TEST 3

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Ans 1:

```
function v = a_LinRegRegularized (xData, yData, x_vals,n,lambda)

m = length(xData);
m2= length(x_vals);

X = [ones(m,1) xData];

for i=2:n
   X = [X xData.^i];
end

dg = eye(n+1);
dg(1,1) = 0;
x_tranpose = X';
theta = pinv(x_tranpose*X + lambda*dg)*x_tranpose*yData;

XINPUT = [ones(m2,1) x_vals];
for j=2:n
```

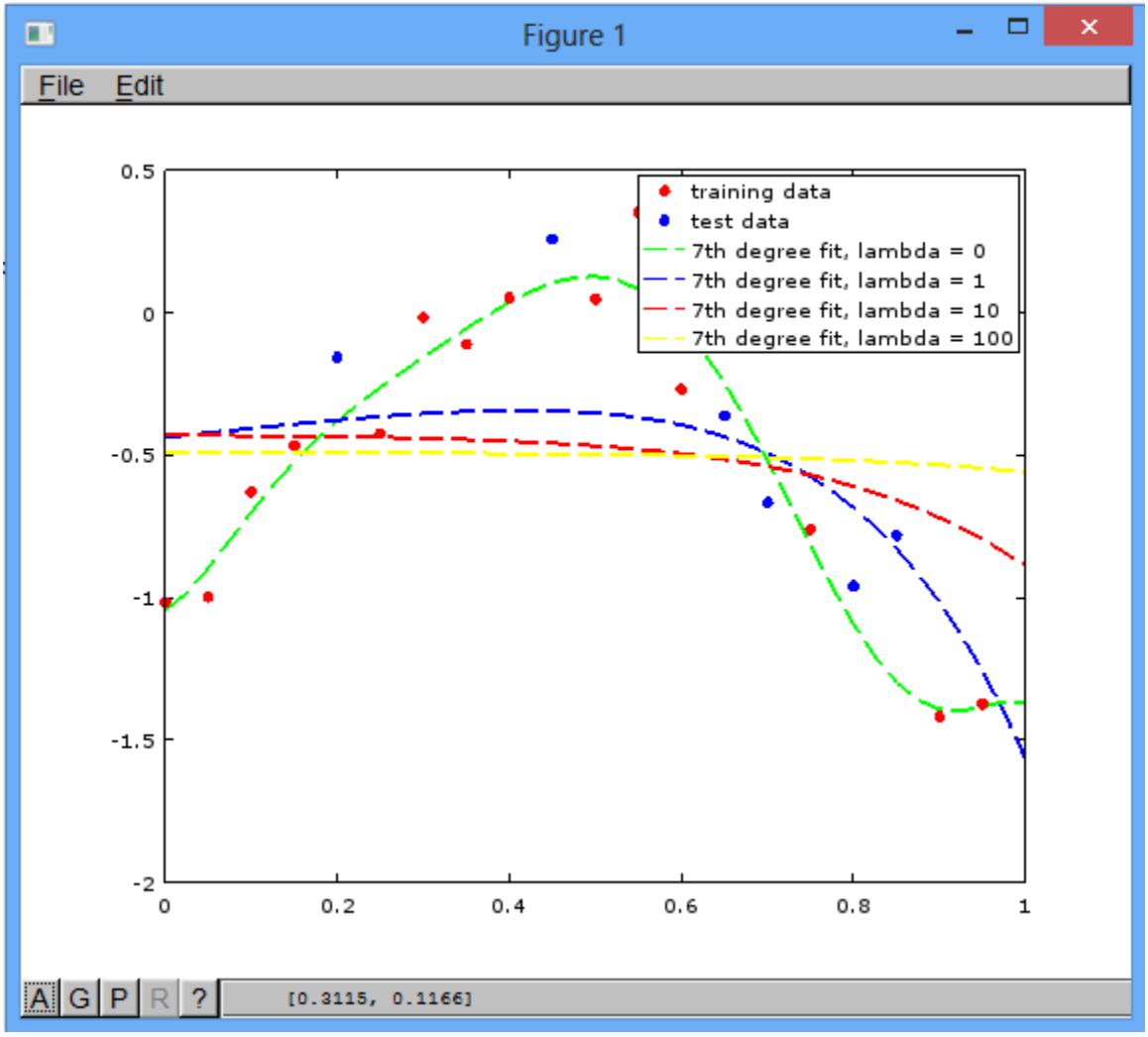
```
    XINPUT = [XINPUT x_vals.^j];
end

v = theta'*XINPUT';

endfunction
```

