BMS COLLEGE OF ENGINEERING

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A report on

"Newton's Backward Interpolation"

submitted in partial fulfillment of the requirements for the Activity Plan

BACHELOR OF ENGINEERING IN

INFORMATION SCIENCE AND ENGINEERING

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C E R T I F I C A T E

This is to certify that the report on “Newton's Backward Interpolation” is a bona-fide work carried out by Aditya P Adka (1BM21ME010) & Swathi Rajeev (1BM21ME100) as a part of an Activity Plan for the Course PROBLEM-SOLVING THROUGH PROGRAMMING with course code 21IS2ESPSP in Department of Mechanical Engineering from Visvesvaraya Technological University, Belgaum during the year 2021-22. It is certified that all corrections/suggestions indicated for Internal Assessments have been incorporated in the report deposited in the departmental library.

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1.Introduction

1.1 Problem Definition:

Newton Backward Interpolation is the technique of estimating the value of a function for any intermediate value of the independent variable, while the process of computing the value of the function outside the given range is called extrapolation.

1.2 Scope

NEWTON'S GREGORY BACKWARD INTERPOLATION FORMULA: **u = (x – an) / h**

This formula is used when the value of f(x) is required at the end of the table. h is known as the common difference. Here an is last term in table.

Example:Input: Population in 1925 ; Output: Value in 1925 is 96.8368.

1891	**46**
1901	**66**
1911	**81**
1921	**93**
1931	**101**

x = 1925

Solution:

The value of table for x and y

x	1891	1901	1911	1921	1931
y	46	66	81	93	101

Newton's backward difference interpolation method to find solution

x	y	∇y	$\nabla^2 y$	$\nabla^3 y$	$\nabla^4 y$
1891	46				
		20			
1901	66		-5		
		15		2	
1911	81		-3		-3
		12		-1	
1921	93		-4		
		8			
1931	101				

The value of x at you want to find the $f(x): x=1925$

$h=x_1-x_0=1901-1891=10$

$p=\frac{x-x_n}{h}=\frac{1925-1931}{10}=-0.6$

Newton's backward difference interpolation formula is

$$y(x)=y_n+p\nabla y_n+\frac{p(p+1)}{2!}\cdot\nabla^2 y_n+\frac{p(p+1)(p+2)}{3!}\cdot\nabla^3 y_n+\frac{p(p+1)(p+2)(p+3)}{4!}\cdot\nabla^4 y_n$$

$$y(1925)=101+(-0.6)\times 8+\frac{-0.6(-0.6+1)}{2}\times -4+\frac{-0.6(-0.6+1)(-0.6+2)}{6}\times -1+\frac{-0.6(-0.6+1)(-0.6+2)(-0.6+3)}{24}\times -3$$

$$y(1925)=101-4.8+0.48+0.056+0.1008$$

$$y(1925)=96.8368$$

<u>Solution of newton's backward interpolation method $y(1925)=96.836$</u>

1.3 Abstract:

This paper offers us the primary statistics of "Newton backward interpolation method" In order to lessen the numerical computations associated to the repeated utility of the prevailing interpolation components in computing a massive quantity of interpolated values, a formula has been derived from Newton's backward interpolation formula for representing the numerical facts on a pair of variables by means of a polynomial curve. application of the components to numerical records has been proven inside the case of representing the records on the total populace of India corresponding as a feature of time.

