MATLAB - POLYNOMIALS

http://www.tutorialspoint.com/matlab/matlab_polynomials.htm

MATLAB represents polynomials as row vectors containing coefficients ordered by descending powers. For example, the equation $P_x = x^4 + 7x^3 - 5x + 9$ could be represented as −

p = [1 7 0 -5 9];

Evaluating Polynomials

The **polyval** function is used for evaluating a polynomial at a specified value. For example, to evaluate our previous polynomial **p**, at x = 4, type −

```
p = [1 7 0  -5 9];
polyval(p,4)
```

MATLAB executes the above statements and returns the following result −

```
ans = 693
```

MATLAB also provides the **polyvalm** function for evaluating a matrix polynomial. A matrix polynomial is a **polynomial** with matrices as variables.

For example, let us create a square matrix X and evaluate the polynomial p, at X −

```
p = [1 7 0  -5 9];
X = [1 2 -3 4; 2 -5 6 3; 3 1 0 2; 5 -7 3 8];
polyvalm(p, X)
```

MATLAB executes the above statements and returns the following result −

```
ans =
        2307        -1769         -939         4499
        2314        -2376         -249         4695
        2256        -1892         -549         4310
        4570        -4532        -1062         9269
```

Finding the Roots of Polynomials

The **roots** function calculates the roots of a polynomial. For example, to calculate the roots of our polynomial p, type −

```
p = [1 7 0  -5 9];
r = roots(p)
```

MATLAB executes the above statements and returns the following result −

```
r =
  -6.8661 + 0.0000i
  -1.4247 + 0.0000i
   0.6454 + 0.7095i
   0.6454 - 0.7095i
```

The function **poly** is an inverse of the roots function and returns to the polynomial coefficients. For example −

```

p2 = poly(r)
```

MATLAB executes the above statements and returns the following result −

```
p2 =

 Columns 1 through 3:

   1.00000 + 0.00000i   7.00000 + 0.00000i   0.00000 + 0.00000i

 Columns 4 and 5:

  -5.00000 - 0.00000i   9.00000 + 0.00000i
```

Polynomial Curve Fitting

The **polyfit** function finds the coefficients of a polynomial that fits a set of data in a least-squares sense. If x and y are two vectors containing the x and y data to be fitted to a n-degree polynomial, then we get the polynomial fitting the data by writing −

```
p = polyfit(x,y,n)
```

Example

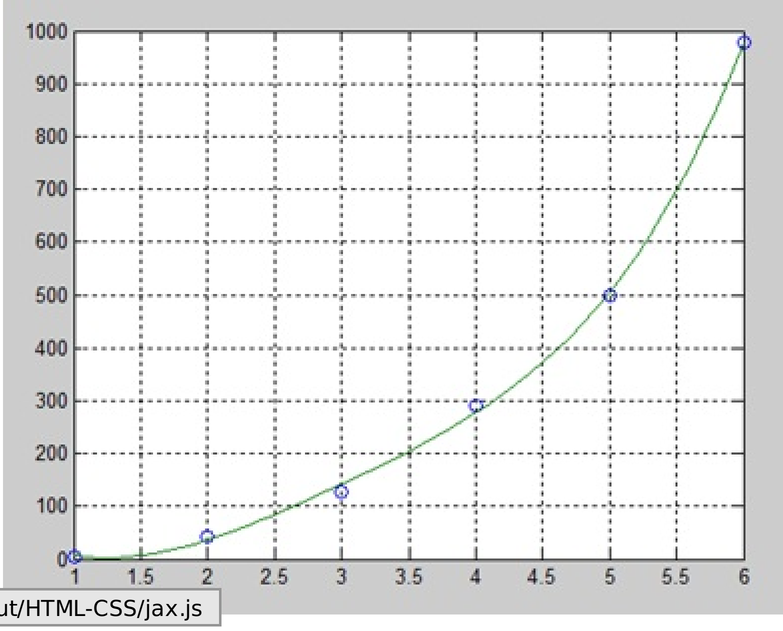
Create a script file and type the following code −

```
x = [1 2 3 4 5 6]; y = [5.5 43.1 128 290.7 498.4 978.67];  %data
p = polyfit(x,y,4)   %get the polynomial
% Compute the values of the polyfit estimate over a finer range,
% and plot the estimate over the real data values for comparison:
x2 = 1:.1:6;
y2 = polyval(p,x2);
plot(x,y,'o',x2,y2)
grid on
```

When you run the file, MATLAB displays the following result −

```
p =
    4.1056  -47.9607  222.2598 -362.7453  191.1250
```

And plots the following graph −



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