ZADATAK 1

$$h(x) = \underset{C_\ell}{\arg\max}\ P(X|C_\ell) \cdot P(C_\ell)$$

a) Bayesov klasif. temelji se na Bayesovom pravilu

$$P(C_j|x) = \frac{p(x|C_j) \cdot P(C_j)}{\sum_{k=1}^{K} p(x|C_k) \cdot P(C_k)}$$

$P(C_j)$ - apriorna vj. klase
$P(x|C_j)$ - izglednost klase } * zajednička gustoća $P(x, C_j)$
↳ klasom uvjetovana gustoća

$P(C_j|x)$ - aposteriorna vj. da primjer x pripada klasi C_j

marginalizacija => marginalna gustoća $p(x)$ je jednaka za sve klase C_j i služi samo za normalizaciju na jedinični interval

b) Model je parametarski budući da se podaci pokoravaju teorijskim razdiobama, pa se učenje svodi na izračunavanje parametara tih razdioba, na temelju podataka

broj par. je uvijek isti

c) To je generativni model jer modeliramo zajedničku vj. koja opisuje način generiranja podataka.

$$P(x, C_j) = P(x|C_j) \cdot P(C_j)$$

$$P(C_j|x) = \frac{P(x|C_j) \cdot P(C_j)}{P(x)}$$

→ opisuje generiranje

ZADATAK 2

$P(C_1) = 0.2$
$P(C_2) = 0.05$
$P(C_3) = 0.75$

$p(\vec{x}|C_1) = 0.8$
$p(\vec{x}|C_2) = 0.5$
$p(\vec{x}|C_3) = 0.5$

a) $P(C_1|\vec{x}) = \dfrac{0.8 \cdot 0.2}{0.8 \cdot 0.2 + 0.05 \cdot 0.5 + 0.75 \cdot 0.5} = \dfrac{2}{7} \approx 0.286$

$P(C_2|\vec{x}) = \dfrac{0.05 \cdot 0.5}{} = \dfrac{5}{112} \approx 0.045$

$P(C_3|\vec{x}) = \dfrac{0.75 \cdot 0.5}{-\,11\,-} = \dfrac{75}{112} \approx 0.669$

$h(\vec{x}) = \underset{C_k}{\arg\max}\; p(\vec{x}|C_k) \cdot p(C_k) = \underline{\underline{C_3}}$

b) odab.

$$L_1 = \begin{array}{c} \\ \\ \\ \end{array}\begin{array}{c} \begin{array}{ccc} C_1 & C_2 & C_3 \end{array} \\ \begin{pmatrix} 0 & 5 & 1 \\ 100 & 0 & 5 \\ 10 & 1 & 0 \end{pmatrix} \end{array} \begin{array}{c} \\ C_1 \\ C_2 \\ C_3 \end{array}$$

stvarno

$C_2 = C_3$ od $C_1 = C_3$
bolje od
$C_3 = C_1$
⇓
vatr. p. kao spam

$R(C_j|x) = \sum_{k=1}^{K} L_{kj} \cdot P(C_k|x)$

$R(C_1|x) = \sum_k L_{k1}\, P(C_1|x) = 0 \cdot P(C_1|x) + 100 \cdot P(C_2|x) + 10 \cdot P(C_3|x)$
$= 100 \cdot \frac{5}{112} + 10 \cdot \frac{75}{112} = \frac{625}{56} = 11.16$

$R(C_2|x) = 5 \cdot P(C_1|x) + P(C_3|x) = \frac{5 \cdot 2}{7} + \frac{75}{112} = \frac{235}{112} = 2.098$

$R(C_3|x) = P(C_1|x) + 2 \cdot P(C_2|x) = \frac{2}{7} + 2 \cdot \frac{5}{112} = \frac{3}{8} = 0.375$

$h_1(x) = \underset{C_k}{\arg\min}\; R(C_k|x) = \underline{\underline{C_3}}$

c) $P'(C_1) = 0.3$

$P'(C_2) = 0.3$

$P'(C_3) = 0.4$

posteriorne vj. isto :)

