

[165]:
```
df.drop_duplicates(inplace=True) #To drop the duplicate values
```

[166]:
```
df.duplicated().sum()
```

[166]: 0

[167]:
```
mode_ram = df['Ram'].mode()[0]          # Calculating mode
```

[168]:
```
mode_ram
```

[168] : '8GB'

[169] :
```
df['Ram'].fillna(mode_ram, inplace=True)
```

[170] :
```
df.isnull().sum()   # Null values are replaced by mode
```

[170] :
```
Unnamed: 0          0
Company             0
TypeName            0
Inches              0
ScreenResolution    0
Cpu                 0
Ram                 0
Memory              0
Gpu                 0
OpSys               0
Weight              0
Price               0
dtype: int64
```

Data preprocessing

[171] :
```
df.drop(columns=['Unnamed: 0'], inplace=True) #Dropping Unnamed: 0 column
↪becuase it is not needed.
```

[172] :
```
df.head()
```

[172]:

	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price
0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8GB	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37kg	71378.6832
1	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8GB	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34kg	47895.5232
2	HP	Notebook	15.6	Full HD 1920x1080	Intel Core i5 7200U 2.5GHz	8GB	256GB SSD	Intel HD Graphics 620	No OS	1.86kg	30636.0000
3	Apple	Ultrabook	15.4	IPS Panel Retina Display 2880x1800	Intel Core i7 2.7GHz	16GB	512GB SSD	AMD Radeon Pro 455	macOS	1.83kg	135195.3360
4	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 3.1GHz	8GB	256GB SSD	Intel Iris Plus Graphics 650	macOS	1.37kg	96095.8080

[173] :
```
df['Ram'] = df['Ram'].str.replace('GB','')      #To remove 'GB' from Ram column
```

[174] :
```
df['Weight'] = df['Weight'].str.replace('kg','') #To remove 'kg' from Ram column
```

[175] :
```
df.head()
```

[175]:

	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price
0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37	71378.6832
1	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34	47895.5232
2	HP	Notebook	15.6	Full HD 1920x1080	Intel Core i5 7200U 2.5GHz	8	256GB SSD	Intel HD Graphics 620	No OS	1.86	30636.0000
3	Apple	Ultrabook	15.4	IPS Panel Retina Display 2880x1800	Intel Core i7 2.7GHz	16	512GB SSD	AMD Radeon Pro 455	macOS	1.83	135195.3360
4	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 3.1GHz	8	256GB SSD	Intel Iris Plus Graphics 650	macOS	1.37	96095.8080

[176] :
```
df['Ram'] = df['Ram'].astype('int32') #Changing the datatypes
```

[177] :
```
df['Weight'] = df['Weight'].astype('float32')
```

[178] :
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1297 entries, 0 to 1305
Data columns (total 11 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   Company           1297 non-null   object 
 1   TypeName          1297 non-null   object 
 2   Inches            1297 non-null   float64
 3   ScreenResolution  1297 non-null   object 
 4   Cpu               1297 non-null   object 
 5   Ram               1297 non-null   int32  
 6   Memory            1297 non-null   object 
 7   Gpu               1297 non-null   object 
 8   OpSys             1297 non-null   object 
 9   Weight            1297 non-null   float32
 10  Price             1297 non-null   float64
dtypes: float32(1), float64(2), int32(1), object(7)
memory usage: 111.5+ KB
```

[179] :
```
df.describe()    # Found outliers in Weight
```

[179]:

	Inches	Ram	Weight	Price
count	1297.000000	1297.000000	1297.000000	1297.000000
mean	15.013647	8.390131	2.806654	59924.888938
std	1.425709	5.091038	27.718493	37296.015690
min	10.100000	2.000000	0.690000	9270.720000
25%	14.000000	4.000000	1.500000	31914.720000
50%	15.600000	8.000000	2.040000	52054.560000
75%	15.600000	8.000000	2.300000	79387.200000
max	18.400000	64.000000	1000.000000	324954.720000

Removing outliers

[180] :
```
Q1 = df.Weight.quantile(0.0)        # Choosing 0 after trial and testing of range
Q3   =    df.Weight.quantile(0.75)
```

[181] :
```
Q1
```

[181]: 0.6899999976158142

[182] :
```
Q3
```

[182]: 2.299999952316284

[183] :
```
IQR = Q3-Q1
```

[184] :
```
IQR
```

[184]: 1.60999995470047

[185] :
```
lower_limit = Q1 - 1.5*IQR
upper_limit = Q3 + 1.5*IQR
lower_limit, upper_limit
```

[185]: (-1.7249999344348907, 4.714999884366989)

[186] :
```
df[(df.Weight<lower_limit) | (df.Weight>upper_limit)]    #To find the outliers
```

[186] :

	Company	TypeName	Inches	ScreenResolution	Cpu
306	Lenovo	Notebook	15.6	1366x768	Intel Core i5 7200U 2.5GHz

	Ram	Memory	Gpu	OpSys	Weight	Price
306	8	2TB HDD	Nvidia GeForce 940MX	No OS	1000.0	29250.72

[187] :
```
df = df[(df.Weight>lower_limit)&(df.Weight<upper_limit)] # To remove the
↪outliers
```

