PATTERN RECOGNITION
LECTURE 1
INTRODUCTION

Dr. Umarani Jayaraman
Assistant Professor

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY,
DESIGN AND MANUFACTURING,
KANCHEEPURAM

What is a pattern?

- A pattern is either a physical object or an abstract notion
  - A book, chair, biometric fingerprints are physical object
  - Style of walking/talking/ writing and hand gesture pattern corresponds to an abstract notion.
  - Abstract notion is also called as an event or a process.

What is a pattern?

- A pattern is a physical object or an abstract notion
- If we are talking about the classes of animals then a description of an animal would be a pattern

- Big animal
- Has four legs
- Big ears
- Long trunk
- A pair of tusks
- ……

What is a pattern?

- If we are talking about classes of balls, then a description of a ball is a pattern

- Size
- Color
- Shape
- Weight
- ….

What is a pattern?

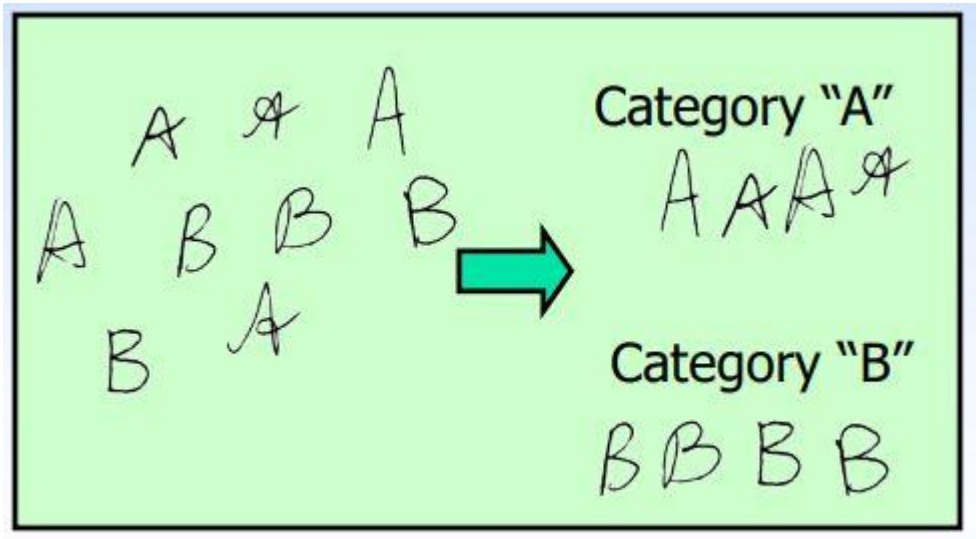
- These patterns are represented by a set of descriptions also known as attributes and features
- If we want to distinguish the animals from balls features of the patterns are used.

Pattern – Book Definition

- A pattern is the representation of an object by the values taken by the set of attributes/features.

Pattern Recognition

- Input: Given a pattern
- Output: Identification of a pattern as a member of a category/class we already know or we are familiar with.
  - Classification (known categories)



Classification

- In the classification problem, we have a set of objects for which the values of the features/attributes are known.
- We have a set of classes and each object belongs to one of these classes
- The classes for the case of animal and balls the patterns are known and it is different
- Given a new pattern, the class of the pattern is to be determined.

Classification - challenges

- The representation of patterns (choice of attributes) is a very important step in pattern classification
- A good representation is one which makes use of discriminating attribute and also reduces the computational cost in pattern classification

Pattern Recognition

- Cognition is the act of *seeing or perceiving*, whereas recognition means as *having seen or perceived*.