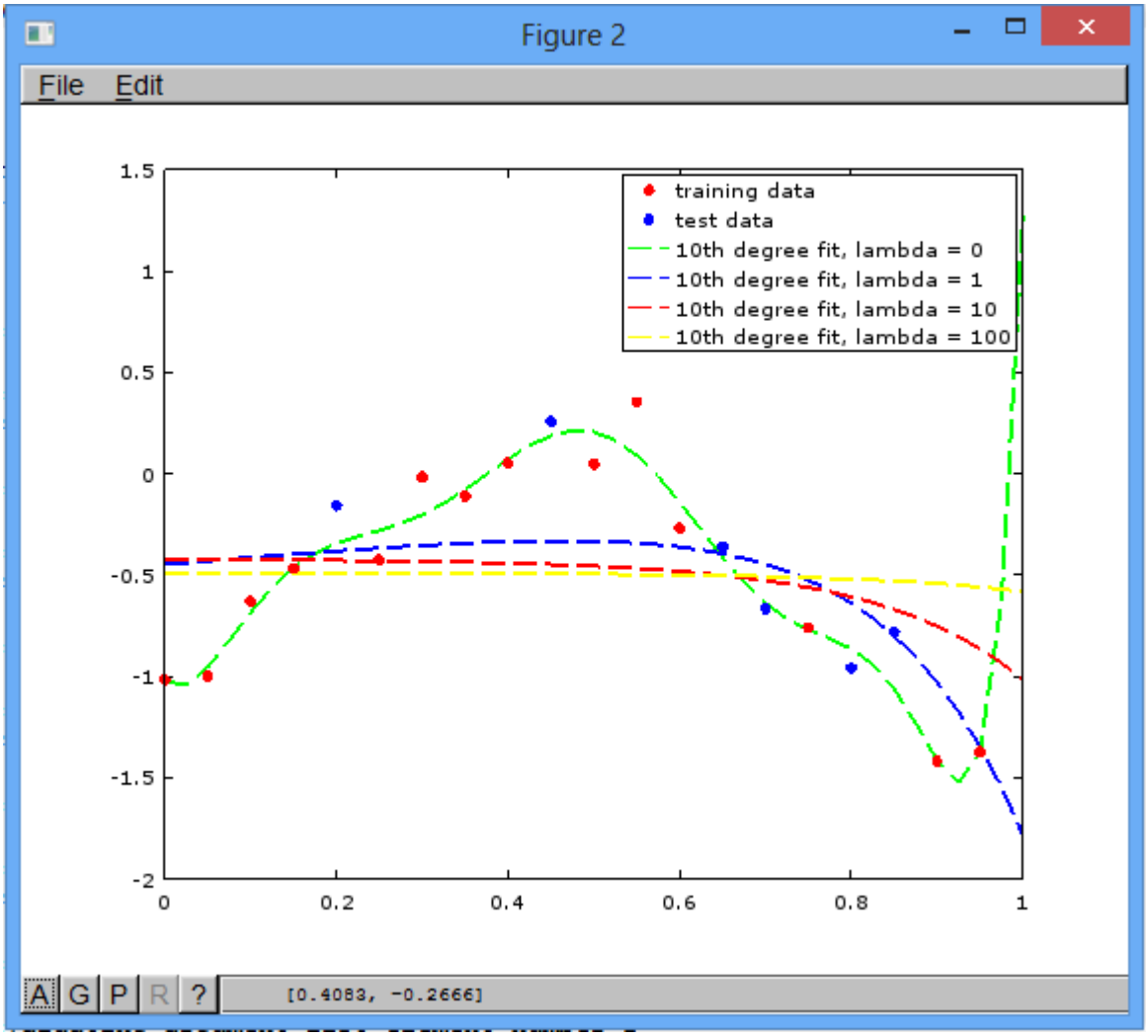
Ans 2(a):

