

$I(x, y)$. Example in the fig. below.

$$\begin{aligned} \text{Total No. of Pixels of } I(x, y) &= 7 * 7 * 5 * 5 \\ &= 495^2 \end{aligned}$$

Hence,

$$\text{Prob}(\text{Class1})_{\text{Blue}} = \frac{85^2}{495^2} = \frac{8}{49}$$

Next,

$$\text{Prob}(\text{Class2})_{\text{pink}} = \frac{25}{49}$$

$$\text{Prob}(\text{Class3})_{\text{yellow}} = \frac{14}{49}$$

$$\text{Prob}(\text{Class4})_{\text{green}} = \frac{2}{49}$$

Note: To verify the Calculation, we should have the following

Property:

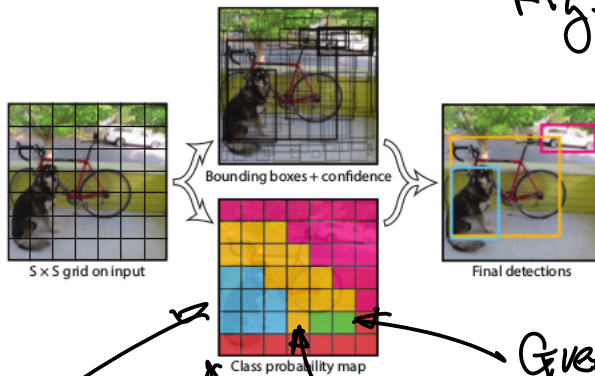
$$\sum_{i=1}^4 \text{Prob}(C_i) = 1 \dots (2)$$

from our Calculation,

$$\begin{aligned} \sum_{i=1}^4 \text{Prob}(C_i) &= \text{Prob}(C_1) + \text{Prob}(C_2) + \dots + \text{Prob}(C_4) \\ &= (8 + 25 + 14 + 2) / 49 = 1. \end{aligned}$$

The Next Step for the Probability Distribution Map Calculation: Segmentation, e.g. A Technique to allow us to classify

Fig.1.



Blue: Segmentation for Class 1

Pink: Segmentation for Class 2

Yellow, Class 3

Green; Class 4.

Objective:

To Find/Define Probability Distribution map for each Class.

$$\text{Prob}(\text{Class1}) = \frac{\left(\begin{array}{c} \text{Pixels belong to} \\ \text{Class1} \end{array} \right)}{\begin{array}{c} \text{Total} \\ \text{No. of pixels} \\ \text{of } I(x, y) \end{array}}$$

... u)

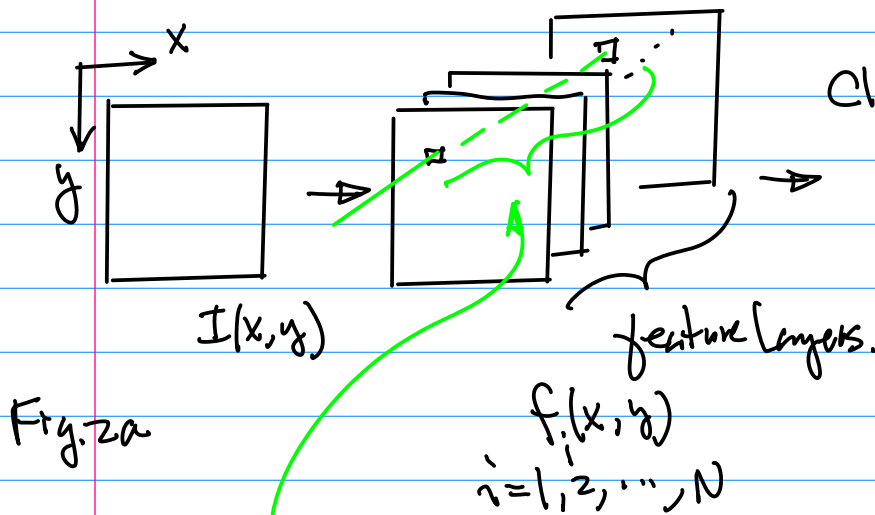
from the given Condition in Fig.1

Since,

$$\left(\begin{array}{c} \text{Pixels belong to} \\ \text{Class1} \end{array} \right) = 8 * (5 * 5) = 85^2$$

pixels One Grid.

Objects into one of the class i .



Form Feature Vectors

2022F-101-cmpe258-note-2022-11-1 (4).pdf

$$\vec{X} = (x_1, x_2, \dots, x_N) \dots (3).$$

introduce Subscript.

$$\vec{X}_i = (x_{i1}, x_{i2}, x_{i3}, \dots, x_{iN}) \dots (3-b)$$

Cluster Finding.

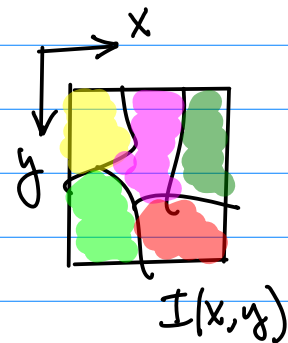
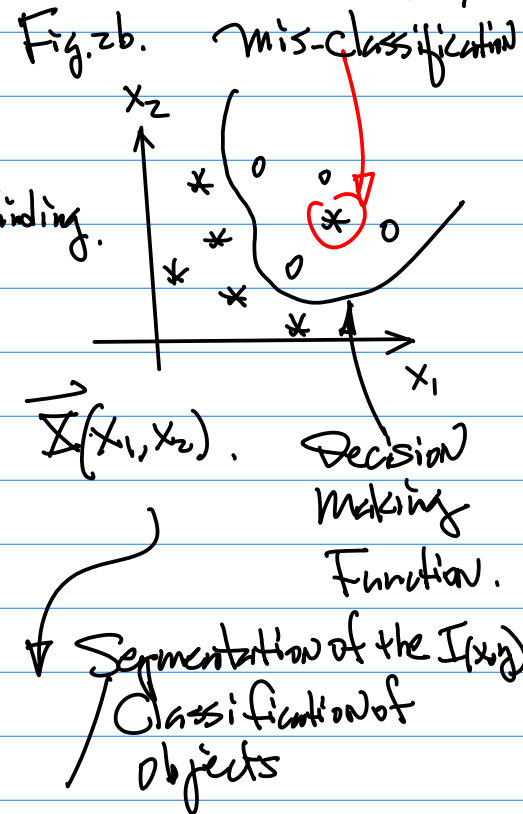


