PROGRAM: 10

Name: Kiran Kanyal

Roll No: 29

Section: A1

Aim: Write a program in C language to implement Newton's Backward Interpolation method.

ALGORITHM:

START

1. Prompt the user to input the number of observations n.
2. Prompt the user to input the value of x[i] and f(x[i]) for n observations.
3. Construct a backward difference table where each is the backward difference calculated as: Δyi=f(xi)−f(xi−1)
4. Prompt the user to input the value of x for which f(x) needs to be interpolated.
5. Find the value of h and u.
    a. h = x[n-1] – x[n-2]
    b. u = (x – x[n-1]) / h, where x[n−1] is the last value of x in the table.
6. Use Newton's Backward Interpolation formula to compute the interpolated value of f(x).
7. Print the backward difference table & the interpolated value of f(x).

STOP

PROGRAM:

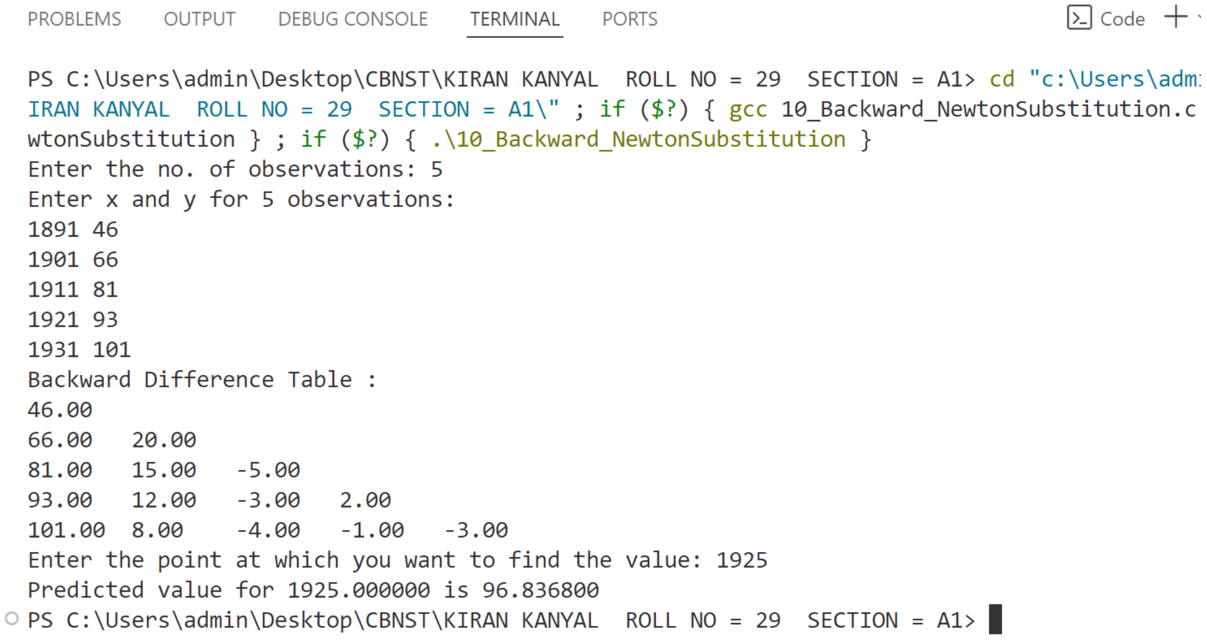
```
#include<stdio.h>

#include<math.h>

int main(){

   int n ;

   printf("Enter the no. of observations: ");

   scanf("%d",&n);

   float x[n];

   float y[n][n];

   printf("Enter x and y for %d observations: \n",n);
for (int i=0; i<n; i++){
    scanf("%f",&x[i]);
    scanf("%f",&y[i][0]);
}
for (int j=1; j<n; j++){
    for (int i=n-1; i>=j; i--){
        y[i][j] = y[i][j-1]-y[i-1][j-1];
} }
printf("Backward Difference Table : \n");
for (int i=0; i<n; i++){
    for (int j=0; j<=i; j++){
        printf("%.2f\t",y[i][j]);
    }
    printf("\n");
}
float xPredict;
printf("Enter the point at which you want to find the value: ");
scanf("%f", &xPredict);
float h = fabs(x[0]-x[1]);
float u = (xPredict-x[n-1])/h;  // x = a+hu calculating u
float predictedValue = y[n-1][0];
float fact = 1;
float uValue = 1;
for (int i=1; i<n; i++){
    fact = fact*i;
    uValue = uValue*(u+i-1);
    predictedValue += (uValue*y[n-1][i])/fact;
}
printf("Predicted value for %f is %f",xPredict,predictedValue);
return 0; }
```

