Plotting in Pandas/Matplotlib

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Plotting in Pandas

- We will start by seeing how to make basic plots in pandas from data stored in a pandas dataframe.

- We will then see how to add the following features to our graphs:

    - Change titles/axis titles
    - Annotate the graph
    - Change the window of the graph
    - Customizing axis labels
    - Create multiple plots

Sleep Data

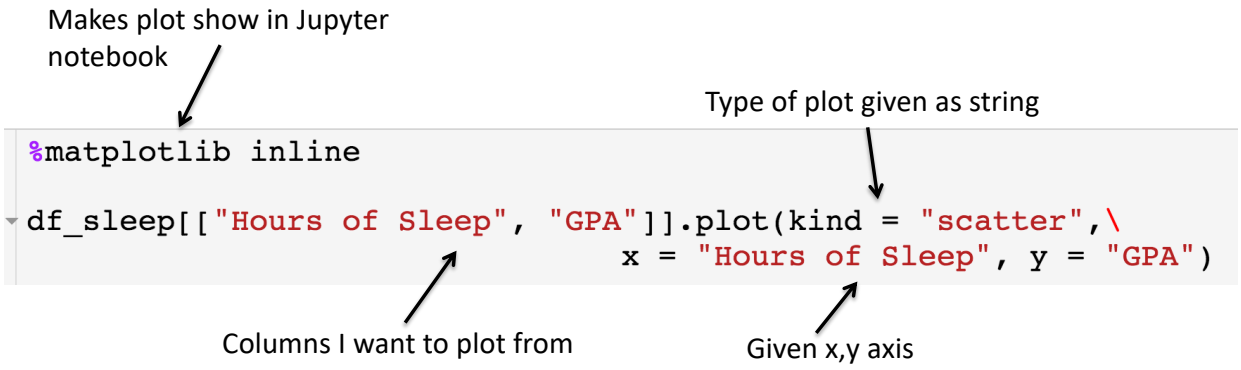
We have the following data on how hours of sleep is related to GPA.

```
df_sleep = pd.read_csv("Data/Sleep.csv")

df_sleep.head()
```

	Gender	Age	Year in College	Hours of Sleep	GPA
0	Female	22	4	7.0	3.80
1	Male	18	1	4.0	3.60
2	Male	19	2	9.0	3.50
3	Female	27	3	7.0	3.00
4	Female	37	3	5.0	3.61

Basic Scatterplot

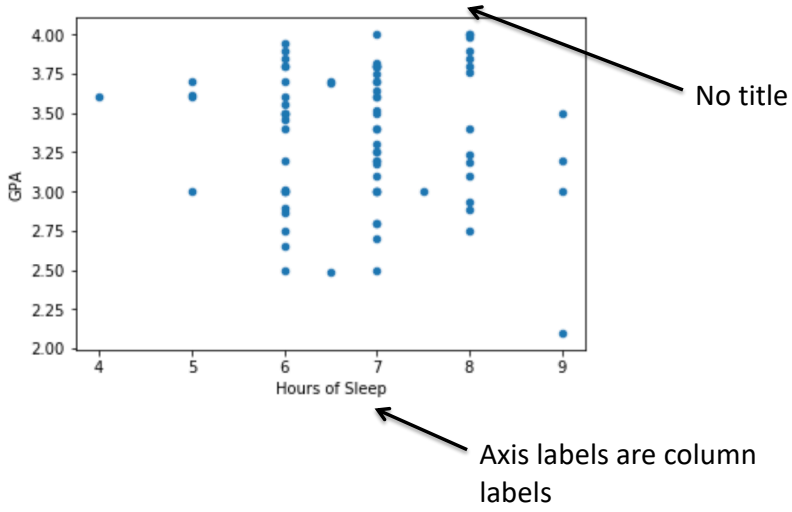


Basic Scatterplot

```
%matplotlib inline

df_sleep[["Hours of Sleep", "GPA"]].plot(kind = "scatter",\
                                         x = "Hours of Sleep", y = "GPA")
```

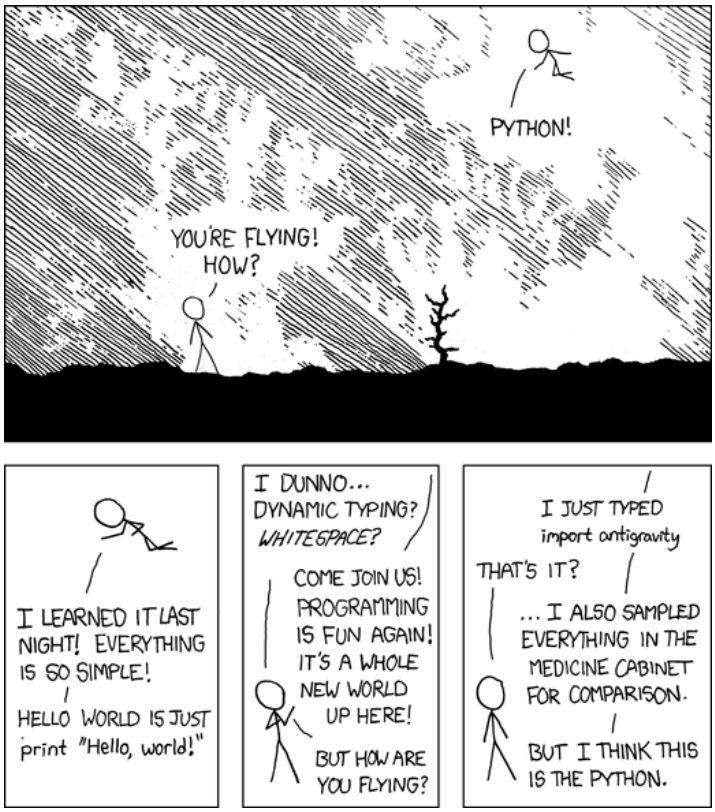
```
<matplotlib.axes._subplots.AxesSubplot at 0x1168c2c18>
```



No title

Axis labels are column labels

Python



Other Types of Plots

pandas.DataFrame.plot

`DataFrame.plot(x=None, y=None, kind='line', ax=None, subplots=False, sharex=None, sharey=False, layout=None, figsize=None, use_index=True, title=None, grid=None, legend=True, style=None, logx=False, logy=False, loglog=False, xticks=None, yticks=None, xlim=None, ylim=None, rot=None, fontsize=None, colormap=None, table=False, yerr=None, xerr=None, secondary_y=False, sort_columns=False, **kwds)` [source]

Make plots of DataFrame using matplotlib / pylab.

New in version 0.17.0: Each plot kind has a corresponding method on the `DataFrame.plot` accessor: `df.plot(kind='line')` is equivalent to `df.plot.line()`.

data *: DataFrame*

x *: label or position, default None*

y *: label or position, default None*

Allows plotting of one column versus another

kind *: str*

- 'line' : line plot (default)
- 'bar' : vertical bar plot
- 'barh' : horizontal bar plot
- 'hist' : histogram
- 'box' : boxplot
- 'kde' : Kernel Density Estimation plot
- 'density' : same as 'kde'
- 'area' : area plot
- 'pie' : pie plot
- 'scatter' : scatter plot
- 'hexbin' : hexbin plot

Basic Barplot

I have computed the average GPA for each. I will show you later on how to do this.

