Lesson 11: Committee Machines, DNN and SVM

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11.1 Introduction

Committee machines, deep neural networks (DNN), and support vector machines (SVM) are all types of machine learning algorithms that are used to solve different types of problems.

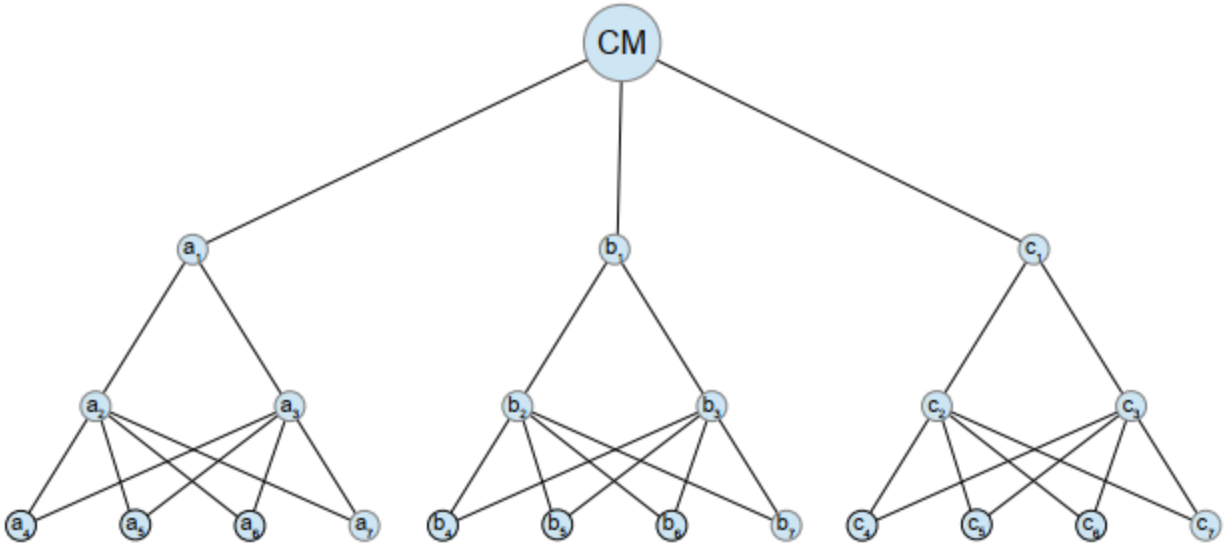
A committee machine is an ensemble of multiple models, such as neural networks, decision trees, or SVM, that work together to make a prediction. Committee machines are typically used in situations where the input data is noisy or unreliable, and the goal is to improve the overall performance of the system by combining the predictions of multiple models.

Deep neural networks (DNN) are a type of machine learning algorithm that is based on artificial neural networks, which are inspired by the structure of the human brain. DNNs are used for a wide range of tasks, such as image and speech recognition, natural language processing, and computer vision. They are particularly useful for processing complex and high-dimensional data, and they have been shown to achieve state-of-the-art performance on many tasks.

Support vector machines (SVMs) are a type of supervised learning algorithm that is used for classification and regression tasks. SVMs are based on the principle of finding the hyperplane that best separates the data into different classes. They are particularly useful for tasks where the input data is high-dimensional and the number of samples is small.

11.2 Committee machines

Committee machines are a type of machine learning algorithm that is based on the principle of combining the predictions of multiple models. The idea behind committee machines is that by combining the predictions of different models, the overall performance of the system can be improved, especially in situations where the input data is noisy or unreliable.



Committee machines can be implemented using a variety of different types of models, such as neural networks, decision trees, or support vector machines (SVMs). Each model in the committee machine is trained on the same data, and the final prediction is made by combining the predictions of all the models. There are several ways to combine the predictions of the models, such as majority voting, weighted voting, or averaging.

One of the main advantages of committee machines is that they can reduce the effect of overfitting. Overfitting is a common problem in machine learning, where a model becomes too complex and starts to memorize the training data instead of generalizing to new data. By using multiple models, committee machines can reduce the effect of overfitting, as each model may capture different aspects of the data.

