IVAN PAVELIĆ 0036543754

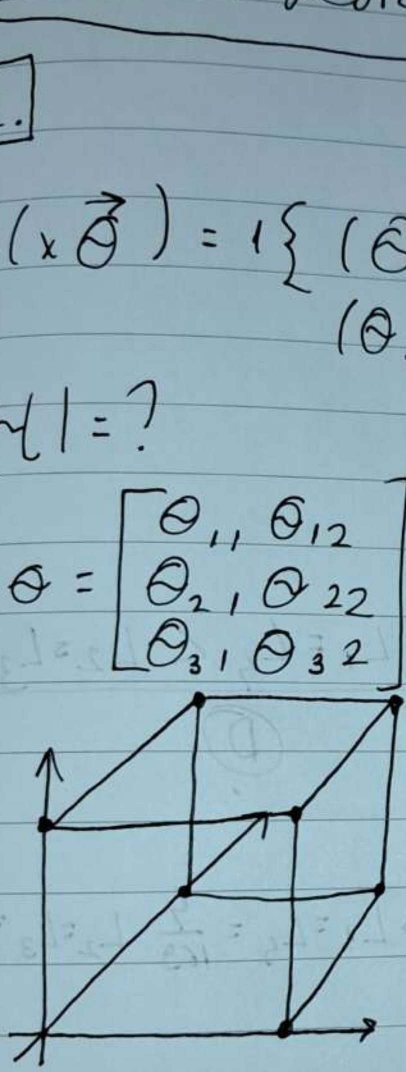
VO2 - Osnovi koncepti

2.2.

$$h(x;\vec{\theta}) = 1\{(\theta_{1,1} \le x_1 \le \theta_{1,2}) \land (\theta_{2,1} \le x_2 \le \theta_{2,1}) \land (\theta_{3,1} \le x_3 \le \theta_{3,3})\}$$

$|\mathcal{H}| = ?$

$$\theta = \begin{bmatrix} \theta_{11}, \theta_{12} \\ \theta_{21}, \theta_{22} \\ \theta_{31}, \theta_{32} \end{bmatrix} \quad \vec{x} \in \{0,1\}^3$$



- model definira kvadar:
  - primjer ima oznaku 1, ako je unutar kvadra
  - primjer ima oznaku 0 inače
- kvadar može obuhvaćati
  - 1 točka: 8
  - brid / 2 točke: 12
  - plohu / 4 točke: 6
  - sve točke: 1
  - niti jednu točku: 1

$|\mathcal{H}| = 28$ (D)

2.8.

$N = 6$

$$D = \{(x^{(i)}, y^{(i)})\} = \{((0,0,0),0), ((1,1,0),0), ((1,0,0),1), ((1,0,1),1), ((0,1,0),1), ((0,1,1),1)\}$$

$F_N = 1$ min i max

$F_P = \frac{1}{2}$ $E(h|D)$

min. pogreška

$$E(h|D) = \frac{1}{6}(5 \cdot 0 + \frac{1}{2}) = \frac{1}{12}$$

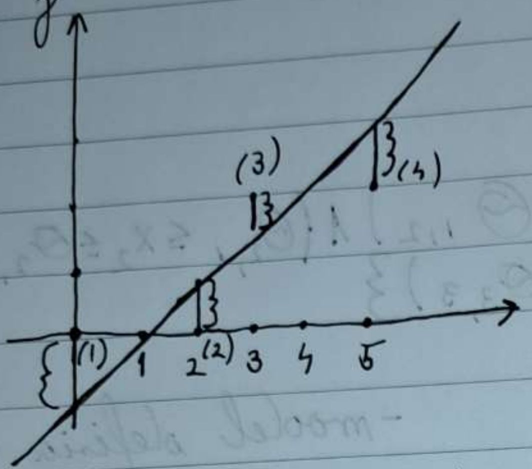
max. pogreška

$$E(h|D) = \frac{1}{6}(0 + 4 \cdot 1 + \frac{1}{2}) = \frac{3}{4}$$

$$\frac{1}{12} \le E(h|D) \le \frac{3}{4}$$ (D)

VO3 - Lineara regresija

$\boxed{2.3}$



Zadatak je moguće rješiti računski

$\vec{w} = (X^T X)^{-1} X^T \vec{y} = \ldots = \begin{bmatrix} -\frac{2}{13} \\ \frac{6}{13} \end{bmatrix}$

$L_1 = L_4 < L_2 = L_3$

D

$h(\vec{x}^i) = -\frac{2}{16} + \frac{6}{13} x$

$L(y^i, h(\vec{x}^i)) = (y^i - h(\vec{x}^i))^2 \Rightarrow L_1 = L_4 = \frac{4}{169} \quad L_2 = L_3 = \frac{100}{169}$

