Weaponry Classification using Artificial Intelligence for Security Surveillance

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Problem Statement

WEAPONRY CLASSIFICATION & DETECTION USING ARTIFICIAL INTELLIGENCE &DL FOR SECURITY SURVEILLANCE.

1. Security is always a main concern in every domain, due to a rise in crime rate in a crowded event or suspicious lonely areas.
2. Due to growing demand in the protection of safety, security and personal properties, needs and deployment of video surveillance systems can recognize and interpret the scene and anomaly events play a vital role in intelligence monitoring.
3. We propose to implement automatic gun (or) weapon detection using a convolution neural network (CNN), Support Vector Machines (SVM) and Random Forest that come under classification.

Data Source

WEB SCRAPING & SELF-CAPTURED IMAGES

- Weapon Images required for this Machine Learning Project are collected by web scraping from google search.
- We have used "**Fatkun Image Downloader Extension"** to download the images in bulk all at once.
- Also, some images are captured using the camera. Collectively these images form our complete dataset.

Data Information

1300+ IMAGES

- Around 1300+ images were collected. Out of which 1040 were used as training data and rest were used for validation and testing.
- The weaponry was divided in to two different types.

Types of Weapons/Classes are:

- **Guns**
- **Knife**

Models

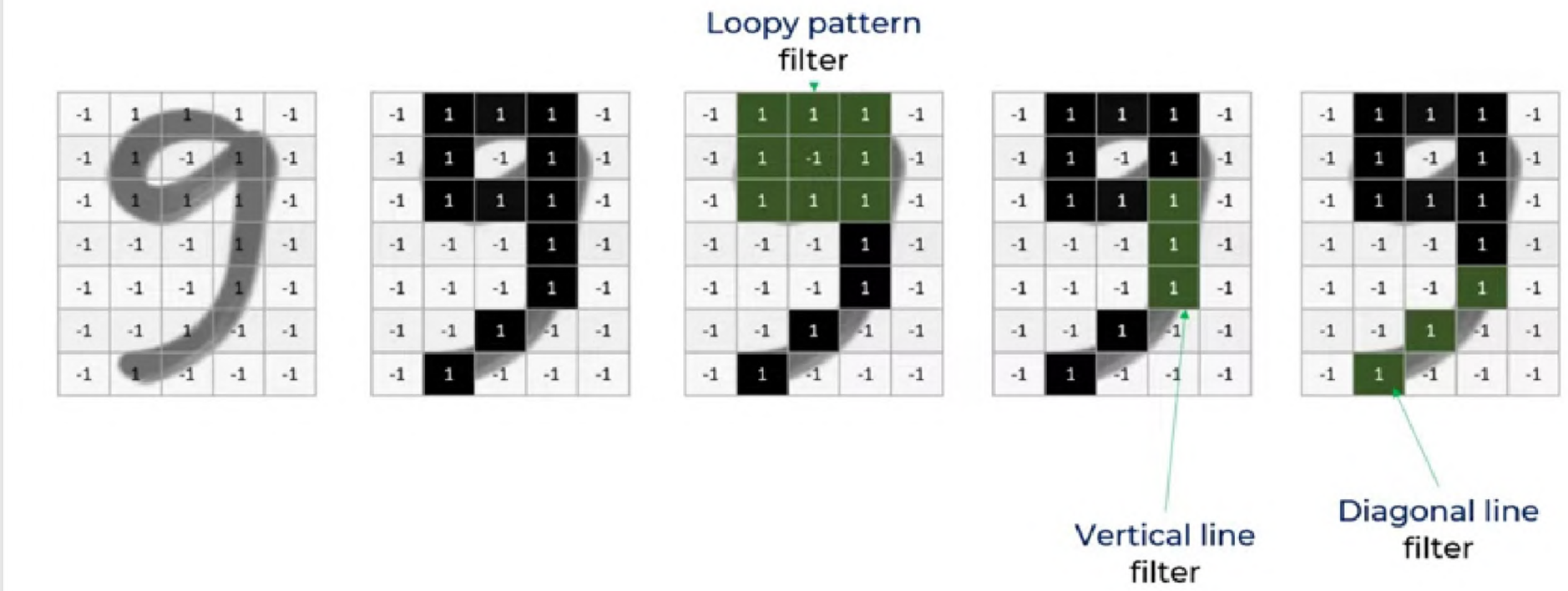
PROPOSED MODELS FOR SOLUTION

1. **CNN:**

- A Convolutional Neural Network (CNN) is a type of deep learning algorithm that is particularly well-suited for image recognition and processing tasks.
- It is made up of multiple layers, including convolutional layers, pooling layers, and fully connected layers.
- The convolutional layers are the key component of a CNN, where filters are applied to the input image to extract features such as edges, textures, and shapes. The output of the convolutional layers is then passed through pooling layers, which are used to down-sample the feature maps, reducing the spatial dimensions while retaining the most important information.
- The output of the pooling layers is then passed through one or more fully connected layers, which are used to make a prediction or classify the image.

Example:

9 Digit Image



How Convolution operation Works??

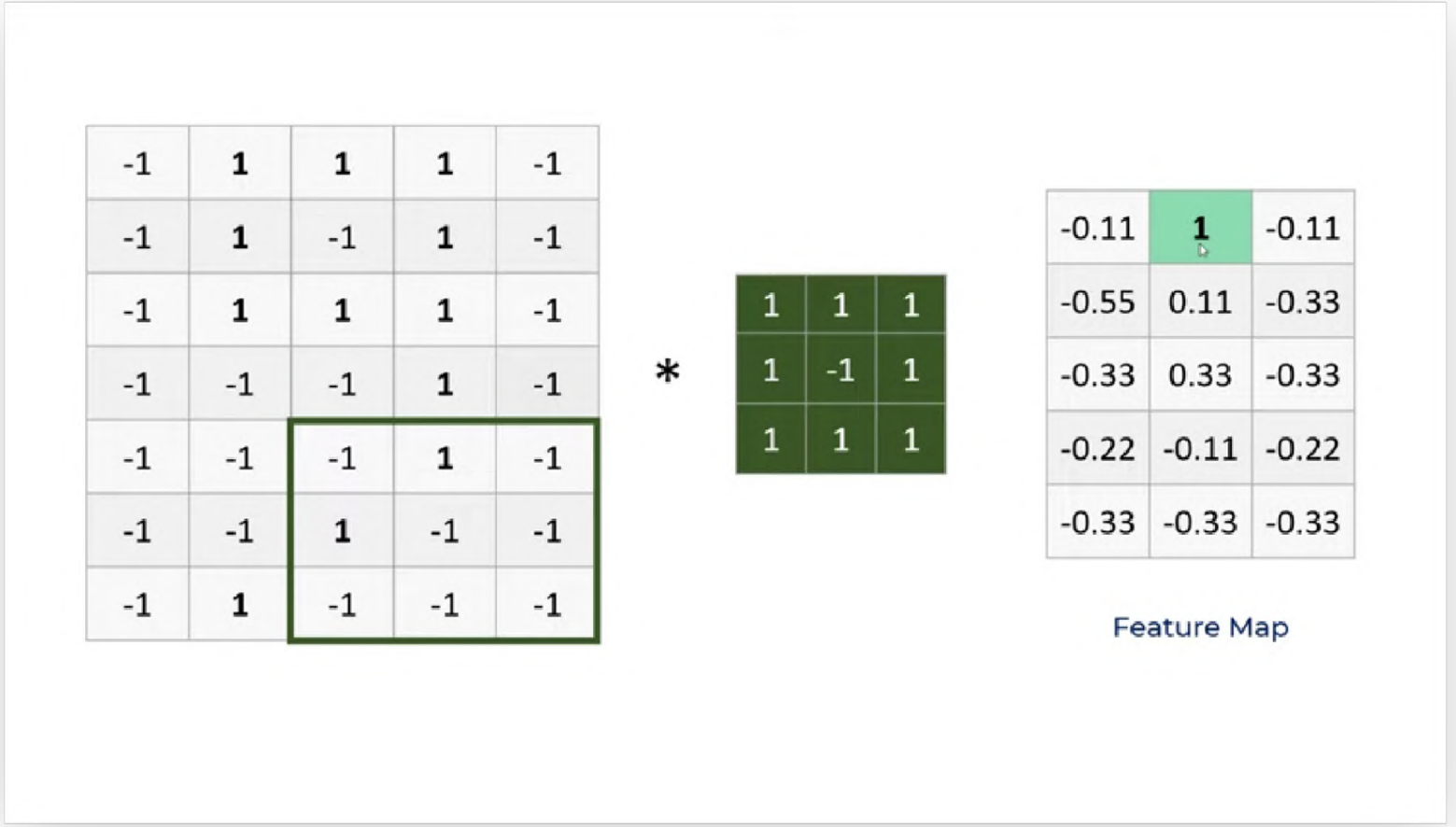
Convolution operation uses **Filters** to compute Feature Maps.

