3/1/2019

Different Paradigms (models) (or) for Pattern Recognition:

1. Statistical Pattern Recognition
2. Syntatic " "
3. Template Matching (or) (Structural Pattern Recog)
4. Neural networks.

→ Of these three basic, Statistical PR is more popular and has received the majority of attention in literature. The main reason for this is that most practical problems in this area deal with noisy data and uncertainty.

↳ Statistics and probability are good tools to deal with such problems.

→ In S.P.R, we focus on the statistical properties of the pattern (generally expressed in probability densities) and this will be used in most of the real time applications.

→ If instead the model consists of some set of crisp ~~rules (or) grammars describes our decision~~ logical rules then we employ the method of syntatic pattern recognition, where the rules (or) grammar describe our decision.

Eg: To classify an English Sentence as grammatical (or) not, here crisp rules are appropriate rather than statistical descriptions such as word frequencies (or) correlations.

→ In statistical pattern recognition, we use vector spaces to represent patterns and classes.

→ The abstractions typically deal with probability density / distributions of points in multi-dimensional spaces. (or)

→ Because of the vector space representation, it is meaningful to talk of sub-spaces / projections and similarity between points in terms of distance measures.

→ There are several soft computing tools associated with this notion.

1. For eg, neural networks, fuzzy sets and rough set based pattern recognition schemes employ ~~vectorial~~ vector representation of ~~Points~~ Patterns and classes.

2. The Bayes classifier characterises optimality in terms of minimum error rate classification.

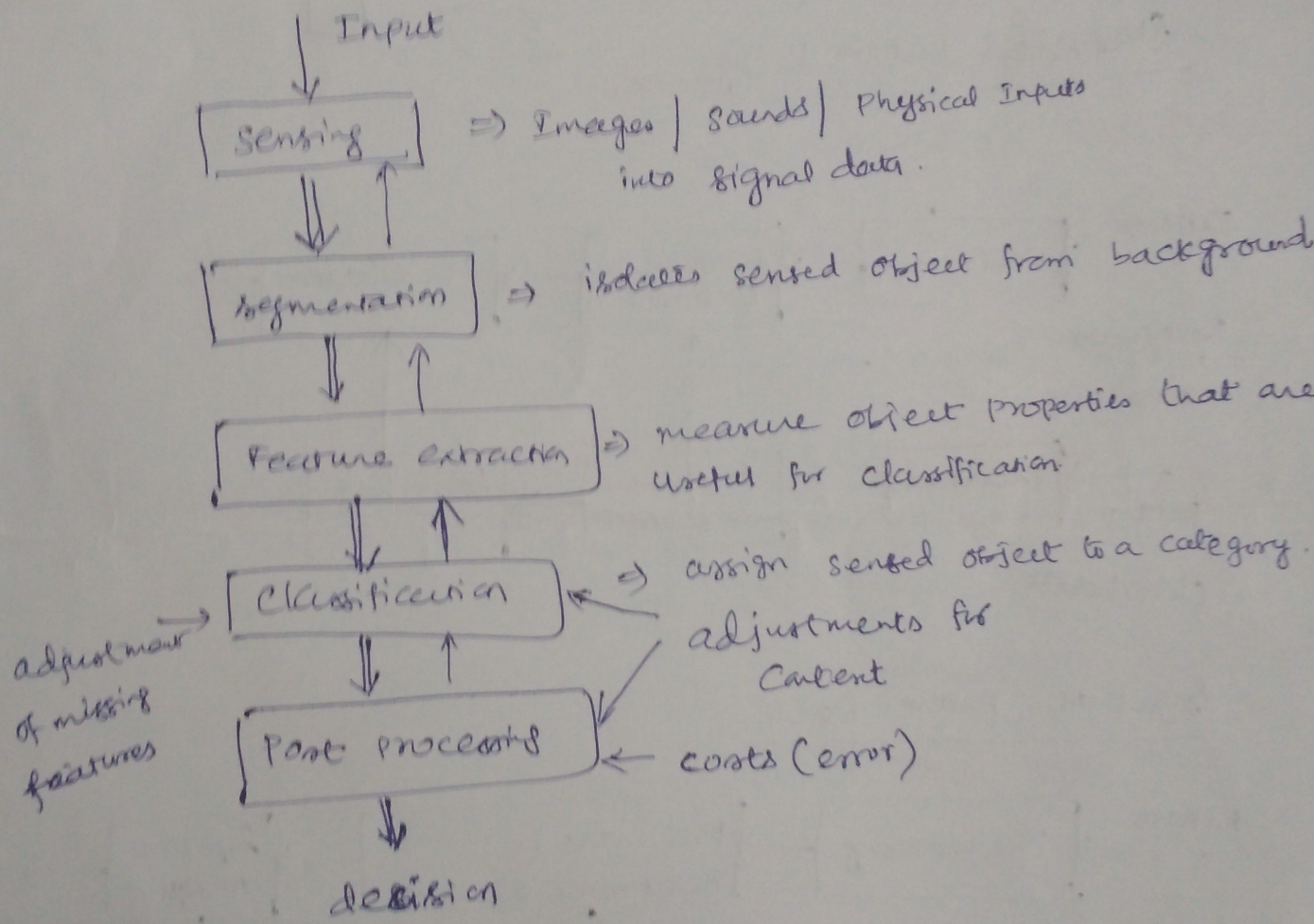
3. The use of hidden markov model (Hmm) is popular in fields like speech recognition.

