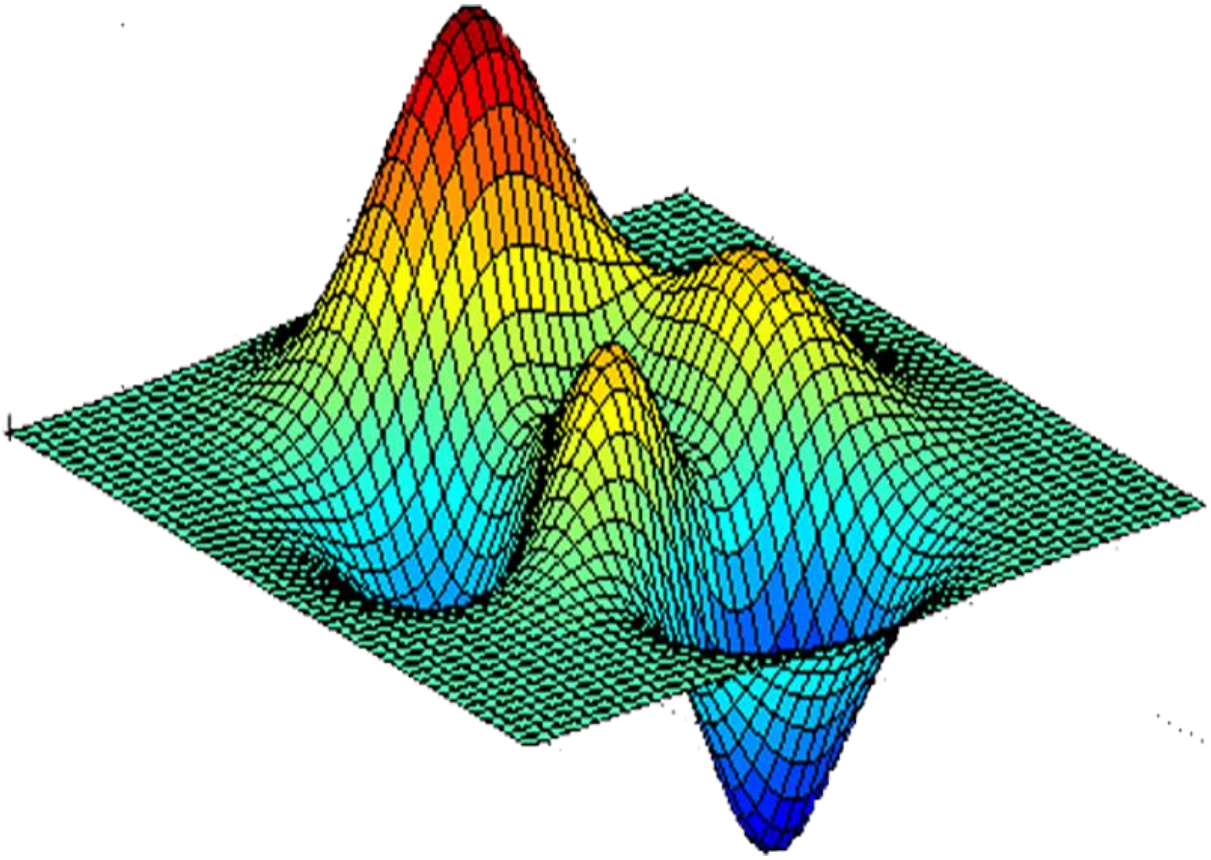
Numerical Computing



QASID AHMED ALEEM

COURSE TEACHER: DR. SHAHID QURESHI
BSC(HONOURS)
H-2 (MORNING)
INSTITUTE OF SPACE AND PLANETARY ASTROPHYSICS
UNIVERSITY OF KARACHI