`df_gpa_gender`

	Gender	Avg_GPA
0	Female	3.427000
1	Male	3.285175

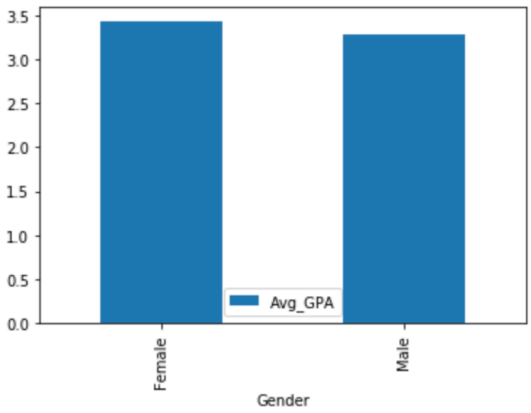
Basic Barplot

```
df_gpa_gender
```

	Gender	Avg_GPA
0	Female	3.427000
1	Male	3.285175

```
df_gpa_gender.plot(kind="bar" , x = "Gender", y = "Avg_GPA")
```

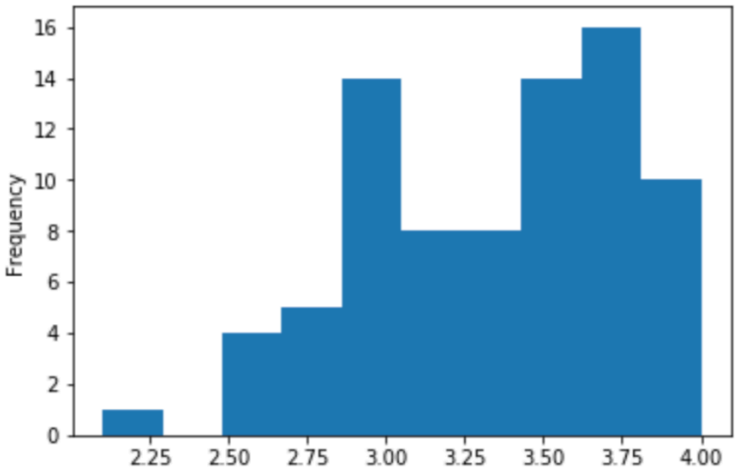
```
<matplotlib.axes._subplots.AxesSubplot at 0x11a6bdfd0>
```



Basic Histogram

```
df_sleep.GPA.plot(kind="hist")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x11a7ed748>
```



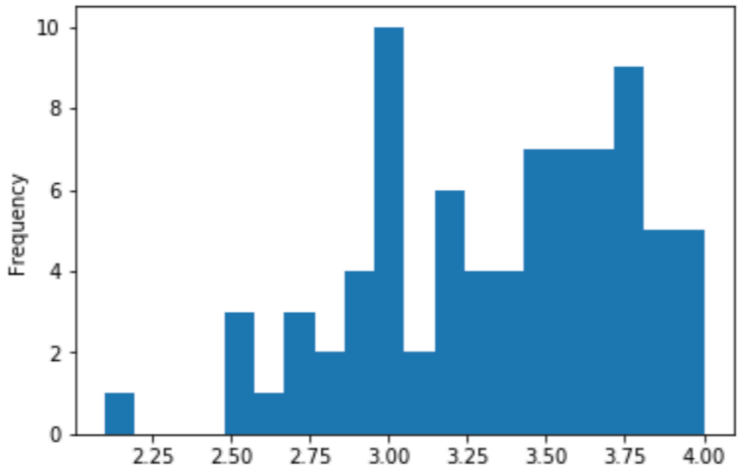
Basic Histogram

```
df_sleep.GPA.plot(kind="hist", bins = 20)
```

