Week 2 and 3 – (Lists, Tuples, Functions, Dictionaries, Sets)

1. The transpose of a matrix is a new matrix that is obtained by exchanging the rows and columns.

Write a program to find the transpose of a matrix.

2. A "**Caesar Cipher**" is a simple way of **encrypting a message** by replacing each letter with a letter a certain number of spaces up the alphabet. For example, if shifting the message by 13, an **A** would become an **N**, while an S would become an **F**.

The encryption can also be represented using **modular arithmetic** by first transforming the letters into numbers, according to the scheme:

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	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

Encryption of a letter P by a shift amount k can be described mathematically as:

$$C = (P + k) \bmod 26$$

Write a program that asks the user for a message (a string) and a **shift amount** (an integer). The values should be passed to a function that accepts a string and an integer as arguments, and returns a string representing the string **encrypted** by shifting the letters by the integer.

For example, a string of "BEWARE THE IDES OF MARCH" and an integer of 13 should result in a string of "ORJNER GUR VQRF BS ZNEPU".

Hint: the ASCII code for the letter 'A' is 65.

3. Write a program that gets a string containing a person's first, middle, and last names, and then display their first, middle, and last initials.

For example, if the user enters Ahmed Mohamed Salah the program should display A. M. S.

4. **Assume** the following list exists:

numbers = [1, 2, 3, 4, 5]

Write a statement that uses a **dictionary comprehension** to create a dictionary in which each element contains a number from the numbers list as its key, and the product of that number times 10 as its value. **In other words**, the dictionary should contain the following elements:

{1: 10, 2: 20, 3: 30, 4: 40, 5: 50}

5. **Write** a program to **evaluate the following polynomial** at a point x, which runs in time that is **at most** $O(n)$ in the **worst case**.

$$P(x) = a_0 + a_1x + a_2x^2 + a_3x^3 + \ldots + a_nx^n$$

6. **Design** a program that asks the user to enter a series of 10 numbers.

   The program should store the numbers in a list then display the following data:

   - The total of the numbers in the list
   - The average of the numbers in the list
   - The lowest number in the list
   - The highest number in the list

7. Write code that sorts a list, reverses the order of the items in the list, and prints the highest value in the list.

8. **Write** a program that uses the following lists:

   - **empId**: a list of five integers to hold employee identification numbers.

     The list should be initialized with the following numbers:

     11 22 33 44 55
   - **hours**: a list of five integers to hold the number of hours worked by each employee.
   - **payRate**: a list of five doubles to hold each employee's hourly pay rate.
   - **wages**: a list of five doubles to hold each employee's gross wages.

   The program should **relate** the data in each list **through the subscripts**.

   The program should display each employee number and ask the user to enter that employee's hours and pay rate.

   It should then calculate the gross wages for that employee (**hours * payRate**) and store them in the wages list. After the data has been entered for all the employees, the program should display each employee's identification number and gross wages.

9. **Get** the key of a minimum value from the following dictionary

   dict = {'Programming': 82, 'Math': 65, 'Algorithms': 75}

10. **Write** a program that asks the user to enter a series of single-digit numbers.

    The program should display the sum of all the single digit numbers in the string.

    For example, if the user enters 2514, the method returns 12, which is the sum of 2, 5, 1 and 4.