

## Homework 2

Due date: Wednesday February 11 2019, 11:59pm

Use the notebook interface and send me the notebook via canvas

1. Write a function *middlesquare(seed)* that codes a random number generator that was first proposed by John von Neumann in the late forties (Wikipedia: [https://en.wikipedia.org/wiki/Middle-square\\_method](https://en.wikipedia.org/wiki/Middle-square_method) [DO NOT USE their python implementation because it is too complicated and unnecessary]) . The pseudocode algorithm is like this:

- (a) write down a 8-digit number  $n$  (the seed) [use numbers that do not contain zeroes]
- (b) square this number  $n^2$
- (c) take out the middle 8 digits (this is the first random number) [the most secure way to do this to find the middle of the string (make sure that you end up using integers and not float numbers e.g.  $5/2$  in python3 will get 2.5 and will fail as an index, but  $\text{int}(5/2)$  will work and returns 2) and then subtract 4 and add 4 from that middle value; do not bother whether this exactly the middle or not (e.g. in a number with 16 digits the middle 8 are from  $\text{int}(16/2)-4:\text{int}(16/2)+4$ , but from a 15 digit number it is  $\text{int}(15/2)-4:\text{int}(15/2)+4$ )
- (d) this random number becomes now the new seed and we start over at 1 again

Print a list of 20 random numbers using this random number generator. Start with 12345678 as a seed. [Hint: use the fact that you can easily convert between numbers and strings and lists, e.g. `str(number)` to generate a string from a number, You can operate using list comprehension directly on the string or then convert to a list using `list(string)` to break a string into characters, to join lists of characters or strings use this

```
mynewstring = "".join(mylist_of_strings)
```

2. Plot a histogram of 10,000 of these random numbers, make sure to label the axes, also use the option to make this a probability distribution (aka the histogram integrates to 1.0).
3. Plot 1000 pairs of these random numbers in a X/Y plot. Make sure the axes are labeled.

If this is too easy for you then look up how to test random numbers and show me that this is not a good random number generator.