DEEP LEARNING FOR PRECEPTION

PROJECT REPORT

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LUNG CANACER DETECTION

OBJECTIVE:

The objective of this project is to develop an accurate deep learning-based diagnostic tool for classifying different types of lung cancer from histopathological images. Two different approaches were used and compared:

- **Part 1**: A custom-built Convolutional Neural Network (CNN)
- **Part 2**: A pretrained Swin Transformer model

PROBLEM STATEMENT:

Lung cancer is one of the most common and deadly cancers worldwide. Early and accurate classification of its subtypes (e.g., adenocarcinoma, squamous cell carcinoma, and benign tissue) is critical for effective treatment. Traditional diagnostic methods are time-consuming and dependent on expert pathologists. This project aims to leverage deep learning to automate and enhance diagnostic accuracy.

METHODOLOGY:

Part 1: Custom CNN

A deep custom CNN architecture was developed incorporating:

- Residual connections
- Batch normalization
- Dropout regularization
- A multi-stage convolutional pipeline followed by fully connected layers

The dataset was split into training, validation, and test sets with appropriate augmentations using ImageDataGenerator. The model was trained using the Adamax optimizer and categorical cross-entropy loss.

Part 2: Pretrained Swin Transformer

A Swin Transformer model (swin_tiny_patch4_window7_224) was used from the timm library. The model was fine-tuned on the same dataset, using:

- Pretrained weights on ImageNet
- Custom classification head for 3 lung cancer classes
- PyTorch DataLoader and tqdm for tracking training time and batch progress
- Optimizer: AdamW
- Loss: CrossEntropyLoss

RESULTS:

Part 1 - Custom CNN

- Train Loss: 0.0128
- Train Accuracy: 0.9967
- Validation Loss: 0.0410
- Validation Accuracy: 0.9827
- Test Loss: 0.0288
- Test Accuracy: 0.9893
- Classification Report:

Classification Report:

	precision	recall	f1-score	support
Lung_adenocarcinoma	0.99	0.98	0.98	515
Lung_benign_tissue	1.00	1.00	1.00	493
Lung_squamous_cell_carcinoma	0.98	0.99	0.99	492
accuracy			0.99	1500
macro avg	0.99	0.99	0.99	1500
weighted avg	0.99	0.99	0.99	1500

- ROC-AUC Score**:** 0.9997

Part 2 - Swin Transformer

- Train Loss: 0.0424
- Train Accuracy: 0.9842
- Classification Report:

Classification Report:

	precision	recall	f1-score	support
Lung_adenocarcinoma	1.00	0.98	0.99	500
Lung_benign_tissue	1.00	1.00	1.00	500
Lung_squamous_cell_carcinoma	0.98	1.00	0.99	500
accuracy			0.99	1500
macro avg	0.99	0.99	0.99	1500
weighted avg	0.99	0.99	0.99	1500

- ROC-AUC Score**:** 1.0000

REFERENCE:

- timm Library: https://github.com/rwightman/pytorch-image-models
- Swin Transformer Paper: https://pmc.ncbi.nlm.nih.gov/articles/PMC11325325/
- Keras and TensorFlow Documentation
- Kaggle Dataset: https://www.kaggle.com/datasets/andrewmvd/lung-and-colon-cancer-histopathological-images
- Scikit-learn: Classification metrics and evaluation tools