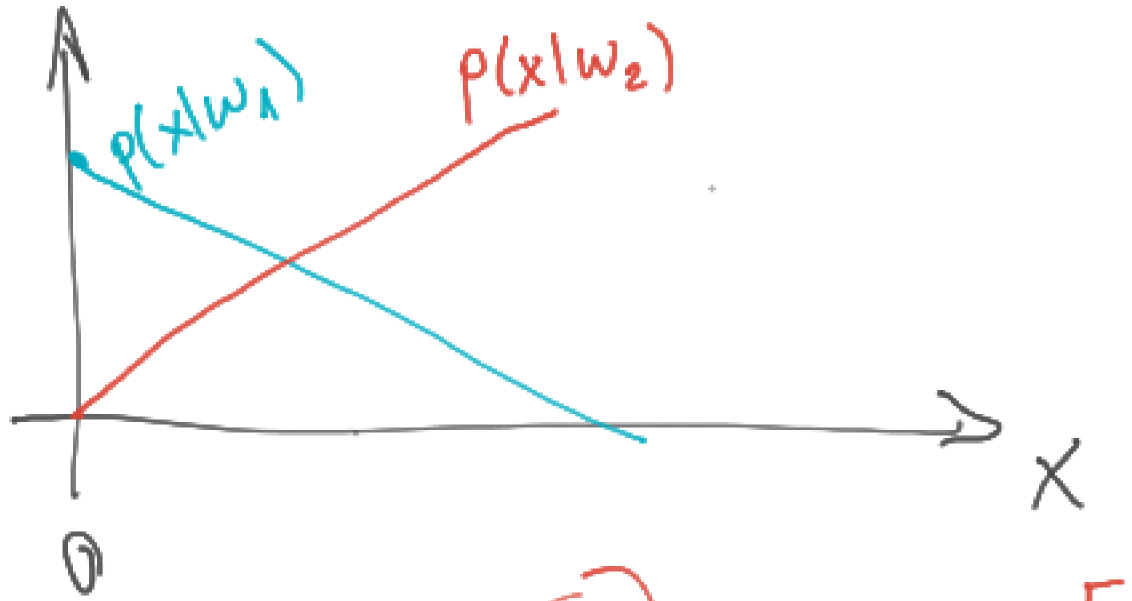
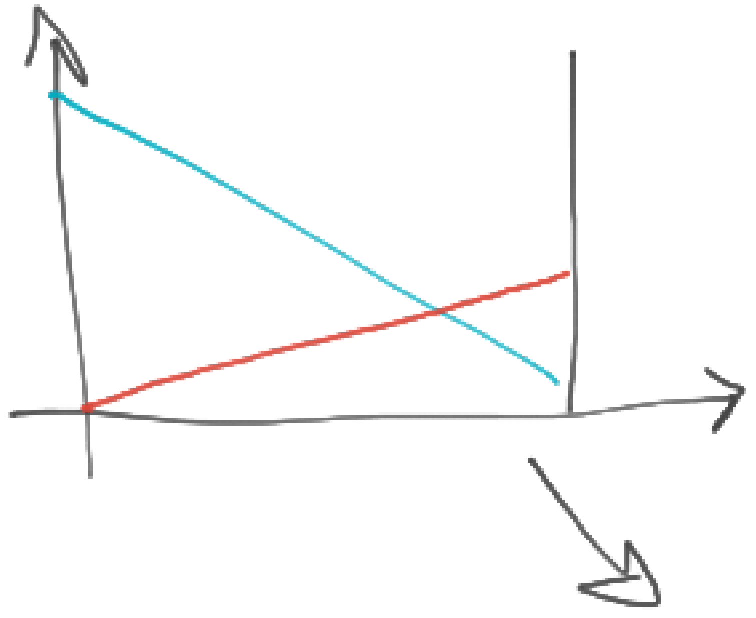
$$P(w_i|x) = P(w_i) \cdot p(x|w_i)$$

