

CPE412 Pattern Recognition

Week 1

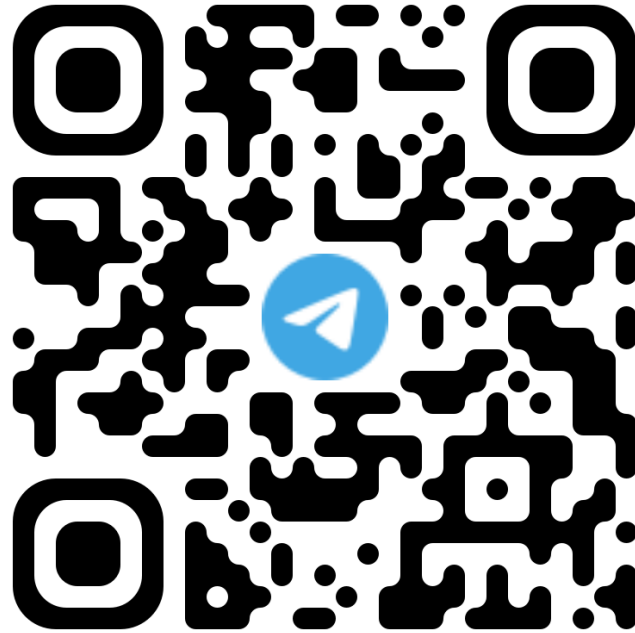
Introduction



Dr. Nehad Ramaha,
Computer Engineering Department
Karabük Universities

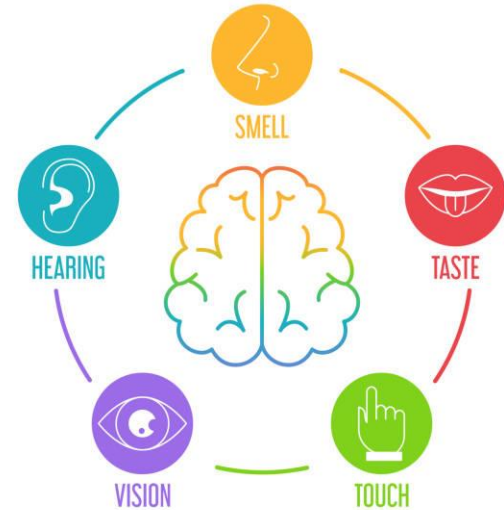
Telegram Group

- ▶ https://t.me/+Xwx8UELos_BiMDI0



Human Perception

- ▶ Humans have developed highly sophisticated skills for **sensing their environment** and taking actions according to what they observe, e.g.,
 - recognizing a face,
 - understanding spoken words,
 - Reading, handwriting,
 - distinguishing fresh food from its smell.
- ▶ We would like to **give similar capabilities to machines**.



Pattern recognition

- ▶ **Pattern recognition** is the study of how machines can:
 - observe the environment,
 - learn to distinguish patterns of interest,
 - make right and reasonable decisions about the **categories** of the patterns.
- ▶ A **pattern** is an entity, that could be given a name, e.g.,:
 - fingerprint image,
 - handwritten word,
 - human face,
 - speech signal,
 - DNA sequence,
 - ...

What is Pattern recognition?

- ▶ "The assignment of a physical object or event to one of several **pre-specified categories**" -- Duda & Hart
- ▶ A **pattern** is an object, process or event.
- ▶ A **class** (or category) is a set of patterns that share common attribute (**features**) usually from the same information source
- ▶ During recognition (or **classification**) classes are assigned to the objects.
- ▶ A **classifier** is a machine that performs such task.

Table 1: Example pattern recognition applications.

