

# A Study of Image Classification using Machine learning-A Systematic Approach

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**Abstract:** Machine learning is an application of artificial intelligence that make the computer to learn by themselves without being explicitly programmed. There are different classification techniques. like supervised and unsupervised classification. The image classification approach in machine learning is explained based on flow chart. Different classification approaches like support vector machine, artificial neural network ,decision tree, fuzzy measure are explained. Their advantages and disadvantages are also described.

**Keywords:** Support vector machine, Artificial neural network ,Decision tree, fuzzy measure, convolutional neural network

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## I. INTRODUCTION

Machine learning application of artificial intelligence that provides systems the ability to automatically learn and improve from experience without being explicitly programmed .Machine learning focuses on the development of computer programs that can access data and use it learn for themselves. Superior data preparation capabilities[1], Knowledge of basic and advanced algorithms, scalability are some of the advantages of machine learning. Applications includes image Recognition, Speech Recognition, Medical Diagnosis, traffic signal detection, brain image segmentation, cancer detection etc . There are different types of machine learning supervised Learning, unsupervised learning, recommended system etc. Supervised learning as the name indicates a presence of supervisor as teacher. Basically supervised learning we use trained data to infer a model. then apply the test data to the inferred model .Application of supervised learning is Intrusion Detection Automatic answering of incoming messages, email extraction and thread summarization etc. In Unsupervised Learning there is no training data. Model inference and application both rely on test data The Application are DNA classification, Market segmentation, Social network analysis etc. Recommender System is a type of machine learning used to predict the rating. They match scores between user and adds. Application is Computational adds

## 2.LITERATURE REVIEW

Supervised learning classified into two categories of algorithms:

**Classification:** A classification problem is when the output variable is a category, such as Red or blue or disease and no disease.  
**Regression:** A regression problem is when input variable is a real value, such as weight or dollars. Examples of supervised algorithm are SVM, Linear regression etc.

Unsupervised learning is the training of machine using information that is neither classified nor labeled and allowing the algorithm to act on that information without guidance. Here the task of machine is to group unsorted information according to similarities, patterns and differences without any prior training of data

Unsupervised learning classified into two categories of algorithms: **Clustering:** A clustering problem is where you want to discover the inherent groupings in the data, such as grouping customers by purchasing behavior. **Association:** An association rule learning problem is where you want to discover rules that describe large portions of your data, such as people that buy X also tend to buy Y. Examples of unsupervised algorithm are K Means clustering, aprori algorithm etc.[2].

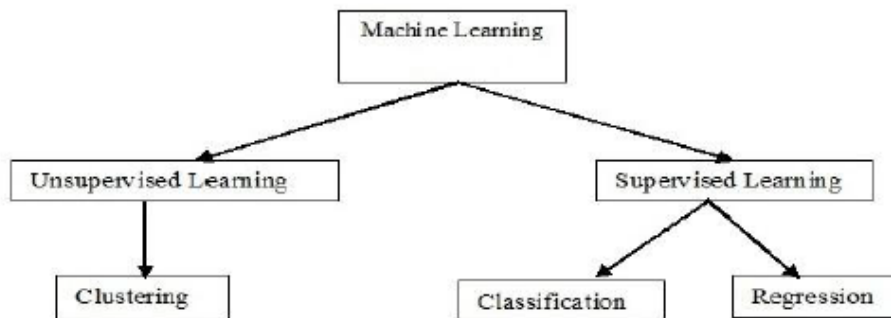


Image classification approaches in processing an image includes, preprocessing, feature extraction, selection of training data, decision and classification, classification output ,post processing ,accuracy assessment.

Image Acquisition: acquire the images from for image processing.

Image Pre-Processing: In preprocessing image transformation, noise removal, atmospherically correction techniques are used.

Feature Extraction: Extracting the important characteristics of the image.

Classification: The images are classified based on the extracted features into predefined categories by using suitable methods that compare the image pattern with images which inside the database.The flow chart of image classification approach is described below.



## 2.1 EXAMPLES OF CLASSIFIERS

### 2.1.1 ARTIFICIAL NEURAL NETWORK (ANN)

It is a type of artificial intelligence (AI) that intimidates some functions of the person mind. It has a normal tendency for storing experimental results. Neural networks consist of input and output layers, a hidden layer consisting of units that transform

the input into something that the output layer can use. They are excellent in finding patterns which are too complex for a human programmer to extract and teach the machine to recognize. The characteristic of this approach is the performance and accuracy depends upon the number of inputs and network structure. Computational rate is high. But the training of ANN is time consuming. Difficulty in choosing the type of network architecture, the initial value of parameters, such as learning rate, and the number of iterations required to train the network and the choice of initial weights.[4]

### 2.1.2 DECISION TREES

Decision Trees (DT) are knowledge based. they are hierarchical rule based approaches. They predict class membership by recursively portioning a data set into homogeneous data sets. They does not require an extensive designing and training. They are simple and have good computational efficiency But becomes complex in calculation when various values are undecided and/or when various outcomes are correlated.

