Term Work On

Computer Based Numerical and Statistical Techniques

PMA 402 · 2020-21

Graphic Era
Deemed to be University

Submitted To:

Mr. Piyush Aggarwal

Assistant Professor, GEU

Submitted by:

Harsh Chaturvedi

Roll No: 2014669

Section: ML

Class Roll No: 29

Acknowledgement

I would like to particularly thank my CBNST Lab Faculty Mr Piyush Aggarwal for his patience, support and encouragement throughout the completion of this Term work.

At last but not the least I greatly indebted to all other persons who directly or indirectly helped me during this course.

Harsh Chaturvedi

Roll No: 2014669

Section: ML

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Program 1 Implement Bisection Method

Algorithm:

1. Start
2. Read x1, x2, e

   *Here x1 and x2 are initial guesses

   e is the absolute error i.e. the desired degree of accuracy*
3. Compute: f1 = f(x1) and f2 = f(x2)
4. If (f1*f2) > 0, then display initial guesses are wrong and goto (11).

   Otherwise continue.
5. x=(x1+x2)/2
6. If([(x1–x2)/x]<e),thendisplayxandgoto(11). * Here [ ] refers to the modulus sign.

   *
7. Else, f = f(x)
8. If((f*f1)>0),thenx1=xandf1=f.
9. Else,x2=xandf2=f.
10. Goto (5).

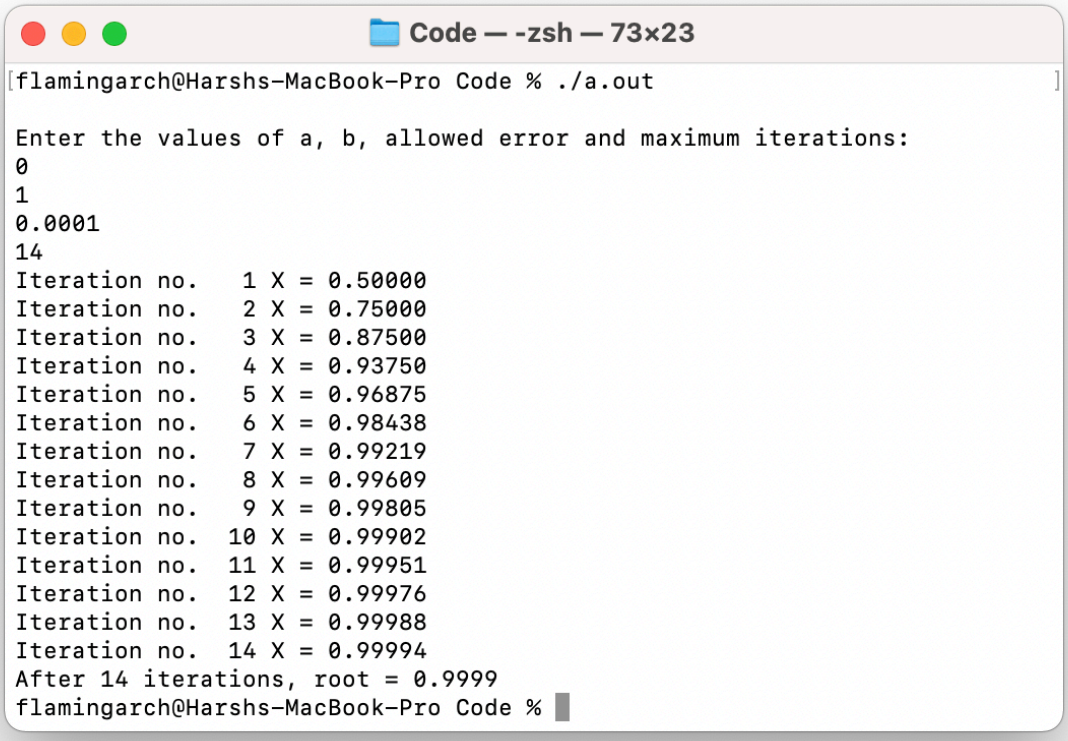
    Now the loop continues with new values.
11. Stop

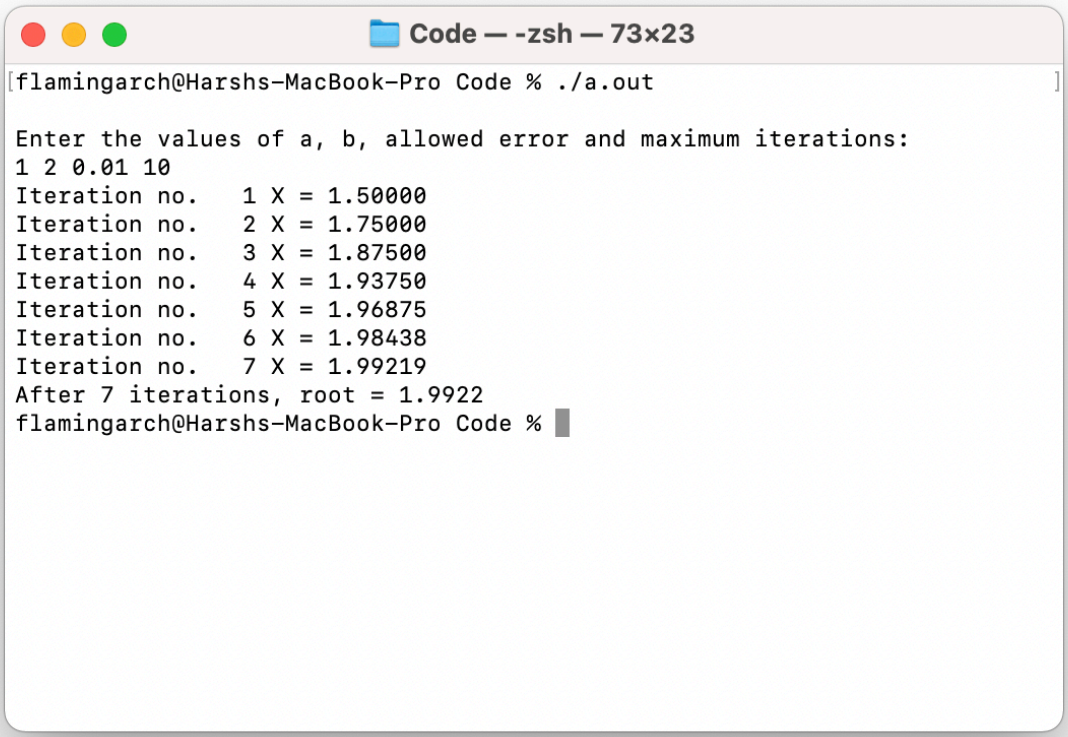
Code

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

float fun(float x)
{
    return (x * x * x - 4 * x - 9) * cos(x) - x * exp(x);
    x = cos(x);
}

/* this function performs and prints the result of one iteration
*/
void bisection(float *x, float a, float b, int *itr)
{
    *x = (a + b) / 2;
    ++(*itr);
    printf("Iteration no. %3d X = %7.5f\n", *itr, *x);
}

int main()
{
    int itr = 0, maxmitr;
    float x, a, b, allerr, x1;
    printf("\nEnter the values of a, b, allowed error and maximum
iterations:\n");
    scanf("%f %f %f %d", &a, &b, &allerr, &maxmitr);
    bisection(&x, a, b, &itr);
    do
    {
        if (fun(a) * fun(x) < 0)
            b = x;
        else
            a = x;
        bisection(&x1, a, b, &itr);
        if (fabs(x1 - x) < allerr)
        {
            printf("After %d iterations, root = %6.4f\n", itr,
x1);
            return 0;
```

```
        }
        x = x1;
    } while (itr < maxmitr);
    printf("The solution does not converge or iterations are not
sufficient");
    return 1;
}
```

Output:


Code — -zsh — 73×23
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the values of a, b, allowed error and maximum iterations:
0
1
0.0001
14
Iteration no.   1 X = 0.50000
Iteration no.   2 X = 0.75000
Iteration no.   3 X = 0.87500
Iteration no.   4 X = 0.93750
Iteration no.   5 X = 0.96875
Iteration no.   6 X = 0.98438
Iteration no.   7 X = 0.99219
Iteration no.   8 X = 0.99609
Iteration no.   9 X = 0.99805
Iteration no. 10 X = 0.99902
Iteration no. 11 X = 0.99951
Iteration no. 12 X = 0.99976
Iteration no. 13 X = 0.99988
Iteration no. 14 X = 0.99994
After 14 iterations, root = 0.9999
flamingarch@Harshs-MacBook-Pro Code %


Code — -zsh — 73×23
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the values of a, b, allowed error and maximum iterations:
1 2 0.01 10
Iteration no.   1 X = 1.50000
Iteration no.   2 X = 1.75000
Iteration no.   3 X = 1.87500
Iteration no.   4 X = 1.93750
Iteration no.   5 X = 1.96875
Iteration no.   6 X = 1.98438
Iteration no.   7 X = 1.99219
After 7 iterations, root = 1.9922
flamingarch@Harshs-MacBook-Pro Code %

Program 2 Implement Regular Falsi Method

Algorithm:

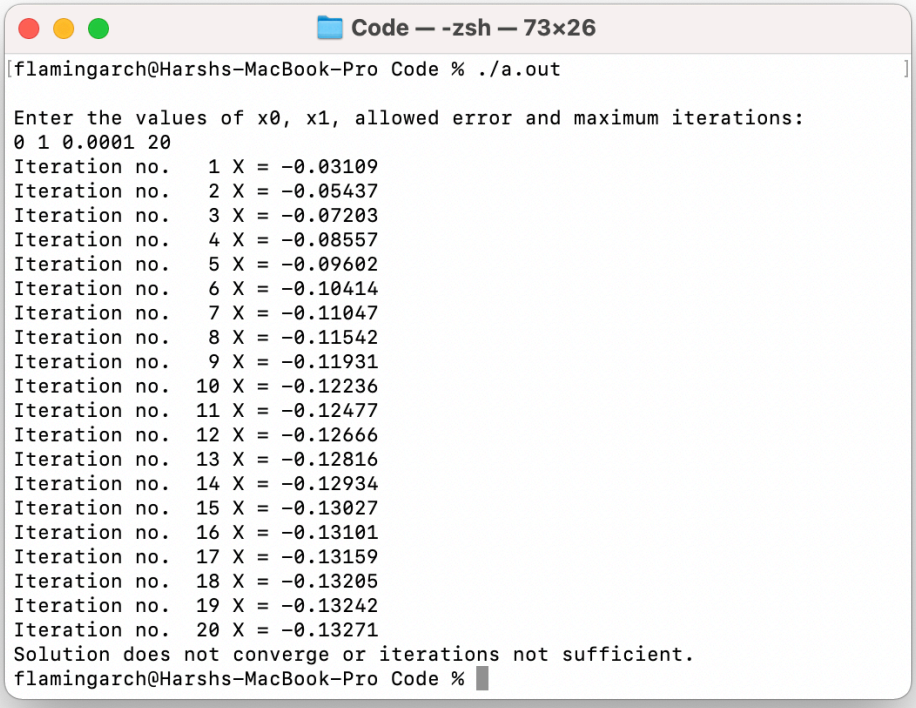
1. Start
2. Read values of x0, x1 and e
   *Here x0 and x1 are the two initial guesses
   e is the degree of accuracy or the absolute error i.e. the stopping criteria*
3. Computer function values f(x0) and f(x1)
4. Check whether the product of f(x0) and f(x1) is negative or not. If it is positive take another initial guesses.
   If it is negative then goto step 5.
5. Determine:
   x = [x0*f(x1) – x1*f(x0)] / (f(x1) – f(x0))
6. Check whether the product of f(x1) and f(x) is negative or not. If it is negative, then assign x0 = x;
   If it is positive, assign x1 = x;
7. Check whether the value of f(x) is greater than 0.00001 or not. If yes, goto step 5.
   If no, goto step 8.
   Here the value 0.00001 is the desired degree of accuracy, and hence the stopping criteria.
8. Display the root as x.
9. Stop

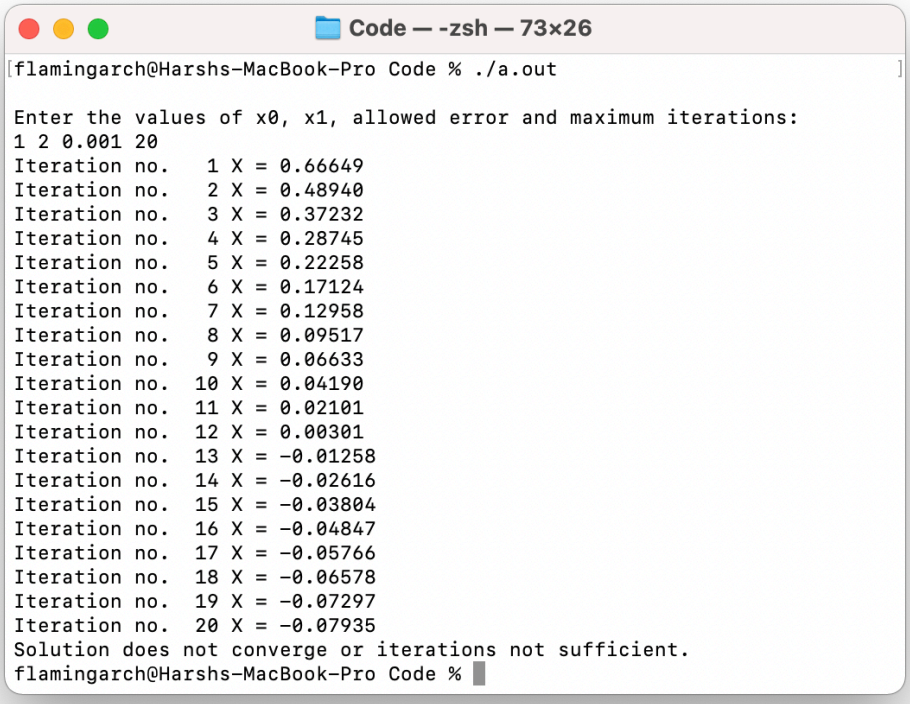
Code

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

float f(float x)
{
    return cos(x) - x * exp(x) * (x * x * x - 4 * x - 9);
    x = cos(x);
}

void regula(float *x, float x0, float x1, float fx0, float fx1,
int *itr)
{
    *x = x0 - ((x1 - x0) / (fx1 - fx0)) * fx0;
    ++(*itr);
    printf("Iteration no. %3d X = %7.5f \n", *itr, *x);
}

int main()
{
    int itr = 0, maxmitr;
    float x0, x1, x2, x3, allerr;
    printf("\nEnter the values of x0, x1, allowed error and
maximum iterations:\n");
    scanf("%f %f %f %d", &x0, &x1, &allerr, &maxmitr);
    regula(&x2, x0, x1, f(x0), f(x1), &itr);
    do
    {
        if (f(x0) * f(x2) < 0)
            x1 = x2;
        else
            x0 = x2;
        regula(&x3, x0, x1, f(x0), f(x1), &itr);
        if (fabs(x3 - x2) < allerr)
        {
            printf("After %d iterations, root = %6.4f\n", itr,
x3);
            return 0;
        }
```

```
        x2 = x3;
    } while (itr < maxmitr);
    printf("Solution does not converge or iterations not
sufficient.\n");
    return 1;
}
```