Problem Domain	Application	Input Pattern	Pattern Classes
Document image analysis	Optical character recognition	Document image	Characters, words
Document classification	Internet search	Text document	Semantic categories
Document classification	Junk mail filtering	Email	Junk/non-junk
Multimedia database retrieval	Internet search	Video clip	Video genres
Speech recognition	Telephone directory assistance	Speech waveform	Spoken words
Natural language processing	Information extraction	Sentences	Parts of speech
Biometric recognition	Personal identification	Face, iris, fingerprint	Authorized users for access control
Medical	Computer aided diagnosis	Microscopic image	Cancerous/healthy cell
Military	Automatic target recognition	Optical or infrared image	Target type
Industrial automation	Printed circuit board inspection	Intensity or range image	Defective/non-defective product
Industrial automation	Fruit sorting	Images taken on a conveyor belt	Grade of quality
Remote sensing	Forecasting crop yield	Multispectral image	Land use categories
Bioinformatics	Sequence analysis	DNA sequence	Known types of genes
Data mining	Searching for meaningful patterns	Points in multidimensional space	Compact and well-separated clusters

What is Pattern recognition(PR)?

- ▶ What is a Pattern Class (or category)?
 - is a set of patterns sharing common attributes
 - a collection of "similar", not necessarily identical, objects
 - During recognition, given objects are assigned to a prescribed class

From
 Jim Elder
 829 Loop Street, Apt 300
 Allentown, New York 14707

To
 Dr. Bob Grant
 602 Queensberry Parkway
 Omar, West Virginia 25638

We were referred to you by Xena Cohen at the University Medical Center. This is regarding my friend, Kate Zack.

It all started around six months ago while attending the "Rubeq" Jazz Concert. Organizing such an event is no picnic, and as President of the Alumni Association, a co-sponsor of the event, Kate was overworked. But she enjoyed her job, and did what was required of her with great zeal and enthusiasm.

However, the extra hours affected her health; halfway through the show she passed out. We rushed her to the hospital, and several questions, x-rays and blood tests later, were told it was just exhaustion.

Kate's been in very bad health since. Could you kindly take a look at the results and give us your opinion?

Thank you!
 Jim

Nov 10, 1999

From
 Jim Elder
 829 Loop Street, Apt 300
 Allentown, New York 14707

To
 Dr. Bob Grant
 602 Queensberry Parkway
 Omar, West Virginia 25638

We were referred to you by Xena Cohen at the University Medical Center. This is regarding my friend, Kate Zack.

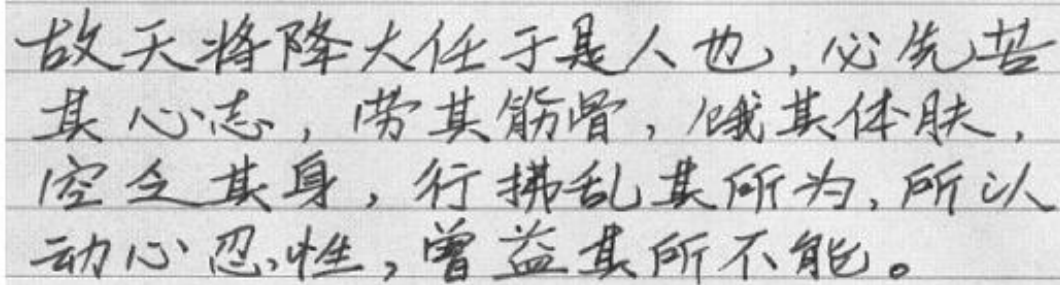
It all started around six months ago while attending the "Rubeq" Jazz Concert. Organizing such an event is no picnic, and as President of the Alumni Association, a co-sponsor of the event, Kate was overworked. But she enjoyed her job, and did what was required of her with great zeal and enthusiasm.

However, the extra hours affected her health; halfway through the show she passed out. We rushed her to the hospital, and several questions, x-ray and blood tests later, were told it was just exhaustion.

Kate's been in very bad health since. Could you kindly take a look at the results and give us your opinion?

Thank you!
 Jim

Figure 1: English handwriting recognition.

A sample of Chinese handwriting in a cursive style, written on a light gray background with horizontal lines. The text is a quote from the Analects of Confucius.

故天将降大任于是人也，必先苦
其心志，劳其筋骨，饿其体肤，
空乏其身，行拂乱其所为，所以
动心忍性，曾益其所不能。

(a) Handwriting

故天将降大任于是人也，必先苦
其心志，劳其筋骨，饿其体肤，
空乏其身，行拂乱其所为，所以
动心忍性，曾益其所不能。

(b) Corresponding Machine Print

Figure 2: Chinese handwriting recognition.

