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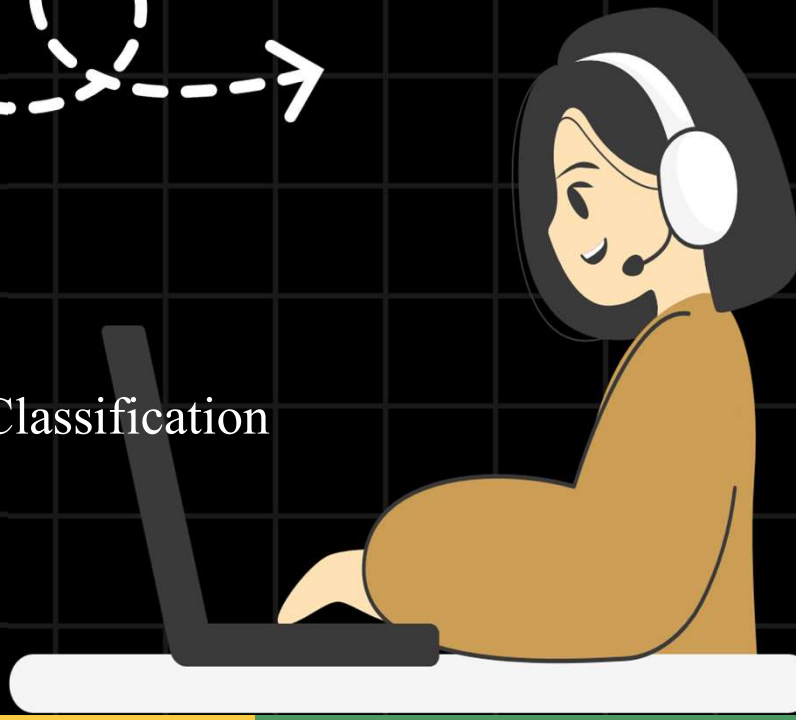
Team Details:-

- **Team name**: Code Rex
- **Team leader name**: Anubhav Sachan
- **Problem Statement:** Knee Osteoarthritis Classification



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Introduction to the Problem

➢ What is Knee Osteoarthritis (OA)?

- A **progressive joint disorder** that leads to pain and reduced mobility.
- Affects **millions of people worldwide**, especially older adults.
- Diagnosed using **X-ray images**, but it requires expertise.

➢ Challenges in Diagnosis

- **Subjective Analysis:** Different doctors may interpret X-rays differently.
- **Time-Consuming:** Manual examination of thousands of images is inefficient.
- **Need for Automation:** AI can help in **fast & accurate classification** of knee conditions.

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OBJECTIVE

- Develop an **AI model** that can classify knee conditions into **three categories**:
  - **Normal:** No signs of bone loss.
  - **Osteopenia:** Early-stage bone loss, requiring medical attention.
  - **Osteoporosis:** Severe bone loss, leading to high fracture risk.

- **Key Goals of Our AI Model**
  - **Automate detection** from knee X-ray images.
  - **Improve diagnostic accuracy** using deep learning.
  - **Provide a scalable & efficient solution** for real-world healthcare applications.

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➢ Problem Statement:

- **Knee Osteoarthritis (OA)** is a degenerative joint disease that affects millions globally, leading to pain and reduced mobility. Diagnosis is primarily done using X-ray images, which is time-consuming, subjective, and requires medical expertise. There is a critical need for an automated, scalable, and accurate diagnostic system to support healthcare professionals and reduce diagnostic errors.

➢ Proposed Solution:

- We propose an AI-powered deep learning approach to automatically classify knee X-ray images into Normal, Osteopenia, and Osteoporosis categories. Using advanced models like Xception, MobileNet, and attention mechanisms with Squeeze & Excitation blocks, our solution enhances diagnostic accuracy and efficiency. This system can assist doctors in early detection and support decision-making in real-world healthcare settings.

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..Opportunities..

