MSPA 400: Session 2 Python

Reading

Think Python 2nd Edition Chapter 3 (3.4 to 3.9), Chapter 10 (10.1 to 10.12)

Think Python 3rd Edition Chapter 3 (pages 24-29), Chapter 10 (pages 105-115)

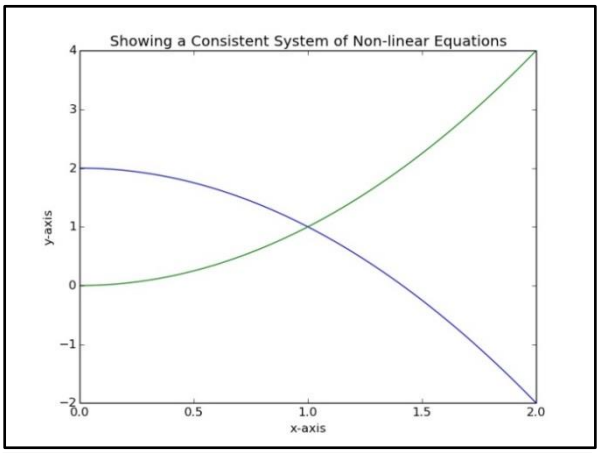
Module 1

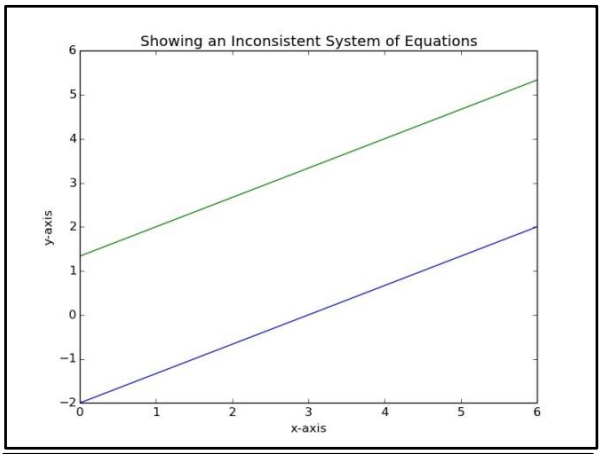
(Session 2 Module 1.py)

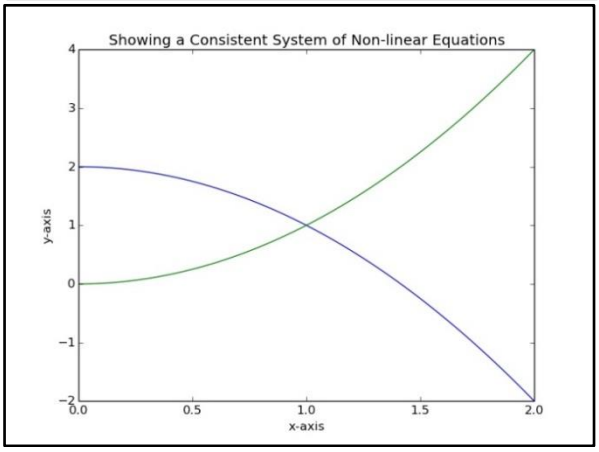
Objectives:

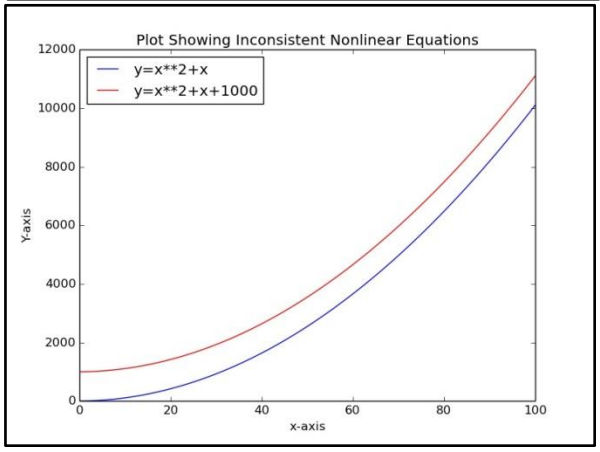
1. Reproduce examples from Lial using Python.
2. Demonstrate how to plot a system of nonlinear equations with Python.

