Karachi Institute 0f Economics & Technologies College of Computing & Information Sciences

Lab Assignment # 1

SU21

Instructor: Aziz Mehmood Farooqi

Deadline: 7th July 2021

Question:

Write a function **`fun3NonLinearMethods(fEq,x0,x1,tol=1e-6,maxiter=100,mt)`** (this is a main function and you can create other functions according to your need) whose input arguments are the function equation **`fEq`**, the interval boundaries **`x0`** and **`x1`**, the absolute error bound **`tol`**, the maximum number of iterations **`maxiter`** and the method type **`mt`**(e.g. bisection, newton or secant). And, as output arguments, the approximate solution **`sol`** and the number of iterations performed **`n`**.

Use this function with

$$f(T_f) = -0.50598\times10^{-10}T_f^3 + 0.38292\times10^{-7}T_f^2 + 0.74363\times10^{-4}T_f + 0.88318\times10^{-2} = 0$$

Use in the interval [-150, -100]

$$T_{f,\ell} = -150\,^{\circ}\mathrm{F},\ T_{f,u} = -100\,^{\circ}\mathrm{F}$$

Python users:

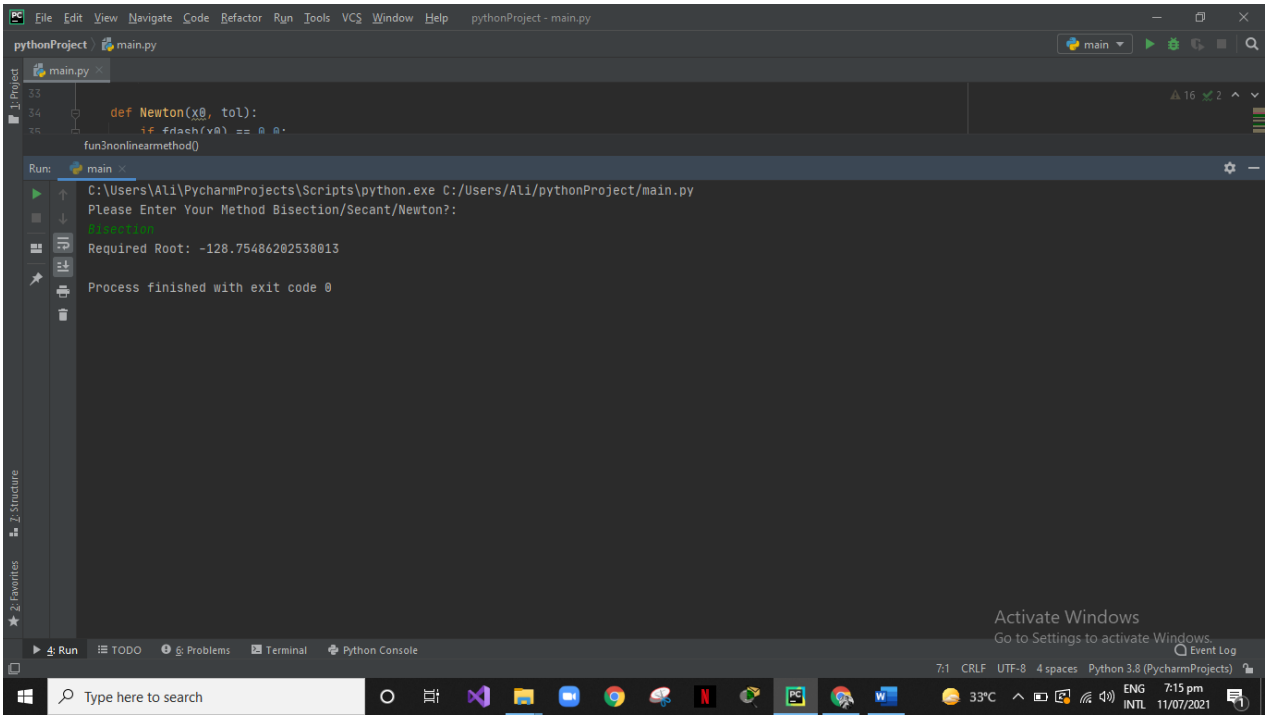
1. Use recursion for solving 3 Non-Linear-Methods (Bisection, Newton & Secant). [6 marks]
2. You have to run your main function with 3 Non-Linear-Methods (Bisection, Newton & Secant) one by one and show their results in your solution. [3 marks]
3. The function equation argument shout be in string format. [1 marks]
4. Please do not just copy the built-in function for Bisection, Newton & Secant.

