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

1. One way to approximate the **area under the curve** is to use line segments as **approximations** of small pieces of the curve and then to **sum the areas of trapezoids**. If you have studied **calculus**, you will observe that the trapezoidal rule is approximating $\int_a^b f(x)dx$.

The **trapezoidal rule** approximates this area A as:

$$A = \frac{h}{2}\left[f(a) + f(b) + 2\sum_{i=1}^{n-1} f(x_i) \right]$$

For n **subintervals** of length h:

$$h = \frac{b-a}{n}$$

Write a function **trap** with input parameters a, b, n, and f that **implements** the **trapezoidal rule**. **Call trap** with values for n of 2, 4, 8, 16, and 32 to **approximate** $\int_0^2 (3x^2 + 2)dx$.

2. Assume list1 is a list of integers. Write a statement that uses a list comprehension to create a second list containing the elements of list1 that are greater than 100.

3. Write a program to merge two lists to a third list.

4. Some Web sites impose certain **rules for passwords**. **Write** a function that checks whether a string is a valid password. Suppose the password rules are as follows:

- A password must have **at least eight characters**.
- A password must **consist of only letters and digits**.
- A password must **contain at least two digits**.

Write a program that prompts the user to enter a password and displays valid password if the rules are followed or invalid password otherwise.

5. **Write** a function that accepts two arguments: a tuple, and a number *n*.
   Assume that the tuple contains numbers. The function should display all of the numbers in the tuple that are greater than the number *n*.

6. **Assume** the following dictionary exists:
   test_averages = {'Ahmed':98, 'Ali': 87, 'Noura':92, 'Ramy':74, 'Sally':89, 'Mai':84}
   Write a program to display the names of the students whose grades are 90 or greater.

7. Write a program to print a dictionary where the keys are numbers between 1 and 10 and the values are square of keys.

8. **Convert** the following two lists into a dictionary.
   k = ['A', 'B', 'C', 'D', 'E', 'F']
   v = [10, 11, 12, 13, 14, 15]
   In other words, the dictionary should contain the following elements:
   {'A': 10, 'B': 11, 'C': 12, 'D': 13, 'E': 14, 'F': 15}

9. **Write** a function that receives a list of words, then determines and displays **only the unique words**. **Treat** uppercase and lowercase letters the **same**.
   Test your function with several sentences.

10. Write a program that lets the user enter a string and displays the character that appears most frequently in the string.

11. Assume list1 is a list of integers. Write a statement that uses a list comprehension to create a second list containing the elements of list1 that are even numbers.