Lab Assignment MA323

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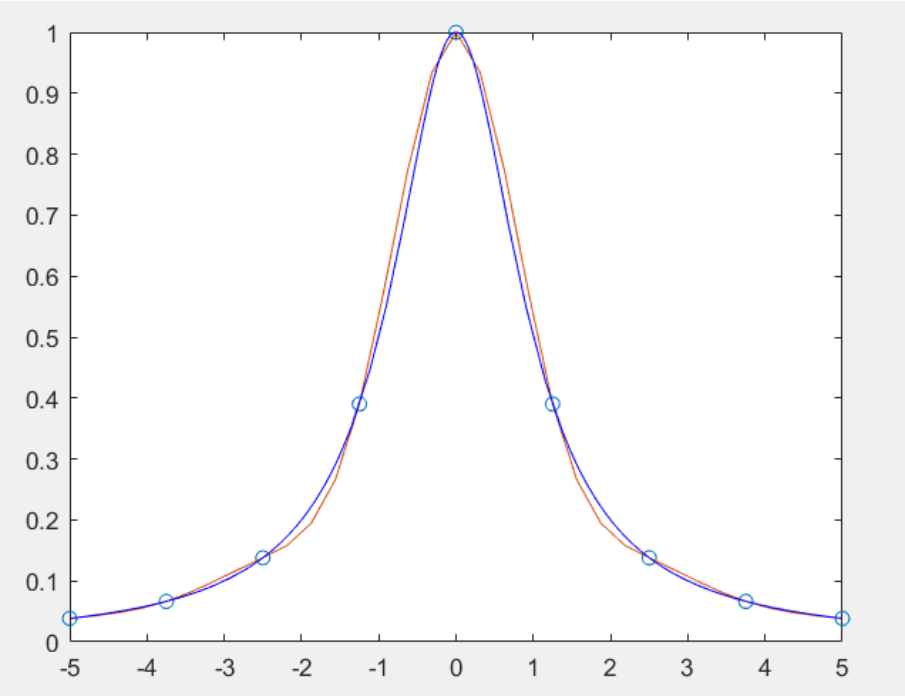
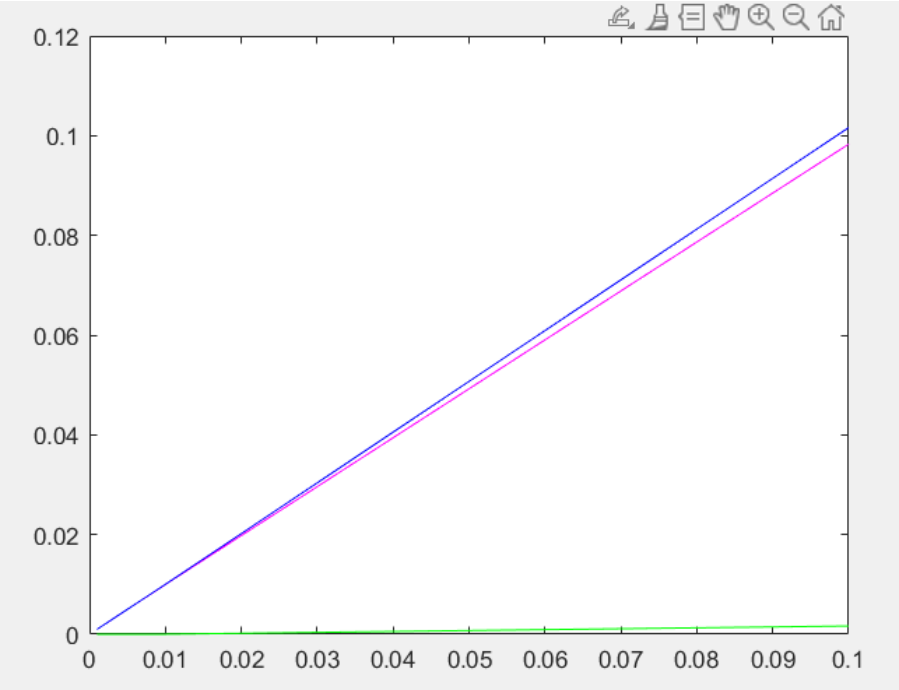
Lab no: 04

Q1



Q2



Q3

```
At x=1, with h=0.001
central difference is: 1.081500000 , error is 0.000428000
taylor difference is: 1.081666667, error is 0.000594667
F' is: 1.081072.
```