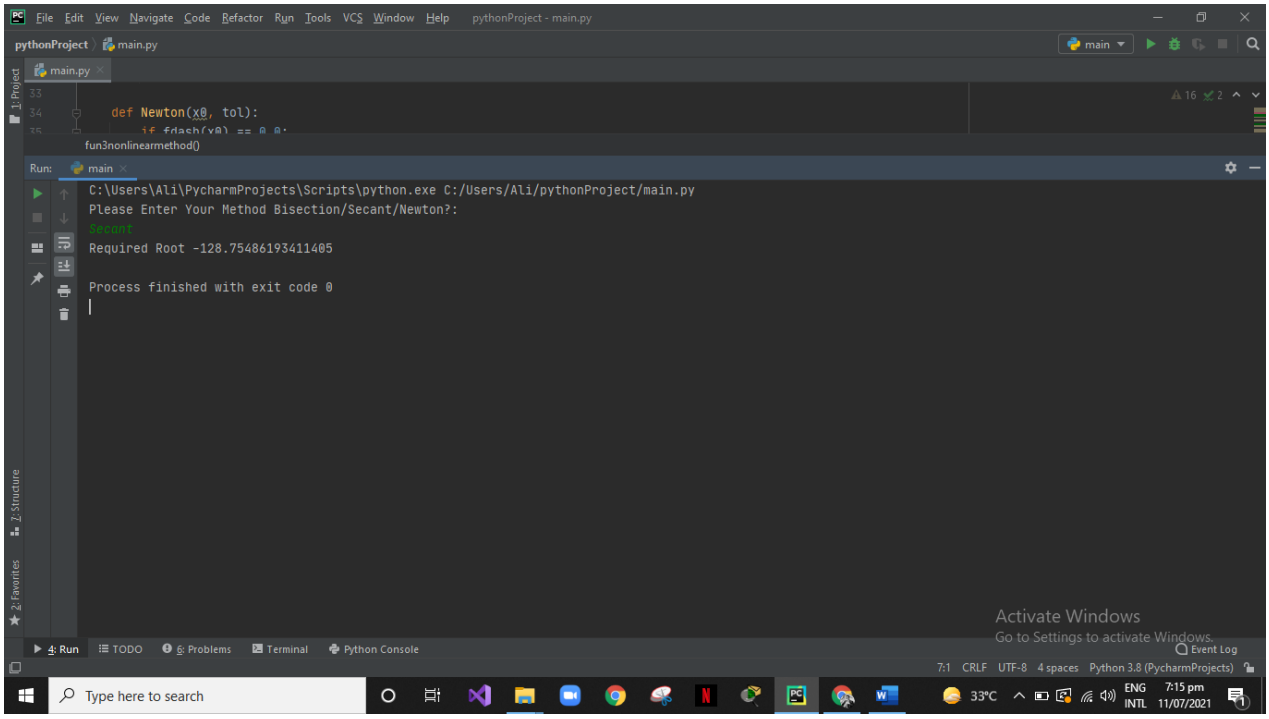
Solution:

```
import sympy as s


def fun3nonlinearmethod(fEq, x0, x1, toll, Met):
    f = s.diff(fEq, 'x')
    der = str(f)

    def f(x):
        e = eval(fEq)
        return e

    def fdash(x):
        e = eval(str(der))
        return e

    def Bisection(x0, x1, tol):
        if (abs((x0 - x1)) < tol):
            print("Required Root:", x1)
        else:
            if (f((x1 + x0) / 2) * f(x1) < 0):
                return Bisection(x1, ((x1 + x0) / 2), tol)
            else:
                return Bisection(((x1 + x0) / 2), x0, tol)

    def Secant(x0, x1, tol):
```

```
        if f(x0) == f(x1):
            print('Equation Has Become Zero now')
        x2 = x0 - (x1 - x0) * f(x0) / (f(x1) - f(x0))
        if abs(f(x0)) < tol:
            print("Required Root", x2)
        else:
            return Secant(x0 - ((x1 - x0) * f(x0)) / (f(x1) - f(x0)), x0, tol)

    def Newton(x0, tol):
        if fdash(x0) == 0.0:
            print('Zero Error"!')
            return 0
        if abs(f(x0)) < tol:
            print("Required Root:", x0)
        else:
            return Newton(x0 - f(x0) / fdash(x0), tol)

    if (Met == 'Bisection'):
        Bisection(x0, x1, toll)

    if (Met == 'Secant'):
        Secant(x0, x1, toll)
    if (Met == 'Newton'):
        Newton(x0, toll)


TOLERANCE = 0.0000001
X0 = -150
x1 = -100
equation = '-
0.000000000050598*x**3+0.000000038292*x**2+0.000074363*x+0.0088318'
condition = True
while (condition):
    print('Please Enter Your Method Bisection/Secant/Newton?:')
    Met = input()
    fun3nonlinearmethod(equation, X0, x1, TOLERANCE, Met)
    condition = False
```

OUTPUT:


File Edit View Navigate Code Refactor Run Tools VCS Window Help pythonProject - main.py
pythonProject main.py
main.py
def Newton(x0, tol):
fun3nonlinearmethod()
Run: main
C:\Users\Ali\PycharmProjects\Scripts\python.exe C:/Users/Ali/pythonProject/main.py
Please Enter Your Method Bisection/Secant/Newton?:
Bisection
Required Root: -128.75486202538013
Process finished with exit code 0
Activate Windows
Go to Settings to activate Windows.
4: Run TODO 6: Problems Terminal Python Console
Event Log
7:1 CRLF UTF-8 4 spaces Python 3.8 (PycharmProjects)
Type here to search
33°C
ENG INTL
7:15 pm 11/07/2021


File Edit View Navigate Code Refactor Run Tools VCS Window Help pythonProject - main.py
pythonProject main.py
main.py
def Newton(x0, tol):
fun3nonlinearmethod()
Run: main
C:\Users\Ali\PycharmProjects\Scripts\python.exe C:/Users/Ali/pythonProject/main.py
Please Enter Your Method Bisection/Secant/Newton?:
Secant
Required Root -128.75486193411405
Process finished with exit code 0
Activate Windows
Go to Settings to activate Windows.
4: Run TODO 6: Problems Terminal Python Console
Event Log
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Type here to search
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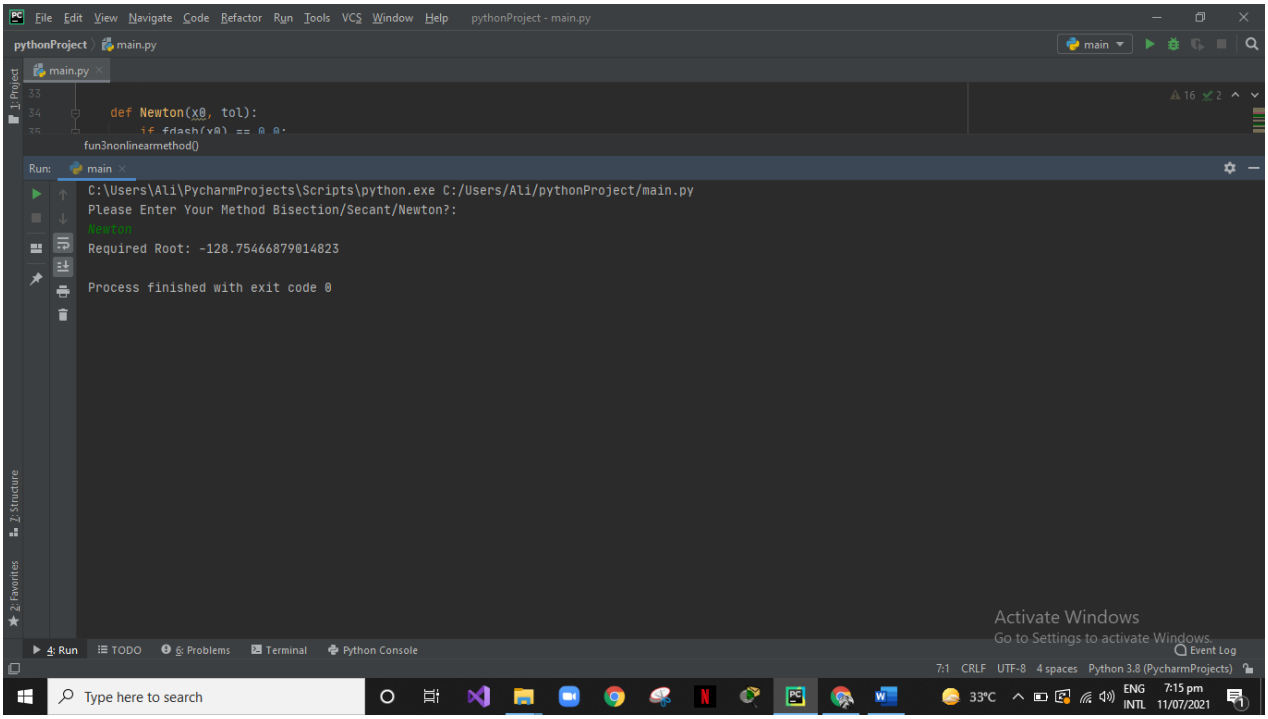
File Edit View Navigate Code Refactor Run Tools VCS Window Help pythonProject - main.py
pythonProject main.py
main
main.py
def Newton(x0, tol):
fun3nonlinearmethod()
Run: main
C:\Users\Ali\PycharmProjects\Scripts\python.exe C:/Users/Ali/pythonProject/main.py
Please Enter Your Method Bisection/Secant/Newton?:
Newton
Required Root: -128.75466879014823
Process finished with exit code 0
Activate Windows
Go to Settings to activate Windows.
4: Run
TODO
6: Problems
Terminal
Python Console
Event Log
7:1 CRLF UTF-8 4 spaces Python 3.8 (PycharmProjects)
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7:15 pm
11/07/2021