Output:


Code — -zsh — 73×26
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the values of x0, x1, allowed error and maximum iterations:
0 1 0.0001 20
Iteration no. 1 X = -0.03109
Iteration no. 2 X = -0.05437
Iteration no. 3 X = -0.07203
Iteration no. 4 X = -0.08557
Iteration no. 5 X = -0.09602
Iteration no. 6 X = -0.10414
Iteration no. 7 X = -0.11047
Iteration no. 8 X = -0.11542
Iteration no. 9 X = -0.11931
Iteration no. 10 X = -0.12236
Iteration no. 11 X = -0.12477
Iteration no. 12 X = -0.12666
Iteration no. 13 X = -0.12816
Iteration no. 14 X = -0.12934
Iteration no. 15 X = -0.13027
Iteration no. 16 X = -0.13101
Iteration no. 17 X = -0.13159
Iteration no. 18 X = -0.13205
Iteration no. 19 X = -0.13242
Iteration no. 20 X = -0.13271
Solution does not converge or iterations not sufficient.
flamingarch@Harshs-MacBook-Pro Code %


Code — -zsh — 73×26
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the values of x0, x1, allowed error and maximum iterations:
1 2 0.001 20
Iteration no. 1 X = 0.66649
Iteration no. 2 X = 0.48940
Iteration no. 3 X = 0.37232
Iteration no. 4 X = 0.28745
Iteration no. 5 X = 0.22258
Iteration no. 6 X = 0.17124
Iteration no. 7 X = 0.12958
Iteration no. 8 X = 0.09517
Iteration no. 9 X = 0.06633
Iteration no. 10 X = 0.04190
Iteration no. 11 X = 0.02101
Iteration no. 12 X = 0.00301
Iteration no. 13 X = -0.01258
Iteration no. 14 X = -0.02616
Iteration no. 15 X = -0.03804
Iteration no. 16 X = -0.04847
Iteration no. 17 X = -0.05766
Iteration no. 18 X = -0.06578
Iteration no. 19 X = -0.07297
Iteration no. 20 X = -0.07935
Solution does not converge or iterations not sufficient.
flamingarch@Harshs-MacBook-Pro Code %

Program 3 Implement Secant Method

Algorithm:

1. Start
2. Get values of x0, x1 and e

   *Here x0 and x1 are the two initial guesses

   e is the stopping criteria, absolute error or the desired degree of accuracy*
3. Compute f(x0) and f(x1)
4. Compute x2 = [x0*f(x1) – x1*f(x0)] / [f(x1) – f(x0)]
5. Test for accuracy of x2

   If [(x2 – x1)/x2] > e, *Here [ ] is used as modulus sign* then assign x0 = x1

   and x1 = x2

   goto step 4

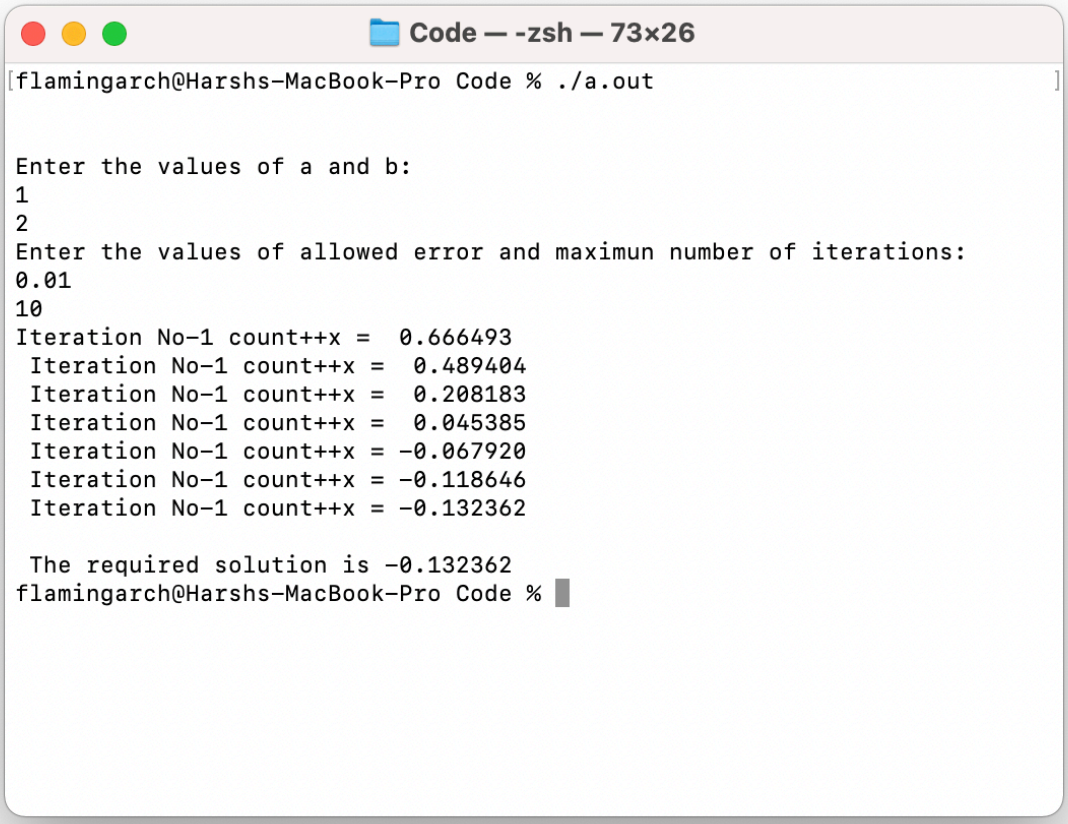
   Else,

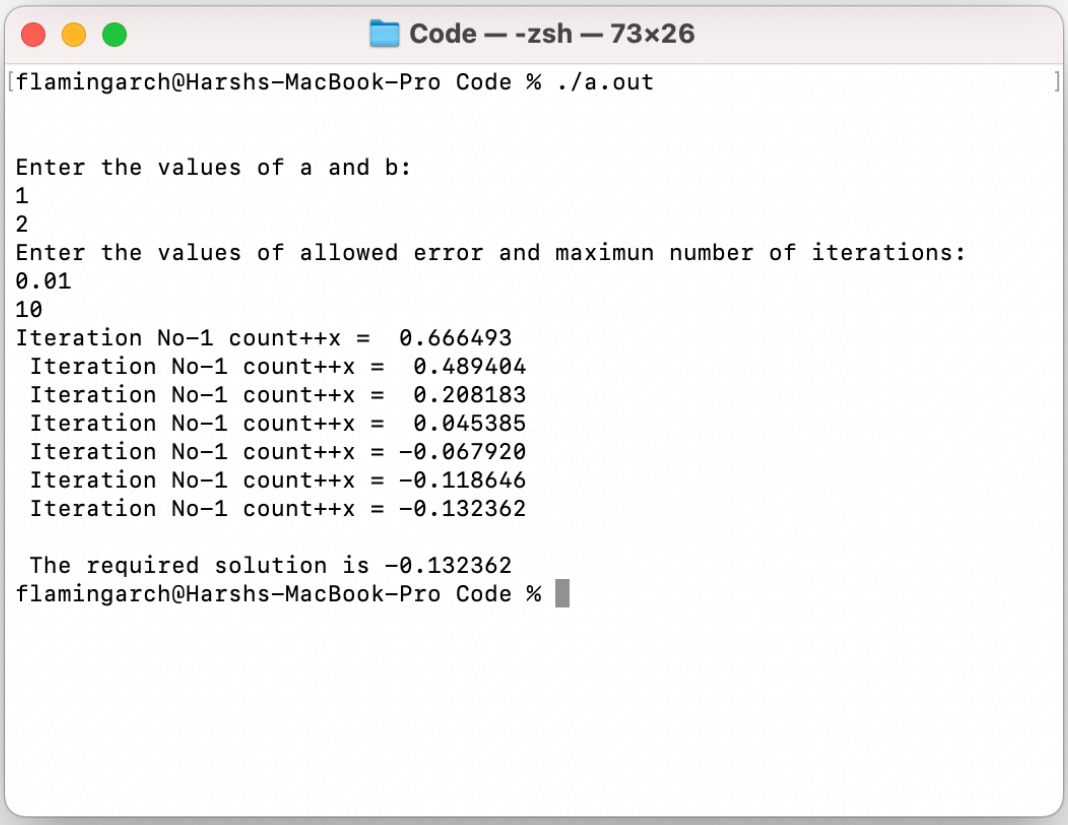
   goto step 6
6. Display the required root as x2.
7. Stop

Code:

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

float f(float x)
{
    return cos(x) - x * exp(x) * (x * x * x - 4 * x - 9);
    x = cos(x);
}
int main()
{
    float a, b, c, d, e;
    int count = 1, n;
    printf("\n\nEnter the values of a and b:\n");
    scanf("%f%f", &a, &b);
    printf("Enter the values of allowed error and maximun number
of iterations:\n");
    scanf("%f %d", &e, &n);
    do
    {
        if (f(a) == f(b))
        {
            printf("\nSolution cannot be found as the values of a
and b are same. \n");
            return 0;
        }
        c = (a * f(b) - b * f(a)) / (f(b) - f(a));
        a = b;
        b = c;
        printf("Iteration No-%d count++x = % f\n ", count, c);
        if (count == n)
        {
            break;
        }
    } while (fabs(f(c)) > e);
    printf("\n The required solution is %f\n", c);
    return 0;
}
```

Output:


Code — -zsh — 73×26
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the values of a and b:
1
2
Enter the values of allowed error and maximun number of iterations:
0.01
10
Iteration No-1 count++x = 0.666493
 Iteration No-1 count++x = 0.489404
 Iteration No-1 count++x = 0.208183
 Iteration No-1 count++x = 0.045385
 Iteration No-1 count++x = -0.067920
 Iteration No-1 count++x = -0.118646
 Iteration No-1 count++x = -0.132362
 The required solution is -0.132362
flamingarch@Harshs-MacBook-Pro Code %


Code — -zsh — 73×26
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the values of a and b:
1
2
Enter the values of allowed error and maximun number of iterations:
0.01
10
Iteration No-1 count++x = 0.666493
 Iteration No-1 count++x = 0.489404
 Iteration No-1 count++x = 0.208183
 Iteration No-1 count++x = 0.045385
 Iteration No-1 count++x = -0.067920
 Iteration No-1 count++x = -0.118646
 Iteration No-1 count++x = -0.132362
 The required solution is -0.132362
flamingarch@Harshs-MacBook-Pro Code %

Program 4 Implement Iteration Method

Algorithm:

1. Start
2. Read values of x0 and e.

   *Here x0 is the initial approximation

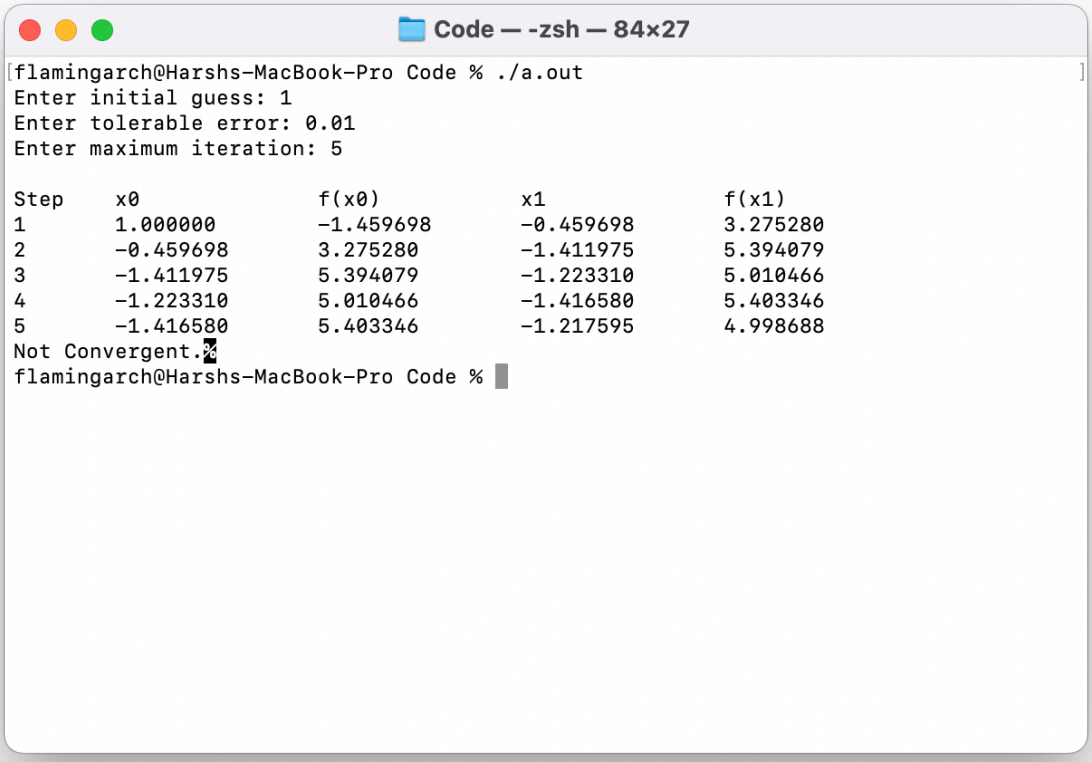
   e is the absolute error or the desired degree of accuracy, also the stopping criteria*
3. Calculate x1 = g(x0)
4. If[x1–x0]<=e,gotostep6.

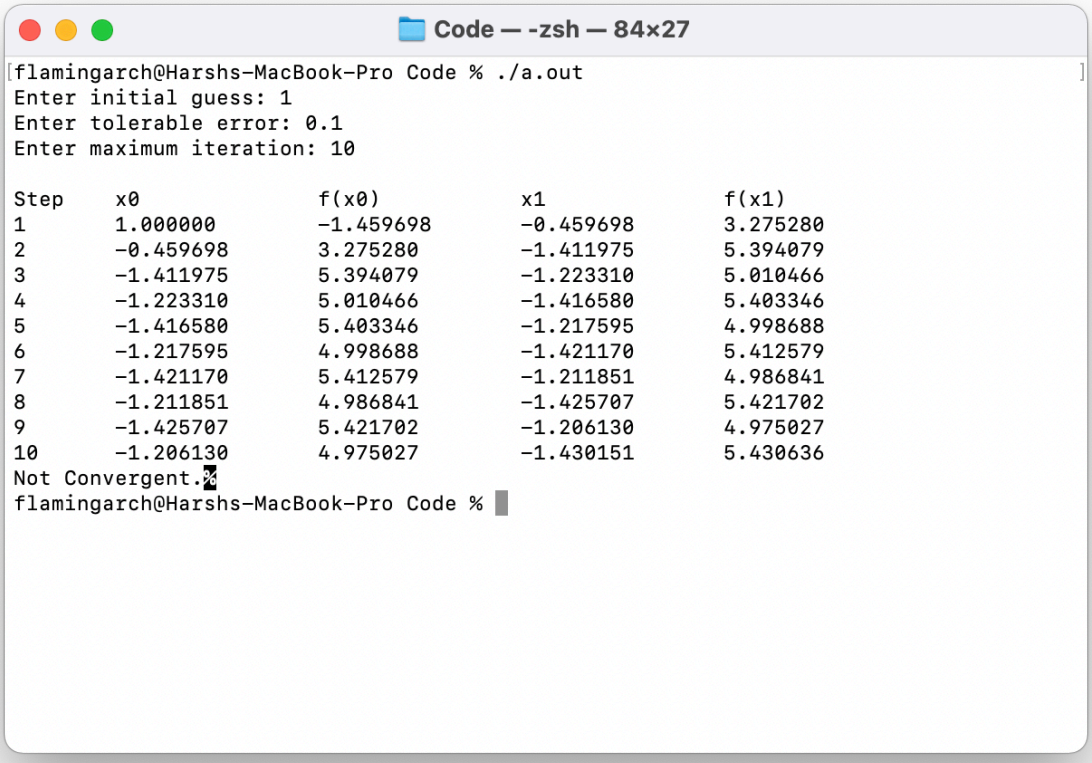
   Here [ ] refers to the modulus sign
5. Else, assign x0 = x1 and goto step 3.
6. Display x1 as the root.
7. Stop

Code:

```
#include <stdio.h>
#include <math.h>
#define f(x) cos(x) - 3 * x + 1
#define g(x) (1 + cos(x)) / x * x * x - x - 1

int main()
{
    int step = 1, N;
    float x0, x1, e;
    printf("Enter initial guess: ");
    scanf("%f", &x0);
    printf("Enter tolerable error: ");
    scanf("%f", &e);
    printf("Enter maximum iteration: ");
    scanf("%d", &N);
    printf("\nStep\tx0\t\tf(x0)\t\tx1\t\tf(x1)\n");
    do
    {
        x1 = g(x0);
        printf("%d\t%f\t%f\t%f\t%f\n", step, x0, f(x0), x1,
f(x1));
        step = step + 1;
        if (step > N)
        {
            printf("Not Convergent.");
            return 0;
        }
        x0 = x1;
    } while (fabs(f(x1)) > e);
    printf("\nRoot is %f", x1);
    return (0);
}
```

Output:


Code — -zsh — 84×27
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter initial guess: 1
Enter tolerable error: 0.01
Enter maximum iteration: 5
Step x0 f(x0) x1 f(x1)
1 1.000000 -1.459698 -0.459698 3.275280
2 -0.459698 3.275280 -1.411975 5.394079
3 -1.411975 5.394079 -1.223310 5.010466
4 -1.223310 5.010466 -1.416580 5.403346
5 -1.416580 5.403346 -1.217595 4.998688
Not Convergent.%
flamingarch@Harshs-MacBook-Pro Code %


Code — -zsh — 84×27
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter initial guess: 1
Enter tolerable error: 0.1
Enter maximum iteration: 10
Step x0 f(x0) x1 f(x1)
1 1.000000 -1.459698 -0.459698 3.275280
2 -0.459698 3.275280 -1.411975 5.394079
3 -1.411975 5.394079 -1.223310 5.010466
4 -1.223310 5.010466 -1.416580 5.403346
5 -1.416580 5.403346 -1.217595 4.998688
6 -1.217595 4.998688 -1.421170 5.412579
7 -1.421170 5.412579 -1.211851 4.986841
8 -1.211851 4.986841 -1.425707 5.421702
9 -1.425707 5.421702 -1.206130 4.975027
10 -1.206130 4.975027 -1.430151 5.430636
Not Convergent.%
flamingarch@Harshs-MacBook-Pro Code %

Program 5 Finding errors

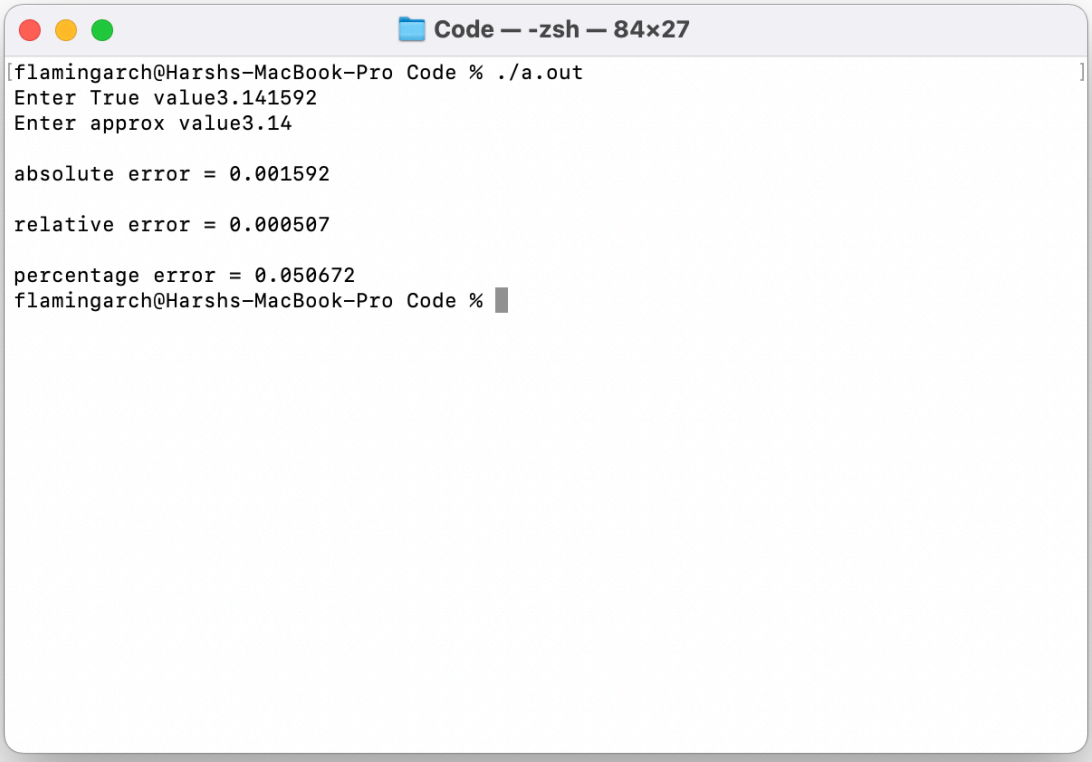
Algorithm:

1. Start
2. Take input say True value and Approximate value
3. Calculate absolute error using formula: Absolute error= True value - Approximate value
4. Calculate relative error using formula: relative error= Approximate value/ True value
5. Calculate percentage error using formula: Percentage error=relative error *100
6. Stop

Code:

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

int main()
{
    float abserror, relerror, percerror, trueval, approxval;
    printf("Enter True value");
    scanf("%f", &trueval);
    printf("Enter approx value");
    scanf("%f", &approxval);
    abserror = fabs(trueval - approxval);
    relerror = abserror / trueval;
    percerror = relerror * 100;
    printf("\nabsolute error = %f\n", abserror);
    printf("\nrelative error = %f\n", relerror);
    printf("\npercentage error = %f\n", percerror);
    return 0;
}
```

Output:


Code — -zsh — 84×27
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter True value3.141592
Enter approx value3.14
absolute error = 0.001592
relative error = 0.000507
percentage error = 0.050672
flamingarch@Harshs-MacBook-Pro Code %

Program 6 Implement Newton Raphson Method

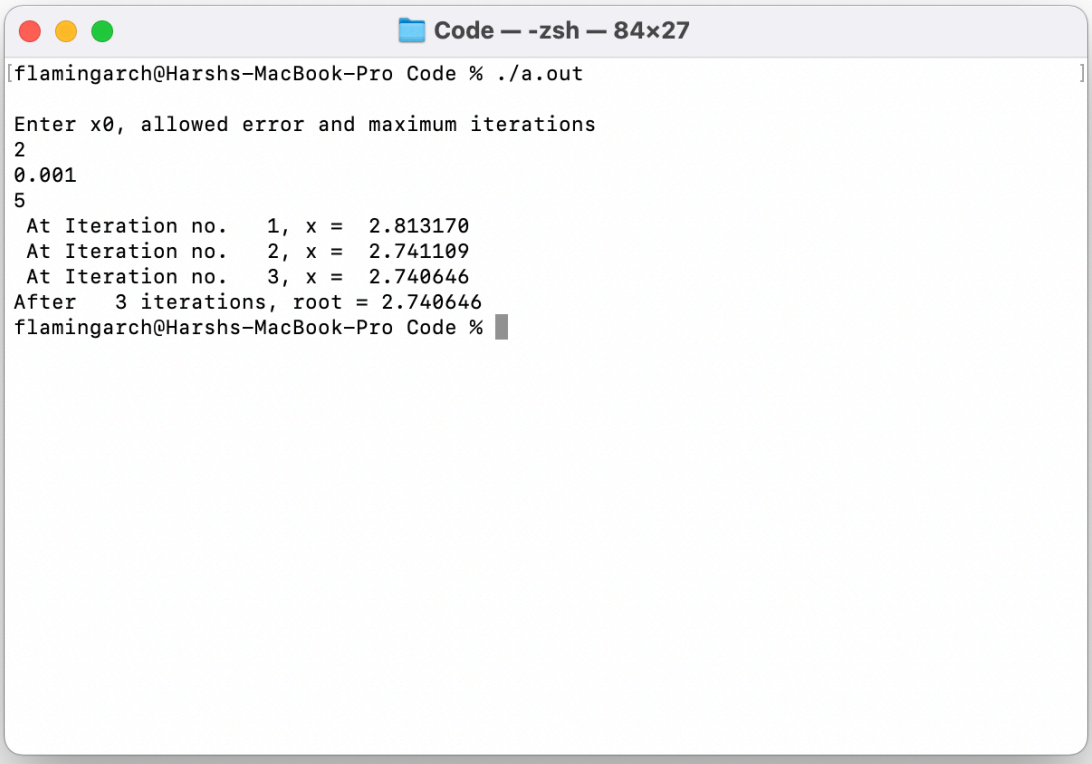
Algorithm:

