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Pattern Recognition

Smita Ghosh, Neeraj Kumar Singh.

Abstract: *"Patter recognition" is the Scientific discipline of machine learning (or Artificial Intelligence) that aims at classifying data (Patterns) into a number of categories of classes." Now what is "Pattern"*
1) A "Pattern" is an object, process or event that can be given a name.
2) A Pattern is a set of patterns sharing common attributes and usually originating from the same source. So, Pattern Recognition may be characterized as an information reduction information mapping, or information labeling process. The objective of this paper is a to "Automatic speech and speaker recognition." This research directions will emerge and new techniques will be developed to solve some of the new challenging problems. Pattern Recognition is identifying patterns in data. These Patterns tell the data stories through ebbs and flows , spikes, and flat lines.
The data itself can be anything :

- *Text*
- *Images*
- *Sounds*
- *Sentiments and others.*

Key words:
Postulates of PR, Evaluation of classifiers, PR Process Acoustic Model output.

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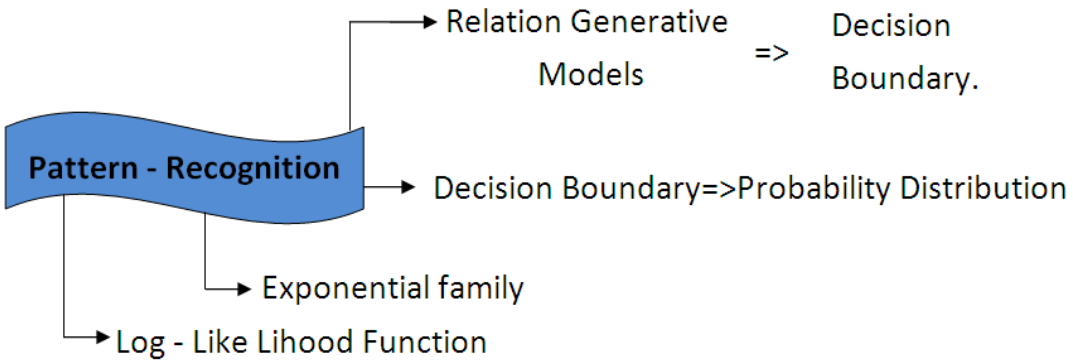
I. Introduction :

We can explain Pattern. Recognition in picture as follows:



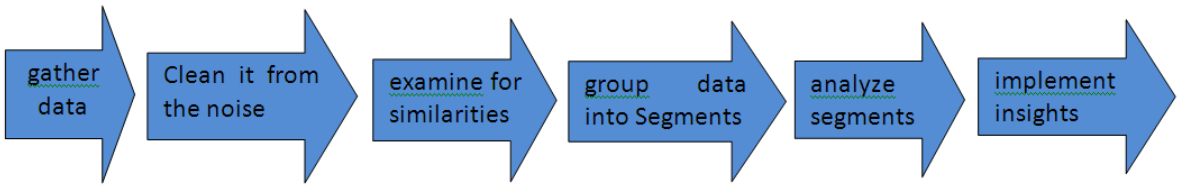
Pattern Recognition is a single blind poor reviewed academic journal published by "Elsevier Science". It was first published in 1968 by "Pergamon Press". The founding editor - in-chief was Robert Ledley, who was succeeded from 2009 until 2016 by Ching Suen of Concordia University, Pattern is everything around in this digital world, A pattern can either be seen physically or it can be observed mathematically by applying algorithms. Pattern recognition can be defined as the classification of data based on knowledge already gained as on statistical information extracted from patterns and / or their representation.

Pattern recognition possesses the following features:

- Pattern recognition System should recognize familiar pattern 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. Pattern Recognition is efficient enough to give machines human recognition intelligence. This is used for image processing Segmentation and analysis. For

example: Computer can detect different types of insects better than humans. "Christopher Bishop" in his seminal work "Pattern Recognition and Machine Learning" describes the concept like pattern recognition deals with the automatic discovery of regularities in data through the use of computer algorithms and with the use of these regularities to take actions such as classifying the data into different categories.

