

# A Review on Automatic Image Annotation Techniques

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# Agenda

- Image Annotation
  - What?
  - Why?
  - Types
- Automatic Image Annotation techniques
- Single labelling annotation using Binary classification
  - Support Vector Machine (SVM)
  - Artificial Neural Network
  - Decision Tree
- Bayesian annotation Model
  - Non Parametric approach
  - Parametric approach
- Incorporating Metadata
- Pros and Cons
- Conclusion
- References



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# What is Image Annotation?

Given an image, What are the words that describe the image



- Jet
- Smoke
- Sky

## What is Image Retrieval?

Given a database of images and a query (eg: Image) ,What are the images are described by the words

Query -JET



# Why Image Annotation?

- Billions of consumers have the ability to create and store digital images.
- People do not spend time labeling, organizing their personal image collections.

## **Label\*:**

- Images are often stored with the name that is produced by the digital camera:  
DSC002861.jpg or GoodTimes.jpg or Chiia05.txt

## **Organize\*\*:**

- No standard scheme exists for filing images
- Individuals use ad hoc methods

- Difficult for an ordinary user to find images.



\*<http://en.wikipedia.org/wiki/Labeling>

\*\*[http://en.wikipedia.org/wiki/Organizing\\_\(structure\)](http://en.wikipedia.org/wiki/Organizing_(structure))

# Types Of Annotation Techniques

## 1. Text based Annotation

Input is the text

Annotated by humans.

**Disadvantage:** Huge amount of images.  
Subjective and Ambiguous.



Tree

Cloud

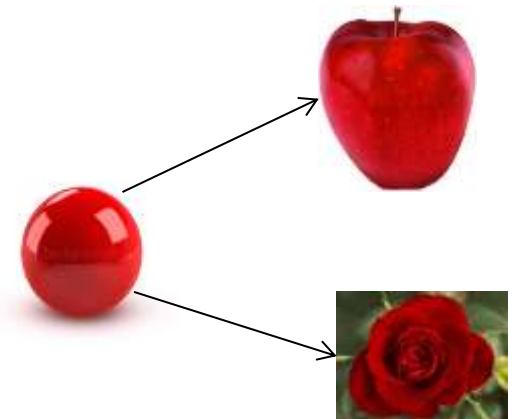
Sun

Water

## 2. Content Based Image Retrieval (CBIR)

Images are indexed and retrieved with low level content features such as shape, colour, texture.

**Disadvantage:** Gap between Low Level Content of the images.



Therefore, we came up with **Automatic Image Annotation (AIA) Technique.**

# Automatic Image Annotation Techniques

- Machine learning algorithms are generated by giving training to the system.
- Algorithm is used to annotate new images.

## **Types Of Automatic Image Annotation Techniques**

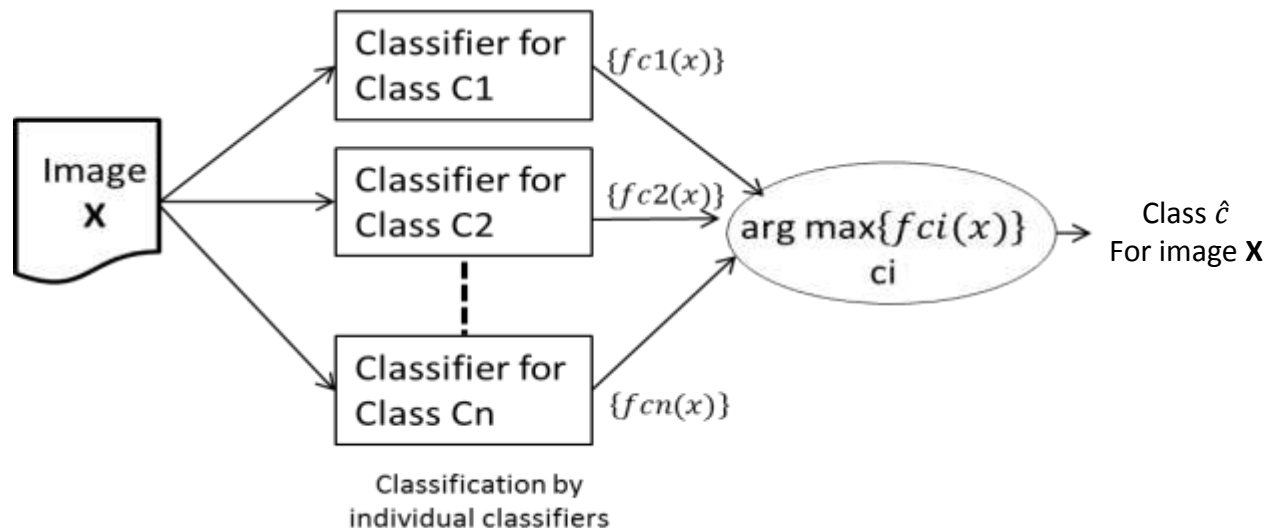
- 1 Single labelling annotation using binary classification**-Low Level features are extracted and fed to Binary Classifier.
  - 1.a Image annotation using Support Vector Machines (SVM)
  - 1.b Image annotation using Artificial Neural Network
  - 1.c Image annotation using Decision Tree
- 2 Multi labelling annotation using Bayesian Methods**-Multi –instance multi label(MIML) concept is followed.
  - 2.a Non Parametric approach
  - 2.b Parametric approach
- 3 Image annotation incorporating metadata**-WWW is a rich source of imagery and text information