In this example of digit 9 we have total 3 filters.

- Loopy Pattern Filter
- Vertical Line Filter
- Diagonal Line Filter

Example:

After Loopy pattern filter is used.

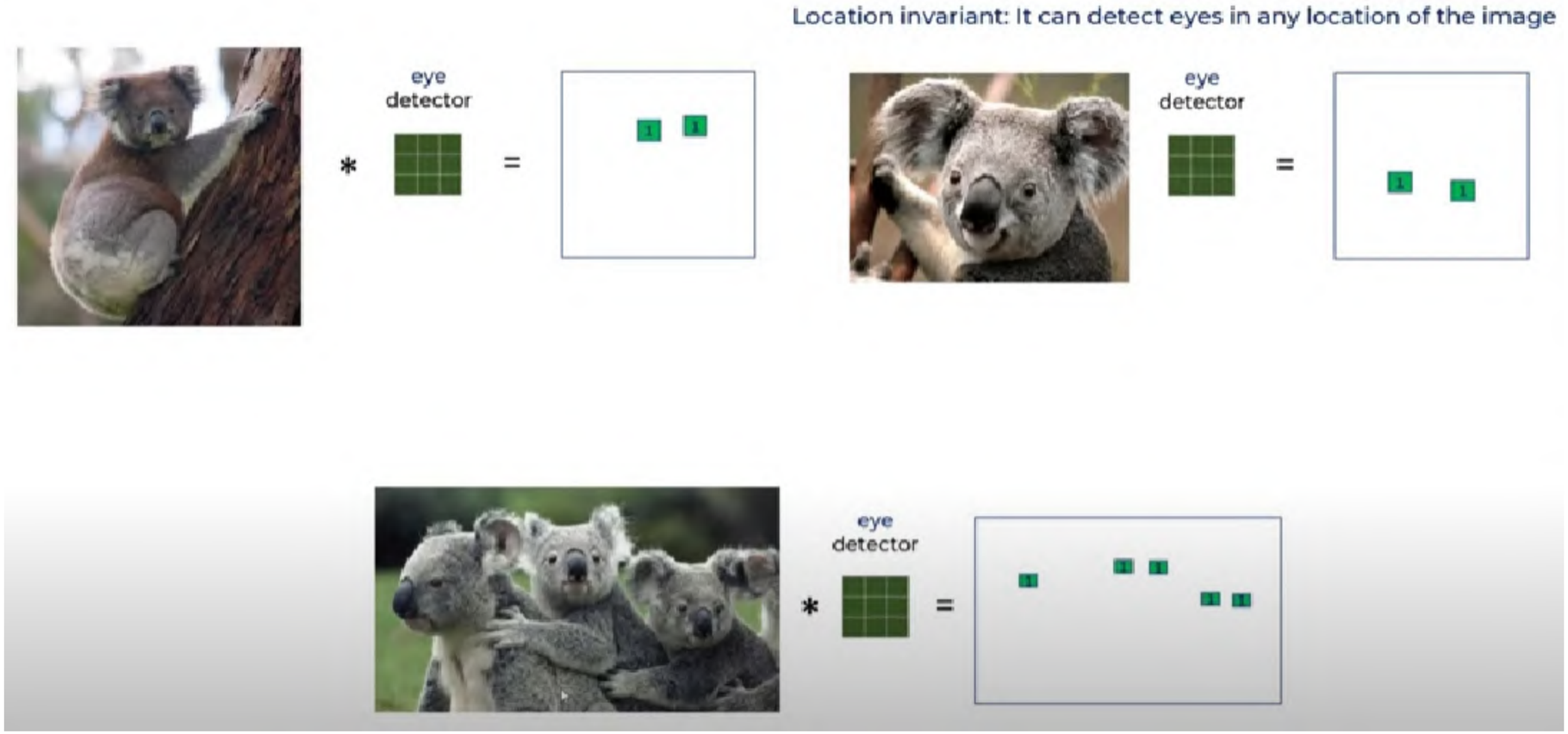


How Convolution operation Works??

