Ex 7

Q 1

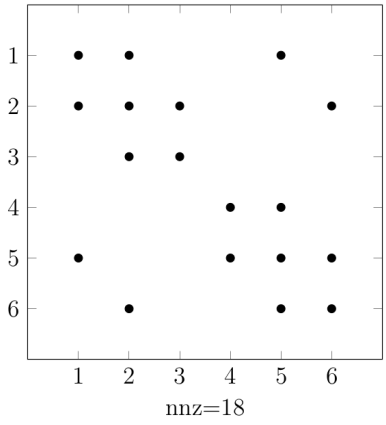
Example 4

Define the matrix A, from Example 2, in MATLAB, followed by the command spy(A), gives:

```
>> A=[1  1  0  0  1  0
      1  1  1  0  0  1
      0  1  1  0  0  0
      0  0  0  1  1  0
      1  0  0  1  1  1
      0  1  0  0  1  1]

>> spy(A)
```

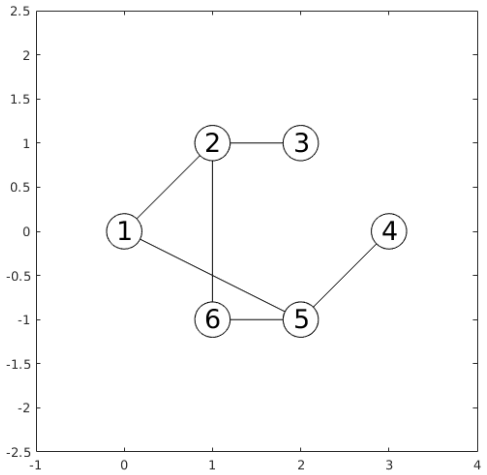
Fig 4. Sparsity pattern for matrix A



1. a)

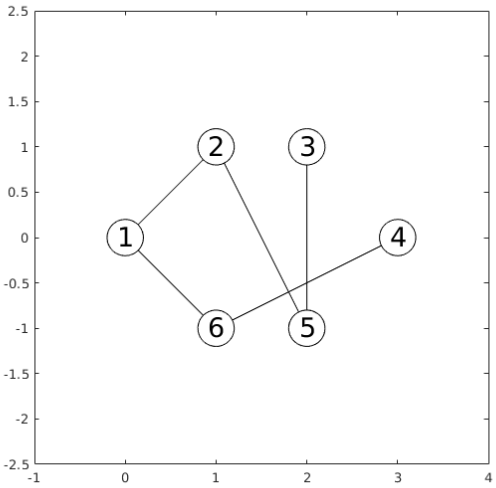
```
xy=[ 0 0;
     1 1;
     2 1;
     3 0;
     2 -1;
     1 -1]
```

```
gplot(A,xy,'k-x');
```

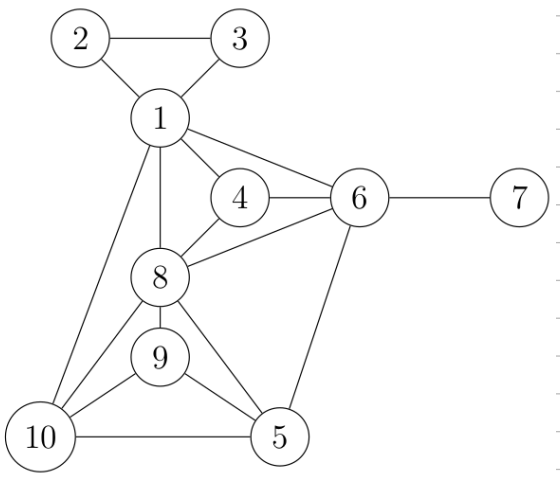


1. b

$$A = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 0 & 1 & 0 & 1 \end{bmatrix}$$



Q2



2.a) Adjacency matrix A

	1	2	3	4	5	6	7	8	9	10
1	■	■	■	■		■		■		■
2	■	■	■							
3	■	■	■							
4	■			■		■		■		
5					■	■		■	■	■
6	■			■	■	■	■	■		
7						■	■			
8	■			■	■	■		■	■	■
9					■			■	■	■
10	■				■			■	■	■

2.b $bw = \max(i,j) = 10-1 = 9$

$A_{bw} = 2 \times 9 + 1 = 9$

Matlab command 1: bandwidth(A)

Matlab command 2:
```
[I, J]=find(A)
bw=max(I-J)
```

2.c Cuthill - Mckee reorder

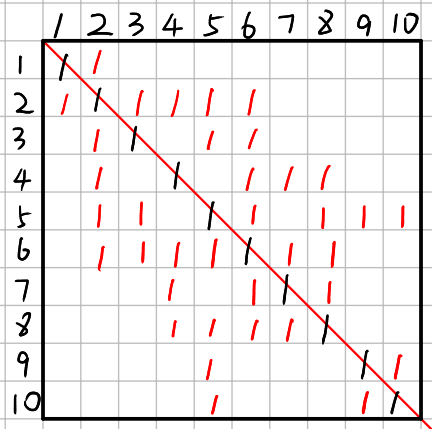
Origind nodes	No. of connections	Resulting Heads	Queue
1	6	7	6
2	2	6	4,5,1,8
3	2	4	-
4	3	5	-
5	4	1	-
6	5	8	9,10
7	1	9	-
8	6	10	-
9	3	2	3
10	4	3	-

