Q To develop an approximate polynomial function of $\sqrt{x}$ using interpolation of x & y values with monomial basis.

Method: Let function be $f(x) = a_0 + a_1 x + a_2 x^2 + a_3 x^3 \cdots + a_8 x^8$

$$A = \begin{bmatrix} 1 & x_1 & x_1^2 & x_1^3 & x_1^4 & x_1^5 & x_1^6 & x_1^7 & x_1^8 \\ 1 & x_2 & x_2^2 & x_2^3 & x_2^4 & x_2^5 & x_2^6 & x_2^7 & x_2^8 \\ \vdots & & & & & & & & \vdots \\ 1 & x_9 & x_9^2 & x_9^3 & x_9^4 & x_9^5 & x_9^6 & x_9^7 & x_9^8 \end{bmatrix}$$

$$Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_9 \end{bmatrix} \qquad C = \begin{bmatrix} a_0 \\ a_1 \\ a_2 \\ \vdots \\ a_8 \end{bmatrix}$$

& given $f(x_1) = y_1, f(x_2) = y_2 \cdots f(x_9) = y_9$

We need to solve

$AC = Y$ here we need to find C (coefficient matrix)

By Gauss elimination method we can calculate C vectors & using C we can get the approximate function $F(x)$

Pseudo code.

main.m

Input values of X & Y
& get coefficient vector C
using interpolation function.
$XC = Y$
& plot $f(x)$ using different values of x

↓

interpolation.m

$XC = Y$ & Crauss Elimination
return C

↓

f.m

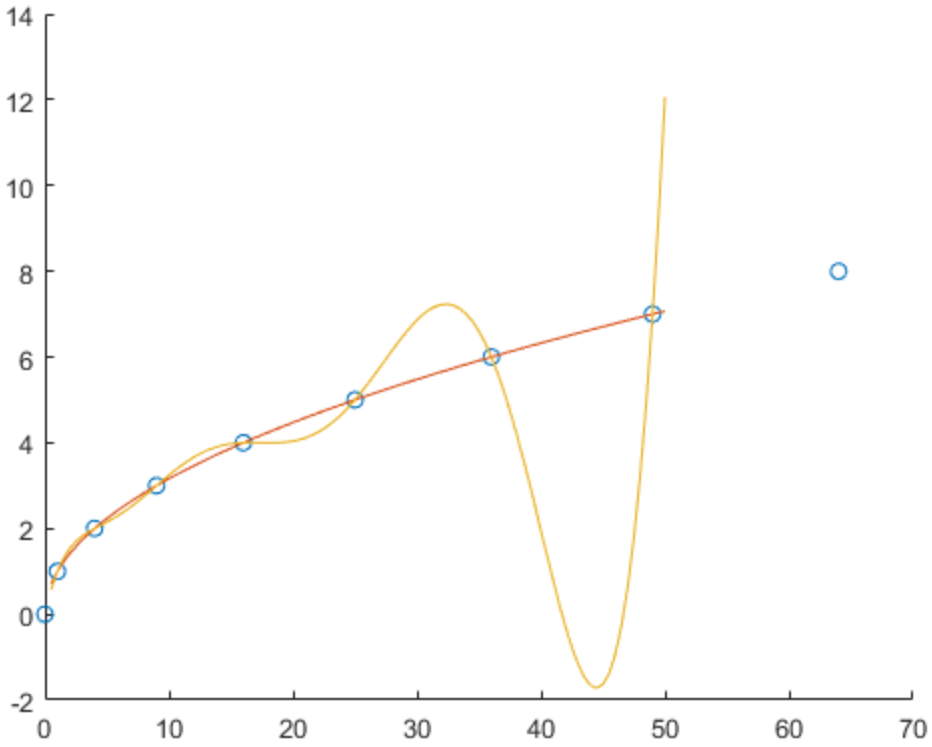
Calculate value of $f(x)$
using coefficients C.

Difference in values of f & sqrt(x) $\left(f(x) - \sqrt{x}\right)$

for x=	Difference
0.5	-0.13234
1.5	0.086065
2.5	0.11955
3.5	0.048049
4.5	-0.045981
5.5	-0.11314
6.5	-0.13268
7.5	-0.1042

```
% Obtaining coefficients by interpolation of data set X and Y with
% monomial basis

X = [0 1 4 9 16 25 36 49 64]; %Input values of X
Y = [0 1 2 3 4 5 6 7 8]; % Input values of Y
coeffs = interpolation(X,Y); %Calling of interpolation method to
 calculate coefficients

%Calculating difference of function values obtained using obtained
 function and by
%direct sqrt() method
x = 0.5:1:7.5;
for i = x
   display("Difference f(x)-sqrt(x) for x = "+i+" is "+(f(i,coeffs)-
sqrt(i))+" ");
end
%Plotting the obtained function and the sqrt function
x1 = 0.5:1:50;
x = 0.5:0.5:50;
y = zeros(1,100);
for i = x;
    y(2*i)=f(i,coeffs);
end
%plot
scatter(X,Y);
hold on;
plot(x,sqrt(x));
hold on;
plot(x,y);
```

```
No. of operations in Gauss elimination
   516

No. of operations in back-substitution
    81

    "Difference f(x)-sqrt(x) for x = 0.5 is -0.13234 "

    "Difference f(x)-sqrt(x) for x = 1.5 is 0.086065 "

    "Difference f(x)-sqrt(x) for x = 2.5 is 0.11955 "

    "Difference f(x)-sqrt(x) for x = 3.5 is 0.048049 "

    "Difference f(x)-sqrt(x) for x = 4.5 is -0.045981 "

    "Difference f(x)-sqrt(x) for x = 5.5 is -0.11314 "

    "Difference f(x)-sqrt(x) for x = 6.5 is -0.13268 "

    "Difference f(x)-sqrt(x) for x = 7.5 is -0.1042 "
```



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```
function result = interpolation(X,Y)
m =size(X);
m = m(2);
A = zeros(m,m);
%Creating a monomial basis interpolation matrix with input values of X
for i = 1:m;
    for j = 1:m;
        A(i,j) = X(i)^(j-1);% making elements of row 1 x x^2 x^3 and
 so on
    end
end
result = GEM(A,Y);%Applying gauss elimination to obtain coefficients
return
end
```

```
Not enough input arguments.

Error in interpolation (line 2)
m =size(X);
```

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```
function result = f(x,coeffs)
% calculate value of f(x) with given coefficients
n= size(coeffs);
n = n(2);
val = 0;
for i = 1:n
    val = val + coeffs(i)*x^(i-1);
end
result =val;
return
end
```

```
Not enough input arguments.

Error in f (line 3)
n= size(coeffs);
```

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