PRACTICAL 4

o **Objective:** To write a C++ program to implement Newton's Divided Difference Formula for estimating value of f(x).

o **Algorithm:**

1. Start
2. Input the number of observations.
3. Input all the values of x.
4. Input all the values of y corresponding to the given values of x.
5. Calculate the divided difference table.
6. Put the values in "Newton's Divided Difference Formula".
7. Print the calculated value.
8. Stop

o **Practical Code:**

```
#include<iostream>
using namespace std;

float proterm(int i, float value, float x[]) {
    float pro = 1;
    for (int j = 0; j < i; j++) {
        pro = pro * (value - x[j]);
    }
    return pro;
}

void dividedDiffTable(float x[], float y[][10], int n) {
    for (int i = 1; i < n; i++) {
        for (int j = 0; j < n - i; j++) {
            y[j][i] = ( y[j][i - 1] - y[j + 1][i - 1] ) / (x[j] - x[i + j] );
        }
    }
}

float applyFormula(float value, float x[], float y[][10], int n) {
    float sum = y[0][0];
    for (int i = 1; i < n; i++) {
        sum = sum + (proterm(i, value, x) * y[0][i]);
    }
    return sum;
}

int main() {
    int n;
```

```
    float k, sum, y[10][10];
    cout<<"Enter the no. of observations : ";
    cin>>n;
    float x[n];

    cout<<"Enter the different values of x\n";
    for(int i=0; i<n; i++) {
       cin >> x[i];
    }

    cout<<"Enter the corresponding values of y\n";
    for(int i=0; i<n; i++) {
       cin >> y[i][0];
    }

    cout << "Enter the value of 'k' for f(k) evaluation : ";
    cin >> k;

    dividedDiffTable(x, y, n);

    cout << "\nValue at " << k << " is "<< applyFormula(k, x, y, n) << endl;
    return 0;
}
```

- **Output:**

Enter the no. of observations : 5

Enter the different values of x
5 7 11 13 17

Enter the corresponding values of y
150 392 1452 2366 5202

Enter the value of 'k' for f(k) evaluation : 9
Value at 9 is 810

- **Application:**
   a. Used for interpolation of values and determining a polynomial using the given
       points (observations).

Q1. What is interpolation?
A1. Interpolation is a type of estimation, a method of constructing (finding) new data points based on the range of a discrete set of known data points.

Q2. What are the different types of interpolation?
A2. Equal interval interpolation and Unequal interval interpolation.

Q3. What are the methods for equal interval interpolation?
A3. Newton's (Forward and Backward) interpolation formula, Gauss (Forward and Backward) interpolation formula, Sterling formula, Bessel's formula.

Q4. What are the methods for unequal interval interpolation?
A4. Newton's divided difference formula, Lagrange's method, Hermite's formula.

Q5. Are finished differences symmetric?
A5. Yes, the finished differences are symmetric.