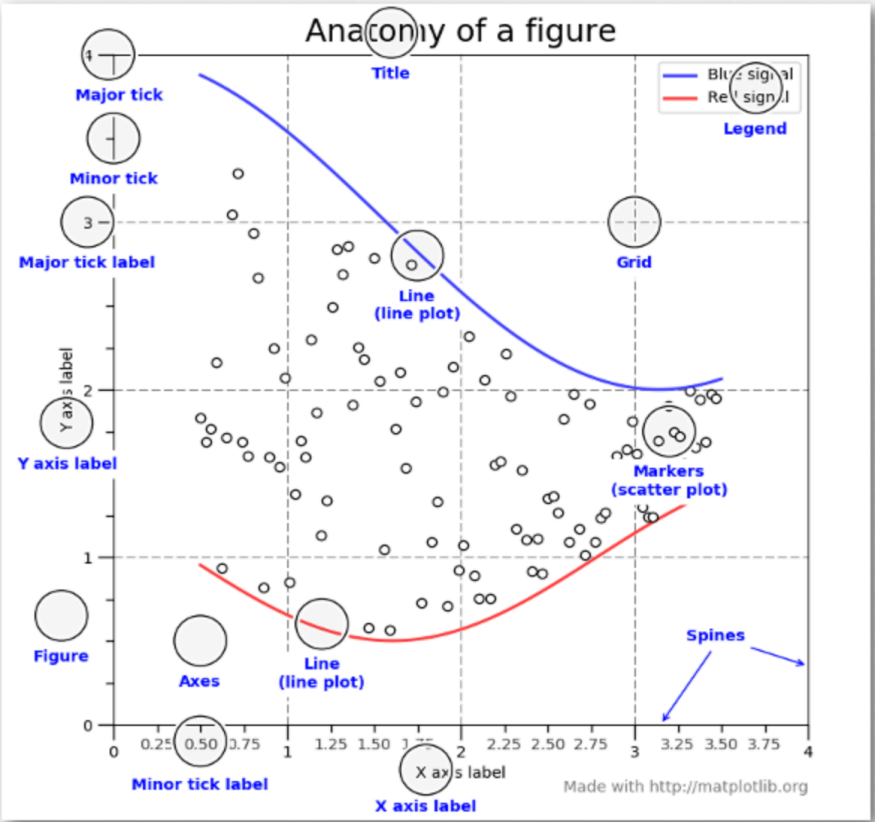
Number of bins to use

Basic Histogram

```
df_sleep.GPA.plot(kind="hist", bins = 20)
```



Customizing the Plots



Sales Data

Consider the data from the top 10 customers:

```
df_top_ten
```

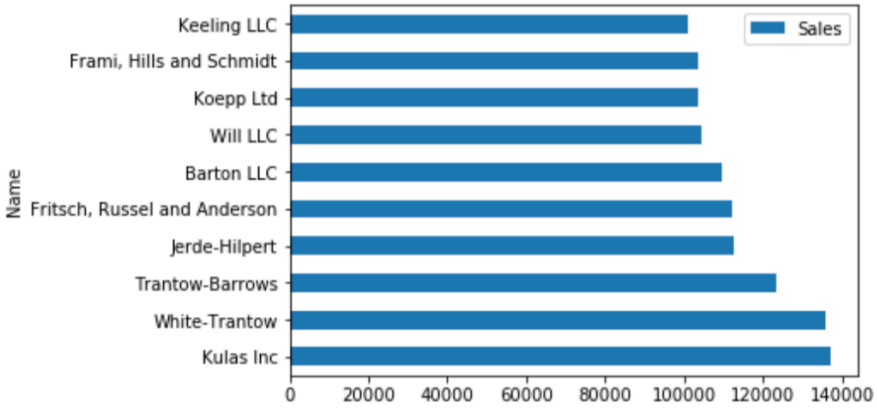
	Name	Sales	Purchases
0	Kulas Inc	137351.96	94
1	White-Trantow	135841.99	86
2	Trantow-Barrows	123381.38	94
3	Jerde-Hilpert	112591.43	89
4	Fritsch, Russel and Anderson	112214.71	81
5	Barton LLC	109438.50	82
6	Will LLC	104437.60	74
7	Koepp Ltd	103660.54	82
8	Frami, Hills and Schmidt	103569.59	72
9	Keeling LLC	100934.30	74

Sales Data

Let's use pandas to create a basic bar plot and then see how we can manipulate it with matplotlib.

```
df_top_ten.plot(kind="barh", y = "Sales", x = "Name")
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x11b269cf8>
```



Maplotlib

We need the following import statement when we want to use matplotlib

```
import matplotlib.pyplot as plt
```

We can use matplotlib to change the styling of our plots:

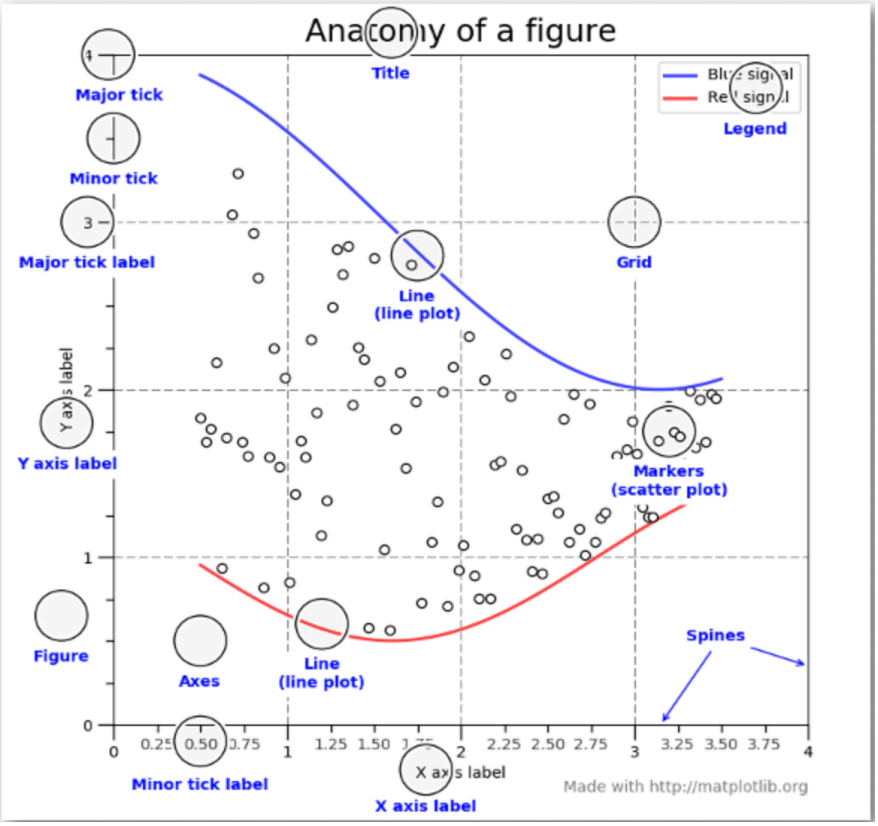
```
#View available styles
print(plt.style.available)
```

```
['bmh', 'classic', 'dark_background', 'fivethirtyeight', 'ggplot', 'grayscale', 'seaborn-bright', 'seaborn-colorblind', 'seaborn-dark-palette', 'seaborn-dark', 'seaborn-darkgrid', 'seaborn-deep', 'seaborn-muted', 'seaborn-notebook', 'seaborn-paper', 'seaborn-pastel', 'seaborn-poster', 'seaborn-talk', 'seaborn-ticks', 'seaborn-white', 'seaborn-whitegrid', 'seaborn']
```

We can change the style as follows:

```
plt.style.use("ggplot")
```

Creating Figure and Axes



Creating Figure + Axis

You will place something like this line of code before every plot that you create. Creates the following to elements of the visualization you want to produce:

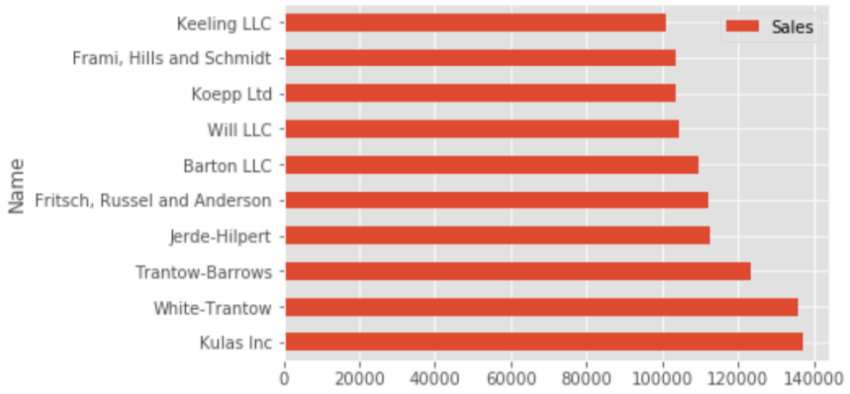
- The variable fig will be the figure, which represents the entire visualization. A figure could contain multiple plots.
    - Adjust size
    - Number of plots
    - Boarders
- The variable ax represents the axes of a single plot
    - Change axis limit/labels/ticks
    - Add multiple plots
    - Change titles

```
#Create figure and axes
fig,ax = plt.subplots()
```

