جَامعة المَنارة
MANARA UNIVERSITY

البرمجة الإجرائية

Lecture No. 13

polynomial

ميكاترونيك-سنة أولى-فصل أول

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Polynomials
كثيرات الحدود

Polynomials could be represented as vectors

vectors	Polynomials
[1 , 2 , 5]	$x^2 + 2x + 5$
[7 , 0.1 , 1 , 5]	$7x^3 + 0.1x^2 + x + 5$
[2, 0, 0, 0, 1, 0, 0, 0]	$2x^7 + x^3$

Most significant coefficient

least significant coefficient

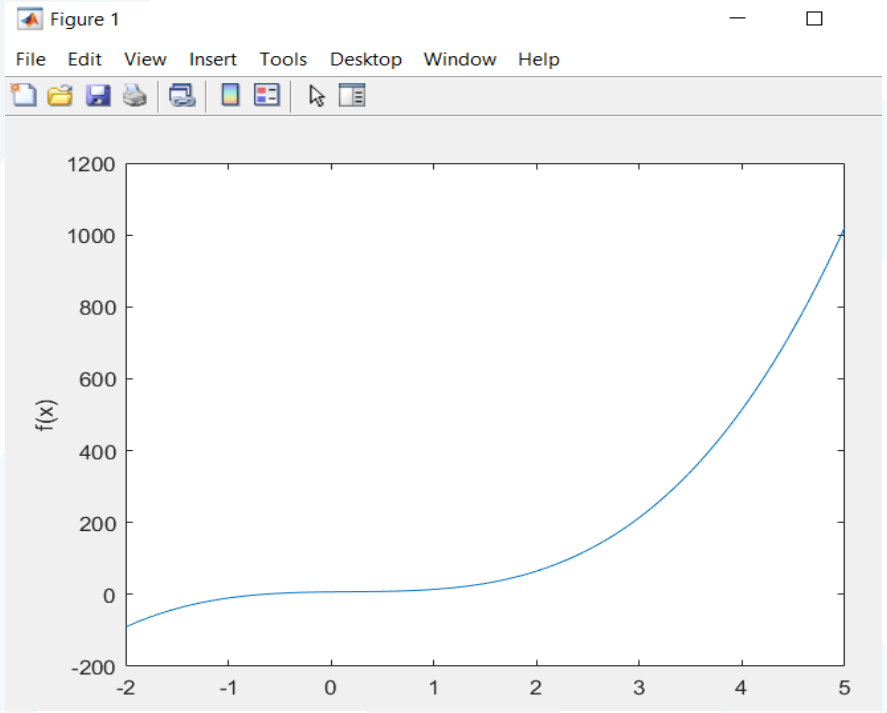
Plotting Polynomials

The function polyval(a,x)evaluates a polynomial at specified values of its independent variable x, which can be a matrix or a vector. The polynomial's coefficients of descending powers are stored in the array a. The result is the same size as x.

Example of Plotting a Polynomial

To plot the polynomial $f(x) = 9x^3 - 5x^2 + 3x + 7$ for $-2 \le x \le 5$, you type

```
a = [9,-5,3,7];
x = [-2:0.01:5];
f = polyval(a,x);
plot(x,f),xlabel('x'),ylabel('f(x)')
```