$P''(C_1|x) = \frac{P(C_1|x) \cdot P(C_1)}{P'(C_1)} = 0.19$

$P''(C_2|x) = 0.0576$

$P''(C_3|x) = 1.256$

$P(C_1|x) = \frac{0.19}{1.435} = 0.13$

$P(C_2|x) = 0.006$

$P(C_3|x) = 0.864$

$$L_2 = \begin{pmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$$

$$P'(C_1|x) = \frac{P(x|C_1) \cdot P(C_1)}{\sum_{i=1}^{3} P(x|C_i) \cdot P(C_i)} = \frac{0.3 \cdot 0.8}{0.3 \cdot 0.8 + 0.3 \cdot 0.5 + 0.4 \cdot 0.5} = \frac{24}{59} = 0.402$$

$$P(C_2|x) = \frac{0.3 \cdot 0.5}{-//-} = \frac{15}{59} = 0.254$$

$$P(C_3|x) = \frac{0.4 \cdot 0.5}{-//-} = \frac{20}{59} = 0.338$$

trebalo je ovo isto izgl. :)

2) $R(C_1|x) = P(C_2|x) + P(C_3|x) = \frac{35}{59}$

$R(C_2|x) = \frac{24}{59} + \frac{20}{59} = \frac{44}{59}$

$R(C_3|x) = \frac{39}{59}$

$$h_2(x) = \underset{C_k}{\operatorname{argmin}}\, R(C_k|x) = \underline{\underline{C_1}}$$

3) $$L_3 = L_1 = \begin{pmatrix} 0 & 5 & 1 \\ 100 & 0 & 5 \\ 10 & 1 & 0 \end{pmatrix}$$

$R(C_1|x) = 100 \cdot \frac{15}{59} + 10 \cdot \frac{20}{59} = \frac{1700}{59} = 23.814$

$R(C_2|x) = 5 \cdot \frac{24}{59} + \frac{39}{59} = \frac{159}{59} = 2.695$

$R(C_3|x) = \frac{24}{59} + 5 \cdot \frac{15}{59} = \frac{99}{59} = 1.678$

$$h_3(x) = \underset{C_k}{\operatorname{argmin}}\, R(C_k|x) = \underline{\underline{C_3}}$$

ZADATAK 3

N B.

a) Naivan Bayes

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

$$y^{(i)} \in \{C_1, \dots, C_k\}$$

$$h(\vec{x}) = \underset{j}{\operatorname{argmax}} \prod_{k=1}^{n} P(x_k | C_j)$$

$$h(x_1, \dots, x_n) = \underset{j}{\operatorname{argmax}}\ P(x_1, \dots, x_n | C_j) \cdot P(y = C_j)$$

b) → pretpostavka o uvjetnoj nez. značajki za klasu

$$P(x_1, \dots, x_n) = P(x_1) \cdot P(x_2 | x_1) \cdot P(x_3 | x_1, x_2) \cdots P(x_n | x_1, \dots, x_{n-1})$$

$$P(x_1, \dots, x_n | C_j) = P(x_1 | C_j) \cdot P(x_2 | x_1, C_j) \cdot \ldots \cdot P(x_n | x_1, \dots, x_{n-1}, C_j)$$

$$= \prod_{k=1}^{n} P(x_k | x_1, \dots, x_{k-1}, C_j) \qquad x_i \perp x_k | C_j \text{ itd}$$

$$\Rightarrow P(x_i | x_j, C) = P(x_i | C)$$

$$P(x_1, \dots, x_n | C_j) = P(x_1 | C_j) \cdot P(x_2 | x_1, C_j) \cdots P(x_n | x_1, \dots, x_{n-1}, C_j)$$

$$= P(x_1 | C_j) \cdot P(x_2 | C_j) \cdot \ldots \cdot P(x_n | C_j) = \prod_{k=1}^{n} P(x_k | C_j)$$

c) Zbog velikog broja parametara imat će vrlo visoku varijancu i bit će sklon prenaučenosti. On savršeno klasif. primjere iz skupa za učenje, ali svim neviđenim daje vjer. 0. Pretpostavka nam treba kako bi smanjili broj par. modela a time i složenost modela. Pripada pristranosti jezika, odnosno pristranosti ograničavanjem.

čim se bira složenost → pristr. jezika

d) 10 klasa

matrica 32 x 32

x_k	C	$P(x_k \mid C)$
0	0	μ_0
1	0	→ ref. $1-\mu_0$
⋮		
0	1	
1	1	

K redaka

com. prob. table

pref. Bayes (rad.)

broj parametara ?