Tasks

Task 1: Bisection Method

Code used:

```c
#include<stdio.h>
#include<math.h>
//Bisection Method
//Qasid Ahmed Aleem
//24 January

double fun_c(double f);

int main()
{
    double a,b,m,fm;
    a=1;
    b=2;
    int x,z;

    printf("how many iterations do you want(atleast 40): ");
    scanf("%d",&z);
    printf("\tcounter\t\ta\t\tb\t\tf(a)\t\tf(b)\t\tm\t\t    f(m)\n");
    for(x=1;x<=z;x+=1)
    {
    if (fun_c(a)*fun_c(b)<0)
    {
        m=(a+b)/2;

        printf("\t%d\t\t%.10f\t%.10f\t%.10f\t%.10f\t%.10f\t%.10f\n",
        x,a,b,fun_c(a),fun_c(b),m,fun_c(m));

        if (fun_c(a)*fun_c(m)<0)
        {
            b=m;
        }
        else
        {
            a=m;
        }
    }
}
printf("the approximate root is %.18f\n",m);
return  (0);
}
double fun_c(double f)
{
    return ((pow(f,3)) + f -5); //x^3-x-5
}
```

Result:

```
how many iterations do you want(atleast 40): 55
        counter         a               b               f(a)            f(b)            m               f(m)
        1               1.0000000000    2.0000000000    -3.0000000000   5.0000000000    1.5000000000    -0.1250000000
        2               1.5000000000    2.0000000000    -0.1250000000   5.0000000000    1.7500000000    2.1093750000
        3               1.5000000000    1.7500000000    -0.1250000000   2.1093750000    1.6250000000    0.9160156250
        4               1.5000000000    1.6250000000    -0.1250000000   0.9160156250    1.5625000000    0.3771972656
        5               1.5000000000    1.5625000000    -0.1250000000   0.3771972656    1.5312500000    0.1216125488
        6               1.5000000000    1.5312500000    -0.1250000000   0.1216125488    1.5156250000    -0.0028038025
        7               1.5156250000    1.5312500000    -0.0028038025   0.1216125488    1.5234375000    0.0591254234
        8               1.5156250000    1.5234375000    -0.0028038025   0.0591254234    1.5195312500    0.0280912519
        9               1.5156250000    1.5195312500    -0.0028038025   0.0280912519    1.5175781250    0.0126263574
        10              1.5156250000    1.5175781250    -0.0028038025   0.0126263574    1.5166015625    0.0049069384
        11              1.5156250000    1.5166015625    -0.0028038025   0.0049069384    1.5161132813    0.0010504836
        12              1.5156250000    1.5161132813    -0.0028038025   0.0010504836    1.5158691406    -0.0008769305
        13              1.5158691406    1.5161132813    -0.0008769305   0.0010504836    1.5159912109    0.0000867087
        14              1.5158691406    1.5159912109    -0.0008769305   0.0000867087    1.5159301758    -0.0003951278
        15              1.5159301758    1.5159912109    -0.0003951278   0.0000867087    1.5159606934    -0.0001542138
        16              1.5159606934    1.5159912109    -0.0001542138   0.0000867087    1.5159759521    -0.0000337536
        17              1.5159759521    1.5159912109    -0.0000337536   0.0000867087    1.5159835815    0.0000264773
        18              1.5159759521    1.5159835815    -0.0000337536   0.0000264773    1.5159797668    -0.0000036382
        19              1.5159797668    1.5159835815    -0.0000036382   0.0000264773    1.5159816742    0.0000114195
        20              1.5159797668    1.5159816742    -0.0000036382   0.0000114195    1.5159807205    0.0000038907
        21              1.5159797668    1.5159807205    -0.0000036382   0.0000038907    1.5159802437    0.0000001262
        22              1.5159797668    1.5159802437    -0.0000036382   0.0000001262    1.5159800053    -0.0000017560
        23              1.5159800053    1.5159802437    -0.0000017560   0.0000001262    1.5159801245    -0.0000008149
        24              1.5159801245    1.5159802437    -0.0000008149   0.0000001262    1.5159801841    -0.0000003443
        25              1.5159801841    1.5159802437    -0.0000003443   0.0000001262    1.5159802139    -0.0000001090
        26              1.5159802139    1.5159802437    -0.0000001090   0.0000001262    1.5159802288    0.0000000086
        27              1.5159802139    1.5159802288    -0.0000001090   0.0000000086    1.5159802213    -0.0000000502
        28              1.5159802213    1.5159802288    -0.0000000502   0.0000000086    1.5159802251    -0.0000000208
        29              1.5159802251    1.5159802288    -0.0000000208   0.0000000086    1.5159802269    -0.0000000061
        30              1.5159802269    1.5159802288    -0.0000000061   0.0000000086    1.5159802279    0.0000000012
        31              1.5159802269    1.5159802279    -0.0000000061   0.0000000012    1.5159802274    -0.0000000024
        32              1.5159802274    1.5159802279    -0.0000000024   0.0000000012    1.5159802276    -0.0000000006
        33              1.5159802276    1.5159802279    -0.0000000006   0.0000000012    1.5159802277    0.0000000003
        34              1.5159802276    1.5159802277    -0.0000000006   0.0000000003    1.5159802277    -0.0000000001
        35              1.5159802277    1.5159802277    -0.0000000001   0.0000000003    1.5159802277    0.0000000001
        36              1.5159802277    1.5159802277    -0.0000000001   0.0000000001    1.5159802277    -0.0000000000
        37              1.5159802277    1.5159802277    -0.0000000000   0.0000000001    1.5159802277    0.0000000000
        38              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    0.0000000000
        39              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
        40              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    0.0000000000
        41              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
        42              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
        43              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    0.0000000000
        44              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    0.0000000000
        45              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    0.0000000000
        46              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    0.0000000000
        47              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
        48              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
        49              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
        50              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    0.0000000000
        51              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
        52              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    0.0000000000
        53              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
        54              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
        55              1.5159802277    1.5159802277    -0.0000000000   0.0000000000    1.5159802277    -0.0000000000
the approximate root is 1.515980227692820500
```