```
df.describe()
```

[187]:

	Inches	Ram	Weight	Price
count	1296.000000	1296.000000	1296.000000	1296.000000
mean	15.013194	8.390432	2.037215	59948.557278
std	1.426166	5.092992	0.665834	37300.667342
min	10.100000	2.000000	0.690000	9270.720000
25%	14.000000	4.000000	1.500000	31914.720000
50%	15.600000	8.000000	2.040000	52107.840000
75%	15.600000	8.000000	2.300000	79424.496000
max	18.400000	64.000000	4.700000	324954.720000

Exploratory Data Analysis

[188] :
```
import seaborn as sns
import matplotlib.pyplot as plt
```

[189] :
```
sns.distplot(df['Price'])
```

<ipython-input-189-87e11caeb2c4>:1: UserWarning:

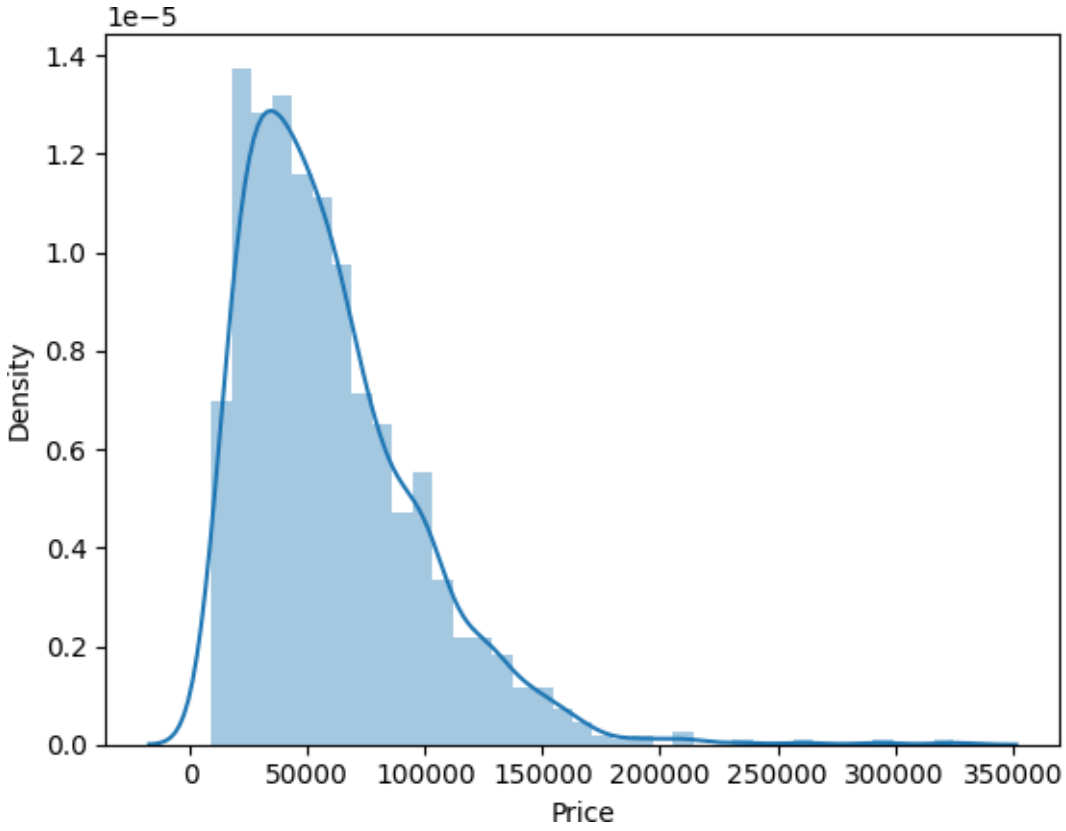
`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

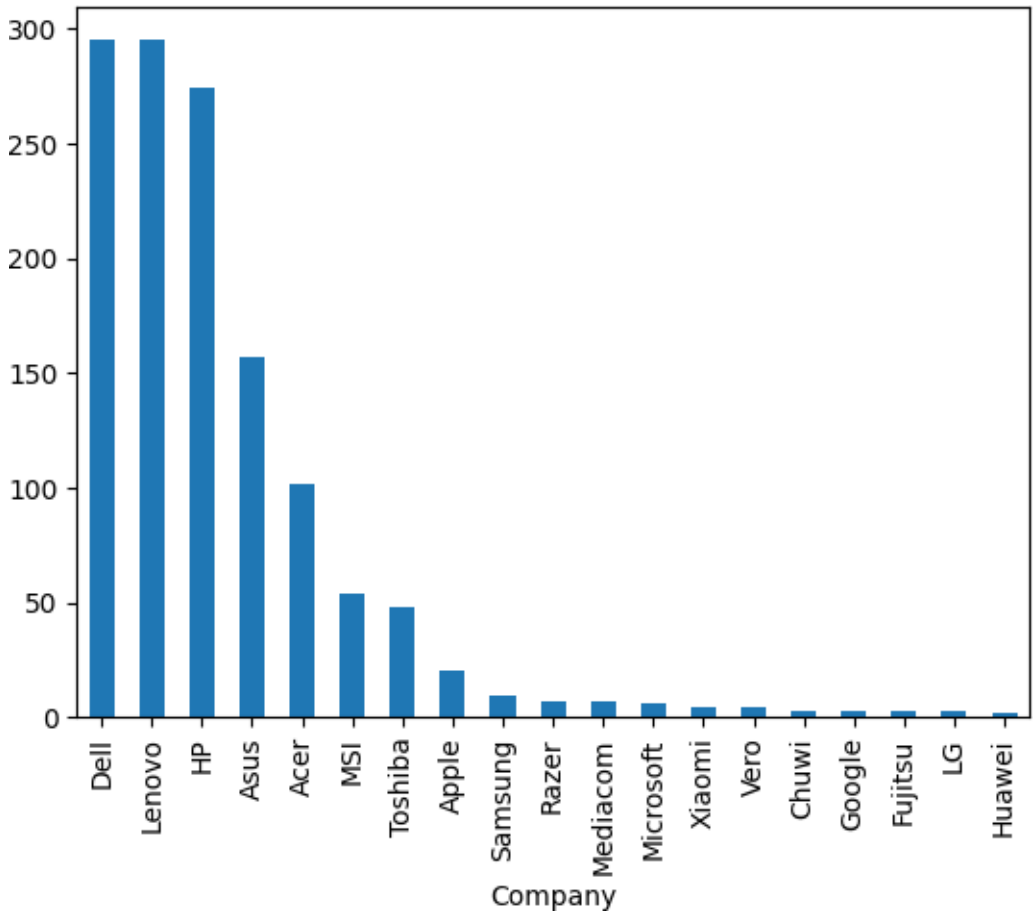
```
sns.distplot(df['Price'])
```

[189] : <Axes: xlabel='Price', ylabel='Density'>

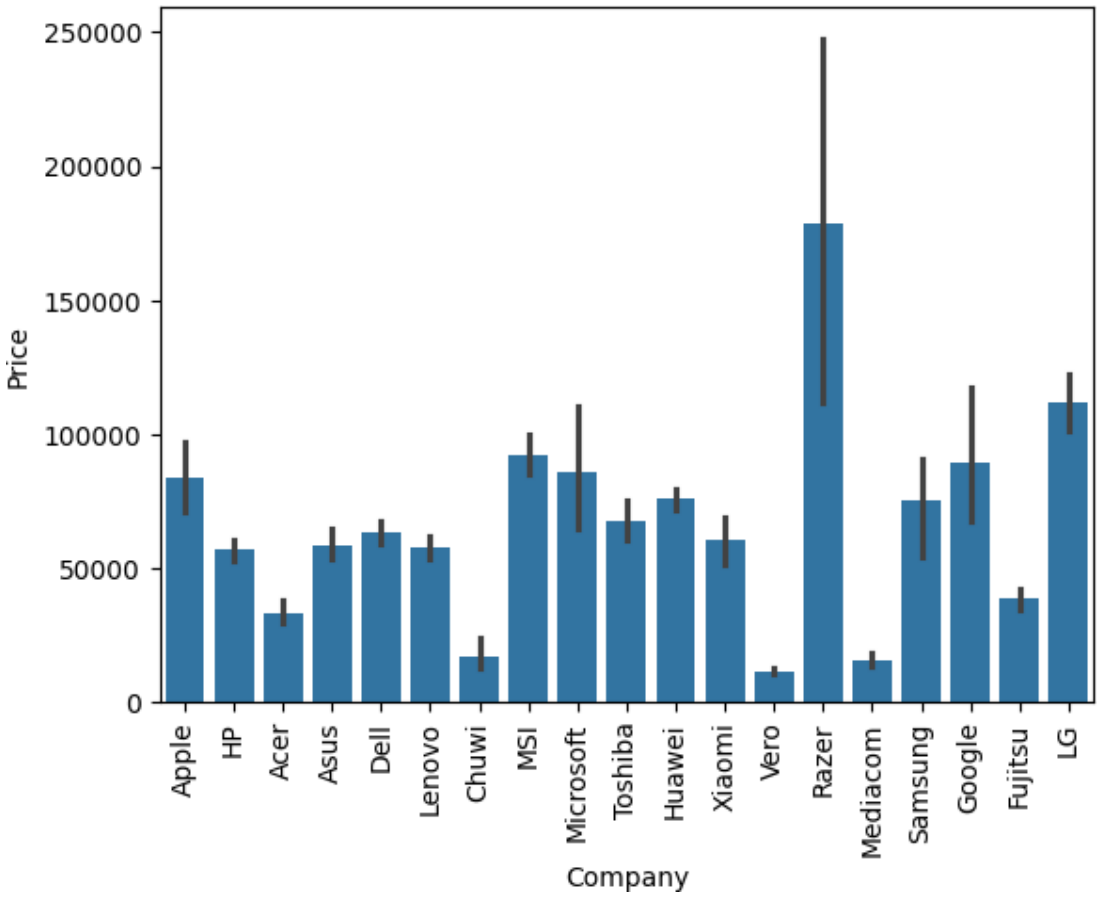


[190] :
```
df['Company'].value_counts().plot(kind='bar') #To show the count of laptop of␣
↪each brand.
```

[190] : <Axes: xlabel='Company'>

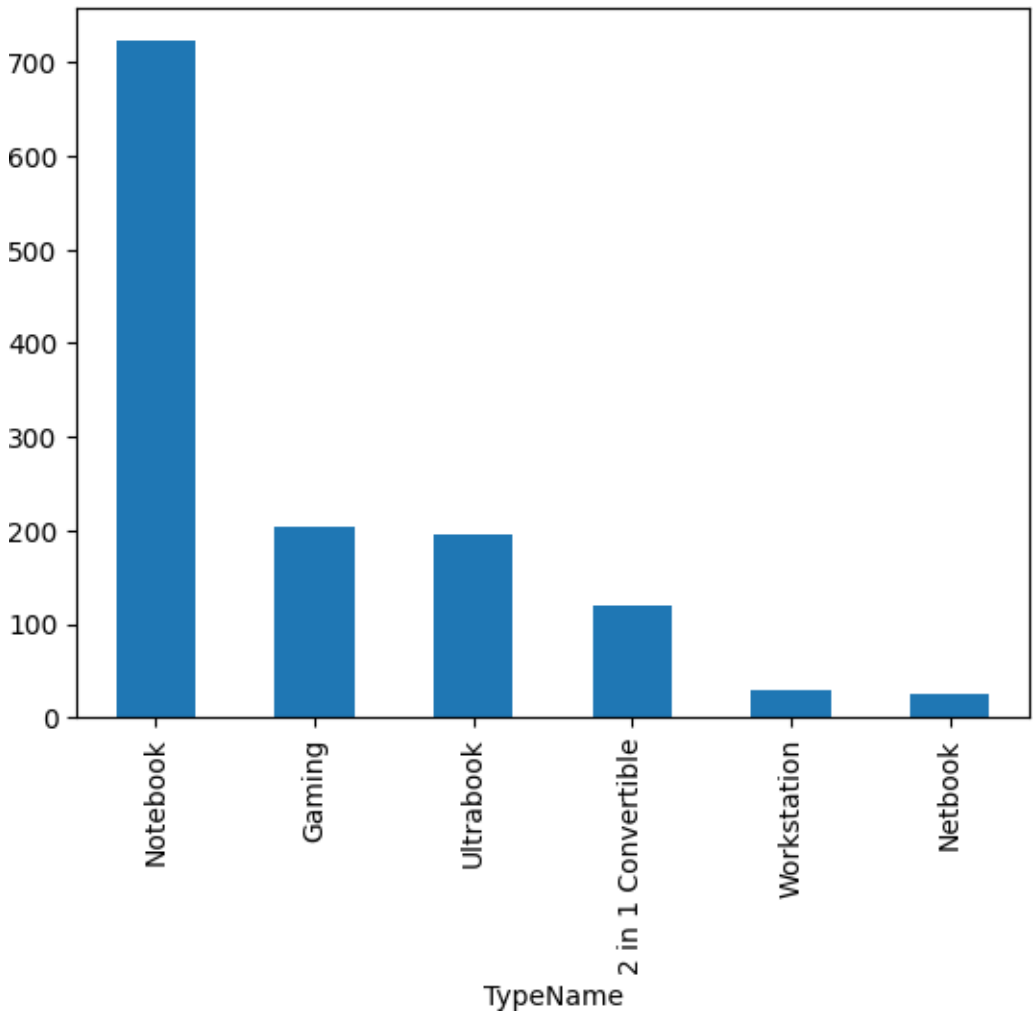


[191] :
```
sns.barplot(x=df['Company'], y=df['Price']) # To find which laptops are costly and which one are budget laptops.
plt.xticks(rotation='vertical')
plt.show()
```

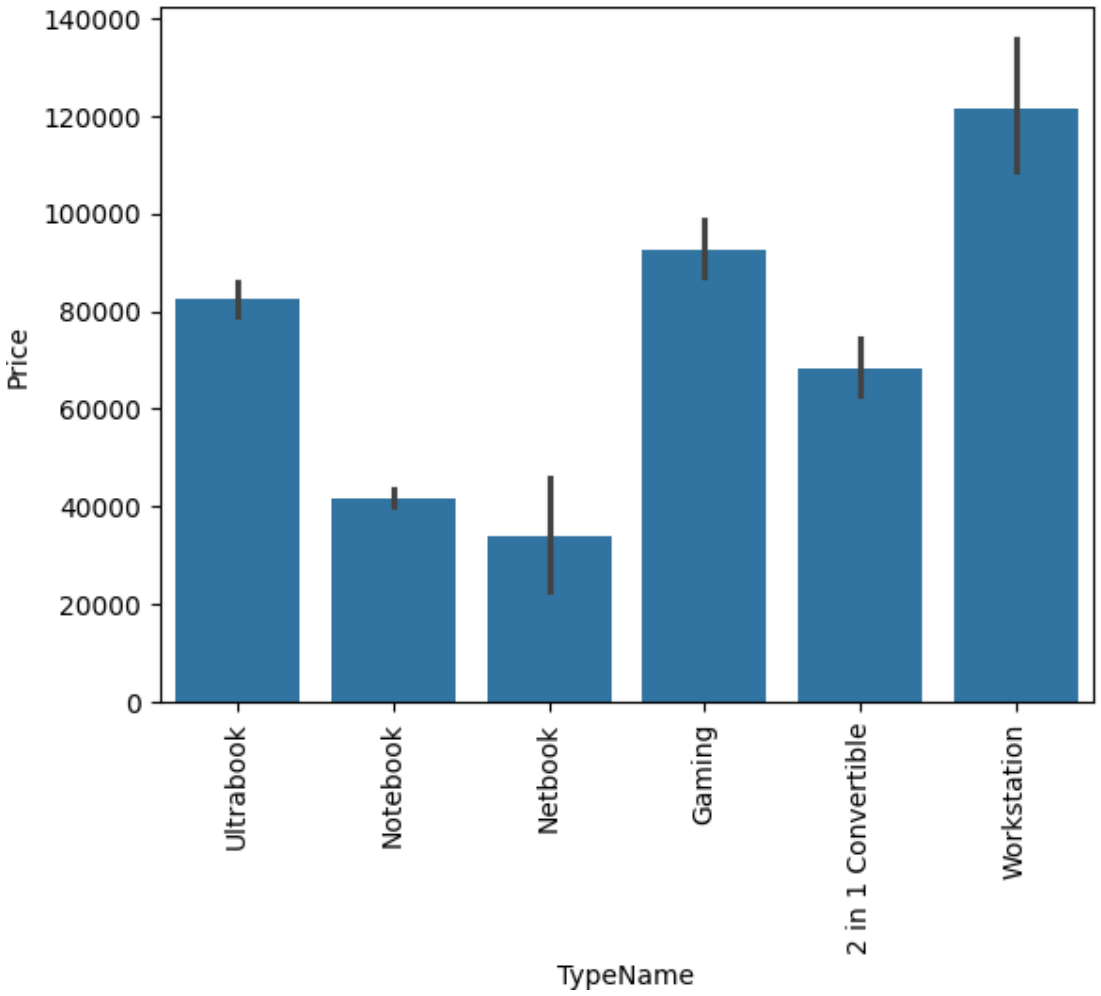


[192] : df['TypeName'].value_counts().plot(kind='bar') #To find the count of

[192] : <Axes: xlabel='TypeName'>



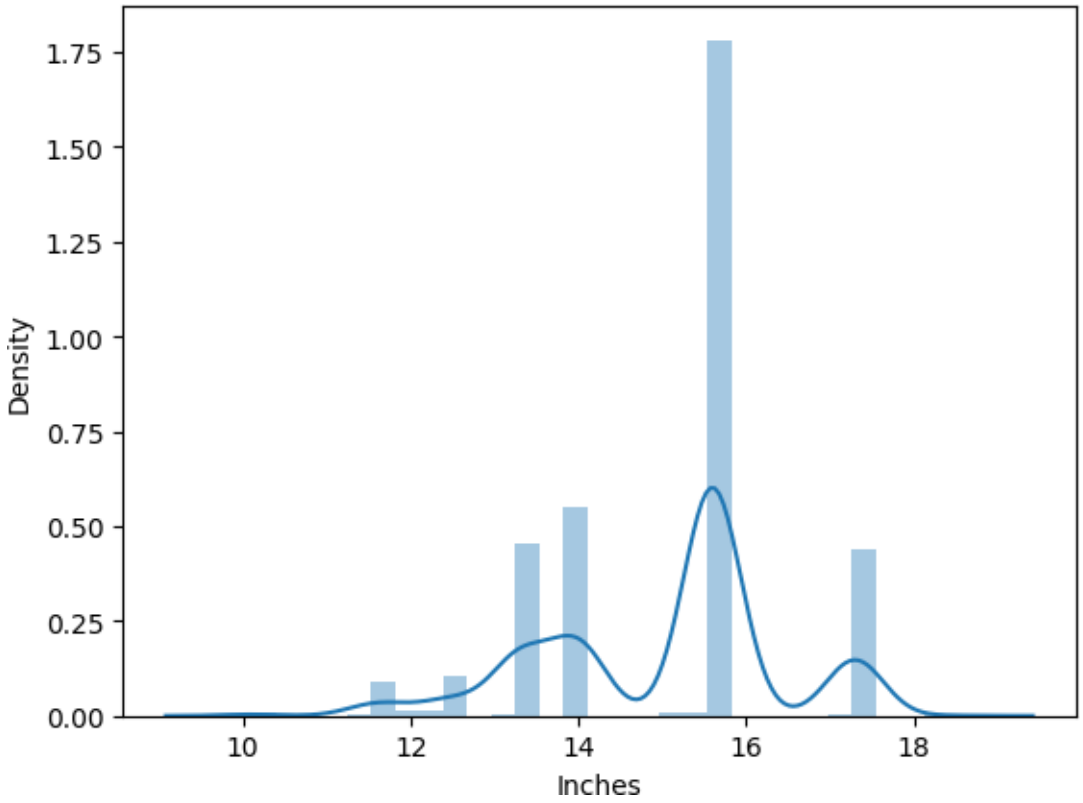
[193] :
```
sns.barplot(x=df['TypeName'], y=df['Price']) # To find which type of laptops
↪are costly and which one are budget laptops.
plt.xticks(rotation='vertical')
plt.show()
```



[194] :
```
sns.distplot(df['Inches'])
```

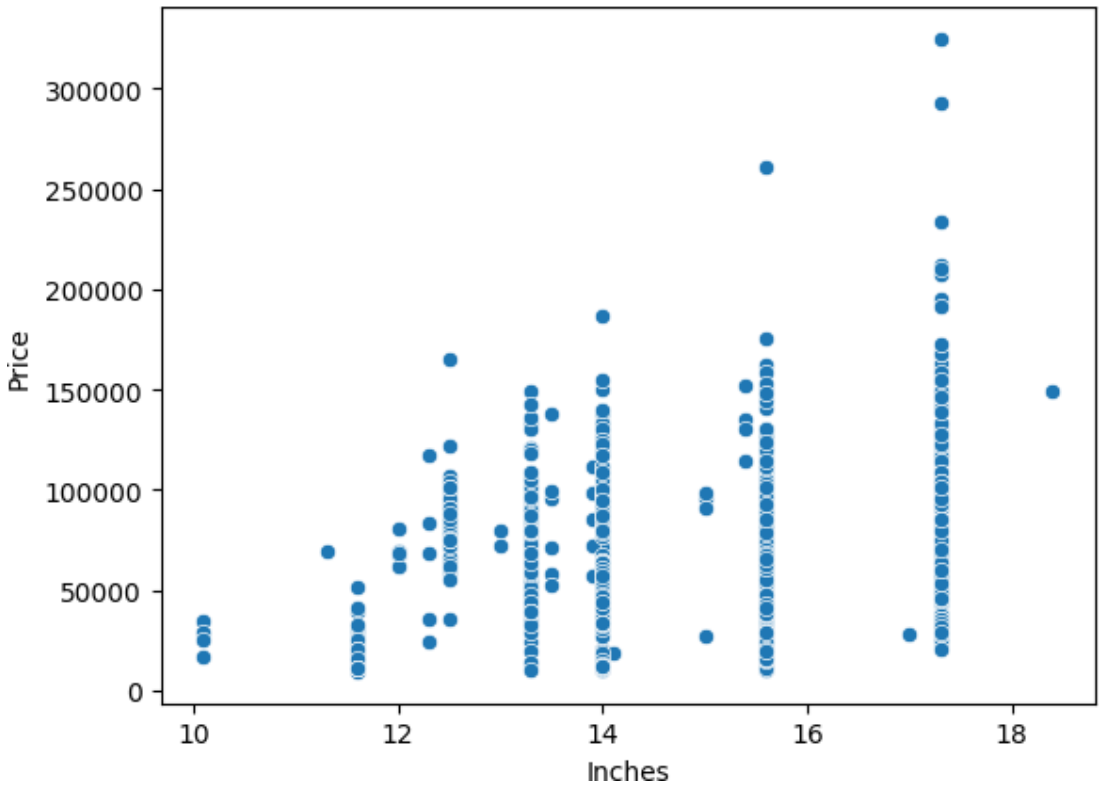
```
<ipython-input-194-51888cb550e6>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df['Inches'])
```

[194] : <Axes: xlabel='Inches', ylabel='Density'>



[195] :
```
sns.scatterplot(x=df['Inches'], y=df['Price']) #To check the relation between␣
↪Inches and price
```

[195] : <Axes: xlabel='Inches', ylabel='Price'>



[196] :
```
df['Touchscreen']=df['ScreenResolution'].apply(lambda x:1 if 'Touchscreen' in x else 0) #To create a new column named 'Touchscreen' if the word is present.
```

[197] :
```
df.head()
```

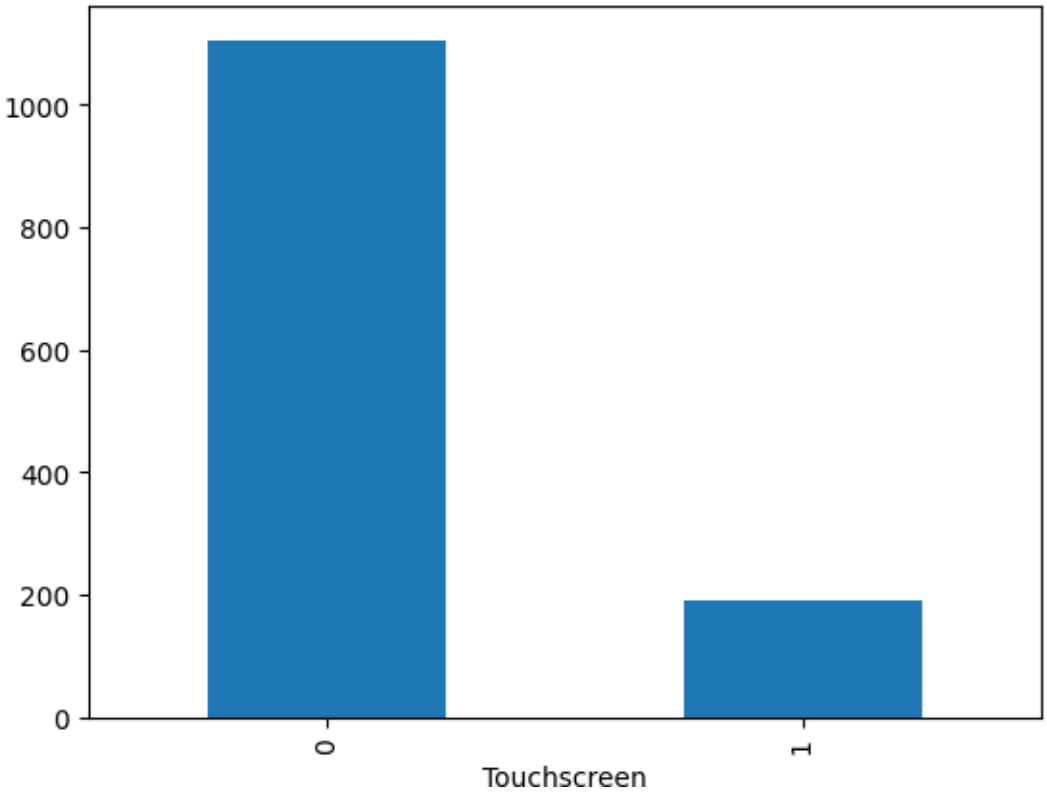
[197]:

	Company	TypeName	Inches	ScreenResolution	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price	Touchscreen
0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 2.3GHz	8	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37	71378.6832	0
1	Apple	Ultrabook	13.3	1440x900	Intel Core i5 1.8GHz	8	128GB Flash Storage					
2	HP	Notebook	15.6	Full HD 1920x1080	Intel Core i5 7200U 2.5GHz	8	256GB SSD					
3	Apple	Ultrabook	15.4	IPS Panel Retina Display 2880x1800	Intel Core i7 2.7GHz	16	512GB SSD					
4	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	Intel Core i5 3.1GHz	8	256GB SSD					

1	Intel HD Graphics 6000	macOS	1.34	47895.5232	0
2	Intel HD Graphics 620	No OS	1.86	30636.0000	0
3	AMD Radeon Pro 455	macOS	1.83	135195.3360	0
4	Intel Iris Plus Graphics 650	macOS	1.37	96095.8080	0

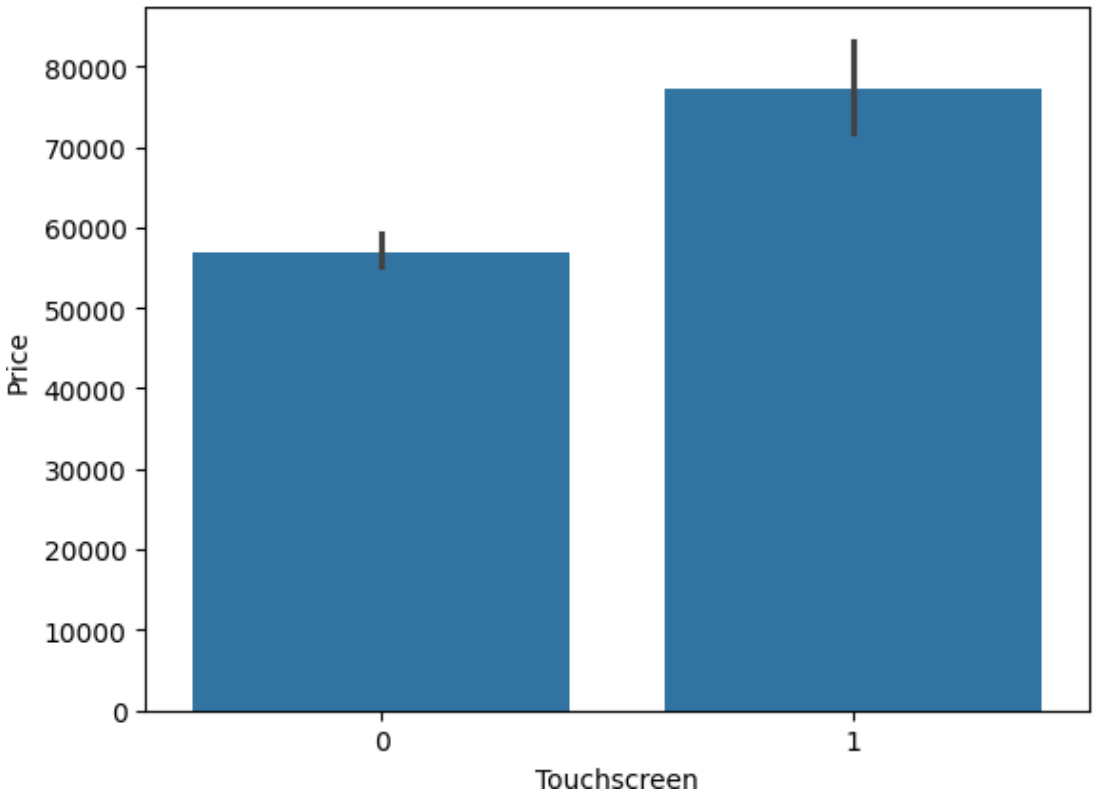
[198] :
```
df['Touchscreen'].value_counts().plot(kind='bar')
```

[198] : <Axes: xlabel='Touchscreen'>



[199] :
```
sns.barplot(x=df['Touchscreen'], y=df['Price']) #To show the relation between␣
↪Touchscreen and Price
```

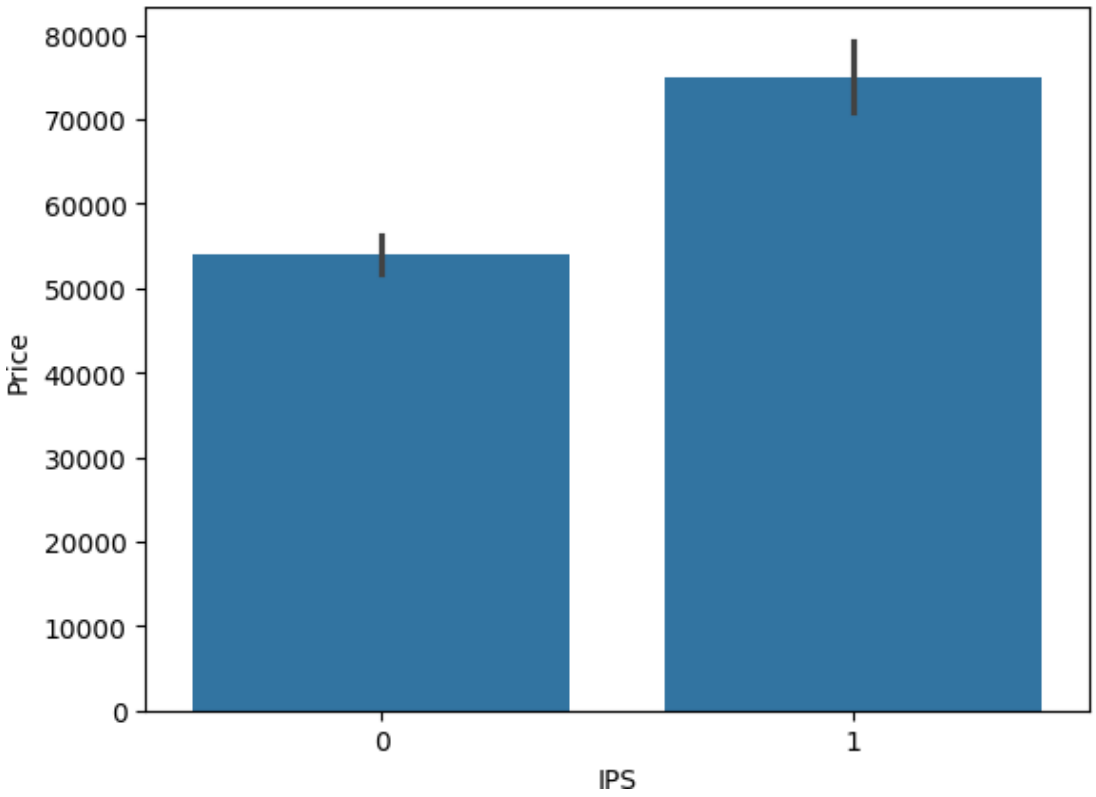
[199] : <Axes: xlabel='Touchscreen', ylabel='Price'>



[200] :
```
df['IPS'] = df['ScreenResolution'].apply(lambda x:1 if 'IPS' in x else 0)
```

[201] :
```
sns.barplot(x=df['IPS'], y=df['Price']) #To show the relation between IPS and Price
```

[201] : <Axes: xlabel='IPS', ylabel='Price'>



[202] :
```
temp = df['ScreenResolution'].str.split('x',n=1,expand=True)
```

'x': This is the delimiter used for splitting the strings.

n=1: This parameter indicates that only the first occurrence of the delimiter should be used for splitting. This means if there are multiple occurrences of 'x' in a string, only the first one will be considered for splitting.

expand=True: This parameter tells pandas to expand the split strings into separate columns. Each part of the split string will be placed into a separate column in the resulting DataFrame.

[203] :
```
df['X_res']= temp[0]
df['Y_res'] = temp[1]
```

[204] :
```
df.head(10)
```

[204]:

	Company	TypeName	Inches	ScreenResolution	\
0	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	
1	Apple	Ultrabook	13.3	1440x900	
2	HP	Notebook	15.6	Full HD 1920x1080	
3	Apple	Ultrabook	15.4	IPS Panel Retina Display 2880x1800	
4	Apple	Ultrabook	13.3	IPS Panel Retina Display 2560x1600	

