Tanner Orndorff
Homework 3
I certify that this is my work and no one else's.
Total Score: 100/100

Section 1.3 Exercises 1.a, 3.a: 20/20

Section 1.3 Computer Problems 1, 3 :20/20

Section 1.4 Exercise 1.b : 10/10

Section 1.4 Computer Problem 1.c : 10/10

Section 1.5 Exercise 1.1a use secant method : 10/10

Section 1.5 Exercise 1.1b use modified secant method with $x_0 = 1$ and $h = .0001$ (modified secant method covered in class): 10/10

Section 1.5 Computer Problem 1 : 20/20

Section 1.3 Exercise 1a 3a

back for $f(r)=0$ → $|f(x_a)|$ for $|r-x_a|$

(1a) Forward Error of $f(x)=4x-3$

~~$|4(.74)-3|$~~ $|3/4 - .74|$

~~or .04~~ or .01

Backward Error:

$|4(.74)-3|$

or .04

(3a) Multiplicity of root $r=0$ of $f(x)=1-\cos x$

$f(0)=1-\cos(0)$

$f(0)=0$

$f'(0)=\sin(0)$

$f'(0)=0$

$f''(0)=\cos(0)$

$f''(0)=1$

Multiplicity of 2 @ $r=0$

Section 1.4 Exercise 1.b

(1b) 2 steps of Newtons Method, $x_0=0$, $x^4-x^2+x-1=0$

$f'(x)=4x^3-2x+1=0$

~~x_0~~ $x_{i+1}=x_i-\frac{f(x_i)}{f'(x_i)}$

$x_1=0-\frac{0^4-0^2+0-1}{4(0)^3-2(0)+1}$

$x_1=0-\frac{-1}{1}$

$x_1=0+1$ $x_1=1$

$x_2=1-\frac{1^4-1^2+1-1}{4(1)^3-2(1)+1}$

$x_2=1-\frac{1-1+1-1}{4-2+1}$ $x_2=1-\frac{0}{3}$

$x_2=1$

Computer Problem Exercise 1.3

(1) $\sin x - x$

$f(0) = \sin(0) - 0$

$f'(0) = \cos(0) = 1$

$f''(0) = -\sin(0)$

$m = 3$ $\quad x_a =$

Computer response: $-2.0735 e^{-08}$

~~$FE = |-2.0735 e^{-8} - 1|$~~

$FE = |0 - -2.073 e^{-8}|$

or $-2.073 e^{-8}$

Section 1.5 Exercise 1.1a, 1.1b

(1a) two step secant method

$x_{i+1} = x_i - \frac{f(x_i)(x_i - x_{i-1})}{f(x_i) - f(x_{i-1})}$

$x_0 = 1 \quad x_1 = 2$

$x^3 = 2x + 2$

$x_2 = 2 - \frac{(-2^3 + 2(2) + 2)(2-1)}{(-2^3 + 4 + 2) - (-1^3 + 2(1) + 2)}$ ~~$f(x_1) = -2$~~

$x_2 = 2 - \frac{(-8+6)(1)}{(-2) - (-1+4)}$ $f(x_2) = -(8/5)^3 + 2(\frac{8}{5}) + 2$

$f(x_2) = 1.104$

$x_2 = 2 - \frac{-2}{-2-3}$

$x_2 = 2 - \frac{-2}{-5}$

$x_2 = \frac{10}{5} - \frac{2}{5}$ or $\boxed{x_2 = \frac{8}{5}}$

$x_3 = \frac{8}{5} - \frac{(1.104)(\frac{8}{5} - 2)}{(1.104) - (-2)}$

$x_3 = \frac{8}{5} - \frac{(1.104)(-.4)}{3.104}$

$x_3 = 8/5 - \frac{-.4416}{3.104}$

$\boxed{x_3 = 1.742268041}$

Section 1.5 Exercise 1.1b

$x_{i+1} = x_i - \frac{(\delta x_i f(x_i))}{f(x_i + \delta x_i) - f(}$

$x_0 = 1 \quad n = .0001 \quad e^x + x - 7$

$x_0 + \delta x_0 = 1 + 1(.0001)$

1.0001

$x_1 = 1 - \frac{.0001(1)(e^1 + 1 - 7)}{(e^{1.0001} + 2.0001 - 7) - (e^1 + 1 - 7)}$

