**2.3 Assignment**

**Example 1: Detecting Spam Emails**

Machine learning models such as logistic regression and decision trees are highly effective in spam email detection due to their ability to process predefined attributes like keyword frequency, embedded links, and sender information. These features can be easily extracted and interpreted, making them suitable for traditional machine learning approaches. Since spam detection often involves smaller datasets, these models are computationally efficient and can be trained rapidly while maintaining reliable performance in classifying emails as spam or legitimate. In contrast, deep learning techniques, such as convolutional neural networks (CNNs), are unnecessary for this application. Spam detection does not require complex feature learning, and deep learning models demand extensive datasets and high computational resources, which are impractical for this task (Zhang et al., 2019; Han et al., 2020).

**Example 2: Image Processing and Recognition**

In the field of image recognition, particularly in facial recognition systems, convolutional neural networks (CNNs) are the most effective. CNNs can automatically extract hierarchical features from raw image data, eliminating the need for manual feature selection. This is crucial for processing high-dimensional image inputs, where characteristics like edges, textures, and facial structures are difficult to define explicitly. Since CNNs are designed to handle large datasets, they excel in accurately distinguishing faces and objects in real-world settings. Traditional machine learning methods, including logistic regression and decision trees, are less suitable for image recognition because they rely on manual feature extraction, which is inefficient for complex visual data. Additionally, these models struggle with high-dimensional inputs and require extensive preprocessing to achieve reasonable accuracy, making them suboptimal for image-related tasks (Deng, 2021; Gu et al., 2018).

**Summary**

The choice of machine learning or deep learning models depends on the complexity of the data and the problem at hand. For detecting spam emails, traditional machine learning models like logistic regression and decision trees are preferable due to their ability to efficiently process predefined features such as keyword frequency, embedded links, and sender details. These models are well-suited for smaller datasets and require minimal computational resources. Deep learning methods like CNNs are not ideal for spam detection, as they demand extensive data and significant computational power, which are unnecessary for a relatively straightforward task.

Conversely, deep learning models like CNNs are the best choice for image recognition tasks, such as facial recognition. These models excel in extracting and learning intricate patterns from high-dimensional image data without requiring manual feature engineering. CNNs are designed to process large datasets and can efficiently recognize complex visual structures such as facial features and object edges. In contrast, traditional machine learning models struggle with high-dimensional image data and require extensive preprocessing, making them less effective for image recognition tasks.

**References**

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