Regression Curve for degree 7 polynomial for different lambda values



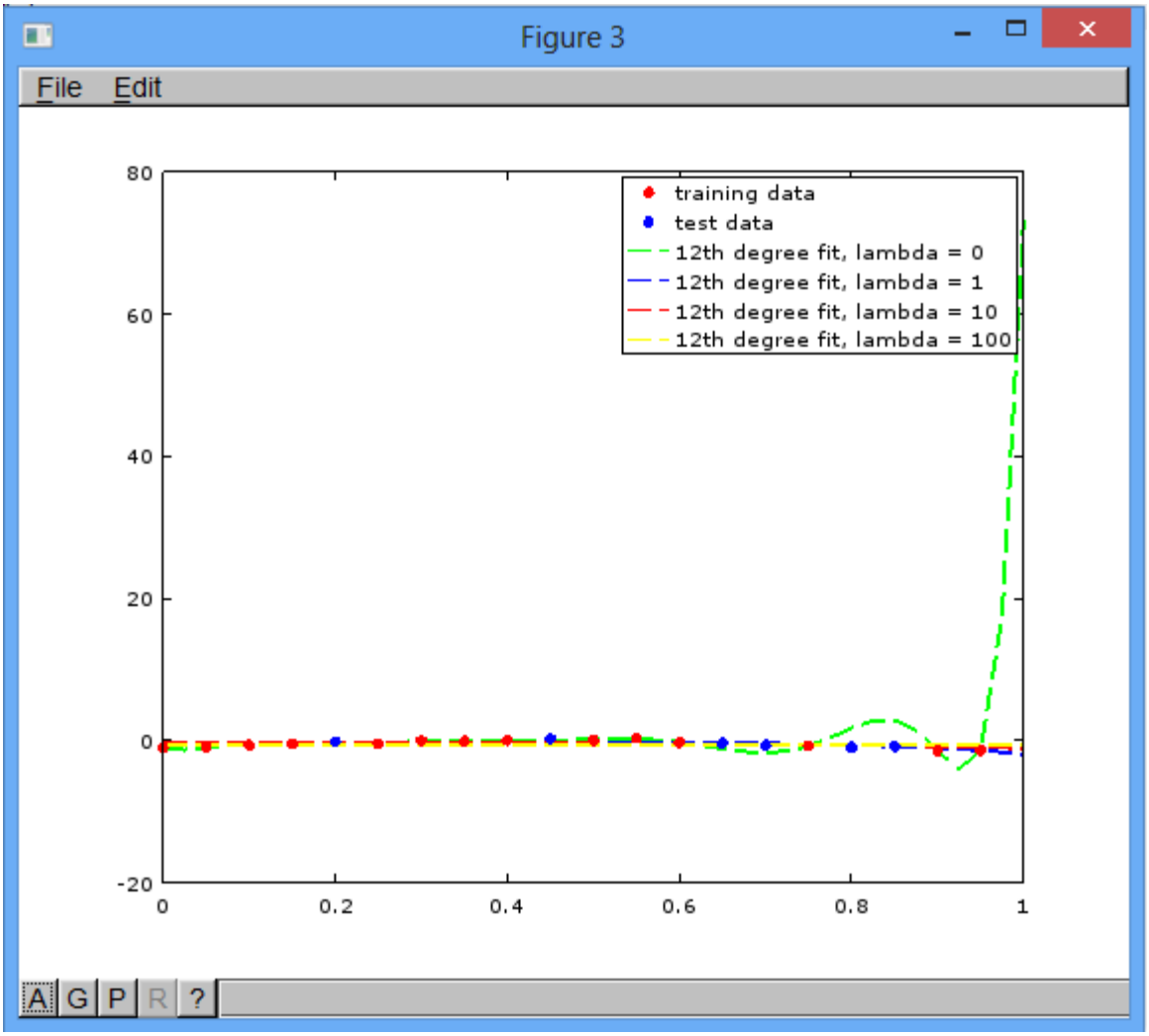
Ans 2(b):

