Internship Task Report: Task 1 – Visualizing the Colorization Process

Introduction

Task 1 of the GenAI-NullClass internship focused on designing and implementing tools to visualize the internal mechanisms and outputs of a deep learning model for image colorization. This process aimed to enhance understanding, interpretability, and transparency of the model's behavior by providing visual and quantitative feedback at multiple processing stages.

Objectives

- Develop techniques to visualize each stage of the image colorization workflow, from grayscale input to the final colored output.
- Extract and display intermediate **feature maps** from network layers.
- Generate **color difference maps** to pinpoint and analyze discrepancies between predicted and true color channels.
- Track and visualize key performance metrics (e.g., loss, accuracy, perceptual metrics) throughout training and evaluation.

Methodology

- The task was implemented in the notebook `colorization_visualization.ipynb`, using a deep neural colorization model (e.g., U-Net or a similar architecture).
- Custom hooks were employed to extract **layer-wise feature maps** during forward passes, providing a window into the model's internal representations.
- **Color difference maps** were computed using per-pixel differences (usually in Lab or ab color space) to visualize where the model predictions diverged most from ground truth.
- **Metric visualization** included:
  - Training/validation loss curves.

    - Test accuracy across epochs.
    - Perceptual metrics such as **SSIM (Structural Similarity Index)** and **LPIPS (Learned Perceptual Image Patch Similarity)**.
- Visual outputs and plots were integrated into the notebook for side-by-side analysis.

Key Results

- Feature map visualizations revealed how the model progressively encodes texture, edges, and semantic information across layers, from shallow to deep.
- Color difference maps highlighted that most model inaccuracies occurred in ambiguous or rare color regions, assisting targeted future improvements.
- Plotted metrics (loss, SSIM, LPIPS) made it straightforward to diagnose underfitting, overfitting, and the tangible impact of architectural or training modifications.

Deliverables

- **Notebook (colorization_visualization.ipynb)** with reproducible code and visualization routines.
- **Saved model weights** for evaluation and further experimentation.
- **Task-specific README** with usage instructions, requirements, and example outputs.

Conclusion

Task 1 established a rich toolkit for **visual insight and diagnostic analysis** in image colorization. The visual and metric-based feedback loop improved model interpretability, facilitated informed debugging, and set a solid foundation for both model enhancements and educational demonstrations.