**MSDS692 – Data Science Practicum 1**

**Progress Report for Week6**

**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) (**DONE**)
* Week 7 – Compare models, optimize performance, interpretability testing (**In Progress**)
* Week 8 – Final report preparation, results presentation, and documentation

**Planned Work for the Week:**

 Conduct **comprehensive evaluation** of trained models (CNN, ResNet, EfficientNet).

 Implement **Grad-CAM** for visual interpretability of predictions.

 Generate **ROC curves and confusion matrices** for model comparison.

 Assess **clinical interpretability** of models.

**Progress for the Week:**

 Implemented **Grad-CAM visualization** for both SimpleCNN and ResNet18 models.

 Generated **heatmaps and overlays** highlighting important X-ray regions influencing predictions.

 Conducted **comparative evaluation** of models with confusion matrices, ROC curves, and performance reports.

 Achieved **good fracture detection ( sensitivity and specificity)** using Improved ResNet50 + Focal Loss.

 Verified **clinical interpretability** — Grad-CAM visualizations clearly highlighted fracture regions.

 Assessed **deployment readiness**: fast inference on GPU, reproducible results, clinically relevant metrics.

**Roadblocks/Issues:**

 Grad-CAM sometimes produced noisy heatmaps on low-quality X-rays, requiring fine-tuning of target layers.

 Computational efficiency could be improved for large-scale deployment scenarios.

**Plan for next Week:**

 Perform **model comparison and optimization** across CNN, ResNet, and EfficientNet.

 Explore **ensemble methods** to further enhance robustness.

 Document **clinical insights** on interpretability.

 Begin drafting **final presentation slides** and **written report**.

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