

MA202

ASSIGNMENT 6

NAME:

ARCHIT AGRAWAL

ROLL NO. :

202051213

SECTION:

2

Answer 1

Root of $\ln(x) - 1$

```
iterations=0;
xl=2;
xr=3;

x0=(xr+xl)/2;
f=@(x)(log(x) - 1);
for i=1:10000

    if f(x0)<0
        xl=x0;
        x0=(xr+xl)/2;
        iterations = iterations + 1;
    elseif f(x0)>0
        xr=x0;
        x0=(xr+xl)/2;
        iterations = iterations + 1;
    else
        break;
    end

    if ((xr-xl)/2)<0.01
        break;
    end

end

disp("The root of the given function is : "+x0);
```

The root of the given function is : 2.7109

```
disp("For 1st answer The number of iterations required in first question for ln of x -1
```

For 1st answer The number of iterations required in first question for ln of x -1 using bisection method a

Root of $\tanh(x)$

```
iterations=0;
xl=2;
xr=3;

x0=(xr+xl)/2;
f=@(x)(tanh(x));
for i=1:10000
```

```

if f(x0)<0
    xl=x0;
    x0=(xr+xl)/2;
    iterations = iterations + 1;
elseif f(x0)>0
    xr=x0;
    x0=(xr+xl)/2;
    iterations = iterations + 1;
else
    break;
end

if ((xr-xl)/2)<0.01
    break;
end

end

disp("The root of the given function is : "+x0);

```

The root of the given function is : 2.0078

```
disp("For 1st answer The number of iterations required using bisection method for tanh(x) : 6");
```

For 1st answer The number of iterations required using bisection method for tanh(x) : 6

Answer 2

Root of sech(x)

```

iterations=0;
xl=2;
xr=3;

f=@(x)(sech(x));
% derivative of f is f1
f1=@(x)(-1*sech(x)*tanh(x));
x0=x0-(f(x0)/f1(x0));
for i=1:10000

    if f(x0)<0
        xl=x0;
        x0=x0-(f(x0)/f1(x0));
        iterations = iterations + 1;
    elseif f(x0)>0
        xr=x0;
        x0=x0-(f(x0)/f1(x0));
        iterations = iterations + 1;
    else
        break;
    end
end

```

```

end

if ((xr-xl)/2)<0.01
    break;
end

end

disp("The root of the given function is : "+x0);

```

The root of the given function is : 711.0498

```

disp("For second answer the number of iterations required using newton raphson method f

```

For second answer the number of iterations required using newton raphson method for sech(x) are : 708

Answer 3

Root of the function $1/x$ using all the four methods

Since $1/x$ doesn't have any root and so the condition of $((xr-xl)/2)<0.1$ has been applied

Method 1 : Bisection method

```

iterations=0;
xl=2;
xr=3;

x0=(xr+xl)/2;
f1=@(x)(1/x)

```

f1 = function_handle with value:
@(x)(1/x)

```

for i=1:10000

    if f1(x0)<0
        xl=x0;
        x0=(xr+xl)/2;
        iterations = iterations + 1;
    elseif f1(x0)>0
        xr=x0;
        x0=(xr+xl)/2;
        iterations = iterations + 1;
    else
        break;
    end

    if ((xr-xl)/2)<0.1
        break;
    end
end

```

```
end
```

```
disp("The root of the given function is : "+x0);
```

The root of the given function is : 2.0625

```
disp("For third question the number of iterations required using bisection method : "+i)
```

For third question the number of iterations required using bisection method : 3

Method 2 : False position method

```
iterations=0;  
xl=2;  
xr=3;  
f=@(x)(atan(x))
```

f = function_handle with value:
@(x)(atan(x))

```
x0=(1/(f(xr)-f(xl)))*((xl*f(xr))-(xr*f((xl))));
```

```
for i=1:10000
```

```
    if f(x0)<0  
        xl=x0;  
        x0=(1/(f(xr)-f(xl)))*((xl*f(xr))-(xr*f((xl))));  
        iterations = iterations + 1;
```

```
    elseif f(x0)>0  
        xr=x0;  
        x0=(1/(f(xr)-f(xl)))*((xl*f(xr))-(xr*f((xl))));  
        iterations = iterations + 1;
```

```
    else  
        break;  
    end
```

```
    if ((xr-xl)/2)<0.01  
        break;  
    end
```

```
end
```

```
disp("The root of the given function is : "+x0);
```

The root of the given function is : 1.4049e-10

```
disp("For third question the number of iterations required using false position were : "+i)
```

For third question the number of iterations required using false position were : 6

Method 3 : Newton Raphson Method

```

iterations=0;
xl=2;
xr=3;

f=@(x)(1/x);
% derivative of f is f1
f1=@(x)(-1/(x*x));
x0=x0-(f(x0)/f1(x0));
for i=1:10000

    if f(x0)<0
        xl=x0;
        x0=x0-(f(x0)/f1(x0));
        iterations = iterations + 1;
    elseif f(x0)>0
        xr=x0;
        x0=x0-(f(x0)/f1(x0));
        iterations = iterations + 1;
    else
        break;
    end

    if ((xr-xl)/2)<0.01
        break;
    end

end

disp("The root of the given function is : "+x0);

```

The root of the given function is : 5.6197e-10

```
disp("For third question the number of iterations required using newton raphson method
```

For third question the number of iterations required using newton raphson method for sech(x) are : 1

Method 4 : Secant Method

```
f=@(x)(1/x)
```

```
f = function_handle with value:
    @(x)(1/x)
```

```
x(1)=2
```

```

x = 1x1000
10154 ×
    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000 ...

