

ASE 211 Homework 3

Due: 12:00 noon, Friday, September 22. Put assignments in the drawer on the third floor of WRW marked 'ASE 211.'

1. By hand, use Gaussian elimination to find the solution of the problem:

$$A\mathbf{x} = \begin{bmatrix} 3 & 2 & -1 \\ 6 & 1 & 0 \\ -3 & 6 & 4 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 9 \\ 11 \end{bmatrix} = \mathbf{b}.$$

Step 1: multiply row 1 by 6/3 and subtract row 2 from row 1 to get:

$$3x_2 - 2x_3 = 11$$

Step 2: multiply row 1 by 3/-3 and subtract row 3 from row 1 to get:

$$-8x_2 - 3x_3 = -21$$

Step 3: multiply row 2 by -8/3 and subtract row 2 from row 3 to get:

$$25/3x_3 = -88/3 + 21 = -25/3.$$

Then $x_3 = -1$. By back substitution, $x_2 = 3$ and $x_1 = 1$.

Check:

$$\begin{bmatrix} 3 & 2 & -1 \\ 6 & 1 & 0 \\ -3 & 6 & 4 \end{bmatrix} \begin{bmatrix} 1 \\ 3 \\ -1 \end{bmatrix} = \begin{bmatrix} 10 \\ 9 \\ 11 \end{bmatrix}.$$

2. Solve the problem above using Matlab. Enter the matrix A and the column vector \mathbf{b} , and use the command

`A\b`

to solve for \mathbf{x} .

```
>> A=[3 2 -1;6 1 0; -3 6 4]
```

A =

```
3    2    -1
6    1     0
```

-3 6 4

```
>> b=[10; 9; 11]
```

b =

```
10
 9
11
```

```
>> x=A\b
```

x =

```
1.0000
3.0000
-1.0000
```

```
>> diary
```

3. Solve problem A3.4 in the book using Matlab.

```
>> d=sqrt(2)/2
```

d =

```
0.7071
```

```
>> A=[1 0 0 0 d 0;0 1 0 1 d 0;0 0 1 0 0 d;0 0 0 -1 0 -d;0 0 0 0 -d -d;0 0 0 0 -d d]
```

A =

```
1.0000    0    0    0    0.7071    0
    0    1.0000    0    1.0000    0.7071    0
    0    0    1.0000    0    0    0.7071
    0    0    0   -1.0000    0   -0.7071
    0    0    0    0   -0.7071   -0.7071
    0    0    0    0   -0.7071    0.7071
```

```
>> b=[0; 0; 0; 0; 100; 0]
```

```
b =
```

```
    0
    0
    0
    0
   100
    0
```

```
>> x=A\b
```

```
x =
```

```
 50.0000
  0.0000
 50.0000
 50.0000
-70.7107
-70.7107
```

```
>> diary
```

Thus $V_1 = 50$, $H_1 = 0$, $V_2 = 50$, $F_{12} = 50$, $F_{13} = -70.7107$ and $F_{23} = -70.7107$ in whatever units W_3 is given in.

4. Suppose we change the matrix A in problem 1 as follows:

$$A = \begin{bmatrix} 3 & 2 & -1 \\ 6 & 1 & 0 \\ -3 & 1 & -1 \end{bmatrix}.$$

By hand, attempt to solve the system in problem 1 with this matrix. What happens?

Step 1: multiply row 1 by $6/3$ and subtract row 2 from row 1 to get:

$$3x_2 - 2x_3 = 11$$

Step 2: multiply row 1 by $3/-3$ and subtract row 3 from row 1 to get:

$$-3x_2 + 2x_3 = -21$$

Now equations 2 and 3 contradict each other. Therefore the solution to this problem does not exist.