Fig. 2c

Ref: fork-mean Cluster Classification. Nov. 7th (Tue).

1. 2022F-101-cmpe258-note-2022-11-1 (4).pdf
2. github, 2022S, Search Keywords "kmean", Two Relevant References
 { PPT. — Formulation.
 { Hand Calculation.

Note 1. Midterm Exam is scheduled ON Next Tuesday (14th). Please Bring Your Laptop Computer to the Class ON Monday. Review and Q&A Session ON Thursday.

CMPE258

F2023

53/

Note1. Ref1. General Background \rightarrow Eqn(1).

Ref4, Hand Calculation

Ref2.

Ref3 PPT Formulation

2018S-107-lec7-ClusterSeekin-2018-3-14.pdf

2022F-108a-Yolo-architecture-loss-function-2022-10-10.pdf

2022S-114c-Korean-handCalculation1-converted.pdf.pdf

2022S-114c-Korean-prob-ap-hl-2023-4-26.pdf

korean-2023S-101-Note-part3-cmpe258-2023-04-27.pdf(1)-1.pdf

korean-2023S-101-Note-part3-cmpe258-2023-04-27.pdf(1)-1(1).pdf

Example: Formulation.

Ref.2. Lecture Notes

Ref.3. Notation

$$\text{Argmin}_S \sum_i \sum_j \|\vec{x} - \vec{\mu}_i\|^2$$

$$S_i^{(k)} = \left\{ \vec{x}_p : \|\vec{x}_p - \vec{\mu}_i\|^2 \leq \|\vec{x}_p - \vec{\mu}_j\|^2, \forall j, j=1,2,\dots,K, \text{ and } j \neq i \right\}$$

$$\vec{x} = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}, \quad \vec{\mu}_i = \begin{pmatrix} \mu_{i1} \\ \mu_{i2} \end{pmatrix}$$

$$\vec{x} - \vec{\mu}_i = \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} - \begin{pmatrix} \mu_{i1} \\ \mu_{i2} \end{pmatrix} = \begin{pmatrix} x_1 - \mu_{i1} \\ x_2 - \mu_{i2} \end{pmatrix}$$

iteration of the Computation,
Check Convergence. \rightarrow if converges, then Stop

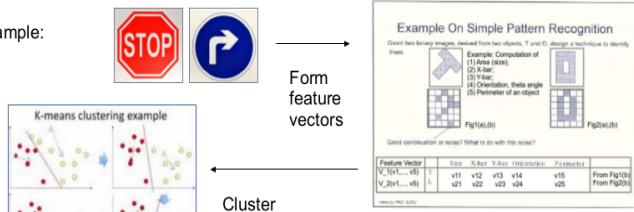
K-mean Algorithm (1)

https://en.wikipedia.org/wiki/K-means_clustering

Given a set of observations (x_1, x_2, \dots, x_n) , where each observation is a d -dimensional real vector, k -means clustering aims to partition the n observations into k ($\leq n$) sets $S = \{S_1, S_2, \dots, S_k\}$ so as to minimize the within-cluster sum of squares (WCSS) (i.e. *variance*). Formally, the objective is to find:

$$\arg \min_S \sum_{i=1}^k \sum_{x \in S_i} \|x - \mu_i\|^2 = \arg \min_S \sum_{i=1}^k |S_i| \text{Var } S_i$$

Example:



Note 1.

Note 2. Squared Distance

$$\arg \min_S \sum_{i=1}^k \sum_{x \in S_i} \|x - \mu_i\|^2 = \arg \min_S \sum_{i=1}^k |S_i| \text{Var } S_i$$

a. "Argmin" minimization ... (3)

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

$$\begin{aligned} \|\vec{x} - \vec{\mu}_i\|^2 &= \sqrt{(x_1 - \mu_{i1})^2 + (x_2 - \mu_{i2})^2}^2 \\ &= (x_1 - \mu_{i1})^2 + (x_2 - \mu_{i2})^2 \dots (4) \end{aligned}$$

Example: K-mean Cluster Algorithm.

First, Notation.

Note 1. Vectors

Given a set of observations (x_1, x_2, \dots, x_n) ,

e.g. $X_1 = (x_{11}, x_{12}, \dots, x_{1N})$
first observation ... (1)

For X_i
Observation i

x_{ij}
Component j
for the Observation i

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

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 X
belonging to Class i

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

Note 6: $\vec{\mu}_i$ (1) $\vec{\mu}_i = (\mu_{i1}, \mu_{i2}, \dots, \mu_{id})$
(2) Cluster for the
Class i

K-mean

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

$\{X_i | i=1, 2, \dots, N\}$... (2)

K-Classes.

S_i for Class i

So, with the Objective Function defined, Now Let's take a look at the following Equation for Computation.

