**Automated Feature Extraction**  
We will implement advanced computer vision techniques to derive pelvic incidence, pelvic tilt, lumbar lordosis angle, sacral slope, pelvic radius, and degree of spondylolisthesis directly from X-rays or CT scans.  
Using automated anatomical landmark detection, these parameters will be measured consistently and sent to the ML model for classification.  
Additionally, the workflow will include a pre-processing step that standardizes image quality (e.g., ensuring uniform brightness and contrast) to optimize landmark detection accuracy.  
A dedicated radiologist interface will allow specialists to review and validate extracted features, with approved adjustments feeding back into the model’s training data to enhance performance over time.  
By eliminating manual measurements, this step reduces errors, improves consistency, and accelerates clinical workflows.

**Integration into Clinical Systems**  
A secure middleware layer will connect our model with PACS and EHR systems, leveraging standards like FHIR and DICOM to ensure smooth data exchange.  
We will also implement role-based access controls and audit logs to maintain compliance with healthcare privacy regulations, ensuring that patient data is only accessible to authorized personnel.

**Data Flow:**  
Images are uploaded to PACS as usual.  
The middleware automatically forwards images to the ML model for feature extraction and classification.  
Results—including classification scores, confidence indicators, and annotated images—are returned directly to the EHR or radiologist dashboard, integrating seamlessly with existing workflows. Clinicians receive notifications when new classifications are ready for review. If a case presents low confidence or ambiguous findings, the system will prompt additional clinical review or request further imaging.

**Clinical Decision Support System (CDSS)**  
We will integrate the model’s outputs into a CDSS, assisting surgeons and radiologists with real-time, clearly labelled predictions (Normal, Herniated Disc, Spondylolisthesis) alongside confidence scores.  
Highlighted visual overlays on the images will pinpoint abnormalities and indicate which parameters influenced the decision, enhancing interpretability.  
For example, a surgeon reviewing a patient’s imaging can quickly see highlighted regions of abnormal curvature alongside quantitative measurements, aiding in surgical planning or the decision to request additional imaging.  
Ambiguous cases can be flagged for further review or additional imaging, ensuring patient safety and facilitating informed decision-making.

**Training, Adoption, and Ongoing Support**  
We will conduct practical workshops and provide hands-on training to help clinicians integrate the new workflow smoothly.  
These workshops will be led by both technical specialists and experienced radiologists who have participated in early pilot tests, providing participants with real-world tips and case examples.  
Clear communication and ongoing support, including a help desk and periodic updates, will emphasize that the system enhances rather than replaces clinical expertise, fostering trust and ensuring long-term adoption.