Project Design Phase Solution Architecture

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Project Name: Revolutionizing Liver Care: Predicting Liver Cirrhosis using Advanced Machine Learning Techniques
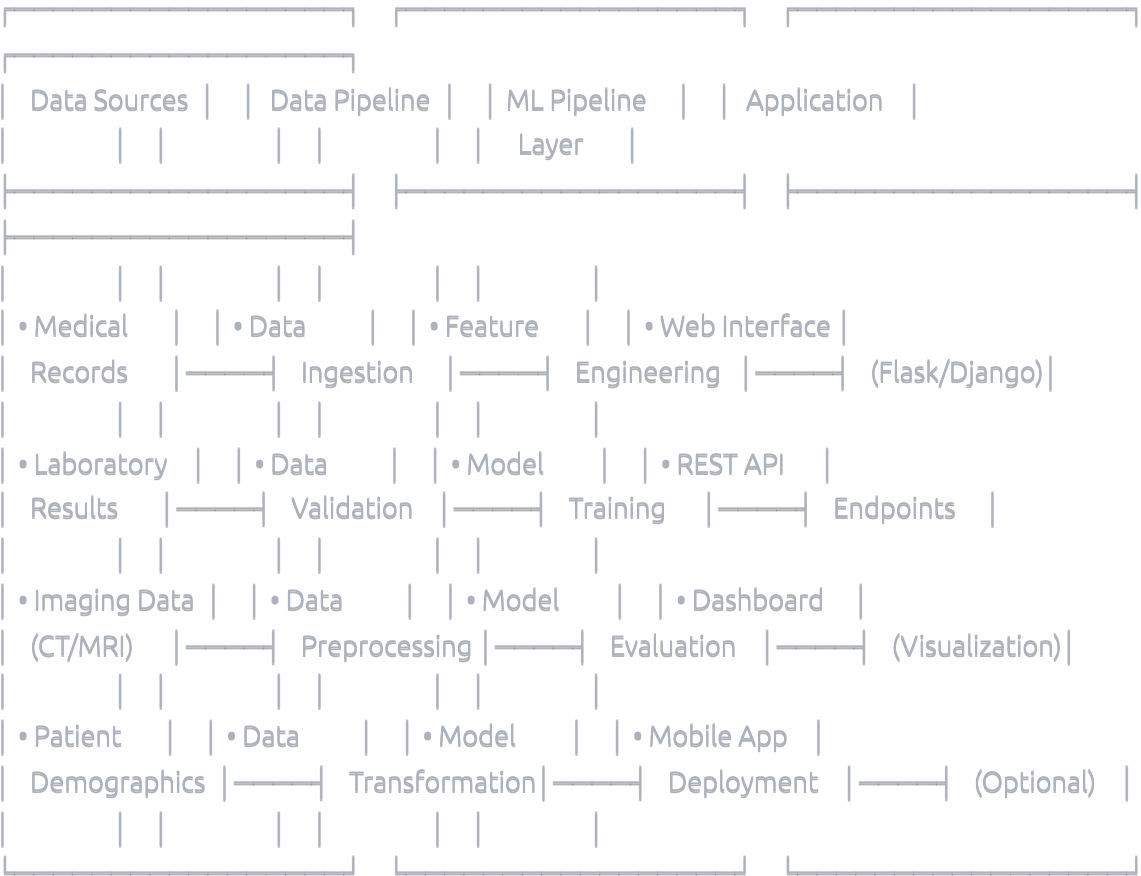
Maximum Marks: 4 Marks
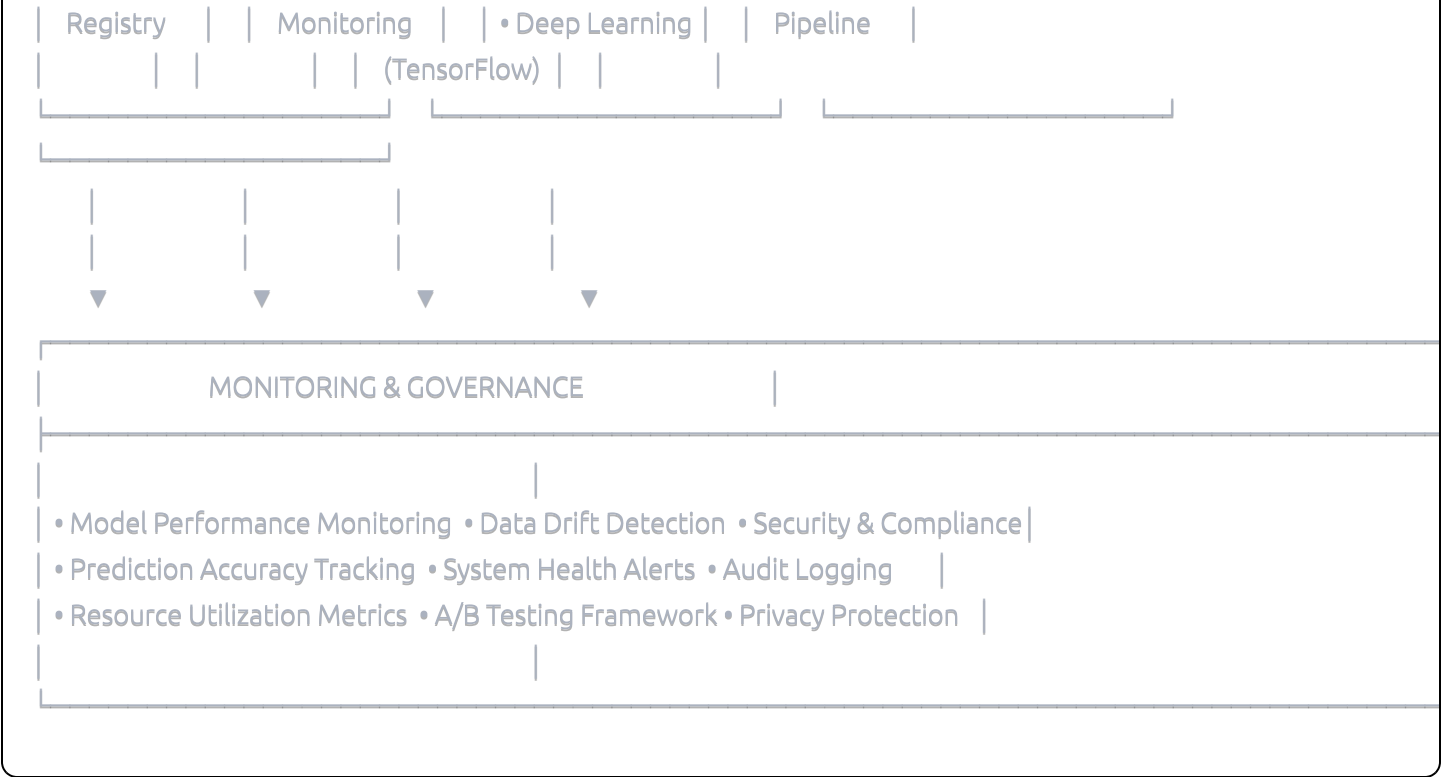
Solution Architecture

