Bahria University,

Karachi Campus

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LAB EXPERIMENT NO.

09

LIST OF TASKS

|  |  |
| --- | --- |
| TASK NO | OBJECTIVE |
| **01** | Write a Python program utilizing Simpson's 3/8 Rule to compute the definite integral where n = 3 represents the number of intervals used in the approximation |
| **02** | Write a python program to determine the approximation of the area beneath the curve represented by y = f(x) using Simpson’s 3/8. The values of the function f(x) are provided within following table   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | X | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 | | F(X) | 4.0552 | 4.953 | 6.0436 | 7.3891 | 9.025 | 10.092 | 11.099 | |
| 03 | Write a python code in the table below to determine the integral for this data: |

Submitted On:

03-12-2024

(Date: DD/MM/YYYY)

**Task No. 01**: Write a Python program utilizing Simpson's 3/8 Rule to compute the definite integral where n = 3 represents the number of intervals used in the approximation



**Solution:**

def f(x):

return 0.5 + 25 \* x - 200 \* x\*\*2 + 675 \* x\*\*3 - 900 \* x\*\*4 + 400 \* x\*\*5

def simpsons\_38\_rule(a, b, n):

# Ensure n is a multiple of 3

if n % 3 != 0:

raise ValueError("n must be a multiple of 3")

# Calculate the step size

h = (b - a) / n

# Initialize the sum with the first and last terms

result = f(a) + f(b)

# Apply the 3/8 Simpson rule for terms with coefficient 3

for i in range(1, n):

if i % 3 == 0: # Terms with coefficient 2

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

else: # Terms with coefficient 3

result += 3 \* f(a + i \* h)

# Multiply the sum by 3h/8

return (3 \* h / 8) \* result

# Given limits and n

a = 0.0

b = 0.8

n = 3

integral = simpsons\_38\_rule(a, b, n)

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

**Output:**



**Task No. 02**: Write a python program to determine the approximation of the area beneath the curve represented by y = f(x) using Simpson’s 3/8. The values of the function f(x) are provided

within following table

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| X | 1.4 | 1.6 | 1.8 | 2.0 | 2.2 | 2.4 | 2.6 |
| F(X) | 4.0552 | 4.953 | 6.0436 | 7.3891 | 9.025 | 10.092 | 11.099 |

**Solution:**

x\_values = [1.4, 1.6, 1.8, 2.0, 2.2, 2.4, 2.6]

f\_values = [4.0552, 4.9530, 6.0436, 7.3891, 9.0250, 10.0920, 11.0990]

# Function to compute the integral using Simpson's 3/8 rule

def simpsons\_38\_rule(x, f\_x):

n = len(x) - 1 # Number of intervals

if n % 3 != 0:

raise ValueError("The number of intervals (n) must be a multiple of 3.")

h = (x[-1] - x[0]) / n # Step size

result = f\_x[0] + f\_x[-1] # First and last term (f(x\_0) and f(x\_n))

# Apply Simpson's 3/8 rule

for i in range(1, n):

if i % 3 == 0:

result += 2 \* f\_x[i] # Terms with weight 2

else:

result += 3 \* f\_x[i] # Terms with weight 3

return (3 \* h / 8) \* result

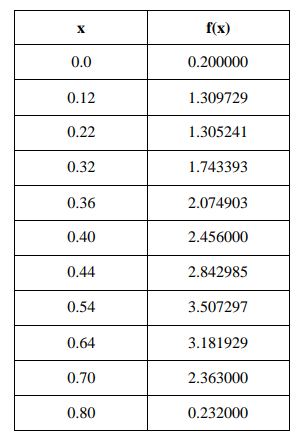
integral = simpsons\_38\_rule(x\_values, f\_values)

print(f"The approximate area under the curve is: {integral:.6f}")

**Output:**



**Task No. 03**: Write a python code in table below to determine the integral for this data:



**Solution:**

x = [0.0, 0.12, 0.22, 0.32, 0.36, 0.40, 0.44, 0.54, 0.64, 0.70, 0.80]

f\_x = [0.200000, 1.309729, 1.305241, 1.743393, 2.074903, 2.456000, 2.842985, 3.507297, 3.181929, 2.363000, 0.232000]

# Applying the Trapezoidal Rule

def trapezoidal\_rule(x, f\_x):

n = len(x)

integral = 0.0

# Calculate h (the width of each interval)

for i in range(n - 1):

h = x[i+1] - x[i]

# Add the trapezoidal area for each segment

integral += (h / 2) \* (f\_x[i] + f\_x[i+1])

return integral

result = trapezoidal\_rule(x, f\_x)

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

**Output:**