$1 \leq j \leq K$ covers all the different classes.

Hand Calculation Example

Given the following feature vectors
Use Kmean Algorithm to find the clusters.

$$S_i^{(t)} = \{x_p : \|x_p - m_i^{(t)}\|^2 \leq \|x_p - m_j^{(t)}\|^2 \forall j, 1 \leq j \leq k\} \quad \dots (1)$$

Ref

20225-114c-Kmean-handCalculation1-c

Note1: A Set of Feature Vectors

$S_i^{(*)}$ ← Captured at Step t
Class id: ith Class

$$S_i^{(*)} = \{\bar{x}_p\}$$

index, $p=1,2,\dots$
just like Notation i, j , or k

$$S_i^{(t)} = \{\bar{x}_p : \text{Condition}\}$$

$$\|\bar{x}_p - m_i^{(t)}\|^2$$

Distance (squared) at time t
to the Cluster of class i

$$\begin{array}{llll} X_1 = \begin{bmatrix} 0 \\ 0 \end{bmatrix} & X_2 = \begin{bmatrix} 1 \\ 0 \end{bmatrix} & X_3 = \begin{bmatrix} 0 \\ 1 \end{bmatrix} & X_4 = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \\ X_5 = \begin{bmatrix} 2 \\ 1 \end{bmatrix} & X_6 = \begin{bmatrix} 1 \\ 2 \end{bmatrix} & X_7 = \begin{bmatrix} 2 \\ 2 \end{bmatrix} & X_8 = \begin{bmatrix} 3 \\ 2 \end{bmatrix} \\ X_9 = \begin{bmatrix} 6 \\ 6 \end{bmatrix} & X_{10} = \begin{bmatrix} 7 \\ 6 \end{bmatrix} & X_{11} = \begin{bmatrix} 8 \\ 6 \end{bmatrix} & X_{12} = \begin{bmatrix} 6 \\ 7 \end{bmatrix} \\ X_{13} = \begin{bmatrix} 7 \\ 7 \end{bmatrix} & X_{14} = \begin{bmatrix} 8 \\ 7 \end{bmatrix} & X_{15} = \begin{bmatrix} 9 \\ 7 \end{bmatrix} & X_{16} = \begin{bmatrix} 7 \\ 8 \end{bmatrix} \\ X_{17} = \begin{bmatrix} 8 \\ 8 \end{bmatrix} & X_{18} = \begin{bmatrix} 9 \\ 8 \end{bmatrix} & X_{19} = \begin{bmatrix} 10 \\ 8 \end{bmatrix} & X_{20} = \begin{bmatrix} 9 \\ 9 \end{bmatrix} \end{array}$$

Sol: Step 1. Define $K=2$ per Heuristics.

Expert Knowledge

Note: "0" Initial Step.

Let cluster

$$\vec{m}_1^0 = \vec{x}_1 = \begin{pmatrix} 0 \\ 0 \end{pmatrix} \dots (1) \quad \text{Initial Arbitrary Values}$$

$$\vec{m}_2^0 = \vec{x}_2 = \begin{pmatrix} 1 \\ 0 \end{pmatrix} \dots (2)$$

"1" Class 1

And Arbitrarily assign Feature Vectors into 2 Classes.

Step 2. Use Eqn (1) To Compute the distance
 $\|\bar{x}_p - m_i^{(t)}\|^2$

Now, check the Hand Calculation that I made and posted on the Class git, e.g. Ref. 4.

K-mean Cluster Algorithm

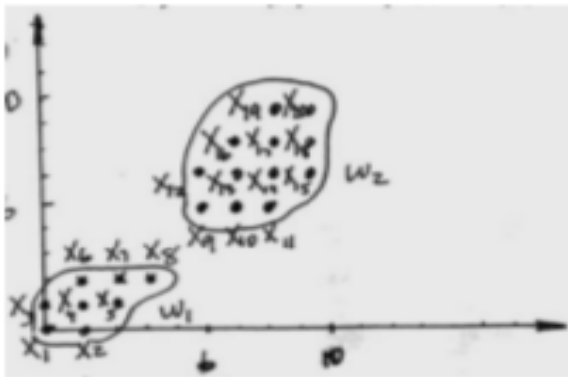
HX

1/3

Given the following feature vectors
Use K-mean Algorithm to find the
clusters.

$$\begin{aligned} X_1 &= \begin{bmatrix} 0 \\ 0 \end{bmatrix} & X_2 &= \begin{bmatrix} 1 \\ 0 \end{bmatrix} & X_3 &= \begin{bmatrix} 0 \\ 1 \end{bmatrix} & X_4 &= \begin{bmatrix} 1 \\ 1 \end{bmatrix} \\ X_5 &= \begin{bmatrix} 2 \\ 1 \end{bmatrix} & X_6 &= \begin{bmatrix} 1 \\ 2 \end{bmatrix} & X_7 &= \begin{bmatrix} 2 \\ 2 \end{bmatrix} & X_8 &= \begin{bmatrix} 3 \\ 2 \end{bmatrix} \\ X_9 &= \begin{bmatrix} 6 \\ 6 \end{bmatrix} & X_{10} &= \begin{bmatrix} 7 \\ 6 \end{bmatrix} & X_{11} &= \begin{bmatrix} 8 \\ 6 \end{bmatrix} & X_{12} &= \begin{bmatrix} 6 \\ 7 \end{bmatrix} \\ X_{13} &= \begin{bmatrix} 7 \\ 7 \end{bmatrix} & X_{14} &= \begin{bmatrix} 8 \\ 7 \end{bmatrix} & X_{15} &= \begin{bmatrix} 9 \\ 7 \end{bmatrix} & X_{16} &= \begin{bmatrix} 7 \\ 8 \end{bmatrix} \\ X_{17} &= \begin{bmatrix} 8 \\ 8 \end{bmatrix} & X_{18} &= \begin{bmatrix} 9 \\ 8 \end{bmatrix} & X_{19} &= \begin{bmatrix} 8 \\ 9 \end{bmatrix} & X_{20} &= \begin{bmatrix} 9 \\ 9 \end{bmatrix} \end{aligned}$$

Sol. We can plot these feature
vectors below



Step 1. Define Number of Cluster
 $K=2$ Based on Heuristics (the
plot of the feature vectors).