$$\begin{cases} P(w_1) = P(w_2) \\ \sum_{j=1}^{c} P(w_j) = 1 \end{cases}$$





$$\begin{cases} P(w_1) = P(w_2) \\ P(w_1) + P(w_2) = 1 \end{cases}$$

$\hookrightarrow P(w_2) + P(w_2) = 1 \rightarrow P(w_2) = \frac{1}{2}$

100

50 → SPAM $\frac{50}{100}$

50 → ~~MAIL~~ HAM $\frac{50}{100}$

$\frac{100}{100}$

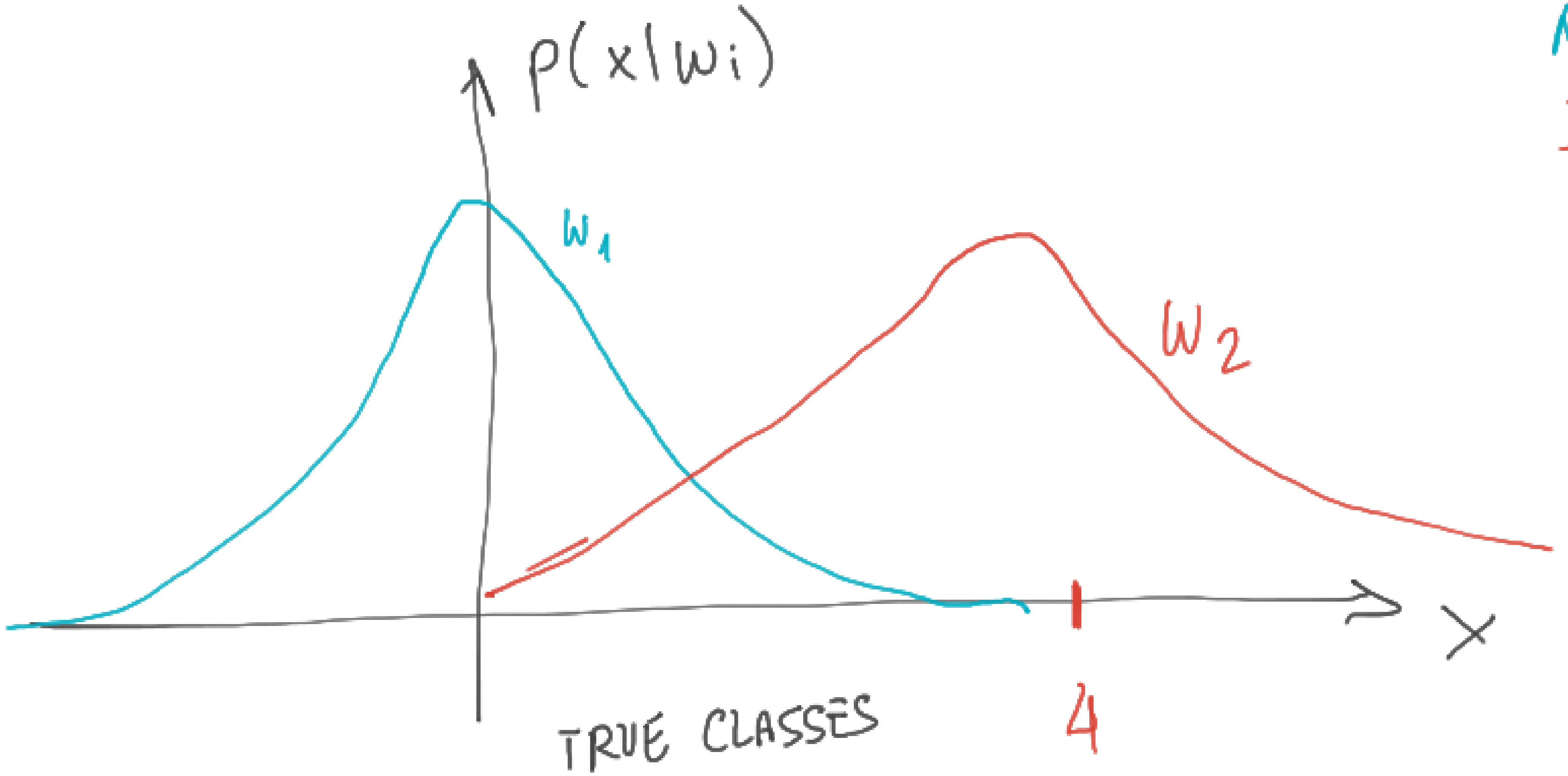
$$\begin{cases} P(\omega_1) = 10\,P(\omega_2) \\ P(\omega_1) + P(\omega_2) = 1 \end{cases}$$

$$\Downarrow$$

$$10P(\omega_2) + P(\omega_2) = 1$$

$$11\,P(\omega_2) = 1 \rightarrow P(\omega_2) = \frac{1}{11}$$

$$P(\omega_1) = 1 - \frac{1}{11} = \frac{10}{11}$$



Normal traffic → ω_1

Intruder → ω_2

$$
\Lambda = \begin{array}{cc} & \text{TRUE CLASSES} \\ \text{ACTIONS} & \begin{bmatrix} 0 & 10 \\ 1 & 0 \end{bmatrix} \end{array} = \begin{bmatrix} 0 & 20 \\ 2 & 0 \end{bmatrix}
$$

λ_{ij} = cost of taking action i but the true class is j

$$
\boxed{10\,\lambda_{21} = \lambda_{12}}
$$

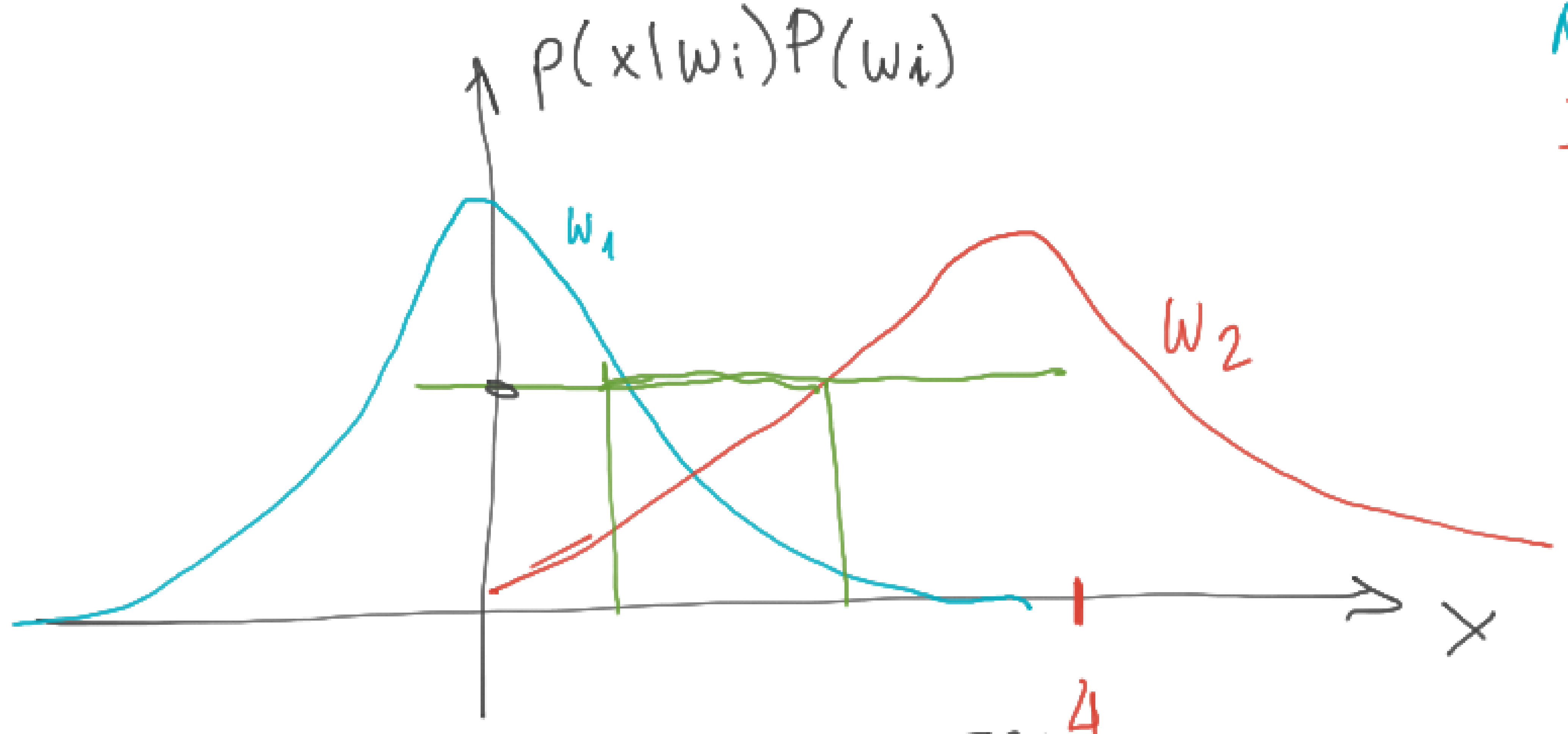
R

$R_1 = R_2$

$\overset{1}{\cancel{2}} \longleftarrow \quad \longrightarrow \overset{10}{\cancel{20}}$

