Bone Fracture Detection

Team Members:

1. **Omnia Saaed** **20228003**
2. **Amira Kamel** **20228004**
3. **Roaa Ahmed** **20228006**
4. **Farah Ashraf** **20228015**
5. **Menna Osama** **20228020**

Supervised By:

Dr: Soha Ahmed

Dr: Ahmed Swar

Overview

To build and evaluate machine learning and deep learning models for automatically classifying X-ray images into **fractured** and **not fractured** categories.

Source: Kaggle Datasets

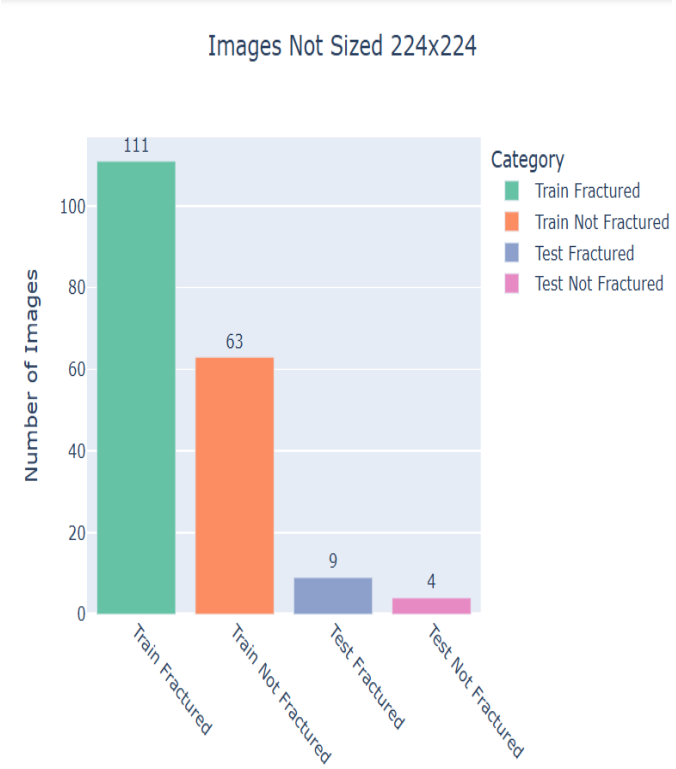
Dataset Preparation

- **Source**: X-ray image folders categorized as:
    - train/fractured-labeled
    - train/not fractured-labeled
    - test/fractured-labeled
    - test/not fractured-labeled