- **Growing Need for AI in Healthcare**: Rising cases of knee osteoarthritis create a **huge demand** for fast and accurate diagnosis.
- **Expanding Telemedicine Market**: Our AI solution can be integrated into **remote healthcare services**, benefiting rural and underserved areas.
- **Cost-Effective & Scalable**: Unlike traditional methods requiring **specialists**, our model provides an **affordable & automated** alternative.

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How is it Different from Existing Solutions?

- **Most existing models focus only on advanced OA detection.**
- Our AI **detects early-stage Osteopenia**, allowing for **preventive care before severe damage occurs**.
- **Uses a hybrid approach (Xception + MobileNet + Attention + SE Block)** for superior accuracy.
- **Can be deployed on mobile & cloud platforms**, unlike hospital-based solutions.

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How Does It Solve the Problem?

- ✓ **Current Issues:**
  - Time-consuming, expensive, and prone to human error.
- ✓ **Our AI Solution:**
  - **Instantly classifies X-ray images** into Normal, Osteopenia, and Osteoporosis.
  - **Reduces dependency on radiologists**, making early detection more accessible.
  - **Improves diagnostic consistency**, ensuring **fewer misdiagnoses.**

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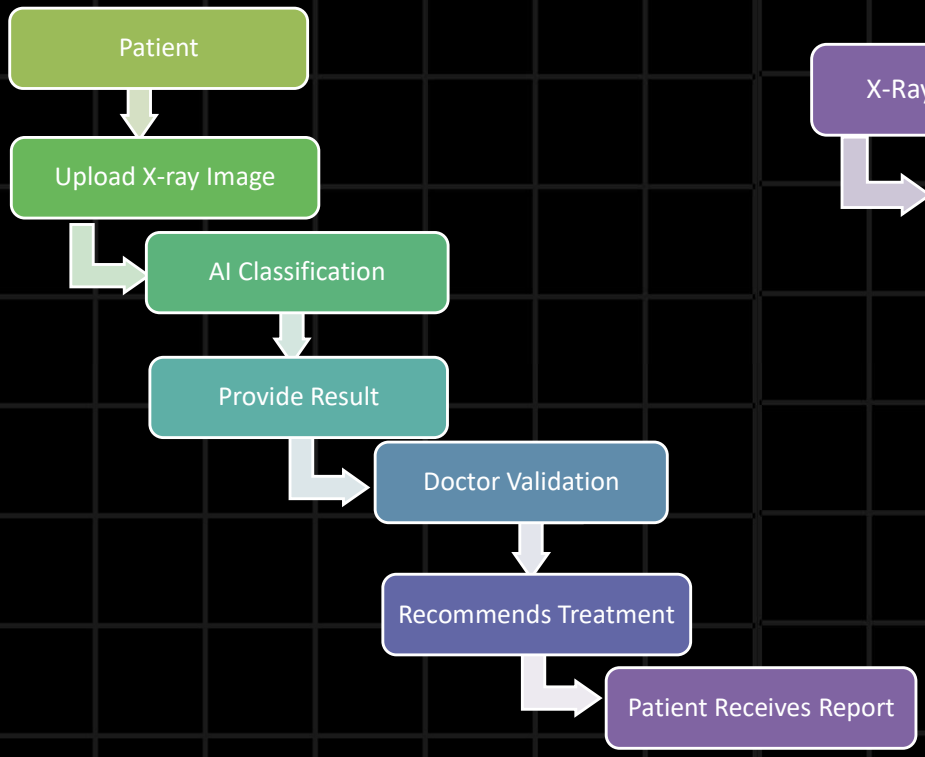
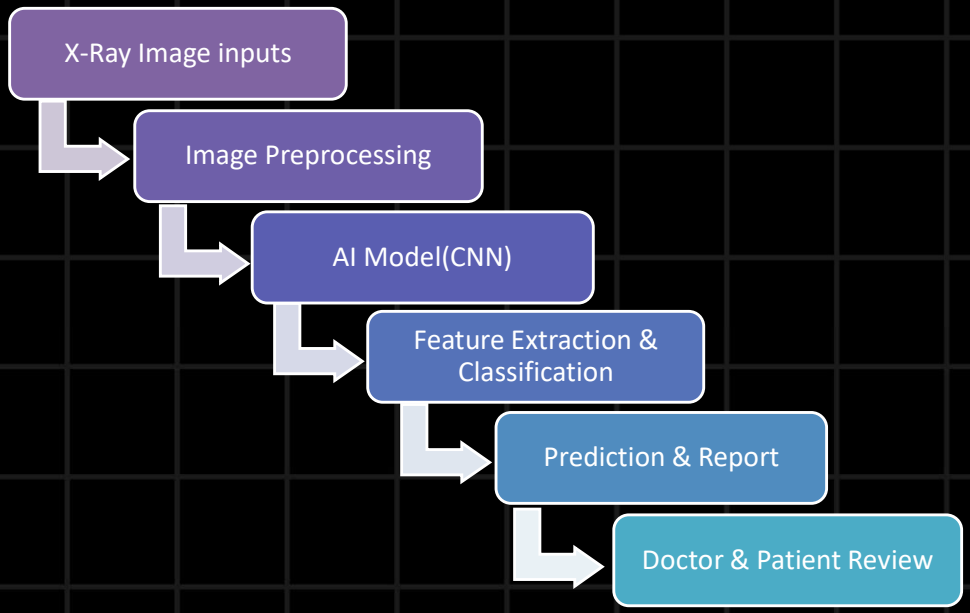
Flowchart of the proposed solution