10 klasa → K = 10 ⇒ $K - 1 = 9 + 32^2 \cdot 10$

$$+ \sum_{k=1}^{n} (K_k - 1) \cdot K$$

(?)

bin. znač. cer. 1024

K = 10

$n = 32 \times 32 = 1024$

$$h(\vec{x}) = \operatorname{argmax} P(C) \prod_{k=1}^{n} P(x_k | C)$$

$P(c=0)$ ... } 10 ⇒ jedna nap. 10-1

$\boxed{10249}$

ZADATAK 4

a) ML. PROCJ.

$P(da \mid Istra, ne, kamp, bus)$
$= P(Istra \mid da) \cdot P(ne \mid da) \cdot P(kamp \mid da) \cdot P(bus \mid da) \cdot P(da)$
$= \frac{2}{2} \cdot \frac{1}{4} \cdot \frac{0}{2} \cdot \frac{0}{2} \cdot \frac{4}{7} = 0$

$P(ne \mid Istra, ne, kamp, bus) = P(Istra \mid ne) \cdot P(ne \mid ne) \cdot P(kamp \mid ne) \cdot P(bus \mid ne) = \frac{0}{2} \cdot \frac{3}{4} \frac{2}{2} \cdot \frac{2}{2} \cdot \frac{3}{7} = \frac{9}{56} = 0$

$h(Istra, ne, kamp, bus) = \underset{C \in \{da, ne\}}{\text{argmax}} \; P(C \mid x) =$ ne može procijeniti

$P(da \mid Dalmacija, da, hotel, bus) = P(Dalm. \mid da) \cdot P(da \mid da) \cdot P(hotel \mid da) \cdot P(bus \mid da) \cdot P(da) = \frac{2}{3} \cdot \frac{3}{3} \cdot \frac{2}{2} \cdot \frac{0}{2} \cdot \frac{4}{7} = 0$

$P(ne \mid Dalm., da, hotel, bus) = P(Dalm \mid ne) \cdot P(da \mid ne) \cdot P(h \mid ne) \cdot P(bus \mid ne) \cdot P(ne) = \frac{1}{3} \cdot \frac{0}{3} \cdot \frac{0}{2} \cdot \frac{2}{2} \cdot \frac{3}{7} = 0$

→ ne može procijeniti

b) LAPLACEOV PROCJ.

$P(x_k \mid C_j) = \frac{N_{kj} + 1}{N_j + k_k}$

$P(mjesto = Istra \mid C = da) = \frac{2+1}{4+3}$

?

NE VALJA LAPLACE ?

k_k - broj mogućih značajki x

$P(da \mid Istra, ne, kamp, bus) =$
$= P(Istra \mid da) \cdot P(ne \mid da) \cdot P(kamp \mid da) \cdot P(bus \mid da) \cdot P(da)$
$= \frac{2+1}{2+3} \cdot \frac{1+1}{4+2} \cdot \frac{0+1}{2+3} \cdot \frac{0+1}{2+3} \cdot \frac{4}{7} = \cancel{\frac{4}{875}} = \cancel{4{,}57 \cdot 10^{-3}}$ 0.001662

$P(ne \mid Istra, ne, kamp, bus) = \frac{2}{5} \cdot \frac{4}{6} \cdot \frac{4}{5} \cdot \frac{4}{5} \cdot \frac{3}{7} = \cancel{0.073}$ 0,0143

$h(Istra, ne, kamp, bus) = ne$

$P(da \mid Dalm, da, hotel, bus) = \frac{2+1}{3+3} \cdot \frac{3+1}{3+2} \cdot \frac{2+1}{2+3} \cdot \frac{0+1}{2+3} \cdot \frac{4}{7} = \cancel{0{,}027}$ 0,0099

$P(ne \mid Dalm, da, hotel, bus) = \frac{3}{6} \cdot \frac{2}{5} \cdot \frac{2}{5} \cdot \frac{4}{5} \cdot \frac{3}{7} = 0{,}027428$ 0.0011

$h(Dalm., da, hotel, bus) = \cancel{\underline{\underline{ne}} \text{ može procj.}}$ DA

