DeDP Seminar 5

$f_1 = 1$

$$\boxed{d(r, s_0)^2 \geq d(r, s_1)^2 + 2\sigma^2 \ln(K)}$$

$K = 1$
$\cancel{\ln K} = 0$

ML:
$K = 1$

(1) $H_1: s_1(t) = 3 \sin(2\pi \cdot t)$

$H_0: s_0(t) = 0$

$r = [1.1 \quad 4.4]$

$t = [0.125 \quad 0.625]$

$D_{ML} = ?$

$s_0 = [0 \quad 0]$

$s_1 = [2.12 \quad -2.12]$

$r = [1.1 \quad 4.4]$

$$s_1(t_1) = 3 \cdot \sin(2\pi \overbrace{0.125}^{1/8}) = 3 \cdot \sin(\pi/4) = 3 \cdot \frac{\sqrt{2}}{2} = 2.12$$

$$s_1(t_2) = 3 \cdot \sin(2\pi \cdot \underbrace{0.625}_{5/8}) = 3 \cdot \sin\left(5\frac{\pi}{4}\right) = -3 \cdot \frac{\sqrt{2}}{2} = -2.12$$

$$d(r, s_0)^2 = 1.1^2 + 4.4^2 = 20.57$$

$$d(r, s_1)^2 = (1.1 - 2.12)^2 + (4.4 + 2.12)^2 = 43.5508$$

$\Rightarrow D_0$ (smallest wins)

② a)

$s_0 = [\,2 \quad 2 \quad -2\,]$

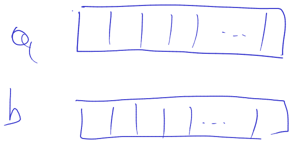
$s_1 = [\,-2 \quad -2 \quad 2\,]$

$r = [\,-1 \quad -1 \quad 1\,]$

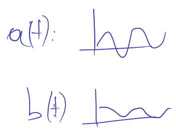
$d(r, s_0)^2 = 9 + 9 + 9 = 27$

$d(r, s_1)^2 = 1 + 1 + 1 = 3$ $\Rightarrow$ D_1

b)



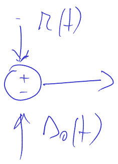
$d(a,b) = \sqrt{\sum_i (a_i - b_i)^2}$ Geometric distance: for vectors

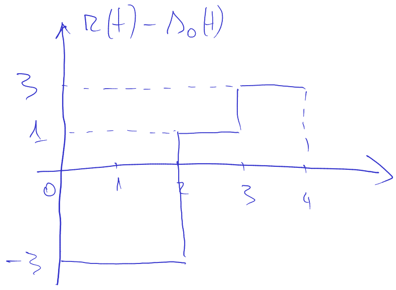


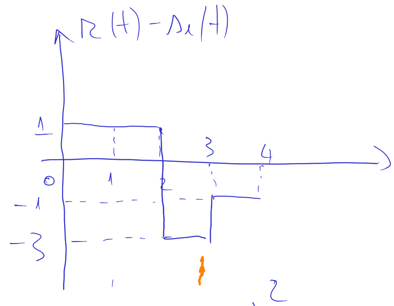
$d(a,b) = \sqrt{\int (a(t) - b(t))^2 dt}$ for cont. signals

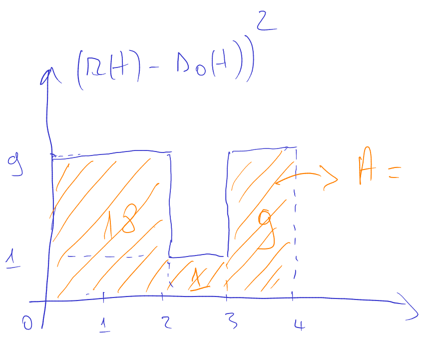
$d(r, s_0)^2 = \int (r(t) - s_0(t))^2 dt = 28$

$d(r, s_1)^2 = \int (r(t) - s_1(t))^2 dt = 12$

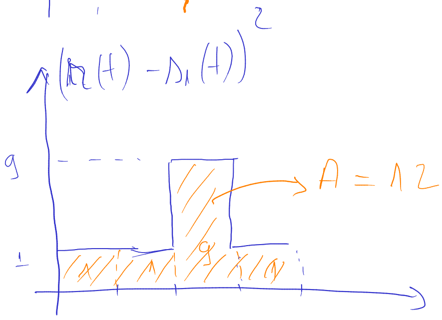








$A = 28 = \int_0^4 (r(t) - s_0(t))^2 dt$



$A = 12$

$\left.\begin{aligned} d(r, s_0)^2 &= 28 \\ d(r, s_1)^2 &= 12 \end{aligned}\right\} \Rightarrow D_1$