Task 2: Newton's Method

Code used:

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

//Newton's Method
//Qasid Ahmed Aleem
//24 January
//for x^3 - x -5
double func_f(double f);
double deri_f(double f);
double x_func(double f);

int main()
{
    double x=1.5,xn=0;
    int i,z;
    printf("how many iterations do you want(at least 10): ");
    scanf("%d",&z);
    printf("\tcounter\t   X\t\t f(x)\t\tf'(x)\t\tx\"\n");

    for(i=0;i<z;i+=1)
    {
        xn=x_func(x);
        printf("\t%d\t%.10f\t%.10f\t%.10f\t%.10f\n",
        i+1,x,func_f(x),deri_f(x),xn);
        x=xn;
    }
    printf("\nThe approximate root is %.18f",x);
    return 0;
}

double func_f(double f)
{
    return ((pow(f,3)) + f -5); //x^3-x-5
}

double deri_f(double f)
{
    return ((3*pow(f,2))+1); //3x^2+1
}

double x_func(double f)
{
    return f-(func_f(f)/deri_f(f)); //x -  f(x)/f'(x)
}
```

Result:

```
how many iterations do you want(atleast 10): 20
        counter    X              f(x)            f'(x)           x"
        1       1.5000000000    -0.1250000000   7.7500000000    1.5161290323
        2       1.5161290323    0.0011748515    7.8959417274    1.5159802404
        3       1.5159802404    0.0000001007    7.8945882683    1.5159802277
        4       1.5159802277    0.0000000000    7.8945881523    1.5159802277
        5       1.5159802277    -0.0000000000   7.8945881523    1.5159802277
        6       1.5159802277    0.0000000000    7.8945881523    1.5159802277
        7       1.5159802277    -0.0000000000   7.8945881523    1.5159802277
        8       1.5159802277    0.0000000000    7.8945881523    1.5159802277
        9       1.5159802277    -0.0000000000   7.8945881523    1.5159802277
        10      1.5159802277    0.0000000000    7.8945881523    1.5159802277
        11      1.5159802277    -0.0000000000   7.8945881523    1.5159802277
        12      1.5159802277    0.0000000000    7.8945881523    1.5159802277
        13      1.5159802277    -0.0000000000   7.8945881523    1.5159802277
        14      1.5159802277    0.0000000000    7.8945881523    1.5159802277
        15      1.5159802277    -0.0000000000   7.8945881523    1.5159802277
        16      1.5159802277    0.0000000000    7.8945881523    1.5159802277
        17      1.5159802277    -0.0000000000   7.8945881523    1.5159802277
        18      1.5159802277    0.0000000000    7.8945881523    1.5159802277
        19      1.5159802277    -0.0000000000   7.8945881523    1.5159802277
        20      1.5159802277    0.0000000000    7.8945881523    1.5159802277

The approximate root is 1.5159802276928205 00
```