Example of cognition

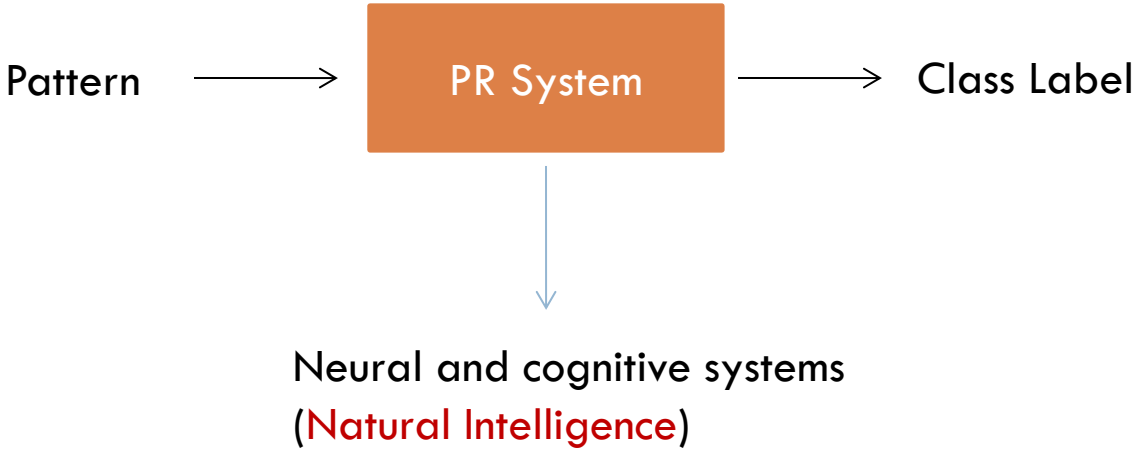
Example of recognition

Example of pattern recognition tasks

- Reading facial expression
- Recognizing speech
- Reading a document
- Identifying a person by fingerprints
- Diagnosis from medical images
- Wine tasting

Human recognition of pattern

- A basic attribute of people/human is categorization of sensory input

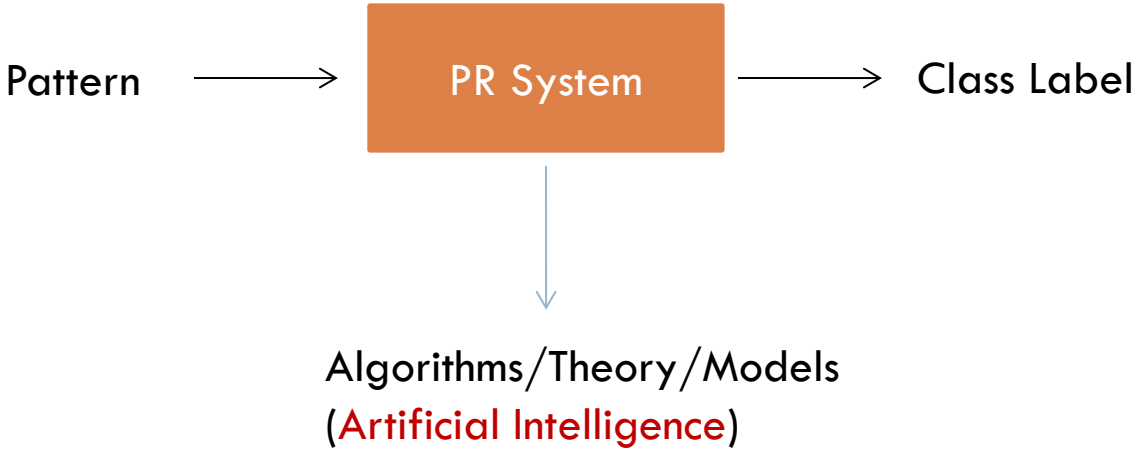


Human recognition of pattern

- We recognize a face, understand spoken words, read handwritten characters, decide whether a banana is ripe by its smell- all these complex processes that underlie the acts of pattern recognition.
- Pattern recognition- The act of taking in raw data and making an action based on the "category" of the pattern- has been crucial for our survival and
- Over the past tens of millions of years we have evolved highly sophisticated neural and cognitive systems for such tasks.

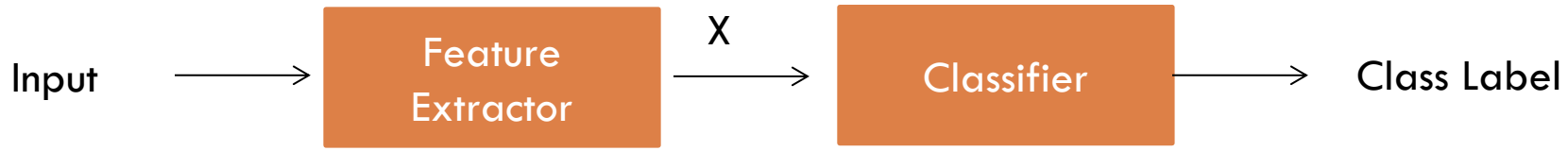
Machine recognition of patterns

- Artificial Intelligence: It tries to transfer the natural intelligence of human to machine by using algorithms/theory/models