Adding Barplot to Figure

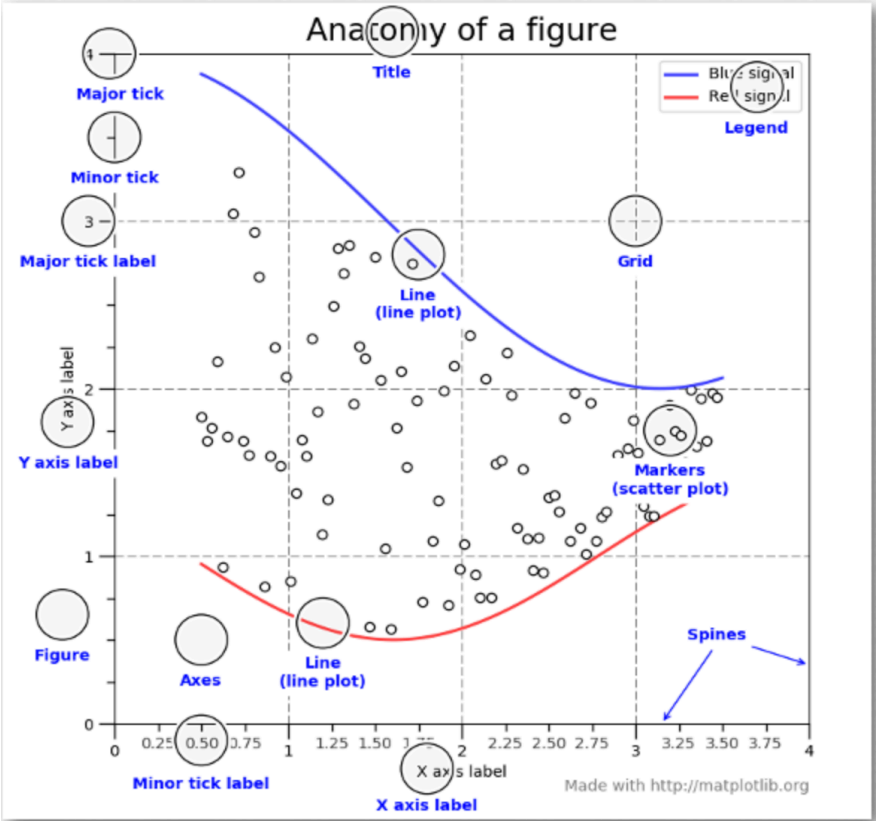
```
#Create figure and axes
fig,ax = plt.subplots()
#Add plot to figure
df_top_ten.plot(kind="barh", y = "Sales", x = "Name", ax=ax )
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x11b607b00>
```



Same plot, but now we can change the plot using attributes of the variables fig and ax.

Changing Features of Axes



Changing Features of Axes

```
#Change x limit
ax.set_xlim([0,140000])
```

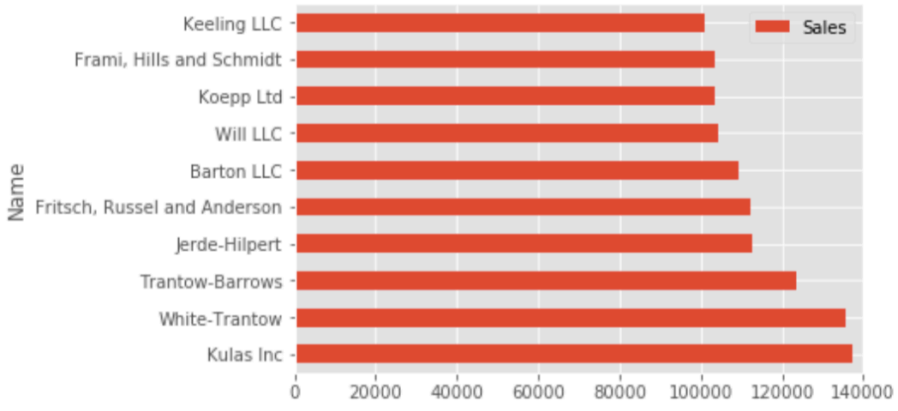
The variable that stores our axes

List of x limits

Changing Features of Axes

```
#Change x limit
ax.set_xlim([0,140000])

#View updated plot
fig
```

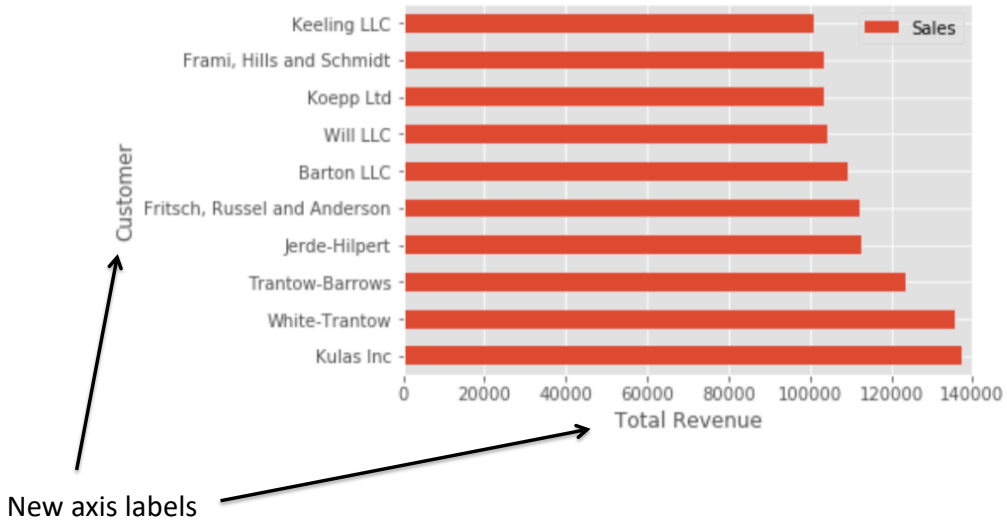


x-axis only goes up to 140000

Changing Features of Axes

```
#Set axis labels
ax.set_xlabel("Total Revenue")
ax.set_ylabel("Customer")

fig
```



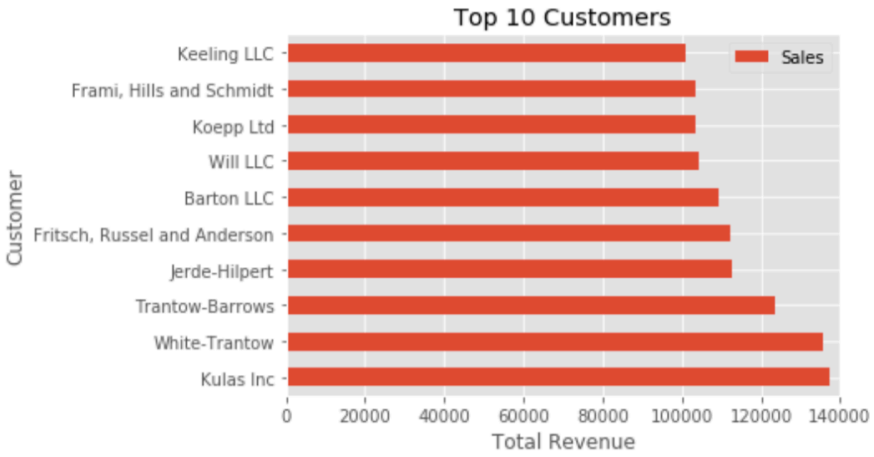
New axis labels

Changing Features of Axes

```
#Adding labels all at once
ax.set(title = "Top 10 Customers", xlabel="Total Revenue",\
       ylabel = "Customer")

fig
```