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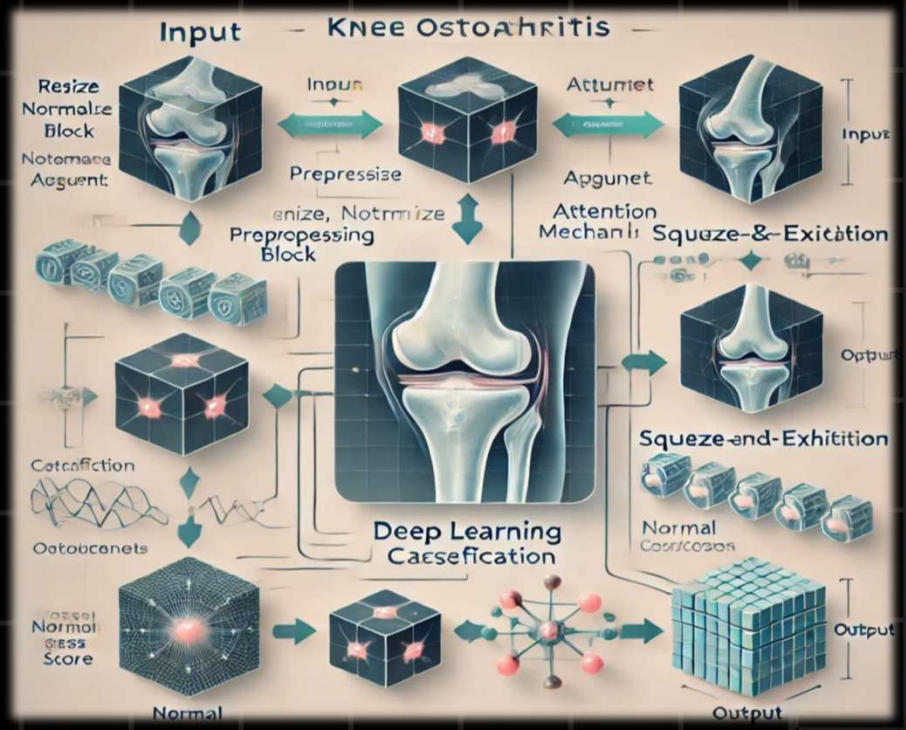
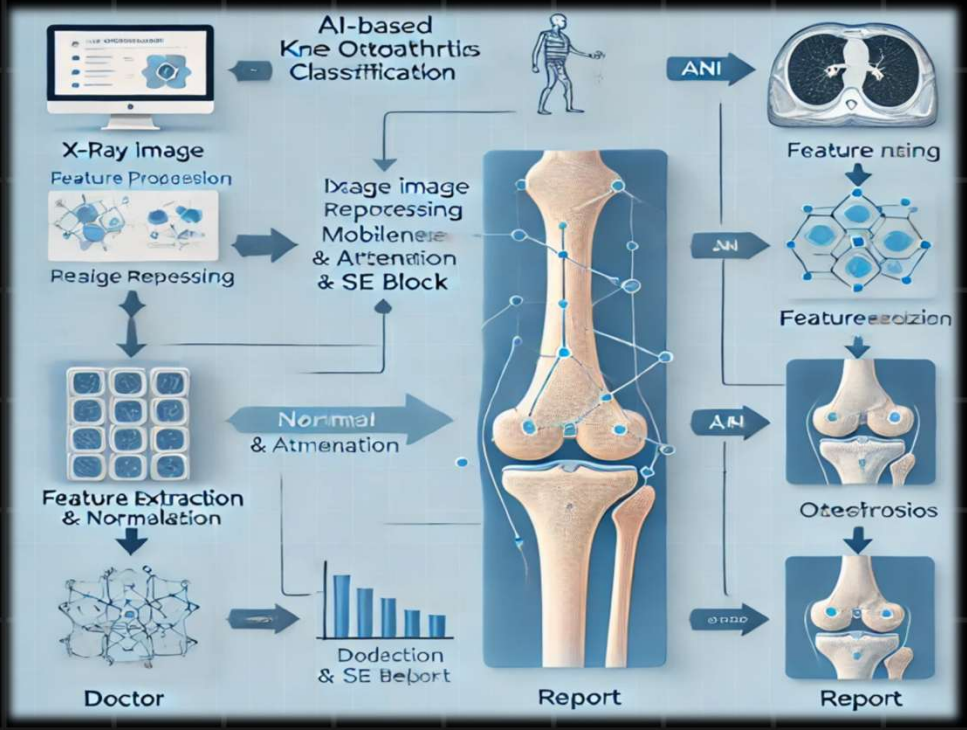
Architecture diagram of the proposed solution