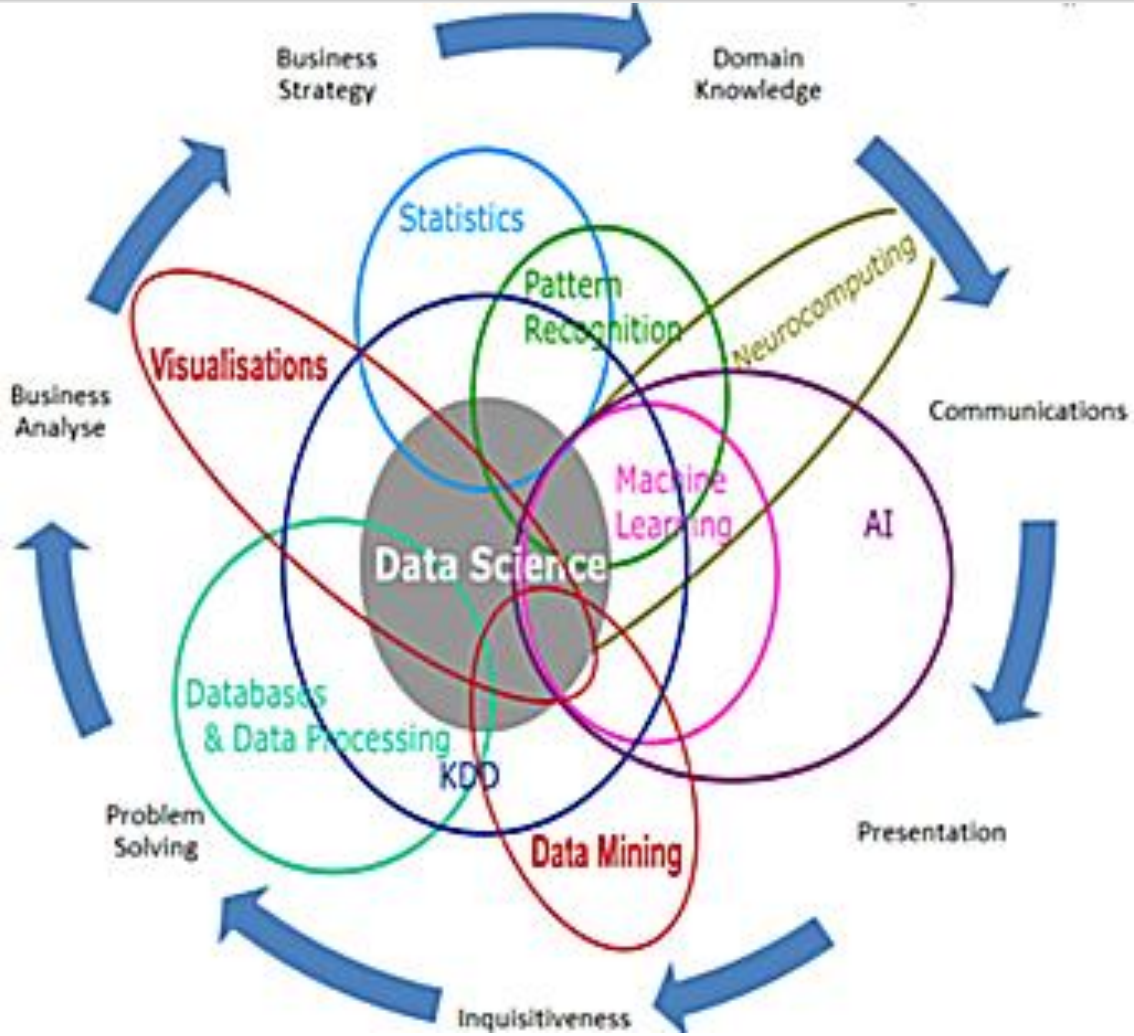


Machine recognition of patterns

- Feature extractor makes some measurements on the input pattern
- X is called feature vector, often $X \in R^d$
- Classifier maps each feature vector to a class label
- Features to be used are problem specific