Let $K=2$

And make initialization by
arbitrarily select 2 points \vec{x}_1
 \vec{x}_2 as the cluster center

Let cluster

$$\vec{m}_1^0 = \vec{x}_1 = \begin{pmatrix} 0 \\ 0 \end{pmatrix}, \dots (1)$$

$$\vec{m}_2^0 = \vec{x}_2 = \begin{pmatrix} 1 \\ 0 \end{pmatrix}, \dots (2)$$

And let Class 1 be

$$C_1: (\vec{x}_1, \vec{x}_3) \dots (3)$$

Class 2 be

$$C_2: (x_2, x_4, x_5, \dots, x_{20}) \dots (4)$$

Step 2. Use Equation

$$\|\vec{x}_p - \vec{m}_i\| \leq \|\vec{x}_p - \vec{m}_j\| \dots (5)$$

for \vec{x}_p from Class i to regroup
feature vectors in Class i to j
if Eqn(5) does not hold. Hence

From Class C_1 ,

$$\begin{aligned} \|\vec{x}_1 - \vec{m}_1^0\| &= \left\| \begin{pmatrix} x_{11} \\ x_{12} \end{pmatrix} - \begin{pmatrix} m_{11} \\ m_{12} \end{pmatrix} \right\| = \\ &= \sqrt{(x_{11} - x_{11})^2 + (x_{12} - x_{12})^2} = 0 \end{aligned}$$

$m_{11} = x_{11}$
 $m_{12} = x_{12}$

$$\begin{aligned} \text{And } \|\vec{x}_1 - \vec{m}_2\| &= \left\| \begin{pmatrix} x_{11} \\ x_{12} \end{pmatrix} - \begin{pmatrix} m_{21} \\ m_{22} \end{pmatrix} \right\| = \\ &= \sqrt{(x_{11} - x_{21})^2 + (x_{12} - x_{22})^2} \\ &= \sqrt{1^2 + 0^2} = 1 \end{aligned}$$

$m_{21} = x_{21}$
 $m_{22} = x_{22}$

Continue to Carry Out the Computation,
See this 3 page Remdout, till Converges.
e.g. $m_i^{(t+1)} = m_i^{(*)}$.
then No New Grouping.
Stop the Computation.

Nov. 9 (Th).

Example: Hand Calculation of the K-mean.

Note 1. Calculation of A Cluster.

Suppose we have Cluster M_i defined as

$$M_i = \frac{1}{M} \sum_{j=1}^M \vec{x}_{ij} \quad \dots (1)$$

Suppose

$$\vec{x}_i = (x_{i1}, x_{i2}, x_{i3}, \dots, x_{ip})$$

P-dimensional.

$$M_i = \frac{1}{M} (\vec{x}_{i1} + \vec{x}_{i2} + \dots + \vec{x}_{ip})$$

$$= \frac{1}{M} \left[\begin{pmatrix} x_{i11} \\ x_{i12} \end{pmatrix} + \begin{pmatrix} x_{i21} \\ x_{i22} \end{pmatrix} + \dots + \begin{pmatrix} x_{ip1} \\ x_{ip2} \end{pmatrix} \right] \quad \dots (1-b)$$

↓ for C_i , Class i ,
drop the Sub "i"
for the Simplicity

$$= \frac{1}{M} \left[\begin{pmatrix} x_{11} \\ x_{12} \end{pmatrix} + \begin{pmatrix} x_{21} \\ x_{22} \end{pmatrix} + \dots + \begin{pmatrix} x_{p1} \\ x_{p2} \end{pmatrix} \right]$$

$$= \frac{1}{M} \begin{pmatrix} x_{11} + x_{21} + x_{31} + \dots + x_{p1} \\ x_{12} + x_{22} + x_{32} + \dots + x_{p2} \end{pmatrix}$$

$$= \begin{pmatrix} \frac{x_{11} + x_{21} + x_{31} + \dots + x_{p1}}{M} \\ \frac{x_{12} + x_{22} + x_{32} + \dots + x_{p2}}{M} \end{pmatrix}$$

for $P=2$

$$M_i = \begin{pmatrix} \frac{x_{11} + x_{21}}{2} \\ \frac{x_{12} + x_{22}}{2} \end{pmatrix} \quad \dots (1-c)$$

Note 2. For Heuristics / Human Expert Knowledge, K is defined Accordingly.

Note 3. Initialization that requires \vec{M}_i for $i=1, 2, \dots, K$
Select \vec{M}_i By Heuristics.

Then, Calculation Based on the following formula,

$$S_i^{(t)} = \{ \quad \}$$

$$\downarrow$$

$$\{ \vec{x}_p : \text{conditions} \}$$

$$\downarrow$$

$$\{ \vec{x}_p : \|\vec{x}_p - \vec{M}_i\|^2 \leq \|\vec{x}_p - \vec{M}_j\|^2, \quad \forall j, j=1, 2, \dots, K \}$$

$$\dots (2)$$

Now, check the convergence.