ZADATAK 5

a) entropija $E(x) = -\sum_x p(x) \ln p(x)$

$$E_R(x) = -\sum_x p(x) \ln g(x)$$

$$D_{KL}(p \| g) = E_R(x) - E(x)$$

$$= -\sum_x p(x) \ln g(x) + \sum_x p(x) \cdot \ln p(x)$$

$$= \sum_x p(x) (\ln p(x) - \ln g(x))$$

$$= \sum_x p(x) \ln \frac{p(x)}{g(x)}$$

$$D_{KL}(P(x,y) \| P(x) \cdot P(y)) = \sum_y \sum_x P(x,y) \ln \frac{P(x,y)}{P(x) P(y)} = I(x,y)$$

b)

x\y	1	2	3	
1	0.2	0.05	0.3	0.55
2	0.05	0.3	0.1	0.45
	0.25	0.35	0.4	

$$I(x,y) = \sum_y \sum_x \ln \frac{P(x,y)}{P(x) \cdot P(y)} = 0.2 \ln \frac{0.2}{0.55 \cdot 0.25} + 0.05 \ln \frac{0.05}{0.45 \cdot 0.25}$$

$$+ 0.05 \cdot \ln \frac{0.05}{0.55 \cdot 0.35} + 0.3 \cdot \ln \frac{0.3}{0.45 \cdot 0.35} + 0.3 \ln \frac{0.3}{0.55 \cdot 0.4}$$

$$+ 0.1 \ln \frac{0.1}{0.45 \cdot 0.4} = 0.1945$$

Nisu nezavisne !

uzajmna info mjeri nezavisnost !

ako je 0 => onda su potpuno nezavisne

ZADATAK 6

$\{0,1\}^5$

$\rightarrow I(x_3, C) > I(x_1, C) > I(x_2, C) > I(x_4 | C) > I(x_5, C)$

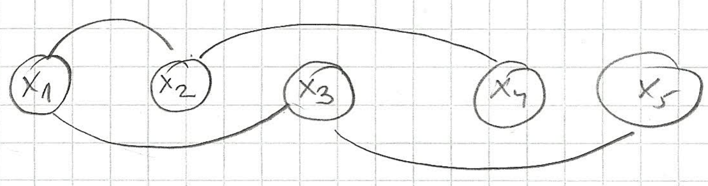
$\rightarrow I(x_1, x_3 | C) > I(x_2, x_4 | C) > I(x_1, x_2 | C) > I(x_3, x_4 | C) > I(x_1, x_4 | C)$
$> I(x_3, x_5 | C) > I(x_1, x_5 | C) > I(x_2, x_3 | C) > I(x_2, x_5 | C) > I(x_4, x_5 | C)$

a) ALGORITAM TAN (Bayesova mreža

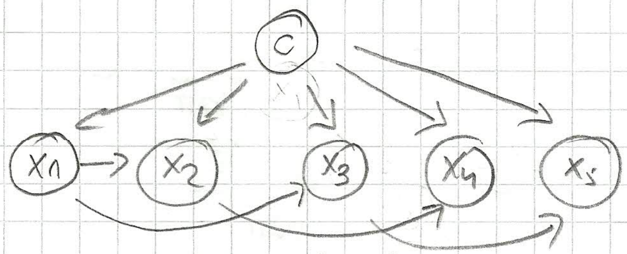
n-1 bridova

4

dok ne dobijemo povezan graf



broj parametara:
$X = \{0,1\}^5$
$K = 2$

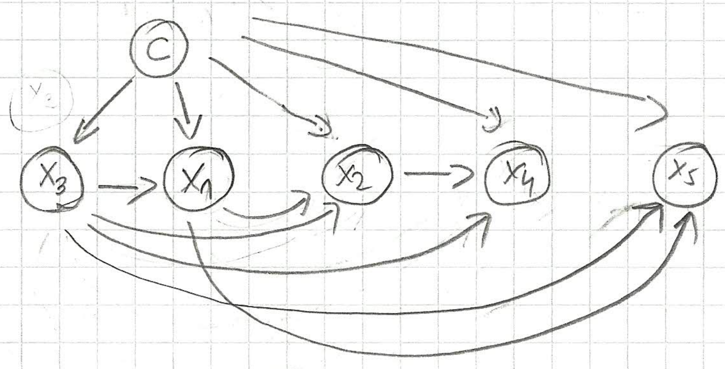


$P(C | x_1, x_2, x_3, x_4, x_5) \propto P(x_1 | C) \, P(x_2 | x_1, C) \cdot P(x_3 | x_1, C) \cdot P(x_4 | x_2, C)$
$\cdot P(x_5 | x_3, C) \cdot P(C)$

2 4 4 4 4 1 $= 19$

broj komb. - 1

b) algoritam 2-DB



P desno strani!