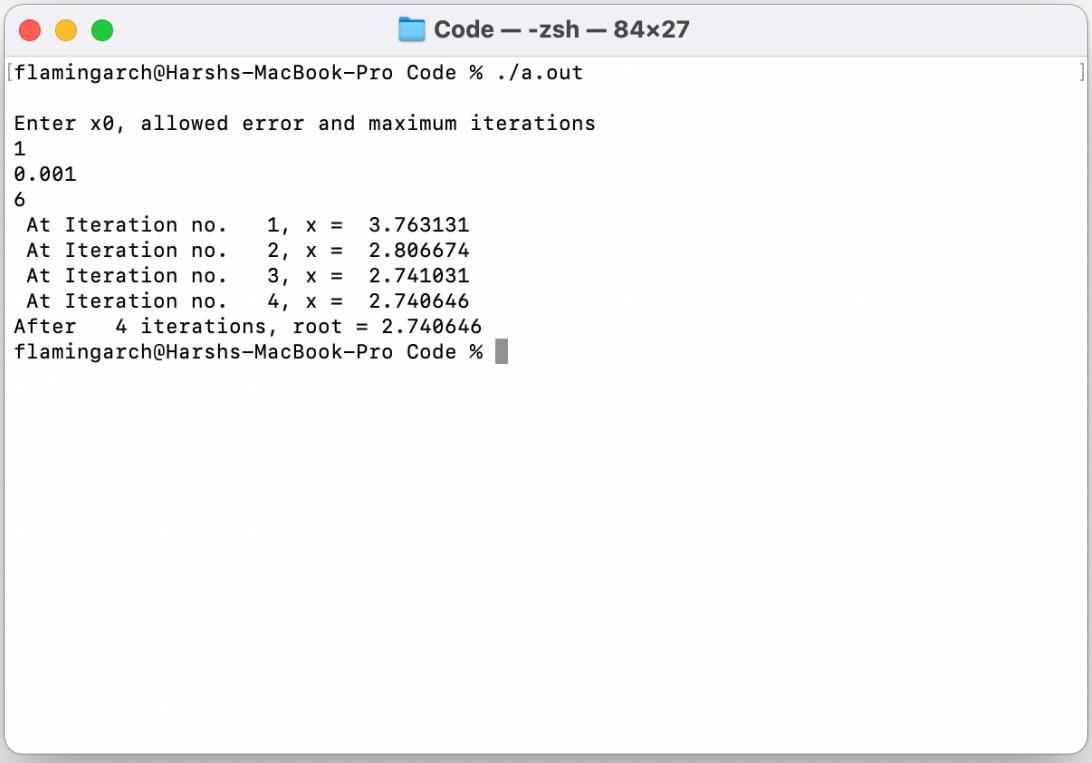
1. Start
2. Read x,e,n,d
   *x is the initial guess
   e is the absolute error i.e the desired degree of accuracy n is for operating loop
   d is for checking slope*
3. Do for I=1 to n in step of 2
4. f = f(x)
5. f1 = f'(x)
6. If ([f1] < d), then display too small slope and goto 11. *[ ] is used as modulus sign*
7. x1=x–f/f1
8. If([(x1–x)/x1]<e), then display the root as x1 and goto 11. *[ ] is used as modulus sign*
9. x=x1 and end loop.
10. Display method does not converge due to oscillation.
11. Stop

Code:

```
#include <stdio.h>
#include <math.h>
float f(float x)
{
    return x * log10(x) - 1.2;
    x *x *x - x *x + 2;
    3 * x - cos(x) - 1;
}
float df(float x)
{
    return log10(x) + 0.43429;
    3 * x *x - 2 * x;
    3 + sin(x);
}
int main()
{
    int itr, maxmitr;
    float h, x0, x1, allerr;
    printf("\nEnter x0, allowed error and maximum iterations\n");
    scanf("%f %f %d", &x0, &allerr, &maxmitr);
    for (itr = 1; itr <= maxmitr; itr++)
    {
        h = f(x0) / df(x0);
        x1 = x0 - h;
        printf(" At Iteration no. %3d, x = %9.6f\n", itr, x1);
        if (fabs(h) < allerr)
        {
            printf("After %3d iterations, root = %8.6f\n", itr,
x1);
            return 0;
        }
        x0 = x1;
    }
    printf(" The required solution does not converge or iterations
are insufficient\n");
    return 1;
}
```

Output:


Code — -zsh — 84×27
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter x0, allowed error and maximum iterations
2
0.001
5
At Iteration no. 1, x = 2.813170
At Iteration no. 2, x = 2.741109
At Iteration no. 3, x = 2.740646
After 3 iterations, root = 2.740646
flamingarch@Harshs-MacBook-Pro Code %


Code — -zsh — 84×27
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter x0, allowed error and maximum iterations
1
0.001
6
At Iteration no. 1, x = 3.763131
At Iteration no. 2, x = 2.806674
At Iteration no. 3, x = 2.741031
At Iteration no. 4, x = 2.740646
After 4 iterations, root = 2.740646
flamingarch@Harshs-MacBook-Pro Code %

Program 7 Implement Gauss Elimination Method

Algorithm:

1. Start
2. Declare the variables and read the order of the matrix n.
3. Take the coefficients of the linear equation as: Do for k=1 to n

   Do for j=1 to n+1

   Read a[k][j]

   End for j End for k
4. Do for k=1 to n-1

   Do for i=k+1 to n

   Do for j=k+1 to n+1

   a[i][j] = a[i][j] – a[i][k] /a[k][k] * a[k][j] End for j

   End for i End for k
5. Compute x[n] = a[n][n+1]/a[n][n]
6. Do for k=n-1 to 1 sum = 0

   Do for j=k+1 to n

   sum = sum + a[k][j] * x[j]

   End for j

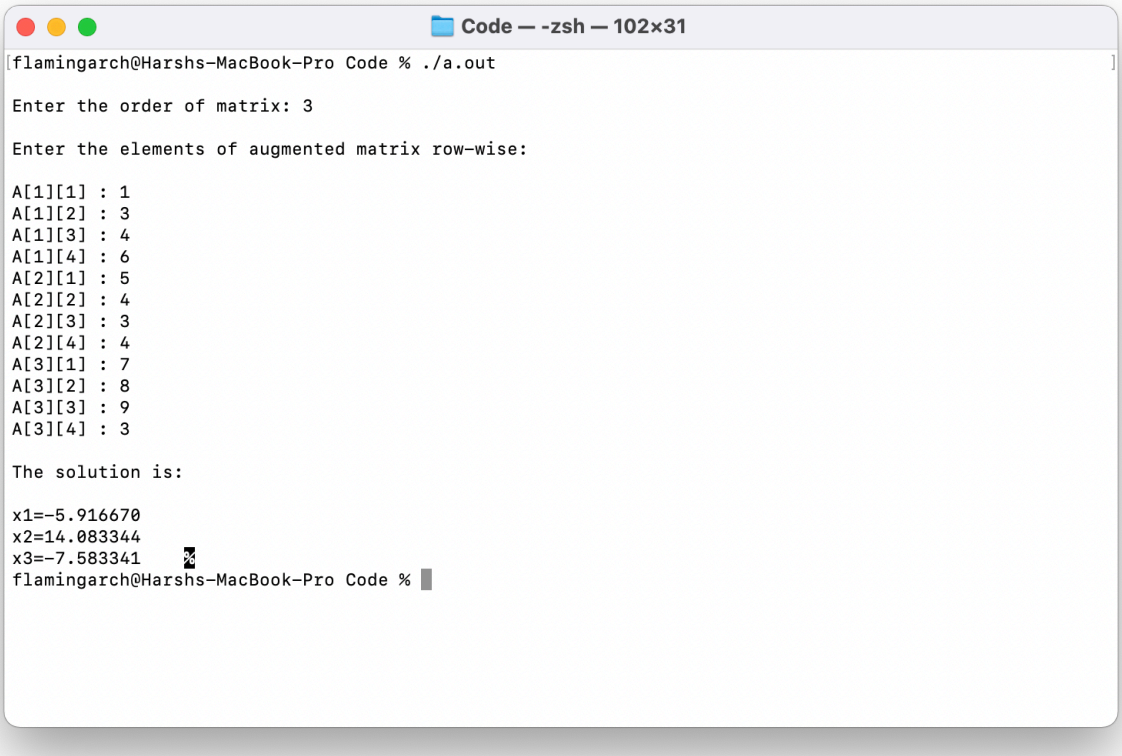
   x[k] = 1/a[k][k] * (a[k][n+1] – sum) End for k
7. Display the result x[k]
8. Stop

Code:

```
#include <stdio.h>

int main()
{
    int i, j, k, n;
    float A[20][20], c, x[10], sum = 0.0;
    printf("\nEnter the order of matrix: ");
    scanf("%d", &n);
    printf("\nEnter the elements of augmented matrix row-wise:
\n\n");
    for (i = 1; i <= n; i++)
    {
        for (j = 1; j <= (n + 1); j++)
        {
            printf("A[%d][%d] : ", i, j);
            scanf("%f", &A[i][j]);
        }
    }
    for (j = 1; j <= n; j++)
    /* loop for the generation of upper triangular matrix*/
    {
        for (i = 1; i <= n; i++)
        {
            if (i > j)
            {
                c = A[i][j] / A[j][j];
                for (k = 1; k <= n + 1; k++)
                {
                    A[i][k] = A[i][k] - c * A[j][k];
                }
            }
        }
    }
    x[n] = A[n][n + 1] / A[n][n];
    for (i = n - 1; i >= 1; i--)
    {
        sum = 0;
        for (j = i + 1; j <= n; j++)
```

```
        {
            sum = sum + A[i][j] * x[j];
        }
        x[i] = (A[i][n + 1] - sum) / A[i][i];
    }
    printf("\nThe solution is: \n");
    for (i = 1; i <= n; i++)
    {
        printf("\nx%d=%f\t", i, x[i]);
    }
    return (0);
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the order of matrix: 3
Enter the elements of augmented matrix row-wise:
A[1][1] : 1
A[1][2] : 3
A[1][3] : 4
A[1][4] : 6
A[2][1] : 5
A[2][2] : 4
A[2][3] : 3
A[2][4] : 4
A[3][1] : 7
A[3][2] : 8
A[3][3] : 9
A[3][4] : 3
The solution is:
x1=-5.916670
x2=14.083344
x3=-7.583341
flamingarch@Harshs-MacBook-Pro Code %

Program 8 Implement Gauss Jordan Method

Algorithm:

1. Start
2. Read the order of the matrix ‘n’ and read the coefficients of the linear equations.
3. Dofork=1ton

   Do for l=k+1 to n+1

   a[k][l] = a[k][l] / a[k][k]

   End for l

   Set a[k][k] = 1

   Do for i=1 to n

   if (i not equal to k) then,

   Do for j=k+1 to n+1

   a[i][j] = a[i][j] – (a[k][j] * a[i][k]) End for j

   End for i

   End for k
4. Doform=1ton x[m] = a[m][n+1] Display x[m]

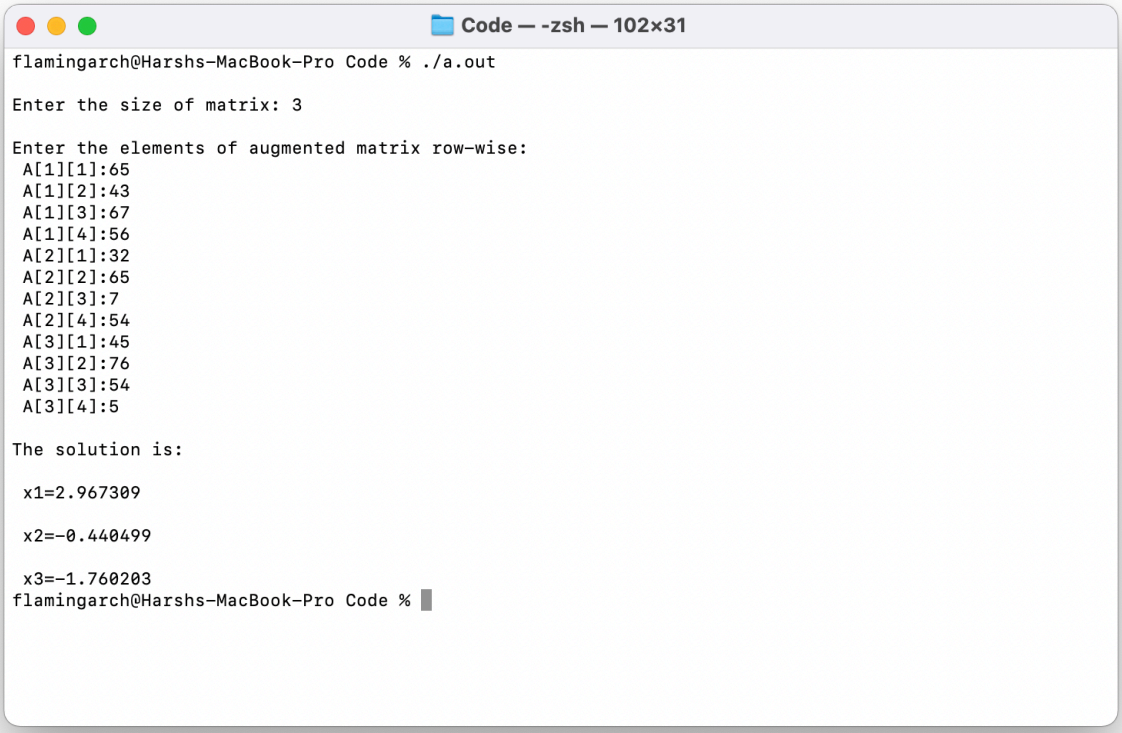
   End for m
5. Stop

Code:

```
#include <stdio.h>

int main()
{
    int i, j, k, n;
    float A[20][20], c, x[10];
    printf("\nEnter the size of matrix: ");
    scanf("%d", &n);
    printf("\nEnter the elements of augmented matrix row-wise:
\n");
    for (i = 1; i <= n; i++)
    {
        for (j = 1; j <= (n + 1); j++)
        {
            printf(" A[%d][%d]:", i, j);
            scanf("%f", &A[i][j]);
        }
    }
    for (j = 1; j <= n; j++)
    {
        for (i = 1; i <= n; i++)
        {
            if (i != j)
            {
                c = A[i][j] / A[j][j];
                for (k = 1; k <= n + 1; k++)
                {
                    A[i][k] = A[i][k] - c * A[j][k];
                }
            }
        }
    }
    printf("\nThe solution is:\n");
    for (i = 1; i <= n; i++)
    {
        x[i] = A[i][n + 1] / A[i][i];
        printf("\n x%d=%f\n", i, x[i]);
    }
```

```
    return (0);
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the size of matrix: 3
Enter the elements of augmented matrix row-wise:
A[1][1]:65
A[1][2]:43
A[1][3]:67
A[1][4]:56
A[2][1]:32
A[2][2]:65
A[2][3]:7
A[2][4]:54
A[3][1]:45
A[3][2]:76
A[3][3]:54
A[3][4]:5
The solution is:
x1=2.967309
x2=-0.440499
x3=-1.760203
flamingarch@Harshs-MacBook-Pro Code %

Program 9 Implement Gauss Jacobi Method

Algorithm:

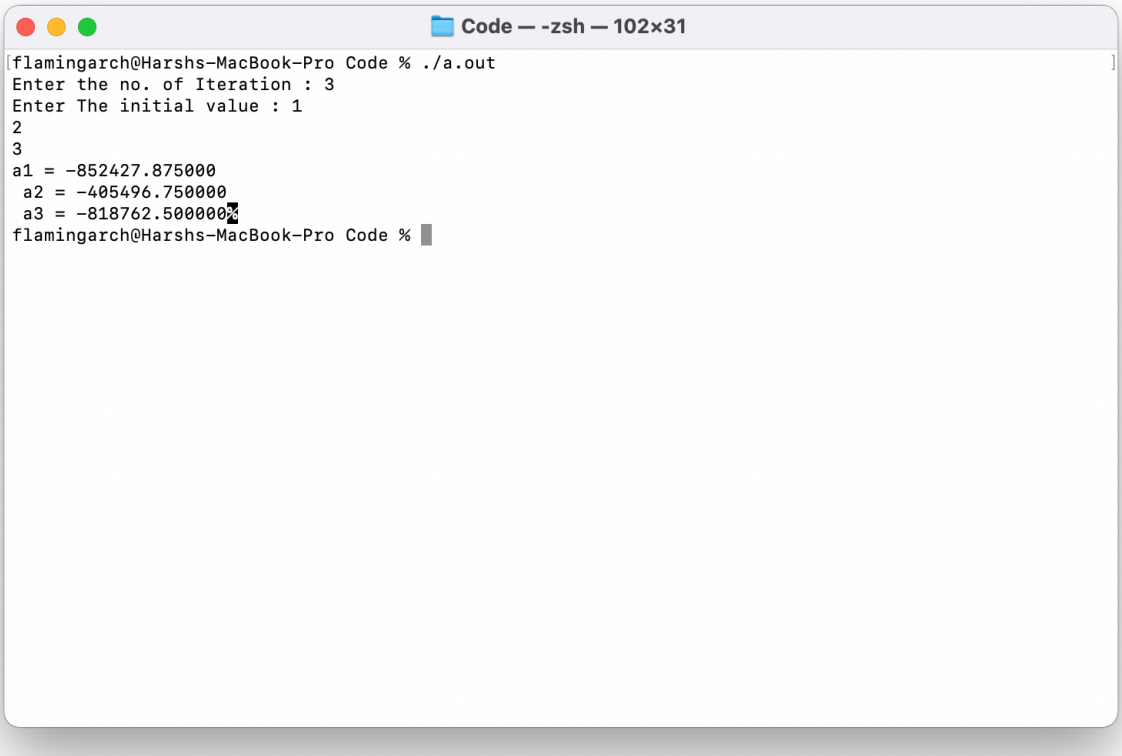
1. Start
2. Arrange the given system of linear equation in diagonally dominant form
3. Read tolerance error
4. Convert the first equation in terms of first variable,and second equation in term of second variable and so on
5. Set initial guess for x0,y0,z0
6. Substitue value of x0,y0,z0,--------from step 5 in equation obtained on step 4 to calculate new values
7. X1,y1,z1----------
8. If /x0-x1/ > e and /y0-y1/ >e and so on ,then goto step 9
9. Set x0=x1,y0=y1,z0=z1, and so on goto step 6
10. Print value of x1,y1,z1 and so on
11. stop

Code:

```
#include <stdio.h>
#include <math.h>
float fx(float y, float z)
{
    float x1;
    x1 = 4 - 2 * y - 3 * z;
    return x1;
}
float fy(float x, float z)
{
    float y1;
    y1 = (8 - 5 * x - 7 * z) / 6;
    return y1;
}
float fz(float x, float y)
{
    float z1;
    z1 = (3 - 9 * x - y) / 2;
    return z1;
}
int main()
{
    int i, j, n;
    float a1, b1, c1;
    float a, b, c;
    float ar[3][4], x[3];
    printf("Enter the no. of Iteration : ");
    scanf("%d", &n);
    printf("Enter The initial value : ");
    scanf("%f %f %f", &a, &b, &c);
    for (i = 0; i < n; i++)
    {
        for (j = 0; j < n; j++)
        {
            a1 = fx(b, c);
            b1 = fy(a, c);
            c1 = fz(a, b);
            a = a1;
```

```
            b = b1;
            c = c1;
        }
    }
    printf("a1 = %f\n a2 = %f\n a3 = %f", a1, b1, c1);
    return 0;
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the no. of Iteration : 3
Enter The initial value : 1
2
3
a1 = -852427.875000
a2 = -405496.750000
a3 = -818762.500000%
flamingarch@Harshs-MacBook-Pro Code %

Program 10 Implement Iteration Method

Algorithm:

1. Start
2. Declare the variables and read the order of the matrix n
3. Read the stopping criteria er
4. Read the coefficients aim as Do for i=1 to n

   Do for j=1 to n

   Read a[i][j]

   Repeat for j Repeat for i
5. Read the coefficients b[i] for i=1 to n
6. Initialize x0[i] = 0 for i=1 to n
7. Set key=0
8. For i=1 to n

   Set sum = b[i]

   For j=1 to n

   If (j not equal to i)

   Set sum = sum – a[i][j] * x0[j] Repeat j

   x[i] = sum/a[i][i]

   If absolute value of ((x[i] – x0[i]) / x[i]) > er, then Set key = 1

   Set x0[i] = x[i]

   Repeat i

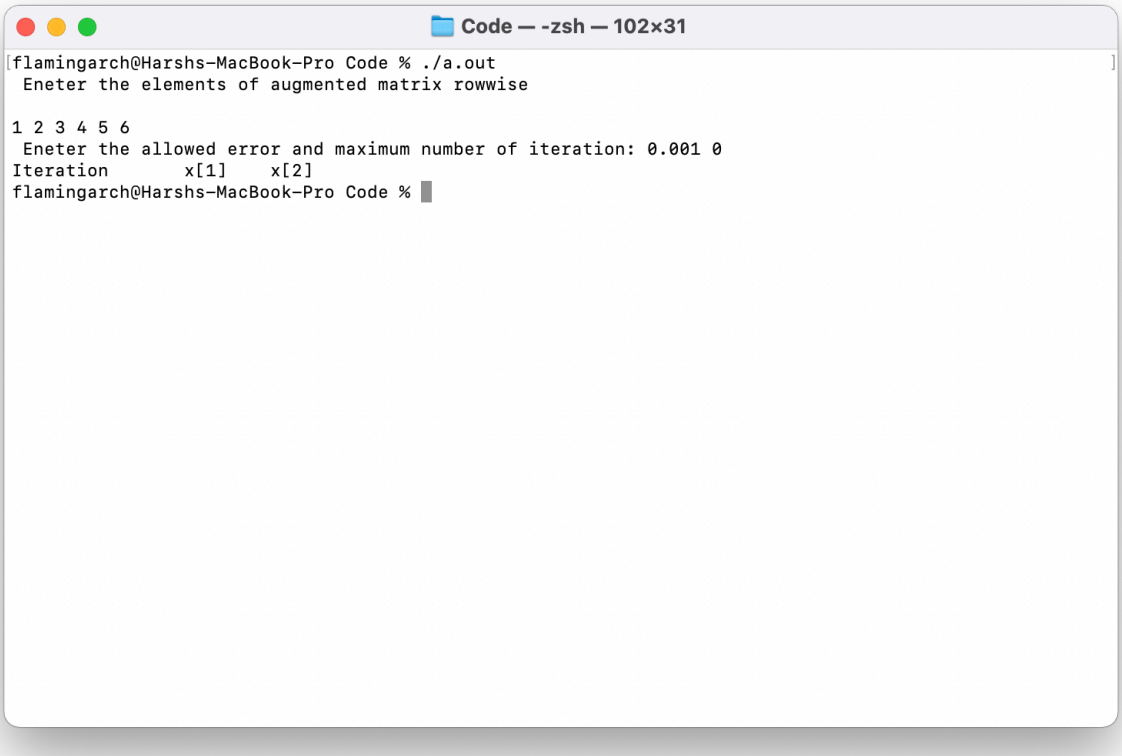
9. 9. If key = 1, then Goto step 6
10. Otherwise print results.

Code:

```
#include <stdio.h>
#include <math.h>
#define X 2
int main()
{
    float x[X][X + 1], a[X], ae, max, t, s, e;
    int i, j, r, mxit;
    for (i = 0; i < X; i++)
        a[i] = 0;
    puts(" Eneter the elements of augmented matrix rowwise\n");
    for (i = 0; i < X; i++)
    {
        for (j = 0; j < X + 1; j++)
        {
            scanf("%f", &x[i][j]);
        }
    }
    printf(" Eneter the allowed error and maximum number of
iteration: ");
    scanf("%f%d", &ae, &mxit);
    printf("Iteration\tx[1]\tx[2]\n");
    for (r = 1; r <= mxit; r++)
    {
        max = 0;
        for (i = 0; i < X; i++)
        {
            s = 0;
            for (j = 0; j < X; j++)
                if (j != i)
                    s += x[i][j] * a[j];
            t = (x[i][X] - s) / x[i][i];
            e = fabs(a[i] - t);
            a[i] = t;
        }
        printf(" %5d\t", r);
        for (i = 0; i < X; i++)
            printf(" %9.4f\t", a[i]);
        printf("\n");
```

```
        if (max < ae)

            printf(" Converses in %3d iteration\n", r);
        for (i = 0; i < X; i++)
            printf("a[%3d]=%7.4f\n", i + 1, a[i]);
        return 0;
    }
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Eneter the elements of augmented matrix rowwise
1 2 3 4 5 6
Eneter the allowed error and maximum number of iteration: 0.001 0
Iteration x[1] x[2]
flamingarch@Harshs-MacBook-Pro Code %

Program 11 Implement Newton Forward Interpolation Method

Algorithm:

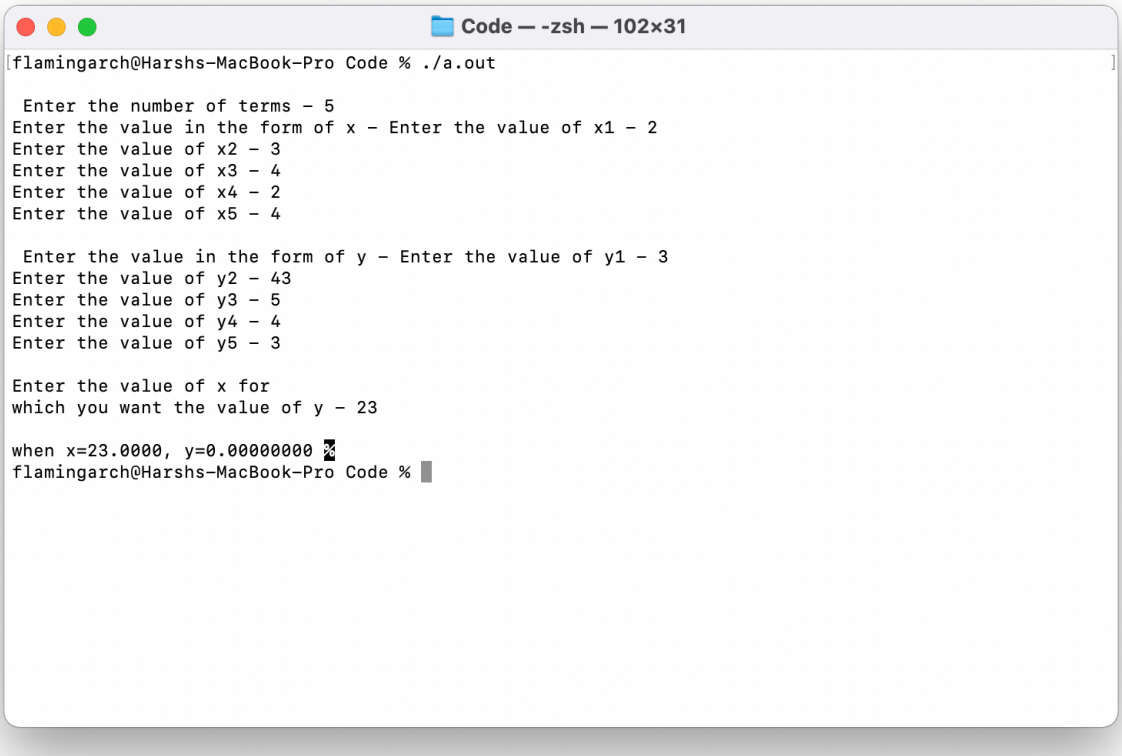
1. Start of the program
2. Input number of terms n
3. Input the array ax
4. Input the array ay
5. h=ax[1] – ax[0]
6. for i=0; i<n-1; i++
7. diff[i] [1]=ay[i + 1] – ay[i]
8. End Loop i
9. for j=2; j<=4; j++
10. for i = 0; i <n – j; i++
11. diff[i][j]=diff [i + 1] [j – 1]-diff [i][j – 1] 12.End Loop i
13. End Loop j
14. i=0
15. Repeat Step 16 until ax[i]<x
16. i=i + 1
17. i=i – 1;
18. p=(x – ax [i])/h
19. y1=p*diff[i – 1][1]
20. y2=p*(p+1)*diff [i – 1][2]/2 21.y3=(p+1)*p*(p-1)*diff[i –2][3]/6
22. y4=(p+2)*(p+1)*p*(p – 1)*diff[i – 3][4]/24 23.y=ay[i]+y1+y2+y3+y4
24. Print output x, y 25.End of program.

Code:

```
#include <stdio.h>

#include <math.h>
#include <string.h>
void main()
{
    int n;
    int i, j;
    float ax[10];
    float ay[10];
    float x;
    float y = 0;
    float h;
    float p;
    float diff[20][20];
    float y1, y2, y3, y4;
    clrscr();
    printf("\n Enter the number of terms - ");
    scanf("%d", &n);
    printf("Enter the value in the form of x - ");
    for (i = 0; i < n; i++)
    {
        printf("Enter the value of x%d - ", i + 1);
        scanf("%f", &ax[i]);
    }
    printf("\n Enter the value in the form of y - ");
    for (i = 0; i < n; i++)
    {
        printf("Enter the value of y%d - ", i + 1);
        scanf("%f", &ay[i]);
    }
    printf("\nEnter the value of x for");
    printf("\nwhich you want the value of y - ");
    scanf("%f", &x);
    h = ax[1] - ax[0];
    for (i = 0; i < n - 1; i++)
    {
        diff[i][1] = ay[i + 1] - ay[i];
```

```
    }
    for (j = 2; j <= 4; j++)
    {
        for (i = 0; i < n - j; i++)
        {
            diff[i][j] = diff[i + 1][j - 1] - diff[i][j - 1];
        }
    }
    i = 0;
    do
    {
        i++;
    } while (ax[i] < x);
    i--;
    p = (x - ax[i]) / h;
    y1 = p * diff[i - 1][1];
    y2 = p * (p + 1) * diff[i - 1][2] / 2;
    y3 = (p + 1) * p * (p - 1) * diff[i - 2][3] / 6;
    y4 = (p + 2) * (p + 1) * p * (p - 1) * diff[i - 3][4] / 24;
    y = ay[i] + y1 + y2 + y3 + y4;
    printf("\nwhen x=%6.4f, y=%6.8f ", x, y);
    getch();
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter the number of terms - 5
Enter the value in the form of x - Enter the value of x1 - 2
Enter the value of x2 - 3
Enter the value of x3 - 4
Enter the value of x4 - 2
Enter the value of x5 - 4
Enter the value in the form of y - Enter the value of y1 - 3
Enter the value of y2 - 43
Enter the value of y3 - 5
Enter the value of y4 - 4
Enter the value of y5 - 3
Enter the value of x for
which you want the value of y - 23
when x=23.0000, y=0.00000000
flamingarch@Harshs-MacBook-Pro Code %

Program 12 Implement Newton Backward Interpolation Method

Algorithm:

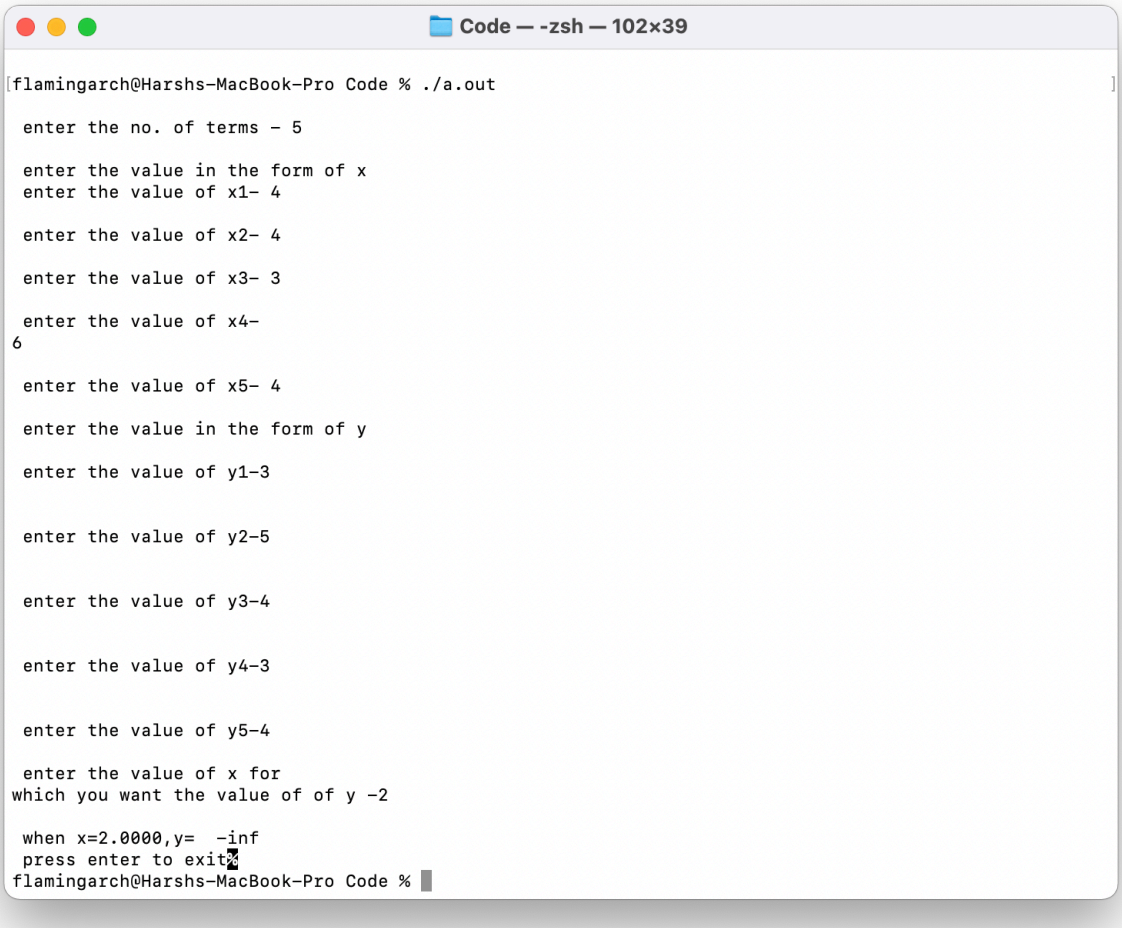
1. Start of the program.
2. Input number of terms n
3. Input the array ax
4. Input the array ay
5. h=ax[1]-ax[0]
6. for i=0; i<n–1; i++
7. diff[i][1]=ay[i+1]–ay[i]
8. End Loop i
9. forj=2;j<=4;j++
10. for i=0; i<n–j; i++
11. diff[i][j]=diff[i+1][j–1]–diff [i][j–1]
12. End Loop i
13. End Loop j
14. i=0
15. Repeat Step 16 until (!ax[i]<x)
16. x0=mx[i] 17.sum=0 18.y0=my[i]
19. fun=1
20. p=(x–x0)/h
21. sum=y0
22. k=1; k<=4; k++
23. fun=(fun*(p–(k–1)))/k
24. sum=sum+fun*diff[i][k]
25. End loop k
26. Print Output x,sum 27.End of Program

Code:

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

int main()
{
    int n, i, j, k;
    float mx[10], my[10], x, x0 = 0, y0, sum, h, fun, p, diff[20]
[20], y1, y2, y3, y4;

    printf("\n enter the no. of terms - ");
    scanf("%d", &n);
    printf("\n enter the value in the form of x");
    for (i = 0; i < n; i++)
    {
        printf("\n enter the value of x%d- ", i + 1);
        scanf("%f", &mx[i]);
    }
    printf("\n enter the value in the form of y ");
    for (i = 0; i < n; i++)
    {
        printf("\n\n enter the value of y%d-", i + 1);
        scanf("%f", &my[i]);
    }
    printf("\n enter the value of x for");
    printf("\nwhich you want the value of of y -");
    scanf("%f", &x);
    h = mx[1] - mx[0];
    for (i = 0; i < n - 1; i++)
    {
        diff[i][1] = my[i + 1] - my[i];
    }
    for (j = 2; j <= 4; j++)
    {
        for (i = 0; i < n - j; i++)
        {
            diff[i][j] = diff[i + 1][j - 1] - diff[i][j - 1];
        }
```

```
    }
    i = 0;
    while (!mx[i] > x)
    {
        i++;
    }
    x0 = mx[i];
    sum = 0;
    y0 = my[i];
    fun = 1;
    p = (x - x0) / h;
    sum = y0;
    for (k = 1; k <= 4; k++)
    {
        fun = (fun * (p - (k - 1)) / k);
        sum = sum + fun * diff[i][k];
    }
    printf("\n when x=%6.4f,y=%6.8f", x, sum);
    printf("\n press enter to exit");
    return 0;
}
```

Output:


Code — -zsh — 102×39
flamingarch@Harshs-MacBook-Pro Code % ./a.out
enter the no. of terms - 5
enter the value in the form of x
enter the value of x1- 4
enter the value of x2- 4
enter the value of x3- 3
enter the value of x4-
6
enter the value of x5- 4
enter the value in the form of y
enter the value of y1-3
enter the value of y2-5
enter the value of y3-4
enter the value of y4-3
enter the value of y5-4
enter the value of x for
which you want the value of of y -2
when x=2.0000,y= -inf
press enter to exit%
flamingarch@Harshs-MacBook-Pro Code %

Program 13 Implement Lagrange's Interpolation Method

Algorithm:

1. Start
2. Read number of data (n)
3. Read data Xi and Yi for i=1 ton n
4. Read value of independent variables say xp

whose corresponding value of dependent say yp is to be determined.

