PYTHON FOR MATLAB USERS

Diving into NumPy arrays

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Calculations on NumPy arrays

```
print(radius)

[[1, 2, 3]]

type(radius))

 <class 'numpy.ndarray'>
```

```
area = np.pi * (radius ** 2)
print(area)

[3.14159265 12.56637061
28.27433388]
```

Operation	Operator
Addition	+
Subtraction	-
Multiplication	*
Division	/
Exponentiation	**

Math between NumPy arrays

```
type(revenue)
```

```
<class 'numpy.ndarray'>
```

```
print(revenue)
```

```
[[100, 114, 96, 120]]
```

```
type(cost)
```

```
<class 'numpy.ndarray'>
```

```
print(cost)
```

```
[102. 104. 101. 102.]
```

```
profit = revenue - cost
print(profit)
```

```
[-2. 10. -5. 18.]
```

Summarizing data in NumPy arrays

```
import numpy as np

np.mean(revenue)

107.5
```

Some useful NumPy functions:

- `np.min()` returns smallest value in array
- `np.max()` returns largest value in array
- `np.sum()` returns sum of all values in array

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Let's practice!

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Indexing NumPy arrays

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Indexing with ranges

```
arr.shape
```

```
(100,)
```

```
slice = arr[10:15]
slice.shape
```

```
(5,)
```

Indexing multidimensional arrays

```
image.shape
```

```
(1920, 1200)
```

```
window = image[100:150,1000:1100]
window.shape
```

```
(50,100)
```

Indexing with Boolean arrays

```
data.shape

(10000,)
```

```
is_valid.dtype

<np.bool>
```

```
np.sum(is_valid)

8732
```

```
valid_data = data[is_valid]
valid_data.shape

(8732,)
```

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Lists

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What is a list?

- Simple Python structure for storing data
- Lists can hold anything
- Similar to MATLAB's cell array
- But only one-dimensional
- Indexing like NumPy arrays

Making lists

```
my_list = [8, 6, 7, 5, 3, 0 ,9]

print(my_list[2])
```

```
7
```

```
print(my_list[-3:])
```

```
[3, 0, 9]
```

Making NumPy arrays from lists

```
my_list = [8, 6, 7, 5, 3, 0 ,9]
```

```
import numpy as np

my_array = np.array(my_list)
type(my_array)

numpy.ndarray
```

Multidimensional NumPy arrays from lists of lists

```
list_of_lists = [[2, 3], [9, 0], [1, 4]]
```

```
import numpy as np

arr = np.array(list_of_lists)
print(arr)

[[2, 3]
 [9, 0]
 [1, 4]]
```

```
arr.shape

(3, 2)
```

Differences between lists and NumPy arrays

NumPy Arrays	Lists
All elements must be same type	Can mix types
`(+)` does element-wise addition	`(+)` concatenates lists
Multidimensional	Single dimension
Range & Boolean indexing	Only Range indexing

When to use each

- Need to do math?
  - NumPy array
- Storing complex structures?
  - list
- Multidimensional data?
  - NumPy array