4. A decision tree is a transparent data structure which can deal with classification of patterns employing both numerical and categorical features.

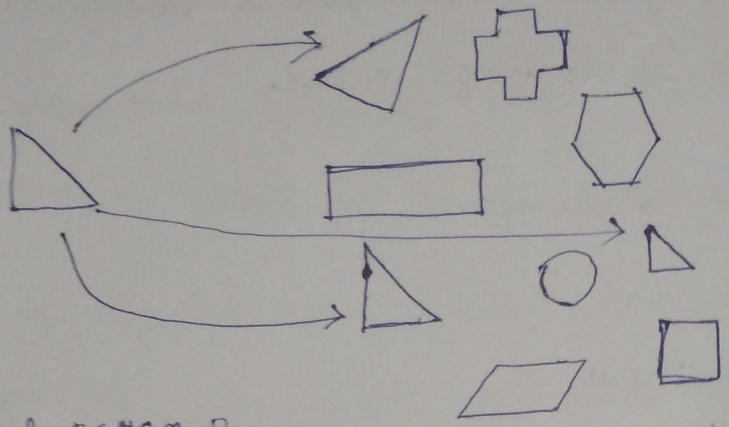
5. nearest neighbour rule: It is the most popular and simple classifier.

A new pattern is classified based on the class label of its nearest neighbour. In such a classification scheme, we do not have a training phase.

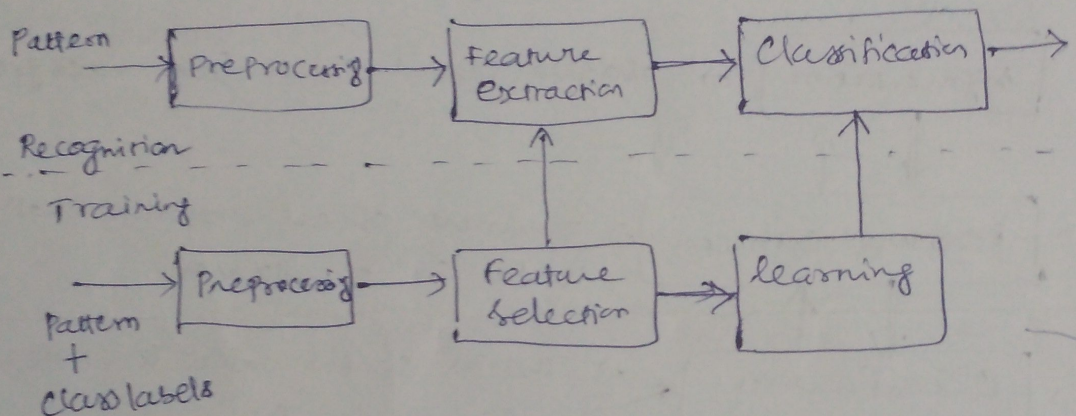
Pattern recognition systems:



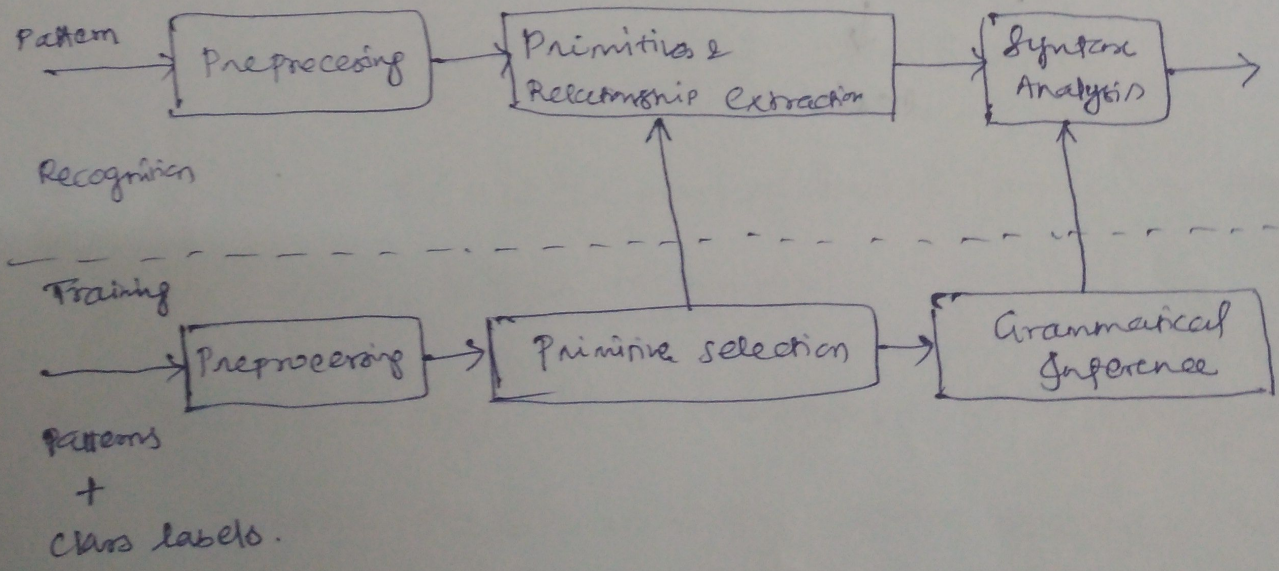
Rigid Template Matching:



Statistical pattern Recog:



Syntetic pattern Recog:



Data structures for pattern representation

(1) Patterns as vectors:

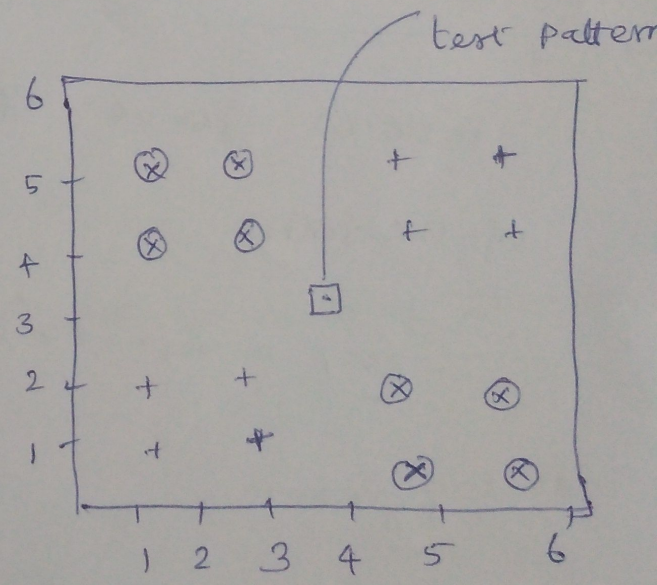
An obvious representation of a pattern will be a vector. Each element of the vector can represent one attribute of the pattern.

Eg: Spherical object (30, 1)
- 30 → weight
- 1 → diameter

(30, 1, 1) → class object.

Using vector representation a set of patterns, can be represented as

<1, 1, 1> ; <1, 2, 1>
<2, 1, 1> ; <2, 2, 1>
<4, 1, 2> ; <5, 1, 2>
<4, 2, 2> ; <5, 2, 2>
<1, 4, 2> ; <1, 5, 2>
<2, 4, 2> ; <2, 5, 2>
<4, 4, 1> ; <5, 5, 1>
<4, 5, 1> ; <5, 4, 1>



② Patterns as strings:

The string may be viewed as a sentence in a language. for ex: DNA sequence (or) a Protein sequence.

As an illustration, a gene can be defined as a region of the chromosomal DNA constructed with 4 nitrogenous bases.

A - adenine ; G - guanine ; C - cytosine and T - Thymine

Thymine

G A A G T C C A G - - -

③ Patterns as logical Descriptions:

Patterns can be represented as a logical description of the form.

$(x_1 = a_1 \ldots a_2) \wedge (x_2 = b_1 \ldots b_2) \wedge \ldots$

An Eg:

(Colour = red v white) ∧ (make = leather) ∧ (shape = sphere)

to represent 'cricket ball'.

(4) Fuzzy and Rough Pattern sets:

* Fuzziness is used where it is not possible to make precise statements. It is therefore used to model subjective, incomplete and imprecise data.

In a fuzzy set, the objects belong to the set depending on a membership value which varies from 0 to 1.

The set X is thus represented by a tuple $\{\underline{X}, \overline{X}\}$ which is composed of the lower and upper approximation.

Eg: "If x_1 is small and x_2 is large, then class 3"

$\langle$ small, large, 3$\rangle$

It can also be used in cases where there are uncertain (or) missing values.

$X = (?, 6.2, 7)$

$X = ([0,7], 6.2, 7)$ with no missing values.

* The values of the features may be rough values. Such F.v are called rough patterns.

A rough value consist of an upper and a lower bound.

Power 'P' can be represented as

$\langle 230, 5.2, (\underline{50}, \overline{49, 51}) \rangle$

↓ V, ↓ C, ↓ frequency