CMPE258 Spring2023 (Part III) 1/

April 20 (Thursday).

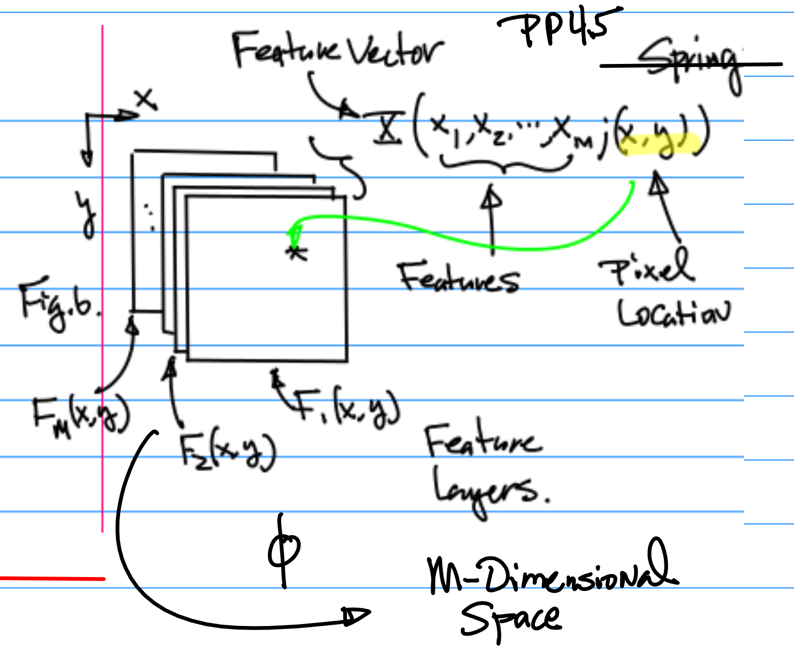
Note 1. Final Exam.

Cluster Analysis. "Mapping"

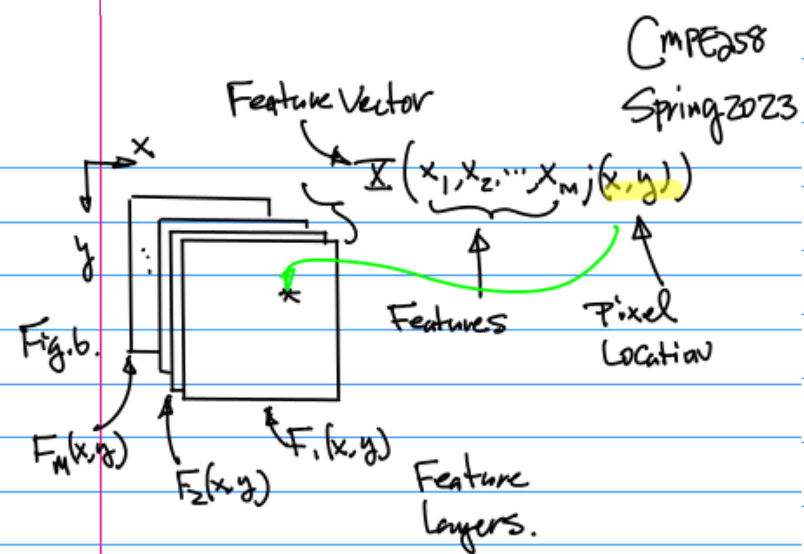
Group II Classes

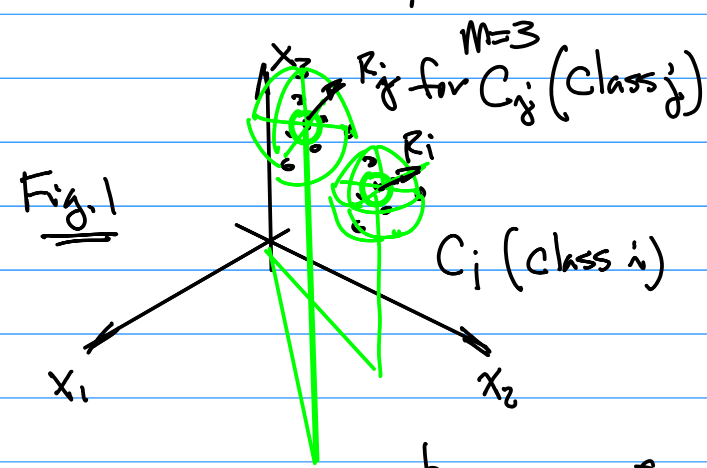
Group II classes are those classes which meet TR, T, R, TWR, MTR, TRF, MTI MTWR, TWRF, RF, TF, TRS.

