

Pattern Recognition and Image Processing

CSE 829

What is Pattern?

Pattern is everything around in this digital world. A pattern can either be seen physically or it can be observed mathematically by applying algorithms.

Example: The colors on the clothes, speech pattern, etc. In computer science, a pattern is represented using vector feature values.

Pattern Recognition?

Pattern recognition, simply put, is a process in which a machine finds and recognizes regularities (patterns) in data based on some features by applying machine learning algorithms. It can be seen as a kind of highly developed data classification based on knowledge already gained.

Pattern Recognition Approaches

- ❑ **Statistical.** This approach is based on statistical decision theory. Pattern recognizer extracts quantitative features from the data along with the multiple samples and compares those features. However, it does not touch upon how those features are related to each other.
- ❑ **Structural.** This approach is closer to how human perception works. It extracts morphological features from one data sample and checks how those are connected and related.
- ❑ **Neural.** In this approach, artificial neural networks are utilized. Compared to the ones mentioned above, it allows more flexibility in learning and is the closest to natural intelligence.

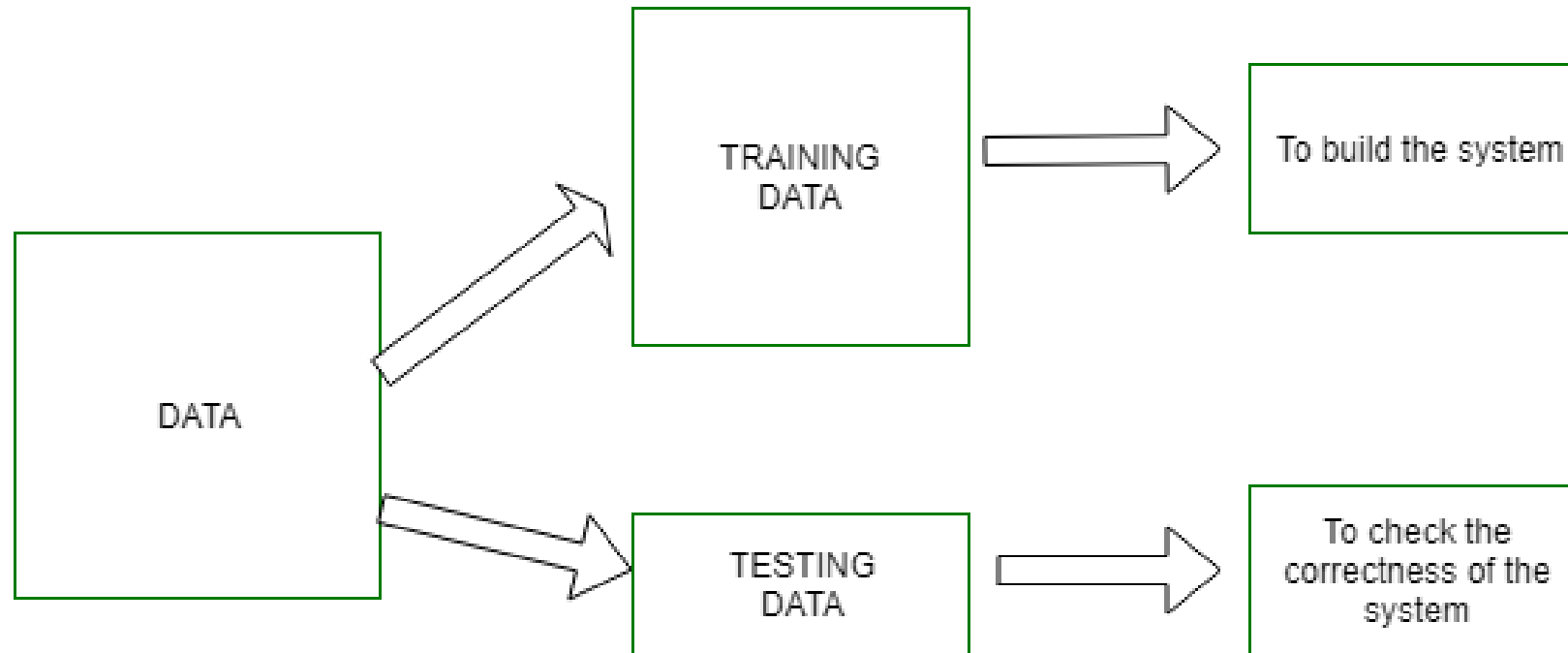
Components of a Pattern Recognition System

- ❑ **Input data:** Large amounts of data enter the system through different sensors.
- ❑ **Preprocessing or segmentation.** At this stage, the system groups the input data to prepare the sets for future analysis.
- ❑ **Feature selection (extraction).** The system searches for and determines the distinguishing traits of the prepared sets of data.
- ❑ **Classification.** Based on the features detected in the previous step, data is assigned a class (or cluster), or predicted values are calculated (in the case of regression algorithms).
- ❑ **Postprocessing.** According to the outcome of the recognition, the system performs future actions.