Pattern Recognition Process

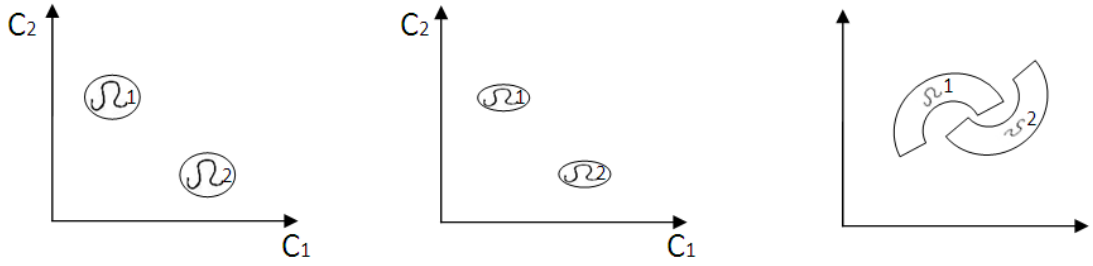


Fundamental of Pattern recognition :
The classic of Pattern recognition we have 6 postulates :

Postulates 1 : Availability of a representative sample W of patterns f(x) for the given field of problems
w = { f(x), ..., f (x)} C i
Postulates 2 : A (simple) pattern has features h characterize its membership in a certain class k .
Postulates 3 : Compact domain in the feature space of features of the same class: domains of different classes are (reasonably) separable.

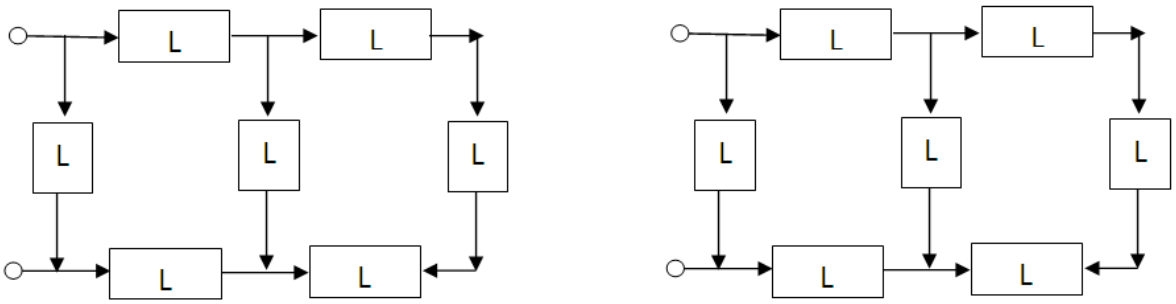
- Small intra - class distance.
- High inter - class distance.

Example of an increasingly less compact domain in the feature space:



Postulates 4 : A (complex) pattern may be decomposed into these constituents.

