

Computational Mathematics Lab

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DATA STRUCTURES LAB

PRACTICAL RECORD

Paper Code : e
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PRACTICAL DETAILS

Experiments according to the lab syllabus prescribed by GGSIPU

Exp. No.	Experiment Name	Performance Date	Date Checked	Remarks	Marks

1 Program for finding roots of $f(x) = 0$ using Newton Raphson Method

```
#include <math.h>
#include <stdio.h>
#define EPSILON 0.0000001
#define f(x) ((352 * x * x * x) - (64 * x * x) + (198 * x) - 36)
#define f1(x) ((1056 * x * x) - (128 * x) + 198)
double newtonRaphson(double x) {
    double h = f(x) / f1(x);
    if (f(x) == 0 || fabs(h) < EPSILON)
        return x;
    return newtonRaphson(x - h);
}
int main() {
    printf("Root for f(x) = 352x^3 - 64x^2 + 198x - 36 is %lf",
        newtonRaphson(-4));
}
```

Root for $f(x) = 352x^3 - 64x^2 + 198x - 36$ is 0.181818

2 Program for finding roots of $f(x) = 0$ using bisection method

```
#include <math.h>
#include <stdio.h>
#include <stdlib.h>
#define EPSILON 0.0000001
#define f(x) ((352 * x * x * x) - (64 * x * x) + (198 * x) - 36)
double bisection(double a, double b) {
    double x;
    if (f(a) * f(b) > 0) {
        printf("The values of function at the respective initial guesses must have "
            "opposite signs");
        exit(1);
    }
    x = (a + b) / 2;
    if (f(x) == 0 || fabs(b - a) < EPSILON)
        return x;
    if (f(x) > 0)
        return bisection(x, b);
    return bisection(a, x);
}
int main() {
    printf("Root for f(x) = 352x^3 - 64x^2 + 198x - 36 is %lf",
        bisection(1.6, -4));
}
```

Root for $f(x) = 352x^3 - 64x^2 + 198x - 36$ is 0.181818

3 Program for finding roots of $f(x) = 0$ using secant method

```
#include <math.h>
#include <stdio.h>
#define EPSILON 0.0000001
#define f(x) ((352 * x * x * x) - (64 * x * x) + (198 * x) - 36)
double secant(double a, double b) {
    double x1;
    x1 = (a * f(b) - b * f(a)) / (f(b) - f(a));
    if (f(x1) == 0 || fabs(a - b) < EPSILON)
        return x1;
    return secant(b, x1);
}
int main() {
    printf("Root for f(x) = 352x^3 - 64x^2 + 198x - 36 is %lf", secant(1.6, -4));
}
```

Root for $f(x) = 352x^3 - 64x^2 + 198x - 36$ is 0.181818

4 Program to implement Lagrange Interpolation.

```
#include <stdio.h>

int main() {
    double xp, yp = 0, p;
    int i, j, n;

    printf("Number of inputs: ");
    scanf("%d", &n);

    double x[n], y[n];
    printf("Input sample space:\n");

    for (i = 0; i < n; i++) {
        printf("x%d: ", i);
        scanf("%lf", x + i);
        printf("y%d: ", i);
        scanf("%lf", y + i);
    }

    printf("Enter interpolation point x: ");
    scanf("%lf", &xp);

    for (i = 0; i < n; i++) {
        p = 1;
        for (j = 0; j < n; j++) {
            if (i != j) {
                p *= (xp - x[j]) / (x[i] - x[j]);
            }
        }
        yp += p * y[i];
    }
    printf("Interpolated value for %lf is %lf.", xp, yp);
}
```

```
Number of inputs: 4
Input sample space:
x0: 0
y0: 2
x1: 1
y1: 3
x2: 2
y2: 12
x3: 5
y3: 147
Enter interpolation point x: 3
Interpolated value for 3.000000 is 35.000000.
```

5 Program to implement Newton's Divided Difference formula.

```
#include <stdio.h>

int main() {
    int n, i, j = 1;
    double xp, yp, f1, f2 = 0;

    printf("Enter the number of inputs: ");
    scanf("%d", &n);

    double x[n], y[n];

    printf("Enter input values:\n");
    for (i = 0; i < n; i++) {
        printf("x%d=", i);
        scanf("%lf", x + i);
        printf("y%d=", i);
        scanf("%lf", y + i);
    }

    yp = y[0];

    printf("Enter interpolation point x: ");
    scanf("%lf", &xp);

    do {
        for (i = 0; i < n - 1; i++)
            y[i] = ((y[i + 1] - y[i]) / (x[i + 1] - x[i]));

        f1 = 1;

        for (i = 0; i < j; i++) {
            f1 *= (xp - x[i]);
        }

        f2 += (y[0] * f1);
        j++;
    } while ((--n) > 1);

    yp += f2;

    printf("Interpolated value for %lf is %lf.", xp, yp);
}
```

```

Enter the number of inputs: 4
Enter input values:
x0=3
y0=9
x1=5
y1=12
x2=9
y2=666
x3=15
y3=10245
Enter interpolation point x: 999
Interpolated value for 999.000000 is 9525764925.000002.

```

6 Program for solving numerical integration by trapezoidal method.

```

#include <math.h>
#include <stdio.h>

#define f(x) ((352 * x * x * x) - (64 * x * x) + (198 * x) - 36)

double trapezoidal_integral(double a, double b, double n) {
    double h = (b - a) / n;

    double s = (f(a) + f(b)) / 2;

    // Add the other heights

    for (int i = 1; i < n; i++)
        s += f(a + i * h);

    return s * h;
}

int main() {
    printf("The area under the curve f(x) = 352x^3 - 64x^2 + 198x - 36 from x=3 "
           "to x=4 is %lf",
           trapezoidal_integral(3, 4, 10000));
}

```

The area under the curve $f(x) = 352x^3 - 64x^2 + 198x - 36$ from $x=3$ to $x=4$ is 1425.444900