By Comparing

$$\vec{\mu}_i^{(t+1)} = \vec{\mu}_i^{(t)} \quad \text{Step at } t$$

for $i = 1, 2, \dots, K$

from the given condition
& our Initialization,

e.g. we have

$$C_1 = (\vec{x}_1, \vec{x}_3)$$

$$\begin{aligned} \vec{\mu}_1' &= \frac{1}{M} \sum_{i=1}^M \vec{x}_i \quad \Big|_{M=2} \\ &= \frac{1}{2} (\vec{x}_1 + \vec{x}_2) \quad \dots (3) \end{aligned}$$

where \vec{x}_1 is equal to the 1st feature vector in C_1
 \vec{x}_2 is the 2nd feature vector.

hence,

$$\begin{aligned} \vec{\mu}_1' &= \frac{1}{2} \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix} + \begin{pmatrix} 0 \\ 1 \end{pmatrix} \right] \\ &= \frac{1}{2} \begin{pmatrix} 0 \\ 1 \end{pmatrix} = \begin{pmatrix} 0 \\ \frac{1}{2} \end{pmatrix} \end{aligned}$$

Now, Check

$$\|\vec{x}_p - \vec{\mu}_1'\|_{p=1} = \left\| \begin{pmatrix} 0 \\ 0 \end{pmatrix} - \begin{pmatrix} 0 \\ \frac{1}{2} \end{pmatrix} \right\|^2 \quad \dots (4)$$

$$= \left\| \begin{pmatrix} 0 \\ \frac{1}{2} \end{pmatrix} \right\|^2 = \sqrt{0^2 + \left(\frac{1}{2}\right)^2}^2 = \frac{1}{2} \quad \dots (4-b)$$

And

$$\|\vec{x}_p - \vec{\mu}_j'\|_{j=2}^2 \quad \dots (5)$$

$$\begin{aligned} \text{where } \vec{\mu}_2' &= \frac{1}{M} \sum_{i=1}^M \vec{x}_i \quad \Big|_{M=18} \\ &= \frac{1}{18} \sum_{i=1}^{18} \vec{x}_i \quad \Big|_{\text{Sub "i" match the Class } C_2} \end{aligned}$$

$$\begin{aligned} &= \frac{1}{18} [\vec{x}_2 + \vec{x}_4 + \vec{x}_5 + \vec{x}_6 + \dots + \vec{x}_{20}] \\ &= \begin{pmatrix} 5.67 \\ 5.33 \end{pmatrix} \end{aligned}$$

hence

$$\|\vec{x}_p - \vec{\mu}_2'\|_{p=1}^2$$

$$= \|\vec{x}_1 - \vec{\mu}_2'\|^2 =$$

$$= \left\| \begin{pmatrix} 0 \\ 0 \end{pmatrix} - \begin{pmatrix} 5.67 \\ 5.33 \end{pmatrix} \right\|^2 \quad \dots (6)$$

Therefore

$$\text{Eqn (4-b)} < \text{Eqn (6)}$$

Similarly, \vec{x}_3 can be verified to satisfy Eqn (2), & stays in C_1 .

Nov. 17th (Th)

Road map for the 2nd half of the semester:

Semantic segmentation to move from YOLO bounding boxes based DCNN technique to Pixel by Pixel based DCNN called Yolact.

If time permits, we will discuss LSTM (Long Short Term Memory) technique, based on the mathematical formulation of Markov Processes.

Note 1. PPT, introduction

Note 1. Ref. on ChatGPT fine tuning.

2023F-104-#190c-9a-chatGPT-API-YZ-HL...

2023F-104-2-API_Key (copy).json

2023F-104-3-requirements.txt

2023F-104-4-test_fine_tuning (copy).py

2023F-104-5-train-cti-data (copy).jsonl

Note 2.

json line file to capture the training data.

```
configure_logging()
Terminal: Local x + v
├─ GPT_Fine_Tuning
│   ├── API_Key.json
│   ├── CMPE244
│   ├── requirements (copy).txt
│   ├── test_fine_tuning.py
│   ├── train-cti-data.jsonl
│   └── train_fine_tuning.py
├─ GPT_Fine_Tuning (1).zip
├─ GPT_Fine_Tuningoutput.log
├─ hello-the-world
│   ├── API_Key.json
│   ├── chatgpt-2023-10-27.yml
│   ├── ChatHistory.json
│   └── GPTWithHistorySaved.py
└─ others
```

Notethis folder consists of the sample code

```

1 #-----
2 # CTI One Corporation
3 # for Chat-GPT
4 # Version x0.1
5 # Coded by: Youran Zheng, 2023-10-27
6 # Create a Anaconda environment;
7 # Open a terminal, then
8 # $ conda env create -f chatgpt-2023-10-27.yml
9 # Activate the Anaconda environment: $ conda activate chatgpt
10 #-----
11 name: chatgpt-2023-10-27
12
13 dependencies:
14   - python==3.7.1
15   - pip
16   - pip:
17     - openai==0.27.9
~
~