Finding the value

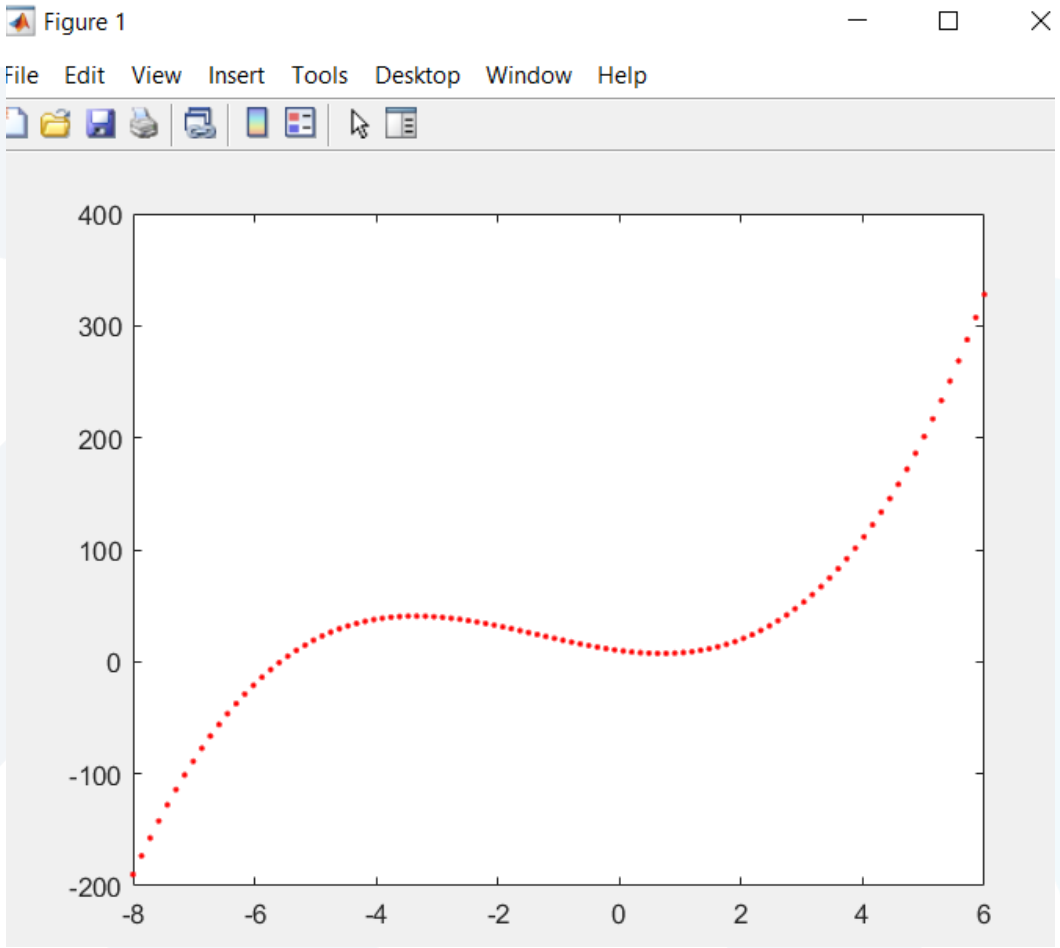
polyval(f,x0)

$$G(x) = x^2+x^1+1$$

```
p = [1,1,1];
x = 3;
gx = polyval(p,x);   %13
```

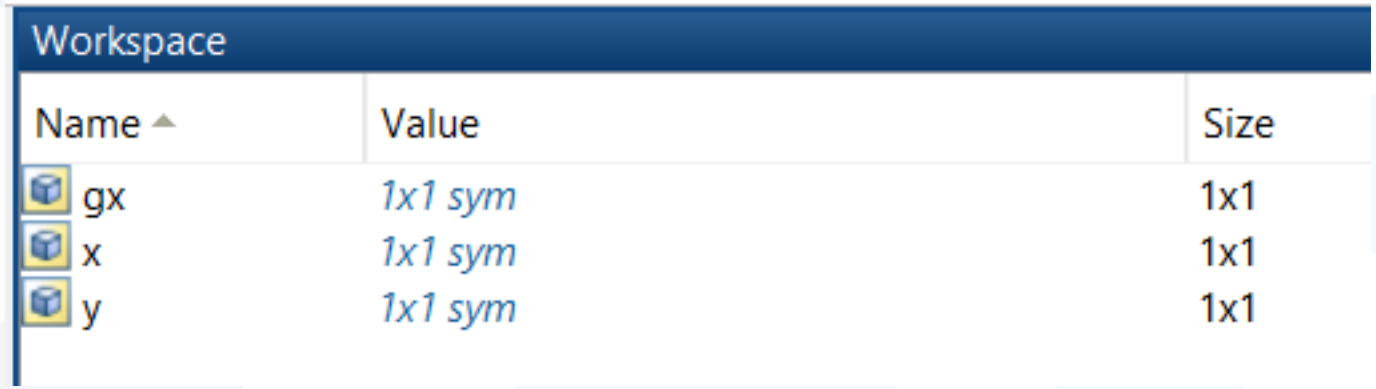
Finding the value

```
p = [1 4 -7 10];
x = linspace(-8,6,100);
plot(x,polyval(p,x),'.r')
```



syms lists the names of all symbolic scalar variables, functions, matrix variables, matrix functions, and arrays in the MATLAB workspace.

```
clc
clear
syms x
gx=x^2+2*x+1
y=subs(gx,3)
```




```
gx =
 x^2 + 2*x + 1


y =
16
```

```
syms x y
gx=y*x^2+y*x+1
y1=subs(gx,x,3)
z=subs(y1,3)
y2=subs(gx,y,3)
```

```
gx =
 y*x^2 + y*x + 1

y1 =
 12*y + 1

z =
 37

y2 =
 3*x^2 + 3*x + 1
```

Polynomial Multiplication and Division

The function conv(a,b) computes the product of the two polynomials described by the coefficient arrays a and b. The two polynomials need not be the same degree. The result is the coefficient array of the product polynomial.