Output from Module 1.py:









Exercise:

1. Refer to Lial Section 2.1 Problem 46 on page 53. Solve for a and b using the Echlon Method. Plot the resulting quadratic function. Compare the code and plot with the answer sheet.

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Module 2

(Session 2 Module 2.py)

Objectives:

1. Demonstrate numpy list and array operations.
   (Numpy lists and arrays are useful data structures that serve multiple purposes. For matrix calculations, numpy arrays must be converted into numpy matrices. Array manipulations are valuable for preparing data for linear algebra. Matrix calculations are shown in Session 2 Module 3. The * following "numpy import" makes all routines within numpy available.)

Output from Module 2.py

Value at first location: 1
Value at third location: 3
Value located using negative index: 2

Comparison of a concatenated list with an array
r= [4, 5, 6] and t= [1, 2, 3]

Concatenation example using t and r lists.

[1, 2, 3, 4, 5, 6]

Comparison of concatenation with array([t,r]).

```
[[1 2 3]
 [4 5 6]]
```

The second element of the preceding list and array: 2 [4 5 6]

Slicing to produce an element, a column and a row of the array: 2 [2 5] [4 5 6]

Example 1 Section 2.3 Lial showing array addition from page 72.

Arrays in sequence: m , n and m+n

```
[[10 12  5]
 [15 20  8]]

[[45 35 20]
 [65 40 35]]

[[55 47 25]
 [80 60 43]]
```

Subtraction of n from m

```
[[-35 -23 -15]
 [-50 -20 -27]]
```

Multiplication by a scalar 2.0

```
[[ -70.  -46.  -30.]
 [-100.  -40.  -54.]]
```

Functions can be applied to an array such as absolute value

```
[[  70.   46.   30.]
 [ 100.   40.   54.]]
```

Exercise:

1. Refer to Lial Section 2.3 Example 7. Write the code which reproduces the calculations shown in that example. For the array which results, slice it to show 1) second row, 2) the third column and 3) the single element common to (1) and (2). Use the demonstrated array methods. Compare your code and results to the answer sheet.

Module 3

(Session 2 Module 3.py)

Objectives:

1. Demonstrate numpy matrix calculations.
   (For matrix calculations, arrays must be converted into numpy matrices.)

Output from Module 3.py

Right Hand Side of Equation

```
[[96]
 [87]
 [74]]
```

Matrix A

```
[[1 3 4]
 [2 1 3]
 [4 2 1]]
```

Inverse of A

```
[[-0.2  0.2  0.2]
 [ 0.4 -0.6  0.2]
 [ 0.   0.4 -0.2]]
```

Identity Matrix

```
[[1 0 0]
 [0 1 0]
 [0 0 1]]
```

Solution to Problem

```
[[13]
 [ 0]
 [20]]
```

Illustration of solution with linalg.solve(,) function

```
[[13]
 [ 1]
 [20]]
```

Example of an inverse matrix for inconsistent equations

```
[[ -2.25179981e+15  -2.25179981e+15   4.50359963e+15]

 [  4.50359963e+15   4.50359963e+15  -9.00719925e+15]

 [ -2.25179981e+15  -2.25179981e+15   4.50359963e+15]]
```

Exercises:

1. Refer to Lial Section 2.5 Example 2. Write the code to reproduce the results in the example. Form the matrix A, find its inverse and verify such by multiplying the two to form the identity matrix. Show the code, matrix A, inverse of A and the Identity matrix.

2. Refer to Lial Section 2.5 page 96 problem #1. Write the code which solves the problem. Use linalg.solve(,).