TEST 3

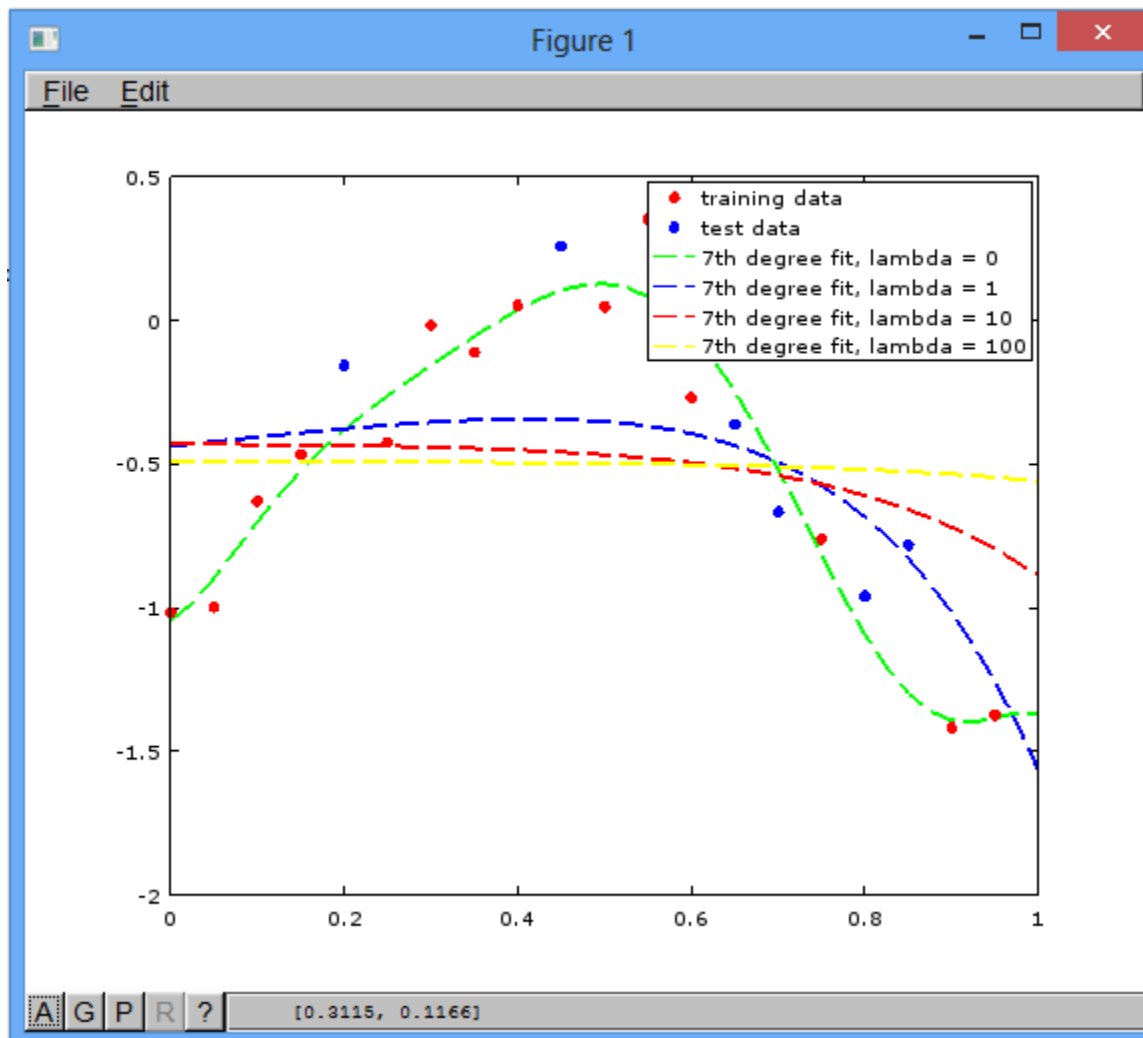Saumil Sabhaya   ID: N02985643

Ans 1:

```
function v = LinRegRegularized(xData,yData,x_vals,n,lambda)
m = length(xData);
m2 = length(x_vals);
for i=1:m
  for j=0:n
   X(i,j+1) = xData(i)^j;
