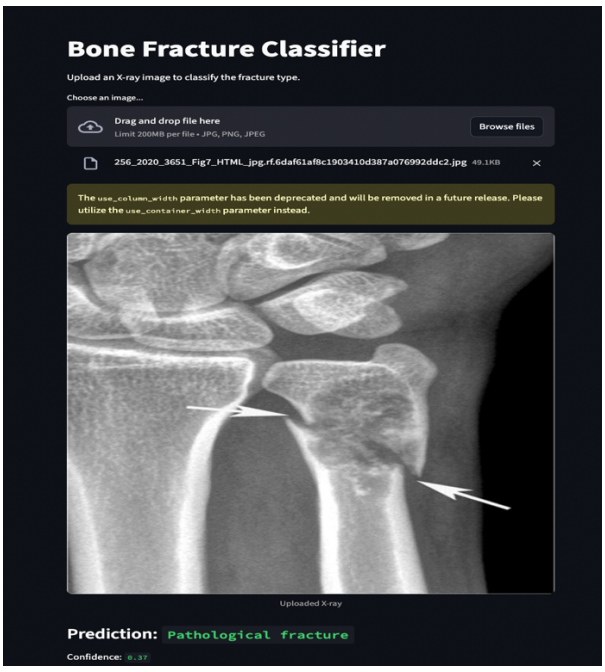
Bone Fracture Classification Report:

1. Data Exploration and Preprocessing
    - The dataset contained 10 types of bone fractures with folders for training and testing.
    - Each image was loaded, resized to 224x224 pixels, and normalized.
    - A label mapping dictionary was created to encode fracture types from strings to numbers.
    - Basic visualizations were used to confirm dataset balance and view representative images per class.
2. Model Development
    - I used **MobileNetV2**, a lightweight pre-trained CNN from Keras.
    - Layers were frozen initially to leverage transfer learning.
    - The classifier was built with:
        - GlobalAveragePooling2D
        - Dense(128, relu)
        - Dense(10, softmax) for classification.
3. Model Evaluation and Improvement
    - **Initial results without augmentation**:
        - Accuracy: ~37%
        - Loss: ~2.05
    - **With Data Augmentation**:
        - Applied: Rotation, Flip, Zoom, Shift
        - Final validation accuracy: **50.7%**
        - Test accuracy: **~44%**
    - **Fine-tuning** (unfreezing last 50 layers):
        - Accuracy didn't improve further. Test accuracy plateaued around 47%.
    - **Conclusion**: MobileNetV2 with data augmentation gave the best balance of performance and training efficiency.

4. Streamlit App Interface
    - Built a simple app using Streamlit that:
        - Let's users upload an X-ray image (.jpg/.png).
        - Displays predicted fracture type and class confidence.
    - Model used: mobilenet_fracture_model_da.keras
    - Screenshots:



This project shows how deep learning models can assist doctors in classifying bone fractures automatically. While not a replacement for expert diagnosis, it can:

- Help in triaging large volumes of X-rays.
- Provide a second opinion to reduce human error.
- Be used in low-resource clinics where radiologists are not always available.