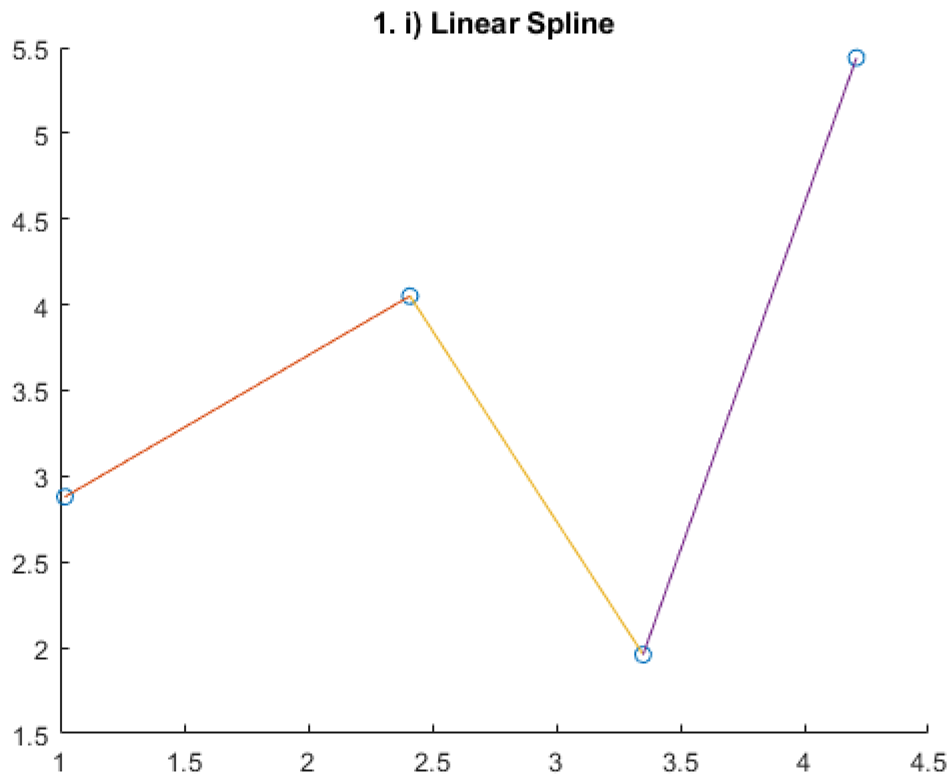
Table of Contents


```
clear;
clc;

% DATA
x_data = [1.02 2.41 3.35 4.21];
y_data = [2.88 4.05 1.96 5.44];
```

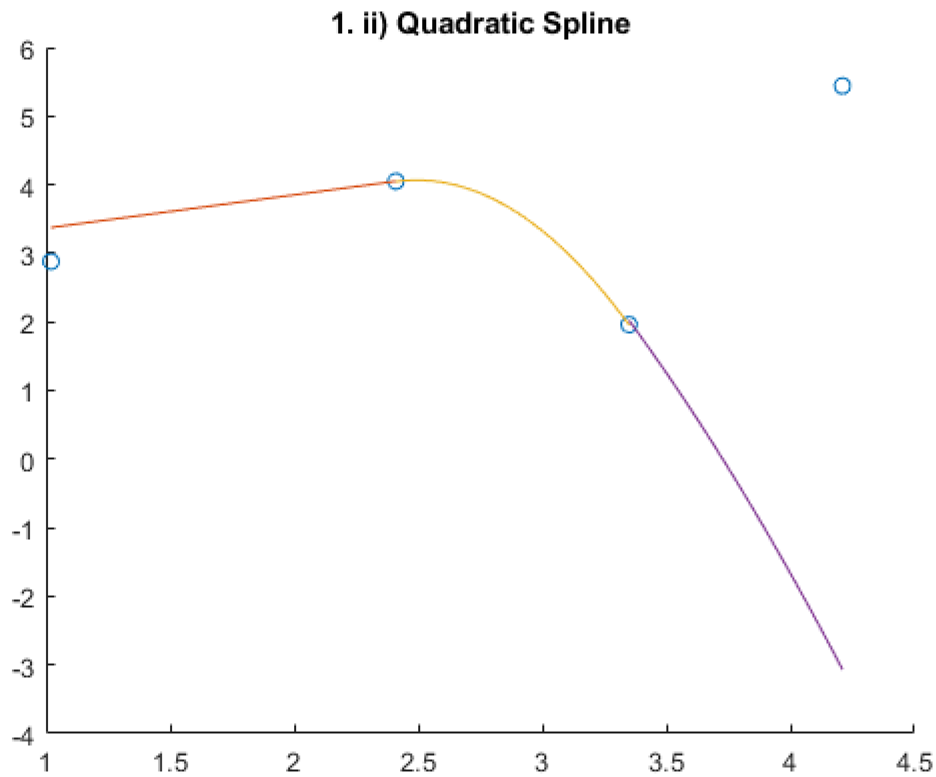
1. i)

```
figure("Name", "Linear Spline")
scatter(x_data, y_data)

hold on

x1 = 1.02 : 0.01 : 2.41;
linearSpline1 = 0.841895756 * x1 + 2.021220159;
plot(x1, linearSpline1)

x2 = 2.41 : 0.01 : 3.35;
linearSpline2 = -2.223979897 * x2 + 9.410652921;
plot(x2, linearSpline2)

x3 = 3.35 : 0.01 : 4.21;
linearSpline3 = 4.046388127 * x3 - 11.59560512;
plot(x3, linearSpline3)

title("1. i) Linear Spline")
hold off
```