  end
end
dg=eye(n+1);
dg(1,1)=0;
theta= pinv((X' * X) + (lambda .* dg)) * (X' * yData);for i=1:m2
  for j=0:n
   XINPUT(i,j+1) = x_vals(i)^j;
  end
end
v = theta' * XINPUT';
end
```
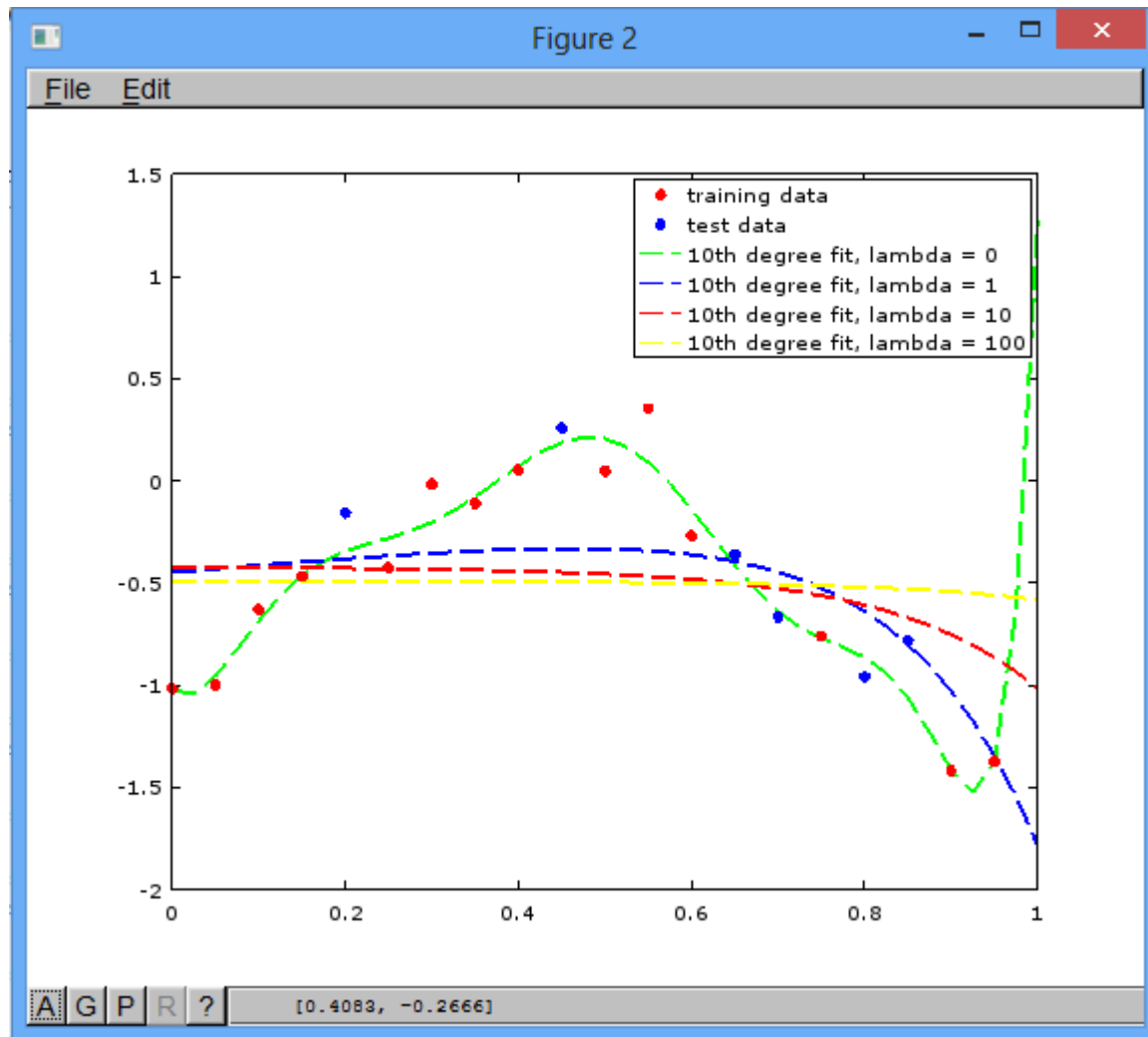
Ans 2(a):