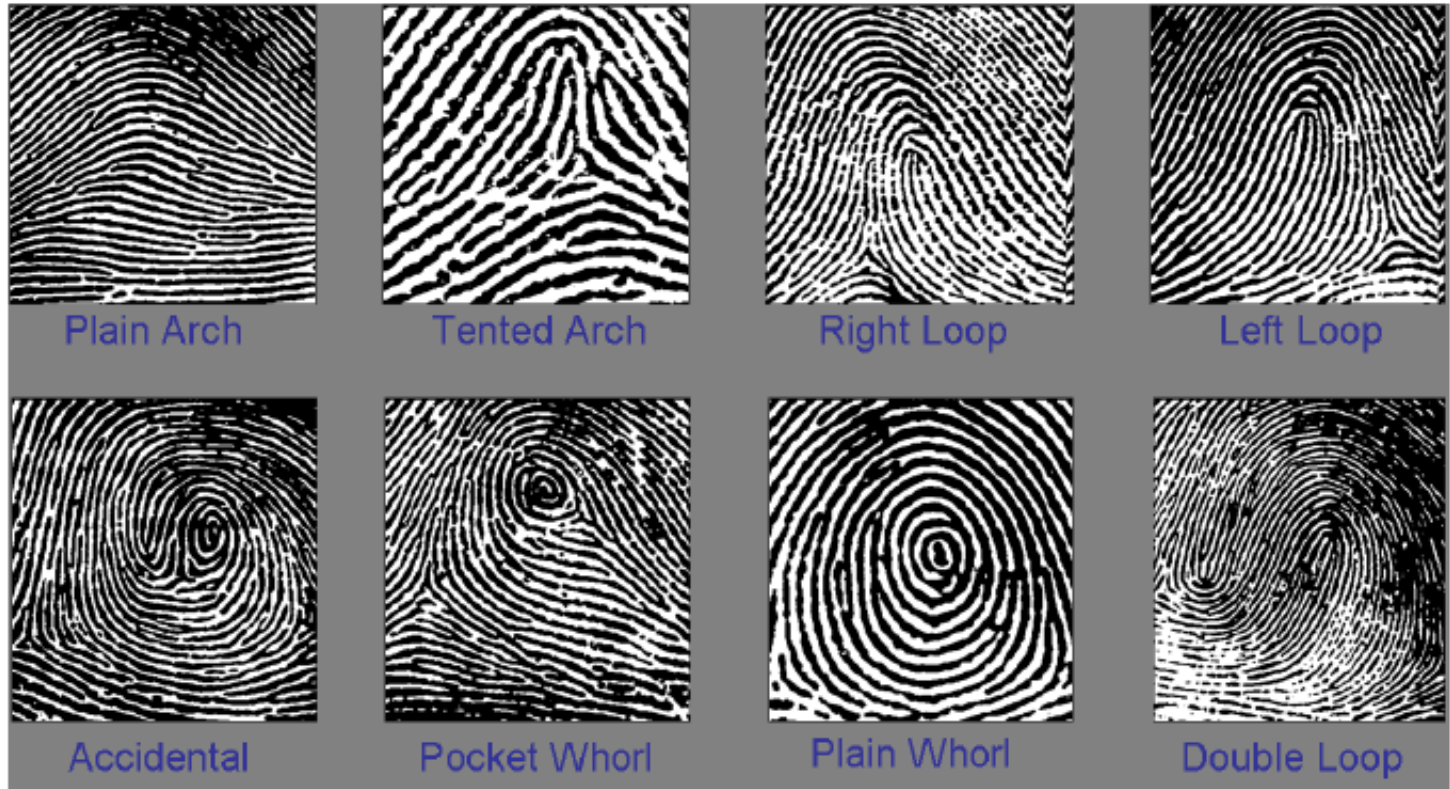


Figure 3: Fingerprint recognition.