Regression Curve for degree 10 polynomial for different lambda values



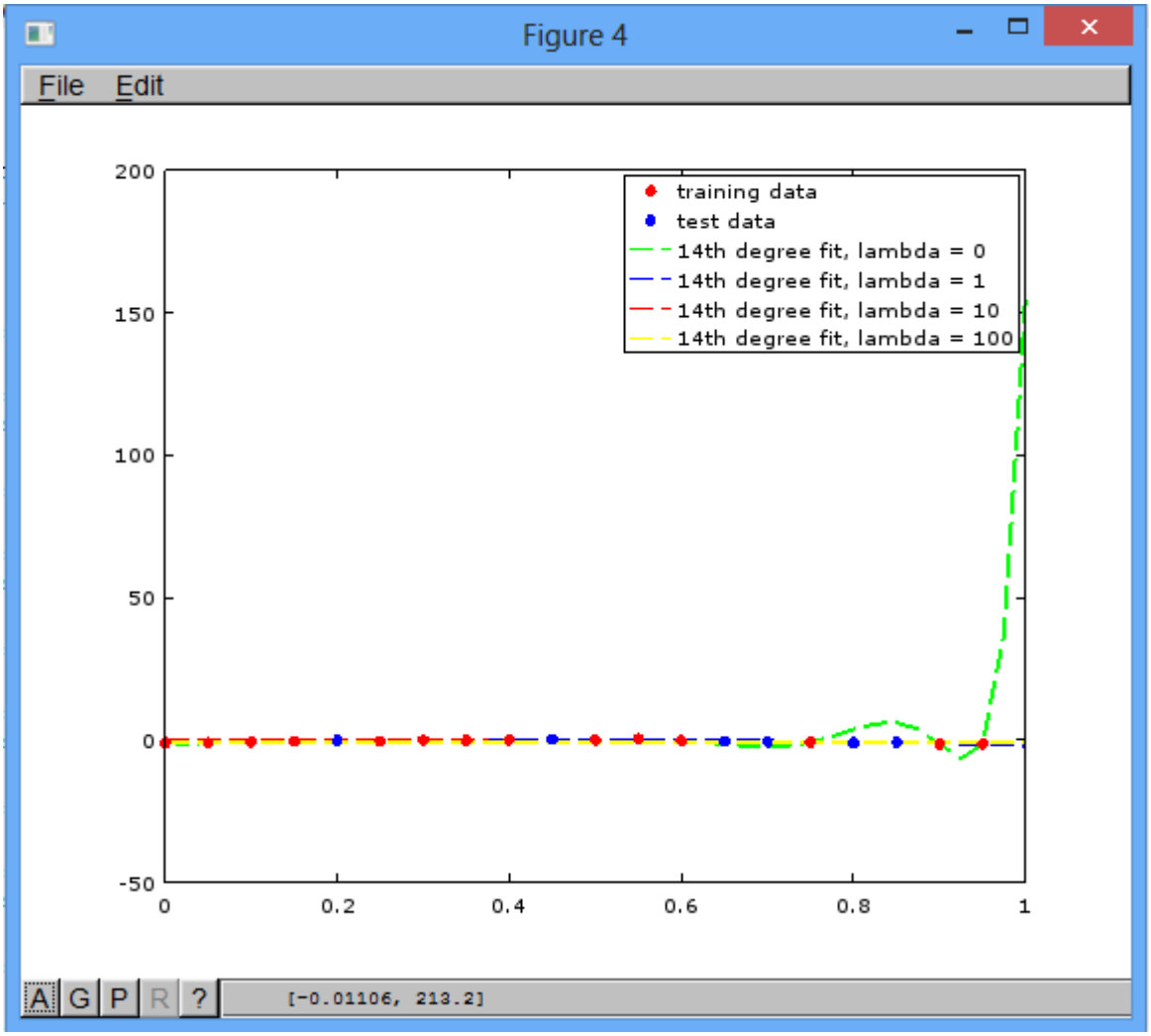
Ans 2(c):

Regression Curve for degree 12 polynomial for different lambda values



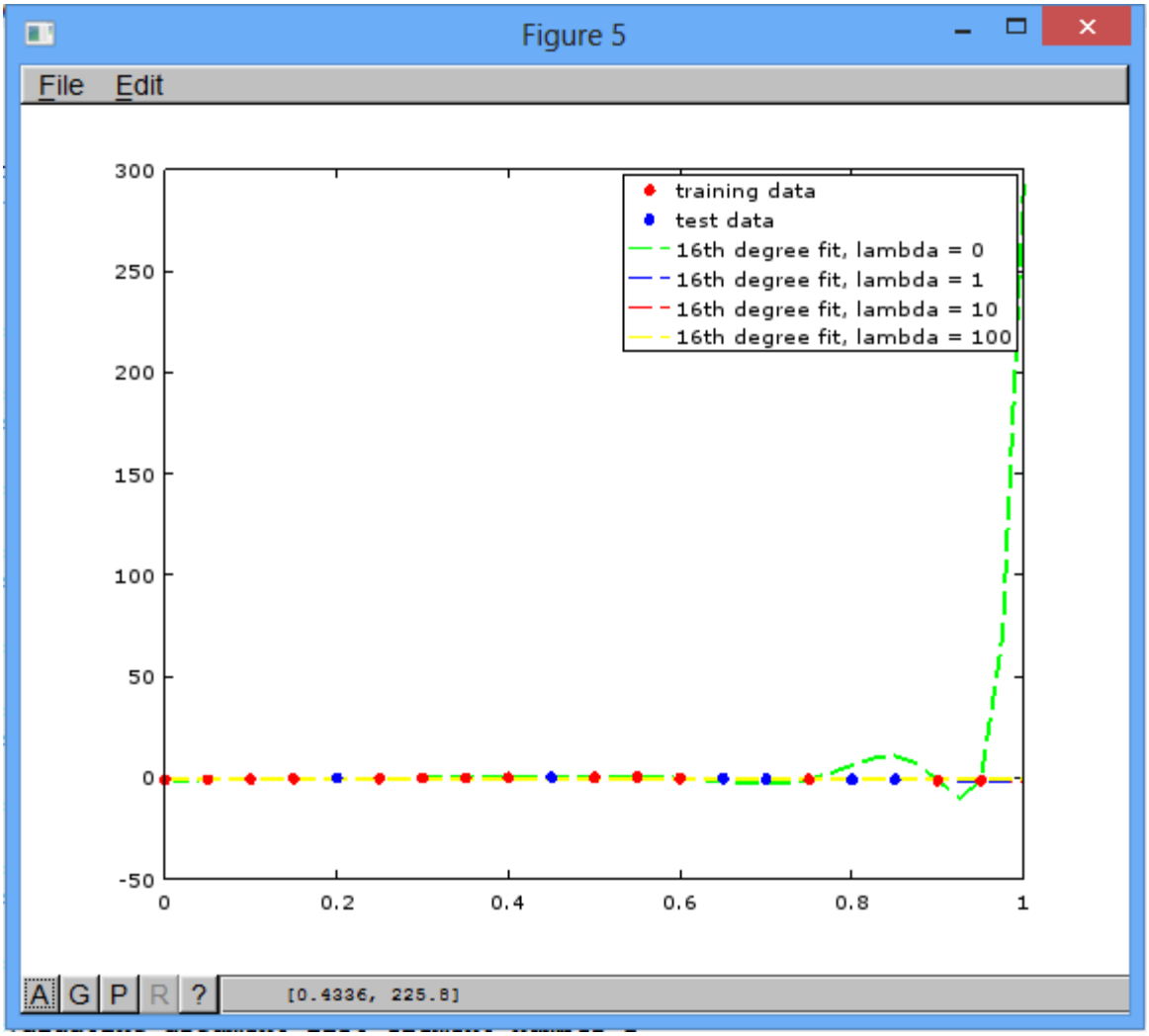
Ans 2(d):

