Birla Institute of Technology, Mesra

NUMERICAL METHOD LAB

Robin

ROLL NO: BTECH/15138/19

Faculty in charge Dr. Prakash Chandra srivastava

Patna off campus

2021

Euler’s Method

Algorithm:

Step 1. Start;
Step 2. Input function f(x, y);
Step 3. Read x0, y0, xn, h;
/* x0, y0 are initial values and xn is the last value of x
where the process will terminate, h is the step size */
Step 4. for x = x0 to xn step h do
y = y0 + h * f(x, y0);
Print x, y;
y0 = y;
end for loop;
Step 5. Stop;

Code:

```
include<stdio.h>
#include<conio.h>
float fun(float x,float y)
{
   float f;
   f=y*y-x*x;
   return f;
}
main()
{
   float a,b,x,y,h,t,k;
   clrscr();
   printf("\nEnter x0,y0,h,xn: ");
   scanf("%f%f%f%f",&a,&b,&h,&t);
   x=a;
   y=b;
   printf("\n  x\t  y\n");
   while(x<=t)
   {
      k=h*fun(x,y);
      y=y+k;
      x=x+h;
      printf("%0.3f\t%0.3f\n",x,y);
   }
getch();
return 0;
}
```

Output:

```
Enter x0,y0,h,xn: 0
1
0.1
1

  x       y
0.100   1.100
0.200   1.200
0.300   1.300
0.400   1.400
0.500   1.500
0.600   1.600
0.700   1.700
0.800   1.800
0.900   1.900
1.000   2.000
```

Runge-Kutta 4th order method

Algorithm:

1. Start

2. Define function f(x,y)

3. Read values of initial condition(x0 and y0),
   number of steps (n) and calculation point (xn)

4. Calculate step size (h) = (xn - x0)/n

5. Set i=0

6. Loop

      k1 = h * f(x0, y0)
      k2 = h * f(x0+h/2, y0+k1/2)
      k3 = h * f(x0+h/2, y0+k2/2)
      k4 = h * f(x0+h, y0+k3)

      k = (k1+2*k2+2*k3+k4)/6

      yn = y0 + k

      i = i + 1
      x0 = x0 + h
      y0 = yn

   While i < n

7. Display yn as result

8. Stop

Code:

```
#include<stdio.h>
#include <math.h>
#include<conio.h>
#define F(x,y)  y-x
void main()
{
   double y0,x0,y1,n,h,f,k1,k2,k3,k4;
   clrscr();
   printf("\nEnter the value of x0: ");
   scanf("%lf",&x0);
   printf("\nEnter the value of y0: ");
   scanf("%lf",&y0);
   printf("\nEnter the value of h: ");
   scanf("%lf",&h);
   printf("\nEnter the value of last point: ");
   scanf("%lf",&n);
   for(; x0<n; x0=x0+h)
   {
```

```
      f=F(x0,y0);
      k1 = h * f;
      f = F(x0+h/2,y0+k1/2);
      k2 = h * f;
      f = F(x0+h/2,y0+k2/2);
      k3 = h * f;
      f = F(x0+h/2,y0+k2/2);
      k4 = h * f;
      y1 = y0 + ( k1 + 2*k2 + 2*k3 + k4)/6;
      printf("\n\n  k1 = %.4lf  ",k1);
      printf("\n\n  k2 = %.4lf ",k2);
      printf("\n\n  k3 = %.4lf ",k3);
      printf("\n\n  k4 = %.4lf ",k4);
      printf("\n\n  y(%.4lf) = %.3lf ",x0+h,y1);
      y0=y1;
   }
   getch();
}
```

Output:

```
Enter the value of x0: 0

Enter the value of y0: 2

Enter the value of h: 0.1

Enter the value of last point: 0.4_
  k3 = 0.2276

  k4 = 0.2276

  y(0.2000) = 2.438

  k1 = 0.2238

  k2 = 0.2399

  k3 = 0.2407

  k4 = 0.2407

  y(0.3000) = 2.675

  k1 = 0.2375

  k2 = 0.2544

  k3 = 0.2552

  k4 = 0.2552

  y(0.4000) = 2.927 _
```