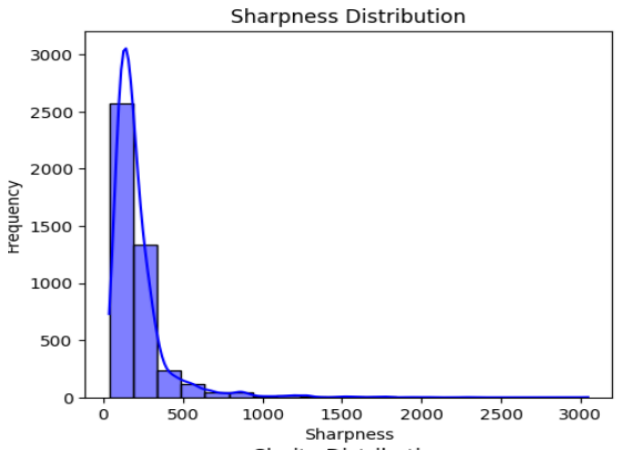
EDA

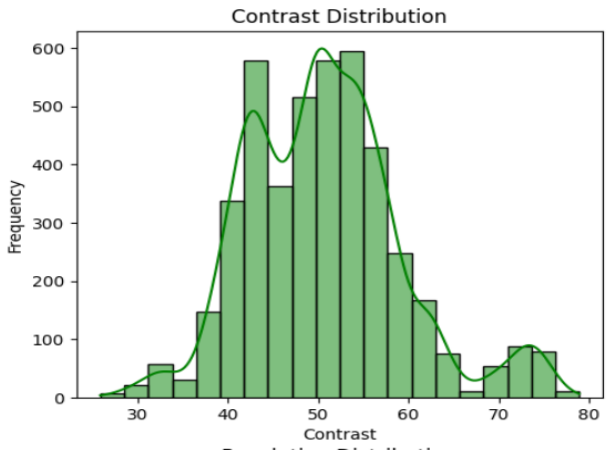
- Show Distribution of the data

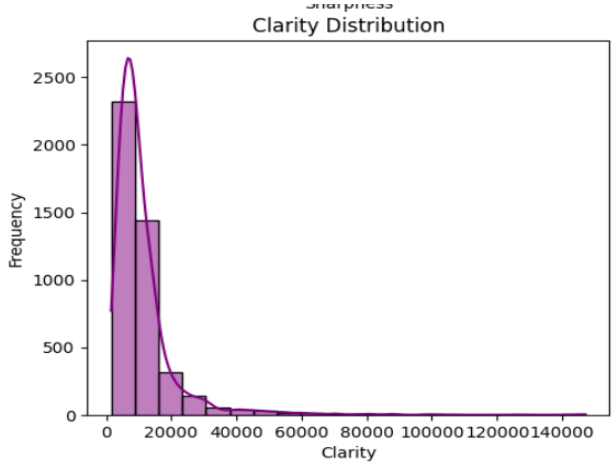
- Check for corrupted/invalid Images
- Check for duplicated Images
- Check for images size

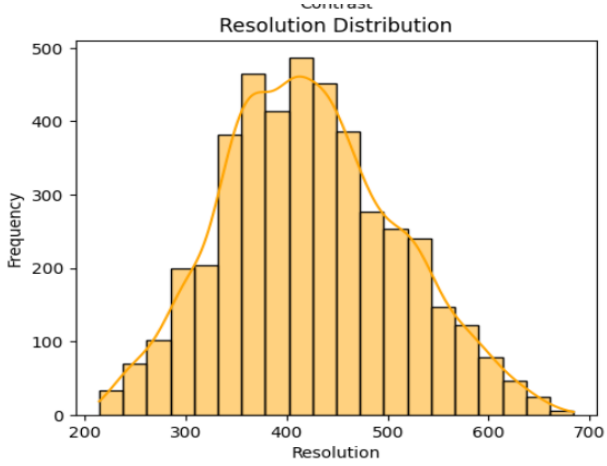


- Check For quality of images









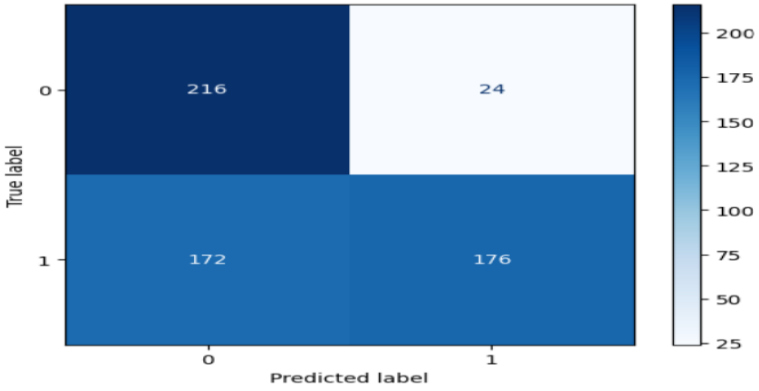
Preprocessing

- Resize Images to ‘224*224’
- Enhance The Image quality by
  - Enhance The Contrast
  - Remove noises using GaussianBlur
- Extracted relative paths for labeling.
- Created CSV files with image paths and binary labels (1 = fractured, 0 = not fractured).
- Combined and shuffled data into train_df and test_df.