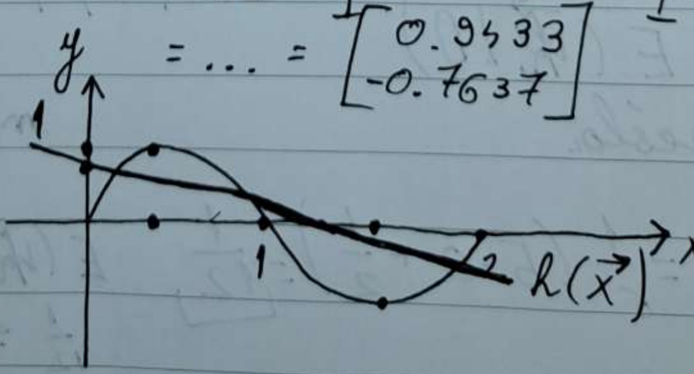
VO4 - Lineara regresija II

$\boxed{1.3}$ $f(x) = \sin(\pi x)$

$D = \{(0.25, 0.707), (0.5, 1), (1, 0), (1.5, -1), (2, 0]\}$

$\boxed{a)}$ $\Phi(\vec{x}) = (1, x)$ $\quad \vec{w} = (\Phi^T \Phi + \lambda I)^{-1} \Phi^T \vec{y}) = \ldots = \begin{bmatrix} 0.9433 \\ -0.7637 \end{bmatrix}$

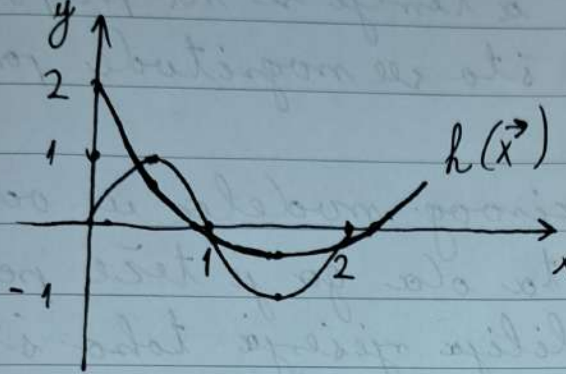
$\Phi = \begin{bmatrix} 1 & 0.25 \\ 1 & 0.5 \\ 1 & 1 \\ 1 & 1.5 \\ 1 & 2 \end{bmatrix}$



IVAN PAVELIĆ 0036543754

b) $\bar{\Phi}(\vec{x}) = (1, x, x^2)$

$$\bar{\Phi} = \begin{bmatrix} 1 & 0.25 & 0.0625 \\ 1 & 0.5 & 0.25 \\ 1 & 1 & 1 \\ 1 & 1.5 & 2.25 \\ 1 & 2 & 4 \end{bmatrix} \quad \vec{w} = (\bar{\Phi}^T \bar{\Phi})^{-1} \bar{\Phi}^T \vec{y} = \begin{bmatrix} 1.7538 \\ -2.9408 \\ 0.9755 \end{bmatrix}$$

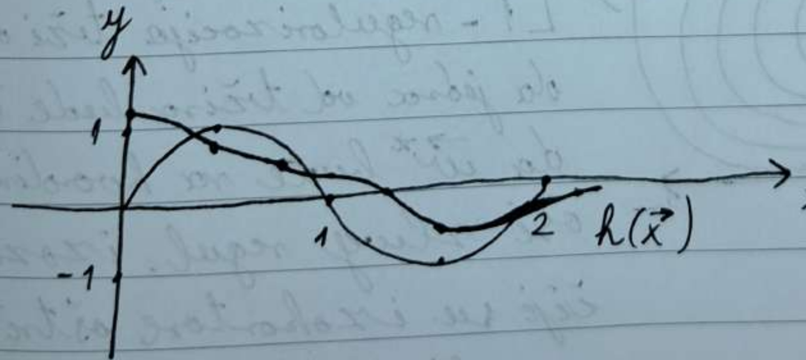


c) $\bar{\Phi}(\vec{x}) = (1, x, x^2, x^3, x^4)$

$\lambda = 1$

$$\vec{w} = (\bar{\Phi}^T \bar{\Phi} + \lambda \underline{I})^{-1} \bar{\Phi}^T \vec{y}$$

$$\vec{w} = \begin{bmatrix} 0.8330 \\ -0.2818 \\ -0.4156 \\ -0.3461 \\ 0.2479 \end{bmatrix} \quad \bar{\Phi} = \begin{bmatrix} 1 & 0.25 & 0.0625 & 0.0156 & 3.906 \cdot 10^{-3} \\ 1 & 0.5 & 0.25 & 0.125 & 0.0625 \\ 1 & 1 & 1 & 1 & 0 \\ 1 & 1.5 & 2.25 & 3.375 & 5.0625 \\ 1 & 2 & 4 & 8 & 16 \end{bmatrix}$$



