

PROJECT OVERVIEW STATEMENT	Project Name: "Classification of Degenerative Lumbar Spine Condition"	Student Name: Daivikh Rajesh Mysuru
Problem/Opportunity: <p>Low back pain is a leading cause of disability worldwide, affecting millions annually. Spondylosis, a degenerative spine condition, often leads to restricted mobility and chronic pain, which can be diagnosed using MRI. The challenge is to develop an artificial intelligence (AI) model capable of detecting and classifying degenerative lumbar spine conditions from MRI scans.</p>		
Goal: <p>The goal of this project is to develop a robust AI model capable of accurately identifying and classifying five lumbar spine degenerative conditions—Left Neural Foraminal Narrowing, Right Neural Foraminal Narrowing, Left Subarticular Stenosis, Right Subarticular Stenosis, and Spinal Canal Stenosis—based on MRI scan data. This model should grade these conditions with severity levels (Normal/Mild, Moderate, Severe).</p> <p>The project seeks to utilize MRI data and AI to automate the classification of spine conditions, which can lead to better patient outcomes.</p>		
Objectives: 1. Data Collection and Preprocessing: <ul style="list-style-type: none"> • Outcome: Aggregate, clean, and prepare the MRI data from the provided dataset for model input. • Time Frame: Completed within the first 2-3 weeks. • Measure: A fully cleaned and preprocessed dataset, with missing values handled and proper mapping between image slices and labeled conditions. • Action: Preprocess the image data using data wrangling techniques, automate cleaning, and ensure efficient mapping of image slices to condition labels. 2. Model Development: <ul style="list-style-type: none"> • Outcome: Develop a deep learning model to classify the degenerative spine conditions with severity scores based on MRI data. • Time Frame: Completed by the end of the first month. • Measure: Initial model performance will be evaluated using weighted log loss. • Action: Implement and train the CNN model on preprocessed MRI data. Use pre-trained models to speed up development. 3. Model Validation and Optimization <ul style="list-style-type: none"> • Outcome: Validate and fine-tune the AI model to enhance accuracy and minimize prediction errors. • Time Frame: Completed by the end of month 2. • Measure: Achieve a reduced weighted log loss score through hyperparameter tuning, cross-validation, and regularization techniques. 		

- **Action:** Perform model optimization by adjusting hyperparameters, learning rates, and testing different architectures if needed.

4. Deployment and Testing:

- **Outcome:** Deploy the trained AI model and evaluate its performance on test set.
- **Time Frame:** Completed by month 3.
- **Measure:** The model should achieve a weighted log loss below a set threshold on the test set. The model's ability to identify severe spinal conditions accurately will be a key success metric.
- **Action:** Deploy the model and run comprehensive tests on the test dataset.

Success Criteria:

The project will be deemed successful if the following criteria are met:

1. **Model Accuracy:** The AI model achieves a weighted log loss that meets or exceeds predefined accuracy benchmarks.
2. **Any Severe Prediction:** The model accurately identifies severe spinal conditions using the prediction metric with a high level of confidence.
3. **Timely Completion:** The project is completed within the 3-month time frame.
4. **Clinical Relevance:** The output classifications align with expert radiologists' assessments, providing actionable insights for medical diagnosis.
5. **Usability:** The model is deployable in a real-world clinical setting with minimal modifications required for integration into hospital systems.

Assumptions, Risks, Obstacles:

➤ Assumptions:

- The AI model will generalize well from the training dataset to unseen MRI scans.
- Sufficient computational resources, such as GPUs, are available to train the AI model.

➤ Risks:

- **Incomplete or Inaccurate Labels:** Missing or incomplete labels in the dataset might affect model training and lead to lower accuracy.
- **Overfitting:** The model might overfit the training data and perform poorly on unseen data.
- **Hardware/Software Failures:** Limitations in computational power or software bugs might delay model training or deployment.
- **Dataset Bias:** The training dataset may not adequately represent the diversity of patient cases, leading to biased predictions.

➤ Obstacles:

- **Data Imbalance:** Some severity categories may be underrepresented, affecting model accuracy.
- **Regulatory Compliance:** The model must adhere to regulatory standards for medical AI systems before deployment in clinical settings.

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