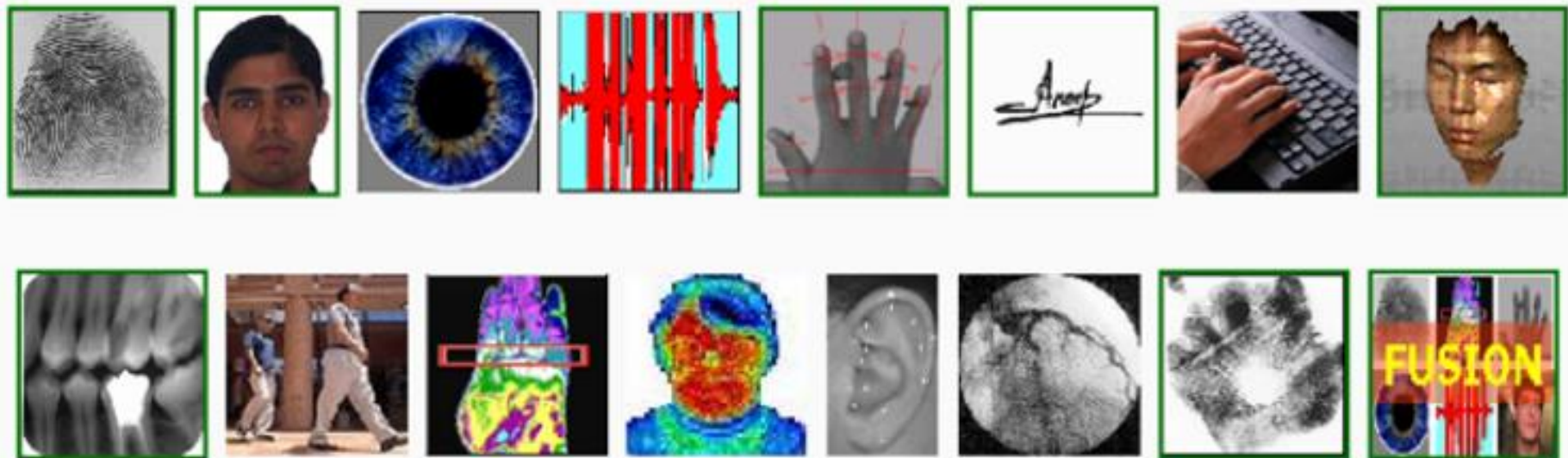


Figure 4: Biometric recognition.