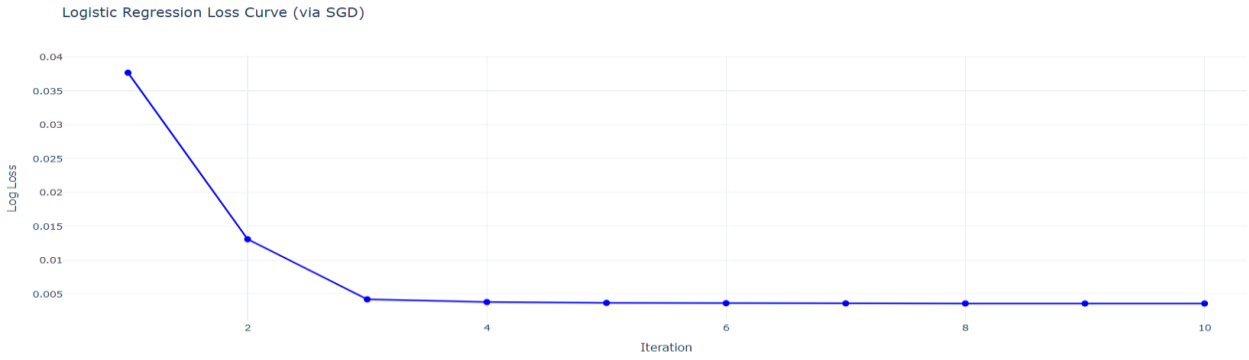
Classical ML

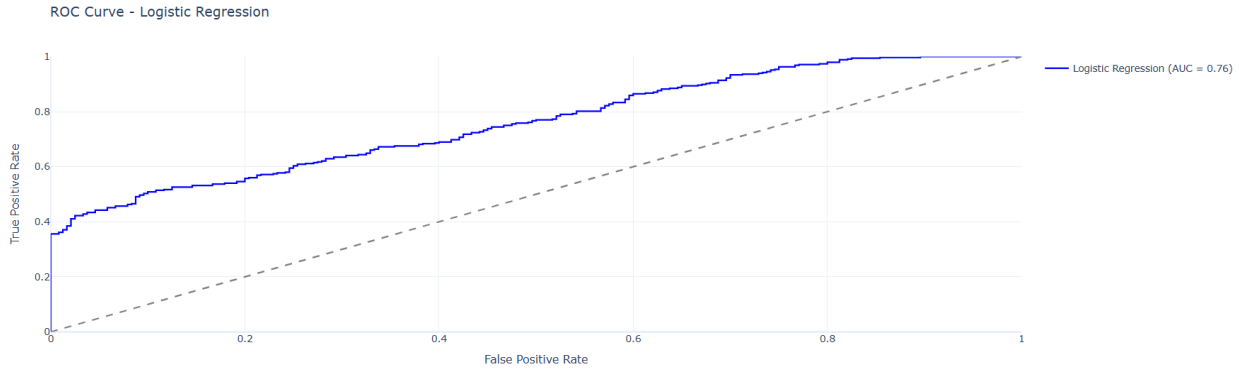
- Used **MobileNetV2** as a feature extractor (without the top classification layer).
- Extracted features and trained:
  - ### 1) Logistic Regression
    - Accuracy: ~67%

- Confusion Matrix



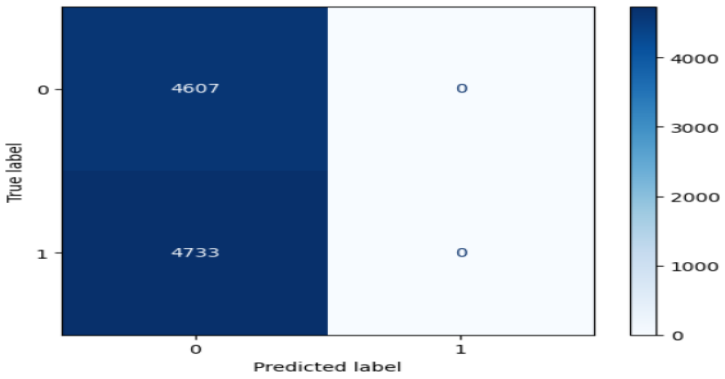
- ROC and loss curves visualized.



