Maple Tutorial Part 2: Linear Algebra with Maple

At the beginning of each worksheet, it is best to restart Maple:

```
> restart;
```

Then, you should load Linear Algebra package using the following command:

```
> with(LinearAlgebra):
```

To define a matrix, type

```
> A:=Matrix([[1,2,3],[3,4,5],[6,7,8]]);
```

$$A := \begin{bmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 6 & 7 & 8 \end{bmatrix}$$

```
> B:=Matrix([[1.2,3.4,7.5],[1.8,4.9,6.3]]);
```

$$B := \begin{bmatrix} 1.2 & 3.4 & 7.5 \\ 1.8 & 4.9 & 6.3 \end{bmatrix}$$

To define a vector, type

```
> v:=Vector([1,2,3]);
```

$$v := \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

```
> u:=Vector([4,5,8]);
```

$$u := \begin{bmatrix} 4 \\ 5 \\ 8 \end{bmatrix}$$

You can transpose a matrix

```
> Transpose(A);
```

$$\begin{bmatrix} 1 & 3 & 6 \\ 2 & 4 & 7 \\ 3 & 5 & 8 \end{bmatrix}$$

Maple allows you to extract, for example, the second colum of the matrix B:

```
> Column(A,2);
```

$$\begin{bmatrix} 2 \\ 4 \\ 7 \end{bmatrix}$$

You can also extract rows

```
> Row(A,1);
```

$$[1, 2, 3]$$

You can construct a linear combination of vectors. For example w=3u-2v would be defined by

```
> w:=3*u-2*v;
```

$$w := \begin{bmatrix} 10 \\ 11 \\ 18 \end{bmatrix}$$

Matrix-vector product is constructed by using "dot" operator:

```
> C:=A.v;
```

$$C := \begin{bmatrix} 14 \\ 26 \\ 44 \end{bmatrix}$$

Please note that Maple refuses to compute vA, as expected:

```
> v.A;
```

```
Error, (in LinearAlgebra:-Multiply) LinearAlgebra:-VectorMatrixMultiply expects
its 1st argument, v, to be of type Vector[row], but received Vector[column](3,
[...], datatype = anything, storage = rectangular, order = Fortran_order, shape =
[])
```

Maple is a powerful tool for solving linear systems. The **LinearSolve** function returns the vector **x** that satisfies the linear system **A . x** = **b**. For example,
in order to solve the system
2x-y=18
x+3y=2
define

```
> A :=Matrix([[2,-1],[1,3]]);
```

$$A := \begin{bmatrix} 2 & -1 \\ 1 & 3 \end{bmatrix}$$

```
> b:=Vector([18,2]);
```

$$b := \begin{bmatrix} 18 \\ 2 \end{bmatrix}$$

```
> LinearSolve(A,b);
```

$$\begin{bmatrix} 8 \\ -2 \end{bmatrix}$$

Which, of course, means that $x = 8$, $y = -2$.

You can also define coefficient matrix

```
> S:=Matrix([[2,-1,18],[1,3,2]]);
```

$$S := \begin{bmatrix} 2 & -1 & 18 \\ 1 & 3 & 2 \end{bmatrix}$$

and then obtain reduced row-echelon form (the command below uses older linear algebra package, hence the strange syntax):

```
> linalg[rref](S);
```

$$\begin{bmatrix} 1 & 0 & 8 \\ 0 & 1 & -2 \end{bmatrix}$$

To check the rank of a matrix, type

```
> Rank(S);
```

$$2$$

Commands described above, together with those described in Maple Tutorial part 1, are the only commands needed to work on Assignment 1 problems requirinng Maple.