Normal traffic $\to \omega_1$

Intruder $\to \omega_2$



$$\Lambda = \begin{array}{cc} & \text{TRUE CLASS} \\ \text{ACTIONS} & \begin{bmatrix} 0.3 & 0.3 \\ 0 & 1 \\ 1 & 0 \end{bmatrix} \end{array}$$

$$\begin{bmatrix} 0.6 & 0.6 \\ 0 & 2 \\ 2 & 0 \end{bmatrix}$$

$$T = \frac{\lambda_e - \lambda_r}{\lambda_e - \lambda_c} = \frac{1 - 0.3}{1} = 0.7$$

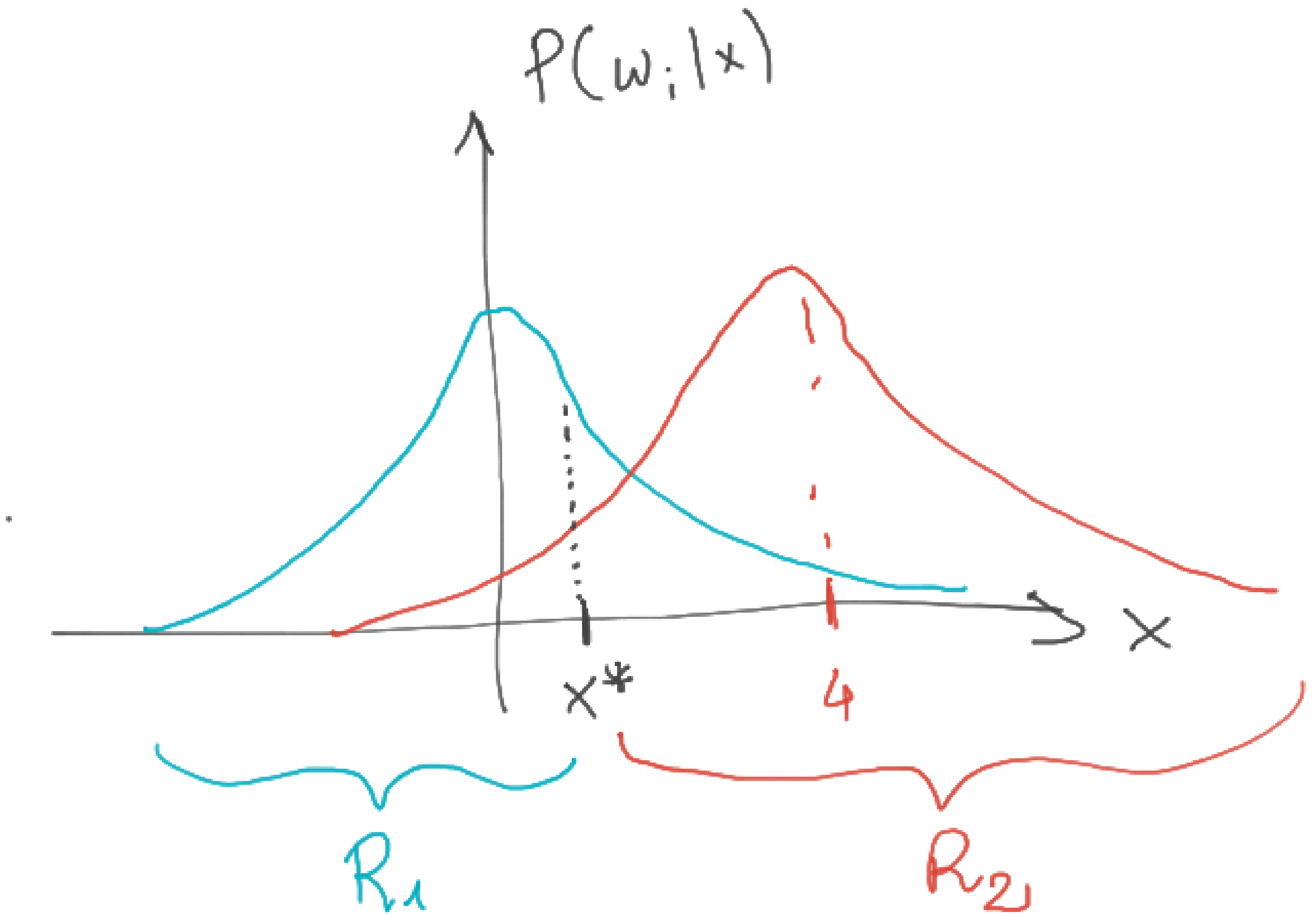
$$T = \frac{2 - 0.6}{2} = \frac{1.4}{2} = 0.7$$

$$P_1 = P_2 = \frac{1}{2}$$

$$p(x|\omega_1) = \mathcal{N}(\overset{\overset{\mu}{\downarrow}}{0}, \overset{\overset{\sigma}{\downarrow}}{1})$$