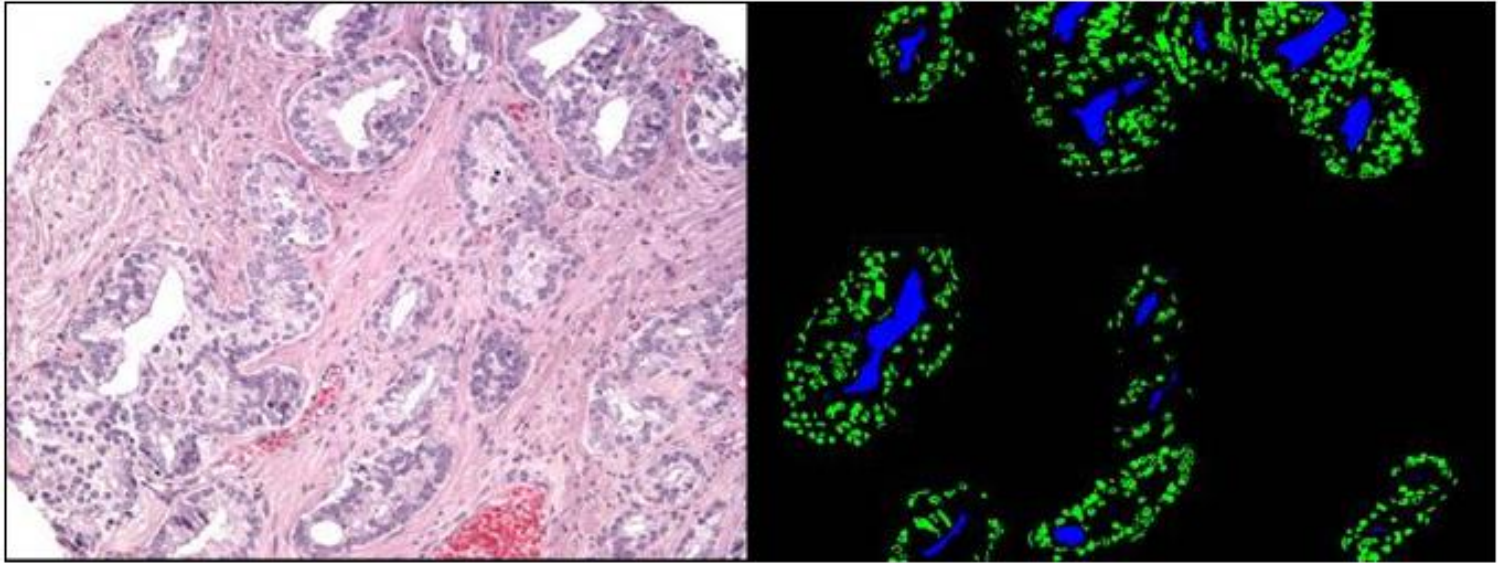


Figure 5: Cancer detection and grading using microscopic tissue data.

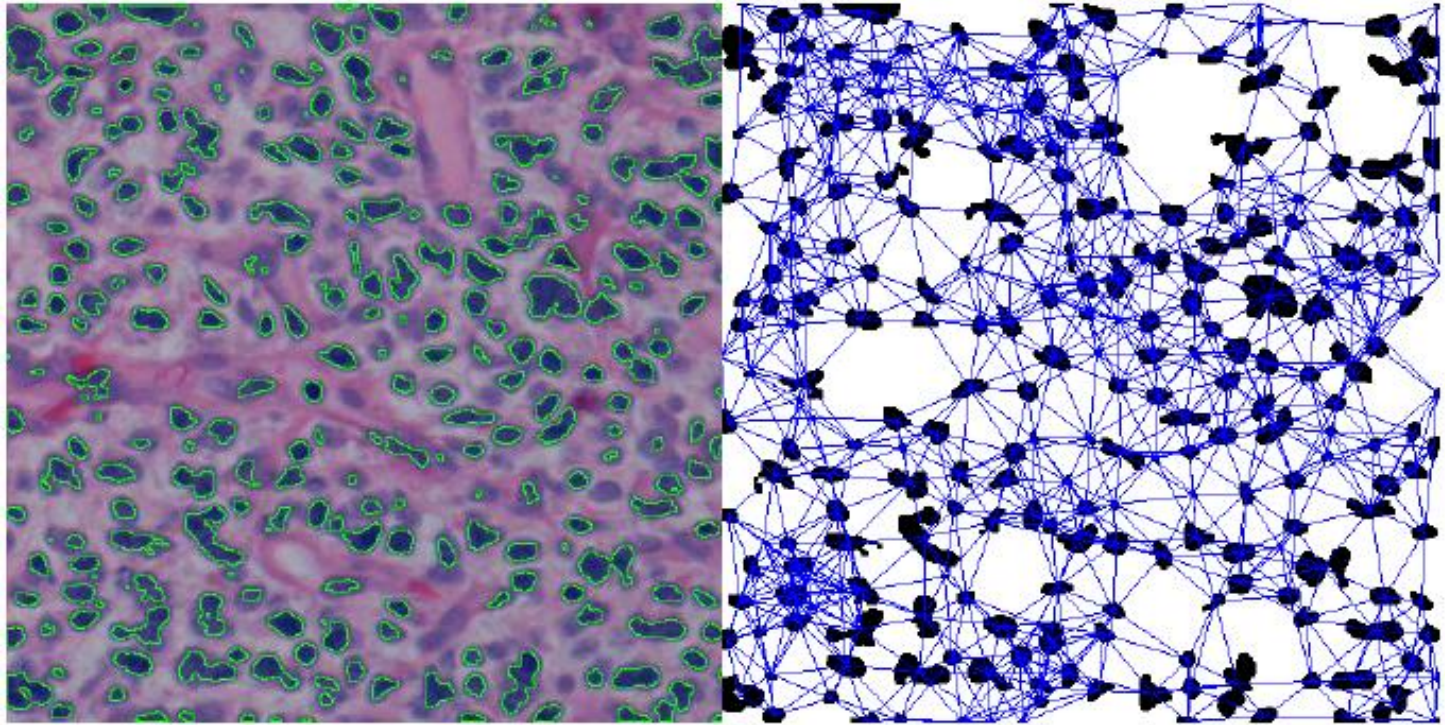


Figure 6: Cancer detection and grading using microscopic tissue data.