$P(C | x_1, x_2, x_3, x_4, x_5) \propto \overset{2}{P(x_3 | C)} \cdot \overset{4}{P(x_1 | x_3, C)} \cdot \overset{8}{P(x_2 | x_1, x_3, C)}$
$\cdot \underset{8}{P(x_4 | x_2, x_3, C)} \cdot \underset{8}{P(x_5 | x_1, x_3, C)} \cdot \underset{1}{P(C)}$

$= \cancel{29}$ 31

c) NAIVAN ~~KK~~ $1 + \overset{n \cdot k}{2 \cdot 5} = 11$

TAN $\Rightarrow 1 + 2 \cdot 2 + 4 \cdot \cancel{3} \cdot 2 = 1+4 + 24 = 29$

DB $\Rightarrow 1 + 2 \cdot 2 + 2 \cdot 3 \cdot 2 + 2 \cdot 3 \cdot 4 = 5 + 12 + 24 = 41$

ZADATAK 7

$\mathcal{X} = \mathbb{R}$ 3 klase

$P(C_1) = 0.3$

$P(C_2) = 0.2$

$P(C_3) = 1 - 0.3 - 0.2 = 0.5$

$\mu_1 = -5, \ \mu_2 = 0, \ \mu_3 = 5$

$\sigma_1^2 = 5 \quad \sigma_2^2 = 1 \quad \sigma_3^2 = 10$

$p(x|C_j), \ p(x, C_j), \ p(x), \ p(C_j|x)$

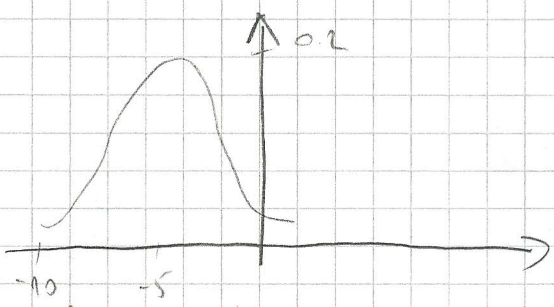
$$p(x|C_j) = \frac{1}{\sqrt{2\pi}\,\sigma_j} \exp\left\{ -\frac{(x-\mu_j)^2}{2\sigma_j^2} \right\}$$

$$p(x|C_1) = \frac{1}{\sqrt{2\pi}\sqrt{5}} e^{-\frac{(x+5)^2}{2\cdot 5}} = \frac{1}{\sqrt{10\pi}} e^{-\frac{(x+5)^2}{10}}$$

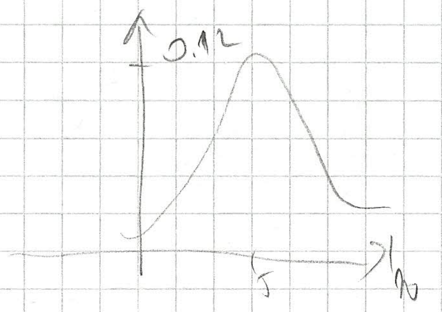
$$p(x|C_2) = \frac{1}{\sqrt{2\pi \cdot 1}} e^{-\frac{x^2}{2}} = \frac{e^{-\frac{x^2}{2}}}{\sqrt{2\pi}}$$

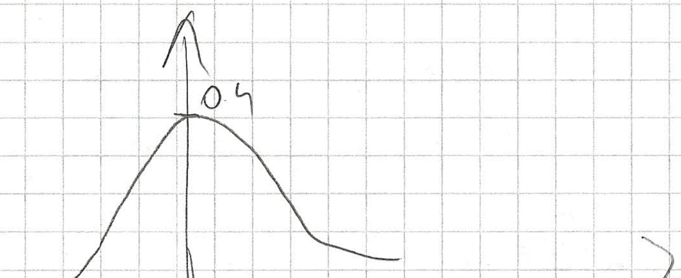
$$p(x|C_3) = \frac{1}{\sqrt{2\pi \cdot 10}} e^{-\frac{(x-5)^2}{2\cdot 10}} = \frac{1}{\sqrt{20\pi}} \cdot e^{-\frac{(x-5)^2}{20}}$$

$p(x|C_1)$



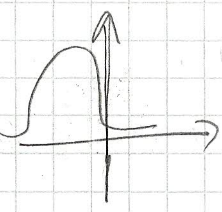
$p(x|C_2)$



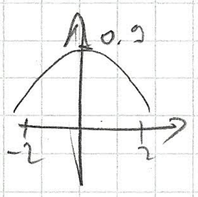


f-je gustoće [illegible]