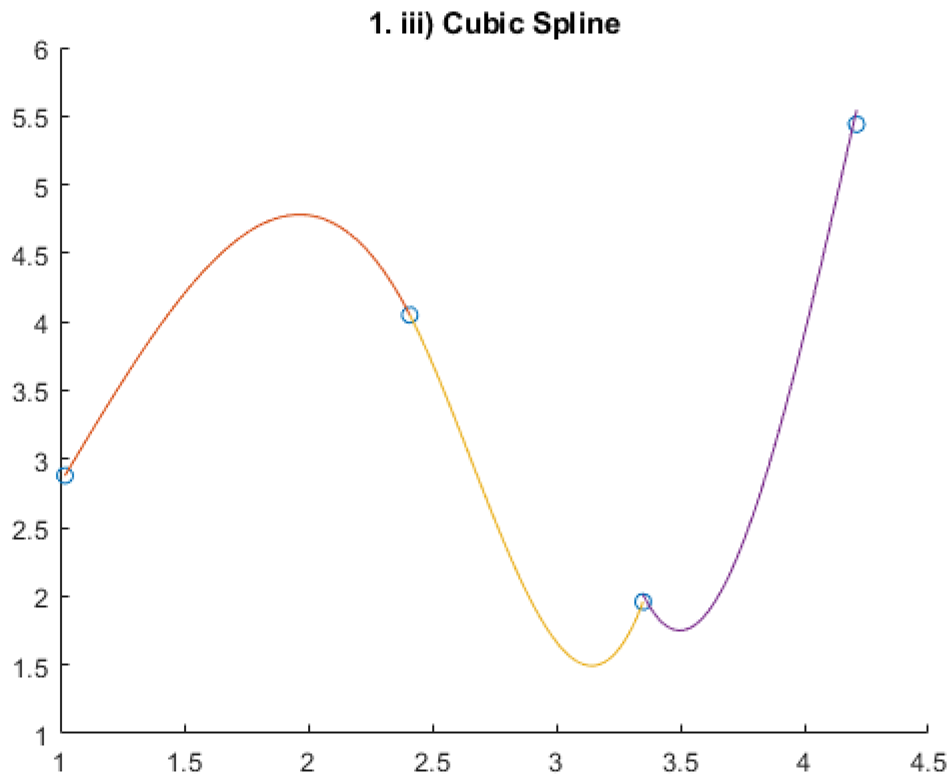
1. ii)

```
figure("Name", "Quadratic Spline")
scatter(x_data, y_data)

hold on

quadSpline1 = 0.4855 * x1 + 2.8805;
plot(x1, quadSpline1)

quadSpline2 = -2.8818 * x2.^2 + 14.3737 * x2 - 13.8577;
plot(x2, quadSpline2)

quadSpline3 = -1.1622 * x3.^2 + 2.872 * x3 + 5.44;
plot(x3, quadSpline3)

title("1. ii) Quadratic Spline")
hold off
```