Properties of a PR System

- Pattern recognition system should recognize familiar patterns quickly and accurate
- Recognize and classify unfamiliar objects
- Accurately recognize shapes and objects from different angles
- Identify patterns and objects even when partly hidden
- Recognize patterns quickly with ease, and with automaticity.

Training and Learning in PR



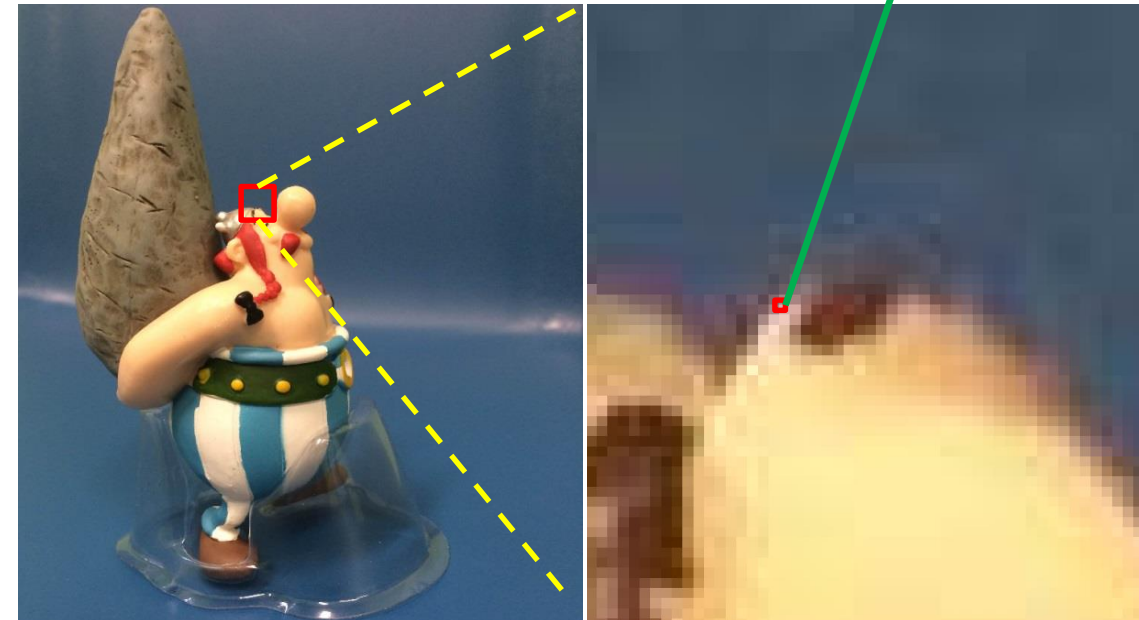
Example of Pattern Recognition

- ❑ NLP (natural language processing): virtual assistants, speech-to-text interfaces, automatic captioning;
- ❑ OCR scanners (optical character recognition): mobile scanner apps;
- ❑ Medical diagnostic software;
- ❑ Meteorological forecast software;
- ❑ NIDS (Network intrusion detection systems): security systems, which recognize patterns of suspicious activities.
- ❑ Remote sensing applications
- ❑ Image (video?) processing and classification

Image?

What is an digital image?

- a two-dimensional function $f(x, y)$
 x and y are spatial coordinates
The amplitude of f is called intensity or gray level at the point (x, y)
- In other words, an image can be defined by a two-dimensional array specifically arranged in rows and columns
 - Pixels are the basic elements of a digital image



Digital Image Processing

— Processing digital images by means of computer algorithm, in order to get enhanced image or to extract some useful information

it covers low-, mid-, and high-level processes

low-level: inputs and outputs are images

mid-level: outputs are attributes extracted from input images

high-level: an ensemble of recognition of individual objects

Types of an Image

BINARY IMAGE– The binary image as its name suggests, contain only two pixel elements i.e 0 & 1, where 0 refers to black and 1 refers to white. This image is also known as Monochrome.

