Modelling and control summaries

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USE OF MATLAB 2b –polynomials

OVERVIEW: These notes gives a very narrow view of MATLAB and how to do a limited number of things. In general students need to become effective independent learners of MATLAB.

MATLAB NOTATION: This note demonstrates how MATLAB deals with polynomials in an efficient manner. The implied notation is used in many MATLAB functions.

KEY POINT: A polynomial is defined by its coefficients and therefore only the coefficients are needed to full describe an implied polynomial.

EXAMPLE 1 : This section demonstrates the role of coefficients in defining a polynomial.

$a(x) = 2x^4 + x^2 - 6x + 5$ 4^{th} order so has 5 coefficients.	2 coefficient of x^4. 0 coefficient of x^3. 1 coefficient of x^2. -6 coefficient of x. 5 coefficient of x^0.
The same coefficients can be stored in a MATLAB vector array with 5 values as follows:	`a=[2 0 1 -6 5]` Coefficient for highest power Coefficient for lowest power

EXAMPLE 2:

$$f(x) = 3x^5 + 2x^4 + 0x^3 + 5x^2 + 8x + 9$$

$$f(x) = a(1)x^5 + a(2)x^4 + a(3)x^3 + a(4)x^2 + a(5)x + a(6)$$

The same coefficients can be stored in a MATLAB vector array 'a' with 6 values as this is 5^{th} order.	a=[3,2,0,5,8,9] Ordering is always with maximum power coefficient is in position 1.

EXAMPLE 3: What polynomial is represented by the following array G=[2 0 3 0 -1 0 0] ?

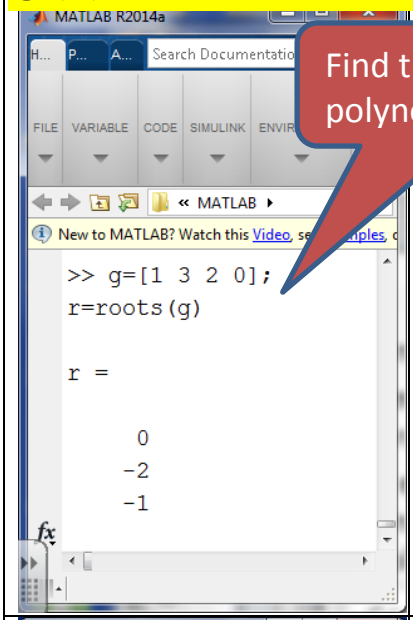
The array has 7 coefficients and therefore represents a 6^{th} order polynomial. The first coefficient is G(1)=2 is the coefficient of the maximum power, that is x^6.	$g(x) = 2x^6 + 3x^4 - x^2$

REMARK: The vector array can either be a column or a row vector, MATLAB will not distinguish.

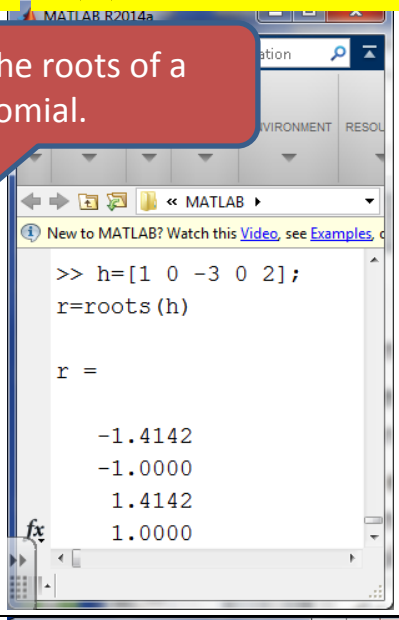
A vector is only interpreted as representing a polynomial when it is used in a function that is written to assume this. In other cases a vector is just a vector.

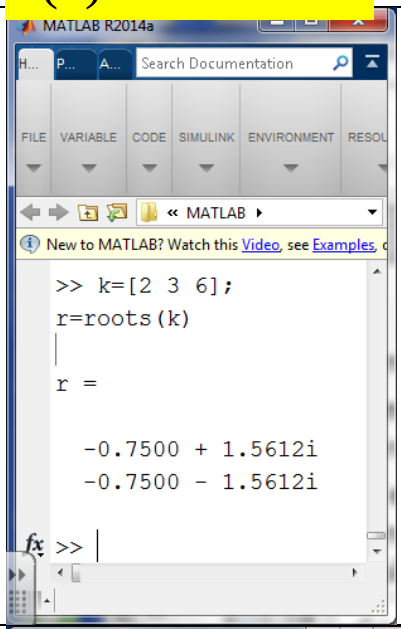
EXAMPLES OF MATLAB CODE WHICH TAKE ADVANTAGE OF A POLYNOMIAL BEING REPRESENTED BY ITS COEFFICIENTS STORED IN A VECTOR.