The function [q,r] = deconv(num,den) computes the result of dividing a numerator polynomial, whose coefficient array is num, by a denominator polynomial represented by the coefficient array den. The quotient polynomial is given by the coefficient array q, and the remainder polynomial is given by the coefficient array r.

Polynomial Multiplication and Division: Examples

```
>>a = [9,-5,3,7];
>>b = [6,-1,2];
>>product = conv(a,b)
product =
  54   -39   41   29   -1   14
>>[quotient, remainder] = deconv(a,b)
quotient =
  1.5   -0.5833
remainder =
  0   0   -0.5833   8.1667
```

```
p1=[1 3 2];
p2=[3 0 2 6 9 5];
pp=conv(p1,p2);
[pd1,pd2]=deconv(pp,p1);
%pd1=result    pd2=reminder
pd1==p2
```

```
ans =

  1×6 logical array

   1   1   1   1   1   1
```

Workspace

Name	Value
ans	*1x6 logical*
p1	[1,3,2]
p2	[3,0,2,6,9,5]
pd1	[3,0,2,6,9,5]
pd2	[0,0,0,0,0,0,0,0]
pp	[3,9,8,12,31,44,33,10]

Polynomial Roots

The function roots(a)computes the roots of a polynomial specified by the coefficient array a. The result is a *column* vector that contains the polynomial's roots.

For example,

```
>>r = roots([2, 14, 20])
r =

   -5
   -2
```

إيجاد جذور كثير حدود باستخدام roots

لاحظ الجذور تمثل على شكل شعاع أعمدة بينما كثير الحدود يمثل على شكل شعاع سطري

```
% x^4-12x^3+25x+87
p=[1 -12  0  25  87];
r=roots(p)
polyval(p,r)
```

```
r =

  11.7660 + 0.0000i
   2.5077 + 0.0000i
  -1.1369 + 1.2869i
  -1.1369 - 1.2869i


ans =

   1.0e-11 *

   0.5855 + 0.0000i
  -0.0242 + 0.0000i
  -0.0099 - 0.0114i
  -0.0099 + 0.0114i
```

Polynomial Coefficients

The function poly(r)computes the coefficients of the polynomial whose roots are specified by the vector r. The result is a *row* vector that contains the polynomial's coefficients arranged in descending order of power.

For example,

- r = roots([2, 14, 20])
- p = poly(r)

```
r =

    -5
    -2

p =

     1     7    10
```

F(t)=t^5+t^3+t+1

```
clc
clear
f=[1 0 1 0 1 1];
roots(f)
Polynomial=poly(ans)
```

ans =

0.7077 + 0.8420i

0.7077 - 0.8420i

-0.3893 + 1.0707i

-0.3893 - 1.0707i

-0.6369 + 0.0000i

Polynomial =

1.0000 -0.0000 1.0000 0.0000 1.0000 1.0000

جمع كثير الحدود

```
p1=[1 2 3];
p2=[2 4 6];
p3=[ 1 2 3 4];
pp=p1+p2
[0 p2]+p3
p2+p3
```

```
pp =
     3     6     9

ans =
     1     4     7    10
Matrix dimensions must agree.
Error in convdeconv (line 41)
p2+p3
```

يجب إضافة أصفار حتى
تتساوى الدرجات

وظيفة اكتب تابع يقوم بجمع كثيري حدود مهما كانت درجتهما

اشتقاق و تكامل Integration and Derivatives:

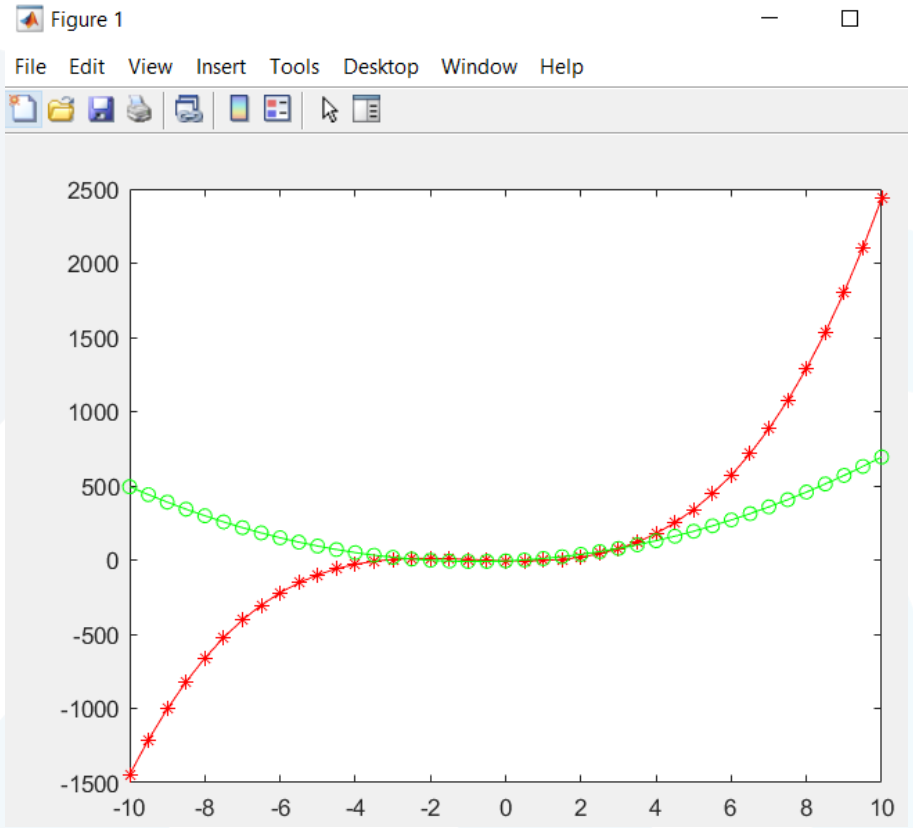
```
p=[ 3 2 2 0 1]
pd=polyder(p)          اشتقاق
pi1=polyint(pd)        تكامل
pi2=polyint(pd,9)      تكامل مع ثابت تكامل
```

```
p =
   3   2   2   0   1

pd =
   12   6   4   0

pi1 =
   3   2   2   0   0

pi2 =
   3   2   2   0   9
```

3x^4+2x^3+2x^2+0x+1

```
x=-10:.5:10;
gx=[2 5 -6 -5]
gxd=polyder(gx)
plot(x,polyval(gx,x),'-*r',x,polyval(gxd,x),'-og')
```

```
gx =
     2     5    -6    -5


gxd =
     6    10    -6
```



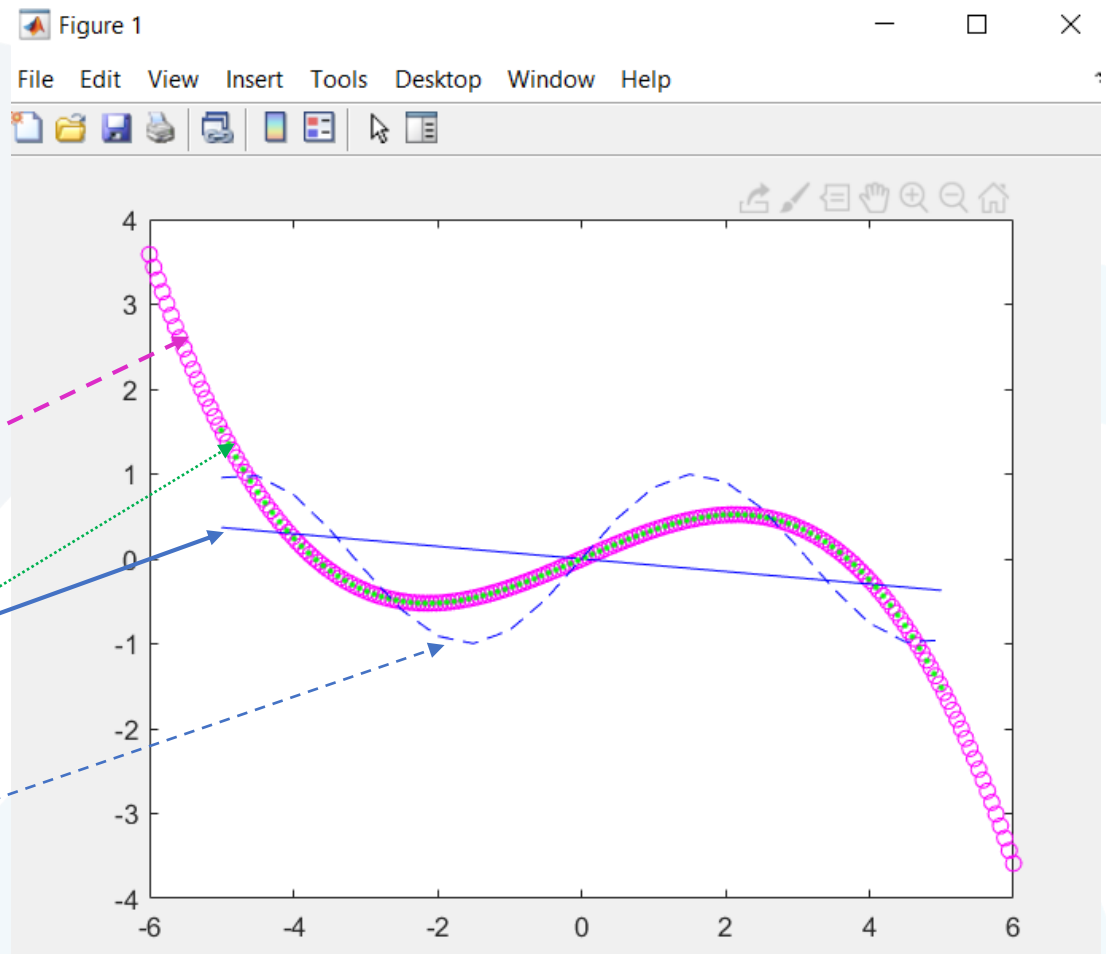
```
syms x
gx=2*x^3 + 5*x^2  -6*x  -5
diff(gx)
```

```
gx =
 2*x^3 + 5*x^2 - 6*x - 5


ans =
6*x^2 + 10*x - 6
```

