

## ITSE 1302 – Assignment 09

### General Points

- Use the course material located at:
  - [Python Data Science Handbook](#)
- Assignment 09 can be completed using previously covered material and content from the following chapters:
  - 00.00-Preface *through* 02.05-Computation on Arrays Broadcasting
- After completing the requirements, test to ensure all cells run correctly in the .ipynb file.
- Include appropriate markdown cells to identify the requirements below by number. See this [example](#).
- Produce an .html file that shows the .ipynb after a *successful test run*.
  - by File | Download as | HTML (.html) .
- Test the .html file by opening it in a browser and ensure the content is produced correctly from the run in Jupyter Notebook.
- Submit **BOTH** the .ipynb and .html files to the appropriate link in Blackboard | Assignments. Submit the files individually (via a multi-select). However, if your browser posts an error for the .html file, submit it as a .zip.
- Submit any additional files required to complete the assignment.

## Requirements

*(Ensure that all Requirements are complete)*

1. Using Jupyter Notebook (or similar tool), create a file named:
  - assignment-09.ipynb
2. Add an H1 markup: “This is Assignment 09 - <yournamehere>”
3. Include appropriate markdown cells to identify the requirements below by number.
4. Explain how NumPy arrays are like Python lists and how they are different. See multiple chapters for this information.

## ITSE 1302 – Assignment 09

5. Explain how variable typing is performed in Python compared to how it is performed in a language like C.
6. Explain how integer storage is performed in Python compared to how it is performed in a language like C.
7. Create a list (L1) of numbers 1-20. Convert the numbers in L1 to strings and store them in a new list (L2).
8. Demonstrate a heterogeneous list with at least **5** different data types.
9. Create a Python array using the built-in array module. Demonstrate the following operations on the array:
  - append
  - insert
  - index
  - attempt to insert an element of a different type
10. Create a NumPy array of 10 floats named `one_d_array`. Demonstrate the following operations on the array:
  - implicit casting (the author calls this up-casting)
  - explicit casting
11. Use list comprehension to create a two-dimensional NumPy array named `two_d_array` with 5 rows and 3 columns with the following content:

```
[[1 2 3]
 [2 3 4]
 [3 4 5]
 [4 5 6]
 [5 6 7]]
```
12. Create a 3-dimensional NumPy array named `three_d_array` with random numbers between 0-99. The *shape* of the array should be (3, 5, 5). Also display the size in bytes of the array.
13. Demonstrate accessing 4 different individual elements of the `three_d_array`.

## ITSE 1302 – Assignment 09

14. Demonstrate modifying 4 different individual elements of the `three_d_array`.
15. Using `one_d_array`, demonstrate slicing:
  - the first 7 elements
  - all after index 7
  - from index 3 to index 8
  - every other element
  - elements reversed
  - reverse every other element from index 7
16. Using `two_d_array`, demonstrate slicing:
  - first 2 rows and first 2 columns
  - all rows and every other column
  - all columns and every other row
  - extracting a subarray
17. Use NumPy's `arrange` and `reshape` methods to create a 10x10 array with values as shown:

```
[[ 1  2  3  4  5  6  7  8  9 10]
 [11 12 13 14 15 16 17 18 19 20]
 [21 22 23 24 25 26 27 28 29 30]
 [31 32 33 34 35 36 37 38 39 40]
 [41 42 43 44 45 46 47 48 49 50]
 [51 52 53 54 55 56 57 58 59 60]
 [61 62 63 64 65 66 67 68 69 70]
 [71 72 73 74 75 76 77 78 79 80]
 [81 82 83 84 85 86 87 88 89 90]
 [91 92 93 94 95 96 97 98 99 100]]
```

18. Using `one_d_array`, create a row vector and a column vector.
19. Explain what a NumPy *universal function* is and why they are useful.
20. Demonstrate the use of the *out* argument.
21. Use aggregates to show the product of all elements of `one_d_array`.

## ITSE 1302 – Assignment 09

22. Create the NumPy arrays `x` and `y` below and use the `multiply()` and `outer()` methods to produce the output as shown.

```
x = [1 2 3 4 5]
y = [2 2 2 2 2]

array([[ 2,  2,  2,  2,  2],
       [ 4,  4,  4,  4,  4],
       [ 6,  6,  6,  6,  6],
       [ 8,  8,  8,  8,  8],
       [10, 10, 10, 10, 10]])
```

23. Demonstrate NumPy's `sum`, `min`, and `max` functions. Use the `%timeit` magic function to compare the performance to Python's built-in `sum`, `min`, and `max` functions.
24. Use the file `president_heights.csv` to produce a histogram of U.S. President height information.
25. Use broadcasting and Matplotlib to plot produce a plot of a two-dimensional array.
26. Use markdown to include a statement at the end of `assignment-09.ipynb` explaining your experiences with Assignment 09. Make this authentic (minimum of 2-3 sentences).

---

**TEST – TEST – TEST** your `.ipynb` file to ensure all requirements are met.

Produce an `.html` file from a *successful test run* of the `.ipynb` file. Ensure that the `.html` is produced correctly by opening it in a browser.

- Use the list above as a confirmation checklist.
- Not meeting all requirements = 0 points for the assignment.