Title



Change Figure Size

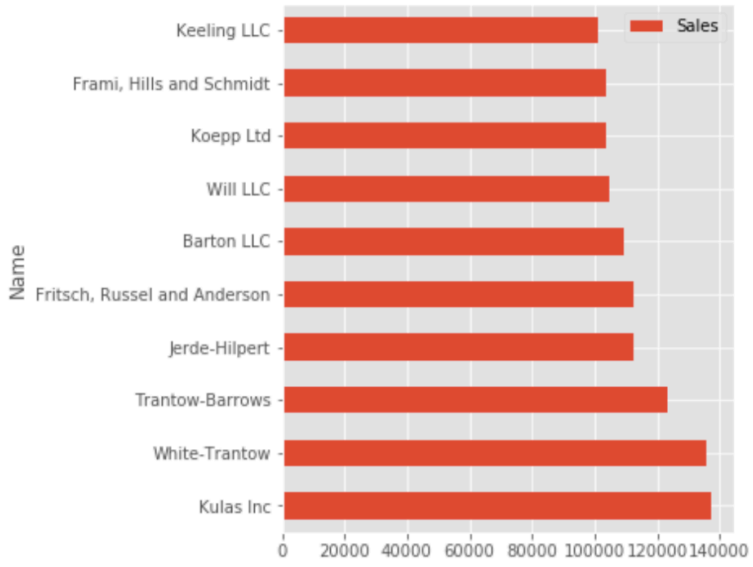
Give list of length of length and width in inches

```
#Change figure size
fig,ax = plt.subplots(figsize = [5,6])
#Add plot to figure
df_top_ten.plot(kind="barh", y = "Sales", x = "Name", ax=ax )
```

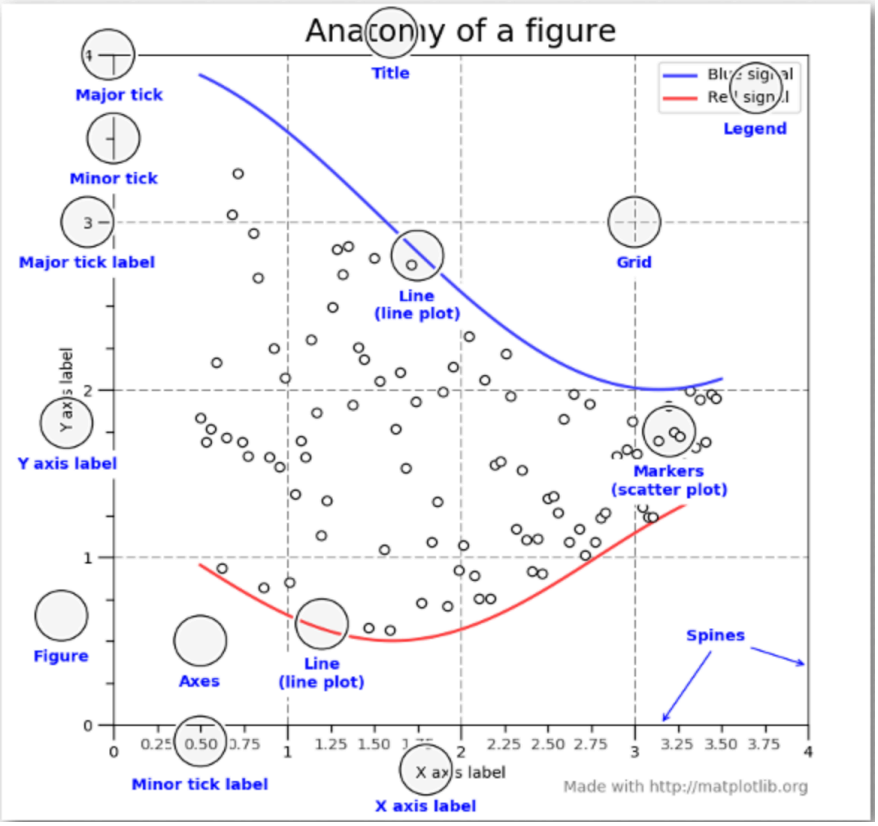
Change Figure Size

```
#Change figure size
fig,ax = plt.subplots(figsize = [5,6])
#Add plot to figure
df_top_ten.plot(kind="barh", y = "Sales", x = "Name", ax=ax )
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x11bc2b748>
```



Move Legend



Move Legend

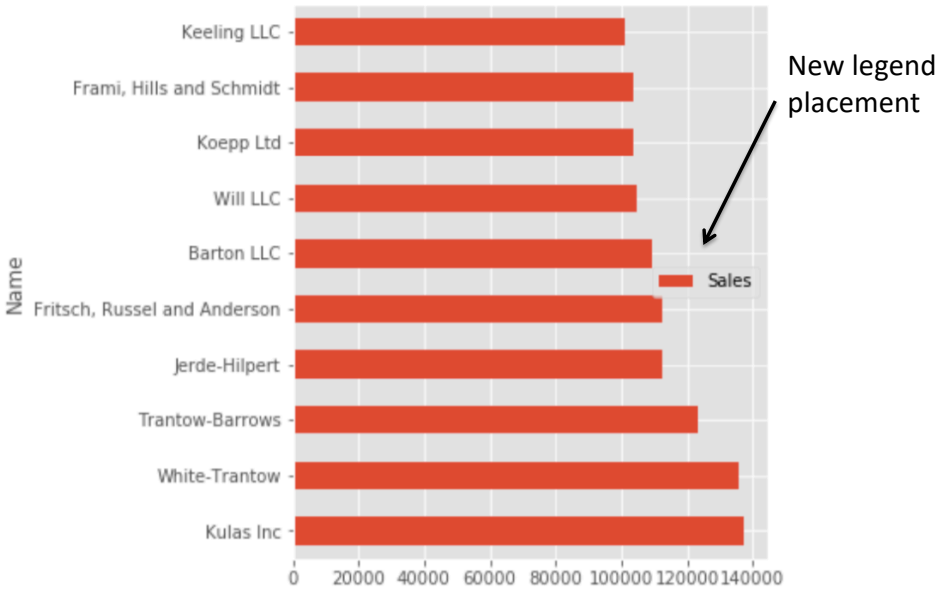
```
#Move Legend
ax.legend(loc = 5)
#View updated figure
fig
```

loc parameter moves legend

Location String	Location Code
'best'	0
'upper right'	1
'upper left'	2
'lower left'	3
'lower right'	4
'right'	5
'center left'	6
'center right'	7
'lower center'	8
'upper center'	9
'center'	10