5. Initialize: yp = 0
6. For i = 1 to n Set p = 1

For j =1 to n

If i ≠ j then

Calculate p = p * (xp - Xj)/(Xi - Xj) End If

Next j

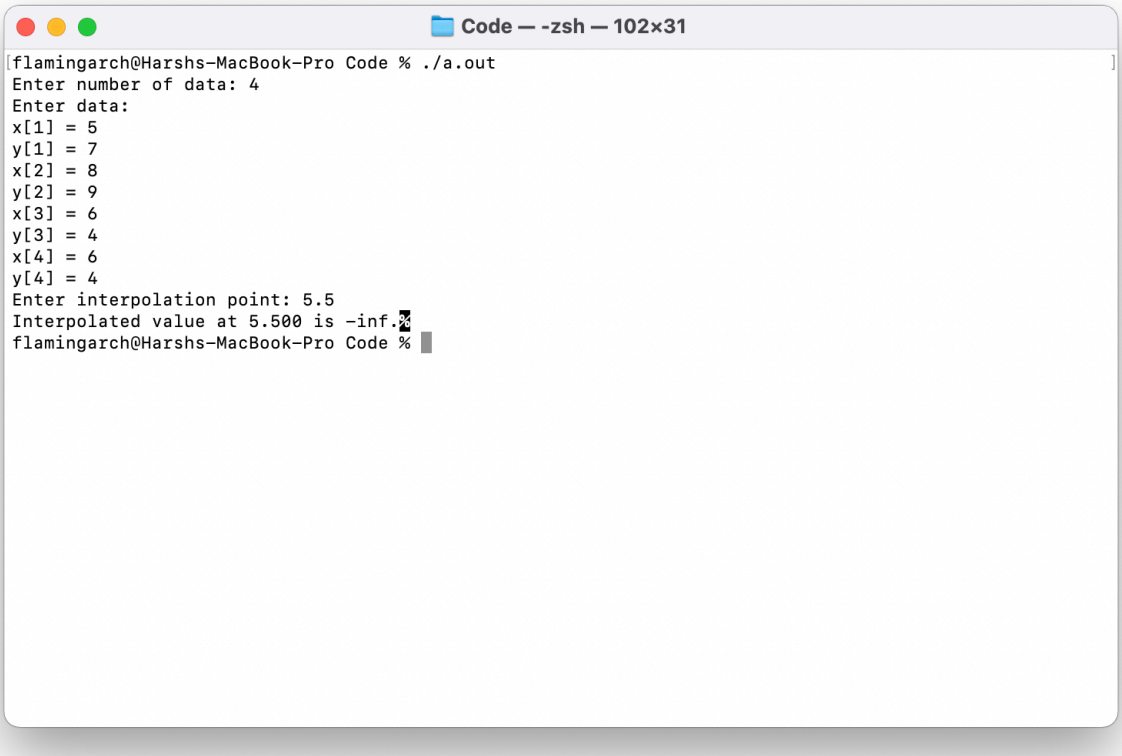
Calculate yp = yp + p * Yi Next i

7. Display value of yp as interpolated value.
8. Stop

Code:

```c
#include <stdio.h>

int main()
{
    float x[100], y[100], xp, yp = 0, p;
    int i, j, n;
    /* Input Section */
    printf("Enter number of data: ");
    scanf("%d", &n);
    printf("Enter data:\n");
    for (i = 1; i <= n; i++)
    {
        printf("x[%d] = ", i);
        scanf("%f", &x[i]);
        printf("y[%d] = ", i);
        scanf("%f", &y[i]);
    }
    printf("Enter interpolation point: ");
    scanf("%f", &xp);
    /* Implementing Lagrange Interpolation */
    for (i = 1; i <= n; i++)
    {
        p = 1;
        for (j = 1; j <= n; j++)
        {
            if (i != j)
            {
                p = p * (xp - x[j]) / (x[i] - x[j]);
            }
        }
        yp = yp + p * y[i];
    }
    printf("Interpolated value at %.3f is %.3f.", xp, yp);
    return 0;
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter number of data: 4
Enter data:
x[1] = 5
y[1] = 7
x[2] = 8
y[2] = 9
x[3] = 6
y[3] = 4
x[4] = 6
y[4] = 4
Enter interpolation point: 5.5
Interpolated value at 5.500 is -inf.%
flamingarch@Harshs-MacBook-Pro Code %

Program 14 Implement Trapezoidal Rule

Algorithm:

1. Start

   Define and Declare function
2. Input initial boundary value, final boundary value and length of interval
3. Calculate number of strips, n = (final boundary value –final boundary value)/ length of interval
4. Perform following operation in loop x[i]=x0+i*h
5. y[i]=f(x[i]) print y[i]
6. • •
7. Initialize se=0, s0=0

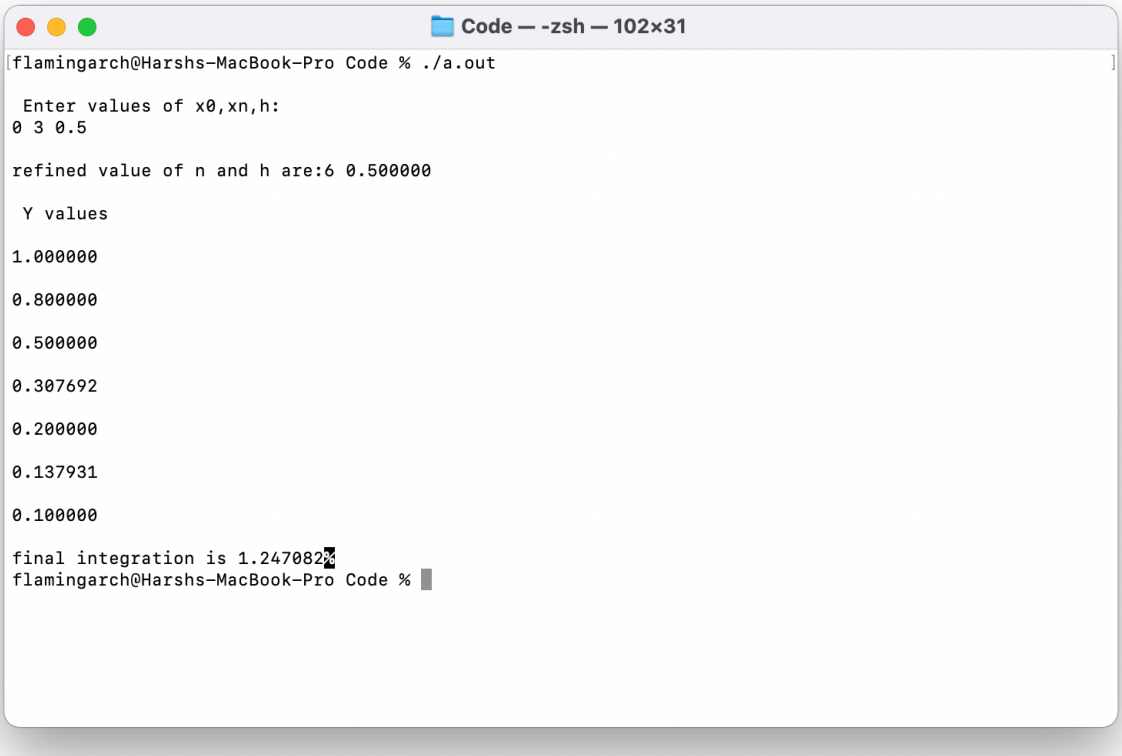
   Do the following using loop
8. If i %2 = 0
9. So=s0+y[i] Otherwise
10. Se=se+y[i]
11. ans= h/3*(y[0]+y[n]+4*so+2*se) print the ans
12. Stop

Code:

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

float f(float x)
{
    return (1 / (1 + pow(x, 2)));
}

int main()
{
    int i, n;
    float x0, xn, h, y[20], so, se, ans, x[20];
    printf("\n Enter values of x0,xn,h:\n");
    scanf("%f%f%f", &x0, &xn, &h);
    n = (xn - x0) / h;
    if (n % 2 == 1)
    {
        n = n + 1;
    }
    h = (xn - x0) / n;
    printf("\nrefined value of n and h are:%d %f\n", n, h);
    printf("\n Y values \n");
    for (i = 0; i <= n; i++)
    {
        x[i] = x0 + i * h;
        y[i] = f(x[i]);
        printf("\n%f\n", y[i]);
    }
    so = 0;
    se = 0;
    for (i = 1; i < n; i++)
    {
        if (i % 2 == 1)
        {
            so = so + y[i];
        }
        else
        {
```

```
            se = se + y[i];
        }
    }
    ans = h / 3 * (y[0] + y[n] + 4 * so + 2 * se);
    printf("\nfinal integration is %f", ans);
    return 0;
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter values of x0,xn,h:
0 3 0.5
refined value of n and h are:6 0.500000
Y values
1.000000
0.800000
0.500000
0.307692
0.200000
0.137931
0.100000
final integration is 1.247082%
flamingarch@Harshs-MacBook-Pro Code %

Program 15 Implement Simpson 1/3 Rule

Algorithm:

Step 1. Start;

Step 2. Input function f(x);

Step 3. Read a,b,n; // the lower and upper limits and number of sub-intervals

Step 4. Compute h=(b-a)/n;

Step 5. Sum = [f(a)-f(a+nh)];

Step 6. for i=1 to n-1 step 2 do

Compute sum = sum + 4*f(a+ih)+2*f(a+(i+1)h); endfor;

Step 7. Compute result = sum * h/3; Step 8. Print result;

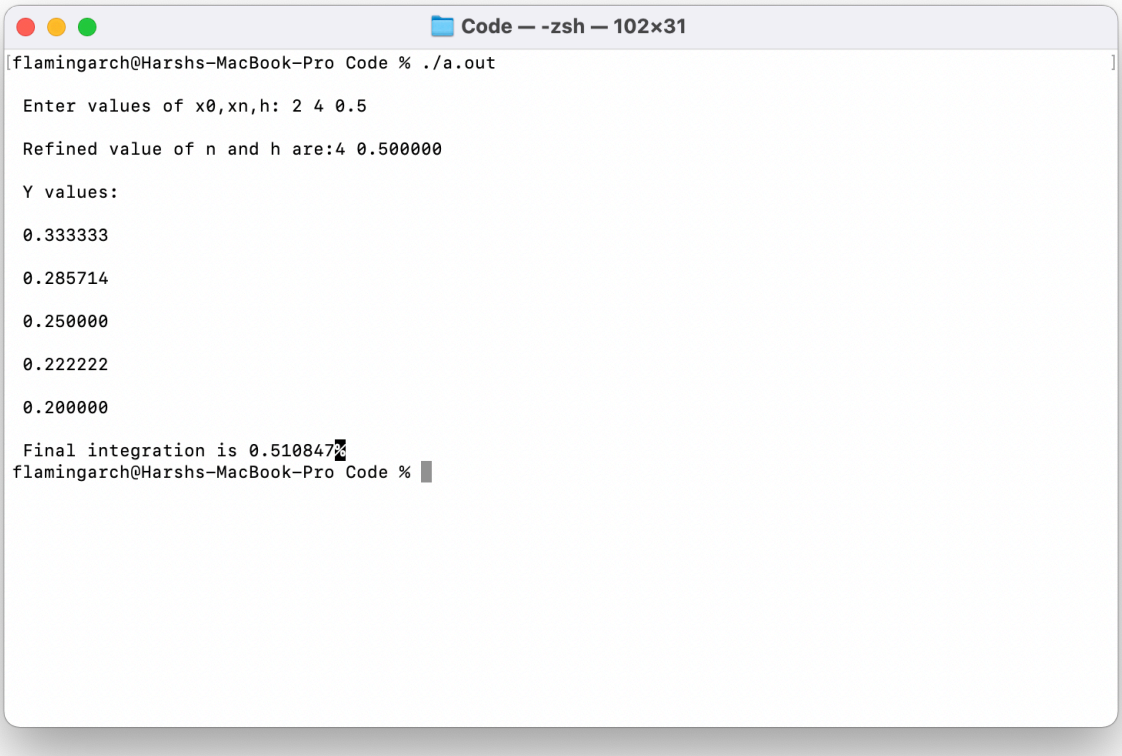
Step 9. Stop;

Code:

```
#include <stdio.h>

float f(float x)
{
    return (1 / (1 + x));
}
int main()
{
    int i, n;
    float x0, xn, h, y[20], so, se, ans, x[20];
    printf("\n Enter values of x0,xn,h: ");
    scanf("%f%f%f", &x0, &xn, &h);
    n = (xn - x0) / h;
    if (n % 2 == 1)
    {
        n = n + 1;
    }
    h = (xn - x0) / n;
    printf("\n Refined value of n and h are:%d %f\n", n, h);
    printf("\n Y values: \n");
    for (i = 0; i <= n; i++)
    {
        x[i] = x0 + i * h;
        y[i] = f(x[i]);
        printf("\n %f\n", y[i]);
    }
    so = 0;
    se = 0;
    for (i = 1; i < n; i++)
    {
        if (i % 2 == 1)
        {
            so = so + y[i];
        }
        else
        {
            se = se + y[i];
        }
```

```
    }
    ans = h / 3 * (y[0] + y[n] + 4 * so + 2 * se);
    printf("\n Final integration is %f", ans);
    return 0;
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter values of x0,xn,h: 2 4 0.5
Refined value of n and h are:4 0.500000
Y values:
0.333333
0.285714
0.250000
0.222222
0.200000
Final integration is 0.510847%
flamingarch@Harshs-MacBook-Pro Code %

Program 16 Implement Simpson 3/8 Rule

Algorithm:

1.Given a function f(x):

2. (Get user inputs) Input a,b=endpoints of interval n=number of intervals 3. Set h= (b-a)/n.