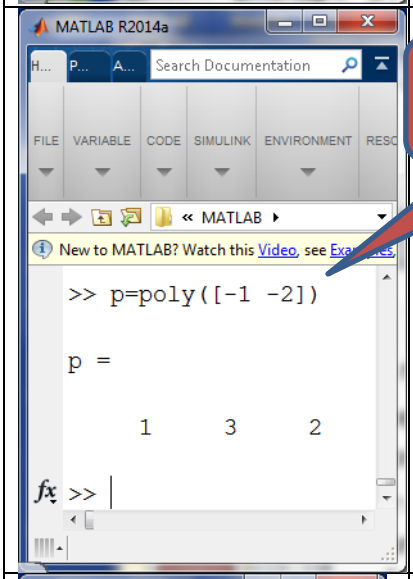
$g(x) = x^3 + 3x^2 + 2x$ $h(x) = x^4 - 3x^2 + 2$ $k(x) = 2x^2 + 3 + 6$



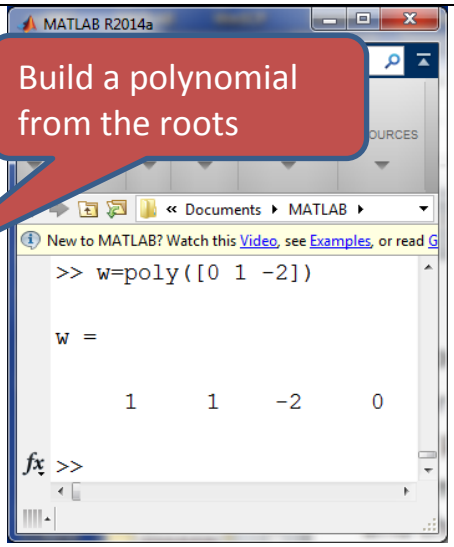
Find the roots of a polynomial.

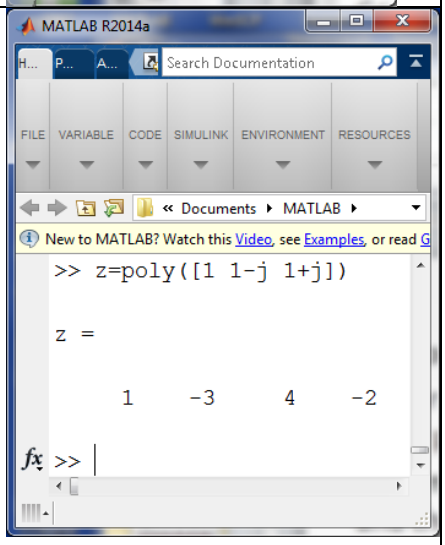


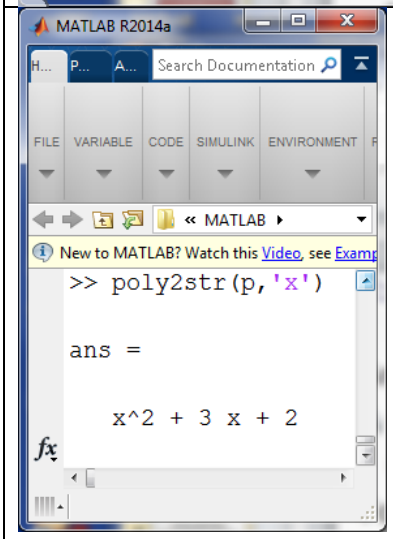


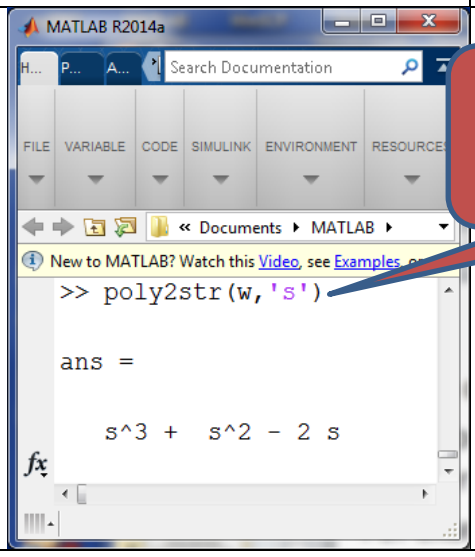


Build a polynomial from the roots









Build a string to represent a polynomial for use in labels and titles.