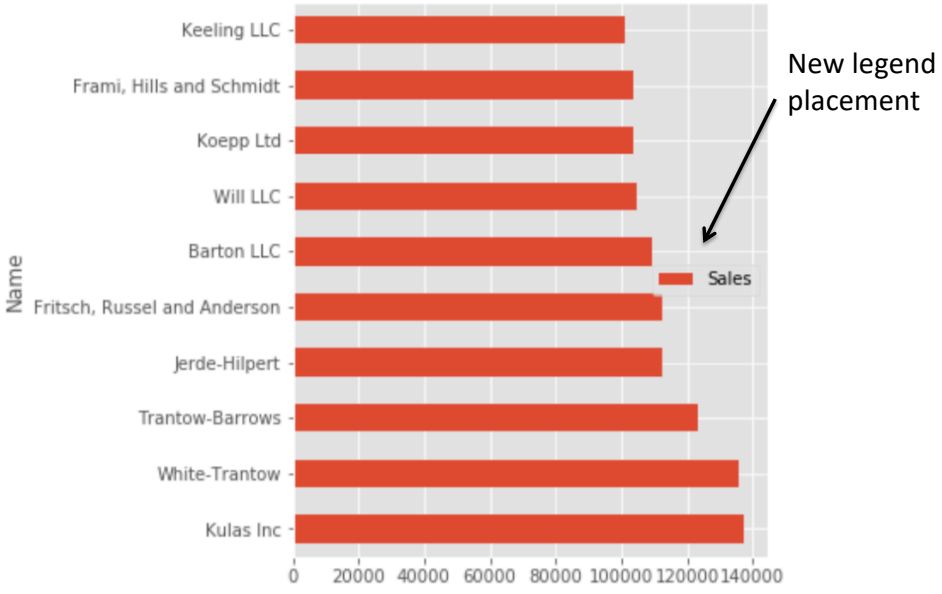
Move Legend

```
#Move Legend
ax.legend(loc = 5)
#View updated figure
fig
```



Move Legend

```
#Move Legend
ax.legend(loc = 5)
#View updated figure
fig
```

Annotate the Plot – Vertical Line

```
#Compute mean revenue
mean_rev = df_top_ten.Sales.mean()
#Add vertical line representing this mean
ax.axvline(x=mean_rev, color='b', label='Average', linestyle='--', linewidth=1)
```

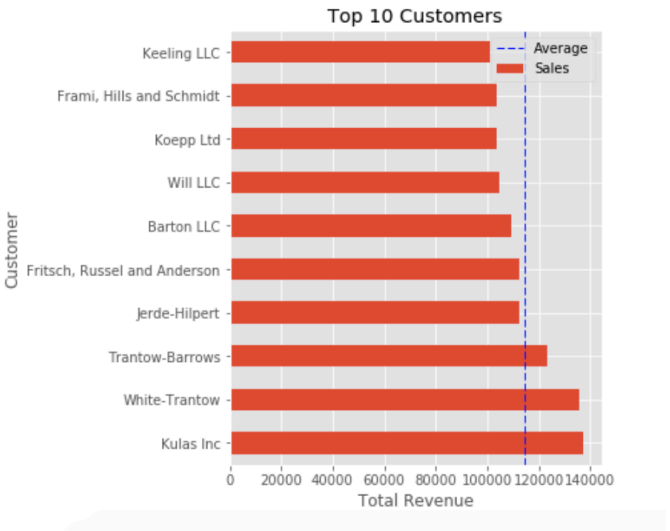
Where to draw vertical line

What do put in legend

Annotate the Plot – Vertical Line

```
#Compute mean revenue
mean_rev = df_top_ten.Sales.mean()
#Add vertical line representing this mean
ax.axvline(x=mean_rev, color='b', label='Average', linestyle='--', linewidth=1)
```

```
#Set legent to best location
ax.legend(loc=0)
fig
```



Annotate the Plot – Add Text

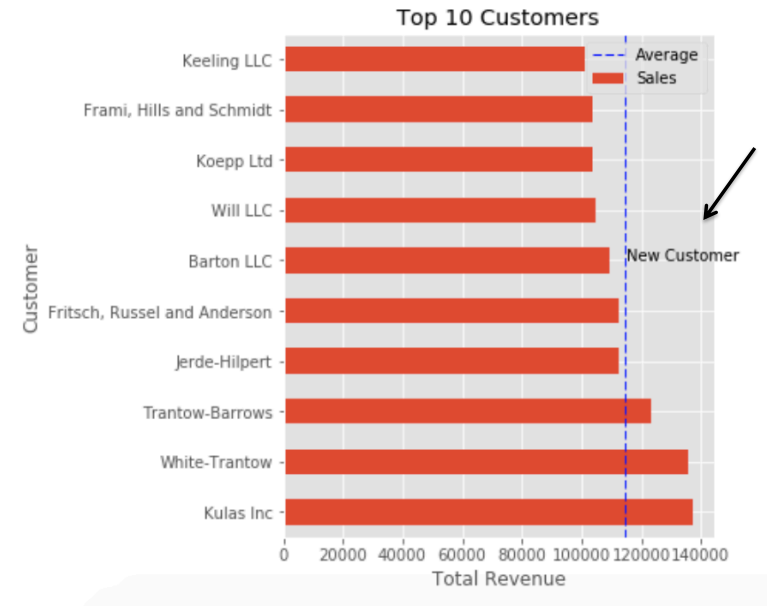
```
#Add Text
ax.text(115000, 5, "New Customer")
fig
```

(x,y) for where to place text

Text to place

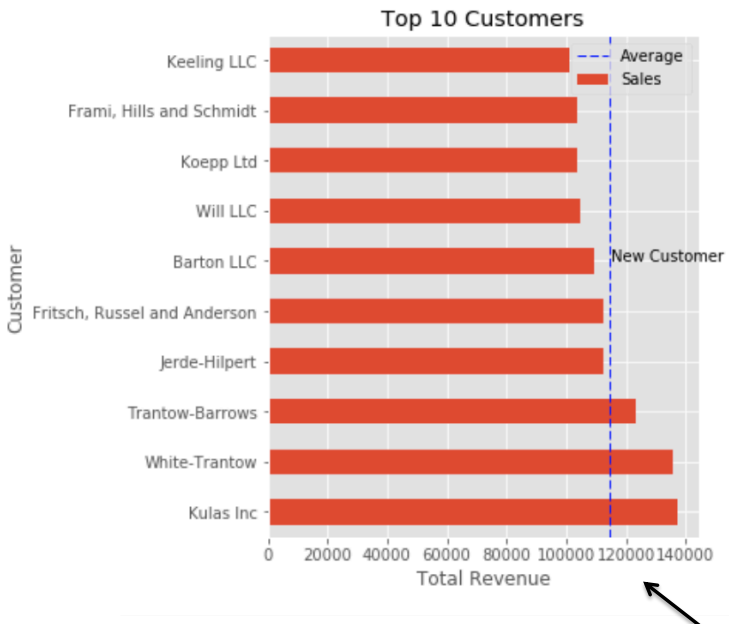
Annotate the Plot – Add Text

```
#Add Text
ax.text(115000, 5, "New Customer")
fig
```