Figure 7: Land cover classification using satellite data.

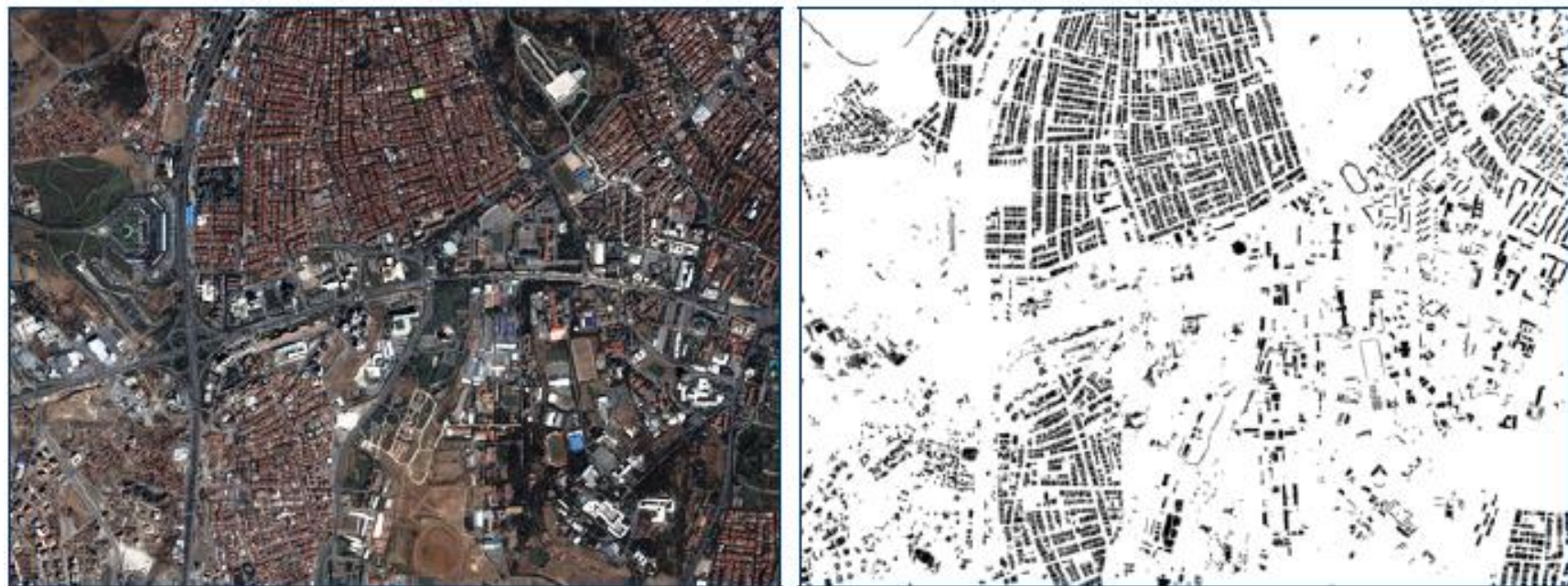


Figure 8: Building and building group recognition using satellite data.



Figure 9: License plate recognition: US license plates.

Pattern Recognition

- ▶ How can a machine learn the rule from data?
- ▶ **Supervised learning:** a teacher provides a category label or cost for each pattern in the training set.
 - Classification
- ▶ **Unsupervised learning:** the system forms clusters or natural groupings of the input patterns (based on some similarity criteria).
 - Clustering
- ▶ Reinforcement learning: no desired category is given but the teacher provides feedback to the system such as the decision is right or wrong.

Topics During the Semester

- ▶ Introduction to Pattern Recognition
- ▶ Feature Formation and Feature Selection
- ▶ BAYES THEOREM
- ▶ KNN (K-Nearest Neighbor)
- ▶ Regression and Linear Regression Analysis
- ▶ Representation of Regression Analysis in Scatter Plot
- ▶ Decision Tree
- ▶ What is Data Cleansing? How to Clean Data?

Thanks 😊