- The benefit is where ever you see no 1 or no close to 1 in the feature map that means there is a loopy pattern in the image.
- It is also called as the feature is activated here in the top.
- So Filters are nothing but the feature detectors.

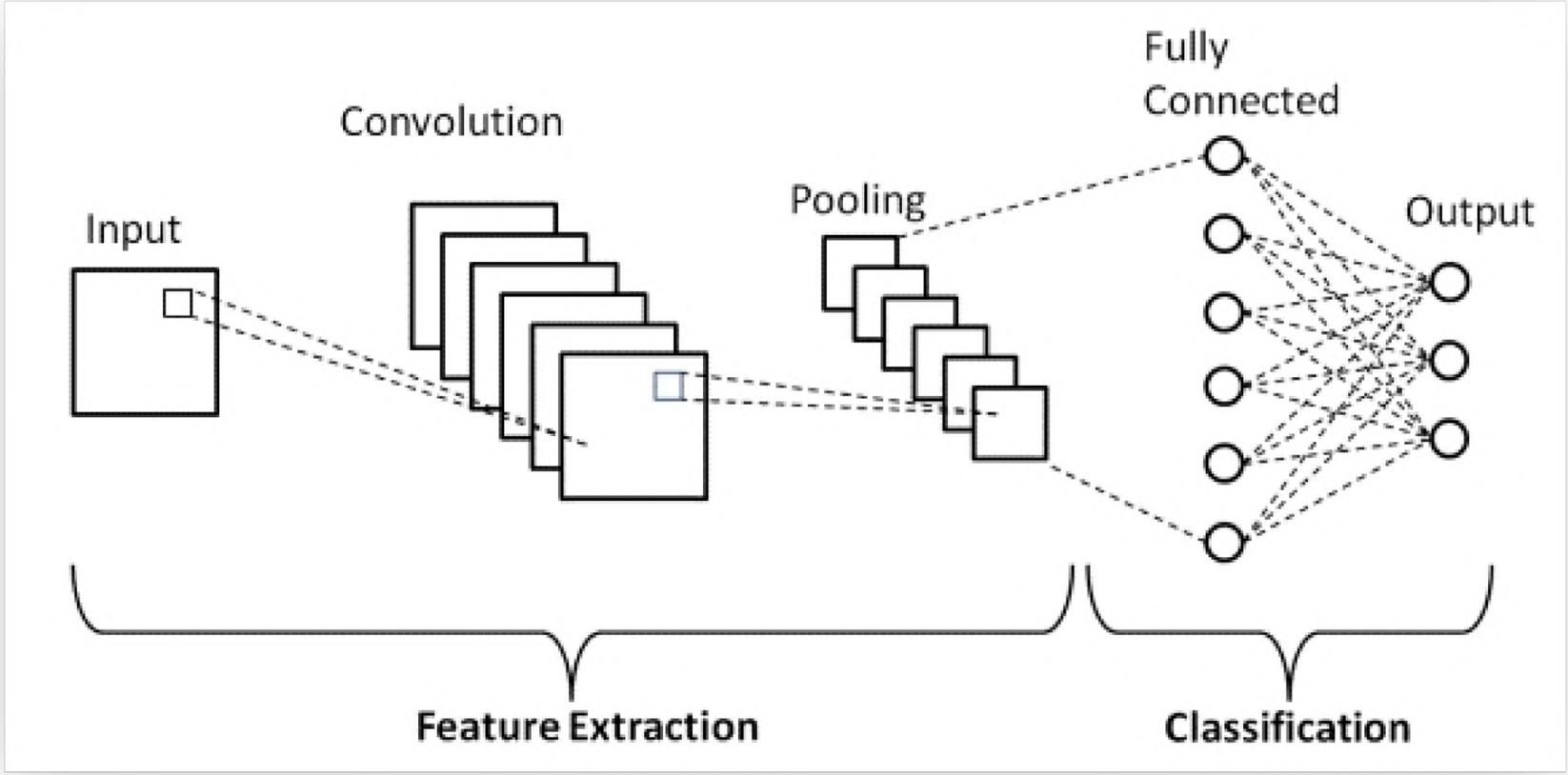
Example:

Koalas Eye Feature Detector



How Convolution operation Works??

- Convolution Operation is Location Invariant.
- Means that doesn't matter where the feature is present in the image using the filters we can detect them.

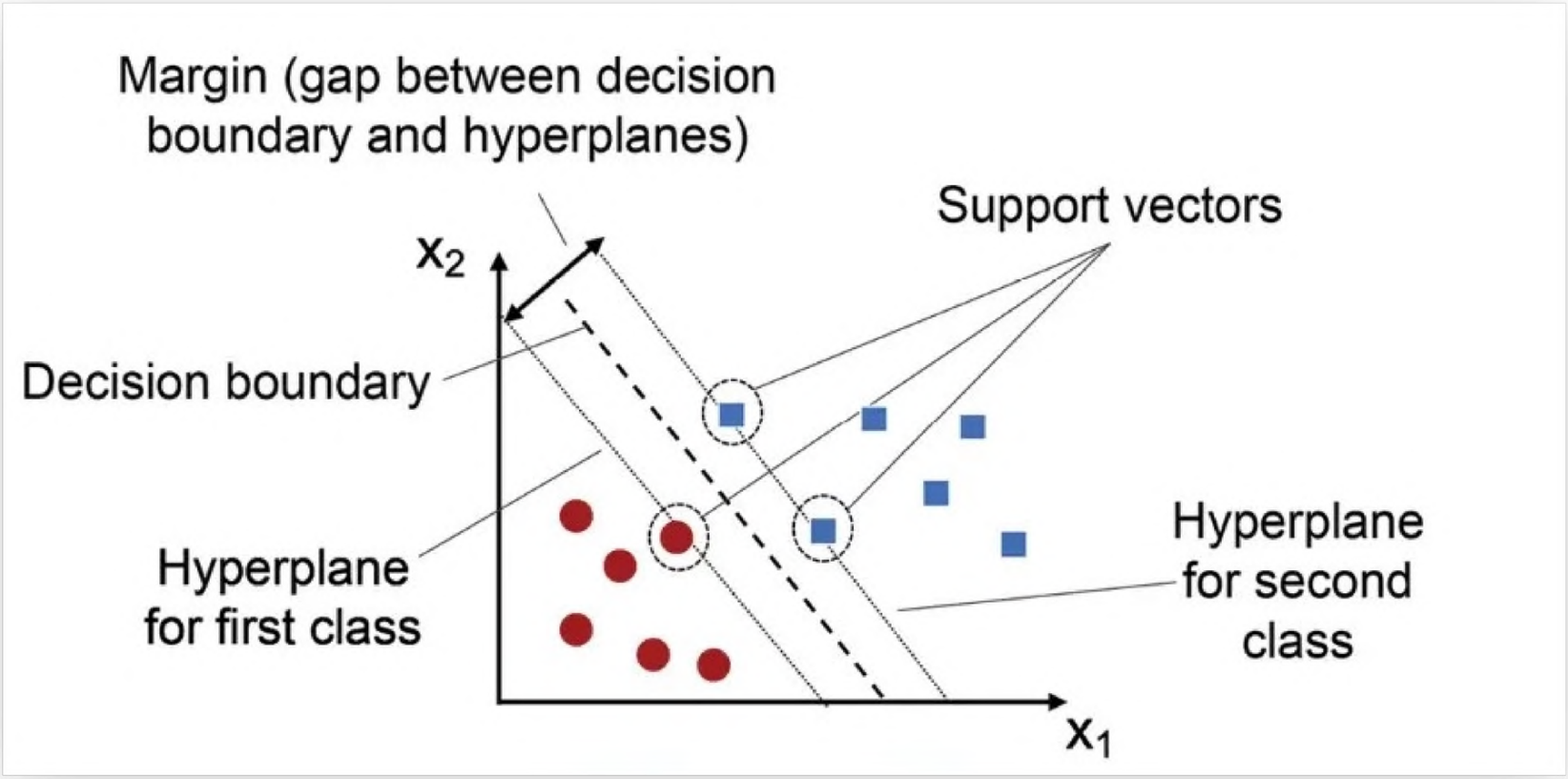


CNN Architecture

Convolutional Neural Network consists of multiple layers like the input layer, Convolutional layer, Pooling layer, and fully connected layers.

2. **SVM:**

- Support Vector Machine or SVM is one of the most popular Supervised Learning algorithms, which is used for Classification as well as Regression problems. However, primarily, it is used for Classification problems in Machine Learning.
- The goal of the SVM algorithm is to create the best line or decision boundary that can segregate n-dimensional space into classes so that we can easily put the new data point in the correct category in the future. This best decision boundary is called a **hyperplane**.