```

Sample example of the .jsonl file as the training data file

From this example, the user is for the part of posting questions, and the assistant is for the part of answer. So, you can modify this sample accordingly to integrate with your Q&A of your training data.

```

configure_logging
Terminal: Local x + v
{"messages": [{"role": "system", "content": "You are Johnny, the CTI One technical support for W100."}, {"role": "user", "content": "Answer the following technical question: What is W100 product?"}, {"role": "assistant", "content": "W100 is a smart walker. It walks up to you when you call it.\n"}]}
{"messages": [{"role": "system", "content": "You are Johnny, the CTI One technical support for W100."}, {"role": "user", "content": "Answer the following technical question: How do I start using W100?"}, {"role": "assistant", "content": "Please first use smart phone to upload your photo to the W100 smart walker.\n"}]}
{"messages": [{"role": "system", "content": "You are Johnny, the CTI One technical support for W100."}, {"role": "user", "content": "Answer the following technical question: How do I set up W100 environment?"}, {"role": "assistant", "content": "Make sure you power up the Wi-Fi router provided in the package and then use your smart phone apps to activate W100 system by initializing it.\n"}]}
{"messages": [{"role": "system", "content": "You are Johnny, the CTI One technical support for W100."}, {"role": "user", "content": "Answer the following technical question:\nSymptom: Battery not charging\nProbable cause: Charger not working"}, {"role": "assistant", "content": "Please replace the charger of W100\n"}]}
{"messages": [{"role": "system", "content": "You are Johnny, the CTI One technical support for W100."}, {"role": "user", "content": "Answer the following technical question:\nSymptom: Battery not charging\nProbable cause: Battery connec

```

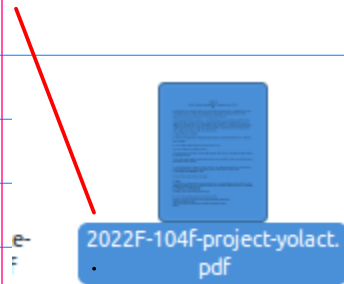
Please walk through the sample code, training and testing code as references for your design.

Note: It is mandatory requirement to have this ChatGPT API capability integrated into your semester long project.

Note: Project assignment for the implementation of Yolact DCNN.

references:

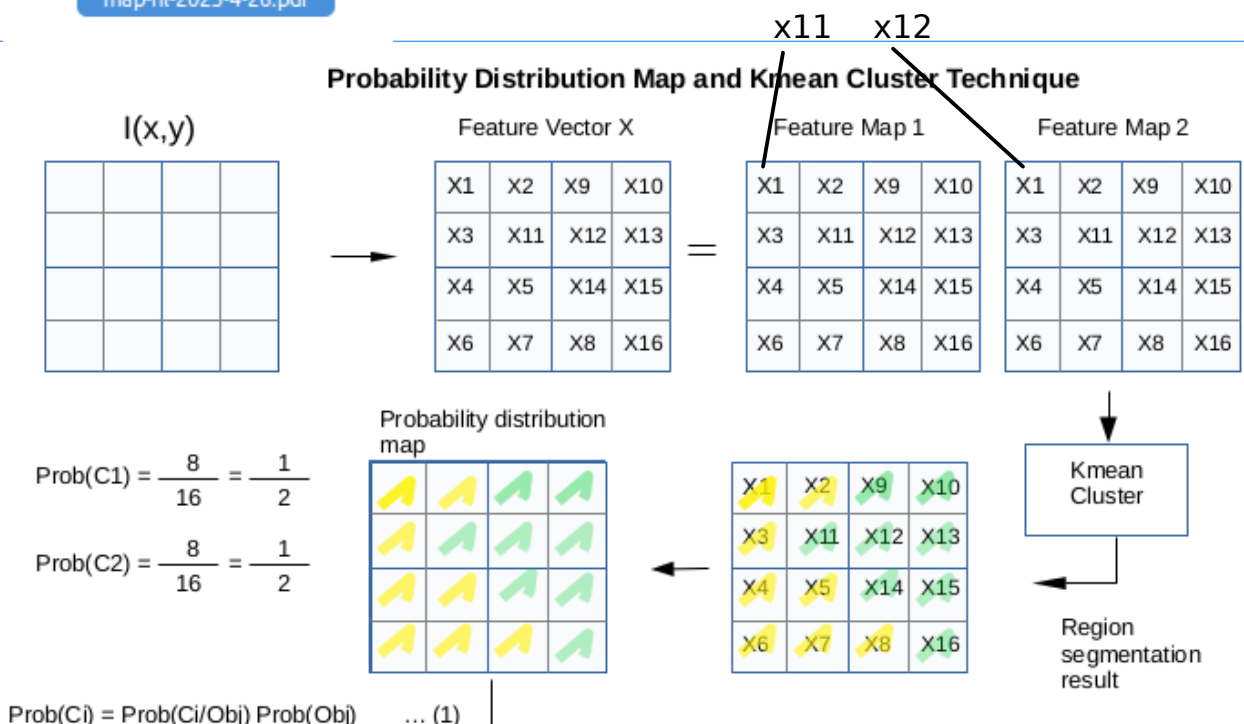
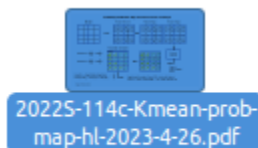
1. Readme on github provides the source github and instructions to build the executable.



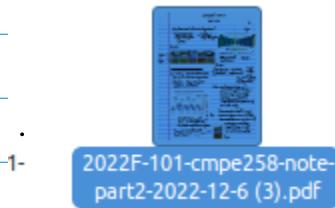
The readme document ID: 2022F-107 ~ on the github.

2. The requirements will be posted on Canvas and it is due on Dec. 3rd (Sunday).

Example: K-mean technique for the probability distribution map calculation.