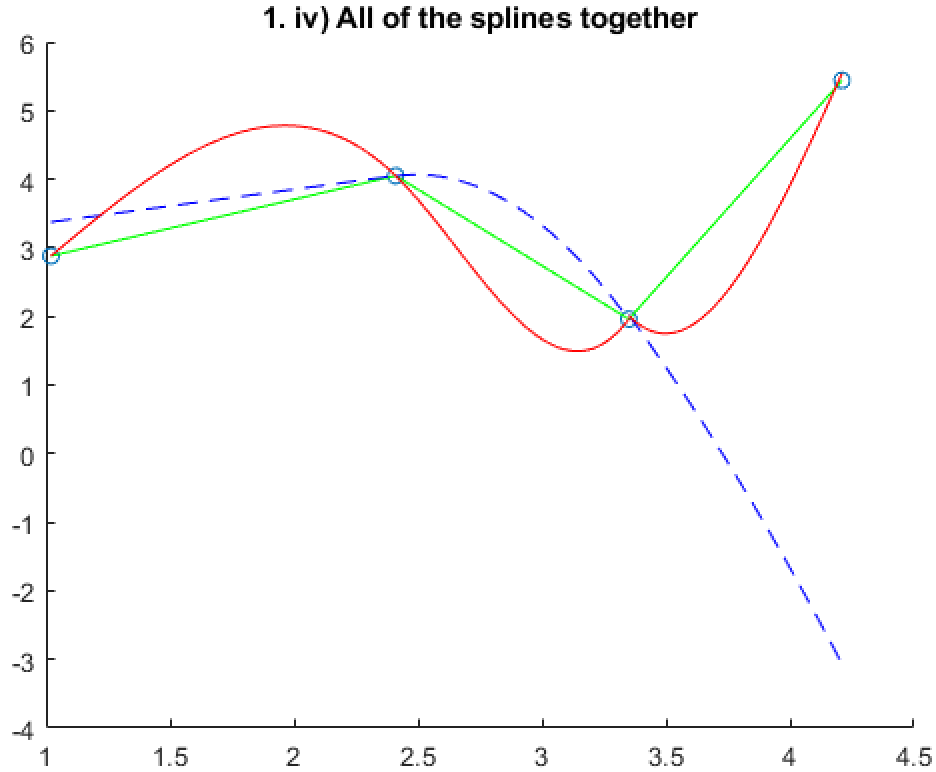
1. iii)

```
figure("Name", "Cubic Spline")
scatter(x_data, y_data)

hold on
cubicSpline1 = -1.12656 * x1.^3 + 3.44727 * x1.^2 - 0.497864 * x1 + 0.996795;
plot(x1, cubicSpline1)

cubicSpline2 = 6.45367 * x2.^3 -51.3578 * x2.^2 + 131.58354 * x2 - 105.1114;
plot(x2, cubicSpline2)

cubicSpline3 = -5.2318 * x3.^3 + 66.095 * x3.^2 - 270.343 * x3 + 362.601;
plot(x3, cubicSpline3)

title("1. iii) Cubic Spline")
hold off
```



ALL AT ONCE

```
figure("Name", "ALL AT ONCE")

scatter(x_data, y_data)

hold on

plot(x1, linearSpline1, "g", x2, linearSpline2, "g", x3,
 linearSpline3, "g", "DisplayName", "Linear Spline")
plot(x1, quadSpline1, "b--", x2, quadSpline2, "b--", x3,
 quadSpline3, "b--", "DisplayName", "Quadratic Spline")
plot(x1, cubicSpline1, "r", x2, cubicSpline2, "r", x3,
 cubicSpline3, "r", "DisplayName", "Cubic Spline")

title("1. iv) All of the splines together")

hold off
```



2. a. ii) Trapezoidal Rule

```
syms x

% Lower Limit
a = 2;

% Upper Limit
b = 6;
n = [0;0;0;0;0;0;0;0;0;0];
I_n = [0;0;0;0;0;0;0;0;0;0];
Error = [0;0;0;0;0;0;0;0;0;0];
I_exact = 435.81767401;

% Segmentation by for loop
for k = 1 : 10
    m = 2.^k;
    % Declare the function
    f1 = x.^4 * cos(x) - 2;

    % inline creates a function of string containing in f1
    f = inline(f1);

    % h is the segment size
    h = (b - a)/(m - 1);
```

```
    % X stores the summation of first and last segment
    X = f(a)+f(b);

    % variables Odd and Even to store
    % summation of odd and even
    % terms respectively
    summation = 0;
    for i = 1:m-1
        xi=a+(i*h);
        summation=summation+f(xi);
    end

    % Formula to calculate numerical integration
    % using Trapezoidal Rule
    I = (h/2)*(X+2*summation);

    I_n(k) = I;
    Error(k) = I - I_exact;
    n(k) = m;

end

disp("Table for Trapezoidal Rule")
Table = table(n, I_n, Error)
```