Plot has been annotated

Formatting Axes Labels



Looks cluttered

Formatting Axes Labels

```
from matplotlib.ticker import FuncFormatter
```

Will allow us to write custom function to format axis

Formatting Axes Labels

```
#Function that will format axis
def currency(x, pos):
    """Input x is axis label and pos is the position"""
    in_thousands = int(x/1000)
    new_label = "$%dK"%in_thousands

    return new_label

currency(100000, 1)
```

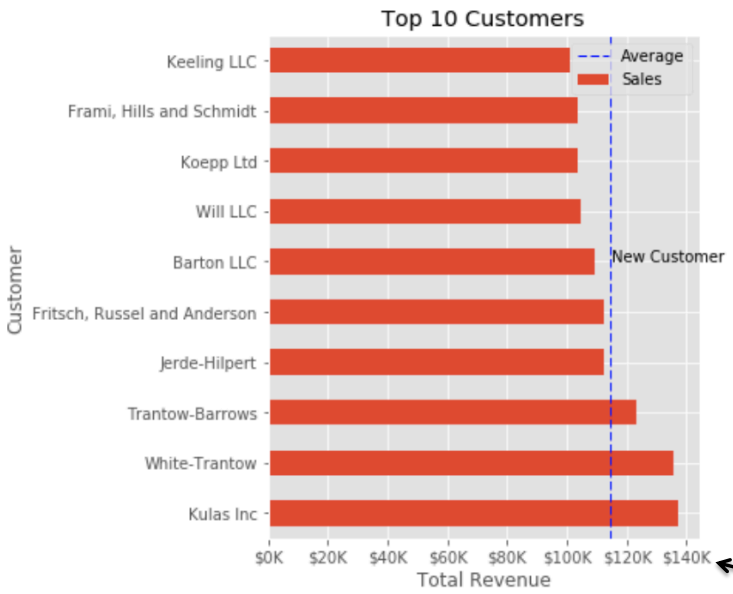
```
'$100K'
```

Formatting Axes Labels

Generic two lines

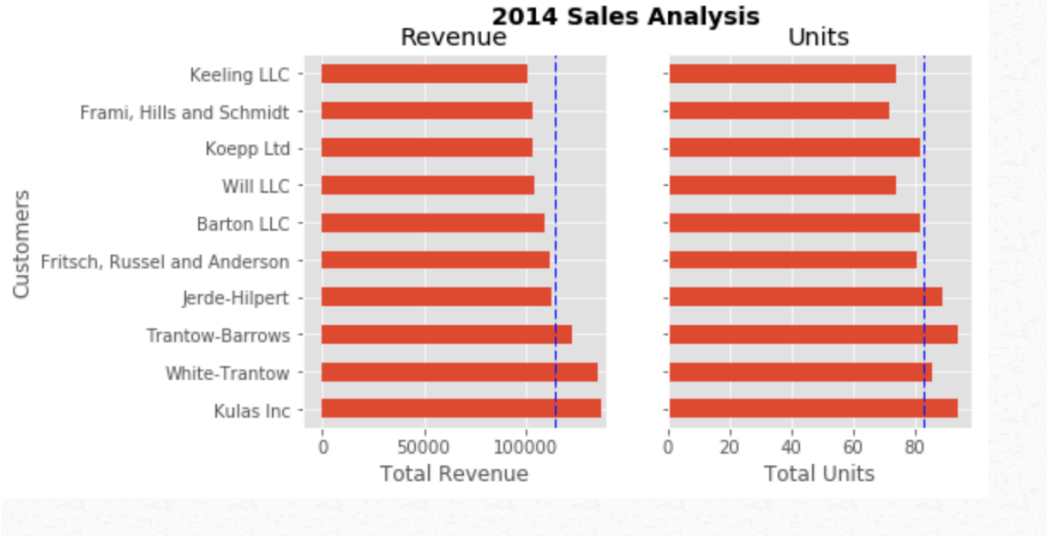
```
#Create Formatter
formatter = FuncFormatter(currency)
#Change x-axis labels
ax.xaxis.set_major_formatter(formatter)
fig
```

Pass function



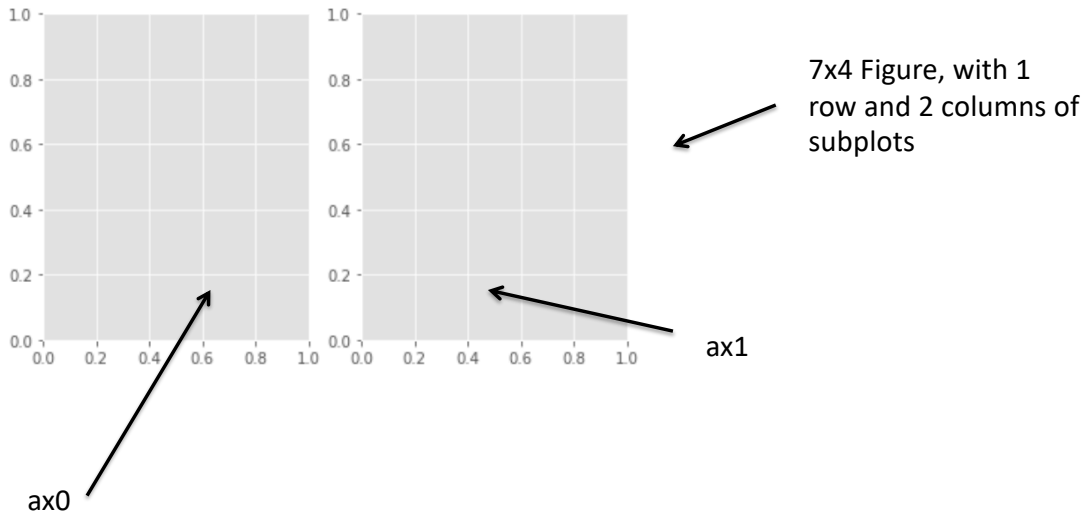
New labels

Creating Multiple Plots



Creating Multiple Plots

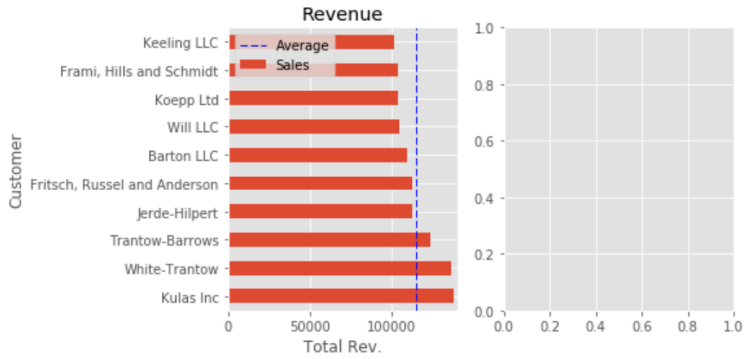
```
fig, (ax0, ax1) = plt.subplots(nrows=1, ncols=2, figsize=(7, 4))
```