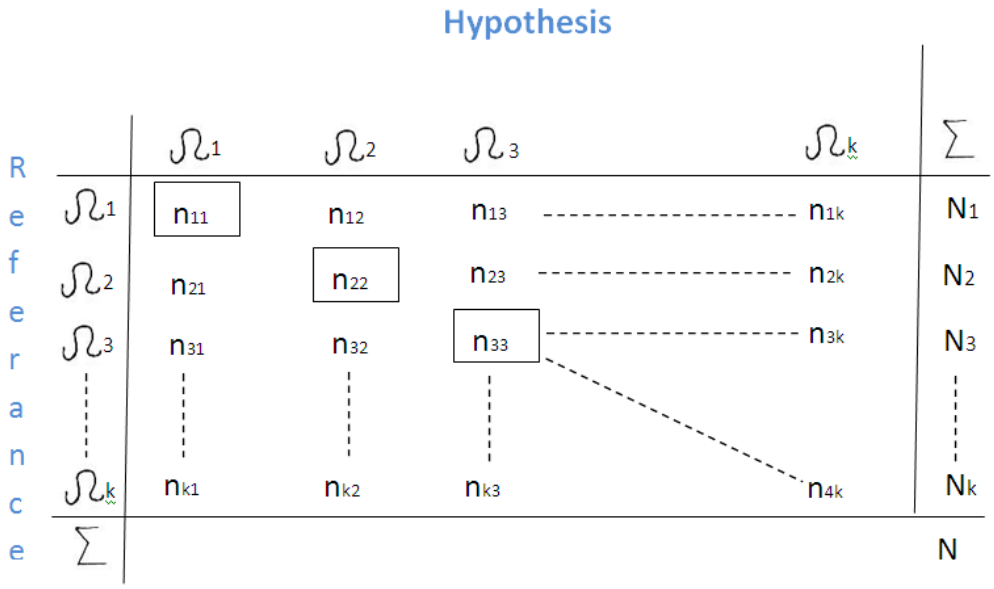
Postulates 5 : A (complex) pattern f(x) € has o certain structure. Not any arrangement of simple constituents is a valid pattern. Many patterns may be represents with relatively few constituents.



Postulates 6 : Two patterns are similar if their features or simpler constituents differ only lightly.

Performance Evaluation :

- Feature vectors are used as input for the classifier.
- Classification results in a discrete class index.
- Confusion matrix.



confusion matrix with absolute frequencies for a K-class problem.

Evaluation of Classifiers:

- A currency / Recognition Rate - RR $\frac{1}{N}\sum_{K=1}^{K} n_{kk}$ 100%
- Recall and Precision

$$\text{Recall}_k = \frac{n_{kk}}{\sum_{i=1}^{K} n_{ki}} = \frac{n_{kk}}{N_k}$$

$$\text{Precision} = \frac{n_{kk}}{\sum_{i=1}^{K} n_{ik}}$$

- Average Recall

$$\text{UAR} = \frac{1}{K}\sum_{K=1}^{K}\frac{n_{kk}}{N_k} \quad 100\%$$

Special Case : Only 2 classes

	Positive	Negative
Positive	True positive	False positive
Negative	False Negative	True Negative

Various performance measures:

- True positive rate (hit rate, recall, Sensuality) $\frac{\#TP}{\#TP + FN}$
- False positive rate (false alarm rate, fall out) $\frac{\#FP}{\#FP + \#TN}$
- Positive predictive wale (precision) : $\frac{\#TP}{\#TP + \#FP}$
- Negative predictive value : $\frac{\#TN}{\#TN + \#FN}$
- True negative rate (specify): $\frac{\#TN}{\#FP + \#TN}$

$= 1-$ false positive rate

- Accuracy: ACC = $\frac{\#TP + \#TN}{\#TP + \#FP + \#FN + \#TN}$
- F- measure: Harmonic mean of recall. and precision :

$$F = \frac{2.\ recall.\ precision}{recall + precision}$$

An obvious representation of a pattern will be a vector. Each element of the vector can represent one attribute of the pattern. The first element of the vector will contain the value of the first attribute for the pattern being considered.

Overall, there are two major parts of pattern recognition algorithms:

- explorative - used to recognize commonalities in the data.
- descriptive - used to categorize the commonalities in a certain manner.

There are three main models of Pattern Recognition:

To identify where the specific.

- Statistical: piece belongs. This model uses supervised machine learning.
- Syntactic/Structural: To define a more complex relationship between elements. This model uses same - Supervised machine learning.
- Template matching : To match the object's features with the predefined template and identify the object by proxy. One of the uses of such a model is plagiarism checking.

