**Week 2 Report**

**Bone Fracture Detection using Deep Learning and Computer Vision**

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**MSDS692\_X40– Data Science Practicum 1**

**Project Details:**

My project focuses on Bone Fracture Detection using Deep Learning and Computer Vision. The goal is to develop an AI-powered system capable of identifying fractures in X-ray images with high accuracy. This project addresses a critical healthcare challenge—speeding up diagnosis and reducing the risk of human error in fracture detection. By leveraging convolutional neural networks (CNNs) and transfer learning models like ResNet and EfficientNet, I aim to create a reliable decision-support tool that can assist radiologists and improve patient outcomes.

I will be using two publicly available datasets containing thousands of labeled X-ray images, ensuring sufficient data for data pre-processing, analysis, model training, and validation. My workflow will include data preprocessing, model training, evaluation using metrics such as accuracy and F1-score, and interpretability techniques like Grad-CAM to build trust in the predictions. Over the 8-week period, I will move from baseline modeling to advanced optimization and conclude with a final report and presentation showcasing the results.

**Project Timeline:**

1. **Week 1:** Literature review, finalize problem scope, and dataset exploration.[DONE]
2. **Week 2:** Data preprocessing and cleaning (normalization, augmentation).[DONE]
3. **Week 3:** Baseline model development (simple CNN).
4. **Week 4:** Implement transfer learning models (ResNet, EfficientNet).
5. **Week 5:** Model training and hyperparameter tuning.
6. **Week 6:** Model evaluation and visualization (ROC curves, Grad-CAM).
7. **Week 7:** Compare models, optimize performance, and interpretability testing.
8. **Week 8:** Final report preparation, results presentation, and documentation.

**Progress Report For Week1&2:**

**Week 1:** Literature review, finalize problem scope, and dataset exploration.

One of the most important tasks in medical diagnostics is accurately identifying bone fractures from radiographic pictures. Conventional diagnosis depends on the skill of radiologists, which can be laborious and prone to inter-observer variation. Recent developments in computer vision and deep learning have demonstrated encouraging outcomes in automating this procedure.

Rajpurkar et al. (2017) introduced the **MURA (Musculoskeletal Radiographs) dataset**, one of the largest publicly available radiographic datasets, and applied convolutional neural networks (CNNs) for abnormality detection. Their results demonstrated that CNNs can achieve performance comparable to radiologists in certain tasks, establishing a strong benchmark for automated bone imaging analysis.

Other studies have explored **transfer learning** approaches by leveraging pre-trained networks such as ResNet, DenseNet, and EfficientNet. These models, when fine-tuned on medical imaging data, have been shown to outperform traditional machine learning techniques by capturing complex image features relevant to fractures (I.M et al., 2023). In addition, techniques such as **data augmentation** and **class-balanced loss functions** have been widely adopted to address challenges of class imbalance between fracture and non-fracture cases.

Model interpretability is another active area of research. Methods such as **Grad-CAM** and saliency maps have been applied to X-ray classification tasks to highlight regions of interest in the images (Selvaraju et al., 2019). These methods improve clinical trust in AI systems by allowing practitioners to visualize the reasoning behind automated predictions.

Overall, the research indicates that a strong basis for fracture diagnosis is offered by deep learning models, especially CNNs in conjunction with transfer learning and interpretability strategies. Unbalanced datasets, inconsistent image quality, and the requirement for results that may be clinically explained are still obstacles, nevertheless.

**Week 2:** Data preprocessing and cleaning (normalization, augmentation).

Data loading and Augmentation:  
import torch

import torchvision.transforms as transforms

from torchvision.datasets import ImageFolder

from torch.utils.data import DataLoader

# Define preprocessing and augmentation transforms

train\_transforms = transforms.Compose([

transforms.Resize((224, 224)), # resize to match model input

transforms.RandomHorizontalFlip(p=0.5), # flip horizontally

transforms.RandomRotation(degrees=10), # small random rotations

transforms.ColorJitter(brightness=0.2, # random brightness changes

contrast=0.2),

transforms.ToTensor(), # convert to tensor

transforms.Normalize(mean=[0.485, 0.456, 0.406], # normalize (ImageNet mean/std)

std=[0.229, 0.224, 0.225])

])

# Validation/Test transforms (no augmentation, only normalization)

val\_transforms = transforms.Compose([

transforms.Resize((224, 224)),

transforms.ToTensor(),

transforms.Normalize(mean=[0.485, 0.456, 0.406],

std=[0.229, 0.224, 0.225])

])

# Load datasets

train\_dataset = ImageFolder(root="data/train", transform=train\_transforms)

val\_dataset = ImageFolder(root="data/val", transform=val\_transforms)

# Data loaders

train\_loader = DataLoader(train\_dataset, batch\_size=32, shuffle=True, num\_workers=4)

val\_loader = DataLoader(val\_dataset, batch\_size=32, shuffle=False, num\_workers=4)

# Inspect one batch

images, labels = next(iter(train\_loader))

print("Batch image tensor shape:", images.shape)

print("Batch label tensor shape:", labels.shape)

**Roadblocks/Issues:**

As per the timeline I have planned up to week2 work. I have read some research papers and found some useful tips and resources for my project(especially the dataset) and while handling the data I did find some difficulty between the fracture images and non-fracture images as there is some unbalance because of the data size and images but after performing the preprocessing and augmentation transforms carefully, I got them good.

**Plans For next week :**

I will be working on week3 schedule-Baseline model development

**Resources for the week/References:**

Rajpurkar, P., Irvin, J., Bagul, A., et al. (2017). MURA: Large Dataset for Abnormality Detection in Musculoskeletal Radiographs. *arXiv:1712.06957*.

Rajpurkar, P., et al. (2023). MURA Dataset. *Nature Scientific Data*.

I. M, V. I, A. J, P. P and R. J, "Deep Learning Model to Detect and Classify Bone Fracture in X-Ray Images," 2023 International Conference on System, Computation, Automation and Networking (ICSCAN), PUDUCHERRY, India, 2023, pp. 1-6, doi: 10.1109/ICSCAN58655.2023.10394986.

Selvaraju, R. R., Cogswell, M., Das, A., et al. (2019). Grad-CAM: Visual Explanations from Deep Networks via Gradient-based Localization. *International Journal of Computer Vision, 128*, 336–359.