Creating Multiple Plots

```
#Make first bar plot
df_top_ten.plot(kind="barh", x = "Name", y = "Sales", ax = ax0)
ax0.set(title = "Revenue", xlabel="Total Rev.", ylabel="Customer")
ax0.set_xlim([0,140000])
avg=df_top_ten.Sales.mean()
ax0.axvline(x = avg, color='b', label="Average", linestyle='--', linewidth=1)
ax0.legend(loc=0)
```

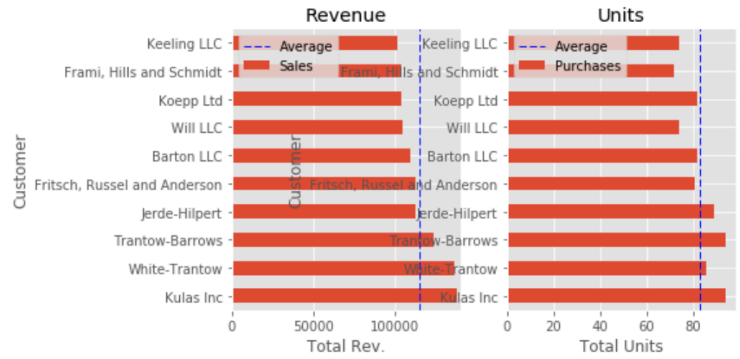
```
<matplotlib.legend.Legend at 0x118d6e438>
```



Notice that all references are made to ax0.

Creating Multiple Plots

```
#Make second bar plot
df_top_ten.plot(kind="barh", x = "Name", y = "Purchases", ax = ax1)
ax1.set(title = "Units", xlabel="Total Units", ylabel="Customer")
avg=df_top_ten.Purchases.mean()
ax1.axvline(x = avg, color='b', label="Average", linestyle='--', linewidth=1)
ax1.legend(loc=0)
fig
```

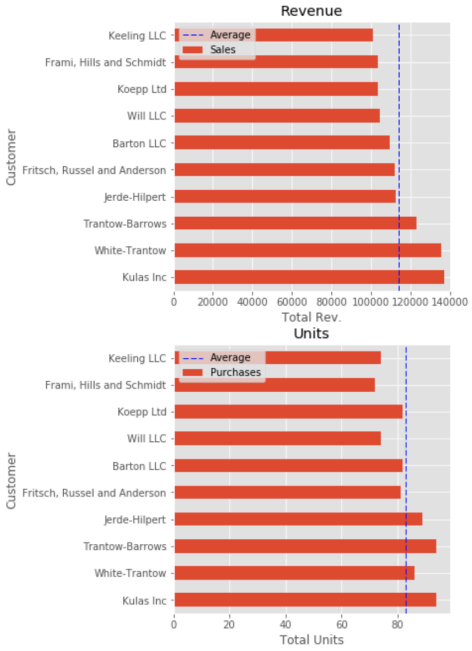


Uh oh! Plots are overlapping. Let's two options for fixing this.

Creating Multiple Plots

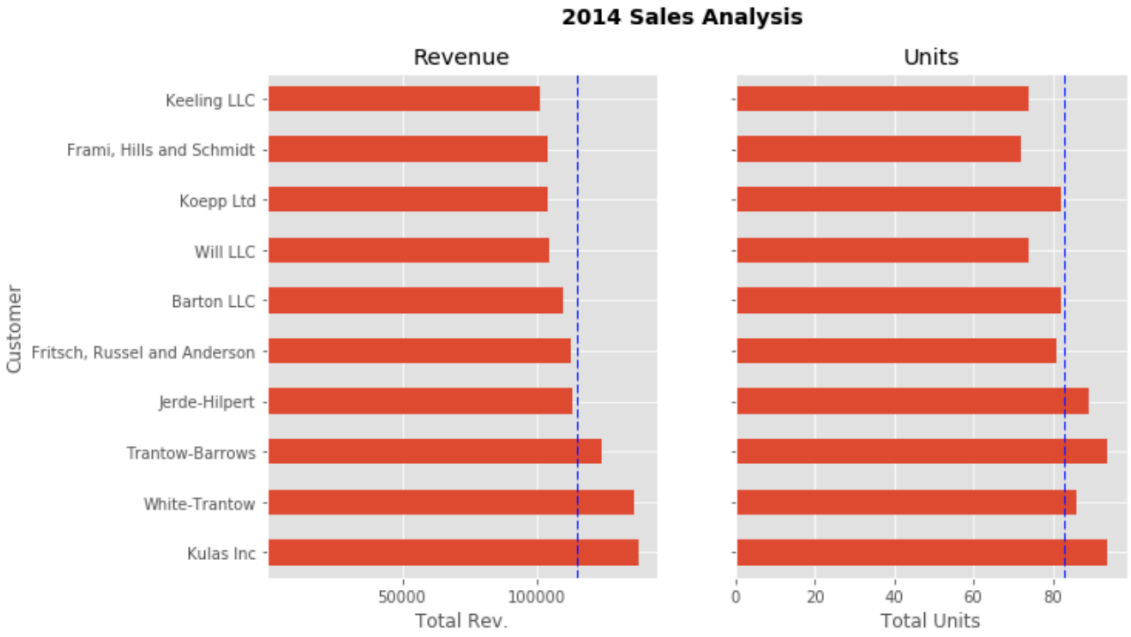
```
#Option 1 - Stack them
fig, (ax0, ax1) = plt.subplots(nrows=2, ncols =1, figsize=(5, 11))
```

updated



Creating Multiple Plots

```
#Option 2  - Have them share y axis
fig, (ax0, ax1) = plt.subplots(nrows=1, ncols=2, sharey=True, figsize=(10, 6))
```



All of the Code

```
#Option 2  - Have them share y axis
fig, (ax0, ax1) = plt.subplots(nrows=1, ncols=2, sharey=True, figsize=(10, 6))

#Make first bar plot
df_top_ten.plot(kind="barh", x = "Name", y = "Sales", ax = ax0)
ax0.set(title = "Revenue", xlabel="Total Rev.", ylabel="Customer")
ax0.set_xticks([50000,100000])
avg=df_top_ten.Sales.mean()
ax0.axvline(x = avg, color='b', label="Average",\
            linestyle='--', linewidth=1)
ax0.legend(loc=0)

#Make second bar plot
df_top_ten.plot(kind="barh", x = "Name", y = "Purchases", ax = ax1)
ax1.set(title = "Units", xlabel="Total Units", ylabel="Customer")
avg=df_top_ten.Purchases.mean()
ax1.axvline(x = avg, color='b', label="Average", linestyle='--', linewidth=1)
ax1.legend(loc=0)

# Title the figure
fig.suptitle('2014 Sales Analysis', fontsize=14, fontweight='bold');

# Hide the legends
ax1.legend().set_visible(False)
ax0.legend().set_visible(False)
```