$$p(x|\omega_2) = \mathcal{N}(4, 1)$$

$$x^* = 1.424$$

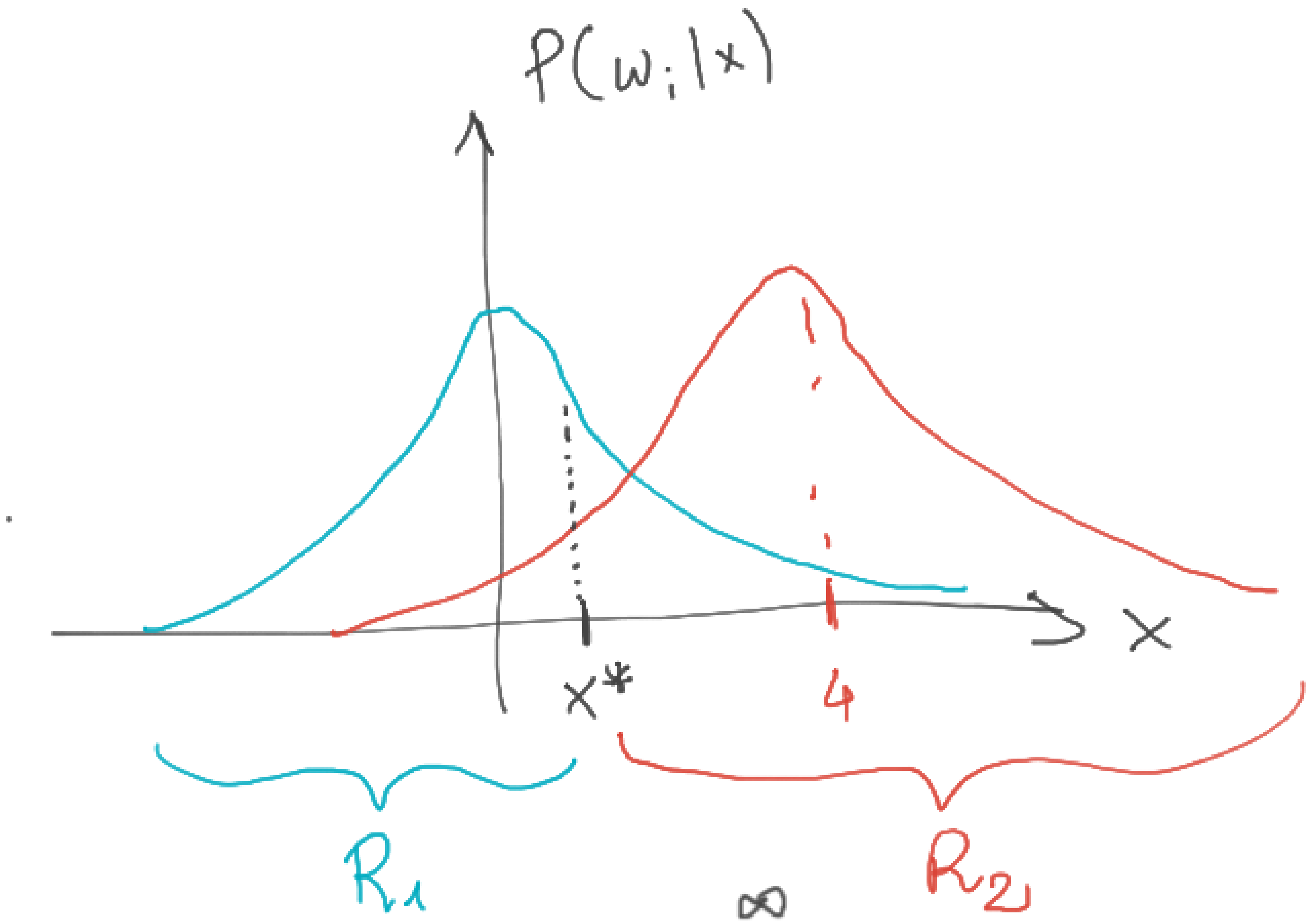


$$P(\text{error}) = P(\omega_1) \cdot \int_{x^*}^{\infty} \mathcal{N}(0,1)\,dx + P(\omega_2) \int_{-\infty}^{x^*} \mathcal{N}(4,1)$$

$$\boxed{\int_{-\infty}^{x} \mathcal{N}(0,1)\,dx = \frac{1}{2} + \frac{1}{2}\,\mathrm{erf}\left(\frac{x}{\sqrt{2}}\right)}$$

