Name _______________________________________________________________

Question One. 25 points. Notice that the contents of each cell in the matrix below is the sum of its row (zero-based) and column (zero-based). Using two nested for loops, supply the missing code below to produce the following output:

\[
\begin{bmatrix}
0 & 1 & 2 & 3 \\
1 & 2 & 3 & 4 \\
2 & 3 & 4 & 5 \\
3 & 4 & 5 & 6 \\
\end{bmatrix}
\]

```
import numpy as np
numbers = np.empty([4,4], dtype='int64')

# the 3 missing lines of code go here

print(numbers)
```
Question Two. 25 points.

Part A. 5 points. Show how to create a variable named *some-variable* that produces the following output when *type(some-variable)* is entered into the Python shell: *
```
<
class
'numpy.ndarray'>
```

Part B. 5 points. Show how to create a variable named *some-variable* that produces the following output when *some-variable.dtype* is entered into the Python shell: *
```
dtype('int64')
```

Part C. 5 points. Show the contents of the variable *numbers* if the user enters a 3.

```python
import numpy
number = int(input("Enter an integer: "))
numbers = numpy.arange(number * number).reshape(number, number)
```

Part D. 10 points. Use string slicing to access the middle column of the following tic-tac-toe board using just one statement.

```python
import numpy
tictactoe = numpy.array([['x', 'x', 'o'], ['o', 'o', 'x'], ['x', 'x', 'o']])
```
Question Three. 50 points. Visualization.

Complete the program below such that it matches the following graph as closely as possible:

```python
import pandas as pd
import matplotlib.pyplot as plt
```