## Introduction

Liver cirrhosis is a severe chronic disease characterized by progressive liver damage. Early prediction of cirrhosis is essential for timely treatment and prevention of complications. Traditional diagnostic methods often detect cirrhosis at later stages, which limits treatment options. This project utilizes machine learning techniques to predict liver cirrhosis early using clinical and biochemical data.

## Objective

To develop a machine learning-based system that can accurately predict liver cirrhosis using patient data, with the aim of assisting healthcare professionals in early diagnosis and improving patient outcomes.

## Dataset Used

The UCI Liver Disorders dataset is used, containing 345 instances and 7 features including Age, Gender, Total Bilirubin, Direct Bilirubin, Alkaline Phosphotase, Alamine Aminotransferase (SGPT), Aspartate Aminotransferase (SGOT), Total Proteins, Albumin, and Albumin and Globulin Ratio.

## Methodology

1. Data Preprocessing: Handling missing values, normalization, encoding categorical variables.

2. Feature Selection: Identifying the most relevant clinical features.

3. Model Selection: Comparing various ML models - Logistic Regression, Random Forest, SVM, XGBoost, and ANN.

4. Model Evaluation: Using metrics like Accuracy, Precision, Recall, F1 Score, and ROC-AUC.

5. Deployment Plan: Integrating the best model into a clinical decision support system.

**Tools and Technologies**

- Python (Pandas, NumPy, Scikit-learn, TensorFlow/Keras)

- Jupyter Notebook for implementation and visualization

- Matplotlib/Seaborn for data visualization

**Results**

Among all models tested, Random Forest and XGBoost delivered the highest accuracy with balanced precision and recall. ROC-AUC scores indicated strong predictive performance. The models were able to identify patients at risk of cirrhosis before clinical symptoms became severe.

**Conclusion**

Machine learning offers a powerful approach for early detection of liver cirrhosis. With accurate prediction models, healthcare providers can take preventive actions earlier, leading to better health outcomes. Future work includes integrating real-time hospital data and deploying a web-based or mobile application.