

## Matlab/Freemat: Polynomials

A polynomial can be defined in Matlab/Freemat as a set of coefficients. In this document polynomial multiplication and division in Matlab/Freemat is considered. Zeros (or roots) of polynomials can also be found directly in Matlab/Freemat.

### Definition of Polynomials

In Matlab/Freemat polynomials are defined as arrays of coefficients. For example the polynomial  $2x^3 - 3x^2 + x - 5$  can be defined as an array in Matlab/Freemat as follows:

```
--> poly=[2 -3 1 -5]
poly =
2 -3 1 -5
-->
```

### Polynomial multiplication: conv

The product  $(2x^3 - 3x^2 + x - 5)(x^2 - 2x + 3)$  can be found using the following Matlab/Freemat code.

```
--> poly=[2 -3 1 -5]
poly =
2 -3 1 -5
--> poly2=[1 -2 3]
poly2 =
1 -2 3
--> conv(poly,poly2)
ans =
2 -7 13 -16 13 -15
```

The answer can be interpreted as  $2x^5 - 7x^4 + 13x^3 - 16x^2 + 13x - 15$ .

[A polynomial can be divided by another polynomial in Matlab (but not Freemat) by the deconv command.]

## Zeros or Roots of Polynomials

The zeros or roots of the polynomial can be found by the command roots().

Eg for the polynomial  $x^2 - 1$

```
--> poly=[1,0,-1]
poly =
1 0 -1
--> roots(poly)
ans =
-1
1
```

Eg for the polynomial  $x^2 + 1$ , with complex<sup>1</sup> zeros,

```
--> poly=[1,0,1]
poly =
1 0 1
--> roots(poly)
ans =
0.0000 + 1.0000i
0.0000 - 1.0000i
```

Eg for the polynomial  $x^6 + 2x^5 + 3x^4 + 4x^3 + 5x^2 + 6x + 7$

```
poly=[1 2 3 4 5 6 7]
poly =
1 2 3 4 5 6 7
--> roots(poly)
ans =
-1.3079 + 0.5933i
-1.3079 - 0.5933i
0.7104 + 1.1068i
0.7104 - 1.1068i
-0.4025 + 1.3417i
-0.4025 - 1.3417i
```

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<sup>1</sup> [Complex Numbers](#)

## Plotting zeros

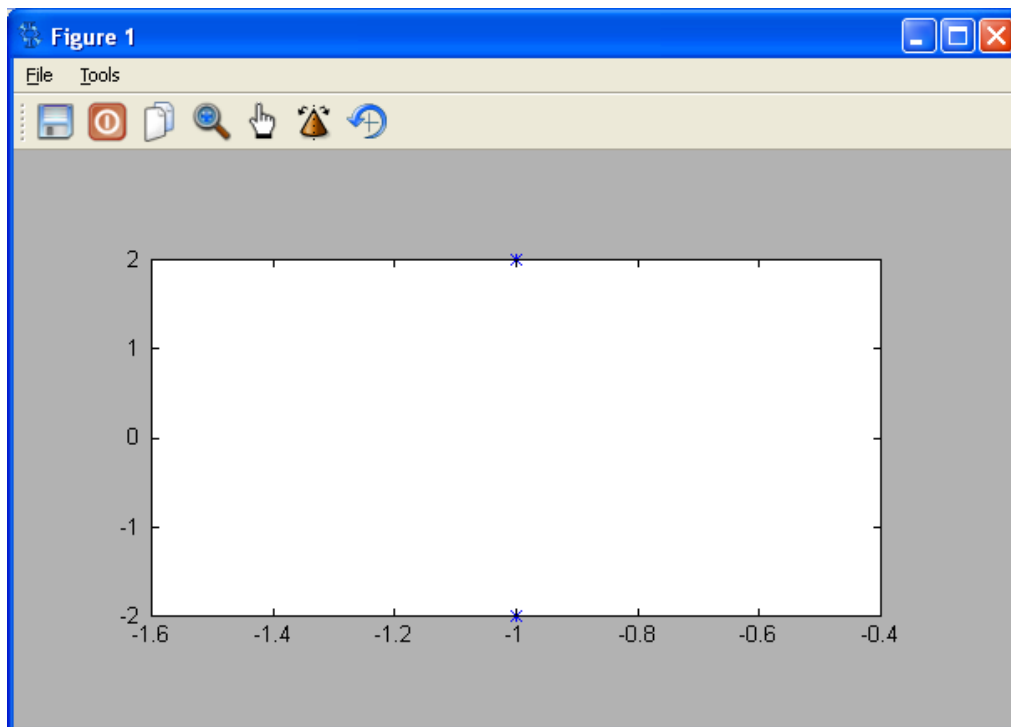
The zeros can be plotted on an Argand Diagram. For example for the quadratic<sup>2</sup>  
 $x^2 + 2x + 5$ .

```
--> poly=[1 2 5]
poly =
1 2 5
--> r=roots(poly)
r =
-1.0000 + 2.0000i

-1.0000 - 2.0000i
--> x=real(r)
x =
-1

-1
--> y=imag(r)
y =
2

-2
--> plot(x,y,'*')
```



<sup>2</sup> [Solution of Quadratic Equations](#)