# Bahria University,

## Karachi Campus



LAB EXPERIMENT NO.

**\_08\_**

LIST OF TASKS

|  |  |
| --- | --- |
| **TASK NO** | **OBJECTIVE** |
| 01 | Write a Python program to determine the area enclosed by the function f(x) = e x over theinterval from x=0 to x=2 using the Trapezoidal Rule with two intervals. |
| 02 | Write a Python program utilizing Simpson's 1/3 Rule to compute the definite integral 𝟐 𝒆𝟐 ∫𝒆 𝟐 𝒍𝒏𝒙 𝒅𝒙 where n = 4 represents the number of intervals used in the approximation. |
|  | Determine the approximation of the area beneath the curve represented by y = f(x) over the interval from x=−4 to x=2 using the Trapezoidal Rule with n=6 subintervals. The values of the function f(x) are provided within following table. |

Submitted On:

Date: 26/11/2024

**Task No 01:** Write a Python program to determine the area enclosed by the function f(x) = e over theinterval from x=0 to x=2 using the Trapezoidal Rule with two intervals.

**Solution:**

import math

def function(x):

    return math.exp(x)

def trapezoidal\_rule(a, b, n):

    h = (b - a) / n

    result = (function(a) + function(b))

    for i in range(1, n):

        result += 2 \* function(a + i \* h)

    return (h / 2) \* result

start\_point = 0

end\_point = 2

sub\_intervals = 2

print("Approximated integral value:", "%.4f" % trapezoidal\_rule(start\_point, end\_point, sub\_intervals))

**Output:**

**A black and white text

Description automatically generated**

**Task No 02:** Write a Python program utilizing Simpson's 1/3 Rule to compute the definite integral 𝟐 𝒆𝟐 ∫𝒆 𝟐 𝒍𝒏𝒙 𝒅𝒙 where n = 4 represents the number of intervals used in the approximation.

**Solution:**

def trapezoidal\_rule\_from\_points(points):

    n = len(points)

    integral = points[0][1] + points[-1][1]

    for i in range(1, n - 1):

        integral += 2 \* points[i][1]

    h = points[1][0] - points[0][0]

    integral \*= h / 2

    return integral

given\_points = [(-4, 0), (-3, 4), (-2, 5), (-1, 3), (0, 10), (1, 11), (2, 2)]

result = trapezoidal\_rule\_from\_points(given\_points)

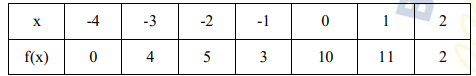
print("Approximated integral value using given points:", result)

**Output:**

**A black and white text

Description automatically generated**

**Task No 03**: Determine the approximation of the area beneath the curve represented by y = f(x) over the interval from x=−4 to x=2 using the Trapezoidal Rule with n=6 subintervals. The values of the function f(x) are provided within following table.



**Solution:**

import math

def calculate\_function\_value(x):

    return math.log(x)

def simpsons\_one\_third\_rule(lower\_limit, upper\_limit, intervals):

    h = (upper\_limit - lower\_limit) / intervals

    x\_values = []

    fx\_values = []

    for i in range(intervals + 1):

        x\_values.append(lower\_limit + i \* h)

        fx\_values.append(calculate\_function\_value(x\_values[i]))

    result = 0

    for i in range(intervals + 1):

        if i == 0 or i == intervals:

            result += fx\_values[i]

        elif i % 2 != 0:

            result += 4 \* fx\_values[i]

        else:

            result += 2 \* fx\_values[i]

    result \*= h / 3

    return result

lower\_limit = math.exp(2)

upper\_limit = 2 \* math.exp(2)

num\_intervals = 4

integral\_result = simpsons\_one\_third\_rule(lower\_limit, upper\_limit, num\_intervals)

print("%.6f" % integral\_result)

**Output:**

****