Relationship with other field

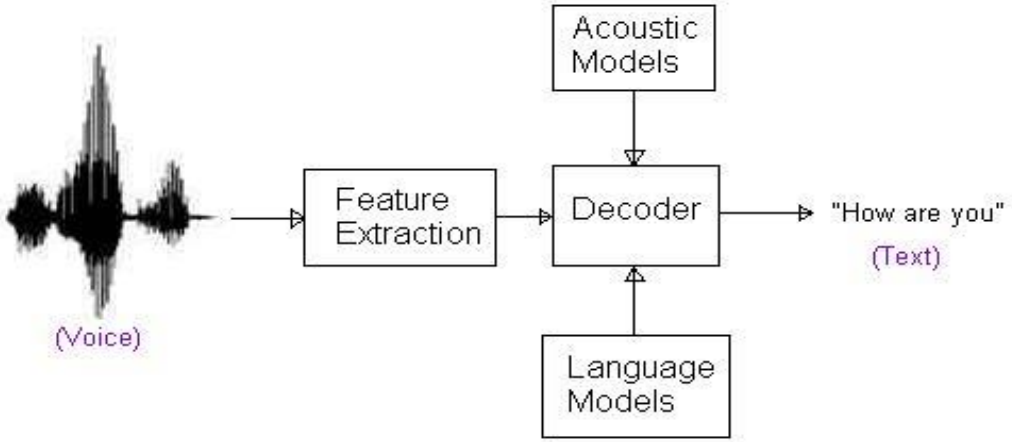


Some examples of PR Tasks

- 1. Character recognition (OCR)
  - Pattern-Image
  - Class- Identifying of character
  - Features- binary image, projects, moments, etc

Some examples of PR Tasks

- 2. Speech recognition
  - Pattern- 1D signal
  - Class-Identifying of speech units
  - Features- spectral info, cepstrum, etc.
  - Patterns can become a sequence of features vectors



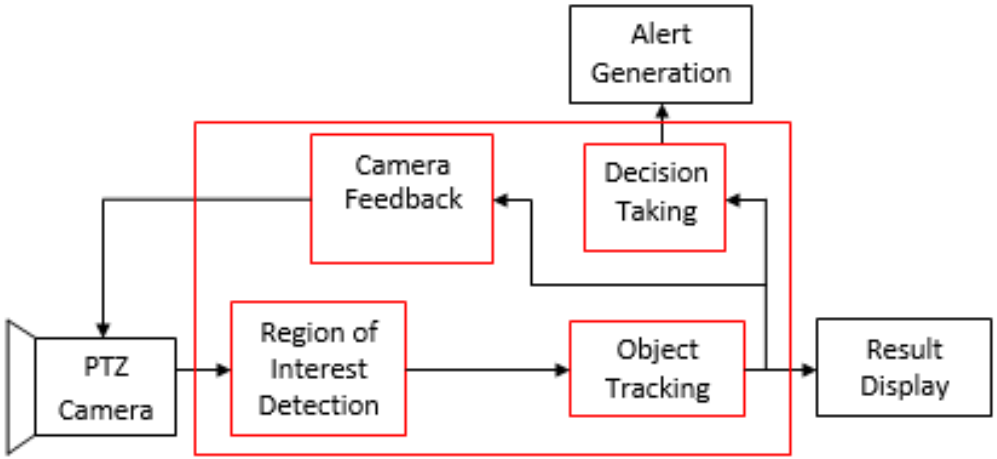
Speech Recognition System

Some examples of PR Tasks

- 3. fingerprint based Identity verification
  - Pattern- Image + Identity claim [login ID]
  - Class- yes/ no
  - Features- minutiae, orientation of ridge lines, pores, etc

Some examples of PR Tasks

- 4. video based surveillance
  - Pattern- Video sequence
  - Class- level of alertness
  - Features – motion trajectories, parameters if pre fixed models, etc



Some examples of PR Tasks

- 5. Credit screening
  - Pattern –details of an applicant (eg. credit card)
  - Class- yes/no
  - Features- Income, job history, credit history, etc

Some examples of PR Tasks

- 6. Imposter detection
  - Pattern- A sequence of transaction (credit card)
  - Class – yes/ no
  - Features- amount of money, location of transaction, etc.

Some examples of PR Tasks

- 7. Document Classification
  - Pattern- A documents and a query
  - Class- relevant or not (rank them)
  - Features – word occurrences, word context, etc.

Some examples of PR Tasks

- 8. Spam filtering
  - Pattern- A sequence of mail
  - Class- relevant or not (important mail)
  - Features – source address, content of mail, word context, word occurrences, etc.

Examples of more patterns

UPC BarCode

Fingerprint

Animal Footprint

Postnet Bar Code

Data Trend

Summary

- Natural Intelligence: The real power of human thinking is based on recognizing patterns.
- Artificial Intelligence: The better machine/computers get at 'pattern recognition', they will act like human.
- Artificial Intelligence (AI) is the field of transferring the natural intelligence of human into machine so that it take decision as like human.

THANK YOU