

Deep Learning: Architectures and Models

Project Proposal

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Abstract

This project investigates the efficacy of knowledge distillation as a method for transferring specific class knowledge from a comprehensive teacher model to a compact student model. The primary goal is to enhance the student model's accuracy while facilitating efficient on-device inference on mobile platforms, thereby improving both performance and security.

1 Introduction

Knowledge distillation is a technique where a smaller, more computationally efficient student model is trained to emulate the performance of a larger, pre-trained teacher model. This approach is invaluable for applications that demand low-latency responses and stringent privacy, such as in mobile and edge computing environments.

2 Problem Statement

The core challenge of this project is to assess the effectiveness of knowledge distillation in transferring knowledge from a teacher model, trained on the comprehensive CIFAR-100 dataset, to a student model that is expected to perform comparably on the simpler CIFAR-10 dataset, despite having reduced complexity and size.

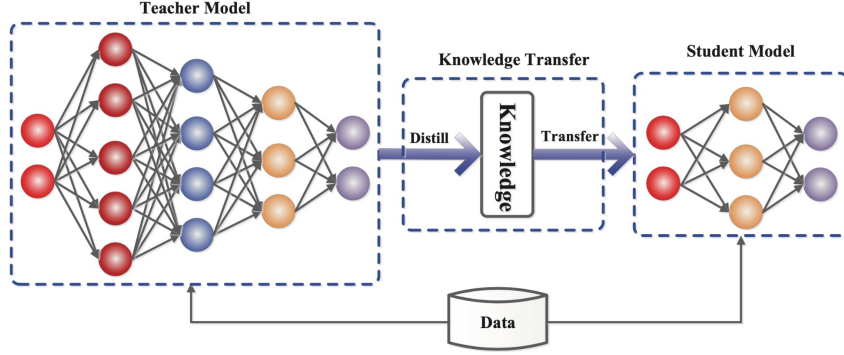


Figure 1: Illustration of Knowledge Distillation Process. Source: neptune.ai

3 Experimental Setup

Our approach involves using a state-of-the-art model trained on the CIFAR-100 dataset as the teacher. The student model, significantly smaller in size, will be trained employing the knowledge distillation technique. We will determine specific models and configurations through initial testing aimed at optimizing both performance and computational efficiency.

4 Choice of Models

4.1 Teacher Model

The selection of the teacher model will be critical and will focus on models known for their robustness and ability to retain essential input information. Techniques such as label smoothing, which might diminish the mutual information within class labels, will be avoided to maintain the integrity and effectiveness of the distillation process.

4.2 Student Model

The student model will be designed with an emphasis on operational efficiency, allowing it to function seamlessly on mobile devices. The model will be optimized to ensure that there is minimal compromise on accuracy, making it suitable for real-world applications.

5 Expected Results

We anticipate that the student model, once trained through our distillation process, will not only approach the accuracy levels of the teacher model but will also significantly surpass the performance metrics if it were trained conventionally on hard labels from the CIFAR-10 dataset.

6 References

- Hinton, G., Vinyals, O., & Dean, J. (2015). Distilling the Knowledge in a Neural Network. Available at: <https://arxiv.org/abs/1503.02531>
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