# Support Vector Machine

- It is a Supervised/binary Classifier
- Finds Hyperplane\* from training samples
- Samples are represented by Feature vector and Class label
- Automatic image annotation require multiclass classifier

## Binary Classifier as Multiclass Classifier

- Train separate SVM ,generating a probability value
- Decision from all classifier are fused to get final result





# Artificial Neural Network OR Multi Layer Perceptron

- It is a Learning Network
- Contains multiple layers of Interconnected nodes (Neurons or Perceptron)

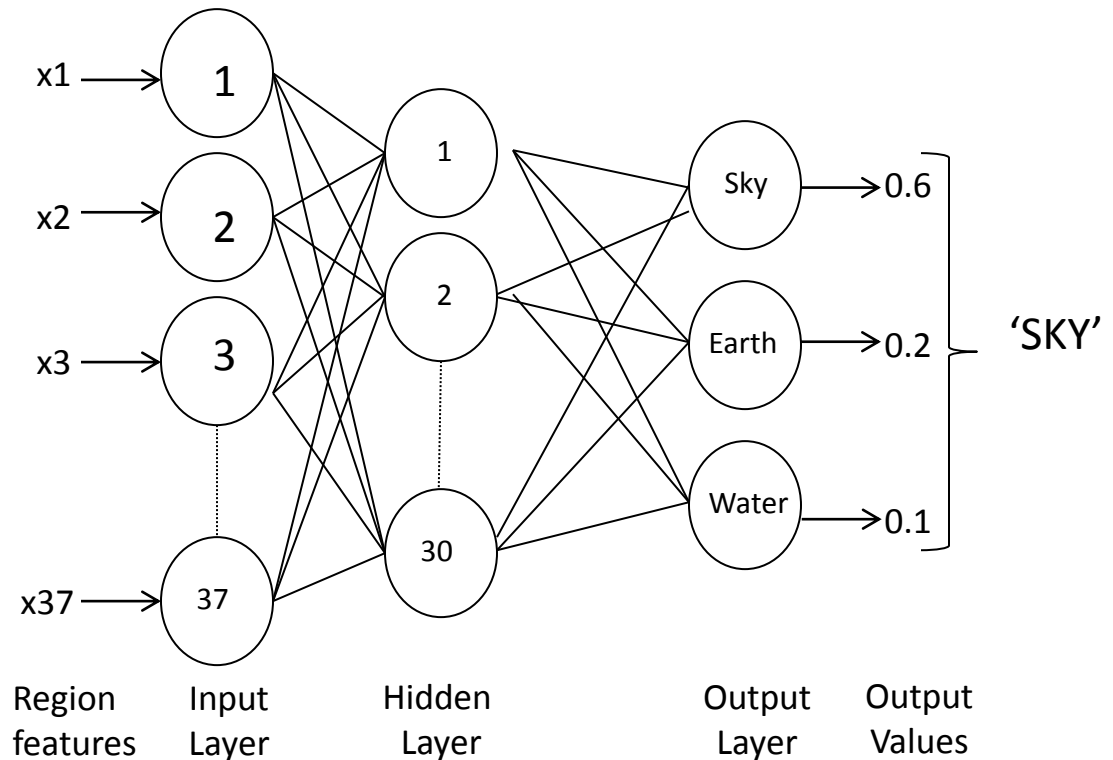
- Input Layer

Neurons equal to dimension of Input sample

- Output Layer

Neurons equal to number of classes

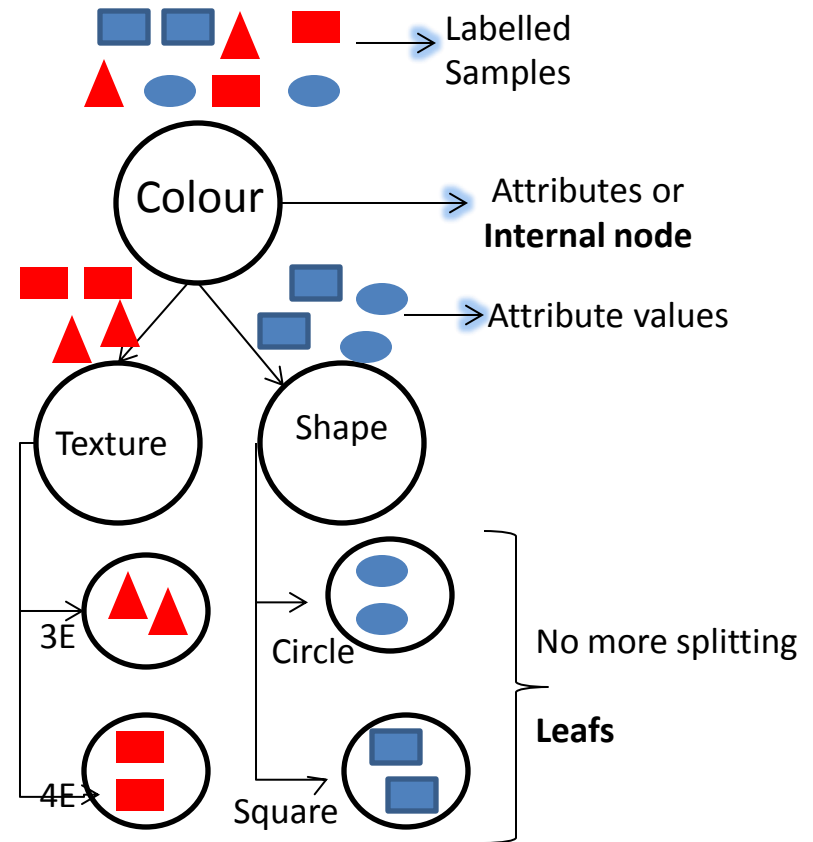
- Neurons connects as per Weight



# Decision Tree

Binary or n-ary Tree

- It is Multi-stage decision or If-then rules
- Set of labelled training samples
- Samples represented with number of attributes
- Dividing samples into non-overlapping sets
- Previous attribute is discarded
- Continues till no splitting possible
- Nodes:
  1. Internal node
  2. Leafs



# Bayesian annotation Model

## Non Parametric approach

- Features distribution is learned from training samples
- Features are extracted and compared with cluster centre
- Closest cluster centres are selected
- **Conditional Probability** is calculated