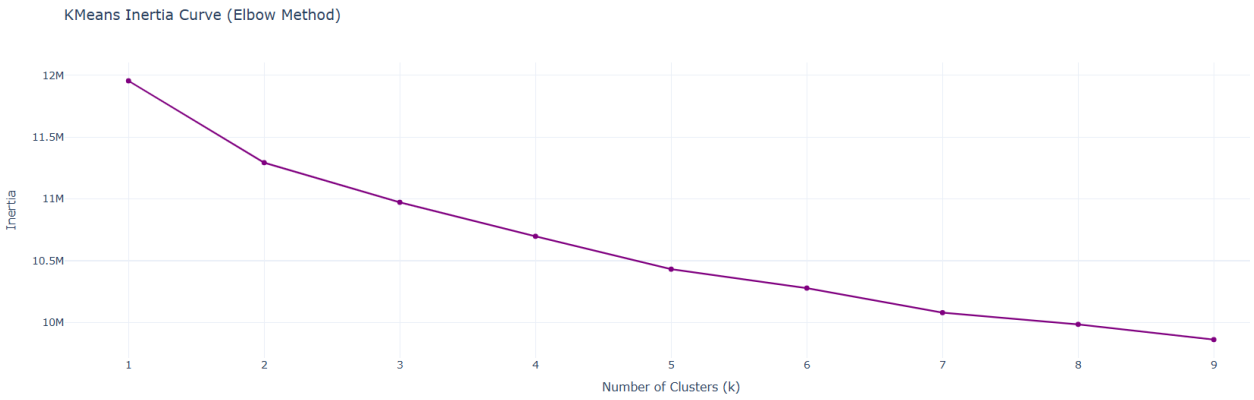


2) KMeans Clustering

- Evaluated as an unsupervised baseline.
- Accuracy: ~49% (as expected from unsupervised learning).
- Confusion Matrix

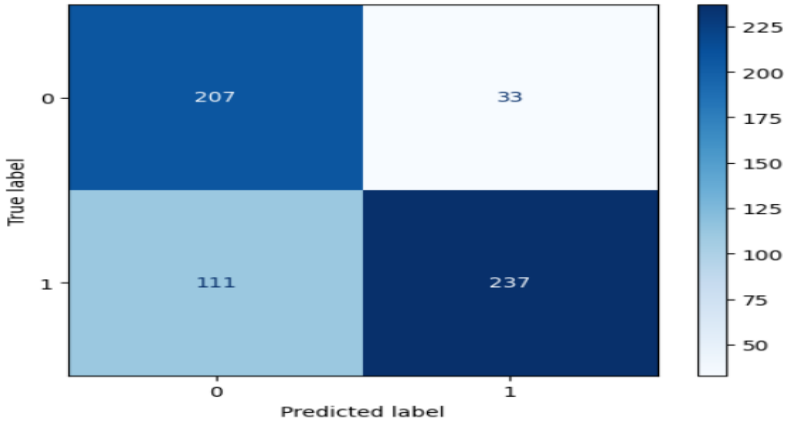


- Plotted inertia curve (Elbow Method) and ROC.