- SVM chooses the extreme points/vectors that help in creating the hyperplane.
- These extreme cases are called as support vectors, and hence algorithm is termed as Support Vector Machine. Consider the below diagram in which there are two different categories that are classified using a decision boundary or hyperplane

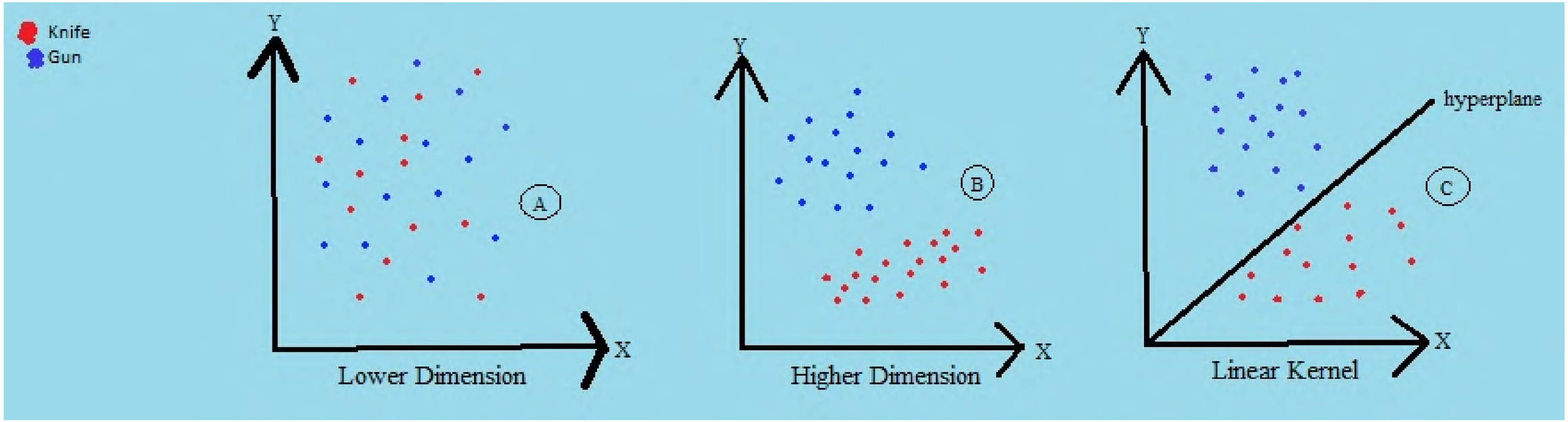


SVM Algorithm

Kernels in SVM

SVM algorithms use a set of mathematical functions that are defined as the kernel. The function of kernel is to take data as input and transform it into the required form. Different SVM algorithms use different types of kernel functions. These functions can be different types. For example ***linear, nonlinear, polynomial, radial basis function (RBF), and sigmoid.***