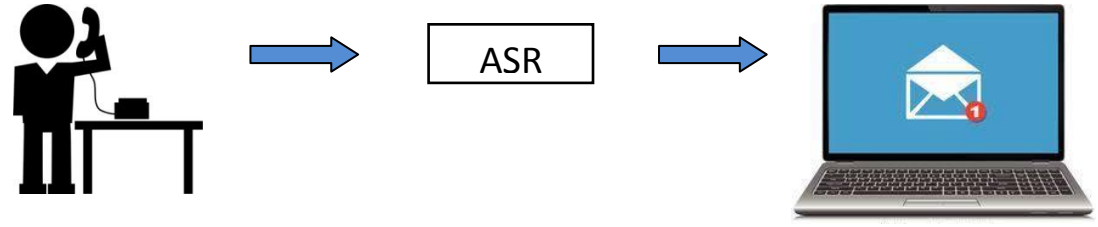
Pattern Recognition Application :

Speech Recognition :

The greatest success in speech recognition has been obtained using pattern recognition paradigms. It is used in various algorithms of speech recognition which tries to avoid the problems of using a phoneme level of description and treats Larger units such as words as pattern.

Speech recognition has already proven useful for certain application, such as telephone voice- response systems for certain applications, such as telephone voice-response systems for selecting services or information digit recognition for cellular phones and data entry while walking around a railway yard or clambering over a jet engine during an inspection.

So at and first what is "Automatic Speech Recognition?"
Automatic Speech Recognition (ASR) systems accurately translate utterances spoken into text (Words, Syllabus etc). Examples are: You Tube closed captioning, voicemail , transcription, Dictation Systems, Siri front and etc.



Speech Signal Text

With the rise of natural language processing that all changes. But what gives the computer the power to actually understand the exact sounds of the person and make sense out of it all? This is the powerful subfield of Al called Speech Recognition.

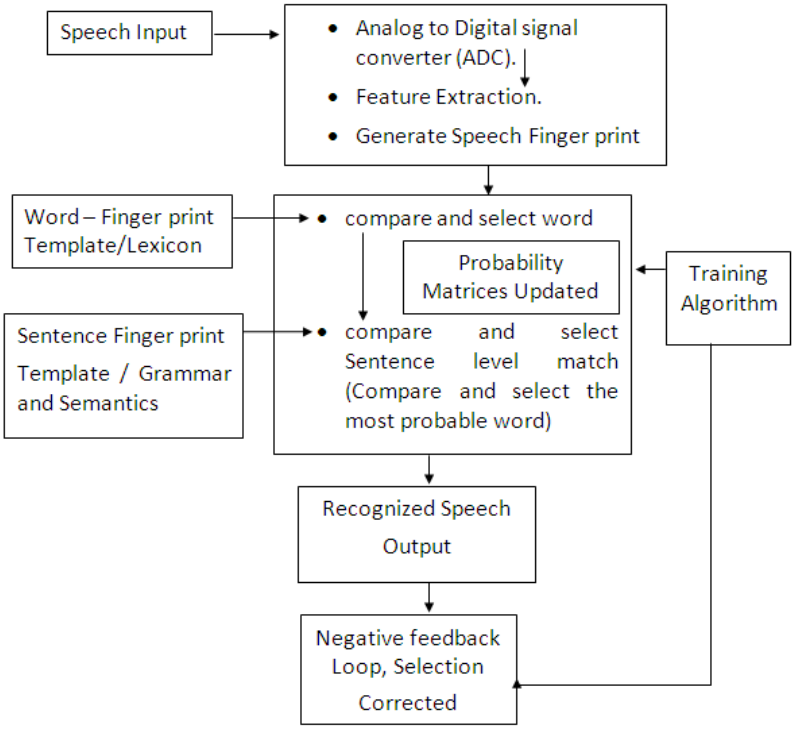
What can you infer from speech?

- what can you infer from speech ?
- what is being said?
- what language is being
- spoken?
- Who is speaking ?
- Gender of the speaker
- Age of the speaker
- Emotion

- Stress level
- Cognitive load level
- Depression level
- Is the person sleepy
- Is the person inebriated.

