Bahria University,

Karachi Campus

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LAB EXPERIMENT NO.

08

LIST OF TASKS

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| --- | --- |
| TASK NO | OBJECTIVE |
| **01** | Write a Python program to determine the area enclosed by the function  f(x) = ex over the interval 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 ∫e2​ 2e2 ln(x) dx where n = 4 represents the number of intervals used in the approximation. |
| 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.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **X** | -4 | -3 | -2 | -1 | 0 | 1 | 2 | | **F(x)** | 0 | 4 | 5 | 3 | 10 | 11 | 2 | |

Submitted On:

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(Date: DD/MM/YYYY)

**Task No. 01**: Write a Python program to determine the area enclosed by the function

f(x) = ex over theinterval from x=0 to x=2 using the Trapezoidal Rule with

two intervals.

**Solution:**

import math

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

h = (b - a) / n

area = 0.5 \* (f(a) + f(b))

for i in range(1, n):

area += f(a + i \* h)

area \*= h

return area

# Define the function f(x) = ex

def f(x):

return math.exp(x)

a = 0 # Start of interval

b = 2 # End of interval

n = 2 # Number of intervals

area = trapezoidal\_rule(f, a, b, n)

print(f"The approximate area under f(x) = e^x from x={a} to x={b} is: {area:.6f}")

**Output:**



**Task No. 02**: Write a Python program utilizing Simpson's 1/3 Rule to compute the definite

Integral ∫e2​ 2e2 ln(x) dx where n = 4 represents the number of intervals used in the approximation.

**Solution:**

import math

def simpsons\_rule(f, a, b, n):

if n % 2 != 0:

raise ValueError("Number of intervals (n) must be even.")

h = (b - a) / n

x = [a + i \* h for i in range(n + 1)] # Generate x values

fx = [f(xi) for xi in x] # Compute f(x) for each x

# Simpson's Rule formula

integral = fx[0] + fx[-1] # f(x\_0) and f(x\_n)

integral += 4 \* sum(fx[i] for i in range(1, n, 2)) # Odd-indexed terms

integral += 2 \* sum(fx[i] for i in range(2, n, 2)) # Even-indexed terms

integral \*= h / 3

return integral

# Define the function f(x) = ln(x)

def f(x):

return math.log(x)

# Define the limits and number of intervals

a = math.e \*\* 2 # Lower limit

b = 2 \* math.e \*\* 2 # Upper limit

n = 4 # Number of intervals

# Compute the integral

result = simpsons\_rule(f, a, b, n)

print(f"The approximate integral is: {result:.6f}")

**Output:**



**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.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| X | -4 | -3 | -2 | -1 | 0 | 1 | 2 |
| F(x) | 0 | 4 | 5 | 3 | 10 | 11 | 2 |

**Solution:**

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

n = len(points)

integral = points[0][1] + points[-1][1] # Adding first and last y-values

for i in range(1, n - 1):

integral += 2 \* points[i][1] # Adding rest of the y-values

h = points[1][0] - points[0][0] # Interval width

integral \*= h / 2 # Final multiplication by h/2

return integral

# Example usage with given points

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)

**Solution:**