4. Set sum=0.

5. Begin For i= 1 to n -1 Set x =a + h*i. If i%3=0 Then Set sum=sum+2*f(x) Else Set sum=sum+3*f(x) End For

6. Set sum = sum + f(a)+f(b)

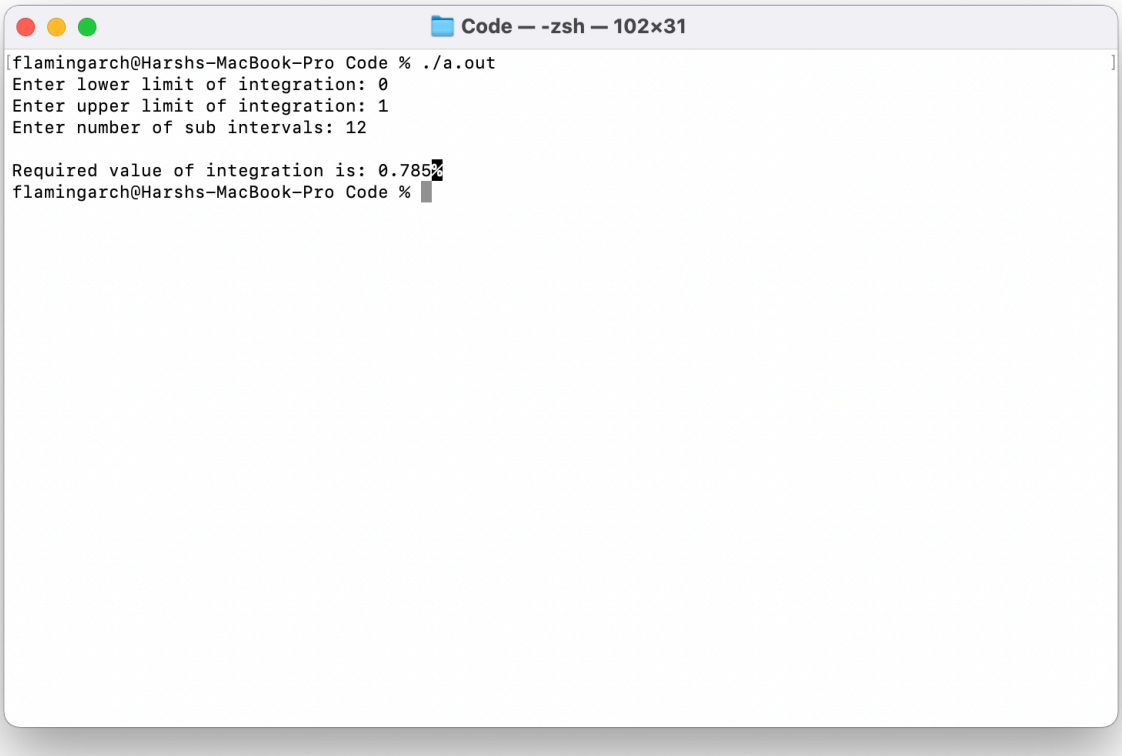
7. Set ans = sum*(3h/8)

8.End

Code:

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

#define f(x) 1 / (1 + x * x)

int main()
{
    float lower, upper, integration = 0.0, stepSize, k;
    int i, subInterval;
    printf("Enter lower limit of integration: ");
    scanf("%f", &lower);
    printf("Enter upper limit of integration: ");
    scanf("%f", &upper);
    printf("Enter number of sub intervals: ");
    scanf("%d", &subInterval);
    stepSize = (upper - lower) / subInterval;
    integration = f(lower) + f(upper);
    for (i = 1; i <= subInterval - 1; i++)
    {
        k = lower + i * stepSize;
        if (i % 3 == 0)
        {
            integration = integration + 2 * f(k);
        }
        else
        {
            integration = integration + 3 * f(k);
        }
    }
    integration = integration * stepSize * 3 / 8;
    printf("\nRequired value of integration is: %.3f",
integration);
    return 0;
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter lower limit of integration: 0
Enter upper limit of integration: 1
Enter number of sub intervals: 12
Required value of integration is: 0.785%
flamingarch@Harshs-MacBook-Pro Code %

Program 17 Fit a Line

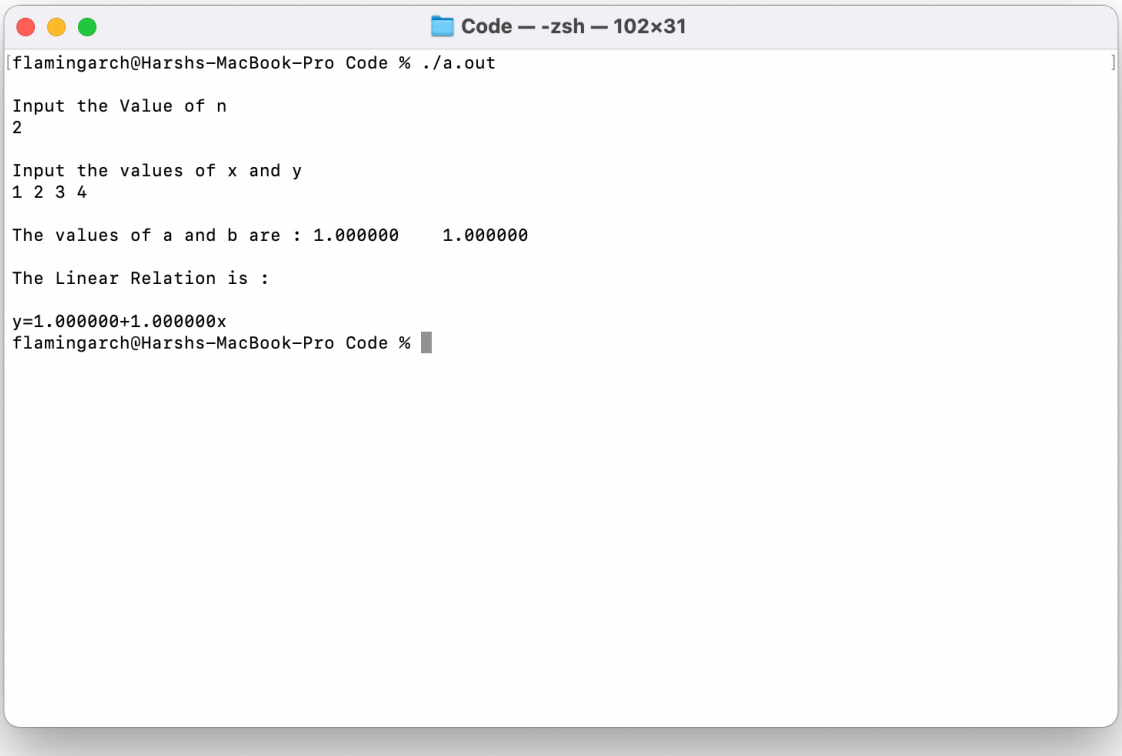
Algorithm:

1. Take two floating types of array. x[10] and y[10].
2. Now take n as input from the user.
3. Take x,y as input from the user with the help of for loop. (0<=i<n)
4. Now find the values of Σx, Σy, Σxy, Σx^2 using for loop.
5. Using the formula to solve the simultaneous equation solve for a and b. For formula have a look at Fig 2.
6. Put the values of a and b in the equation of the straight line by checking the condition if b>0 or b=0.
7. Print the result.

Code:

```c
#include <stdio.h>

int main()
{
    int i, j, n;
    float x[10], y[10], sum1 = 0, sum2 = 0, sum3 = 0, sum4 = 0;
    float a, b, d;
    printf("\nInput the Value of n\n");
    scanf("%d", &n);
    printf("\nInput the values of x and y\n");
    for (i = 0; i < n; i++)
    {
        scanf("%f%f", &x[i], &y[i]);
    }
    for (i = 0; i < n; i++)
    {
        sum1 = sum1 + x[i];
        sum2 = sum2 + x[i] * x[i];
        sum3 = sum3 + y[i];
        sum4 = sum4 + x[i] * y[i];
    }
    d = n * sum2 - sum1 * sum1;
    a = (sum2 * sum3 - sum1 * sum4) / d;
    b = (n * sum4 - sum1 * sum3) / d;
    printf("\nThe values of a and b are : %f\t%f\n", a, b);
    printf("\nThe Linear Relation is : \n");
    if (b > 0)
    {
        printf("\ny=%f+%fx\n", a, b);
    }
    else
    {
        printf("y=%f%fx", a, b);
    }
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Input the Value of n
2
Input the values of x and y
1 2 3 4
The values of a and b are : 1.000000 1.000000
The Linear Relation is :
y=1.000000+1.000000x
flamingarch@Harshs-MacBook-Pro Code %

Program 18 Fit a Parabola

Algorithm:

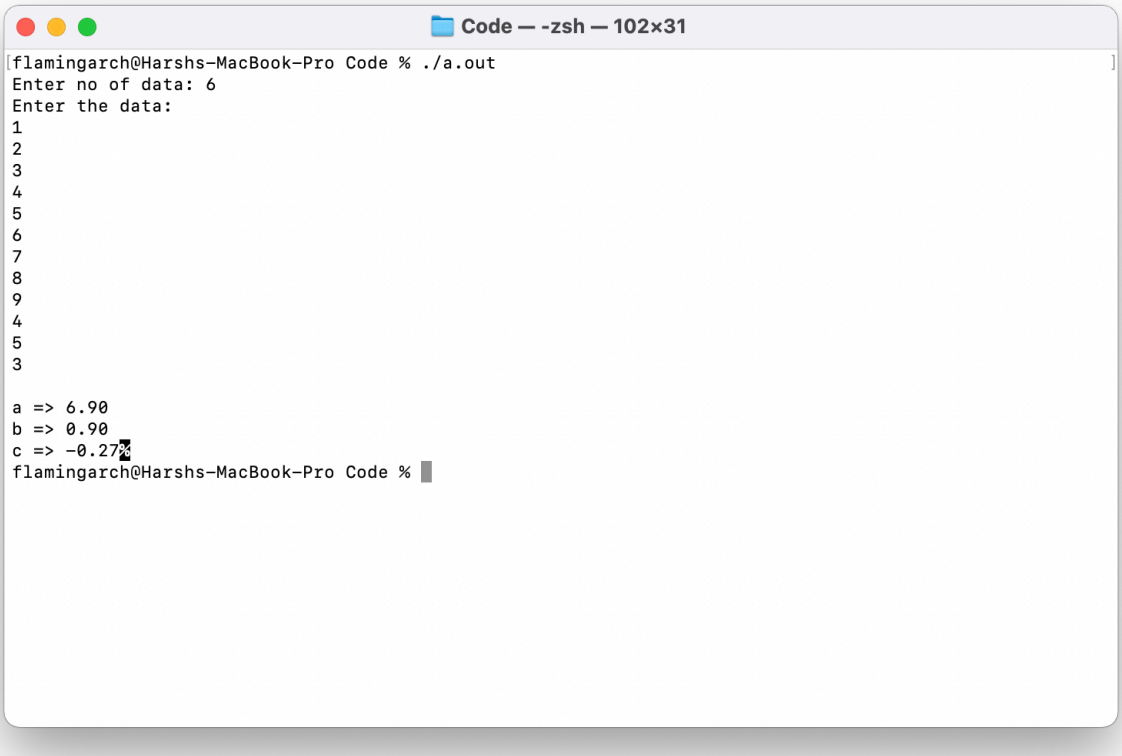
1. Read no. of data points n and order of polynomial Mp .
2. Read data values .
3. If n< Mp [Regression is not possible] stop else continue ;
4. SetM=Mp+1;
5. Compute co-efficient of C-matrix .
6. Compute co-efficient of B-matrix .
7. Solve for the co-efficients a1,a2,. . . . . an .
8. Write the co-efficient .
9. Estimate the function value at the given of independents variables .

Code:

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

int main()
{
    float xy[20][20], matrix[3][4], ratio, a;
    float sum_x = 0, sum_y = 0, sum_x2 = 0, sum_x3 = 0, sum_x4 =
0, sum_xy = 0, sum_x2y = 0;
    int i, j, k, n;
    printf("Enter no of data: ");
    scanf("%d", &n);
    printf("Enter the data: \n");
    for (i = 0; i < 2; i++)
    {
        for (j = 0; j < n; j++)
        {
            scanf("%f", &xy[i][j]);
        }
    }
    for (i = 0; i < n; i++)
    {
        sum_x += xy[0][i];
        sum_y += xy[1][i];
        sum_x2 += pow(xy[0][i], 2);
        sum_x3 += pow(xy[0][i], 3);
        sum_x4 += pow(xy[0][i], 4);
        sum_xy += xy[0][i] * xy[1][i];
        sum_x2y += pow(xy[0][i], 2) * xy[1][i];
    }
    matrix[0][0] = n;
    matrix[0][1] = sum_x;
    matrix[0][2] = sum_x2;
    matrix[0][3] = sum_y;
    matrix[1][0] = sum_x;
    matrix[1][1] = sum_x2;
    matrix[1][2] = sum_x3;
    matrix[1][3] = sum_xy;
    matrix[2][0] = sum_x2;
```

```
    matrix[2][1] = sum_x3;
    matrix[2][2] = sum_x4;
    matrix[2][3] = sum_x2y;
    for (i = 0; i < 3; i++)
    {
        for (j = 0; j < 3; j++)
        {
            if (i != j)
            {
                ratio = matrix[j][i] / matrix[i][i];
                for (k = 0; k < 4; k++)
                {
                    matrix[j][k] -= ratio * matrix[i][k];
                }
            }
        }
    }
    for (i = 0; i < 3; i++)
    {
        a = matrix[i][i];
        for (j = 0; j < 4; j++)
        {
            matrix[i][j] /= a;
        }
    }
    for (i = 0; i < 3; i++)
    {
        printf("\n%c => %.2f", 97 + i, matrix[i][3]);
    }
}
```

Output:


Code — -zsh — 102×31
flamingarch@Harshs-MacBook-Pro Code % ./a.out
Enter no of data: 6
Enter the data:
1
2
3
4
5
6
7
8
9
4
5
3
a => 6.90
b => 0.90
c => -0.27%
flamingarch@Harshs-MacBook-Pro Code %