مواءمة المعطيات في منحنيات أي إيجاد أقرب تابع يمر من نقاط محددة

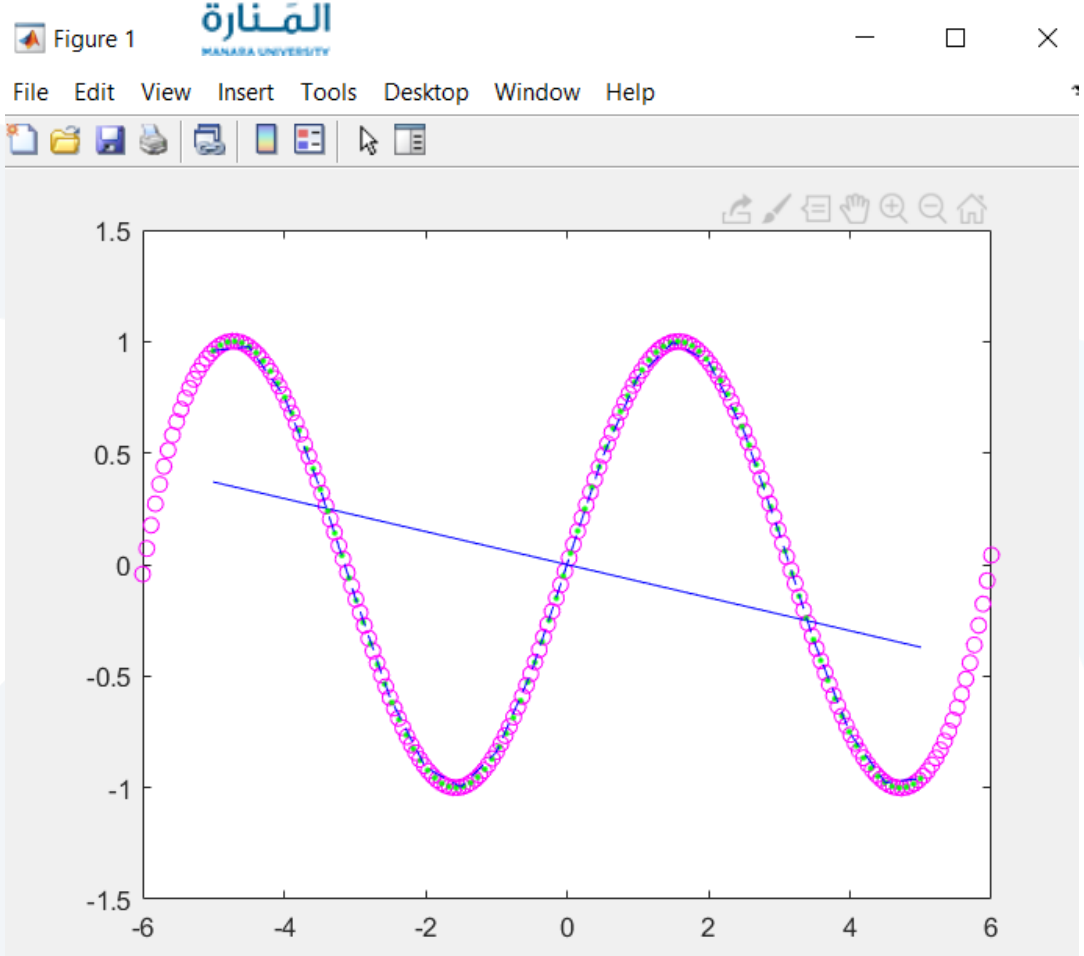
باستخدام التابع polyfit(x,y,n) أقرب كثير حدود من الدرجة n يمر من النقاط المحددة في x و y

```
clc
clear
x=-5:.5:5;
y=sin(x);
p1=polyfit(x,y,1);
p2=polyfit(x,y,4);
% p2=polyfit(x,y,8);
xx=linspace(-5,5,100);
yy1=polyval(p1,xx);
yy2=polyval(p2,xx);
xxx=linspace(-6,6,200);
yyy=polyval(p2,xxx);
plot(xxx,yyy,'om', xx,yy1,'b' ,  xx,yy2, '.g',  x,y,'--b')
```