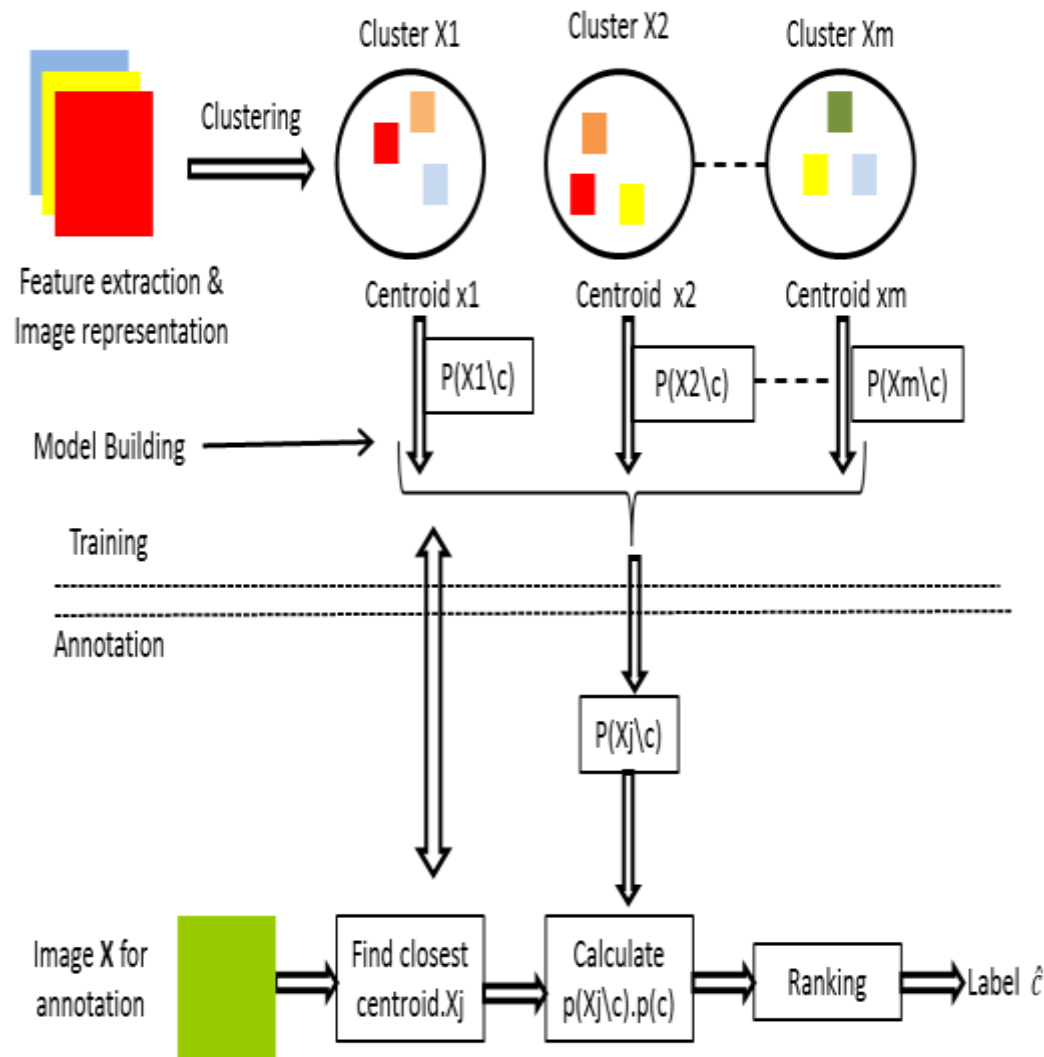
$p(X|c) \approx p(X_j|c) = (\text{No. of samples in } x_j \text{ which are from concept } c / \text{Total no. of samples from concept } c)$

- **Map Criterion** is calculated

$p(c|X_j) = (\text{Total no. of annotation } c \text{ inherited into cluster } X_j / \text{Total no. of all annotation words in } X_j)$

## Parametric approach

- Features are assumed to be continuous distributed
- Gaussian distribution is followed



# Incorporating Metadata

- Web images come with text descriptions, URL,HTML,code etc
- Web information used for image annotation and retrieval

- **D.cai\*** proposed two Level annotation and clustering mechanism

1.Textual clustering for semantic annotation

- Textual features
- Link Graph

2.Visual clustering for re organisation of images

Re organise images into clusters based on visual features

- **X-J Wang\*\*** proposed an automatic system that annotates using web description and content features
- At least one correct initial keyword and one example image to initiate the process
- 36 dimensional colour correlogram is used
- Web descriptions of the image is clustered
- Each cluster is scored
- Words in the top scored clusters are used for annotations

\*D.cai,X he,z,Li,w-y,Ma J-R wen ,Hierarchical clustering of www image search result using visual ,textual and link information in: proceedings of the ACM International conference on Multimedia 2004

\*\*X-j Wang,FJL Zhang W-Y Ma Annosearch: Image auto-annotation by search,in: proceedings of the CVPR06,vol2 2006

