

# Applied: Exercise 15

## Import notebook functions

```
from notebookfuncs import *
```

## Exercise 15

This problem involves writing functions.

### (a)

Write a function, `Power()`, that prints out the result of raising 2 to the 3<sub>rd</sub> power. In other words, your function should compute  $2^3$  and print out the results.

**Hint:** Recall that  $x^a$  raises  $x$  to the power  $a$ . Use the `print()` function to display the result.

```
def Power():  
    print(2 ** 3)  
  
Power()
```

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### (b)

Create a new function, `Power2()`, that allows you to pass any two numbers,  $x$  and  $a$ , and prints out the value of  $x^a$ . You can do this by beginning your function with the line

```
def Power2(x, a):
```

You should be able to call your function by entering, for instance, `Power2(3, 8)` on the command line. This should output the value of  $3^8$ , namely, 6,561.

```
def Power2(x, a):  
    print(x ** a)
```

```
Power2(3, 8)
```

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**(c)**

Using the `Power2()` function that you just wrote, compute  $10^3$ ,  $8^{17}$ , and  $131^3$ .

```
Power2(10,3)  
Power2(8,17)  
Power2(131, 3)
```

1000  
2251799813685248  
2248091

**(d)**

Now create a new function, `Power3()`, that actually returns the result  $x^a$  as a Python object, rather than simply printing it to the screen. That is, if you store the value  $x^a$  in an object called `result` within your function, then you can simply return this result, using the following line:

```
return result
```

Note that the line above should be the last line in your function, and it should be indented 2 or 4 spaces, based on your preference.

```
def Power3(x, a):  
    result = x ** a  
    return result
```

(e)

Now using the `Power3()` function, create a plot of  $f(x) = x^2$ . The x-axis should display a range of integers from 1 to 10, and the y-axis should display  $x^2$ . Label the axes appropriately, and use an appropriate title for the figure. Consider displaying either the x-axis, the y-axis, or both on the log-scale. You can do this by using the `ax.set_xscale()` and `ax.set_yscale()` methods of the axes you are plotting to.

```
import matplotlib.pyplot as plt
import numpy as np
scales = ["linear", "linear-log", 'log-linear', 'log-log']
fig, axs = plt.subplot_mosaic([scales[0:2],
                               scales[2:]], layout='tight')

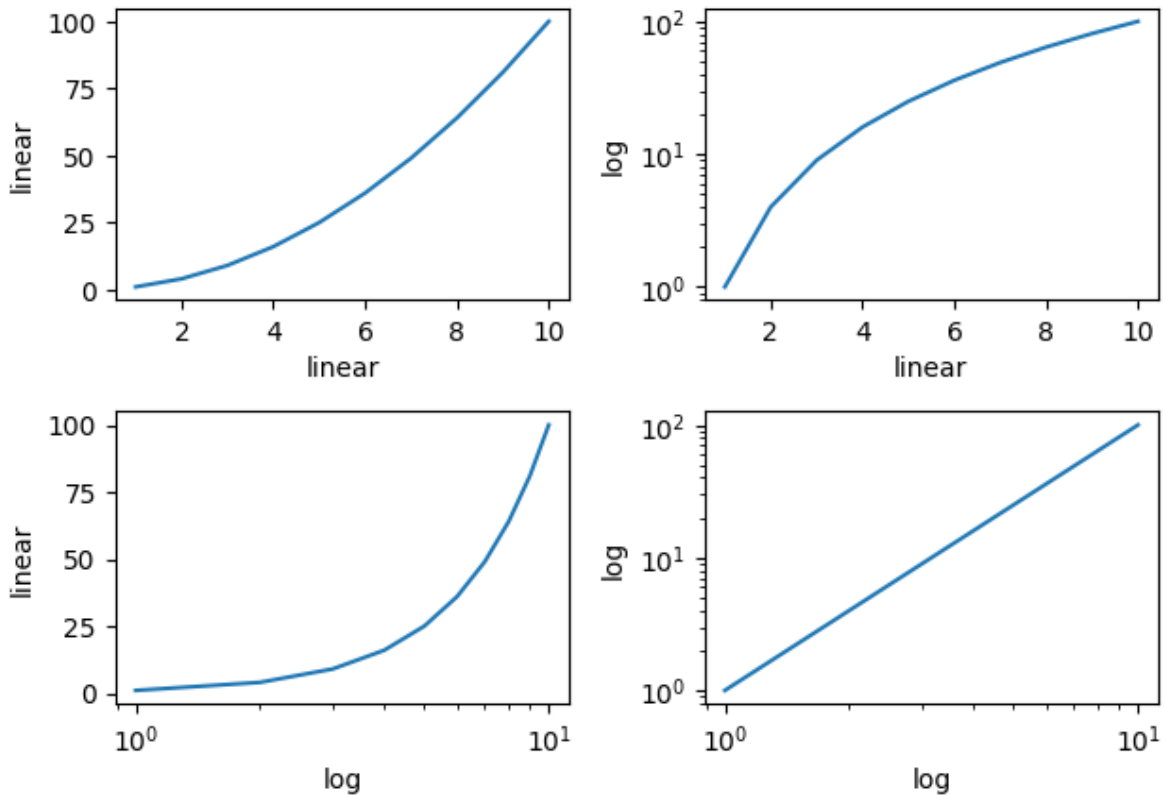
fig.suptitle("Power3() plot")
fig.subplots_adjust(hspace=0.5)
fig.subplots_adjust(wspace=0.5)
x = np.arange(1, 11, 1)
y = Power3(x, 2)

def get_labels(scales):
    if scales is None:
        return None
    labels = []
    for scale in scales:
        arr = scale.split('-')
        if len(arr) == 1:
            labels.append(tuple((arr[0], arr[0])))
        else:
            labels.append(tuple((arr[0], arr[1])))
    return labels

labels = get_labels(scales)

for ax, scale, label in zip(axs.values(), scales, labels):
    ax = axs[scale]
    ax.plot(x, y)
    ax.set_xlabel(label[0])
    ax.set_ylabel(label[1])
    ax.set_xscale(label[0])
    ax.set_yscale(label[1])
```