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Customizing plots

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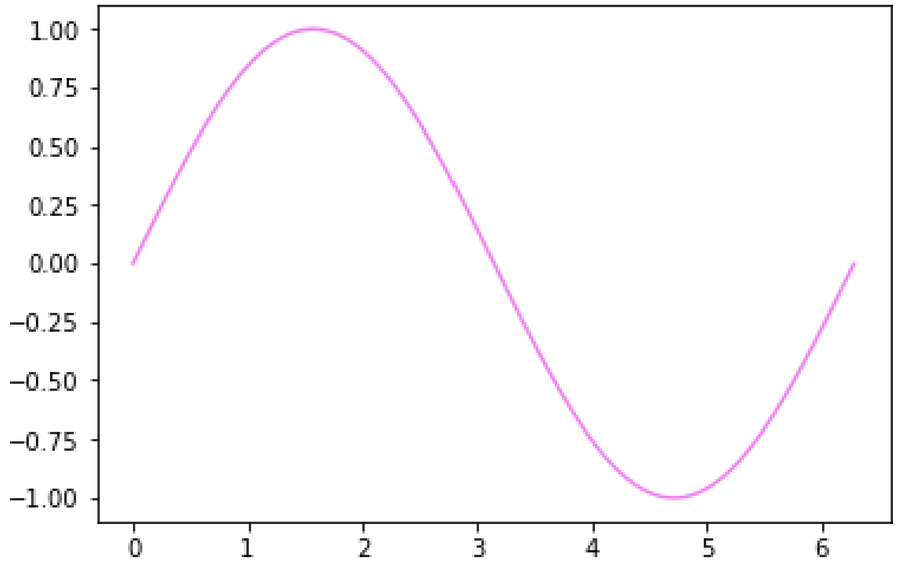
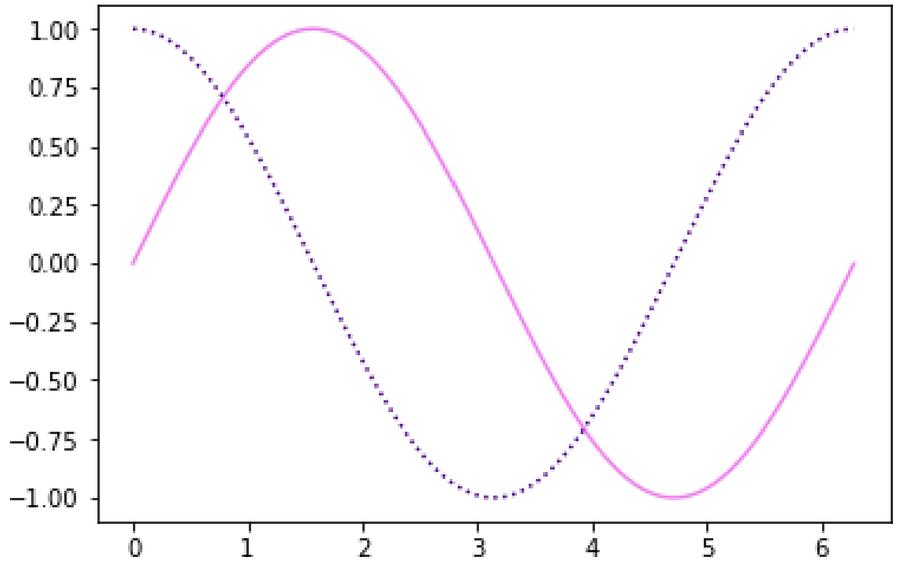
Custom colors

```
import numpy as np
import matplotlib.pyplot as plt

# Generate data
x = np.arange(0,2*np.pi,0.01)
y = np.sin(x)

# Plot data
plt.plot(x,y,color='violet')
plt.show()
```



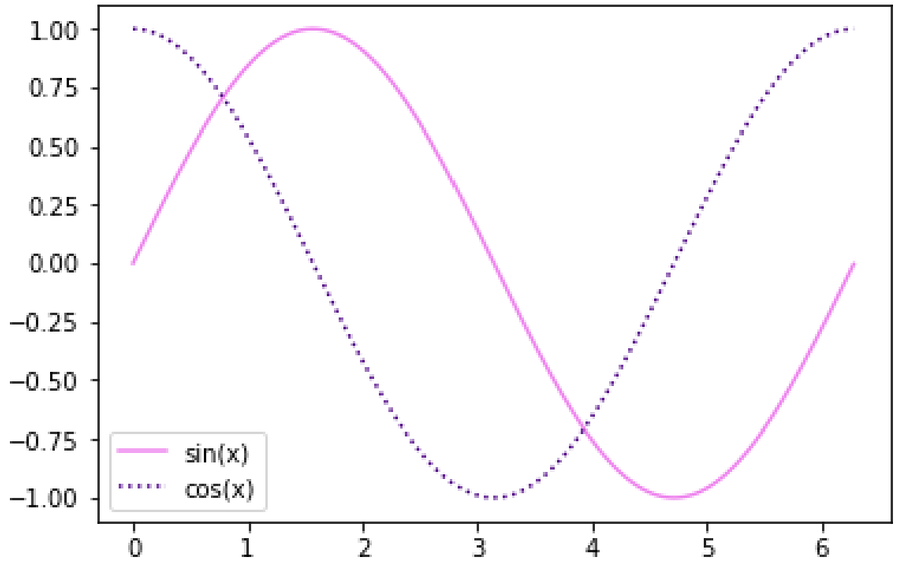
Custom line styles

```
import numpy as np
import matplotlib.pyplot as plt

# Generate data
x = np.arange(0,2*np.pi,0.01)
y = np.sin(x)
y2 = np.cos(x)

# Plot data
plt.plot(x, y,
         color='violet')
plt.plot(x, y2,
         color='indigo',
         linestyle=':')
plt.show()
```