To calculate

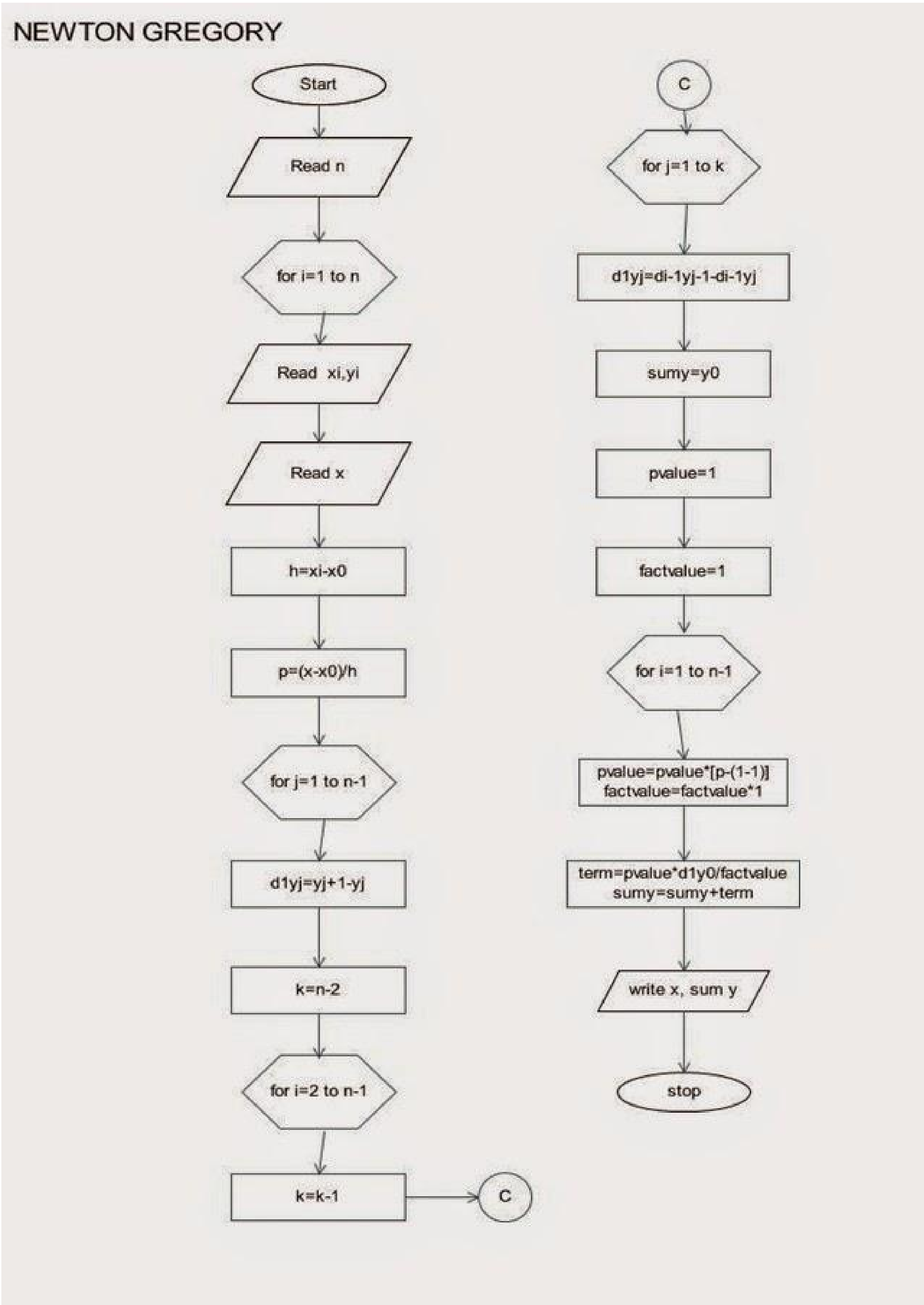
$$p = x - x_n$$

$$y(x) = y_n + p\nabla y_n + p(p+1)/2! \cdot \nabla^2 y_n + p(p+1)(p+2)/3! \cdot \nabla^3 y_n + p(p+1)(p+2)(p+3)/4! \cdot \nabla^4 y_n + .$$

2. Implementation:

Interpolation/extrapolation formulas are frequently used to derive numerical schemes for solving initial or boundary-value problems. A good example I have seen this semester in my courses is the derivation of the Adams-Bashforth scheme. They are also often used to create numerical boundary values at ghost points in those same schemes. As such, these formulas have uses all over applied mathematics and physics.The Newton's backward interpolation is one of most important numerical techniques which have huge application in **mathematics, computer science and technical science**.

3. Flowchart:


NEWTON GREGORY
Start
Read n
for i=1 to n
Read xi,yi
Read x
h=xi-x0
p=(x-x0)/h
for j=1 to n-1
d1yj=yj+1-yj
k=n-2
for i=2 to n-1
k=k-1
C
C
for j=1 to k
d1yj=di-1yj-1-di-1yj
sumy=y0
pvalue=1
factvalue=1
for i=1 to n-1
pvalue=pvalue*[p-(1-1)]
factvalue=factvalue*1
term=pvalue*d1y0/factvalue
sumy=sumy+term
write x, sum y
stop

4 .Experimental Analysis and Result:

```
#include<stdio.h>
#include<conio.h>
#include<math.h>
#include<process.h>
#include<string.h>
void main()
{
  int n;
  int i,j,k;
  float mx[10];
  float my[10];
  float x;
  float x0=0;
  float y0;
  float sum;
  float h;
  float fun;
  float p;
  float diff[20][20];
  float y1,y2,y3,y4;
  clrscr();
  printf("\n Enter the number of term -");
  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 Enter the value of y%d  -",i+1);
        scanf("%f",&my[i]);
  }

   printf("\n Enter the value of x for- -");
   printf("\n which you want the value 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\n\n Press Enter to Exit");
 getch();
 }
```

OUTPUT

```
  46
  66       20
  81       15       -5
  93       12       -3        2
 101        8       -4       -1       -3
```

Value at 1925 is 96.8368

5.Conclusion:

This algorithm can be especially useful to determine which interpolation are best for user-based applications and which one are more durable for long term storage. This program is also user Friendly, in the aspects that the user just must input different values for the values to be calculated and the program will provide the output in a few seconds which make it time efficient.Hence,this algorithm is essential regarding batteries and their various properties.