# ECE 257 - LESSON 26
# OFF THE SHELF MATLAB PROGRAMS

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## IN CLASS

The emphasis in this class has been on writing our own Matlab programs. This has been great but it doesn't really make sense to spend a lot of time writing programs that are already available for free or at "low cost". Many such programs are available in Matlab "Toolboxes" as well as online. Our main goal in this Lesson is to illustrate some readily available Matlab programs.

ROOTS OF POLYNOMIALS

1. First order polynomial

```
>>  coeff = [1  1];
>>  roots(coeff)
```

   a. Verify that the root is the solution of $x + 1 = 0$

2. Higher order polynomial

```
>>  coeff = [1  -7  40  -34];
>>  roots(coeff)
```

   a. Verify that the roots are the solutions of $x^3 - 7x^2 + 40x - 34 = 0$

POLYNOMIAL EQUATIONS FROM THEIR ROOTS

3. First order polynomial

```
>>  roots = [-1];
>>  poly(roots)
```

   a. Verify that the result is for the polynomial $x + 1$ with root $r = -1$

4. Higher order polynomial

```
>>  roots = [1+j  1-j];
>>  poly(roots)
```

   a. Verify that the result is for the polynomial $x^2 - 2x + 2$ with roots 1+j and 1–j

CURVE FITTING

5. Finding $m$ and $b$ of a least squares line $y = mx + b$ through a set of data points

```
>>  x = 0: 0.5: 10;
>>  y = 2*x + 3;
>>  polyfit (x, y, 1)
```

   a. Verify that polyfit gives the coefficients of the line $y = 2x + 3$ going through the "data"
   b. What do we mean when we say a curve is a least squares fit of the data

6. Finding $a$ and $m$ of a least squares exponential $y = a(10)^{mx}$ through a set of data points. We first transform the exponential data into linear form by taking logs of both sides as follows

$$y = a(10)^{mx} \qquad \log_{10}(y) = mx + \log_{10}(a)$$

We then have a linear equation of the form

$$w = mx + b$$

with $w = \log_{10}(y)$ and $b = \log_{10}(a)$

```
>>  x = 0: 0.1: 3;
>>  y =3*(10).^(-2*x);
>>  w = log10 (y);
>>  coeff = polyfit (x, w, 1);
>>  m = coeff(1)
>>  a = 10^coeff(2)
```

a. Verify that polyfit gives the parameters of $y = 3 \times 10^{-2x}$

ZEROS OF MORE GENERAL FUNCTIONS

7. The following code illustrates how *fzero* can be used to find the zeros of a more general function like

$$y = \frac{1.5}{(x-1)^2 + 0.5} - 2$$

We first write a function for $y$ and then call it when we use *fzero*

```
function  y = bump (x)
y = 1.5./((x-1).^2 + 0.5) -2;
end

% code to find the roots of the function y
x = linspace (0, 3, 301);
y = bump (x);
plot (x, y)  % we do this plot so we can estimate where the zeros are located
z1 = fzero ('bump', 0.5)
bump (z1)
z2 = fzero ('bump', 1.5)
bump (z2)

% Finding a zero in an interval
z3 = fzero ('bump', [0 1] )
z4 = fzero ('bump', [1 2])
z5 = fzero ('bump', [2 3])
```

a. Describe how to use *fzero*
b. Is it possible for *fzero* to say it can't find a zero in an interval when there really is one