ASSIGNMENT NO:2 **DATE:30/01/2015**

PROGRAM STATEMENT:For given set of values

x|	0	1	2	3
f(x)|	1	2	11	34

Compute the value of f(2.5) using Newton's Backward Interpolation Formula

THEORY: *Newton's Backward Interpolation Formula is,*

$$f(x)\approx p(x)=f(x_n)+u.\nabla f(x_n)+u.(u-1)\nabla^2 f(x_n)/2!+.....+u(u-1)....(u-n+1).\nabla^n f(x_n)/n!$$

Where xn is the starting point of an equispaced(of spaced h) n intervals, p(x) is the assumed a polynomial of degree less than or equal to n,f(x) is the required function,each $\nabla^r f(x_0)=-\nabla^{r-1}f(x_0-h)+\nabla^{r-1}f(x_0)$.

PROGRAM CODE:

```
//C Program to Implement Newton's Backward Method
#include <stdio.h>
int main()
{
      int n,i,j,m;
      double x,h,u,p,s;
      printf("Enter number of arguments:");
      scanf("%d",&n);
      m=n+1;
      double f[n][n+1];
      printf("Enter values of x\n");
      for(i=0;i<n;i++)
      {
            scanf("%lf",&f[i][0]);
            if(i==1)
            {
                  h=f[1][0]-f[0][0];
            }
            if((i>1)&&(f[i][0]-f[i-1][0]!=h))
            {
                  printf("%lf %lf Non-equispaced intervals. Program
Terminated\n",h,f[i][0]-f[i-1][0]);
                  return 1;
            }
      }
      printf("Enter corresponding values of y i.e f(x)\n");
      for(i=0;i<n;i++)
      {
            scanf("%lf",&f[i][1]);
      }
      for(i=1;i<n;i++)
      {
            for(j=0;j<m;j++)
            {
                  f[j][i+1]=f[j+1][i]-f[j][i];
            }
            m--;
      }
      m=n+1;
      printf("The Backward Difference Table is:\nx\tf(x)\t∇f(x)");
```

```
      for(i=2;i<n;i++)
      {
            printf("\t∇^%df(x)",i);
      }
      printf("\n--------------------");
      for(i=2;i<=n;i++)
      {
            printf("-------");
      }
      for(i=0;i<n;i++)
      {
            printf("\n");
            for(j=0;j<m;j++)
            {
                  printf("%.3lf\t",f[i][j]);
            }
            m--;
      }
      printf("\nEnter x for which you want to find the value of f(x):");
      scanf("%lf",&x);
      if(x<(f[0][0]+f[n-1][0])/2)
      {
            printf("Value of x is near the front of the table. Use
Newton's Forward formula. Program Terminated\n");
            return 2;
      }
      u=(x-f[n-1][0])/h;
      s=f[n-1][1];
      p=u;
      m=n+1;
      for(i=n-2,j=2;i>=0;i--,j++)
      {
            s=s+(p*f[i][j]);
            p=p*(u+j-1)/j;
      }
      printf("The value of f(x) for given x is %.3lf\n",s);
      return 0;
}
```

OUTPUT:

```
Enter number of arguments:4
Enter values of x
0 1 2 3
Enter corresponding values of y i.e f(x)
1 2 11 34
The Backward Difference Table is:
x     f(x)       ∇f(x)      ∇^2f(x)    ∇^3f(x)
----------------------------------------
0.000 1.000      1.000      8.000      6.000
1.000 2.000      9.000      14.000
2.000 11.000     23.000
3.000 34.000
Enter x for which you want to find the value of f(x):2.5
The value of f(x) for given x is 20.375
```