Math 4610 – HW 3

Jake Daniels A02307117

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Task 1:

The 6 codes written up in C can be found on my github. From the link below click on Root Finding Code (C) to find the 6 codes I wrote up for this first task.

https://jake-daniels16.github.io/math4610/

Task 2:

The following code is my 'root finding test.c' file I created to test Newton's Method:

```c
#include <stdio.h>
#include <stdlib.h>
#include <math.h>

double newtonsMethod();

int main()
{
    double a = -0.5;
    double b = 0.8;
    double tol = .00000001;
    double maxIter = 25;
    double rootval = newtonsMethod(fval, fpval, b, tol, maxIter);
}

double newtonsMethod(double (*f)(), double (*fp)(), double x0, double tol, double maxIter)
{
    double error = 10.0 * tol;
    double iter = 0.0;
    while(error > tol && iter < maxIter)
    {
        double f0 = f(x0);
        double fp0 = fp(x0);
        double x1 = x0 - f0 / fp0;
        error = fabs(x1 - x0);
        x0 = x1;
        iter = iter + 1.0;
    }
    printf("\n newtons method root value = %f\n", x0);
    return x0;
}

double fval(double xval)
{
    double fval = xval * exp( - xval );
    return fval;
}

double fpval(double xval)
{
    double fpval = exp( - xval ) - xval * exp( - xval );
    return fpval;
}
```

The codes output is as follows:

```
 newtons method root value = -0.000000
```

Which is the exact same as what we got on previous tasks, and is where the root should be, namely at $x = 0$.

Task 3:

The adjusted 'root finding test.c' file can be found in the same place as the original six codes found through the link. The output for this file using the same values as above yields:

```
bisect root value = -0.000000

functional iteration root value = 0.000000

newton hybrid root value = -0.000000

newtons method root value = -0.000000

secant method root value = 0.000000

secant hybrid root value = 0.000000
```

Note that all the following codes approximate a number near $x = 0$ meaning they all are able to approximate the root of our function well because we know that there exists a root at $x = 0$.

Task 4:

The following are screenshots showing me creating the shared library in the temp folder.

```
jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math
$ cd temp

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ ls
 bisect.c  'functional iteration.c'  'newton hybrid.c'  'newtons method.c'  'secant hybrid.c'   secant.c

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ gcc -c bisect.c

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ gcc -c functional\ iteration.c

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ gcc -c newton\ hybrid.c

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ gcc -c newtons\ method.c

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ gcc -c secant\ hybrid.c

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ gcc -c secant.c

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ ar rcv root_finding.a *.o
a - bisect.o
a - functional iteration.o
a - newton hybrid.o
a - newtons method.o
a - secant hybrid.o
a - secant.o

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ ranlib root_finding.a
```

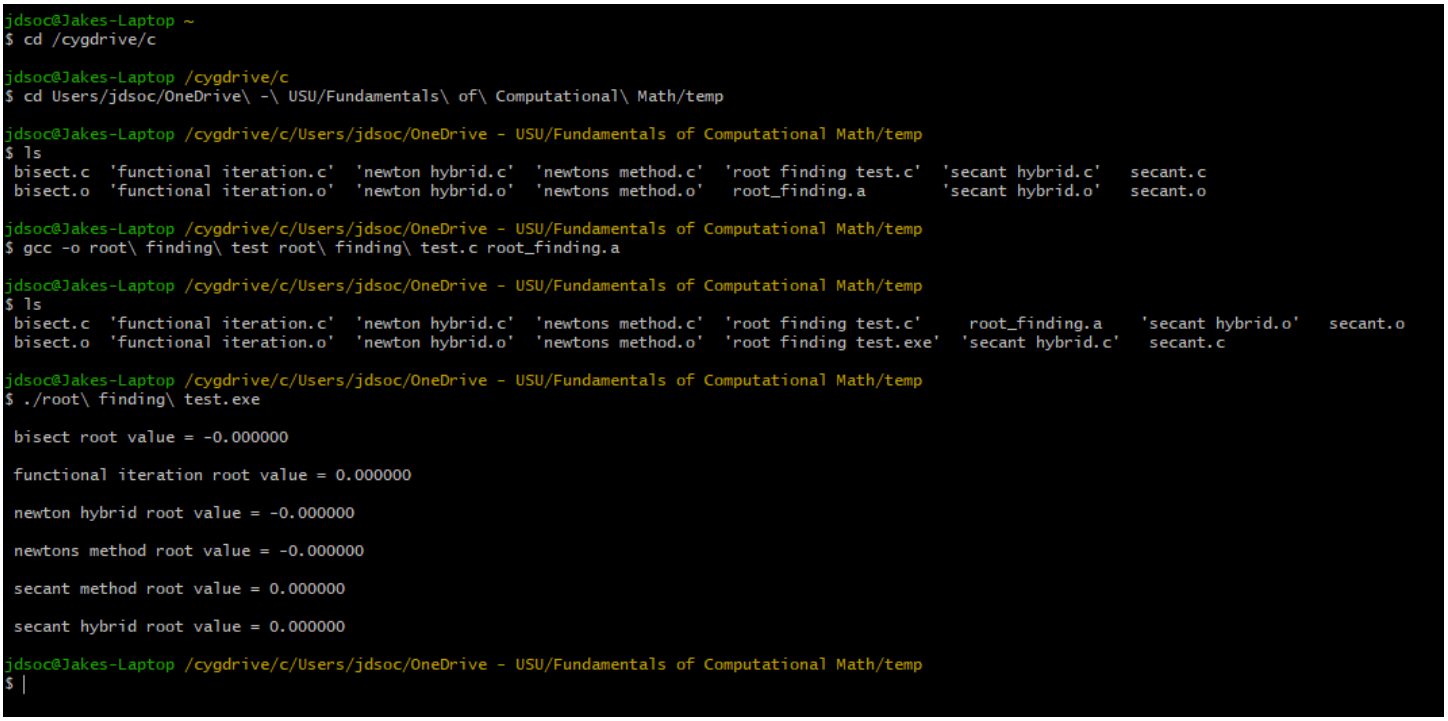
```
inary ihex plugin

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$ ar tv root_finding.a
rw-r--r-- 2883003748/40605028   1956 Oct  3 19:15 2022 bisect.o
rw-r--r-- 2883003748/40605028   1631 Oct  3 19:15 2022 functional iteration.o
rw-r--r-- 2883003748/40605028   2323 Oct  3 19:15 2022 newton
rw-r--r-- 2883003748/40605028   1906 Oct  3 19:15 2022 newtons method.o
rw-r--r-- 2883003748/40605028   2031 Oct  3 19:16 2022 secant
rw-r--r-- 2883003748/40605028   1739 Oct  3 19:16 2022 secant.o

jdsoc@Jakes-Laptop /cygdrive/c/Users/jdsoc/OneDrive - USU/Fundamentals of Computational Math/temp
$
```

Task 5:

The following screenshot is me creating the test root finding.exe file and running it.



Notice that the output is exactly the same as when we ran it before.