MA1710: Key points in week 5 Matlab session

Creating matrices with [and]

In mathematical notation consider the following.

$$A = \begin{pmatrix} 2 & -3 & 1 \\ 3 & 4 & -5 \\ 5 & -1 & -3 \end{pmatrix}, \quad \underline{b} = \begin{pmatrix} 0 \\ 2 \\ 1 \end{pmatrix}, \quad C = \begin{pmatrix} 2 & -3 & 1 & 0 \\ 3 & 4 & -5 & 2 \\ 5 & -1 & -3 & 1 \end{pmatrix},$$

In Matlab these can be created with the following statements.

```
A = [2 -3 1; 3 4 -5; 5 -1 -3]
b = [0; 2; 1]
C = [A, b]
```

Referring to entries and blocks of entries

$$C = \begin{pmatrix} 2 & -3 & 1 & 0 \\ 3 & 4 & -5 & 2 \\ 5 & -1 & -3 & 1 \end{pmatrix},$$

In the Matlab version you can have the following.

```
v = C(3, 2)          % 3,2 entry

y = C(2, :)          % 2nd row

z = C(:, 3)          % 3rd column
```

Creating a column of all the entries

$$C = \begin{pmatrix} 2 & -3 & 1 & 0 \\ 3 & 4 & -5 & 2 \\ 5 & -1 & -3 & 1 \end{pmatrix},$$

Consider the following statements.

```
y = C(2, :)
y = y(:)
```

The second statement creates a column vector of all the entries.

Basic operations including the matrix product

We can multiply matrices by scalars, we can add them and the operator * means matrix multiplication. As examples you can do the following.

```
A = [2 -3 1; 3 4 -5; 5 -1 -3]
```

```
B = 5+2*A
```

```
x = [1; 1; 1]
```

```
z = A*x
```

The matrix product continued

In the following we create A and B and we create the matrix products AB and BA.

```
A = [2 -3 1; 3 4 -5; 5 -1 -3]
```

```
B = 5+2*A
```

```
AB = A*B
```

```
BA = B*A
```

Solving linear equations using \

When A is a $n \times n$ matrix and $\underline{b}$ is a $n \times 1$ matrix we often wish to attempt to solve the linear equations

$$A\underline{x} = \underline{b}.$$

In Matlab this can be done with the following statement.

```
x = A\b
```

The functions `zeros`, `ones` and `eye`

The following Matlab statements

```
Z = zeros(3, 5)
O = ones(3)
I3 = eye(3)
```

create the following output.

```
Z =
     0     0     0     0     0
     0     0     0     0     0
     0     0     0     0     0
O =
     1     1     1
     1     1     1
     1     1     1
I3 =
     1     0     0
     0     1     0
     0     0     1
```

The functions `inv` and `rref`

In your linear algebra lectures you learn about the matrix inverse and the reduced row echelon form. Matlab has functions for these which can be used as follows.

```
C = [2 -3 1 -1;  3 4 -5 -4;  5 -1 -3 -6];
A3 = C(:, 1:3)
A3I = inv(A3)
rC = rref(C)
```

```
A3 =
     2    -3     1
     3     4    -5
     5    -1    -3
A3I =
    1.8889    1.1111   -1.2222
    1.7778    1.2222   -1.4444
    2.5556    1.4444   -1.8889
rC =
     1     0     0     1
     0     1     0     2
     0     0     1     3
```