```
5    Acer   Notebook   15.6                            1366x768
6   Apple  Ultrabook   15.4  IPS Panel Retina Display 2880x1800
7   Apple  Ultrabook   13.3                            1440x900
8    Asus  Ultrabook   14.0                         Full HD 1920x1080
9    Acer  Ultrabook   14.0               IPS Panel Full HD 1920x1080

                          Cpu  Ram               Memory  \
0       Intel Core i5 2.3GHz    8            128GB SSD
1       Intel Core i5 1.8GHz    8  128GB Flash Storage
2  Intel Core i5 7200U 2.5GHz    8            256GB SSD
3       Intel Core i7 2.7GHz   16            512GB SSD
4       Intel Core i5 3.1GHz    8            256GB SSD
5     AMD A9-Series 9420 3GHz    4            500GB HDD
6       Intel Core i7 2.2GHz   16  256GB Flash Storage
7       Intel Core i5 1.8GHz    8  256GB Flash Storage
8  Intel Core i7 8550U 1.8GHz   16            512GB SSD
9  Intel Core i5 8250U 1.6GHz    8            256GB SSD

                            Gpu       OpSys  Weight        Price  Touchscreen  \
0  Intel  Iris Plus Graphics 640       macOS    1.37   71378.6832            0
1         Intel HD Graphics 6000       macOS    1.34   47895.5232            0
2          Intel HD Graphics 620       No OS    1.86   30636.0000            0
3              AMD Radeon Pro 455       macOS    1.83  135195.3360            0
4  Intel  Iris Plus Graphics 650       macOS    1.37   96095.8080            0
5                 AMD Radeon R5  Windows 10    2.10   21312.0000            0
6        Intel Iris Pro Graphics     Mac OS X    2.04  114017.6016            0
7         Intel HD Graphics 6000       macOS    1.34   61735.5360            0
8           Nvidia GeForce MX150  Windows 10    1.30   79653.6000            0
9         Intel UHD Graphics 620  Windows 10    1.60   41025.6000            0

   IPS                          X_res Y_res
0    1  IPS Panel Retina Display 2560  1600
1    0                           1440   900
2    0                        Full HD 1920  1080
3    1  IPS Panel Retina Display 2880  1800
4    1  IPS Panel Retina Display 2560  1600
5    0                           1366   768
6    1  IPS Panel Retina Display 2880  1800
7    0                           1440   900
8    0                        Full HD 1920  1080
9    1              IPS Panel Full HD 1920  1080
```

[205] :
```
df['X_res'].str.replace(',','').str.findall(r'(\d+\.?\d+)') # The output is an␣
↪array
```

[205]:
```
0    [2560]
1    [1440]
```

```
2          [1920]
3          [2880]
4          [2560]
             ...
1301       [1920]
1302       [3200]
1303       [1366]
1304       [1366]
1305       [1366]
Name: X_res, Length: 1296, dtype: object
```

Putting it all together, the pattern (+.?+) matches sequences of one or more digits, optionally followed by a dot, and then followed by one or more digits. This pattern is commonly used to extract numerical values (possibly with decimal points) from strings.

[206] :
```
df['X_res']=df['X_res'].str.replace(',','').str.findall(r'(\d+\.?\d+)').
↪apply(lambda x:x[0]) #Applied Lambda function to return the 0th value of the␣
↪array
```

[207] :
```
df.head(10)
```

[207]:

	Company	TypeName	Inches	ScreenResolution	\
0	Apple	Ultrabook	13.3	IPS Panel Retina Display	2560x1600
1	Apple	Ultrabook	13.3		1440x900
2	HP	Notebook	15.6	Full HD	1920x1080
3	Apple	Ultrabook	15.4	IPS Panel Retina Display	2880x1800
4	Apple	Ultrabook	13.3	IPS Panel Retina Display	2560x1600
5	Acer	Notebook	15.6		1366x768
6	Apple	Ultrabook	15.4	IPS Panel Retina Display	2880x1800
7	Apple	Ultrabook	13.3		1440x900
8	Asus	Ultrabook	14.0	Full HD	1920x1080
9	Acer	Ultrabook	14.0	IPS Panel Full HD	1920x1080

	Cpu	Ram	Memory	\
0	Intel Core i5 2.3GHz	8	128GB SSD	
1	Intel Core i5 1.8GHz	8	128GB Flash Storage	
2	Intel Core i5 7200U 2.5GHz	8	256GB SSD	
3	Intel Core i7 2.7GHz	16	512GB SSD	
4	Intel Core i5 3.1GHz	8	256GB SSD	
5	AMD A9-Series 9420 3GHz	4	500GB HDD	
6	Intel Core i7 2.2GHz	16	256GB Flash Storage	
7	Intel Core i5 1.8GHz	8	256GB Flash Storage	
8	Intel Core i7 8550U 1.8GHz	16	512GB SSD	
9	Intel Core i5 8250U 1.6GHz	8	256GB SSD	

	Gpu	OpSys	Weight	Price	Touchscreen	\
0	Intel Iris Plus Graphics 640	macOS	1.37	71378.6832	0	

1	Intel HD Graphics 6000	macOS	1.34	47895.5232	0	
2	Intel HD Graphics 620	No OS	1.86	30636.0000	0	
3	AMD Radeon Pro 455	macOS	1.83	135195.3360	0	
4	Intel Iris Plus Graphics 650	macOS	1.37	96095.8080	0	
5	AMD Radeon R5	Windows 10	2.10	21312.0000	0	
6	Intel Iris Pro Graphics	Mac OS X	2.04	114017.6016	0	
7	Intel HD Graphics 6000	macOS	1.34	61735.5360	0	
8	Nvidia GeForce MX150	Windows 10	1.30	79653.6000	0	
9	Intel UHD Graphics 620	Windows 10	1.60	41025.6000	0	

	IPS	X_res	Y_res
0	1	2560	1600
1	0	1440	900
2	0	1920	1080
3	1	2880	1800
4	1	2560	1600
5	0	1366	768
6	1	2880	1800
7	0	1440	900
8	0	1920	1080
9	1	1920	1080

[208] :
```
df['X_res'] = df['X_res'].astype('int32')
df['Y_res'] = df['Y_res'].astype('int32')
```

[209] :
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 1296 entries, 0 to 1305
Data columns (total 15 columns):
 #   Column            Non-Null Count  Dtype  
---  ------            --------------  -----  
 0   Company           1296 non-null   object 
 1   TypeName          1296 non-null   object 
 2   Inches            1296 non-null   float64
 3   ScreenResolution  1296 non-null   object 
 4   Cpu               1296 non-null   object 
 5   Ram               1296 non-null   int32  
 6   Memory            1296 non-null   object 
 7   Gpu               1296 non-null   object 
 8   OpSys             1296 non-null   object 
 9   Weight            1296 non-null   float32
 10  Price             1296 non-null   float64
 11  Touchscreen       1296 non-null   int64  
 12  IPS               1296 non-null   int64  
 13  X_res             1296 non-null   int32  
 14  Y_res             1296 non-null   int32  
```

```
dtypes: float32(1), float64(2), int32(3), int64(2), object(7)
memory usage: 141.8+ KB
```

[210] :
```
df.shape
```

[210]: (1296, 15)

PPI is a measure of pixel density or resolution of a computer screen, television screen or other display device.