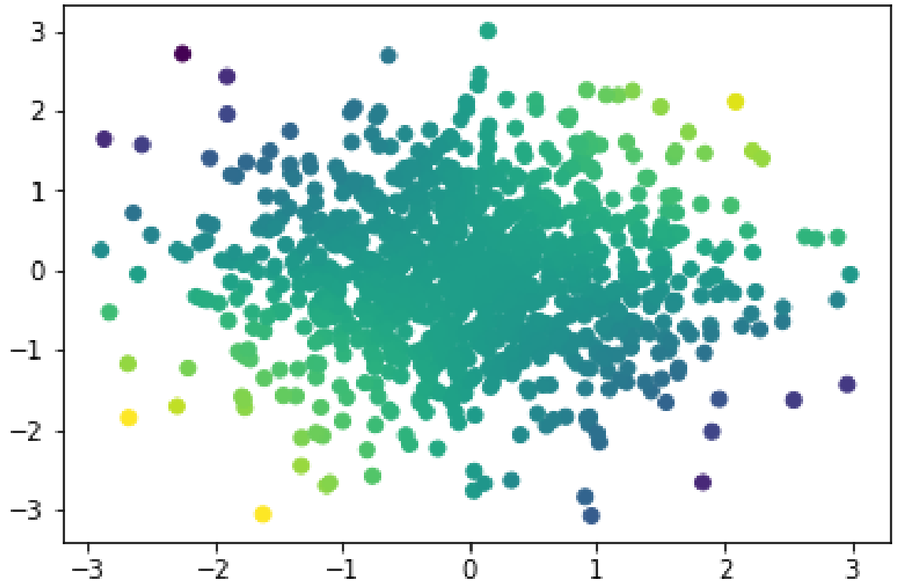
Adding a legend

```
import numpy as np
import matplotlib.pyplot as plt

# Generate data
x = np.arange(0,2*np.pi,0.01)
y = np.sin(x)
y2 = np.cos(x)

# Plot data
plt.plot(x, y,
         color='violet',
         label='sin(x)')
plt.plot(x, y2,
         color='indigo',
         linestyle=':',
         label='cos(x)')

# Add a legend
plt.legend()
plt.show()
```



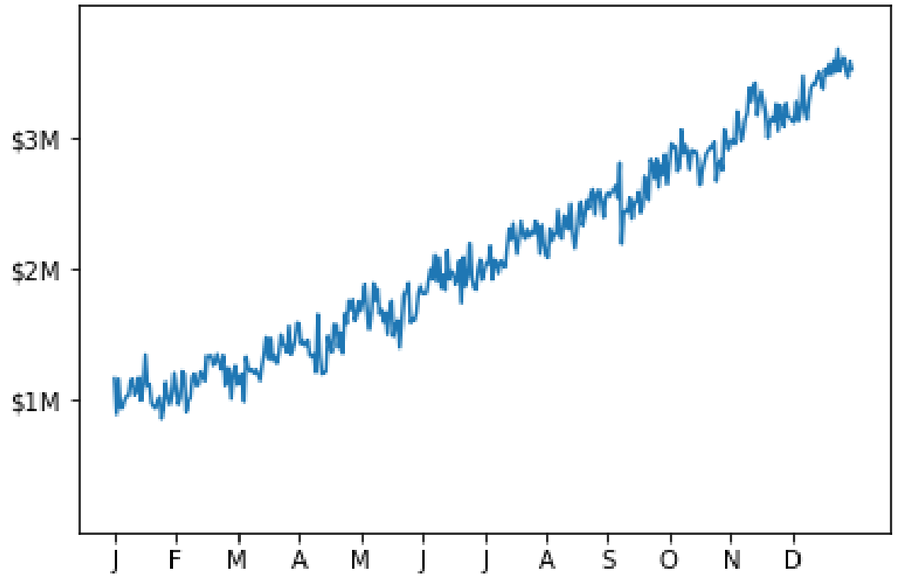
Encoding data in marker color

```
import numpy as np
import matplotlib.pyplot as plt

# Generate data
x = np.random.randn(1000)
y = np.random.randn(1000)
z = x * y

# Plot the data
plt.scatter(x,y,c=z)
plt.show()
```



Custom tick labels

```
# Create the plot
plt.plot(months,revenue)

# Customize the ticks
plt.yticks(
    [1,2,3],
    ['$1M','$2M','$3M'])
plt.xticks(
    [0,1,2,3,4,5,6,7,8,9,10,11],
    list('JFMAMJJASOND'))
```



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Let's plot some data!