Assignment 3

Group Number 32

Software used: **Matlab**

Sanit Prashant Bhatkar (173109003)
Omkar Anil Pawar(173106001)

1. TDMA Method

Code	Output
fprintf('\n\nTDMA Method for Ax=b\n\n') **p=0;q=0;** **%Matrix size definition** **b=[40.8;0.8;0.8;200.8]** **[n,k]=size(b);** **fprintf('Size of matrix b is %d x %d\n',n,k);** **A=[2.04,-1,0,0;-1,2.04,-1,0;0,-1,2.04,-1;0,0,-1,2.04]** **[n,k]=size(A);** **fprintf('Size of matrix A is %d x %d\n',n,k);** **%Checking Matrix is TDMA or not** **for i=2:n-1** **if diag(A,i)==0 & diag(A,-i)==0** **p=1;** **else** **q=1;** **end** **end** **if q == 1** **fprintf('Matrix A is not Tridiagonal matrix and code is not applicable\n\n ');** **else** **fprintf('Matrix A is Tridiagonal matrix\n\n');** **beta(1)=A(1);** **g(1)=b(1);** **%TDMA triangular matrix solution for Lg=b form where g=UX** **for i=2:n** **alpha(i)=A(i,i-1)/beta(i-1);** **beta(i)=A(i,i)-alpha(i)*A(i-1,i);** **g(i)=b(i)-alpha(i)*g(i-1);** **end** **%Back substitution for solving g=UX** **x(n)=g(n)/beta(n);** **for i=n-1:-1:1** **x(i)=(g(i)-A(i,i+1)*x(i+1))/beta(i);** **end** **x** **end**	a) For $2.04x_1 + x_2 = 40.8$ $-x_1 + 2.04x_2 - x_3 = 0.8$ $-x_2 + 2.04x_3 - x_4 = 0.8$ $-x_3 + 2.04x_4 = 200.8$ **Output:** TDMA Method for Ax=b b = 40.8000 0.8000 0.8000 200.8000 Size of matrix b is 4 x 1 A = 2.0400 -1.0000 0 0 -1.0000 2.0400 -1.0000 0 0 -1.0000 2.0400 -1.0000 0 0 -1.0000 2.0400 Size of matrix A is 4 x 4 Matrix A is Tridiagonal matrix x = 65.9698 93.7785 124.5382 159.4795

Equation	Root
$2.04x_1 + x_2 = 40.8$ $-x_1 + 2.04x_2 - x_3 = 0.8$ $-x_2 + 2.04x_3 - x_4 = 0.8$ $-x_3 + 2.04x_4 = 200.8$	$x_1 = 65.9698$ $x_2 = 93.7785$ $x_3 = 124.5382$ $x_4 = 159.4795$

2. Gauss Seidel Method

$27x_1 + 6x_2 - x_3 = 85$
$6x_1 + 15x_2 + 2x_3 = 72$
$x_1 + x_2 + 54x_3 = 110$

Code	Output

fprintf('\n\nGauss Seidel Method for Ax=b\n\n')
%Defining matrx
b=[85;72;110]
[n,k]=size(b);
fprintf('Size of matrix b is %d x %d\n',n,k);
A=[27,6,-1;6,15,2;1,1,54]
[n,k]=size(A);
fprintf('Size of matrix A is %d x %d\n',n,k);x=zeros(n,1);
xin=zeros(n,1);
error=1;
m=0;
p=input('Error limit: ');
 	
%Checking Matrix is TDMA or not
for i=2:n-1
 	
  if diag(A,i)==0 & diag(A,-i)==0
  p=1;
  else
  q=1;
  end
end
if q == 1
  fprintf('Matrix A is not Tridiagonal matrix\n\n ');
else
  fprintf('Matrix A is Tridiagonal matrix\n\n');
end
 	
while error(1)>p
 	
  xin=x;
  m=m+1;
  %Formula for gauss-seidel
  x(1)=(b(1)-A(1,2:n)*x(2:n,1))/A(1,1);
  for i=2:n-1
  x(i)=(b(i)-A(i,1:i-1)*x(1:i-1,1)-A(i,i+1:n)*x(i+1:n,1))/A(i,i);
  end
  x(n)=(b(n)-A(n,1:n-1)*x(1:n-1,1))/A(n,n);
  for i=1:n
  error(i)=norm((x(i)-xin(i)),inf)/norm(xin(i),inf);
  end
  %Norm calculation
  error= sort(error(1:n),'descend');
end
x
fprintf('Number of iterations are %d \n\n',m);
	a) For
	$27x_1 + 6x_2 - x_3 = 85$
	$6x_1 + 15x_2 + 2x_3 = 72$
	$x_1 + x_2 + 54x_3 = 110$
	
	Output:
	
	Gauss Seidel Method for Ax=b
	
	b =
	
	85
	72
	110
	
	Size of matrix b is 3 x 1
	
	A =
	
	27 6 -1
	6 15 2
	1 1 54
	
	Size of matrix A is 3 x 3
	Error limit: 10e-12
	Matrix A is not Tridiagonal matrix
	
	x =
	
	2.4255
	3.5730
	1.9260
	
	Number of iterations are 11

Equation	Root
$27x_1 + 6x_2 - x_3 = 85$ $6x_1 + 15x_2 + 2x_3 = 72$ $x_1 + x_2 + 54x_3 = 110$	x1=2.4255 x2=3.5730 x3=1.9260