[211] :
```
df['ppi'] = (((df['X_res']**2)+(df['Y_res'])**2)**0.5/df['Inches']).
↪astype('float')
```

[212] :
```
df.drop(columns=['ScreenResolution','X_res','Y_res', 'Inches'], inplace=True)
```

[213] :
```
df.head()
```

[213]:

	Company	TypeName	Cpu	Ram	Memory	Gpu	OpSys	Weight	Price	Touchscreen	IPS	ppi
0	Apple	Ultrabook	Intel Core i5 2.3GHz	8	128GB SSD	Intel Iris Plus Graphics 640	macOS	1.37	71378.6832	0	1	226.983005
1	Apple	Ultrabook	Intel Core i5 1.8GHz	8	128GB Flash Storage	Intel HD Graphics 6000	macOS	1.34	47895.5232	0	0	127.677940
2	HP	Notebook	Intel Core i5 7200U 2.5GHz	8	256GB SSD	Intel HD Graphics 620	No OS	1.86	30636.0000	0	0	141.211998
3	Apple	Ultrabook	Intel Core i7 2.7GHz	16	512GB SSD	AMD Radeon Pro 455	macOS	1.83	135195.3360	0	1	220.534624
4	Apple	Ultrabook	Intel Core i5 3.1GHz	8	256GB SSD	Intel Iris Plus Graphics 650	macOS	1.37	96095.8080	0	1	226.983005

[214] :
```
df['Cpu']
```

[214] :
```
0                Intel Core i5 2.3GHz
1                Intel Core i5 1.8GHz
2             Intel Core i5 7200U 2.5GHz
```

```
3                    Intel Core i7 2.7GHz
4                    Intel Core i5 3.1GHz
                     ...
1301           Intel Core i7 6500U 2.5GHz
1302           Intel Core i7 6500U 2.5GHz
1303  Intel Celeron Dual Core N3050 1.6GHz
1304           Intel Core i7 6500U 2.5GHz
1305  Intel Celeron Dual Core N3050 1.6GHz
Name: Cpu, Length: 1296, dtype: object
```

[215] :
```
df['Cpu Name']=df['Cpu'].apply(lambda x:" ".join(x.split()[0:3]))  # To get the first three words
```

[216] :
```
df['Cpu Name']
```

[216] :
```
0             Intel Core i5
1             Intel Core i5
2             Intel Core i5
3             Intel Core i7
4             Intel Core i5
                ...
1301          Intel Core i7
1302          Intel Core i7
1303   Intel Celeron Dual
1304          Intel Core i7
1305    Intel Celeron Dual
Name: Cpu Name, Length: 1296, dtype: object
```

[217] :
```
def fetch_processor(text):
  if text == 'Intel Core i7' or text == 'Intel Core i5':
    return text
  else:
    if text.split()[0] == 'Intel':
      return 'Other Intel Processor'
    else:
      return 'AMD Processor'
```

[218] :
```
df['Cpu brand'] = df['Cpu Name'].apply(fetch_processor)
```

[219] :
```
df.head()
```

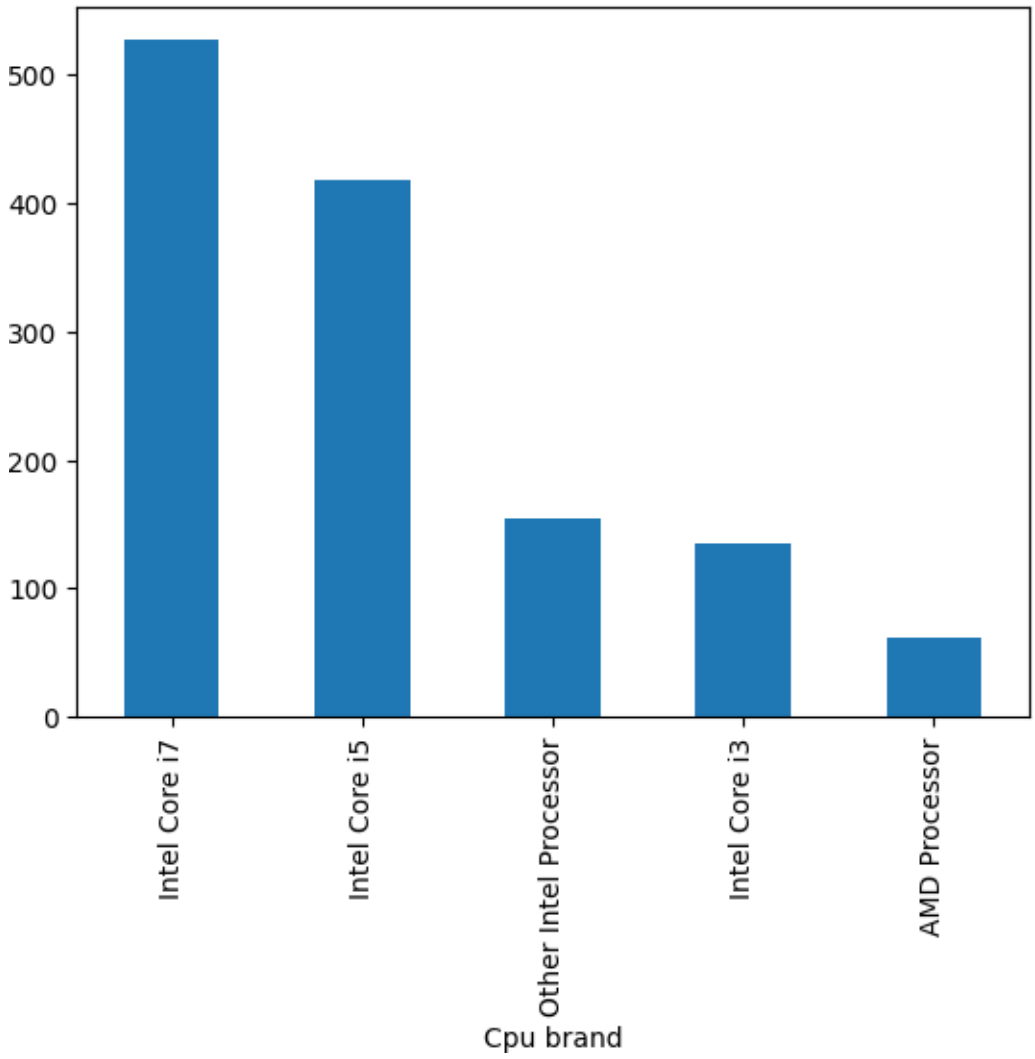
[219]:

	Company	TypeName	Cpu	Ram	Memory \
0	Apple	Ultrabook	Intel Core i5 2.3GHz	8	128GB SSD
1	Apple	Ultrabook	Intel Core i5 1.8GHz	8	128GB Flash Storage
2	HP	Notebook	Intel Core i5 7200U 2.5GHz	8	256GB SSD
3	Apple	Ultrabook	Intel Core i7 2.7GHz	16	512GB SSD

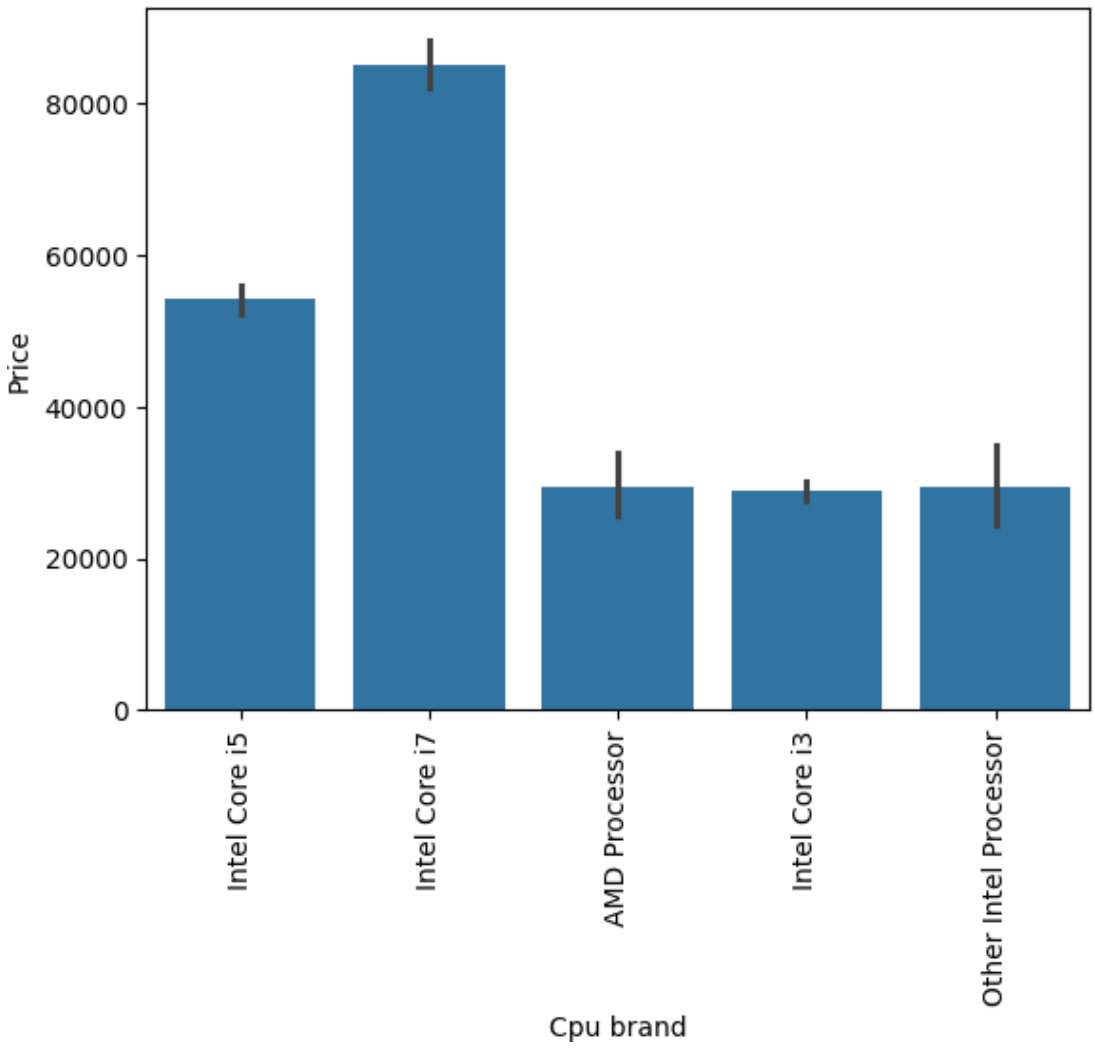
```
4   Apple   Ultrabook         Intel Core i5 3.1GHz    8              256GB SSD

                                Gpu  OpSys  Weight        Price  Touchscreen  IPS  \
0  Intel  Iris Plus Graphics 640  macOS    1.37   71378.6832            0    1
1         Intel HD Graphics 6000  macOS    1.34   47895.5232            0    0
2          Intel HD Graphics 620  No OS    1.86   30636.0000            0    0
3              AMD Radeon Pro 455  macOS    1.83  135195.3360            0    1
4  Intel  Iris Plus Graphics 650  macOS    1.37   96095.8080            0    1

          ppi         Cpu Name      Cpu brand
0  226.983005 Intel Core i5   Intel Core i5
1  127.677940 Intel Core i5   Intel Core i5
2  141.211998 Intel Core i5   Intel Core i5
3  220.534624 Intel Core i7   Intel Core i7
4  226.983005 Intel Core i5   Intel Core i5
```

[220] :
```
df['Cpu brand'].value_counts().plot(kind='bar')
```

[220] : <Axes: xlabel='Cpu brand'>



[221] :
```
sns.barplot(x=df['Cpu brand'], y=df['Price'])
plt.xticks(rotation='vertical')
plt.show()
```



[222] :
```
df.drop(columns=['Cpu','Cpu Name'], inplace=True) # Dropping the CPU and Cpu␣
↪Name column because we have created a new column Cpu brand
```

[223] :
```
df.drop(columns=['Memory'], inplace=True)
```

[224] :
```
df.head()
```

[224]:

	Company	TypeName	Ram	Gpu	OpSys	Weight	\
0	Apple	Ultrabook	8	Intel Iris Plus Graphics 640	macOS	1.37	
1	Apple	Ultrabook	8	Intel HD Graphics 6000	macOS	1.34	
2	HP	Notebook	8	Intel HD Graphics 620	No OS	1.86	
3	Apple	Ultrabook	16	AMD Radeon Pro 455	macOS	1.83	
4	Apple	Ultrabook	8	Intel Iris Plus Graphics 650	macOS	1.37	

	Price	Touchscreen	IPS	ppi	Cpu brand
0	71378.6832	0	1	226.983005	Intel Core i5
1	47895.5232	0	0	127.677940	Intel Core i5
2	30636.0000	0	0	141.211998	Intel Core i5
3	135195.3360	0	1	220.534624	Intel Core i7
4	96095.8080	0	1	226.983005	Intel Core i5