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):
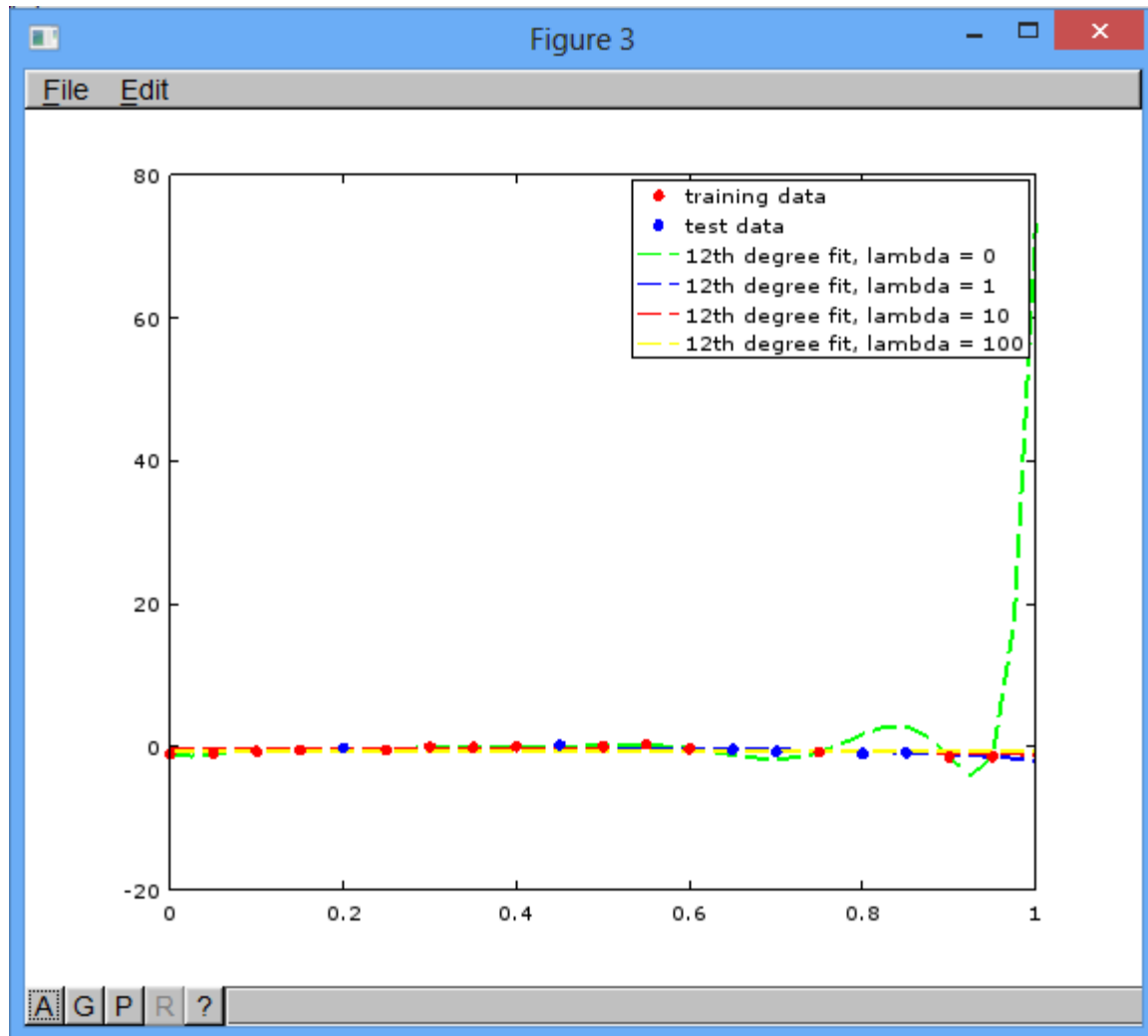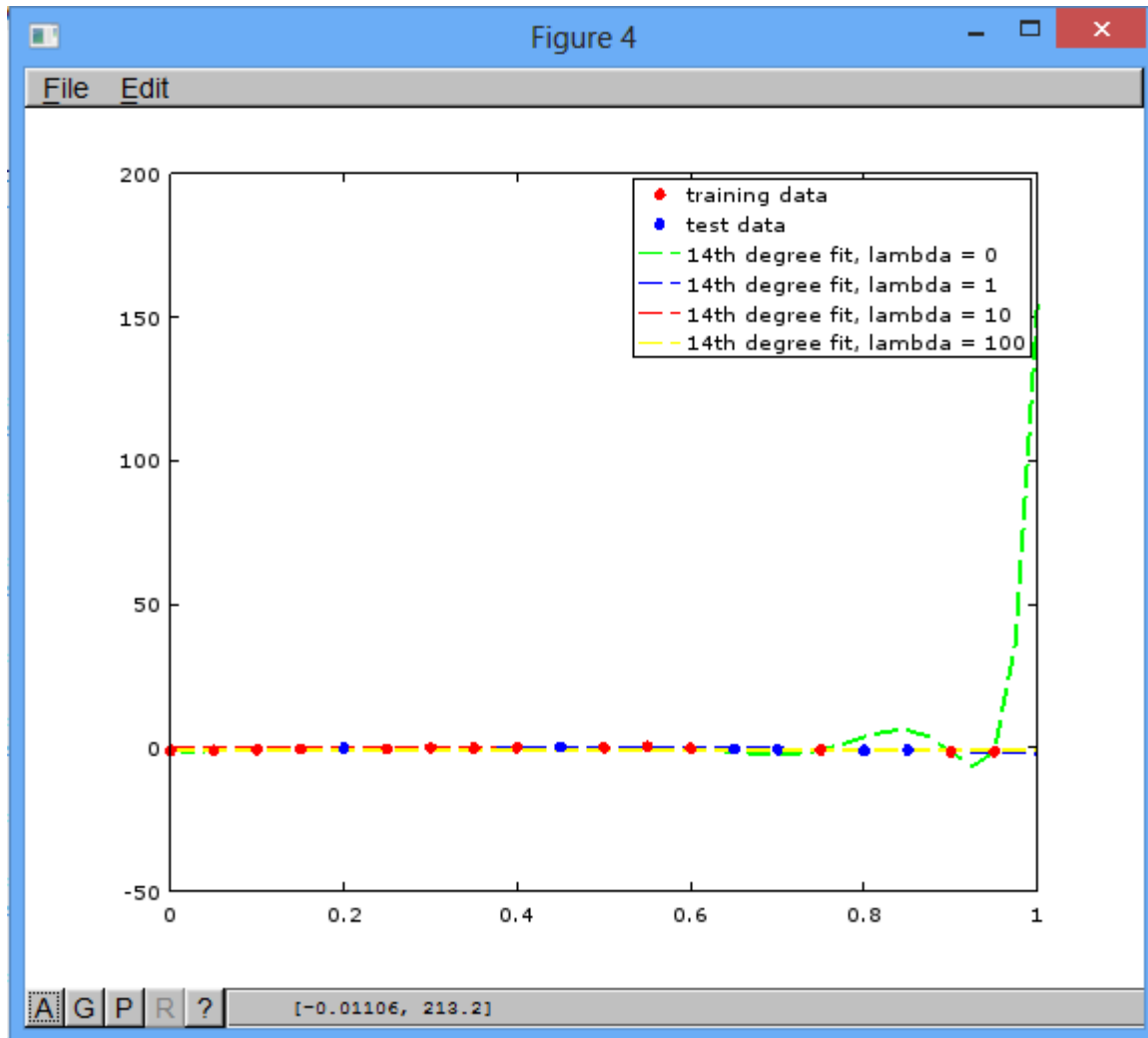