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Assignment 3 (written)

Task1 :

1. Degree=1; Lambda=0

   Training Stage:

   w0=-6.3872
   w1=0.0276
   w2=0.0432
   w3=0.0126
   w4=0.0176
   w5=0.0080
   w6=-0.0058
   w7=-0.0081
   w8=0.0714
   w9=-0.0153
   w10=-0.0190
   w11=0.0117
   w12=0.0222
   w13=-0.0018
   w14=-0.0013
   w15=0.0091
   w16=0.0382

   Last line of Test Object:
   ID= 3498, output= 3.8514, target value = 4.0000, squared error = 0.0221

2. Degree=1; Lambda=1

   Training stage:

   w0=-6.2611
   w1=0.0275
   w2=0.0428
   w3=0.0126
   w4=0.0172
   w5=0.0078
   w6=-0.0059
   w7=-0.0081
   w8=0.0713
   w9=-0.0154
   w10=-0.0191
   w11=0.0116

w12=0.0221
w13=-0.0018
w14=-0.0017
w15=0.0090
w16=0.0383

Last line of test object:
ID= 3498, output= 3.8528, target value = 4.0000, squared error = 0.0217

3. Degree=2; Lambda=0

   Training stage:

   w0=-7.5608
   w1=0.0223
   w2=0.0001
   w3=0.0352
   w4=0.0000
   w5=0.0049
   w6=-0.0000
   w7=-0.0299
   w8=0.0002
   w9=0.0327
   w10=-0.0001
   w11=0.0694
   w12=-0.0004
   w13=0.0079
   w14=-0.0002
   w15=0.0596
   w16=-0.0003
   w17=-0.0184
   w18=-0.0000
   w19=0.0093
   w20=0.0002
   w21=0.0162
   w22=-0.0000
   w23=0.0398
   w24=-0.0002
   w25=-0.0041
   w26=0.0001
   w27=0.0538
   w28=-0.0007
   w29=-0.0149
   w30=0.0002
   w31=0.1215
   w32=-0.0007

Last line of test object:
ID= 3498, output= 3.6074, target value = 4.0000, squared error = 0.1542

4. Degree=2; Lambda=1

Training stage:
w0=-7.0384
w1=0.0219
w2=0.0001
w3=0.0310
w4=0.0001
w5=0.0043
w6=-0.0000
w7=-0.0345
w8=0.0002
w9=0.0315
w10=-0.0001
w11=0.0678
w12=-0.0004
w13=0.0077
w14=-0.0002
w15=0.0574
w16=-0.0003
w17=-0.0192
w18=-0.0000
w19=0.0091
w20=0.0002
w21=0.0156
w22=-0.0000
w23=0.0401
w24=-0.0002
w25=-0.0050
w26=0.0001
w27=0.0536
w28=-0.0007
w29=-0.0155
w30=0.0002
w31=0.1208
w32=-0.0007

Last line of test object:
ID= 3498, output= 3.6001, target value = 4.0000, squared error = 0.1599

Task2

Given,
$x_1 = 5.3$, $t_1 = 9.6$, $x_2 = 7.1$, $t_2 = 4.2$, $x_3 = 6.4$, $t_3 = 2.2$

Here we need to fit a line to this data and lambda is approaching positive infinity.
As, the lambda is reaching positive infinity the way to achieve minimum value is to minimize E(w). This can be done by removing lambda from the overall calculation which is multiplied with (w^Tw). So in order to minimize the E_Dw, w^Tw should be equal to zero. So, lambda is not involved in the calculation when w a 2D vector is zero Vector. *Therefore, w should be zero vector where lambda approaches infinity; to minimize E_Dw.*

Task3

Given values,
$x_1 = 5.3$, $t_1 = 9.6$, $x_2 = 7.1$, $t_2 = 4.2$, $x_3 = 6.4$, $t_3 = 2.2$

Given functions,

- $f(x) = 3.1x + 4.2$
- $f(x) = 2.4x - 1.5$

To find the better functions we need to find the predicted value and find the squared errors and see the difference in total error.
Let T1, T2 and T3 be E1,E2 and E3 for respective cases in both functions.

For first function, $f(x) = 3.1x + 4.2$
Predicted values are:
T1=3.1*5.3+4.2 = 20.63
T2=3.1*7.1+4.2 = 26.21
T3=3.1*6.4+4.2 = 24.04

Squared error values:
$E1= (T1-t1)^2 =(20.63-9.6)^2 =121.661$
$E2= (T2-t2)^2 =(26.21-4.2)^2 =484.440$
$E3= (T3-t3)^2 =(24.04-2.2)^2 =476.986$

Total error (TE1) = E1+E2+E3 =1083.887

For second function, $f(x) = 2.4x - 1.5$
Predicted values are:
T1=2.4*5.3-1.5 =11.22
T2=2.4*7.1-1.5 =15.54
T3=2.4*6.4-1.5 =13.86

Squared error values:
$E1= (T1-t1)^2 =(11.22-9.6)^2 =2.624$
$E2= (T2-t2)^2 =(15.54-4.2)^2 =197.122$

$E3= (T3-t3)^2 =(13.86-2.2)^2 =135.956$

Total error (TE2) = E1+E2+E3 = 335.702

Here, TE2<TE1 that is total sum of squared error for second function is less than first function so, function f(x) = 2.4x - 1.5 is better solution according to sum of squares criterion.