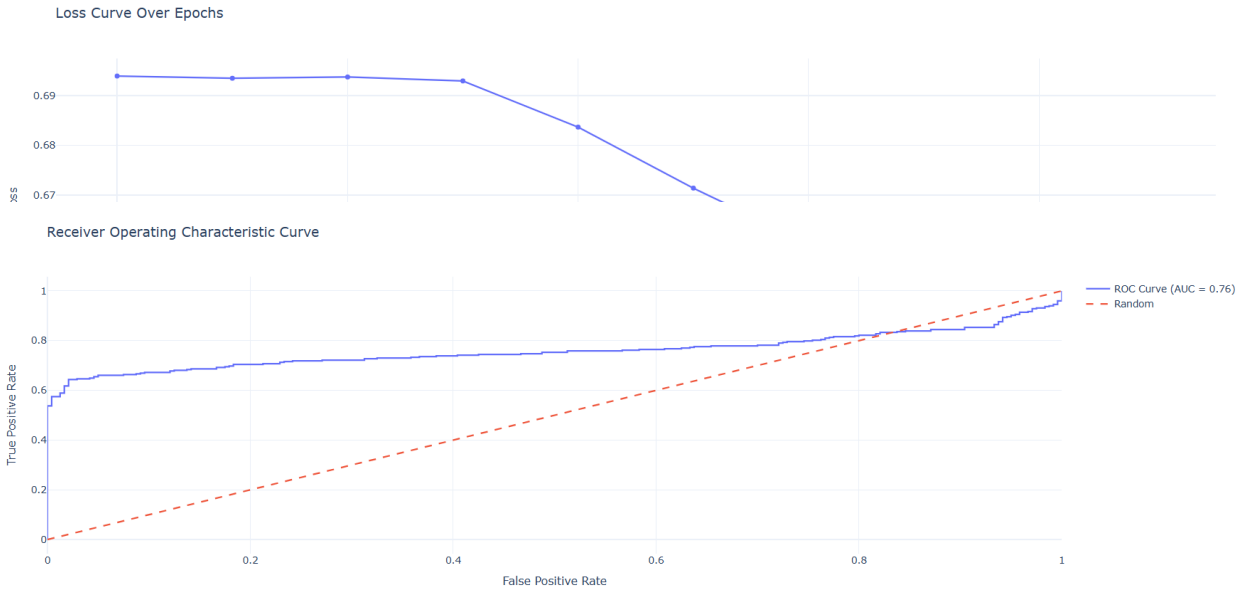


3. Deep Learning CNN Model (Custom)

- Built a custom CNN with:
    - Conv2D, MaxPooling, GlobalAveragePooling, Dense, and Dropout.
- Trained with early stopping on accuracy.
- Evaluation:
    - Accuracy on test set plotted. ~76%
    - Confusion matrix

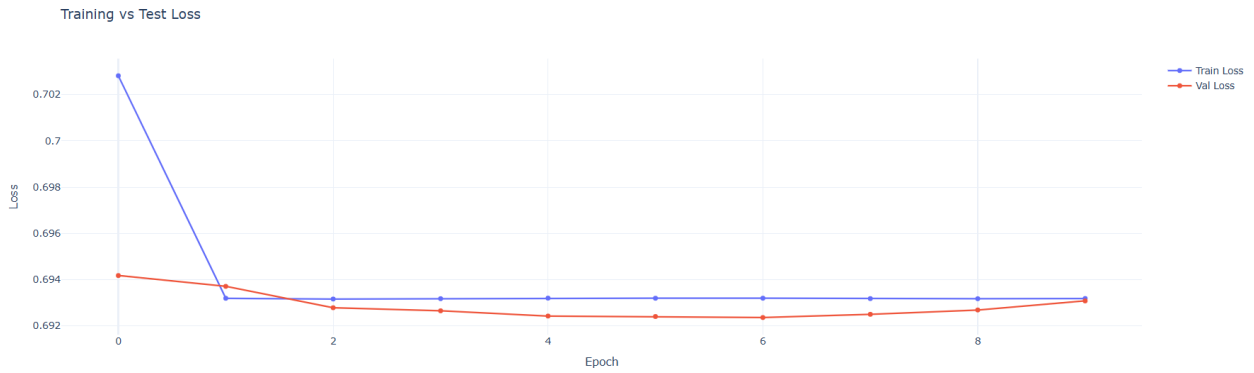


    - ROC curve, and loss curves visualized.



4. Transfer Learning (ResNet50)

- Used **ResNet50 (pretrained on ImageNet)** as a frozen feature extractor.
- Added custom classification head.
- Trained and evaluated on the same X-ray dataset.
- Results included classification report and accuracy. ~59%
- ROC curve, and loss curves visualized.



📈 Key Metrics (Sample Summary)

Model	Accuracy	AUC (ROC)	Notes
Logistic Regression	~0.67	~0.70	Classical ML with deep features
KMeans Clustering	~0.49	~0.50	Unsupervised baseline
Custom CNN	~0.75+	~0.80	End-to-end image learning
ResNet50 Transfer	TBD	TBD	Powerful pretrained backbone

Conclusion

This project showcases a full **machine learning pipeline**:

- Data labeling & preprocessing
- Deep feature extraction & classical modeling
- Custom deep learning modeling
- Transfer learning with state-of-the-art architectures
- Evaluation using both **metrics** and **visualizations**