Another advantage of committee machines is that they can improve the robustness of the system. By using multiple models, committee machines can reduce the effect of outliers and noisy data, as some models may be more robust to noise than others. Committee machines can also be used to improve the performance of a single model. For example, by combining the predictions of multiple neural networks with different architectures, the overall performance of the system can be improved.

11.3 Deep Neural Networks

Deep neural networks (DNNs) are a type of machine learning algorithm that is based on the structure of the human brain. DNNs are composed of multiple layers of interconnected nodes, called artificial neurons, that process and transmit information. Each layer of neurons performs a specific computation on the input data and passes the result to the next layer. The deep architecture of DNNs allows them to learn and represent complex and hierarchical patterns in the data.

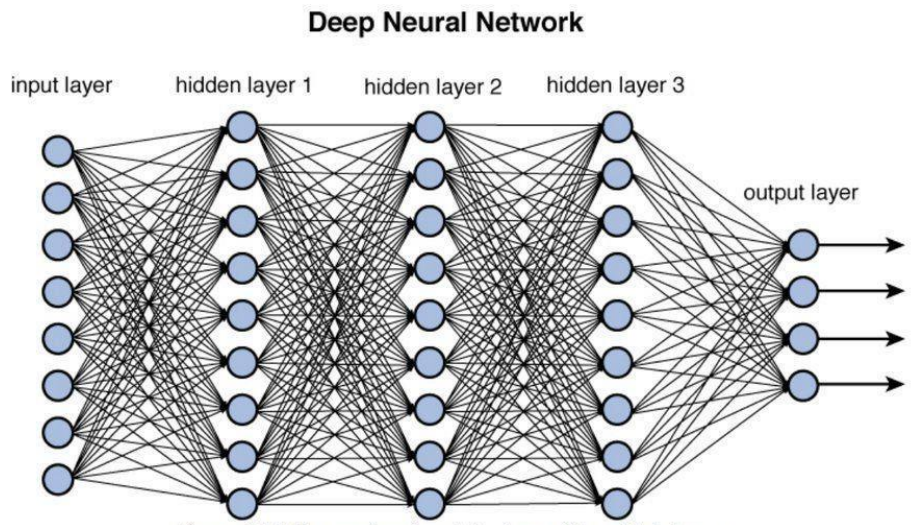


Figure 12.2 Deep network architecture with multiple layers.

DNNs are typically trained using a technique called backpropagation, which is an efficient method for adjusting the weights of the neurons in the network. During training, the input data is presented to the network, and the output of the network is compared to the desired output. The weights of the neurons are then adjusted to minimize the difference between the desired output and the actual output.