Consider Semantic Segmentation
ref 1. on the github



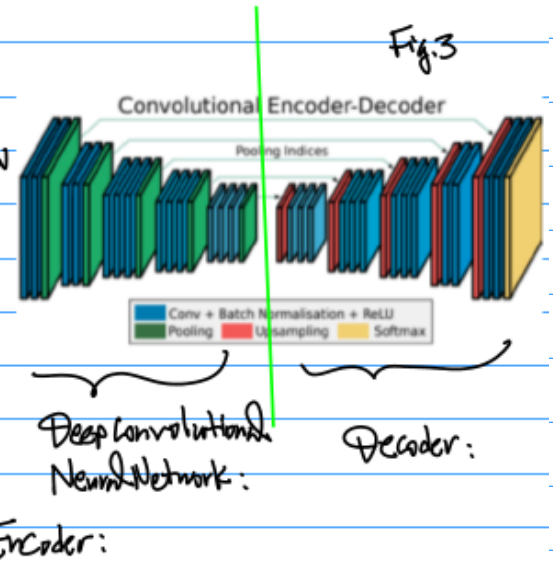
CMPE258 PART II
Nov.10,22

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Now, Discussion On Semantic Segmentation.
Bounding Box Based Object Recognition (YOLO) → Pixel Based Object Recognition

Example:

Before
J.S.
After.



Encoder:

Decoder:

Nov.21st (Tuesday).

Note 1. Semester Long Project Presentation. Nov. 30th (Thur). and Dec. 5 (Tue) Scheduled for the team/individual Project Presentation

Note 2. Mandatory Requirement: To integrate ChatGPT APIs in your project.

Group II Classes

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

Regular Class Start Times	Final Examination Days	Final Examination Times
7:00 through 8:25 AM	Tuesday, December 12	7:15-9:30 AM
8:30 through 9:25 AM	Thursday, December 14	7:15-9:30 AM
9:30 through 10:25 AM	Monday, December 11	9:45 AM-12:00 PM
10:30 through 11:25 AM	Wednesday, December 13	9:45 AM-12:00 PM
11:30 AM through 12:25 PM	Friday, December 8	9:45 AM-12:00 PM
12:30 through 1:25 PM	Tuesday, December 12	12:15-2:30 PM
1:30 through 2:25 PM	Thursday, December 14	12:15-2:30 PM
2:30 through 3:25 PM	Monday, December 11	2:45-5:00 PM
3:30 through 4:25 PM*	Wednesday, December 13	2:45-5:00 PM
4:30* through 5:25 PM*	Friday, December 8	2:45-5:00 PM

Example: Architecture of the DCNN, esp. Decoder

Ref 1. From the Yolact Paper

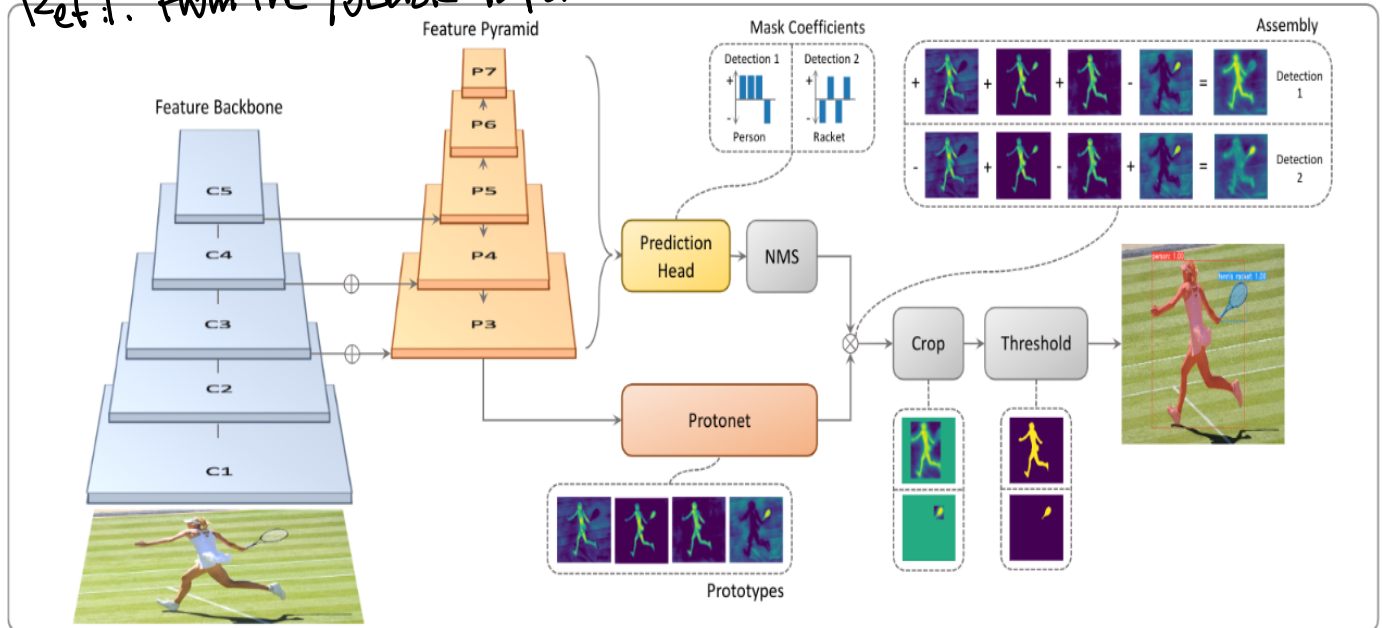


Figure 2: YOLACT Architecture Blue/yellow indicates low/high values in the prototypes, gray nodes indicate functions that are not trained, and $k = 4$ in this example. We base this architecture off of RetinaNet [27] using ResNet-101 + FPN.

