Intel Unnati Training Report

Problem Statement 2: Enhancing Image Sharpness via Knowledge Distillation

Objective

The aim of this project is to enhance the clarity of low-resolution (LR) images by employing a knowledge distillation approach within a teacher-student framework. The strategy focuses on conveying the capabilities of a larger, high-performance model (teacher) to a smaller, computationally efficient model (student) while maintaining high image quality.

Dataset

- **Total Images:** 200 high-resolution (HR) samples sourced from the DIV2K dataset on Kaggle.

- **Preprocessing Steps:**

    - Simulated image degradation using Gaussian blur.

    - Created LR versions by downsampling (×4) and then upsampling.

    - Standardized image size to 128×128 pixels.

    - Implemented a custom dataset class to manage HR-LR image pairs and transformations.

Model Architecture

1. Teacher Model

- Composed of several residual blocks.

- Deep and wide structure optimized using L1 loss against HR targets.

- Generates outputs and intermediate features to guide the student model.

2. Student Model

- Compact and lightweight network.

- Uses L1 loss to align final outputs with HR targets.

- Also utilizes MSE loss to match internal features with those of the teacher.

- Designed to mimic the teacher's performance with significantly lower complexity.
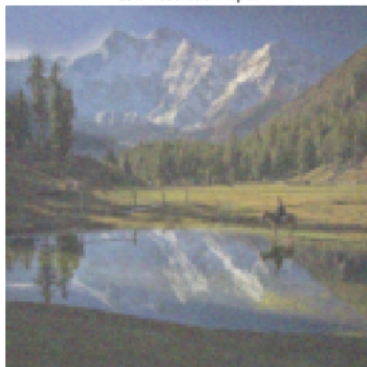
Training Insights

- Both models experienced a >30× reduction in loss throughout training.

- The student model closely approximated the teacher's performance by the 15th epoch.

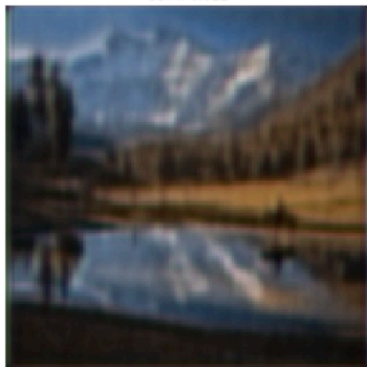Training Loss per Epoch

Results

SSIM Trend for Student Model
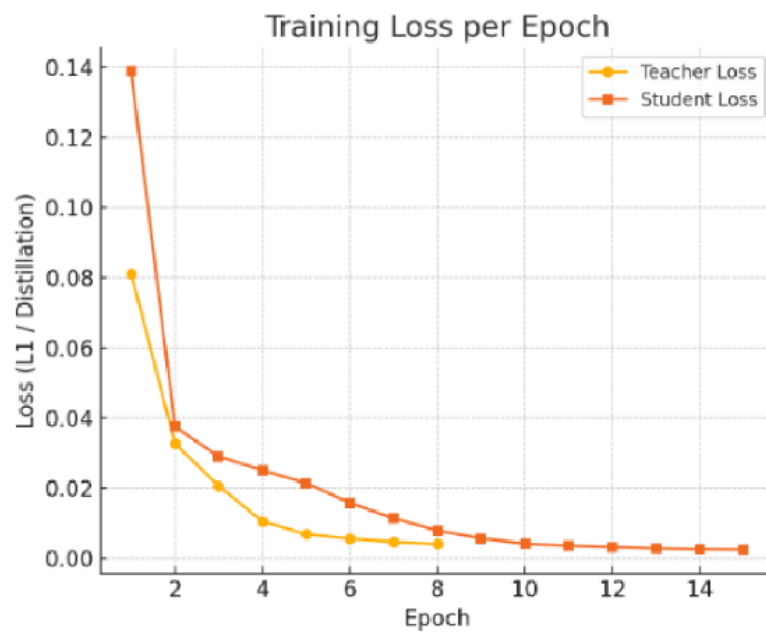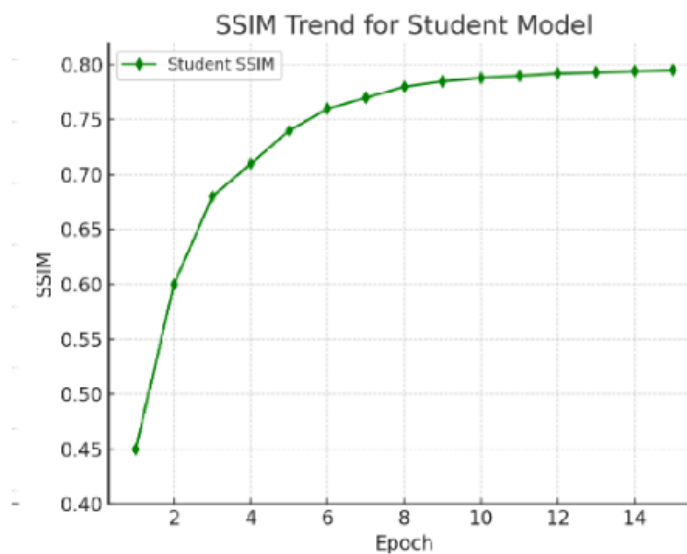
Low Resolution Input

Sharpened Output
SSIM: 0.822

Ground Truth