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AI Models Used

- **Why Deep Learning?**
  - Traditional methods rely on **handcrafted features**.
  - Deep learning models can **automatically learn patterns** in images.
- **Models Implemented.**
  - **Xception:**
    - A powerful **CNN model** for high-quality feature extraction.
    - Uses **depthwise separable convolutions** for efficient learning.
  - **MobileNet:**
    - Lightweight architecture optimized for **faster inference**.
    - Ideal for **deploying AI models in mobile/edge devices**.
  - **Attention Mechanism:**
    - Helps the model focus on **relevant knee regions**.
  - **Squeeze & Excitation (SE) Block:**
    - Improves the model's ability to **highlight important features**.

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Model Training & Optimization

➢ Dataset Splitting:

- **Training Set:** 80%
- **Validation Set:** 10%
- **Test Set:** 10%

➢ Techniques Used for Optimization:

- **Transfer Learning:** Pre-trained models fine-tuned for knee classification.
- **Image Data Augmentation:** Prevents overfitting & improves generalization.
- **Early Stopping:** Stops training when **validation loss stops decreasing**.
- **Batch Normalization & Dropout:** Helps stabilize training & prevents overfitting.

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Future Scope

- **Enhancing Model Accuracy:**
  - Experiment with Hybrid Architectures (CNN + Transformer).
- **Deploying AI Model in Real Healthcare Systems.**
- **Building a Mobile App for Doctors & Patients.**
- **Training on a Larger & More Diverse Dataset.**
- Illustration of a **mobile app interface for AI-assisted knee diagnosis**.

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THANK YOU !

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