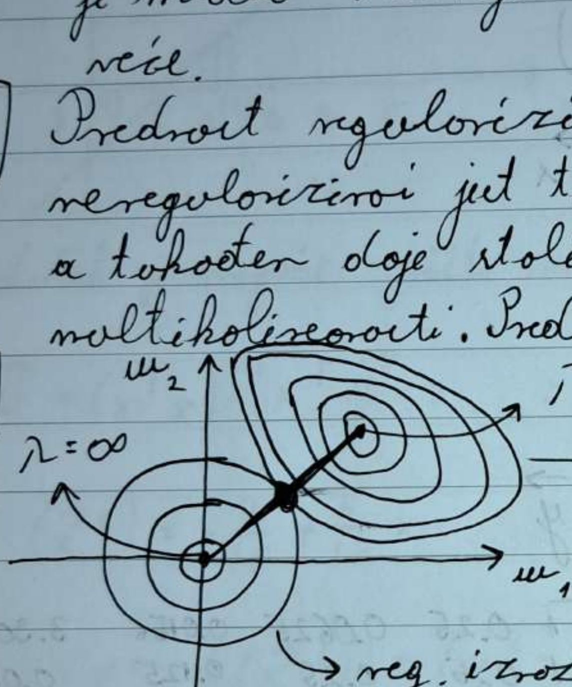
d) U ovom slučaju najprikladniji model je c) jer ima najmanju kvadratnu pogrešku

1.5.

a) Svrha regularizacije je da spriječi prenaučenost modela na način da ograniči rast vrijednosti parametara modela, a temelji se na pretpostavci da je model složeniji što su magnitude parametara veće.

b) Prednost regulariziranog modela u odnosu na neregularizirani jest ta da ga je teže prenaučiti, a također daje stabilija rješenja tako što smanjuje multikolinearnosti. Prednost dolazi kada imamo malo primjera.

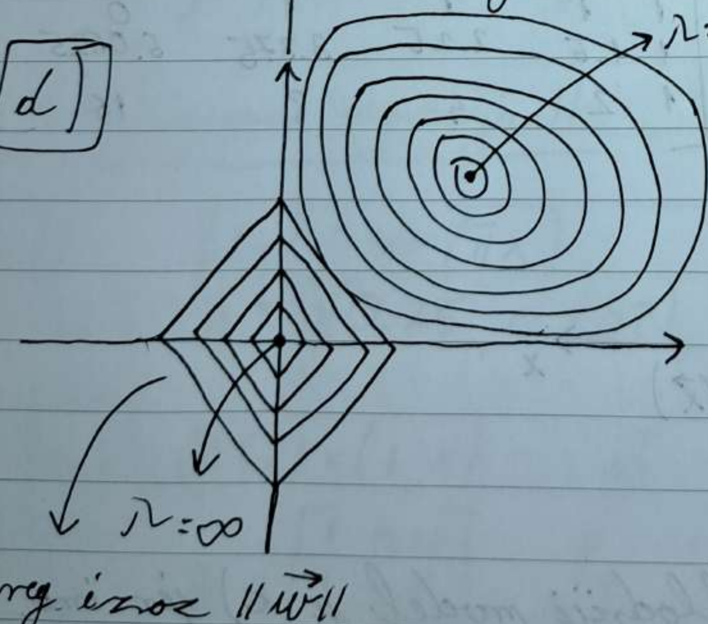
c)



izokonture emp. pogreške

L2-regularizacijom parametri modela se priteže prema 0. Optimalni parametri w_1^* i w_2^* su oni u kojima se izokonture dodiruju

d)



izokonture emp. pogreške

L1-regularizacija teži dogoditi da jedna od težina bude $\vec{0}$ tj. da $\vec{w}^*$ bude na koordinatnoj osi zbog regul. izraza čije su izokonture oštri rubovi, a posljedica su rijetki modeli

IVAN PAVELIĆ 0036543754

$\boxed{2.3}$ x_1-x_4 = ocjene srednje škole
x_5 = prosjek svih ocjena => kolinearnost
x_6 = matematika
x_7 = fizika

$\Phi(x_1, x_2, x_3, x_4, x_6, x_7)$

$$\left.\begin{array}{ll} 1 & -1 \\ x_i & -6 \\ x_i^2 & -6 \\ x_i x_j & -15 \\ x_i x_j x_z & -20 \end{array}\right\} 48 \text{ značajki}$$

rješenje je stabilno i bez regularizacije

$N \geq n(+1) \rightarrow$ uračunato kod preslika.

$\underline{N \geq 48}$ C