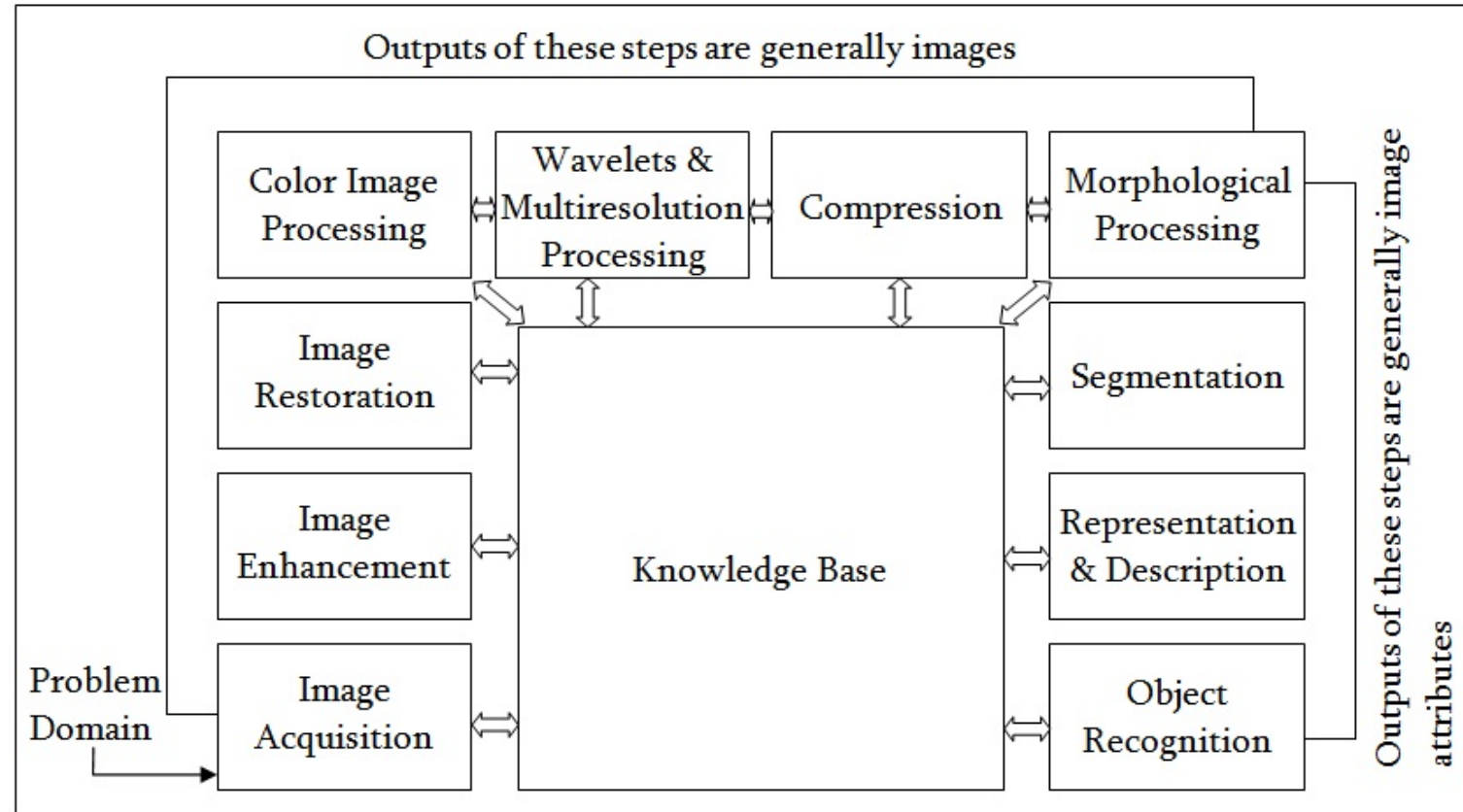
BLACK AND WHITE IMAGE– The image which consist of only black and white color is called BLACK AND WHITE IMAGE.

8 bit COLOR FORMAT– It is the most famous image format. It has 256 different shades of colors in it and commonly known as Grayscale Image. In this format, 0 stands for Black, and 255 stands for white, and 127 stands for gray.

16 bit COLOR FORMAT– It is a color image format. It has 65,536 different colors in it. It is also known as High Color Format. In this format the distribution of color is not as same as Grayscale image.

A 16 bit format is actually divided into three further formats which are Red, Green and Blue. That famous RGB format.

Fundamental Steps of Image Processing



End of this Lecture