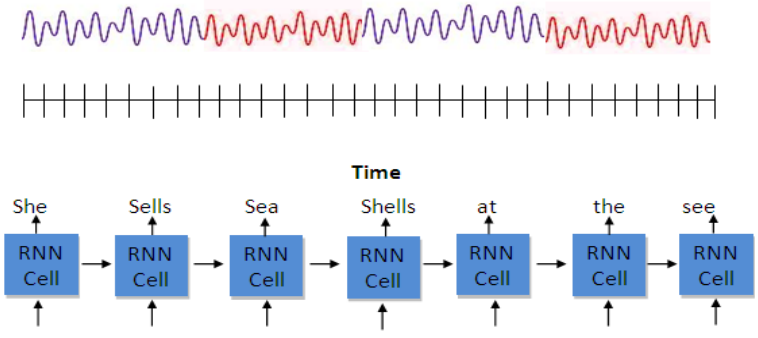
Speech conveys several types of information
- linguistic : message and language information
- Para linguistic : emotional and physiological Characteristics.

Speech Recognition Algorithms :
Almost all SR systems follow some basic structure :

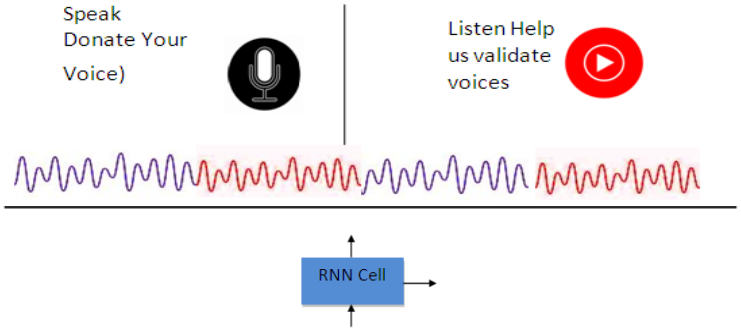


Out comes of review and research direction :
How to Deal with all physical Aspects of speech ?
In a Neural Net Requirements:

- process sequential data.
- Low compute
- real time capability

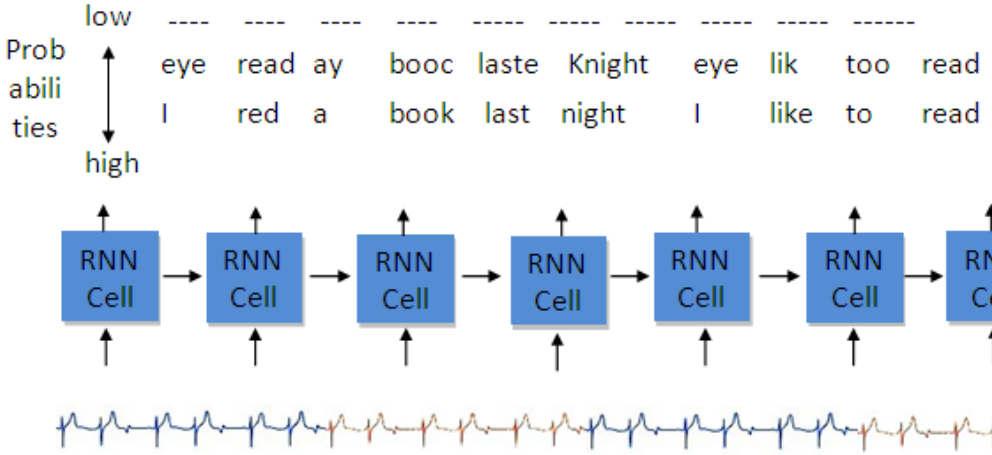


Acoustic Model Approach :



So, now How to deal with Linguistic Aspect?

So, it is Language Model + Rescoring Algorithm



What a more likely Sentence?