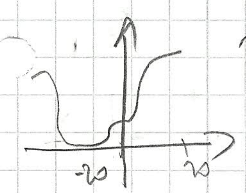
$$p(x) = p(x|C_1)\cdot P(C_1) + p(x|C_2)\cdot P(C_2) + p(x|C_3)\cdot P(C_3)$$
$$= \frac{1}{\sqrt{10\pi}}\, e^{-\frac{(x+5)^2}{10}} + \frac{1}{\sqrt{2\pi}}\, e^{-\frac{x^2}{2}} + \frac{1}{\sqrt{20\pi}}\cdot e^{-\frac{(x-5)^2}{20}}$$



$$p(C_1, x) = \frac{\frac{1}{\sqrt{10\pi}}\, e^{-\frac{(x+5)^2}{10}}}{\frac{1}{\sqrt{10\pi}}\, e^{-\frac{(x+5)^2}{10}} + \frac{1}{\sqrt{2\pi}}\, e^{-\frac{x^2}{2}} + \frac{1}{\sqrt{20\pi}}\cdot e^{-\frac{(x-5)^2}{20}}}$$



$$p(C_2\, x) = \frac{\frac{1}{\sqrt{2\pi}}\, e^{-\frac{x^2}{2}}}{\frac{1}{\sqrt{10\pi}}\, e^{-\frac{(x+5)^2}{10}} + \frac{1}{\sqrt{2\pi}}\, e^{-\frac{x^2}{2}} + \frac{1}{\sqrt{20\pi}}\cdot e^{-\frac{(x-5)^2}{20}}}$$



$$p(C_3|x) = \frac{\frac{1}{\sqrt{20\pi}}\, e^{-\frac{(x-5)^2}{20}}}{\frac{1}{\sqrt{10\pi}}\, e^{-\frac{(x+5)^2}{10}} + \frac{1}{\sqrt{2\pi}}\, e^{-\frac{x^2}{2}} + \frac{1}{\sqrt{20\pi}}\, e^{-\frac{(x+5)^2}{20}}}$$

$$p(x, C_1) = p(x|C_1)\cdot p(C_1) = \frac{0.3}{\sqrt{10\pi}}\cdot e^{-\frac{(x+5)^2}{10}}$$

$$p(x, C_2) = \frac{0.2}{\sqrt{2\pi}}\, e^{-\frac{x^2}{2}}$$

$$p(x, C_3) = \frac{0.5}{\sqrt{20\pi}}\, e^{-\frac{(x-5)^2}{20}}$$

ZADATAK 8

$X = \mathbb{R}^n \quad , \mathcal{N}(\mu_j, \Sigma_j)$

OPĆENITI BAYES

$$p(x|C_j) = \frac{1}{(2\pi)^{n/2} |\Sigma_j|^{1/2}} \cdot \exp\left\{-\frac{1}{2}(x-\mu_j)^T \Sigma_j^{-1} (x-\mu_j)\right\}$$

$$h_j(x) = \ln p(x|C_j) + \ln P(C_j)$$

$$= \ln (2\pi)^{-n/2} + \ln |\Sigma_j|^{-\frac{1}{2}} + \ln e^{-\frac{1}{2}(x-\mu_j)^T \Sigma_j^{-1}(x-\mu_j)} + \ln P(C_j)$$

$$= \underbrace{-\frac{n}{2}\cancel{\ln(2\pi)}}_{\text{konst.}} - \frac{1}{2}\ln|\Sigma_j| - \frac{1}{2}(x-\mu_j)^T \Sigma_j (x-\mu_j) + \ln P(C_j)$$

$$= -\frac{1}{2}\ln|\Sigma_j| - \frac{1}{2}(x-\mu_j)^T \Sigma_j^{-1}(x-\mu_j) + \ln P(C_j)$$

$$= -\frac{1}{2}\ln|\Sigma_j| - \frac{1}{2}x^T\Sigma_j^{-1}x + \frac{1}{2}x^T\Sigma_j^{-1}\mu_j + \frac{1}{2}\mu_j^T\Sigma_j^{-1}x - \frac{1}{2}\mu_j^T\Sigma_j^{-1}\mu_j + \ln P(C_j)$$

$$= -\frac{1}{2}\ln|\Sigma_j| - \frac{1}{2}x^T\Sigma_j^{-1}x + x^T\Sigma_j^{-1}\mu_j - \frac{1}{2}\mu_j^T\Sigma_j^{-1}\mu_j + \ln P(C_j)$$

