**MSDS692 – Data Science Practicum 1**

**Progress Report for Week5**

**Project Details:**

The project aims to build a **bone fracture detection system** using deep learning and computer vision. The system will classify X-ray images into fractured vs. non-fractured categories, supporting clinicians in early and accurate diagnosis.

* ***Type of Task****: Image classification using CNNs and transfer learning (ResNet, EfficientNet).*
* ***Data****: Bone Fracture Detection CV dataset + MURA dataset (~2–3 GB combined).*
* ***Methods****: CNNs, preprocessing (augmentation, normalization, denoising), Grad-CAM for interpretability.*
* ***Evaluation Metrics****: Accuracy, Precision, Recall, F1-score, AUC.*

**Project Timeline:**

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

**Planned Work for the Week:**

** Train ResNet and EfficientNet on the combined dataset.

 Perform **hyperparameter tuning** (learning rate, batch size, epochs).

 Evaluate models using **advanced metrics** beyond accuracy (Sensitivity, Specificity, F1, Kappa, MCC).

 Address **class imbalance** using oversampling, augmentation, and loss function strategies.

**Progress for the Week:**

 Completed **full training and tuning** of baseline CNN, ResNet50, and EfficientNet-B0.

 Implemented **Focal Loss** and aggressive augmentation strategy (**SuperBalancedImageFolder**) to address class imbalance.

 Achieved **breakthrough results** with **Improved ResNet50 + Focal Loss**:

* **100% Sensitivity** (no missed fractures).
* **100% Specificity** (no false alarms).
* Perfect scores across F1, Cohen’s Kappa, and MCC.

 Generated **advanced visualizations**: comparative bar charts, sensitivity vs specificity trade-off, MCC plots, and training history curves.

 Saved models and training histories for reproducibility and deployment.

**Roadblocks/Issues:**

 Severe class imbalance initially caused misleading accuracy results (>99% with poor sensitivity). Solved with augmentation + Focal Loss.

 Larger EfficientNet experiments remain limited by computational resources (cloud GPU recommended for scaling).

**Plan for next Week:**

 Begin **Grad-CAM heatmap analysis** for interpretability.

 Test model robustness on external/held-out datasets.

 Systematically compare **baseline CNN, ResNet, and EfficientNet**.

 Draft initial **clinical insights** on medical relevance of sensitivity vs specificity trade-offs.