[225] :
```
df['Gpu'].unique()
```

[225] :
```
array(['Intel Iris Plus Graphics 640', 'Intel HD Graphics 6000',
       'Intel HD Graphics 620', 'AMD Radeon Pro 455',
       'Intel Iris Plus Graphics 650', 'AMD Radeon R5',
       'Intel Iris Pro Graphics', 'Nvidia GeForce MX150',
       'Intel UHD Graphics 620', 'Intel HD Graphics 520',
       'AMD Radeon Pro 555', 'AMD Radeon R5 M430',
       'Intel HD Graphics 615', 'AMD Radeon Pro 560',
       'Nvidia GeForce 940MX', 'Intel HD Graphics 400',
       'Nvidia GeForce GTX 1050', 'AMD Radeon R2', 'AMD Radeon 530',
       'Nvidia GeForce 930MX', 'Intel HD Graphics',
       'Intel HD Graphics 500', 'Nvidia GeForce 930MX ',
       'Nvidia GeForce GTX 1060', 'Nvidia GeForce 920MX',
       'AMD Radeon R4 Graphics', 'AMD Radeon 520',
       'Nvidia GeForce GTX 1070', 'Nvidia GeForce GTX 1050 Ti',
       'Nvidia GeForce MX130', 'AMD R4 Graphics',
       'Nvidia GeForce GTX 940MX', 'AMD Radeon RX 560',
       'Nvidia GeForce 920M', 'AMD Radeon R7 M445', 'AMD Radeon RX 550',
       'Nvidia GeForce GTX 1050M', 'Intel HD Graphics 515',
       'AMD Radeon R5 M420', 'Intel HD Graphics 505',
       'Nvidia GTX 980 SLI', 'AMD R17M-M1-70', 'Nvidia GeForce 150MX',
       'Nvidia GeForce GTX 1080', 'Nvidia Quadro M1200',
       'Nvidia GeForce 920MX ', 'Nvidia GeForce GTX 950M',
       'AMD FirePro W4190M ', 'Nvidia GeForce GTX 980M',
       'Intel Iris Graphics 550', 'AMD Radeon RX 580',
       'Nvidia GeForce 930M', 'Intel HD Graphics 630',
       'AMD Radeon R5 430', 'Nvidia GeForce GTX 940M',
       'Intel HD Graphics 510', 'Intel HD Graphics 405',
       'AMD Radeon RX 540', 'Nvidia GeForce GT 940MX',
       'AMD FirePro W5130M', 'Nvidia Quadro M2200M', 'AMD Radeon R4',
       'Nvidia Quadro M620', 'AMD Radeon R7 M460',
       'Intel HD Graphics 530', 'Nvidia GeForce GTX 965M',
       'Nvidia GeForce GTX1080', 'Nvidia GeForce GTX1050 Ti',
       'Nvidia GeForce GTX 960M', 'AMD Radeon R2 Graphics',
       'Nvidia Quadro M620M', 'Nvidia GeForce GTX 970M',
       'Nvidia GeForce GTX 960<U+039C>', 'Intel Graphics 620',
       'Nvidia GeForce GTX 960', 'AMD Radeon R5 520',
       'AMD Radeon R7 M440', 'AMD Radeon R7', 'Nvidia Quadro M520M',
       'Nvidia Quadro M2200', 'Nvidia Quadro M2000M',
```

```
       'Intel HD Graphics 540', 'Nvidia Quadro M1000M', 'AMD Radeon 540',
       'Nvidia GeForce GTX 1070M', 'Nvidia GeForce GTX1060',
       'Intel HD Graphics 5300', 'AMD Radeon R5 M420X',
       'AMD Radeon R7 Graphics', 'Nvidia GeForce 920',
       'Nvidia GeForce 940M', 'Nvidia GeForce GTX 930MX',
       'AMD Radeon R7 M465', 'AMD Radeon R3', 'Nvidia GeForce GTX 1050Ti',
       'AMD Radeon R7 M365X', 'Intel Iris Graphics 540',
       'AMD Radeon R9 M385', 'Intel HD Graphics 620 ',
       'Nvidia Quadro 3000M', 'Nvidia GeForce GTX 980 ',
       'AMD Radeon R5 M330', 'AMD FirePro W4190M', 'AMD FirePro W6150M',
       'AMD Radeon R5 M315', 'Nvidia Quadro M500M', 'AMD Radeon R7 M360',
      'Nvidia Quadro M3000M', 'Nvidia GeForce 960M', 'ARM Mali T860 MP4'],
      dtype=object)
```

[226] :
```
df['Gpu'].apply(lambda x:x.split()[0])
```

[226]:
```
0       Intel
1       Intel
2       Intel
3         AMD
4       Intel
        ...
1301    Intel
1302    Intel
1303    Intel
1304      AMD
1305    Intel
Name: Gpu, Length: 1296, dtype: object
```

[227] :
```
df['Gpu brand'] = df['Gpu'].apply(lambda x:x.split()[0])
```

[228] :
```
df.head()
```

[228]:

	Company	TypeName	Ram	Gpu	OpSys	Weight	Price	Touchscreen	IPS	ppi	Cpu brand	Gpu brand
0	Apple	Ultrabook	8	Intel Iris Plus Graphics 640	macOS	1.37	71378.6832			226.983005	Intel Core i5	Intel
1	Apple	Ultrabook	8	Intel HD Graphics 6000	macOS	1.34	47895.5232			127.677940	Intel Core i5	Intel
2	HP	Notebook	8	Intel HD Graphics 620	No OS	1.86	30636.0000			141.211998	Intel Core i5	Intel
3	Apple	Ultrabook	16	AMD Radeon Pro 455	macOS	1.83	135195.3360			220.534624	Intel Core i7	AMD
4	Apple	Ultrabook	8	Intel Iris Plus Graphics 650	macOS	1.37	96095.8080			226.983005	Intel Core i5	Intel

[229] :
```
df.drop(columns=['Gpu'], inplace=True)   # Drop the GPU column
```

[230] :
```
df.head()
```

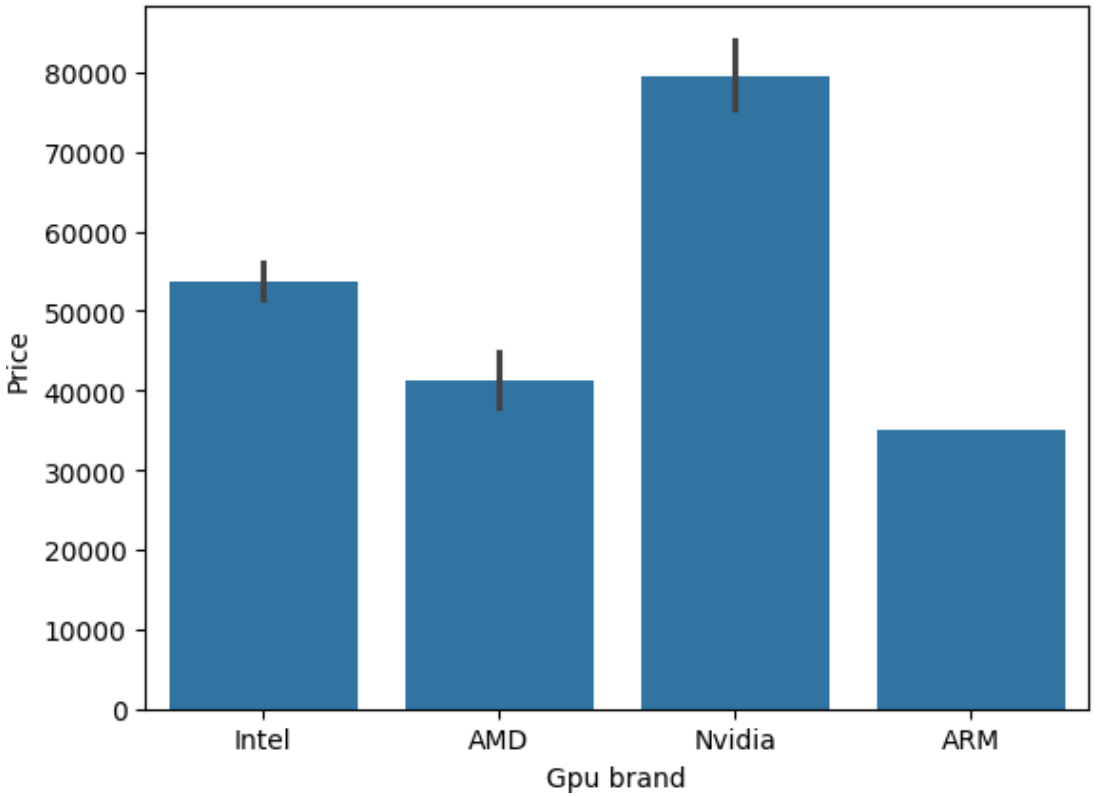
[230] :

	Company	TypeName	Ram	OpSys	Weight	Price	Touchscreen	IPS	\
0	Apple	Ultrabook	8	macOS	1.37	71378.6832	0	1	
1	Apple	Ultrabook	8	macOS	1.34	47895.5232	0	0	
2	HP	Notebook	8	No OS	1.86	30636.0000	0	0	
3	Apple	Ultrabook	16	macOS	1.83	135195.3360	0	1	
4	Apple	Ultrabook	8	macOS	1.37	96095.8080	0	1	

	ppi	Cpu brand	Gpu brand
0	226.983005	Intel Core i5	Intel
1	127.677940	Intel Core i5	Intel
2	141.211998	Intel Core i5	Intel
3	220.534624	Intel Core i7	AMD
4	226.983005	Intel Core i5	Intel

[231] :
```
sns.barplot(x=df['Gpu brand'], y=df['Price'])
```

[231] : <Axes: xlabel='Gpu brand', ylabel='Price'>



[232] :
```
df['OpSys'].value_counts()
```

[232] :
```
OpSys
Windows 10      1068
No OS             64
Linux             62
Windows 7         45
Chrome OS         27
macOS             12
Mac OS X           8
Windows 10 S       8
Android            2
Name: count, dtype: int64
```

[233] :
```
def cat_os(input):      # cat_os means category of OS
  if input == 'Windows 10' or input == 'Windows 7' or input == 'Windows 10 S':
    return 'Windows'
  elif input == 'macOS' or input == 'Mac OS X':
    return 'Mac'
  else:
    return 'Other OS/Linux/No OS'
```

[234] :
```
df['os'] = df['OpSys'].apply(cat_os)
```

[235] :
```
df.head()
```

[235]:

	Company	TypeName	Ram	OpSys	Weight	Price	Touchscreen	IPS	\
0	Apple	Ultrabook	8	macOS	1.37	71378.6832	0	1	
1	Apple	Ultrabook	8	macOS	1.34	47895.5232	0	0	
2	HP	Notebook	8	No OS	1.86	30636.0000	0	0	
3	Apple	Ultrabook	16	macOS	1.83	135195.3360	0	1	
4	Apple	Ultrabook	8	macOS	1.37	96095.8080	0	1	

	ppi	Cpu brand	Gpu brand	os
0	226.983005	Intel Core i5	Intel	Mac
1	127.677940	Intel Core i5	Intel	Mac
2	141.211998	Intel Core i5	Intel	Other OS/Linux/No OS
3	220.534624	Intel Core i7	AMD	Mac
4	226.983005	Intel Core i5	Intel	Mac

[236] :
```
df.drop(columns=['OpSys'], inplace=True)
```

[237] :
```
df.head()
```

[237] :

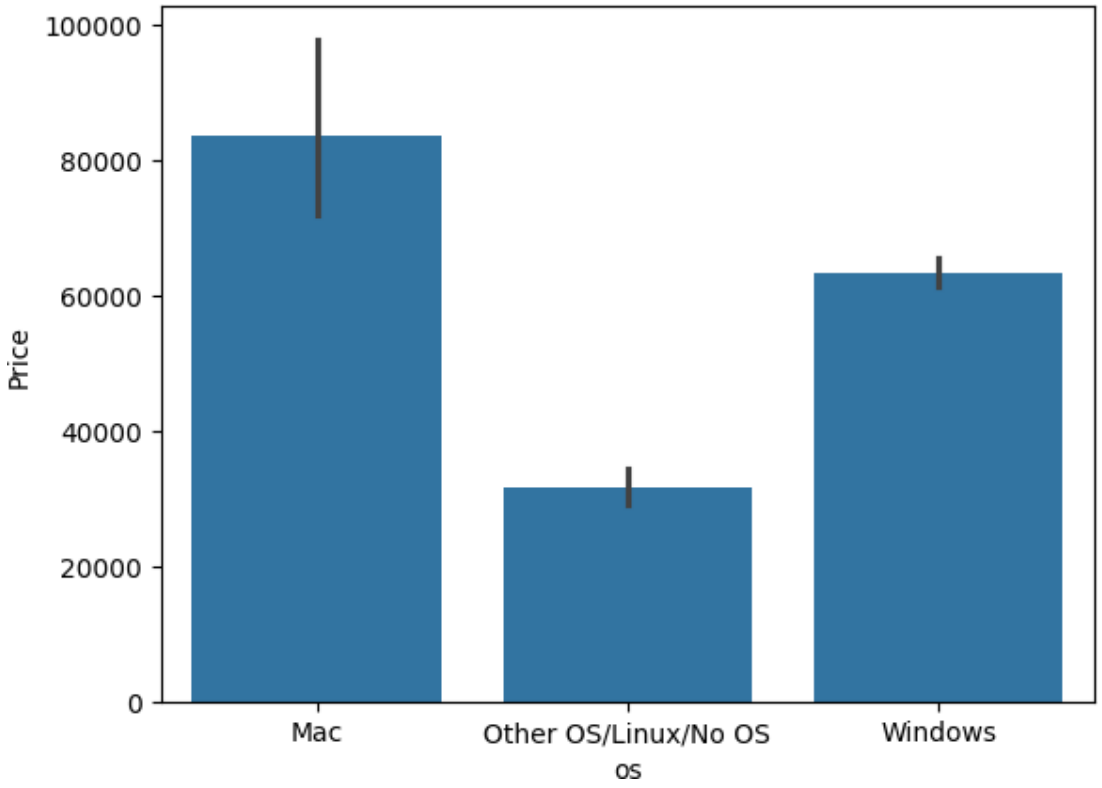
	Company	TypeName	Ram	Weight	Price	Touchscreen	IPS	ppi	\
0	Apple	Ultrabook	8	1.37	71378.6832	0	1	226.983005	
1	Apple	Ultrabook	8	1.34	47895.5232	0	0	127.677940	