Power3() plot



(f)

Create a function, `PlotPower()`, that allows you to create a plot of  $x$  against  $x^a$  for a fixed  $a$  and a sequence of values of  $x$ . For instance, if you call

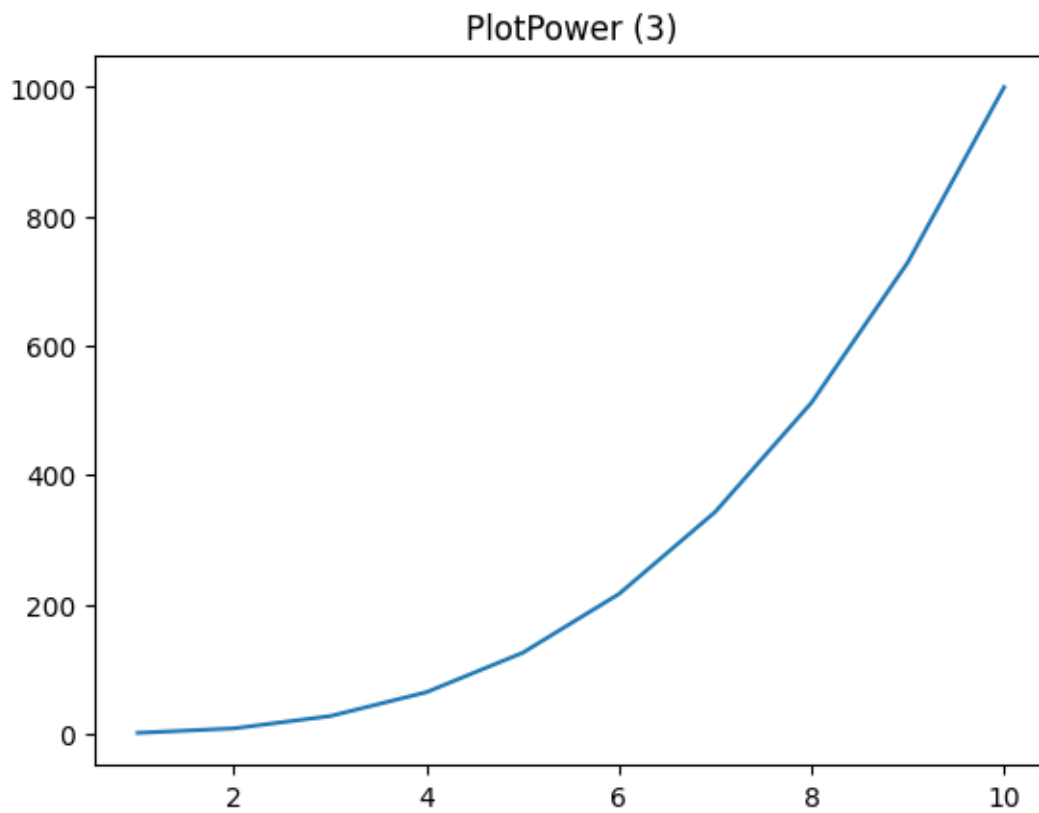
```
PlotPower(np.arange(1, 11),3)
```

then a plot should be created with an x-axis taking on values 1, 2, . . . , 10, and a y-axis taking on values  $1^3, 2^3, \dots, 10^3$ .

```
def PlotPower(X, a):
    if X is None or a is None:
        return None
    Y = Power3(X, a)
    fig, ax = plt.subplots(1)
```

```
ax.plot(X,Y)
ax.set_title(f"PlotPower ({a})")

PlotPower(np.arange(1,11), 3)
```



```
allDone();
```

<IPython.lib.display.Audio object>