Normal Standard Distribution

$$e^{-z^2} \rightarrow z^2 = \frac{t^2}{2}$$



$$P_1 = P_2 = \frac{1}{2}$$

$$p(x|\omega_1) = \mathcal{N}(\overset{\mu}{0}, \overset{\sigma}{1})$$

$$p(x|\omega_2) = \mathcal{N}(4, 1)$$

$$x^* = 1.424$$

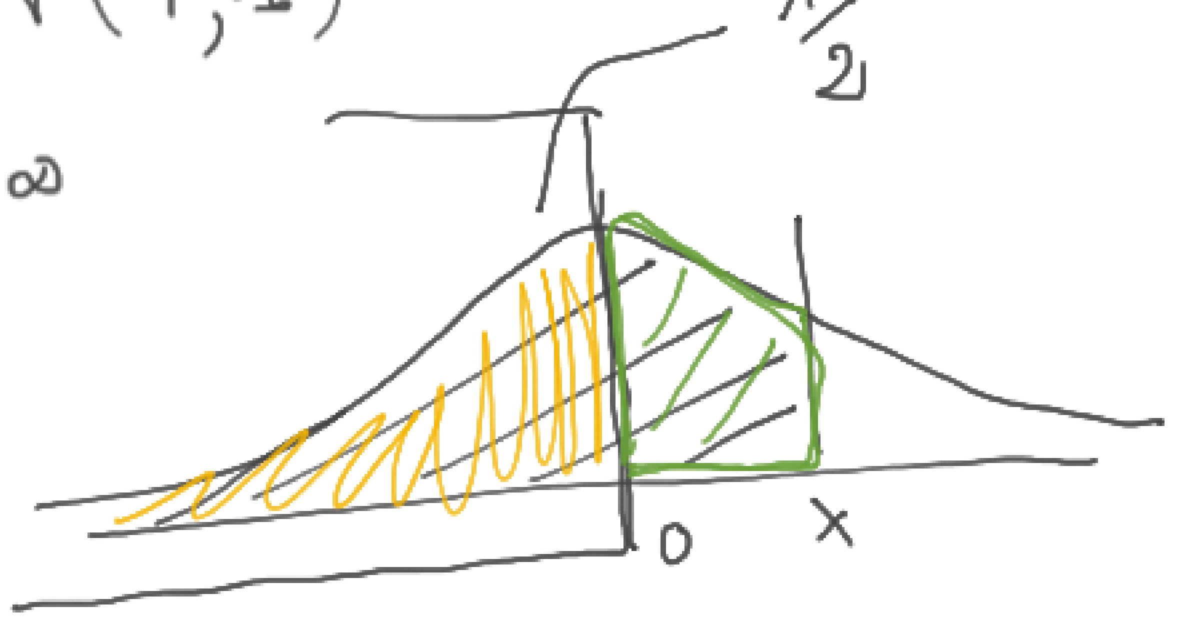
$$erfc(x) = 1 - erf(x)$$

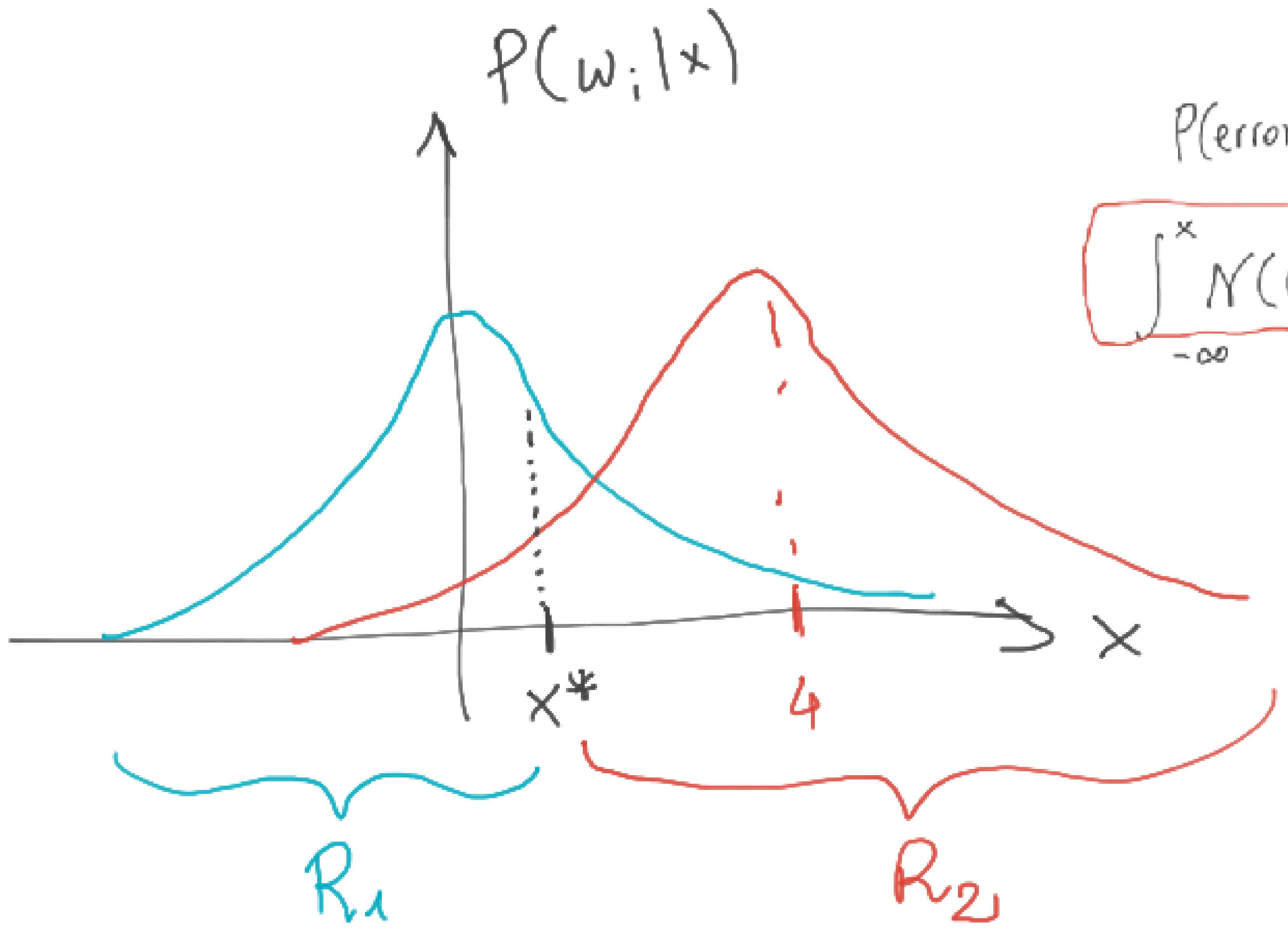
$$P(error) = P(\omega_1) \cdot \int_{x^*}^{\infty} \mathcal{N}(0,1)\,dx + P(\omega_2) \int_{-\infty}^{x^*} \mathcal{N}(4,1)$$

x^*

$$\boxed{\int_{-\infty}^{x} \mathcal{N}(0,1)\,dx = \frac{1}{2} + \overbrace{\frac{1}{2} erf\left(\frac{x}{\sqrt{2}}\right)}}$$

Normal Standard Distribution





$$P(\text{error}) = P(\omega_1)\cdot\int_{x^*}^{\infty} N(0,1)\,dx + P(\omega_2)\int_{-\infty}^{x^*} N(4,1)$$

$$\boxed{\int_{-\infty}^{x} N(0,1)\,dx = \frac{1}{2} + \overbrace{\frac{1}{2}\operatorname{erf}\left(\frac{x}{\sqrt{2}}\right)}}$$