2	HP	Notebook	8	1.86	30636.0000		0	0	141.211998
3	Apple	Ultrabook	16	1.83	135195.3360		0	1	220.534624
4	Apple	Ultrabook	8	1.37	96095.8080		0	1	226.983005

	Cpu brand	Gpu brand	os
0	Intel Core i5	Intel	Mac
1	Intel Core i5	Intel	Mac
2	Intel Core i5	Intel	Other OS/Linux/No OS
3	Intel Core i7	AMD	Mac
4	Intel Core i5	Intel	Mac

[238] :
```
sns.barplot(x=df['os'], y=df['Price'])
```

[238] : <Axes: xlabel='os', ylabel='Price'>



Weight

[239] :
```
sns.distplot(df['Weight'])
```

<ipython-input-239-05ee4c8848be>:1: UserWarning:

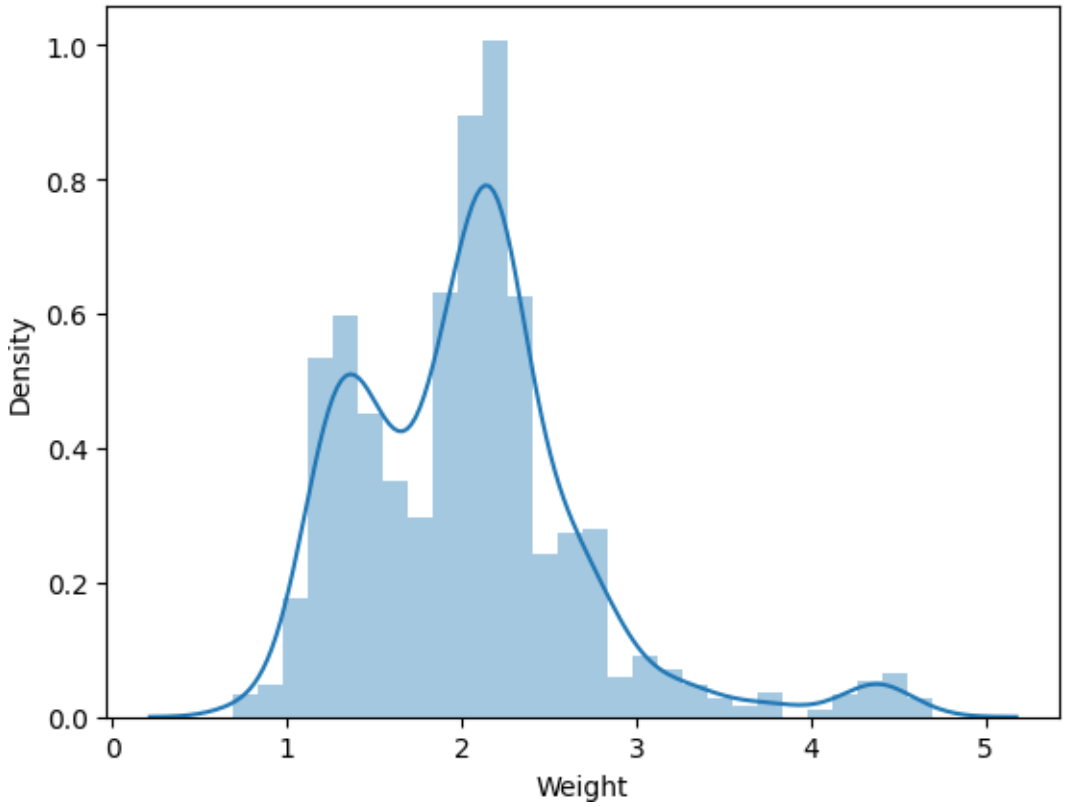
`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

```
sns.distplot(df['Weight'])
```

[239] : <Axes: xlabel='Weight', ylabel='Density'>



[240] :
```
df.dtypes
```

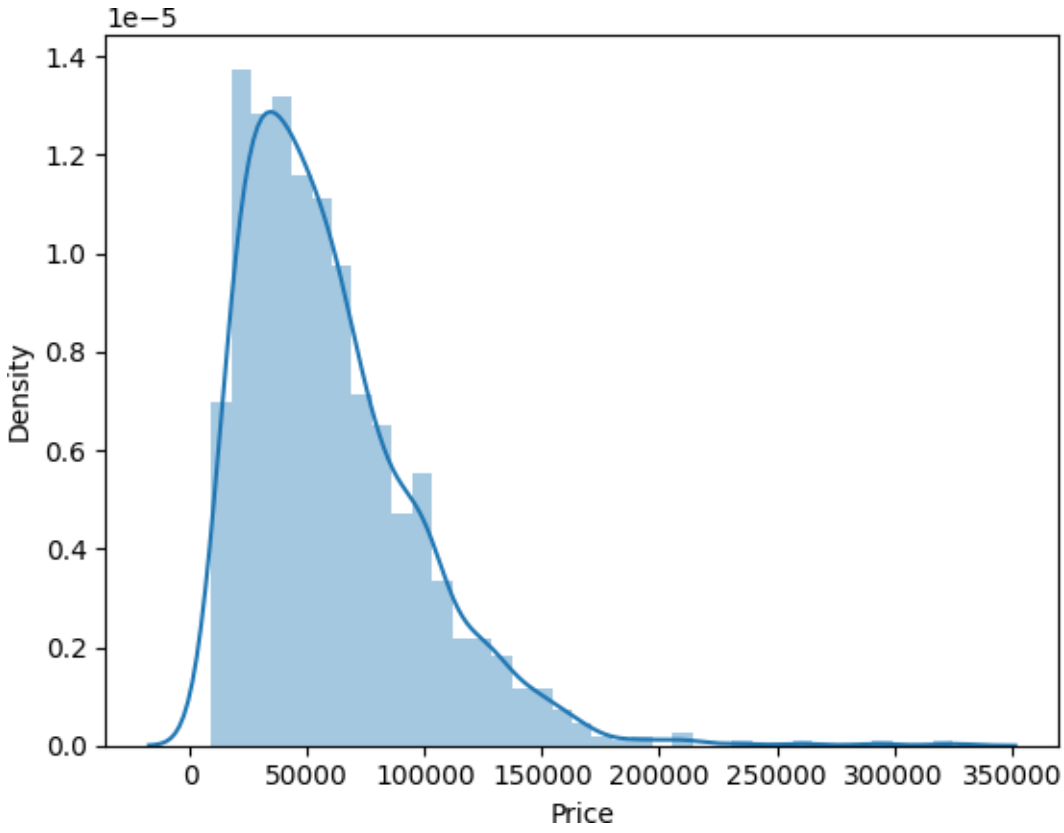
[240] :
```
Company          object
TypeName         object
Ram               int32
Weight          float32
Price           float64
Touchscreen       int64
IPS               int64
ppi             float64
```

```
Cpu brand       object
Gpu brand       object
os              object
dtype: object
```

[241] :
```
sns.distplot(df['Price'])        # We can see the graph is skewed
```

```
<ipython-input-241-0a9ec3ba582e>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(df['Price'])          # We can see the graph is skewed
```

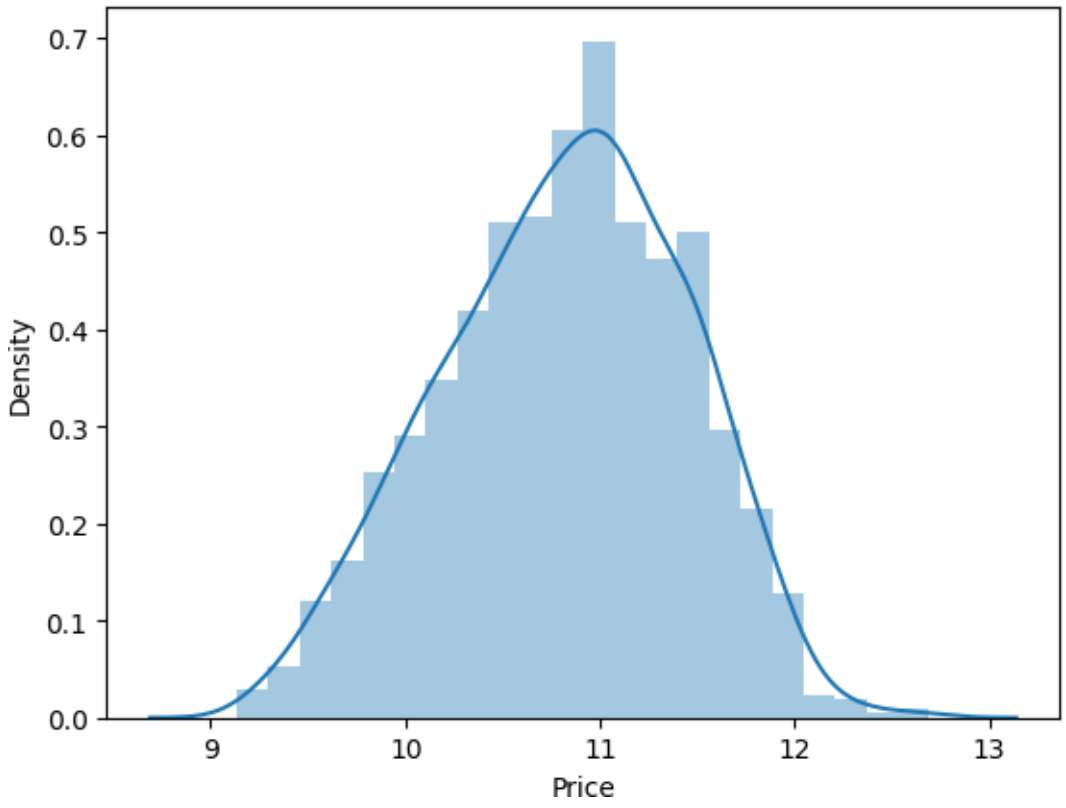
[241] : <Axes: xlabel='Price', ylabel='Density'>



[242] :
```
sns.distplot(np.log(df['Price']))      # Normalized graph
```

```
<ipython-input-242-cfba2a5ffa37>:1: UserWarning:

`distplot` is a deprecated function and will be removed in seaborn v0.14.0.

Please adapt your code to use either `displot` (a figure-level function with
similar flexibility) or `histplot` (an axes-level function for histograms).

For a guide to updating your code to use the new functions, please see
https://gist.github.com/mwaskom/de44147ed2974457ad6372750bbe5751

  sns.distplot(np.log(df['Price']))          # Normalized graph
```

[242] : <Axes: xlabel='Price', ylabel='Density'>



[243] :
```
X = df.drop(columns=['Price'])
y = np.log(df['Price'])        # To normalise the data
```

[244] :
```
X
```

[244] :