Regression Curve for degree 14 polynomial for different lambda values



Ans 2(e):

Regression Curve for degree 16 polynomial for different lambda values



Ans 3:

```
------------------------------------------------------------------------
For 7 degree polynomial
------------------------------------------------------------------------

Lambda = 0
Training Error: 0.20296      Testing Error: 0.39355
Lambda = 1
Training Error: 1.9555      Testing Error: 0.52449
Lambda = 10
Training Error: 3.1195      Testing Error: 0.76844
Lambda = 100
Training Error: 3.8386      Testing Error: 0.98678

------------------------------------------------------------------------
For 10 degree polynomial
------------------------------------------------------------------------

Lambda = 0
Training Error: 0.17228      Testing Error: 0.132
Lambda = 1
Training Error: 1.8651      Testing Error: 0.55134
Lambda = 10
Training Error: 2.9609      Testing Error: 0.74804
Lambda = 100
Training Error: 3.7953      Testing Error: 0.97948

------------------------------------------------------------------------
For 12 degree polynomial
------------------------------------------------------------------------

Lambda = 0
Training Error: 0.082682      Testing Error: 22.589
Lambda = 1
Training Error: 1.8535      Testing Error: 0.56909
Lambda = 10
Training Error: 2.9018      Testing Error: 0.74382
Lambda = 100
Training Error: 3.7759      Testing Error: 0.977
```

```
--------------------------------------------------------------------------
For 14 degree polynomial
--------------------------------------------------------------------------

Lambda = 0
Training Error: 0.065562      Testing Error: 73.724
Lambda = 1
Training Error: 1.8528      Testing Error: 0.58251
Lambda = 10
Training Error: 2.8632      Testing Error: 0.74258
Lambda = 100
Training Error: 3.7616      Testing Error: 0.97552

--------------------------------------------------------------------------
For 16 degree polynomial
--------------------------------------------------------------------------

Lambda = 0
Training Error: 0.054484      Testing Error: 189.003
Lambda = 1
Training Error: 1.8556      Testing Error: 0.59189
Lambda = 10
Training Error: 2.8372      Testing Error: 0.74267
Lambda = 100
Training Error: 3.751      Testing Error: 0.97462

>>
```

Ans 4:

Overfitting occurs when the algorithm fits the data too well. More the value of degree of polynomial, more is the overfitting because it can cover most of the training data points.

When we apply regularization, as we increase the value of lambda, there will be an increase in the error function of the training data. When the degree of polynomial is less, error function for test data will also increase with increase in lambda values. And when there is an increase in the degree of polynomial, with increase in lambda values, there will be decrease in the error function of the test data and after that with increase in lambda, the value of cost function for test data will increase again but at a very slow pace.