LAB-5

AIM OF THE EXPERIMENT :-

Formulate a MATLAB algorithm for the interpolation using **Newton's Forward-Backward interpolation** formula.

OBJECTIVES :-

1. To understand the concept of numerical interpolation.
2. To construct forward and backward difference tables in MATLAB.
3. To evaluate unknown function values using Newton's Forward and Backward formulas.
4. To compare the suitability of forward and backward interpolation methods.

PROGRAM STATEMENT :-

1. (Forward Interpolation)
x 0 1 2 3 4
f(x) 1 3 7 13 21
Use Newton's forward interpolation formula to estimate f(0.5).

```
clc ;
clear;
close all;
x = [0 1 2 3 4];
y = [1 3 7 13 21];
X = 0.5;
r = X-x(1) / x(2)- x(1);
n = length(x);
D = zeros(n,n);
D(:,1) = y';
for j = 2:n
   for i = 1: (n-j+1)
       D(i,j) = D (i+1,j-1) - D(i,j-1);
   end
end
A = y(1);
G = r;
for k=1:n-1
   A = A+G*D(1 , k+1);
   G = ((r-k)/(k+1))*G;
```

```
end
fprintf('Value of f(%.2f) = %.4f\n', X, A');
```

OUTPUT

```
Value of f(0.50) = 1.7500
```

2. x 10 20 30 40 50
f(x) 100 400 900 1600 2500
Estimate f(45) using Newton's backward interpolation.

```
clc ;
clear;
close all;
x = [10 20 30 40 50];
y = [100 400 900 1600 2500];
X = 45;
n = length(x);
r = (X-x(n))/(x(2)- x(1));
D = zeros(n,n);
D(:,1) = y';
for j = 2:n
   for i = n:-1:j
       D(i,j) = D(i,j-1) - D(i-1,j-1);
   end
end
A = y(n);
G = r;
for k=1:n-1
   A = A+G*D(n,k+1);
   G = ((r+k)/(k+1))*G;
end
fprintf('Value of f(%.2f) = %.4f\n', X, A');
```

OUTPUT

```
Value of f(45.00) = 2025.0000
```

3. x 1 2 3 4 5
f(x) 2 8 18 32 50
Find f(2.5) using Newton's forward difference method.

```
clc ;
clear;
close all;
x = [1 2 3 4 5];
y = [2 8 18 32 50];
X = 2.5;
r = X-x(1) / x(2)- x(1);
n = length(x);
D = zeros(n,n);
D(:,1) = y';
for j = 2:n
   for i = 1: (n-j+1)
       D(i,j) = D (i+1,j-1) - D(i,j-1);
   end
end
A = y(1);
G = r;
for k=1:n-1
   A = A+G*D(1 , k+1);
   G = ((r-k)/(k+1))*G;
end
fprintf('Value of f(%.2f) = %.4f\n', X, A');
```

<u>OUTPUT</u>

```
Value of f(2.50) = 8.0000
```

4. x 2 4 6 8 10
f(x) 4 16 36 64 100
Use Newton's backward interpolation to compute f(9).

```
clc ;
clear;
close all;
x = [2 4 6 8 10];
y = [4 16 36 64 100];
X = 9;
n = length(x);
r = (X-x(n))/(x(2)- x(1));
D = zeros(n,n);
D(:,1) = y';
```

```
for j = 2:n
   for i = n:-1:j
       D(i,j) = D(i,j-1) - D(i-1,j-1);
   end
end
A = y(n);
G = r;
for k=1:n-1
   A = A+G*D(n,k+1);
   G = ((r+k)/(k+1))*G;
end
fprintf('Value of f(%.2f) = %.4f\n', X, A');
```

OUTPUT

```
Value of f(9.00) = 81.0000
```

5. x 5 6 7 8 9
f(x) 150 216 294 384 486
(a) Estimate f(5.2) using an appropriate interpolation formula.
(b) Estimate f(8.8) using an appropriate interpolation formula.
(Choose the forward or backward method accordingly.)

FORWARD

```
clc ;
clear;
close all;
x = [5 6 7 8 9];
y = [150 216 294 384 486];
X = 5.2;
r = X-x(1) / x(2)- x(1);
n = length(x);
D = zeros(n,n);
D(:,1) = y';
for j = 2:n
   for i = 1: (n-j+1)
       D(i,j) = D (i+1,j-1) - D(i,j-1);
   end
end
A = y(1);
G = r;
for k=1:n-1
   A = A+G*D(1 , k+1);
```

```
    G = ((r-k)/(k+1))*G;
end
fprintf('Value of f(%.2f) = %.4f\n', X, A');
```

OUTPUT

```
Value of f(5.20) = 114.4067
```

CONCLUSION :-

Newton's Forward interpolation is suitable when the interpolation point is near the beginning of the data set, whereas Newton's Backward interpolation is suitable when the point is near the end. The method provides accurate approximation for equally spaced data points.

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