Probability (I read a book) = .95

Probability (I red a book) = .25

Acoustic model output => Language model + Rescoring algorithm => Hypothesis (Beams)

Therefore hypothesis (beams) outcomes :

Probability (i read a book last night i like to read) = .95

Probability (i red a book last night i like to read) = .35

Probability (i red a book last night i like to reed) = .15

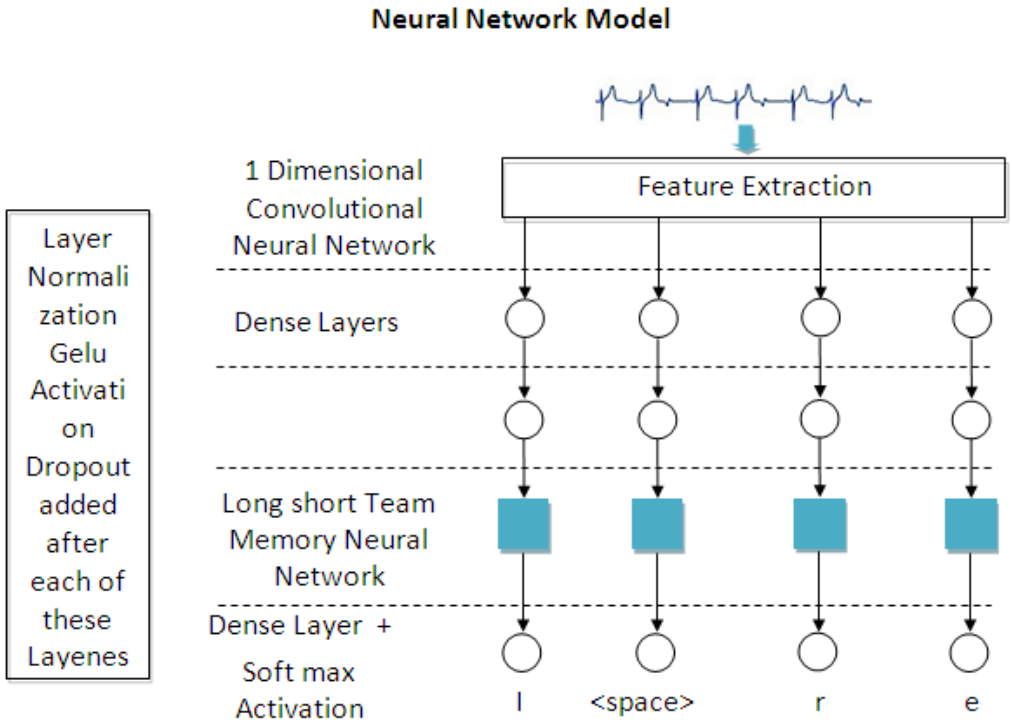
Data Processing Pipeline → It transforming audio waves in mel spectrograms as features to feed it into the neural network. Now transforms our labels into integer indexes. Our network will characters instead of words.

" I read a book "

[101 19 65 12 13 16 1612]

Now augment our data to effectively have a bigger dataset

"Spectrogram augmentation " is the technique randomly cuts out features in time and frequency domain.



Most of the memory required for training deep recurrent network is used to store activations through each Layer for use by back propagation, not to store the parameters of the network.

For example : Storing the weights for La **70M parameter network** with a layers requires approximately 280MB of memory, but storing the activations for a batch of 64, seven - Second Utterances requires 1.5 GB of memory. Such as Titan X GPUs include 12 GB of GDDR5 RAM.
But **"Acoustic Model"** storing the weights for a **4M parameter network**.

II. Conclusion :

Our study has recognized some limitations, PR may be characterized as an information reduction , information mapping or information labeling process. As no single technology is always the optimal solution for a given PR problem. Pattern provide a means to capture successful solutions to common Software problems in a formal written manner so that they can be successfully passed on to and understood by Software development. In this paper we approaching our "Acoustic Model". Getting to this information is simply a matter of establishing the parameters of the search so that the qualifying and symbols can be for delivered to the network. So that it can save time by not Id bothering someone and so shed "Speech Recognition has a long history with my several waves of major innovations.

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