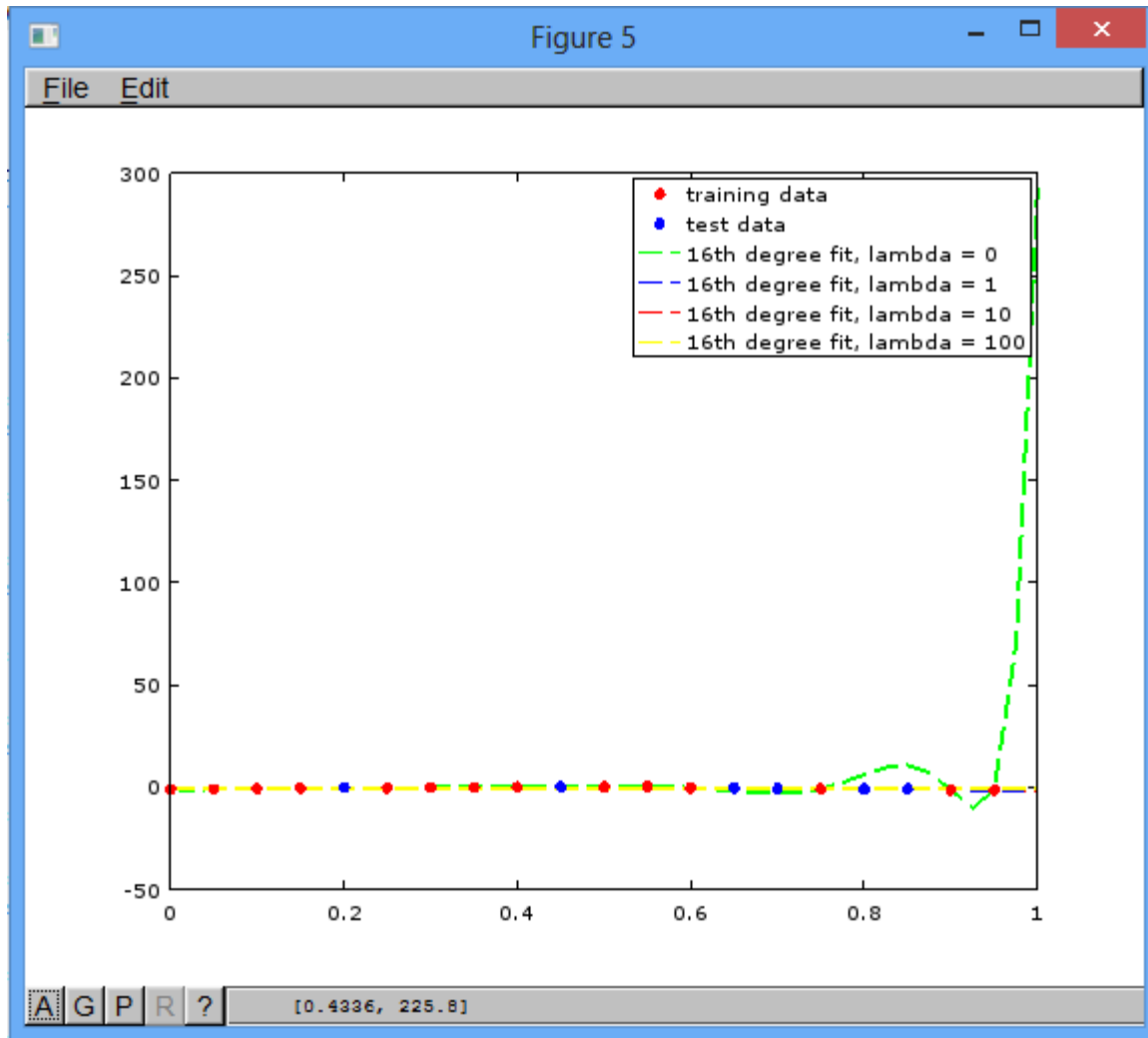
Regression Curve for degree 14 polynomial for different lambda values