Normal Standard Distribution

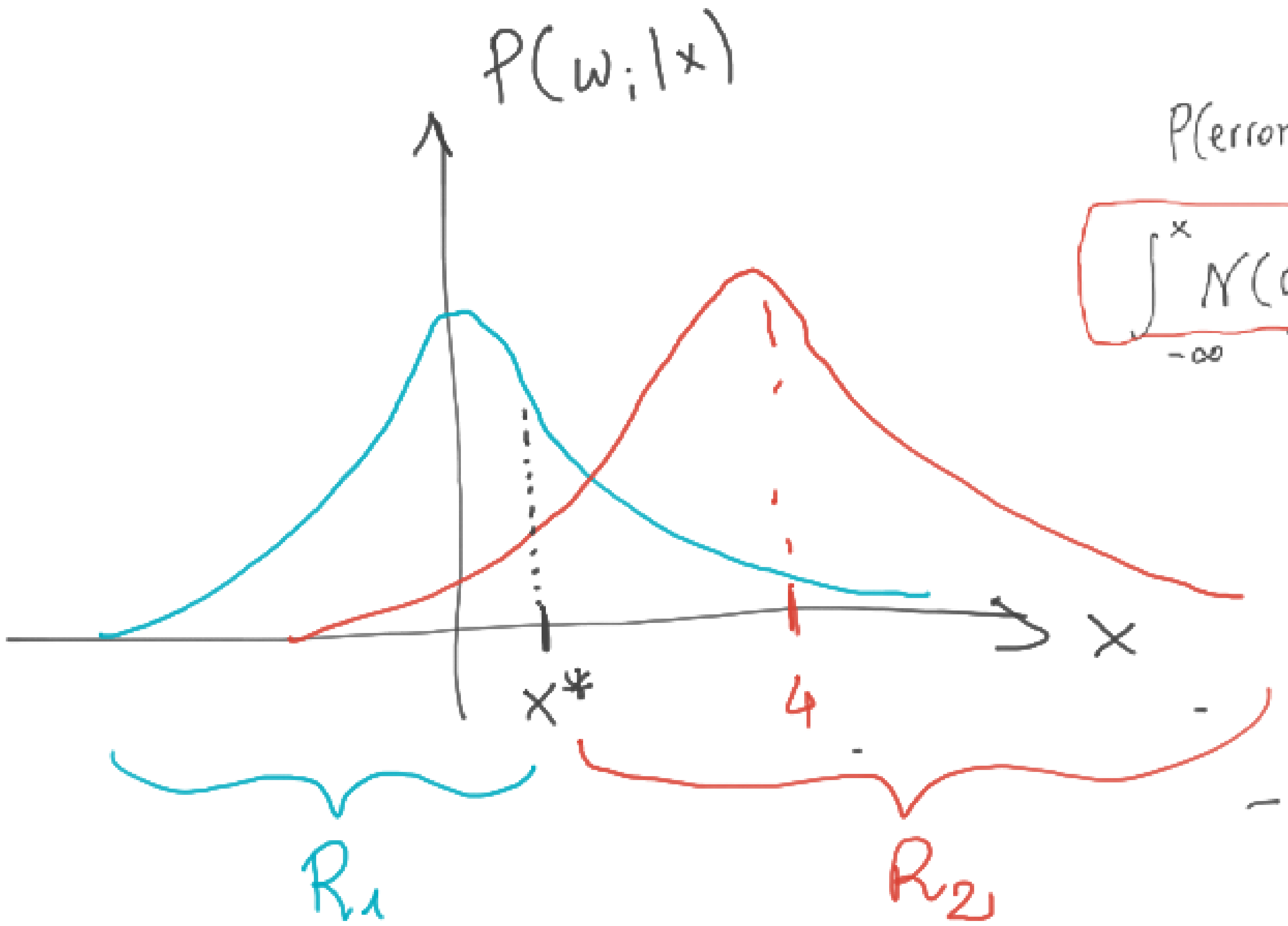
$$\underset{P(\omega_1)}{\frac{1}{2}}\underbrace{\left(\frac{1}{2}\operatorname{erfc}\left(\frac{1.42}{\sqrt{2}}\right)\right)}_{\text{Integral of Gaussian}} = \frac{1}{2}\left(\frac{1}{2}\cdot 0.157\right) = 0.039$$

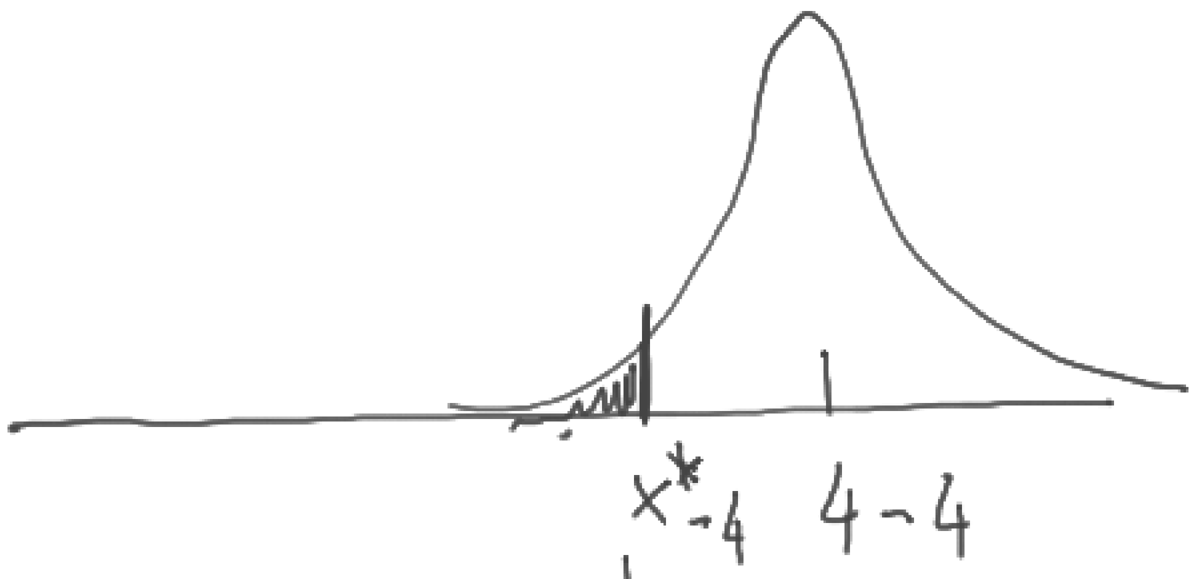
error for class ω_1

$$P(\text{error}) = P(\omega_1) \cdot \int_{x^*}^{\infty} N(0,1)\,dx + P(\omega_2) \int_{-\infty}^{x^*} N(4,1)$$

$$\boxed{\int_{-\infty}^{x} N(0,1)\,dx = \frac{1}{2} + \frac{1}{2}\,\text{erf}\left(\frac{x}{\sqrt{2}}\right)}$$