OUTPUT:

1. Find f(1925) for given table :-

   x: 1891 1901 1911 1921 1931

   y: 46   66   81   93   101



```
PS C:\Users\admin\Desktop\CBNST\KIRAN KANYAL  ROLL NO = 29  SECTION = A1> cd "c:\Users\adm
IRAN KANYAL  ROLL NO = 29  SECTION = A1\" ; if ($?) { gcc 10_Backward_NewtonSubstitution.c
wtonSubstitution } ; if ($?) { .\10_Backward_NewtonSubstitution }
Enter the no. of observations: 5
Enter x and y for 5 observations:
1891 46
1901 66
1911 81
1921 93
1931 101
Backward Difference Table :
46.00
66.00   20.00
81.00   15.00   -5.00
93.00   12.00   -3.00   2.00
101.00  8.00    -4.00   -1.00   -3.00
Enter the point at which you want to find the value: 1925
Predicted value for 1925.000000 is 96.836800
PS C:\Users\admin\Desktop\CBNST\KIRAN KANYAL  ROLL NO = 29  SECTION = A1> 
```

PROGRAM: 11

Name: Kiran Kanyal

Roll No: 29

Section: A1

Aim: Write a program in C language to implement the Gauss Forward Interpolation method.

ALGORITHM:

START

```
1. Prompt the user to input the number of observations n.
2. Prompt the user to input the value of x[i] and f(x[i]) for n observations.
3. Construct a forward difference table where each entry is the forward difference
   calculated as: Δyi=f(xi+1)−f(xi)
4. Prompt the user to input the value of x for which f(x) needs to be interpolated.
5. Find the value of h and u.
      a. h = x[1] – x[0]
      b. u = (x – x[0]) / h,  where x[0] is the first value of x in the table.
6. Use Gauss's Forward Interpolation formula to compute the interpolated value of f(x).
7. Print the forward difference table & the interpolated value of f(x).
```

STOP

PROGRAM:

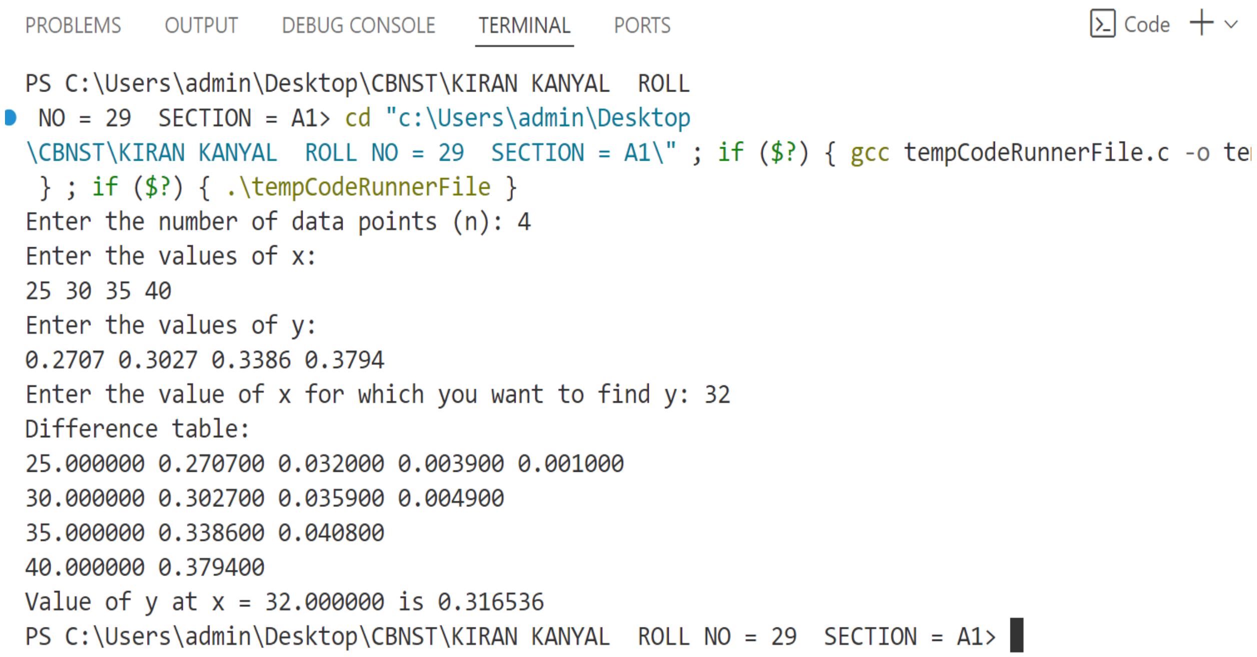
```
#include <stdio.h>

int main() {

  int n;

  float x, y;

  printf("Enter the number of data points (n): ");

  scanf("%d", &n);

  float arr[n][n + 1];

  printf("Enter the values of x:\n");
```

```
for (int i = 0; i < n; i++) {
    scanf("%f", &arr[i][0]);
}
printf("Enter the values of y:\n");
for (int i = 0; i < n; i++) {
    scanf("%f", &arr[i][1]);
}
printf("Enter the value of x for which you want to find y: ");
scanf("%f", &x);
for (int j = 2; j < n + 1; j++) {
    for (int i = 0; i < n - j + 1; i++) {
        arr[i][j] = arr[i + 1][j - 1] - arr[i][j - 1];
    }
}
printf("Difference table:\n");
for (int i = 0; i < n; i++) {
    for (int j = 0; j <= n - i; j++) {
        printf("%f ", arr[i][j]);
    }
    printf("\n");
}
float h = (arr[1][0] - arr[0][0]);
int i = 0;
while (arr[i][0] < x) {
    i++;
}
i--;
float u = (x - arr[i][0]) / h;
float m = u;
if (u < 0 || u > 0.5) {
        printf("Wrong data\n");
    } else {
        int k = 0, l = 3;
        y = m * arr[i - k][2];
        for (int j = 2; j < n + 1; j++) {
            if (j % 2 == 1) {
                m = m * ((u + k) / j);
            } else {
                k = k + 1;
                m = m * ((u - k) / j);
            }
            if ((i - k) < 0 || (i - k) > (n - j + 1)) {
                break;
            }
            y = y + m * arr[i - k][l];
            l++;
        }
    }
    y = y + arr[i][1];
    printf("Value of y at x = %f is %f\n", x, y);
    return 0;
}
```

OUTPUT:

1. Find f(32) for given table :-

x:	25	30	35	40
y:	0.2707	0.3027	0.3386	0.3794



```
PS C:\Users\admin\Desktop\CBNST\KIRAN KANYAL  ROLL
 NO = 29  SECTION = A1> cd "c:\Users\admin\Desktop
\CBNST\KIRAN KANYAL  ROLL NO = 29  SECTION = A1\" ; if ($?) { gcc tempCodeRunnerFile.c -o te
 } ; if ($?) { .\tempCodeRunnerFile }
Enter the number of data points (n): 4
Enter the values of x:
25 30 35 40
Enter the values of y:
0.2707 0.3027 0.3386 0.3794
Enter the value of x for which you want to find y: 32
Difference table:
25.000000 0.270700 0.032000 0.003900 0.001000
30.000000 0.302700 0.035900 0.004900
35.000000 0.338600 0.040800
40.000000 0.379400
Value of y at x = 32.000000 is 0.316536
PS C:\Users\admin\Desktop\CBNST\KIRAN KANYAL  ROLL NO = 29  SECTION = A1> █
```

PROGRAM: 12

Name: Kiran Kanyal

Roll No: 29

Section: A1

Aim: Write a C program to interpolate numerically using Lagrange's method.