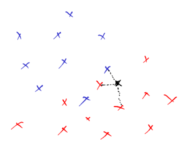
③

$d(x, v_1) =$

$d(x, v_2) =$

$\vdots$

$d(x, v_{10}) =$



- Class A:

$$\vec{v}_1 = \begin{bmatrix} 2 \\ -4 \end{bmatrix} \quad \vec{v}_2 = \begin{bmatrix} 1 \\ -5 \end{bmatrix} \quad \vec{v}_3 = \begin{bmatrix} -2 \\ 6 \end{bmatrix} \quad \vec{v}_4 = \begin{bmatrix} -3 \\ 4 \end{bmatrix} \quad \vec{v}_5 = \begin{bmatrix} 2 \\ -5 \end{bmatrix}$$

- Class B:

$$\vec{v}_6 = \begin{bmatrix} 3 \\ 1 \end{bmatrix} \quad \vec{v}_7 = \begin{bmatrix} -1 \\ 1 \end{bmatrix} \quad \vec{v}_8 = \begin{bmatrix} -4 \\ -3 \end{bmatrix} \quad \vec{v}_9 = \begin{bmatrix} -3 \\ 0 \end{bmatrix} \quad \vec{v}_{10} = \begin{bmatrix} -2 \\ 3 \end{bmatrix}$$

$x = \begin{bmatrix} -2 \\ 5 \end{bmatrix}$

$d(x, v_1) = \sqrt{16 + 81} = \sqrt{97}$

$d(x, v_2) = \sqrt{9 + 100} = \sqrt{109}$

$d(x, v_3) = \sqrt{1}$

$d(x, v_4) = \sqrt{2}$

$d(x, v_5) = \sqrt{116}$

$d(x, v_6) = \sqrt{41}$

$d(x, v_7) = \sqrt{17}$

$d(x, v_8) = \sqrt{68}$

$d(x, v_9) = \sqrt{26}$

$d(x, v_{10}) = \sqrt{4}$

increasing distance $\rightarrow$

V_3	V_4	V_{10}	V_7	V_9	V_6	V_8	V_1	V_2	V_5
A	A	B	B	B	B	B	A	A	A

$K = 1 \quad \Rightarrow A$

$K = 3 \quad \Rightarrow A$

$K = 5 \quad \Rightarrow B$

$K = 7 \quad \Rightarrow B$

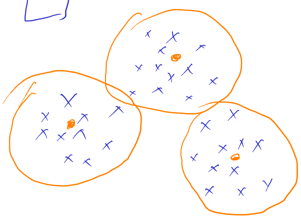
$K = 9 \quad \Rightarrow B$

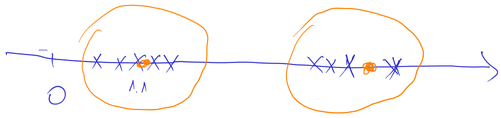
④

$$\vec{v} = \{v_i\} = [\boxed{1.1}, 0.9, 5.5, 0.6, 5, 6, 1.3, 4.8, 6, 0.8]$$

K-Means

clusterization





$C_1 = 0.95$

$C_2 = 0.96$

1) a) C_1 : 0.9 0.6 0.8

C_2 : 1.1 5.5 5 6 1.3 4.8 6

average

average

b). $C_1 = \frac{0.9+0.6+0.8}{3} = 0.76$

$C_2 = 4.24$

2) a) C_1 : 1.1 0.9 0.6 1.3 0.8

C_2 : 5.5 5 6 4.8 6

b). $C_1 = 0.94$

$C_2 = 5.46$

$$\vec{v} = \{v_i\} = [1.1, 0.9, 5.5, 0.6, 5, 6, 1.3, 4.8, 6, 0.8]$$

3). a) C_1 : 1.1 0.9 0.6 1.3 0.8

C_2 : 5.5 5 6 4.8 6

b). $C_1 = 0.94$

$C_2 = 5.46$

Algorithm converged