COSE474-2024F: Final Project Proposal
"Fine-Tuning Pre-trained Models for Pneumonia Detection in Chest X-rays"

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1. Introduction

Early detection of pneumonia in patients via X-rays is critical for timely treatment. Deep learning models such as convolutional neural networks (CNNs) have been successfully implemented in medicine. A lot of existing research has focused on the performance of individual models. However, ensemble learning, which combines multiple models, has shown potential for further accuracy enhancements. The main goal of this project is to use ensemble learning by fine-tuning pre-trained models to improve pneumonia detection using chest X-rays.

2. Problem definition & challenges

The project focuses on classifying chest X-rays into pneumonia-positive or healthy categories.

Challenges:

- **Small labeled dataset**: Medical datasets are often limited in size, making it difficult to train deep learning models without overfitting.
- **Subtle features**: Pneumonia may cause only minor changes visible in X-rays, making them hard to detect and requiring highly sensitive models.
- **Generalization**: Pre-trained models need careful fine-tuning to work effectively with medical images.

3. Related Works

- Kim, H. E., Cosa-Linan, A., Santhanam, N., Jannesari, M., Maros, M. E., & Ganslandt, T. (2022). Transfer learning for medical image classification: a literature review. BMC Medical Imaging, 22(1). https://doi.org/10.1186/s12880-022-00793-7https://doi.org/10.1186/s12880-022-00793-7
- Sarvamangala, D. R., & Kulkarni, R. V. (2021). Convolutional neural networks in medical image understanding: a survey. Evolutionary Intelligence, 15(1), 1–22. https://doi.org/10.1007/s12065-020-00540-3
- Sharma, S., & Guleria, K. (2023). A systematic literature review on deep learning approaches for pneumonia detection using chest X-ray images. Multimedia Tools and Applications, 83(8), 24101–24151. https://doi.org/10.1007/s11042-023-16419-1

4. Datasets

The main dataset that will be used for this project is the publicly available "Chest X-ray Images (Pneumonia)" dataset from Kaggle, which contains 5,863 images labeled as pneumonia-positive or healthy. This dataset has been used widely for medical image classification.

5. State-of-the-art methods and baselines

State-of-the-art methods for pneumonia detection often leverage pre-trained models like ResNet50, VGG16, DenseNet121, and Bayesian CNNs, achieving high classification accuracy. For this project, multiple models will be combined in an ensemble learning approach to build upon the baselines and attempt to boost the accuracy of the predictions.

6. Schedule

- Week 1-2: Literature review, dataset exploration, and data preprocessing.
- Week 3-4: Fine-tuning of ResNet50 and VGG16 models, implementing data augmentation.
- Week 5: Develop ensemble model, experimenting with various combination strategies (e.g., majority voting and averaging).
- Week 6: Hyperparameter tuning and model evaluation.
- Week 7: Compare ensemble results with individual model performances and state-of-the-art methods.
- Week 8: Finalize report and prepare for presentation.