# Pros and Cons

Annotation Method	Pros	Cons
Support Vector Machine	Small Samples Optimal Class boundary Non Linear classification	Single labelling Expensive trail & run
Artificial Neural Network	Multiclass outputs Robust to noisy data	Single labelling Expensive training, Complex
Decision Tree	Intuitive, semantic rules, multiclass outputs, fast, allow missing values, categorical & numerical values allowed	Single labelling, need pruning, can be unstable
Non Parametric	Multi Labelling, model free	Large number of parameter & samples, sensitive to noisy data
Parametric	Multi labelling, small sample, good approximation of unknown distribution	Predefined distribution expensive training, approximate, boundary
Metadata	Use of textual & visual features	Difficult to relate visual features with textual features, difficult textual feature extraction

# Conclusion

## Issues to be resolved

1. High Dimensional features analysis
2. How to build an effective annotation model
3. Alternative for annotation and ranking done online
4. Ranking of Images
5. Lack of standard vocabulary and taxonomy for annotation
6. No acceptable image database for AIA training and evaluation

# References

- C.wang, Image annotation refinement using random walk with restarts
- D.cai,X he,z,Li,w-y,Ma J-R wen ,Hierarchical clustering of www image search result using visual ,textual and link information
- X-j Wang,FJL Zhang W-Y Ma Annosearch: Image auto-annotation by search

**Thank You**