3. Gauss Seidel Method

$3.122x_1 + 0.576x_2 - 0.1565x_3 - 0.0067x_4 = 1.571$
$0.5761x_1 + 2.93x_2 + 0.1103x_3 - 0.0015x_4 = -0.9275$
$-0.5761x_1 + 0.1103x_2 + 4.127x_3 + 0.2051x_4 = -0.0625$
$-0.0067x_1 - 0.0015x_2 + 02051x_3 + 4.133x_4 = --0.0178$

Code	Output

```
fprintf('\n\nGauss Seidel Method for Ax=b\n\n')
%Defining matrx
b=[1.571;-0.9275;-0.0652;-0.0178]
[n,k]=size(b);
fprintf('Size of matrix b is %d x %d\n',n,k);
A=[3.122,0.5756,-0.1565,-0.0067;0.5756,2.93,0.1103,-
0.0015;-0.1565,0.1103,4.127,0.2051;-0.0067,-
0.0015,0.2051,4.133]
[n,k]=size(A);
fprintf('Size of matrix A is %d x %d\n',n,k);
%Size of matrix
x=zeros(n,1);
xin=zeros(n,1);
error=1;
m=0;
%Checking Matrix is TDMA or not
for i=2:n-1

   if diag(A,i)==0 & diag(A,-i)==0
      p=1;
   else
      q=1;
   end
end
if q == 1
   fprintf('Matrix A is not Tridiagonal matrix \n\n ');
else
   fprintf('Matrix A is Tridiagonal matrix\n\n');
end

itr=input('Maximum Iterations:  ');
p=input('\n\nMaximum error:  ');

while m<itr

   xin=x;
   m=m+1;
   %Formula for gauss-seidel
   x(1)=(b(1)-A(1,2:n)*x(2:n,1))/A(1,1);
   for i=2:n-1
   x(i)=(b(i)-A(i,1:i-1)*x(1:i-1,1)-A(i,i+1:n)*x(i+1:n,1))/A(i,i);
   end
   x(n)=(b(n)-A(n,1:n-1)*x(1:n-1,1))/A(n,n);
   for i=1:n
   error(i)=norm((x(i)-xin(i)),inf)/norm(xin(i),inf);
   end
```

a) For

$3.122x_1 + 0.576x_2 - 0.1565x_3 - 0.0067x_4 = 1.571$
$0.5761x_1 + 2.93x_2 + 0.1103x_3 - 0.0015x_4 = -0.9275$
$-0.5761x_1 + 0.1103x_2 + 4.127x_3 + 0.2051x_4 = -0.0625$
$-0.0067x_1 - 0.0015x_2 + 02051x_3 + 4.133x_4 = --0.0178$

Output:

```
Gauss Seidel Method for Ax=b


b =

   1.5710
  -0.9275
  -0.0652
  -0.0178

Size of matrix b is 4 x 1

A =

   3.1220   0.5756  -0.1565  -0.0067
   0.5756   2.9300   0.1103  -0.0015
  -0.1565   0.1103   4.1270   0.2051
  -0.0067  -0.0015   0.2051   4.1330

Size of matrix A is 4 x 4
Matrix A is not Tridiagonal matrix

 Maximum Iterations:  100


Maximum error:  10e-5
Iteration 1


xk =

   0.5032  -0.4154   0.0144  -0.0044


error =

   Inf   Inf   Inf   Inf
```

```
    fprintf('Iteration %d\n\n',m);
    xk=x'
    error
    %Norm calculation
    error= sort(error(1:n),'descend');
    if error(1)< p
       break
    end
end

fprintf('Number of iterations are %d \n\n',m);
```

```
Iteration 2


xk =

    0.5805   -0.4311    0.0180   -0.0044


error =

    0.1536    0.0379    0.2480    0.0132

Iteration 3


xk =

    0.5836   -0.4319    0.0181   -0.0044


error =

    0.0053    0.0017    0.0078    0.0005

Iteration 4


xk =

    0.5837   -0.4319    0.0181   -0.0044


error =

   1.0e-03 *

    0.2455    0.0773    0.3556    0.0225

Iteration 5


xk =

    0.5837   -0.4319    0.0181   -0.0044


error =

   1.0e-04 *

    0.1110    0.0351    0.1608    0.0102

Number of iterations are 5
```

Equation	Root
$3.122x_1 + 0.576x_2 - 0.1565x_3 - 0.0067x_4 = 1.571$ $0.5761x_1 + 2.93x_2 + 0.1103x_3 - 0.0015x_4 = -0.9275$ $-0.5761x_1 + 0.1103x_2 + 4.127x_3 + 0.2051x_4 = -0.0625$ $-0.0067x_1 - 0.0015x_2 + 02051x_3 + 4.133x_4 = --0.0178$	x_1=0.5837 x_2=-0.4319 x_3=0.0181 x_4=-0.0044

The Norm of X = .72633