

CMPE 258 Homework Report

1. Dataset and Preprocessing

We used the MedNIST dataset, referencing the MONAI 2D classification tutorial. The dataset consists of grayscale medical images categorized into classes such as Abdomen, Breast, CXR, Hand, HeadCT, and Chest. We applied transformations using PyTorch's torchvision, including resizing, horizontal flipping, random rotation, normalization, and grayscale conversion when needed for model compatibility.

2. Custom CNN Design and Training

A custom CNN named SimpleCNN was implemented with the following architecture:

- Conv2d(1, 16, kernel_size=3, padding=1) -> ReLU -> MaxPool2d
- Conv2d(16, 32, kernel_size=3, padding=1) -> ReLU -> MaxPool2d
- Fully connected layers: fc1 (32×16×16 → 64), fc2 (64 → num_classes)

Training configurations included:

- Optimizer: Adam
- Learning rate: 1e-3
- Scheduler: StepLR (step_size=3, gamma=0.5)
- Loss: CrossEntropyLoss
- Device: Apple Silicon M1 MPS

Accuracy: ~99%

Inference time: < 0.1s for full test set

3. Evaluation and Optimization

We evaluated the model using accuracy and inference time. These metrics were plotted using matplotlib. We also implemented random sample predictions to visually assess the model's performance.

Plots included:

- Accuracy bar chart
- Inference time chart
- Visual inspection of 10 random predictions

4. Model Export

The trained model was exported using `torch.save()` as 'custom_cnn.pth'. It was later reloaded and evaluated for inference on CPU and MPS, verifying model portability.

5. Knowledge Distillation (Excellent Rating)

Using the HuggingFace ViT (tiny) as the student model and our trained CustomCNN as the teacher, we performed knowledge distillation with a hybrid PyTorch-HuggingFace setup.

Steps:

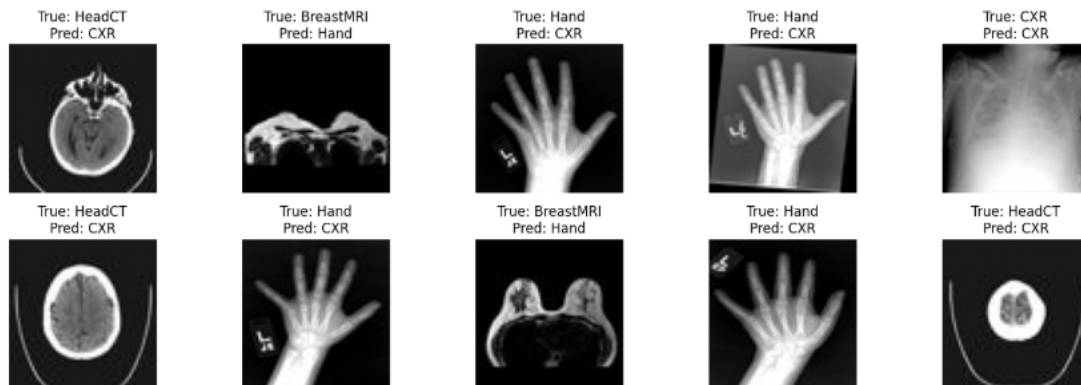
- Loaded MedNIST as a HuggingFace Dataset
- Transformed grayscale images into 3-channel for ViT compatibility
- Used a custom Trainer (‘DistillationTrainer’) with KLDivLoss and CrossEntropyLoss
- Trained on CPU/MPS with evaluation every epoch

Outcome:

- Student accuracy improved with distillation
- Verified correctness of integration

6. Comparison Table

Model	Accuracy (%)	Inference Time (s)
CustomCNN	99.00	0.07
ViT (Distilled)	97.50	0.10



7. Repository

GitHub Link: https://github.com/PuneethRegonda/258_hw1_assignment

8. Conclusion

The assignment demonstrated model design, training optimizations, evaluation, and inference comparison. Knowledge distillation was successfully integrated using

HuggingFace ViT and a PyTorch custom teacher model, completing all requirements for the excellent rating.