DIJELJENA

$$\hat{\Sigma} = \sum_j \hat{P}(C_j) \cdot \hat{\Sigma}_j$$

$$h_j(x) = \underbrace{-\frac{1}{2}\cancel{\ln\hat{\Sigma}}}_{\text{konst.}} \underbrace{-\cancel{\frac{1}{2}x^T\hat{\Sigma}^{-1}x}}_{\text{konst.}} + x^T\Sigma^{-1}\mu_j - \frac{1}{2}\mu_j^T\Sigma_j^{-1}\mu_j + \ln P(C_j)$$

$$= x^T\Sigma^{-1}\mu_j - \frac{1}{2}\mu_j^T\Sigma_j^{-1}\mu_j + \ln P(C_j)$$

Uz pretpostavku kako var. nisu korelirane $\Rightarrow$ dijagonalna kov. matrica

$\Sigma = \mathrm{diag}(\sigma_i^2) \Rightarrow$ invert $\Sigma^{-1} = 1/\sigma_i^2 \, I$

$$h_j(x) = \sum_{i=1}^{n} \frac{x_i \cdot \mu_{ij}}{\sigma_i^2} - \frac{1}{2}\sum_{i=1}^{n}\frac{\mu_{ij}^2}{\sigma_i^2} + \ln P(C_j)$$

$$= \sum_{i=1}^{n}\left(\frac{x_i\mu_{ij}}{\sigma_i^2} - \frac{\mu_{ij}^2}{2\sigma_i^2}\right) + \ln P(C_j)$$

$$= -\sum_{i=1}^{n}\frac{\mu_{ij}}{\sigma^2}(-2x_i + \mu_{ij}) + \ln P(C_j)$$

$\Rightarrow$ dodaje se redudantni član x^2 (jednako u svim hipotezama pa nam ništa ne znači za maksim.

$$h_j(x) = -\frac{1}{2}\sum_{i=1}^{n} \frac{x_i^2 - 2x_i\mu_{ij} + \mu_{ij}^2}{\sigma_i^2} + \ln P(G_j)$$

$$= -\frac{1}{2}\sum_{i=1}^{n}\left(\frac{x_i - \mu_{ij}}{\sigma_i}\right)^2 + \ln P(G_j)$$

ZADATAK 9

G_1 = "završava FER u roku"

G_2 = "Produljuje studij"

-> svaki primjer ima 6 ulaznih varijabli => 1. - 4.

$\mathcal{H}_1$ => dijeljena kov. m.

$\mathcal{H}_2$ => dijagonalna kov. m.

$\mathcal{H}_3$ => izotropna kov. m.

a) $\mathcal{H}_1$ => $K n$ => vektori srednjih vrijednosti $6 \cdot 2 = 12$

$\frac{n}{2}(n+1)$ => kovarijacijska $\frac{6}{2} \cdot 7 = 21$

$K-1$ => apriorne 1

34 parametara

$\mathcal{H}_2$ => $K n$ => srednje v. $6 \cdot 2 = 12$

n => kovarij. 6

$K-1$ => apriori 1

19 parametara

$\mathcal{H}_3$ => $K n$ => srednje 12

1 => kov. 1

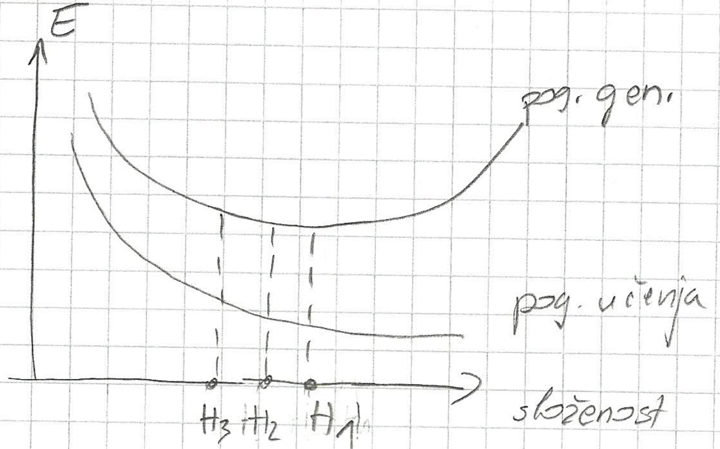
$K-1$ => apriorne 1

14 parametara

b) Razumno je pretpostaviti da postoji korelacija između prosjeka u sr. šk. i uspjeha na drž. mat, uz to i da će uspjeh učenika rasti kroz razrede, => veća var. u 1. i 2., a manja u 3. i 4. zbog prilagodbe

