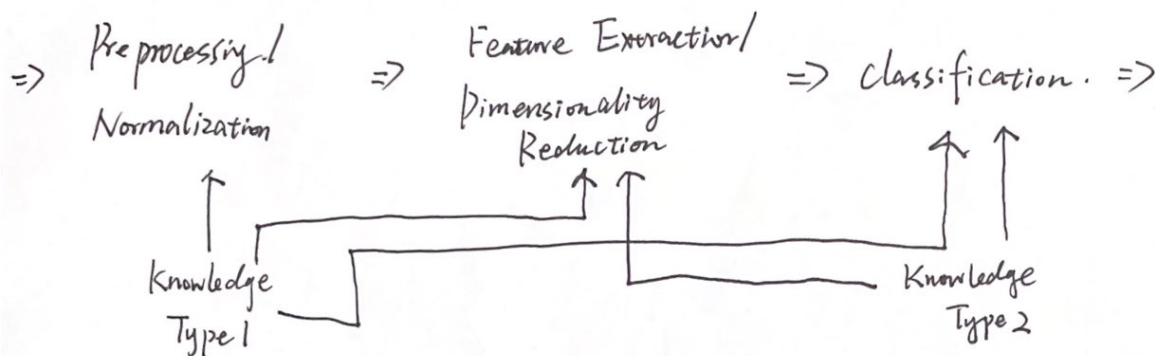EE7403 LEC 8 Pattern Recognition & Decision Theory.

1. Intro.

perceive. extract the relevant info. , understand info. make decision automatically.

$\Rightarrow$ **Preprocessing/** $\Rightarrow$ **Feature Extraction/** $\Rightarrow$ **Classification.** $\Rightarrow$

    Normalization   Dimensionality
                       Reduction

       Knowledge   Knowledge
       Type 1   Type 2

2. Decision Theory.
Maximum a posterior (MAP) rule

Decide W_k : if $P(w_k|x) > P(w_i|x)$, $i \neq k$

or $w_k = \arg\max\limits_{w_i} [P(w_i|x)]$

wrong decision $P(e_k|x) = 1 - P(w_k|x)$ minimize error probability.

$\sum_{i=1}^{c} P(w_i|x) = 1$ for $\forall x$ $\Rightarrow$ $P(e_k|x) = \sum_{\substack{i=1 \\ i \neq k}}^{c} P(w_i|x)$

$P(w_i|x) = \dfrac{P(x|w_i)P(w_i)}{P(x)}$. $P(x) = \sum_{i=1}^{c} P(x|w_i) P(w_i)$ prior p^{ro} : $P(w_i)$

                                                cond.pro: $P(x|w_i)$

To fully automatically recognize a person's gender need.

for a random variable: $P(e) = \sum_{x=-\infty}^{\infty} P(e_k|x) P(x)$

       or $P(e) = \int_{-\infty}^{+\infty} P(e_k|x) P(x) dx$

$P(e) = \int_{-\infty}^{+\infty} P(e_k|x) P(x) dx = \int_{-\infty}^{+\infty} [1 - P(w_k|x)] P(x) dx$

    $= \int_{-\infty}^{+\infty} [1 - \dfrac{P(x|w_k) P(w_k)}{P(x)}] P(x) dx = 1 - \int_{-\infty}^{+\infty} P(x|w_k) P(w_k) dx$

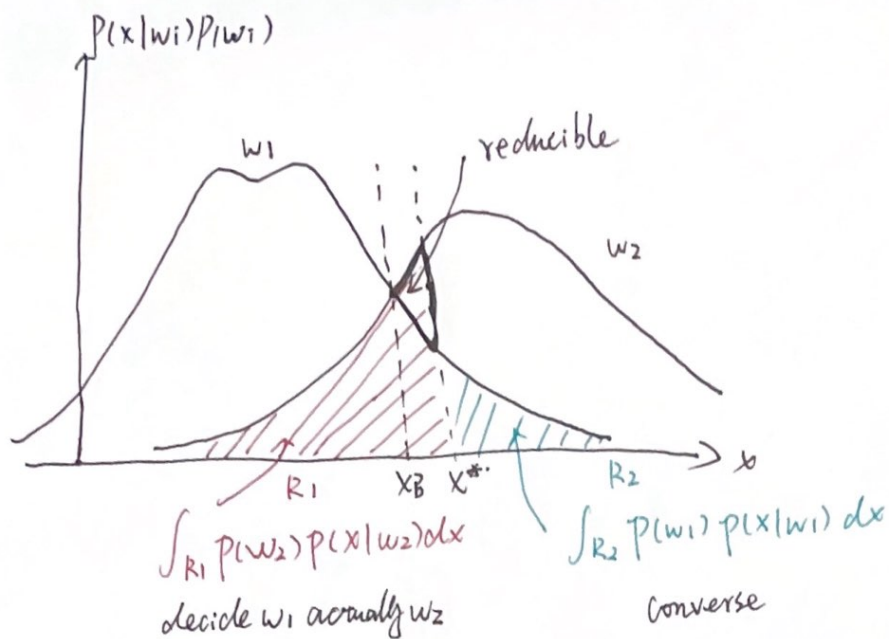different region of x . the sys has different decision w_k.

partition the whole space of x into c decisions R_1 , hence

     $P(e) = 1 - \int_{-\infty}^{+\infty} P(w_k)(x|w_k) dx = 1 - \sum_{i=1}^{c} P(w_i) \int_{R_i} P(x|w_i) dx$

     $\Rightarrow$ $P(correct) = 1 - P(e) = \sum_{i=1}^{c} P(w_i) \int_{R_i} P(x|w_i) dx$

$P(x|wi)P(|wi)$

w1

reducible

w2

R1 X_B X^* R2 x

$\int_{R_1} P(w_2) P(x|w_2) dx$ $\int_{R_2} P(w_1) P(x|w_1) dx$

decide w1 actually w2   converse

$$P(e) = 1 - \int_{R_1} P(w_1) P(x|w_1) dx - \int_{R_2} P(w_2) P(x|w_2) dx$$

$$= \int_{R_1} P(w_2) P(x|w_2) dx + \int_{R_2} P(w_1) P(x|w_1) dx$$

$$= P(w_1) \int_{R_2} P(x|w_1) dx + P(w_2) \int_{R_1} P(x|w_2) dx$$

The ↑ of info or data or feature in general ↑ the possibility of correct decision or reduce the probability of the decision error.