Ref 2. Lecture Notes

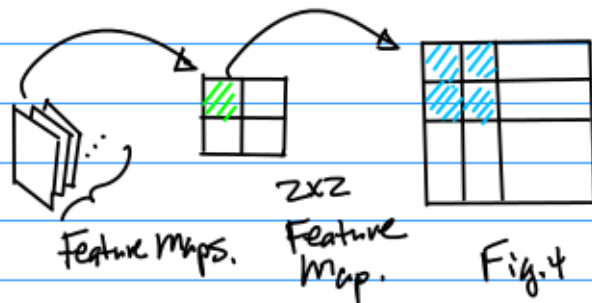
1-



Note 1. from the Ref. Technique 1.

Design of Example: Up Sampling Techniques

Nov. 1



Consider A Design of The Simplest Up Sampling. Duplication of the pixel.

Technique 1.



Fig.5

NN

Handwritten mathematical notes and formulas, including a definition of the nearest neighbor function.

Continued from the Ref. Technique 2.
Bi-Linear Interpolation

Step 1. place "Anchor Points" onto the higher resolution patch.

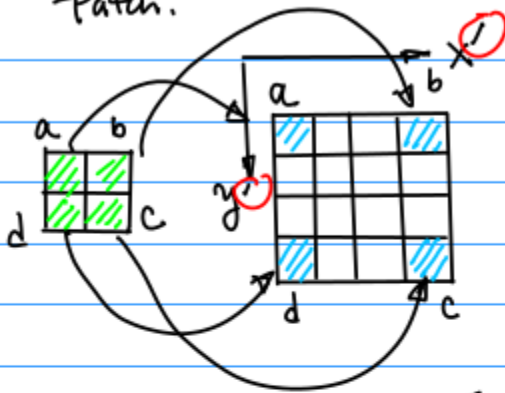


Fig. 1

Step 2. Perform Interpolation

Background: Given (x_1, y_1) , (x_2, y_2) and x_3 , Find $y_3 = ?$

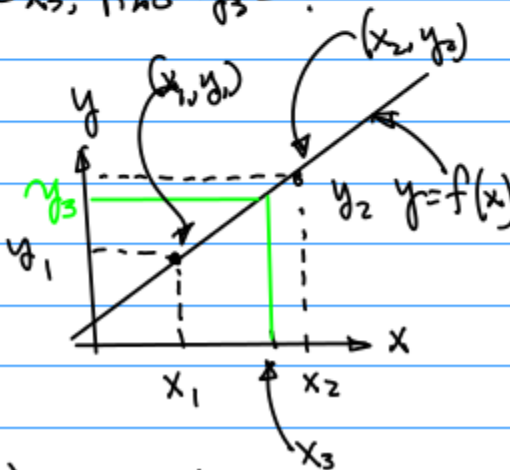


Fig. 7

$$y = f(x), \quad y = ax + b \quad \dots (1)$$

After the Math. Manipulation, we have the formula Eqn (3)

$$y = \underbrace{\frac{y_2 - y_1}{x_2 - x_1}}_a x - \underbrace{\frac{y_2 - y_1}{x_2 - x_1} x_1 + y_1}_{b} \dots (3)$$

$$a = \frac{y_2 - y_1}{x_2 - x_1} \dots (3-b)$$

$$b = -\frac{y_2 - y_1}{x_2 - x_1} x_1 + y_1 \dots (3-c)$$

Let $x = x'$, y equal to the intensity,

$$\text{So } x_1 = 0, y_1 = 10$$

$$x_2 = 3, y_2 = 20$$

Applying the Eqn to the top line of the feature plan. Eqn (3-b):

$$a = \frac{\text{feature @ pt } b - \text{feature @ pt } a}{(\text{slope}) \text{ Index @ } b - \text{Index @ } a \text{ Coordinates}}$$

$$= \frac{20 - 10}{3 - 0} = 10/3$$

So, for the offset from Eqn (3-c)

$$b (\text{offset}) = -\frac{10}{3} \cdot x_1 \Big|_{x_1=0} + y_1 \Big|_{y_1=10}$$

$$= 10$$

therefore

$$y = ax + b = \frac{10}{3}x + 10$$

Find the feature @ (1,0), hence,

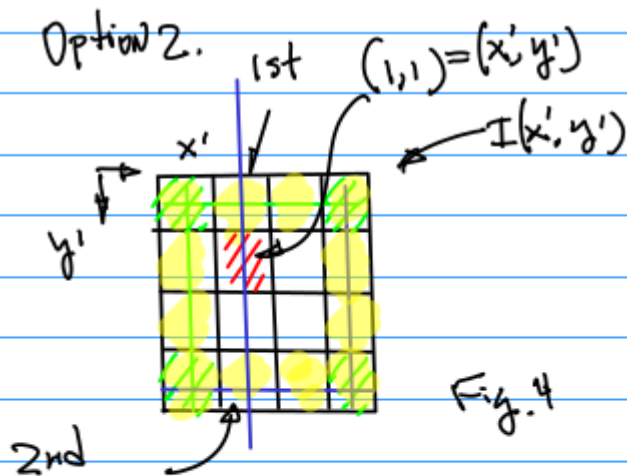
$$y = \frac{10}{3}x \Big|_{x=1} + 10 = \frac{10}{3} + \frac{30}{3} = \frac{40}{3}$$

Once the interpolation along x -axis all done, then move to the interpolations along y -axis.

Note: From the Lecture Notes, Ref. 2.

We can carry out the 2nd Dimension interpolation as illustrated Below.

FP.5b.



Apply the Same Interpolation Equation Except the independent Variable Changed from x' to y' , Use $I(1,0)$ as the 1st pt, $I(1,3)$ for the Interpolated

Technique for N_q Sampling, Ref.