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CSE 4309 – HW 03

Task 1

Degree = 1, Lambda = 0	Degree = 1, Lambda = 1	Degree = 2, Lambda = 0	Degree = 2, Lambda = 1
w0 = -8.2007 w1 = 0.0810 w2 = -0.0867 w3 = -0.0936 w4 = 0.1021 w5 = 0.1581 w6 = 0.1108 w7 = -0.0995 w8 = -0.1322 w9 = 0.1186 w10 = 0.1615 w11 = -0.1337 w12 = -0.6561 w13 = 0.0895 w14 = 1.3469 w15 = -0.0338	w0 = -8.0392 w1 = 0.0809 w2 = -0.0871 w3 = -0.0937 w4 = 0.1016 w5 = 0.1579 w6 = 0.1107 w7 = -0.0995 w8 = -0.1324 w9 = 0.1185 w10 = 0.1614 w11 = -0.1338 w12 = -0.6562 w13 = 0.0894 w14 = 1.3465 w15 = -0.0340	w0 = 13.7235 w1 = 0.0670 w2 = -0.0001 w3 = -0.1481 w4 = 0.0010 w5 = -0.0348 w6 = 0.0001 w7 = -0.8114 w8 = 0.0056 w9 = 0.0856 w10 = -0.0003 w11 = 0.4622 w12 = -0.0027 w13 = 0.1399 w14 = -0.0021 w15 = -0.1173 w16 = 0.0015 w17 = 0.0648 w18 = 0.0004 w19 = 0.1138 w20 = -0.0010 w21 = -0.1320 w22 = 0.0002 w23 = -0.3783 w24 = -0.0031 w25 = 0.0021 w26 = 0.0007 w27 = 0.9531 w28 = 0.0045 w29 = -0.0503 w30 = 0.0003	w0 = 12.8034 w1 = 0.0677 w2 = -0.0001 w3 = -0.1409 w4 = 0.0010 w5 = -0.0336 w6 = 0.0001 w7 = -0.8032 w8 = 0.0055 w9 = 0.0877 w10 = -0.0003 w11 = 0.4647 w12 = -0.0027 w13 = 0.1404 w14 = -0.0021 w15 = -0.1133 w16 = 0.0014 w17 = 0.0665 w18 = 0.0004 w19 = 0.1138 w20 = -0.0010 w21 = -0.1310 w22 = 0.0002 w23 = -0.3796 w24 = -0.0031 w25 = 0.0037 w26 = 0.0006 w27 = 0.9540 w28 = 0.0045 w29 = -0.0495 w30 = 0.0003
ID= 3498, output= 5.43, target value= 0.00, squared error=29.4481	ID= 3498, output= 5.43, target value= 0.00, squared error=29.4710	ID= 3498, output= 2.47, target value= 0.00, squared error=6.1035	ID= 3498, output= 2.48, target value= 0.00, squared error=6.1588

Task 2

$$\mathbf{w} = (\lambda \mathbf{I} + \Phi^T \cdot \Phi)^{-1} \cdot \Phi^T \cdot \mathbf{t}$$

$$\varphi(x) = x$$

$$\mathbf{t} = \begin{bmatrix} 9.6 \\ 4.2 \\ 2.2 \end{bmatrix} \quad \Phi = \begin{bmatrix} 1 & 5.3 \\ 1 & 7.1 \\ 1 & 6.4 \end{bmatrix} \quad \Phi^T = \begin{bmatrix} 1 & 1 & 1 \\ 5.3 & 7.1 & 6.4 \end{bmatrix}$$

$$\Phi^T \cdot \mathbf{t} = \begin{bmatrix} 16 \\ 95 \end{bmatrix}$$

$$\Phi^T \cdot \Phi = \begin{bmatrix} 3 & 20 \\ 20 & 119.5 \end{bmatrix}$$

$$\mathbf{w} = \left(\begin{bmatrix} 3 + \lambda & 20 \\ 20 & 119.5 + \lambda \end{bmatrix} \right)^{-1} \cdot \begin{bmatrix} 16 \\ 95 \end{bmatrix}$$

Since $\lambda \rightarrow \infty$, and while taking inverse of the matrix we must divide the matrix by its discriminant, $1/\infty \rightarrow 0$. Therefore $\mathbf{w} \rightarrow \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

This is true because as the λ value decreases, the polynomial starts underfitting the data and will look flat.

Task 3

	$f1(x) = 3.1x + 4.2$	$f2(x) = 2.4x - 1.5$
$x1 = 5.3$	21.56	11.22
$x2 = 7.1$	26.21	15.54
$x3 = 6.4$	24.04	13.86

$$E1(x) = 0.5 * [(9.6 - 21.56)^2 + (4.2 - 26.21)^2 + (2.2 - 24.04)^2] = 552.2$$

$$E2(x) = 0.5 * [(9.6 - 11.22)^2 + (4.2 - 15.54)^2 + (2.2 - 13.86)^2] = 133.58$$

According to sum-of-squares criterion, $f2(x) = 2.4x - 1.5$ is a better solution because it minimizes the sum of squares which means it is a closer fit to our data line.