```

```
x(2)=3
```

```

x = 1x1000
10154 ×

```

0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 ...

```
n=0.1
```

```
n = 0.1000
```

```
iteration=0;  
root=x(1)
```

```
root = 2
```

```
for i=3:1000  
    x(i) = x(i-1) - (f(x(i-1)))/((x(i-1) - x(i-2))/(f(x(i-1)) - f(x(i-2))));  
    iteration=iteration+1;  
    if abs((x(i)-x(i-1))/x(i))*100<n  
        root=x(i)  
        break  
    end  
end
```

```
disp("The root of the given function is : "+root);
```

The root of the given function is : 2

```
disp("For third question the number of iterations required using newton raphson method
```

For third question the number of iterations required using newton raphson method for sech(x) are : 998

Since the $1/x$ doesn't have any root and so we get different answers and the number of iterations for each method show the rate of convergence of that method.

Less the number of iterations for the same level of difference between x_r and x_l , the more faster rate of divergence it has.

Answer 4

Root of $\sin(x)$

Method 1 : Bisection method

```
iterations=0;  
xl=2;  
xr=4;  
  
x0=(xr+xl)/2;  
f1=@(x)(sin(x))
```

```
f1 = function_handle with value:  
    @(x)(sin(x))
```

```

for i=1:10000

    if f1(x0)<0
        x1=x0;
        x0=(xr+x1)/2;
        iterations = iterations + 1;
    elseif f1(x0)>0
        xr=x0;
        x0=(xr+x1)/2;
        iterations = iterations + 1;
    else
        break;
    end

    if ((xr-x1)/2)<0.01
        break;
    end

end

disp("The root of the given function is : "+x0);

```

The root of the given function is : 2.0078

```
disp("For fourth question the number of iterations required using bisection method : "+
```

For fourth question the number of iterations required using bisection method : 7

Method 2 : False position method

```

iterations=0;
x1=2;
xr=4;
f=@(x)(sin(x))

```

f = function_handle with value:
 @(x)(sin(x))

```

x0=(1/(f(xr)-f(x1)))*((x1*f(xr))-(xr*f((x1))));

for i=1:10000

    if f(x0)<0
        x1=x0;
        x0=(1/(f(xr)-f(x1)))*((x1*f(xr))-(xr*f((x1))));
        iterations = iterations + 1;
    elseif f(x0)>0
        xr=x0;
        x0=(1/(f(xr)-f(x1)))*((x1*f(xr))-(xr*f((x1))));
        iterations = iterations + 1;
    end
end

```



```

else
    break;
end

if ((xr-xl)/2)<0.01
    break;
end

end

disp("The root of the given function is : "+x0);

```

The root of the given function is : 3.1416

```
disp("For fourth question the number of iterations required using false position were : ");
```

For fourth question the number of iterations required using false position were : 2

Method 3 : Newton Raphson Method

```

iterations=0;
xl=2;
xr=4;

f=@(x)(sin(x));
% derivative of f is f1
f1=@(x)(cos(x));
x0=x0-(f(x0)/f1(x0));
for i=1:10000

    if f(x0)<0
        xl=x0;
        x0=x0-(f(x0)/f1(x0));
        iterations = iterations + 1;
    elseif f(x0)>0
        xr=x0;
        x0=x0-(f(x0)/f1(x0));
        iterations = iterations + 1;
    else
        break;
    end

    if ((xr-xl)/2)<0.01
        break;
    end

end

disp("The root of the given function is : "+x0);

```

The root of the given function is : 3.1416

```
disp("For fourth question the number of iterations required using newton raphson method")
```

For fourth question the number of iterations required using newton raphson method for sech(x) are : 10000

Method 4 : Secant Method

```
f=@(x)(sin(x))
```

```
f = function_handle with value:  
@(x)(sin(x))
```

```
x(1)=2
```

```
x = 1×1000  
10154 ×  
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 ...
```

```
x(2)=3
```

```
x = 1×1000  
10154 ×  
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 ...
```

```
n=0.1
```

```
n = 0.1000
```

```
iteration=0;  
  
for i=3:1000  
    x(i) = x(i-1) - (f(x(i-1)))*((x(i-1) - x(i-2))/(f(x(i-1)) - f(x(i-2))));  
    iteration=iteration+1;  
    if abs((x(i)-x(i-1))/x(i))*100<n  
        root=x(i)  
        break  
    end  
end
```

```
root = 3.1416
```

```
disp("The root of the given function is : "+root);
```

The root of the given function is : 3.1416

```
disp("For third question the number of iterations required using newton raphson method")
```

For third question the number of iterations required using newton raphson method for sech(x) are : 3