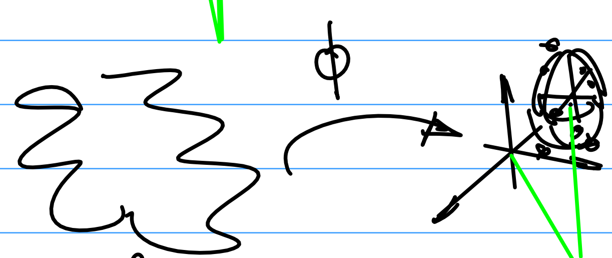
Regular Class Start Times	Final Examination Days	Final Examinatior
7:00 through 8:25 AM	Monday, May 22	7:15-9:30 AM
8:30 through 9:25 AM	Wednesday, May 17	7:15-9:30 AM
9:30 through 10:25 AM	Friday, May 19	9:45 AM-12:00 PM
10:30 through 11:25 AM	Tuesday, May 23	9:45 AM-12:00 PM
11:30 AM through 12:25 PM	Thursday, May 18	9:45 AM-12:00 PM
12:30 through 1:25 PM	Monday, May 22	12:15-2:30 PM
1:30 through 2:25 PM	Wednesday, May 17	12:15-2:30 PM
2:30 through 3:25 PM	Friday, May 19	2:45-5:00 PM
3:30 through 4:25 PM*	Tuesday, May 23	2:45-5:00 PM
4:30* through 5:25 PM*	Thursday, May 18	2:45-5:00 PM



From Notes Part II, PP.45







$\mathbf{X}(x_1, x_2, \cdots, x_N)$

$\mathbf{X}(x_1, x_2, \cdots x_M; (x,y))$

$\downarrow$

$\mathbf{X}(x_1, x_2, \cdots x_M)$

Cluster Analysis Technique.

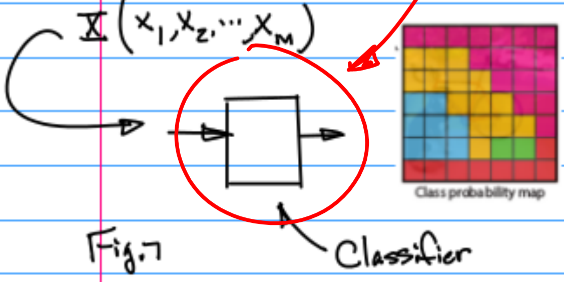


Fig.7

$I(x,y) \rightarrow$ Feature $\xrightarrow{\phi}$ Classification

Pixel(s) $\quad \mathbf{X}(x_1, x_2, \cdots, x_N) \quad C_i$

Prob(C_i)

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(III)

Note: $\sum_{i=1}^{N} \text{Prob}(C_i) = 1$ (Previously M)

Number of Classes.

from "Heuvestics" Expert Knowledge.

Consider K-mean Cluster Algorithm.

github.

2022S-114c-Kmean-handCalculation...

2022S-114c-KmeanCluster-v3-2022-... PPT

Example: K-mean Cluster Algorithm.

First, Notation. Note 1. Vectors

Given a set of observations $(\mathbf{x}_1, \mathbf{x}_2, \ldots, \mathbf{x}_n)$,

e.g. $\underline{X}_1 = (x_{11}, x_{12}, \cdots, x_{1N})$ ... (1)

first observation

For $\underbrace{\underline{X}_i}_{\text{Observation } i}$ $\quad x_{ij}$

Component j for the Observation i

Note: if for d-dimensional Vector, then Eqn(1) has its $N = d$

K-mean

partition the n observations into k ($\leq n$) sets $\mathbf{S} = \{S_1, S_2, \ldots, S_k\}$

$\{\underline{X}_i \mid i = 1, 2, \cdots, N\}$ ... (2)

K-Classes.

S_i for Class i

Note 1. Note 2 Squared Distance

$$\underset{\mathbf{S}}{\arg\min} \sum_{i=1}^{k} \sum_{\mathbf{x} \in S_i} \|\mathbf{x} - \boldsymbol{\mu}_i\|^2 = \underset{\mathbf{S}}{\arg\min} \sum_{i=1}^{k} |S_i| \operatorname{Var} S_i \quad \ldots (3)$$

a. "Argmin" minimization

b. "S" Domain, Scope of the minimization

Example for $\|\vec{x} - \vec{\mu}_i\|^2$,

if $\vec{x} = (x_1, x_2)$, $\vec{\mu}_i = (\mu_{i1}, \mu_{i2})$

then

$$\|\vec{x} - \vec{\mu}_i\|^2 = \left(\sqrt{(x_1 - \mu_{i1})^2 + (x_2 - \mu_{i2})^2}\right)^2$$

$$= (x_1 - \mu_{i1})^2 + (x_2 - \mu_{i2})^2 \quad \ldots (4)$$

Note 3. "$\sum_{x \in S_i}$" Notation $\sum_{i=1}^{M} x_i$

Summation for each & every x as Long as it is from the set S_i

Note 4: from Eqn(3), we have

S_i : Collection of Vectors $\underline{X}$ belonging to Class i

Note 5: $\sum_{i=1}^{k}$ → to Cover the Collection of all Classes.

Note 6: $\vec{\mu}_i$ ① $\vec{\mu}_i = (\mu_{i1}, \mu_{i2}, \cdots, \mu_{id})$

② Cluster for the Class i