Code

Q1

```
clear;
clc;
x=[-5, -3.75, -2.50, -1.25, 0, 1.25, 2.5, 3.75, 5];
y= zeros(9,1);

for r = 1:9
    y(r) = f(x(r));
end
N = length(x);
n =N -1;
h = (x(N)-x(1))/n;
Trid = diag(4*ones(1,n-1))+ diag(ones(1,n-2),1)+diag(ones(1,n-2),-1);
for  i = 1:n-1
    z(i) = 6/h^2*(y(i+2)-2*y(i+1)+y(i));
end
z = z';
w = inv(Trid)*z;
sigma = [0; w; 0];
for i = 1:n
    d(i) = y(i);
    b(i) = sigma(i)/2;
    a(i) = (sigma(i+1)-sigma(i))/(6*h);
    c(i) = (y(i+1)-y(i))/h-h/6*(2*sigma(i)+sigma(i+1));
end
r = 4;
hh = h/r;
m=x(1): hh:x(N);
for i =1:n
    for j = r* (i-1)+1:r*i
        s(j) = a(i)* (m(j)-x(i))^3+b(i)*(m(j)-x(i))^2+c(i)*(m(j)-x(i))+ d(i);
    end
end
s(r*n+1) =y(N);
plot(x, y, 'o')
hold on
plot(m,s,'-')
fplot(@(x) f(x),[-5 5],'b')
hold off

function [value] = f(x)
value = 1/(1+x*x);
end
```

q2

```
clear
clc
H = [0.1, 0.01, 0.001];
Ef = [abs(fprime(1) - forwardder(1, 0.1)), abs(fprime(1) - forwardder(1, 0.01)),
abs(fprime(1) - forwardder(1, 0.001))];
Eb = [abs(fprime(1) - backwardder(1, 0.1)), abs(fprime(1) - backwardder(1, 0.01)),
abs(fprime(1) - backwardder(1, 0.001))];
Ec = [abs(fprime(1) - centraldiff(1, 0.1)), abs(fprime(1) - centraldiff(1, 0.01)),
abs(fprime(1) - centraldiff(1, 0.001))];

fprintf("\n\nAt x=1, with h=0.1 \n");
fprintf("forward difference is: %.9f , error is %.9f\n", forwardder(1, 0.1),
Ef(1));
fprintf("backward difference is: %.9f, error is %.9f \n", backwardder(1, 0.1),
Eb(1));
fprintf("central difference is: %.9f , error is %.9f\n", centraldiff(1, 0.1),
Ec(1));
fprintf("F' is: %.9f \n", fprime(1));

fprintf("\n\nAt x=1, with h=0.01 \n");
fprintf("forward difference is: %.9f , error is %.9f\n", forwardder(1, 0.01),
Ef(2));
fprintf("backward difference is: %.9f, error is %.9f \n", backwardder(1, 0.01),
Eb(2));
fprintf("central difference is: %.9f , error is %.9f\n", centraldiff(1, 0.01),
Ec(2));
fprintf("F' is: %.9f \n", fprime(1));

fprintf("\n\nAt x=1, with h=0.001 \n");
fprintf("forward difference is: %.9f , error is %.9f\n", forwardder(1, 0.001),
Ef(3));
fprintf("backward difference is: %.9f, error is %.9f \n", backwardder(1, 0.001),
Eb(3));
fprintf("central difference is: %.9f , error is %.9f\n", centraldiff(1, 0.001),
Ec(3));
fprintf("F' is: %.9f \n", fprime(1));

plot(H, Ef, 'm')
hold on
plot(H, Eb, 'b')
plot(H, Ec, 'g')
hold off

function [value] = forwardder(x, h)
value = (f(x+h) - f(x))/(h);
end

function [value] = backwardder(x, h)
value = (f(x) - f(x-h))/(h);
end

function [value] = centraldiff(x, h)
value = (f(x+h) - f(x-h))/(2*h);
end

function [value] = f(x)
value = x*log(1+(x*x));
```

```
end

function [value] = fprime(x)
value = log(1+(x*x)) + ((1/(1+x*x))*2*x*x);
end
```

Q3

```
clear
clc

x = [0.398, 0.399, 0.400, 0.401, 0.402];
y = [0.408591, 0.409671, 0.410752, 0.411834, 0.412915];

fprintf("\n\nAt x=1, with h=0.001 \n");
fprintf("central difference is: %.9f , error is %.9f\n", centraldiff(0.400,
0.001), abs(1.081072 - centraldiff(0.400, 0.001)));
fprintf("taylor difference is: %.9f, error is %.9f \n", fprime(0.400, 0.001),
abs(1.081072 - fprime(0.400, 0.001)));
fprintf("F' is: 1.081072. \n");


function [value] = f(x)
if x==0.398
    value = 0.408591;
elseif x==0.399
        value = 0.409671;
elseif x==0.400
        value = 0.410752;
elseif x==0.401
        value = 0.411834;
elseif x==0.402
        value = 0.412915;
end
end

function [value] = centraldiff(x, h)
value = (f(x+h) - f(x-h))/(2*h);
end

function [value] = fprime(x, h)
value = (-f(x+2*h) + 8*f(x+h) - 8*f(x-h) + f(x-2*h))/(12*h);
end
```