↑ ↑ Normal Standard Distribution





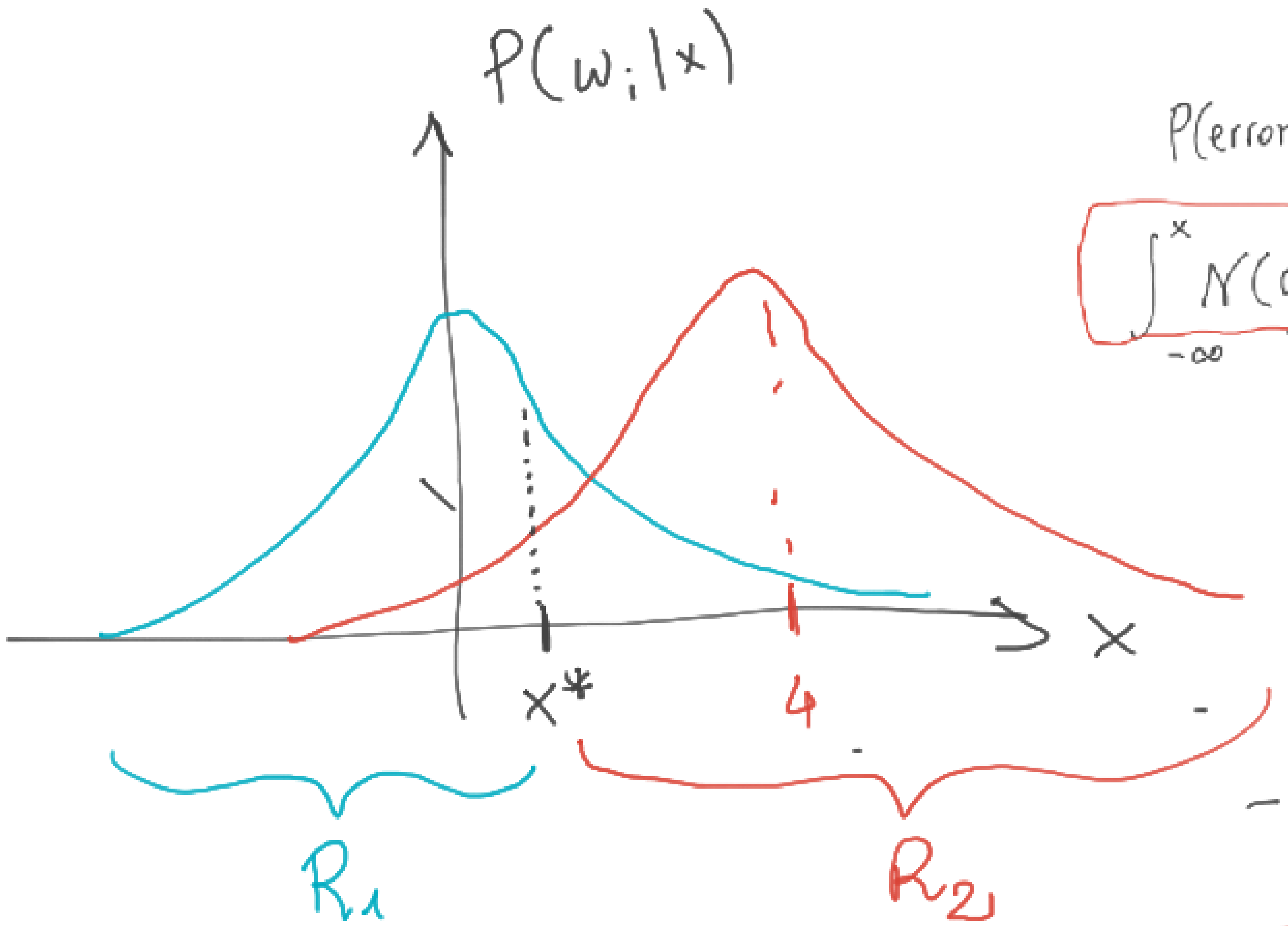
$1.424 - 4$

0

$$\frac{1}{2} \cdot \left[\frac{1}{2} \cdot \text{erf}\left(\frac{-2.58}{\sqrt{2}}\right)\right]$$

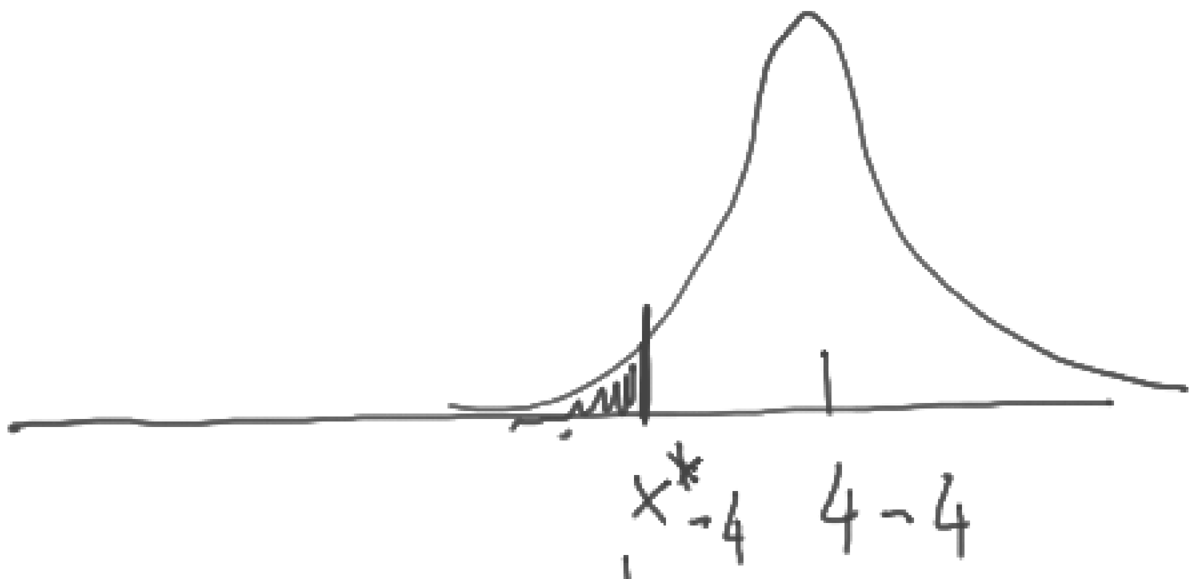
$$\hookrightarrow \text{erf}(-1.82) = -\,\text{erf}(1.82) = 0.011$$

$$P(\text{error}) = P(\omega_1) \cdot \int_{x^*}^{\infty} N(0,1)\,dx + P(\omega_2) \int_{-\infty}^{x^*} N(4,1)$$



$$\boxed{\int_{-\infty}^{x} N(0,1)\,dx = \frac{1}{2} + \frac{1}{2}\,\text{erf}\left(\frac{x}{\sqrt{2}}\right)}$$