	Company	TypeName	Ram	Weight	Touchscreen	IPS	ppi	Cpu brand	Gpu brand	os
0	Apple	Ultrabook	8	1.37	0	1	226.983005	Intel Core i5	Intel	Mac
1	Apple	Ultrabook	8	1.34	0	0	127.677940	Intel Core i5	Intel	Mac
2	HP	Notebook	8	1.86	0	0	141.211998	Intel Core i5	Intel	Other OS/Linux/No OS
3	Apple	Ultrabook	16	1.83	0	1	220.534624	Intel Core i7	AMD	Mac
4	Apple	Ultrabook	8	1.37	0	1	226.983005	Intel Core i5	Intel	Mac
...	...	...	...	...	...	...	...	...	...	...
1301	Lenovo	2 in 1 Convertible	4	1.80	1	1	157.350512	Intel Core i7	Intel	Windows
1302	Lenovo	2 in 1 Convertible	16	1.30	1	1	276.053530	Intel Core i7	Intel	Windows
1303	Lenovo	Notebook	2	1.50	0	0	111.935204	Other Intel Processor	Intel	Windows
1304	HP	Notebook	6	2.19	0	0	100.454670	Intel Core i7	AMD	Windows
1305	Asus	Notebook	4	2.20	0	0	100.454670	Other Intel Processor	Intel	Windows

[1296 rows x 10 columns]

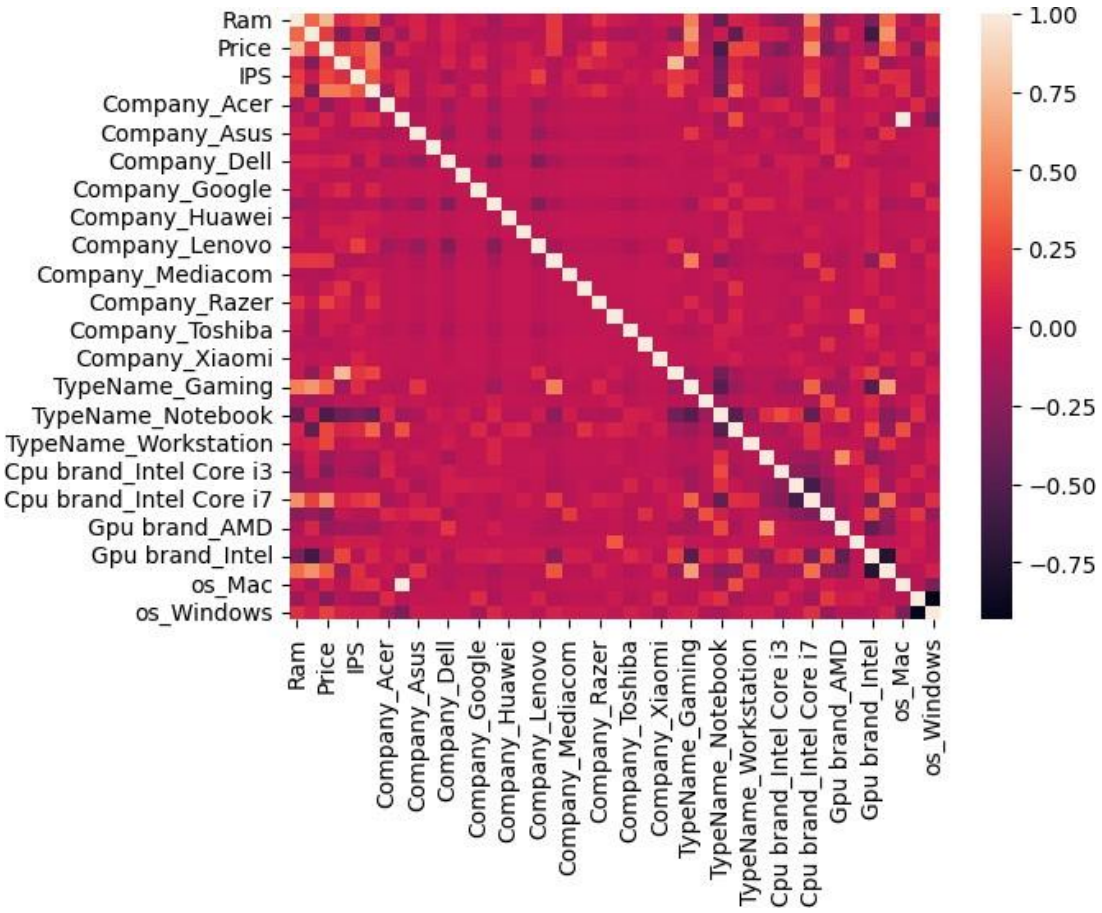
[245] :
```
y
```

[245]:
```
0        11.175755
1        10.776777
2        10.329931
3        11.814476
4        11.473101
           ...
1301     10.433899
1302     11.288115
1303      9.409283
1304     10.614129
1305      9.886358
Name: Price, Length: 1296, dtype: float64
```

[246] :
```
from sklearn.compose import ColumnTransformer
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error
from sklearn.preprocessing import OneHotEncoder
```

[260]:
```
sns.heatmap(df_encoded.corr())
```

[260]: <Axes: >



[247] :
```
df_encoded = pd.get_dummies(df, columns=['Company', 'TypeName', 'Cpu brand',
↪'Gpu brand', 'os'])
```

[248] :
```
df_encoded
```

[248]:

	Ram	Weight	Price	Touchscreen	IPS	ppi	Company_Acer \
0	8	1.37	71378.6832	0	1	226.983005	False
1	8	1.34	47895.5232	0	0	127.677940	False
2	8	1.86	30636.0000	0	0	141.211998	False
3	16	1.83	135195.3360	0	1	220.534624	False
4	8	1.37	96095.8080	0	1	226.983005	False
...	...	...	...	...	...	...	
1301	4	1.80	33992.6400	1	1	157.350512	False
1302	16	1.30	79866.7200	1	1	276.053530	False

```
1303    2    1.50   12201.1200            0    0  111.935204         False
1304    6    2.19   40705.9200            0    0  100.454670         False
1305    4    2.20   19660.3200            0    0  100.454670         False

      Company_Apple  Company_Asus  Company_Chuwi  ...  \
0              True         False          False  ...
1              True         False          False  ...
2             False         False          False  ...
3              True         False          False  ...
4              True         False          False  ...
...             ...           ...            ...  ...
1301          False         False          False  ...
1302          False         False          False  ...
1303          False         False          False  ...
1304          False         False          False  ...
1305          False          True          False  ...

      Cpu brand_Intel Core i5  Cpu brand_Intel Core i7  \
0                        True                    False
1                        True                    False
2                        True                    False
3                       False                     True
4                        True                    False
...                       ...                      ...
1301                    False                     True
1302                    False                     True
1303                    False                    False
1304                    False                     True
1305                    False                    False

      Cpu brand_Other Intel Processor  Gpu brand_AMD  Gpu brand_ARM  \
0                               False          False          False
1                               False          False          False
2                               False          False          False
3                               False           True          False
4                               False          False          False
...                               ...            ...            ...
1301                            False          False          False
1302                            False          False          False
1303                             True          False          False
1304                            False           True          False
1305                             True          False          False

      Gpu brand_Intel  Gpu brand_Nvidia  os_Mac  os_Other  OS/Linux/No OS  \
0                True             False    True                     False
1                True             False    True                     False
2                True             False   False                      True
```

```
3                False                False     True                    False
4                 True                False     True                    False
...               ...                 ...       ...                     ...
1301              True                False     False                   False
1302              True                False     False                   False
1303              True                False     False                   False
1304             False                False     False                   False
1305              True                False     False                   False

      os_Windows
0          False
1          False
2          False
3          False
4          False
...          ...
1301        True
1302        True
1303        True
1304        True
1305        True

[1296 rows x 43 columns]
```

[249]:
```
df_encoded.columns
```

[249] :
```
Index(['Ram', 'Weight', 'Price', 'Touchscreen', 'IPS', 'ppi', 'Company_Acer',
       'Company_Apple', 'Company_Asus', 'Company_Chuwi', 'Company_Dell',
       'Company_Fujitsu', 'Company_Google', 'Company_HP', 'Company_Huawei',
       'Company_LG', 'Company_Lenovo', 'Company_MSI', 'Company_Mediacom',
       'Company_Microsoft', 'Company_Razer', 'Company_Samsung',
       'Company_Toshiba', 'Company_Vero', 'Company_Xiaomi',
       'TypeName_2 in 1 Convertible', 'TypeName_Gaming', 'TypeName_Netbook',
       'TypeName_Notebook', 'TypeName_Ultrabook', 'TypeName_Workstation',
       'Cpu brand_AMD Processor', 'Cpu brand_Intel Core i3',
       'Cpu brand_Intel Core i5', 'Cpu brand_Intel Core i7',
       'Cpu brand_Other Intel Processor', 'Gpu brand_AMD', 'Gpu brand_ARM',
       'Gpu brand_Intel', 'Gpu brand_Nvidia', 'os_Mac',
       'os_Other OS/Linux/No OS', 'os_Windows'],
      dtype='object')
```

[250] :
```
X = df_encoded.drop('Price', axis=1)  # 'Price' is your target variable
y = np.log(df_encoded['Price'])
```

[251] :
```
X
```

[251]:

	Ram	Weight	Touchscreen	IPS	ppi	Company_Acer	Company_Apple	\
0	8	1.37	0	1	226.983005	False	True	
1	8	1.34	0	0	127.677940	False	True	
2	8	1.86	0	0	141.211998	False	False	
3	16	1.83	0	1	220.534624	False	True	
4	8	1.37	0	1	226.983005	False	True	
...	...	...	...	...	...	...	...	
1301	4	1.80	1	1	157.350512	False	False	
1302	16	1.30	1	1	276.053530	False	False	
1303	2	1.50	0	0	111.935204	False	False	
1304	6	2.19	0	0	100.454670	False	False	
1305	4	2.20	0	0	100.454670	False	False	

Company_Asus	Company_Chuwi	Company_Dell	...	Cpu brand_Intel	Core i5	\
False	False	False	...		True	
False	False	False	...		True	
False	False	False	...		True	
False	False	False	...		False	
False	False	False	...		True	
...	...	...	...	...		
False	False	False	...		False	
False	False	False	...		False	
False	False	False	...		False	
False	False	False	...		False	
True	False	False	...		False	

Cpu brand_Intel	Core i7	Cpu brand_Other	Intel Processor	Gpu brand_AMD	\
	False		False	False	
	False		False	False	
	False		False	False	
	True		False	True	
	False		False	False	
	...		...	...	
	True		False	False	
	True		False	False	
	False		True	False	
	True		False	True	
	False		True	False	

Gpu brand_ARM	Gpu brand_Intel	Gpu brand_Nvidia	os_Mac	\
False	True	False	True	
False	True	False	True	
False	True	False	False	
False	False	False	True	
False	True	False	True	
...	...	...	...	
False	True	False	False	

```
1302          False              True              False    False
1303          False              True              False    False
1304          False             False              False    False
1305          False              True              False    False

      os_Other  OS/Linux/No OS  os_Windows
0                         False        False
1                         False        False
2                          True        False
3                         False        False
4                         False        False
...                         ...          ...
1301                      False         True
1302                      False         True
1303                      False         True
1304                      False         True
1305                      False         True

[1296 rows x 42 columns]
```

[252] :
```
y
```

[252]:
```
0        11.175755
1        10.776777
2        10.329931
3        11.814476
4        11.473101
            ...
1301     10.433899
1302     11.288115
1303      9.409283
1304     10.614129
1305      9.886358
Name: Price, Length: 1296, dtype: float64
```

[253] :
```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2,␣
↪random_state=42)
```

[254] :
```
rf_model = RandomForestRegressor(random_state=42)
rf_model.fit(X_train,    y_train)
```

[254] :
```
RandomForestRegressor(random_state=42)
```

[255] :
```
y_pred = rf_model.predict(X_test)
```

[256] :
```
# Evaluate the model
mse = mean_squared_error(y_test, y_pred)
```

```
print("Mean Squared Error:", mse)
```

Mean Squared Error: 0.05299513432325618

[257] :
```
# Calculate RMSE
rmse = np.sqrt(mse)
print("Root Mean Squared Error (RMSE):", rmse)
```

Root Mean Squared Error (RMSE): 0.23020672084727714

[258] :
```
from sklearn.metrics import r2_score

# Calculate R^2 score
r2 = r2_score(y_test, y_pred)

print("R^2 Score:", r2)
```

R^2 Score: 0.8570143929282722