Table for Trapezoidal Rule

Table =

10×3 table

n	I_n	Error
2	7437	7001.1
4	2283.2	1847.3
8	1179.3	743.45
16	774.36	338.54
32	597.82	162
64	515.11	79.291
128	475.05	39.231
256	455.33	19.513
512	445.55	9.7313
1024	440.68	4.8593

2. b. ii) Simpson's 1/3 Rule

```
syms x

% Lower Limit
a = 2;
```

```
% Upper Limit
b = 6;
n = [0;0;0;0;0;0;0;0;0;0];
I_n = [0;0;0;0;0;0;0;0;0;0];
Error = [0;0;0;0;0;0;0;0;0;0];
I_exact = 435.81767401;

% Segmentation by for loop
for k = 1 : 10
    m = 2.^k;
    % Declare the function
    f1 = x.^4 * cos(x) - 2;

    % inline creates a function of string containing in f1
    f = inline(f1);

    % h is the segment size
    h = (b - a)/m;

    % X stores the summation of first and last segment
    X = f(a)+f(b);

    % variables Odd and Even to store
    % summation of odd and even
    % terms respectively
    Odd = 0;
    Even = 0;
    for i = 1:2:m-1
        xi=a+(i*h);
        Odd=Odd+f(xi);
    end
    for i = 2:2:m-2
        xi=a+(i*h);
        Even=Even+f(xi);
    end

    % Formula to calculate numerical integration
    % using Simpsons 1/3 Rule
    I = (h/3)*(X+4*Odd+2*Even);

    I_n(k) = I;
    Error(k) = I - I_exact;
    n(k) = m;

end

disp("Table for Simpson's 1/3 Rule")

Table = table(n, I_n, Error)
```

Table for Simpson's 1/3 Rule

Table =

```
  10×3 table

     n        I_n           Error    
    _____    ______    _____________

       2    370.93           -64.89
       4    422.48          -13.333
       8    435.02         -0.79773
      16    435.77        -0.049158
      32    435.81       -0.0030611
      64    435.82      -0.00019113
     128    435.82      -1.1936e-05
     256    435.82      -7.3896e-07
     512    435.82      -3.9182e-08
    1024    435.82       4.5527e-09
```

2. c. ii) Simpson's 3/8 Rule

```
syms x

% Lower Limit
a = 2;

% Upper Limit
b = 6;
n = [0;0;0;0;0;0;0;0;0;0];
I_n = [0;0;0;0;0;0;0;0;0;0];
Error = [0;0;0;0;0;0;0;0;0;0];
I_exact = 435.81767401;

% Segmentation by for loop
for k = 1 : 10
    m = 2.^k;

    % Declare the function
    f1 = x.^4 * cos(x) - 2;

    % inline creates a function of string containing in f1
    f = inline(f1);

    % h is the segment size
    h = (b - a)/m;

    % X stores the summation of first and last segment
    X = f(a)+f(b);

    % variables Odd and Even to store
    % summation of odd and even
    % terms respectively
    divisibleby3 = 0;
    nondivisibleby3 = 0;
```

```
    for i = 1:m-1
        xi=a+(i*h);
        if i / 3 == 0
            divisibleby3 = divisibleby3 + f(xi);
        else
            nondivisibleby3 = nondivisibleby3 + f(xi);
        end
    end


    % Formula to calculate numerical integration
    % using Simpsons 3/8 Rule
    I = (3*h/8)*(X + 2 * divisibleby3 + 3 * nondivisibleby3);


    I_n(k) = I;
    Error(k) = I - I_exact;
    n(k) = m;

end

disp("Table for Simpson's 3/8 Rule")

Table = table(n, I_n, Error)
```

```
Table for Simpson's 3/8 Rule

Table =

  10×3 table
```

n	I_n	Error
2	544.29	108.48
4	376.88	-58.934
8	403.44	-32.379
16	439.62	3.8062
32	463.17	27.349
64	476.28	40.466
128	483.18	47.36
256	486.71	50.891
512	488.49	52.677
1024	489.39	53.575

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