ALGORITHM:

START

1. Prompt the user to input the number of observations n.
2. Prompt the user to input the value of x[i] and f(x[i]) for n observations.
3. Construct the Lagrange polynomial:
4. For each value of x[i], calculate the Lagrange basis polynomial $L(x)$. Then, multiply each basis polynomial Li(x) by the corresponding f(xi), and sum them up to form the Lagrange interpolation polynomial.
5. Prompt the user to input the value of x for which f(x) needs to be interpolated.
6. Use the Lagrange interpolation formula to compute the interpolated value of f(x).
7. Print the Lagrange basis polynomials and the interpolated value of f(x)

STOP

PROGRAM:

```
#include<stdio.h>

int main(){

   int n;

   printf("Enter the number of observations: ");

   scanf("%d",&n);

   float x[n];

   float y[n];

   printf("Enter x & y for %d observations: ",n);

   for (int i=0; i<n; i++){

      scanf("%f%f", &x[i], &y[i]);
```

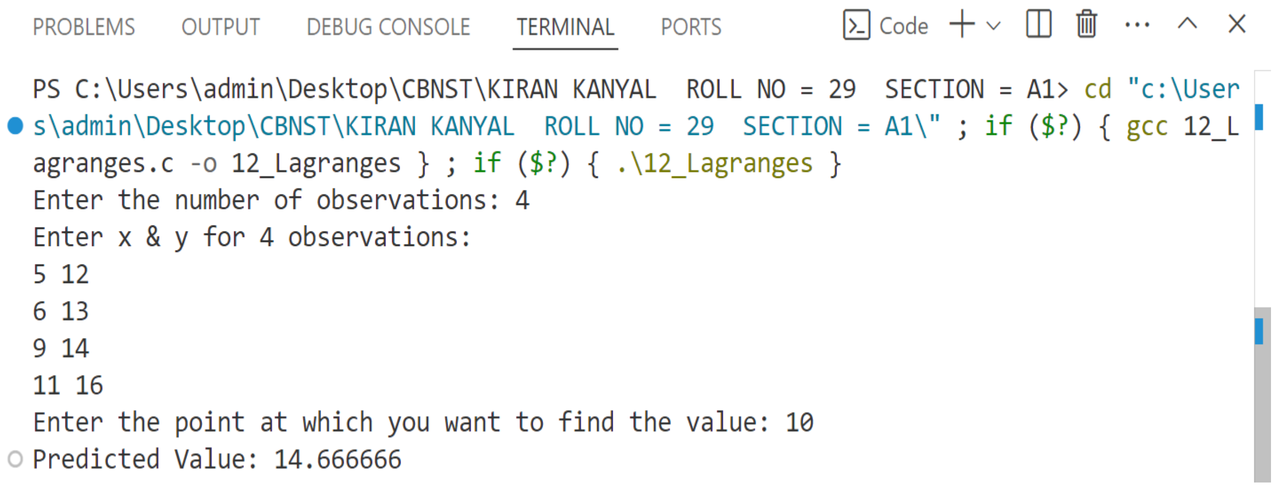
```
    }
    float xPredict;
    printf("Enter the point at which you want to find the value: ");
    scanf("%f",&xPredict);
    float res = 0;
    for (int i=0; i<n; i++){
        float numerator = 1;
        float denominator = 1;
        for (int j=0; j<n; j++){
            if (i==j) continue;
            numerator *= (xPredict-x[j]);
            denominator *= (x[i]-x[j]);
        }
        res += (numerator/denominator)*y[i];
    }
    printf("Predicted Value: %f",res);
}
```

OUTPUT:

1. Find f(10) for given table :-

   x: 5   6   9   11

   y: 12 13 14 16



```
PS C:\Users\admin\Desktop\CBNST\KIRAN KANYAL  ROLL NO = 29  SECTION = A1> cd "c:\User
s\admin\Desktop\CBNST\KIRAN KANYAL  ROLL NO = 29  SECTION = A1\" ; if ($?) { gcc 12_L
agranges.c -o 12_Lagranges } ; if ($?) { .\12_Lagranges }
Enter the number of observations: 4
Enter x & y for 4 observations:
5 12
6 13
9 14
11 16
Enter the point at which you want to find the value: 10
Predicted Value: 14.666666
```