Ans 2(e):

Regression Curve for degree 16 polynomial for different lambda values

Ans 3:

```
>> sabhaya_excercises
----------------------------------------------------------------
For 7 degree polynomial
----------------------------------------------------------------

Lambda = 0
Training Error: 0.20296      Testing Error: 3.3003
Lambda = 1
Training Error: 1.9555       Testing Error: 1.9219
Lambda = 10
Training Error: 3.1195       Testing Error: 1.035
Lambda = 100
Training Error: 3.8386       Testing Error: 0.8703


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

Lambda = 0
Training Error: 0.17228      Testing Error: 3.3003
Lambda = 1
Training Error: 1.8651       Testing Error: 1.9604
Lambda = 10
Training Error: 2.9609       Testing Error: 1.0482
Lambda = 100
Training Error: 3.7953       Testing Error: 0.87182


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

```
Lambda = 0
Training Error: 0.082681       Testing Error: 3.3003
Lambda = 1
Training Error: 1.8535       Testing Error: 1.9689
Lambda = 10
Training Error: 2.9018       Testing Error: 1.0516
Lambda = 100
Training Error: 3.7759       Testing Error: 0.87222


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


Lambda = 0
Training Error: 0.065562       Testing Error: 3.3003
Lambda = 1
Training Error: 1.8528       Testing Error: 1.9726
Lambda = 10
Training Error: 2.8632       Testing Error: 1.0532
Lambda = 100
Training Error: 3.7616       Testing Error: 0.8724


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


Lambda = 0
Training Error: 0.054484       Testing Error: 3.3003
Lambda = 1
Training Error: 1.8556       Testing Error: 1.9743
Lambda = 10
Training Error: 2.8372       Testing Error: 1.0539
Lambda = 100
Training Error: 3.751       Testing Error: 0.8725
```

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 but there will be decrease in the error function of the test data.