Normal Standard Distribution



$1.424 - 4$ $\quad$ 0

$$\frac{1}{2} \cdot \left[\frac{1}{2} \cdot \text{erf}\left(\frac{-2.58}{\sqrt{2}}\right)\right] = 0.0027$$

error for class ω_2

$$\hookrightarrow \text{erf}(-1.82) = -\text{erf}(1.82) = 0.011$$

A	1.1 1.3	1.7 1.4	1.2 2.0	1.6 1.9
B	2.7 1.4	2.6 1.2	2.2 2.0	2.2 1.3
C	1.4 2.5	1.2 2.4	1.8 2.6	1.5 2.9

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

$$d_{(x_{a1}, x_t)} = \sqrt[2]{(x_{a_{1,1}} - x_{t,1})^2 + (x_{a_{1,2}} - x_{t,2})^2} = \sqrt{(1.1-2)^2 + (1.3-2)^2} =$$

$$= \sqrt{(0.9)^2 + (0.7)^2} = \sqrt{0.81 + 0.49} = 1.14$$

A	1.1 1.3	1.7 1.4	1.2 2.0	1.6 1.9
B	2.7 1.4	2.6 1.2	2.2 2.0	2.2 1.3
C	1.4 2.5	1.2 2.4	1.8 2.6	1.5 2.9

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

$$d_{xa2,x_t} = (1.7-2)^2 + (1.4-2)^2 = 0.3^2 + 0.6^2 = $$
$$= 0.09 + 0.36 = 0.45$$

$$d_{xa3,x_t} = (1.2-2)^2 + (2-2)^2 = 0.8^2 =$$
$$= 0.64$$

$$d_{xa4,x_t} = (1.6-2)^2 + (1.9-2)^2 =$$
$$= 0.16 + 0.01 = 0.17$$

$1 \times n$

squared distances
$$\begin{bmatrix} 1.3 \\ 0.45 \\ 0.64 \\ 0.17 \end{bmatrix}$$

$$\text{squared distances} = [\underbrace{1.3,\ 0.45,\ 0.64,\ 0.17}_{A},\ \underbrace{0.85,\ 1.00,\ 0.04,\ 0.53}_{B},\ \underbrace{0.61,\ 0.80,\ 0.40,\ 1.06}_{C}]$$

B

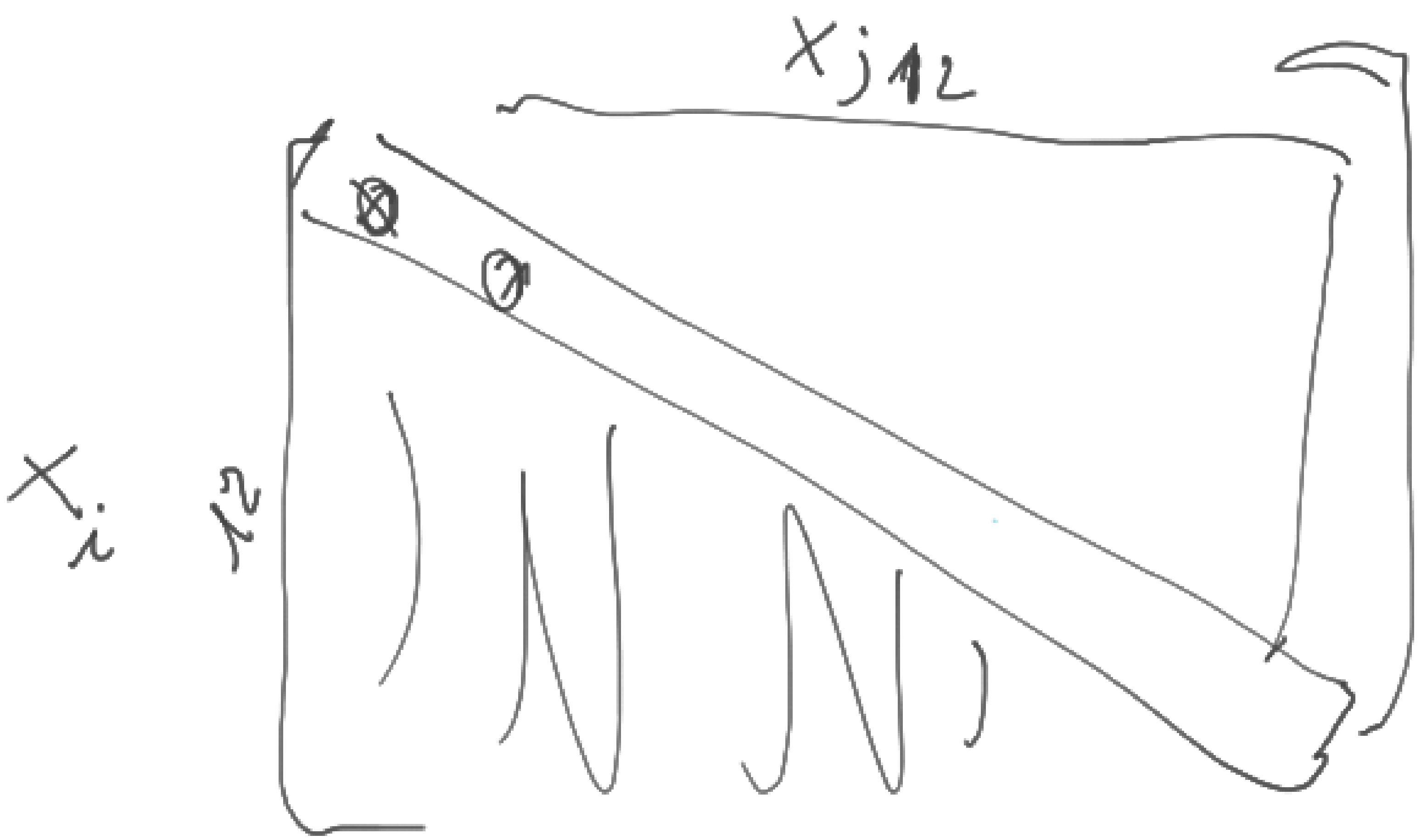
A	1.1 1.3	1.7 1.4	1.2 2.0	1.6 1.9
B	2.7 1.4	2.6 1.2	2.2 2.0	2.2 1.3
C	1.4 2.5	1.2 2.4	1.8 2.6	1.5 2.9

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

$$d^{M}_{xa2,\, x_t} = |1.7-2| + |1.4-2| = 0.3 + 0.6 = 0.9$$

12 distances

Manhattan $[\ \dots\ ]$



$12 \times 12 = 144$