Linear Kernel



Conclusion

The average accuracy after cross validation of 10 is **75.3%**

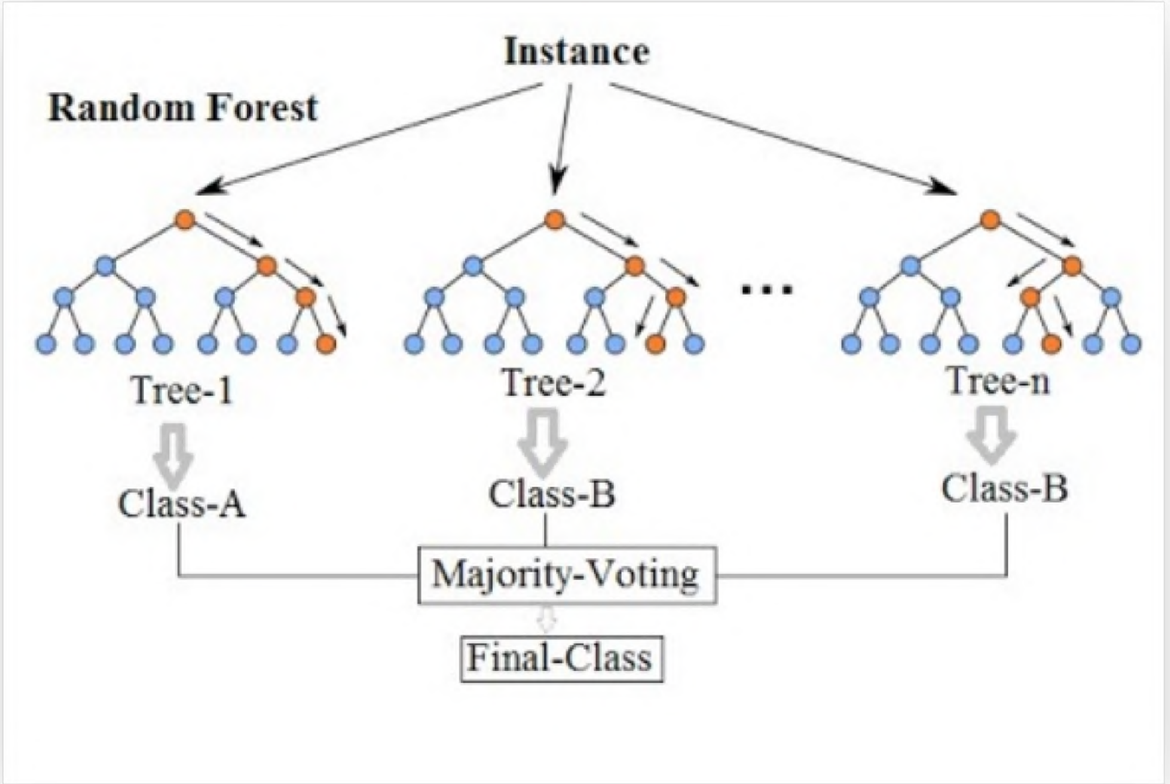
3. **Random Forest:**

- Random Forest is a popular machine learning algorithm that belongs to the **supervised learning technique**. It can be used for both Classification and Regression problems in ML.
- It is based on the concept of **ensemble learning,** which is a process of *combining multiple classifiers to solve a complex problem and improve the performance of the model.*
- *It is based on the **Bagging method**.*
- Instead of relying on one decision tree, the random forest takes the prediction from each tree and based on the majority votes of predictions, and it predicts the final output.
- The greater number of trees in the forest leads to higher accuracy.

Basic Limitations:

- Increased accuracy requires more trees.
- More trees slow down model.

The average accuracy after cross-validation is 88.6%.



Random Forest Algorithm