Model $\mathcal{H}_1$ bio bi najbolji jer druga dva uvode previše pretpostavki i postaju prejednostavni.

c)



d) Na odluku utječe više faktora

→ ravnaju li se primjeri prema nekoj dist. i kojoj?

→ želimo li žrtvovati točnost zbog memorije / vremena

ali najviše ovisi o samom problemu.

Isprobati više različitih modela, usporediti empirijske i pog. gen., usporediti perf.

→ eksperimentalno UNAKRSNA provjera

ZADATAK 10

$L(y, h(x|\theta))$, $E(\theta, D)$

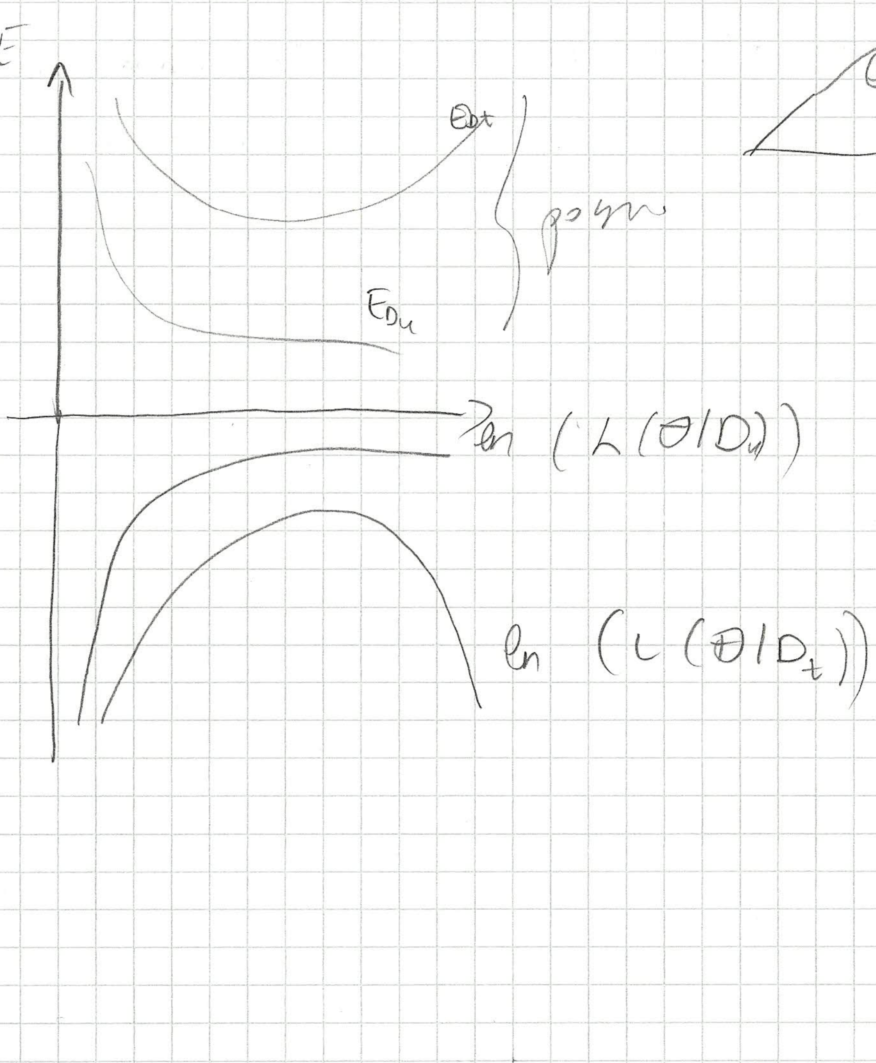
a) Izraziti f-ju gubitka B.k. preko f-je izglednosti

$\ln L(y | h(x|\theta))$

Rj: $L(y, h(\vec{x}|\theta)) = -N \ln p(x|\theta)$

NA SLAJDU!!! cf. G

b)



log-izgl. je neg.

jer će manje od N