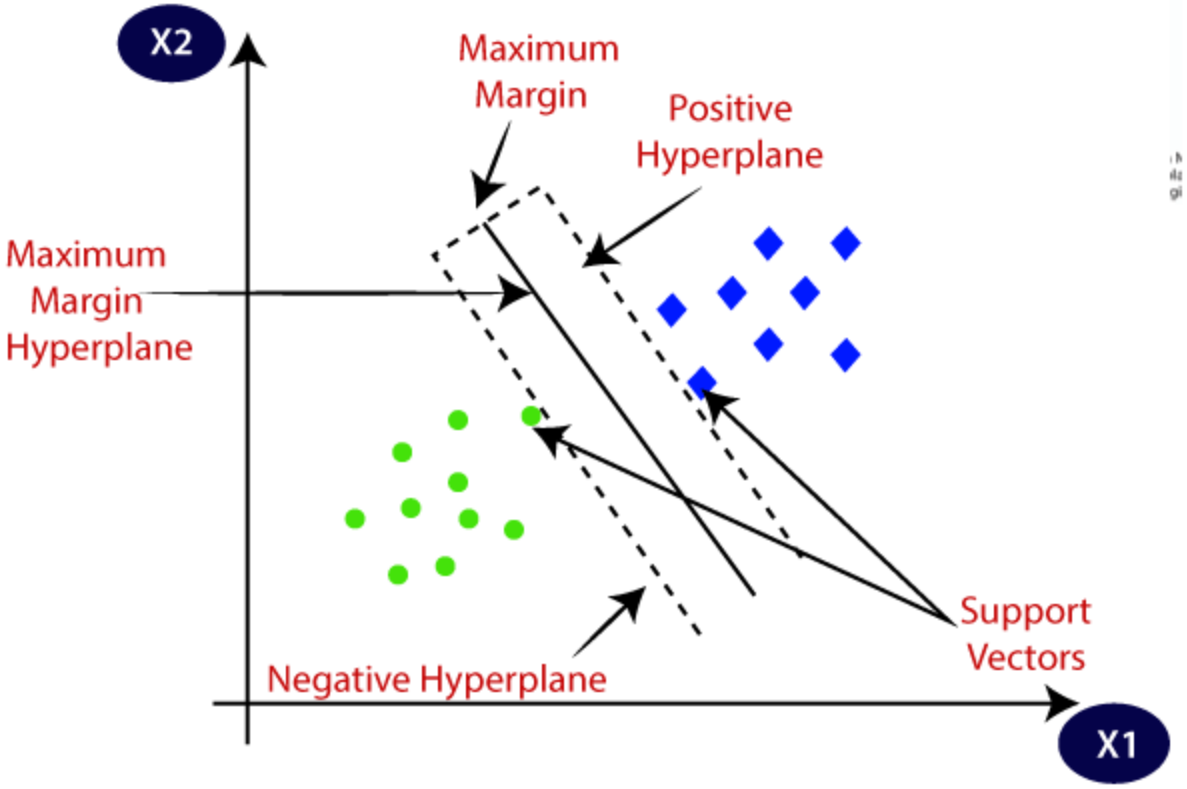
DNNs are used for a wide range of tasks, such as image and speech recognition, natural language processing, and computer vision. They have been shown to achieve state-of-the-art performance on many tasks, and they have been used in many applications, such as self-driving cars, medical imaging, and natural language understanding.

DNNs are particularly useful for processing complex and high-dimensional data, such as images and speech signals. They can learn to extract useful features from the data and can handle large amounts of data. They also can work on images, videos and audio with very high accuracy.

Some popular types of DNNs include convolutional neural networks (CNNs) which are used for image and video processing, and recurrent neural networks (RNNs) which are used for natural language processing and speech recognition.

11.4 Support vector Machine

Support Vector Machines (SVMs) are a type of supervised learning algorithm that is used for classification and regression tasks. The main idea behind SVMs is to find the best hyperplane, which is a line or a plane that separates the data into different classes. The best hyperplane is the one that maximizes the margin, which is the distance between the hyperplane and the closest data points from each class.SVMs are particularly useful for tasks where the input data is high-dimensional and the number of samples is small. In high-dimensional spaces, it is often difficult to find a good linear boundary that separates the data. SVMs can handle this problem by using a technique called kernel trick, which maps the input data into a higher-dimensional space where a linear boundary can be found.



SVMs can be used for classification tasks by finding a hyperplane that separates the data into different classes. They can also be used for regression tasks by finding a hyperplane that is close to as many data points as possible.SVMs have several advantages, such as they are robust to noise and they can handle high-dimensional data. They also have a regularization parameter that allows to control the trade-off between maximizing the margin and minimizing the classification error. SVMs have been used in many applications, such as text classification, image classification, and bioinformatics. They have also been used in finance, medicine, and natural language processing.

11.5 Lesson 11 Questions

1. What is a committee machine and how does it work?
2. How do DNNs differ from traditional neural networks?
3. What types of tasks are DNNs commonly used for and why?
4. What is the purpose of a support vector machine and how does it work?
5. When might it be appropriate to use an SVM instead of a DNN?
6. How can a committee machine be used to improve the performance of a DNN or SVM?
7. What are some potential issues or challenges with using committee machines?
8. What are some of the advantages and disadvantages of DNNs and SVMs?
9. How can regularization be used to prevent overfitting in DNNs?
10. What are some examples of real-world applications of DNNs and SVMs?