$x_1 = 1 - \frac{(1.0001)(-3.281718172)}{(-3.281718172) - (-3.281718172)}$

2.389895041

$x_1 = 1 - \frac{-3.282046344}{5.671613213}$

$\delta x_1 = 1.578679508E^{-4}$

$f(x_1) = -.572771380 1$

$f(x_1 + \delta x_1) = -.571848021$

$x_1 = 1.578679508$

$x_2 = 1.578679508 - \frac{1.578\ldots E^{-4}(-.571848021)}{(-.571848021) - (-.572771380 1)}$

$x_2 = 1.676607003$

Matlab code:

```
clc
%Computer Problem 1.3, 1
Xa1 = fzero('sin(x)-x',.1)
FE1 = abs(0 - fzero('sin(x)-x',.1))
BE1 = sin(Xa) - Xa
%Computer Problem 1.3, 3a
rootA = fzero('(2*x)*cos(x)-(2*x)+sin(x.^3)',[-.1,.2])
FE3 = abs(0 - fzero('(2*x)*cos(x)-(2*x)+sin(x.^3)',[-.1,.2]))
BE3 = (2*rootA)*cos(rootA)-(2*rootA)+sin(rootA.^3)
%%Computer Problem 1.3, 3b
BM3 = bisect(@(x) (2*x)*cos(x)-(2*x)+sin(x.^3), -.1,.2,.00001)
%Computer Problem 1.4, 1a
NEW = newtons(@(x) exp(x) + sin(x) - 4, @(x) exp(x) - cos(x), 1,8)
%computer Problem 1.5, 1
SecA = secantm(@(x) -x^3 + (2*x) + 2,1,2)
SecB = secantm(@(x) exp(x) + x - 7, 1, 2)
SecC = secantm(@(x) exp(x) + sin(x) - 4, 1, 2)
```

Outputs:

```
Xa1 =

  -2.0735e-08

FE1 =

   2.0735e-08

BE1 =

     0
```

```
rootA =

   1.6881e-04

FE3 =

   1.6881e-04

BE3 =

     0

BM3 =

  -6.1035e-05
```

```
NEW =

   1.129986080000000

SecA =

   1.769292354248405

SecB =

   1.672821698628907

SecC =

   1.129980498650832
```

Function Matlab code:

```
%Program 1.1 Bisection Method
%Computes approximate solution of f(x) = 0
%input: function handle f; a,b such that f(a) * f(b) < 0
% and tolerance tol
%output: approximate solution xc
function xc=bisect(f,a,b,tol)
if sign(f(a))*sign(f(b)) >= 0
    error('f(a)f(b)<0 not satisfied!')
end
fa=f(a);
fb=f(b);
while(b-a)/2>tol
    c=(a+b)/2;
    fc=f(c);
    if fc == 0
        break
    end
    if sign(fc)*sign(fa)<0
        b=c;fb=fc;
    else
        a=c;fa=fc;
    end
end
xc = (a+b)/2;

%Program 1.4 Newton Method
function x=newtons(f,fp,xi,iter)
for i=0:iter
    xi=xi-(f(xi)/fp(xi));
end
format long
x = xi;
x = round(x,8);


%Program 1.5 Secant method
function x=secantm(f,xa,xi)
for i = 0:5
    temp = xi;
    xi=xi-((f(xi)*(xi-xa))/(f(xi)-f(xa)));
    xa = temp;
end
format long
x = xi;
```