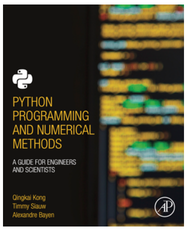

This notebook contains an excerpt from the [Python Programming and Numerical Methods - A Guide for Engineers and Scientists](), the content is also available at [Berkeley Python Numerical Methods]().

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Linear Interpolation

In **linear interpolation**, the estimated point is assumed to lie on the line joining the nearest points to the left and right. Assume, without loss of generality, that the x-data points are in ascending order; that is, $x_i < x_{i+1}$, and let x be a point such that $x_i < x < x_{i+1}$. Then the linear interpolation at x is: $\hat{y}(x) = y_i + \frac{(y_{i+1} - y_i)(x - x_i)}{(x_{i+1} - x_i)}.$

TRY IT! Find the linear interpolation at $x = 1.5$ based on the data x = [0, 1, 2], y = [1, 3, 2]. Verify the result using scipy's function *interp1d*.

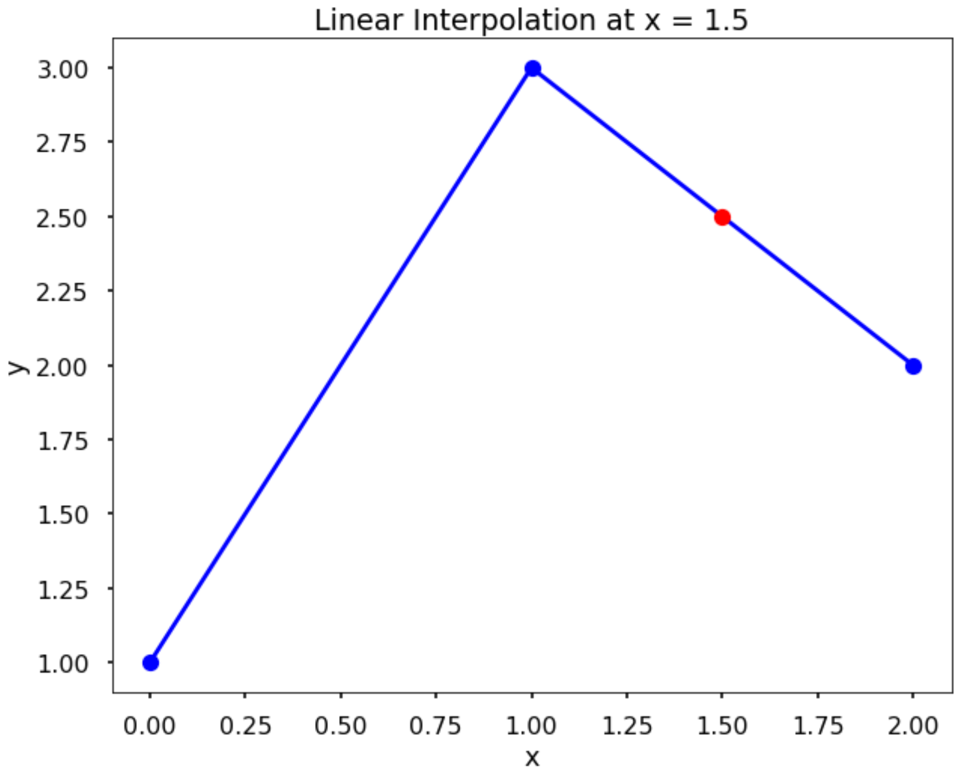
Since $1 < x < 2$, we use the second and third data points to compute the linear interpolation. Plugging in the corresponding values gives $\hat{y}(x) = y_i + \frac{(y_{i+1} - y_i)(x - x_i)}{(x_{i+1} - x_i)} = 3 + \frac{(2-3)(1.5-1)}{(2-1)} = 2.5$

```
from scipy.interpolate import interp1d
import matplotlib.pyplot as plt

plt.style.use('seaborn-poster')
```

```
x = [0, 1, 2]
y = [1, 3, 2]

f = interp1d(x, y)
y_hat = f(1.5)
print(y_hat)
```

```
2.5
```

```
plt.figure(figsize = (10,8))
plt.plot(x, y, '-ob')
plt.plot(1.5, y_hat, 'ro')
plt.title('Linear Interpolation at x = 1.5')
plt.xlabel('x')
plt.ylabel('y')
plt.show()
```



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