2.d RCM reorder

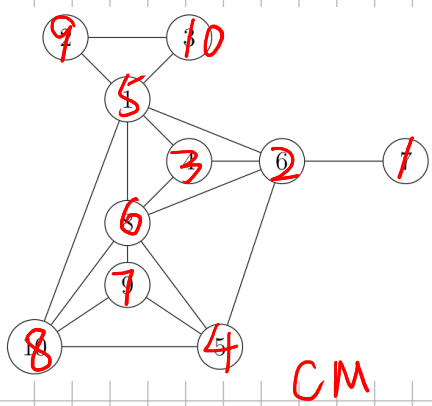
RCM	New nodes
3	1
2	2
10	3
9	4
8	5
1	6
5	7
4	8
6	9
7	10

2.b) CM reorder

B

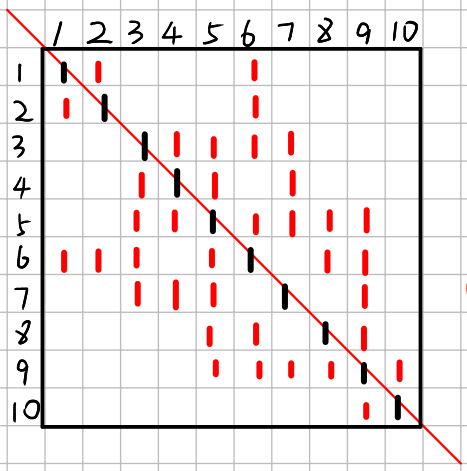


bw = 5

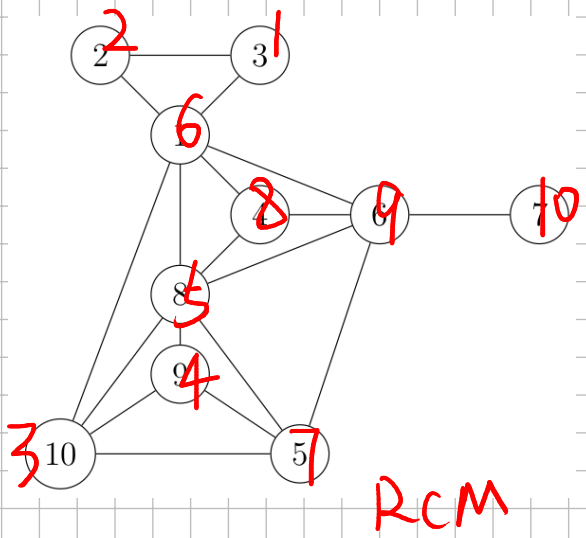


2.c) RCM reorder

C



bw = 5



2.d)

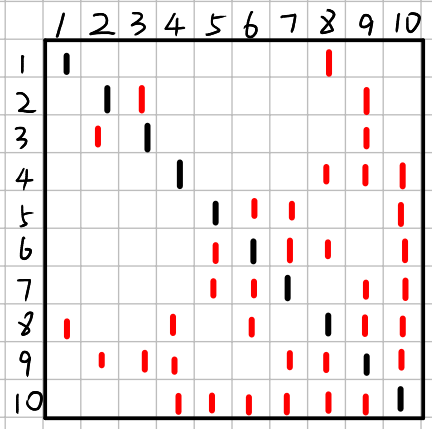
bandwidth (A) = 9	9×2+1 = 19
bandwidth (B) = 5	5×2+1 = 11
bandwidth (C) = 5	5×2+1 = 11

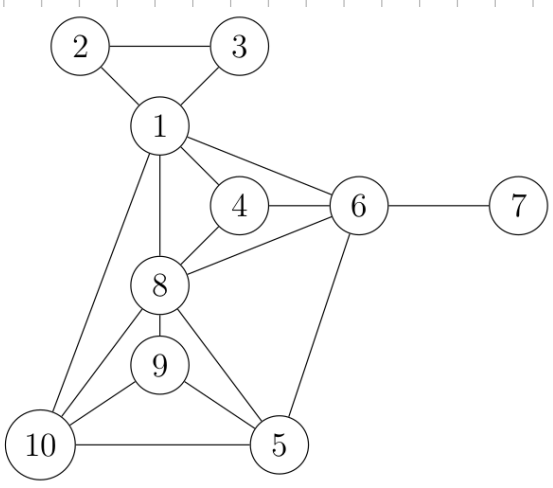
2.e) Column-Count Reordering

old node	1	2	3	4	5	6	7	8	9	10
No. of connections.	6	2	2	3	4	5	1	6	3	4
New nodes	9	2	3	4	6	8	1	10	5	7

New nodes	1	2	3	4	5	6	7	8	9	10
old nodes	7	2	3	4	9	5	10	6	1	8

Matrix D





2.f) Minimum Degree Re-ordering (ascend)

Steps	New order	1	2	3	4	5	6	7	8	9	10
		6	2	2	3	4	5	1	6	3	4
1	7	6	2	2	3	4	4	x	6	3	4
2	2	5	x	1	3	4	4	x	6	3	4
3	3	4	x	x	3	4	4	x	6	3	4
4	4	3	x	x	x	4	3	x	5	3	4
5	1	x	x	x	x	4	2	x	4	3	3
6	6	x	x	x	x	3	x	x	3	3	3
7	5	x	x	x	x	x	x	x	2	2	2
8	8	x	x	✓	x	x	x	x	x	1	1
9	9	x	x	x	x	x	x	x	x	x	1
10	10	x	x	x	x	x	x	x	x	x	x