# Optical Character Recognition (OCR) Using Artificial Neural Networks (ANN) and Support Vector Machines (SVM)

## Artificial Neural Networks (ANN)

Artificial Neural Networks (ANN) are computing systems inspired by the biological neural networks of animal brains. An ANN consists of interconnected nodes, known as neurons, which process information by responding to external inputs, modifying their internal state (activation) according to that input, and producing an output depending on the input and activation.

### How ANN Works:

Input Layer: Receives the raw input data (in OCR, this is the pixels of the images).  
Hidden Layers: Perform transformations of the inputs received from the previous layer using weights (parameters) and biases (constant values to help the model fit better). Each hidden layer's output is passed to the next layer.  
Output Layer: Produces the final output, which in the case of OCR would be the recognized characters.

### Application in OCR:

The image of the text is divided into smaller segments, each containing a single character. These segments are then fed into the ANN. The network uses the pixel values of each segment as inputs, processes these inputs through its layers, and predicts the corresponding character. Training involves adjusting the weights and biases of the neurons so that the network can accurately recognize characters from different fonts and styles.

## Support Vector Machines (SVM)

Support Vector Machines (SVM) are a set of supervised learning methods used for classification, regression, and outliers detection. The basic principle of SVM is to find a hyperplane in an N-dimensional space (N — the number of features) that distinctly classifies the data points.

### How SVM Works:

Hyperplane: In two-dimensional space, this hyperplane is simply a line dividing a plane in two parts where in each class lay in either side.  
Support Vectors: Data points that are closer to the hyperplane and influence the position and orientation of the hyperplane. Using these support vectors, SVM finds the optimal hyperplane that separates classes by the largest possible margin.  
Kernel Trick: In OCR, where data might not be linearly separable, SVM can efficiently perform a non-linear classification using the kernel trick, a method capable of converting a non-linear separation problem into a linear one in higher-dimensional space.

### Application in OCR:

Each character image is represented as a point in high-dimensional space. These points are labeled based on which character they represent. SVM then creates a hyperplane that best separates these points into categories, corresponding to different characters. During the training phase, SVM learns the optimal hyperplane using a subset of the input data called the support vectors, which helps the model generalize better to new characters.