### 2.1.3 SUPPORT VECTOR MACHINE

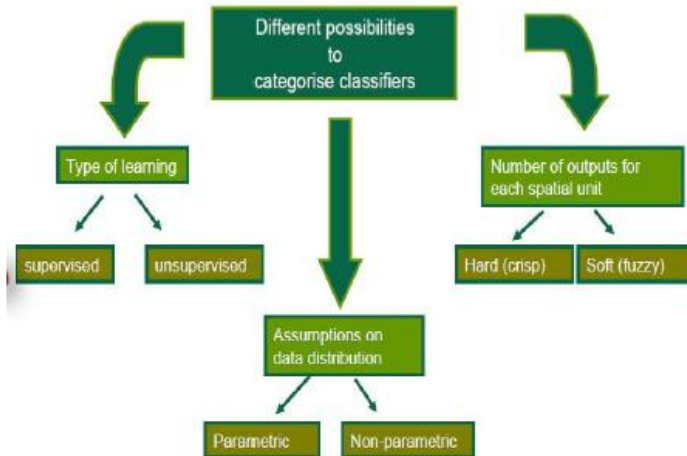
Support vector machine builds a hyper plane or set of hyper planes in high or infinite dimensional space used for classification. Good separation is achieved by hyper-plane that has the largest distance to the nearest training data points of any class. Generally larger the margin lower the generalization error of the classifiers The performance and accuracy depends on the hyper-plane selections and kernel parameters. [7] The main advantage of SVM is it contains a non linear transformation. They provide good generalization capability. Reduction in computational complexity. They are simple to manage decision rule complexity. The disadvantages of SVM include low transparency. Training is time consuming and the structure of algorithm is difficult to understand.

### 2.1.4 CONVOLUTIONAL NEURAL NETWORKS (CNN)

CNN is used for Image Classification. CNN-Type of feed-forward Multi layer perceptron. Neurons in one layer are only connect to neurons in the next layer, they dont form a cycle. There for the layer is not recursive. Convolution neural networks are called CONVNETS ,they are inspired by biological process in the visual cortex.CNN consists mainly input layer hidden layer,output layer. Hidden layer consists of Convolution layers, Max pooling, Full connected layer are layers .In convolutional layer they apply convolution operation to input and result is fed to next layer. They are rectangular grid of neurons with weights specifying the convolution filter. They have several grids in each layer. Each grid takes input from all layers using different filters. Max pooling layer takes small block from convolutional layer and subsample to produce single output from the block. Fully connected layer have high level of resoning.It takes neurons from previous layer and connects it to every single neuron .There is no convolution layer after fully connected layer[8]

### 2.1.5 FUZZY MEASURE

In traditional classification methods like as minimum distance method, each pixel /segment in the image will have an attribute equals to 1 or 0 expressing whether the pixel / segment belongs to a certain class or not,. In fuzzy classification, instead of a binary decision making problem, the possibility of each pixel/segment belonging to a specific class is considered, which is defined using membership functions. A membership function offers a membership degrees of values ranging from 0 to 1, where 1 means fully belonging to the class and 0 means not belonging to the class. Implementing fuzzy logic ensure that ,the borders were not crisp thresholds any more, but membership functions within which each parameter value will have a specific probability to be assigned to a specific class are used. [7]Appending more parameters to this classification, better results will be achieved. Using fuzzy logic, classification accuracy is less sensitive compared to the thresholds. The figure below shows architecture of fuzzy logic.



## 2.2.ADVANTAGES AND DISADVANTAGES OF DIFFERENT CLASSIFICATION METHODS

Name of classification	Advantages	Disadvantages
Decision Tree	Variable screening or feature selection. Data preparation is easy. Explicit all possible alternatives and traces each alternative	Due to over fit, they are prone to sampling errors
Support Vector	Machine Can be used on larger dimension. Different kernel function for various decision function.	Features greater then samples. Probabilities are not directly estimated
Fuzzy measure	Efficiently handles uncertainty .properties are described by stochastic relationship	Without prior knowledge output is not good.precise solution depends upon the direction of decisions
Convolutional neural network	Error is very less when compare to pervious Classification problem on object recognition.	. More hidden layers Time and space

## 3. CONCLUSION

Machine learning application of artificial intelligence that provides systems the ability to automatically learn and improve from experience without being explicitly programmed .In this paper we discussed different Image Classification Techniques based on machine learning approach. Some of the most commonly used techniques were discussed. We also described supervised and unsupervised classification techniques in machine learning[9]. The common method of image classification flow chart is mentioned .Advantages and disadvantages of each classification methods are also clearly described.

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