# Bahria University,

## Karachi Campus



LAB EXPERIMENT NO.

**\_12\_**

LIST OF TASKS

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| **TASK NO** | **OBJECTIVE** |
| 01 | Write a Python program that implements golden section search method to find the max and min value of the following functions:  a. 𝑥2 + 2 ; −3 ≤ 𝑥 ≤ 5  b. 0.5 − 𝑥 𝑒−𝑥 2 + 2 ; 0 ≤ 𝑥 ≤ 2 |
| 02 |  |
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Submitted On:

Date: 22/12/2024

**Task No 01: Write a Python program that implements golden section search method to find the max and min value of the following functions:**

**a. 𝑥2 + 2 ; −3 ≤ 𝑥 ≤ 5**

**b. 0.5 − 𝑥 𝑒−𝑥 2 + 2 ; 0 ≤ 𝑥 ≤ 2**

**Solution:**

import math

def golden\_section\_search(f, a, b, is\_max=True, tol=1e-5):

"""

Perform the Golden Section Search to find the maximum or minimum of a function.

Parameters:

f (function): The function to optimize.

a (float): The lower bound of the search interval.

b (float): The upper bound of the search interval.

is\_max (bool): True for maximization, False for minimization.

tol (float): The tolerance for convergence.

Returns:

float: The x-value of the maximum or minimum.

float: The corresponding function value.

"""

golden\_ratio = (math.sqrt(5) - 1) / 2 # Golden ratio constant

# Initialize points

c = b - golden\_ratio \* (b - a)

d = a + golden\_ratio \* (b - a)

while abs(b - a) > tol:

if (f(c) < f(d)) if is\_max else (f(c) > f(d)):

a = c

else:

b = d

# Update points

c = b - golden\_ratio \* (b - a)

d = a + golden\_ratio \* (b - a)

# Return the midpoint and corresponding function value

x\_opt = (a + b) / 2

return x\_opt, f(x\_opt)

# Function definitions

def func\_a(x):

return x\*\*2 + 2

def func\_b(x):

return 0.5 - x \* math.exp(-x\*\*2) + 2

# Interval and tolerance

interval\_a = (-3, 5)

interval\_b = (0, 2)

tolerance = 1e-5

# Finding max and min for function a

x\_max\_a, f\_max\_a = golden\_section\_search(func\_a, \*interval\_a, is\_max=True, tol=tolerance)

x\_min\_a, f\_min\_a = golden\_section\_search(func\_a, \*interval\_a, is\_max=False, tol=tolerance)

# Finding max and min for function b

x\_max\_b, f\_max\_b = golden\_section\_search(func\_b, \*interval\_b, is\_max=True, tol=tolerance)

x\_min\_b, f\_min\_b = golden\_section\_search(func\_b, \*interval\_b, is\_max=False, tol=tolerance)

# Display results

print("Function a: x^2 + 2")

print(f"Maximum value: f({x\_max\_a}) = {f\_max\_a}")

print(f"Minimum value: f({x\_min\_a}) = {f\_min\_a}")

print("\nFunction b: 0.5 - x \* exp(-x^2) + 2")

print(f"Maximum value: f({x\_max\_b}) = {f\_max\_b}")

print(f"Minimum value: f({x\_min\_b}) = {f\_min\_b}")

**Output:**

**A math equation with numbers and equations

Description automatically generated**