جعل درجة p2تساوي 10
في الكود السابق

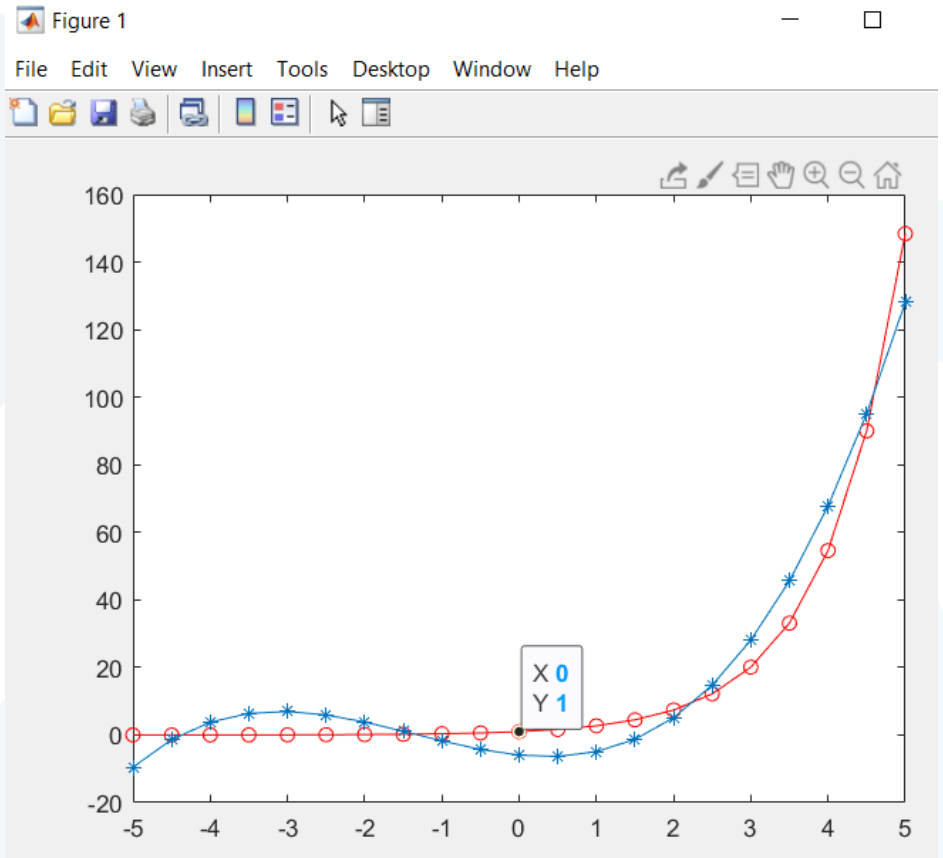
```
p2=polyfit(x,y,10);
```



Finding the equation :

```
clc
clear
x=-5:.5:5;
y=exp(x)
u=polyfit(x,y,3);
t=polyval(u,x);
plot(x,y,'-or', x,t,'-*')
```

U=0.6396 2.6091 -2.2349 -5.9565



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Thanks .