Final Project Proposal

Student name(s): Kavana Manvi Krishnamurthy, Shams Nahid Kotnur, Shardul Janaskar

Description of the project: Our aim is to develop a deep learning based system for reconstructing shuffled or disordered images. This project models real-world applications such as forensic reconstruction of shredded documents, restoration of damaged historical photographs, and reassembly of corrupted digital images. Our approach involves building a custom deep learning model capable of understanding and reorganizing spatial information within an image, beyond solving simple puzzles.

Proposed Methodology and Techniques: We will divide input images into grids, randomly shuffle the patches, and train a model to predict their correct spatial arrangement. Our methodology involves using a pretrained convolutional backbone for feature extraction (e.g., ResNet18), while designing a custom feature aggregation head that predicts either the correct tile position or adjacency relationships. The model will be trained in a supervised manner using datasets like CIFAR-10 and STL-10. Loss functions will include cross-entropy loss for positional prediction and optionally contrastive loss to improve local feature coherence. Emphasis will be placed on building custom layers to aggregate and reason over tile features rather than using standard off-the-shelf solutions.

References:

1. Noroozi, M., & Favaro, P. (2016). Unsupervised Learning of Visual Representations by Solving Jigsaw Puzzles. *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*.
2. Kim, D., & Hwang, S. J. (2018). PuzzleMix: Exploiting Saliency and Local Statistics for Optimal Mixup. *arXiv preprint arXiv:2006.07700*.

Tentative Schedule:

- Week 1 - Dataset preparation, tile generation pipeline
- Week 2 - Model architecture design: encoder + custom aggregation head
- Week 3 - Training initial models and evaluating baseline results
- Week 4 - Improving model performance with enhanced loss functions and tuning
- Week 5 - Testing on unseen images and adding robustness experiments
- Week 6 - Preparing demo outputs, visualizations, and final presentation