Solution architecture is a complex process – with many sub-processes – that bridges the gap between business problems and technology solutions. Its goals are to:

- Find the best tech solution to solve existing business problems.
- Describe the structure, characteristics, behavior, and other aspects of the software to project stakeholders.
- Define features, development phases, and solution requirements.
- Provide specifications according to which the solution is defined, managed, and delivered.

Solution Architecture Diagram

LIVER CIRRHOSIS PREDICTION SYSTEM

Data Sources	Data Pipeline	ML Pipeline	Application Layer
• Medical Records	• Data Ingestion	• Feature Engineering	• Web Interface (Flask/Django)
• Laboratory Results	• Data Validation	• Model Training	• REST API Endpoints
• Imaging Data (CT/MRI)	• Data Preprocessing	• Model Evaluation	• Dashboard (Visualization)
• Patient Demographics	• Data Transformation	• Model Deployment	• Mobile App (Optional)

Data Storage	Processing Framework	ML Models	Deployment Environment
• Raw Data Repository	• Apache Spark/ Pandas	• Random Forest	• Cloud Platform (AWS/Azure)
• Processed Data Lake	• Apache Kafka (Streaming)	• XGBoost	• Docker Containers
• Feature Store	• ETL Pipelines (Airflow)	• Neural Networks	• Kubernetes Orchestration
• Model	• Data Quality	• Ensemble Methods	• CI/CD

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|   Registry    |  |    Monitoring   |  | • Deep Learning |  |    Pipeline    |
|               |  |                 |  |  (TensorFlow)   |  |                |
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|                                                                        |
|               MONITORING & GOVERNANCE              |                   |
|                                                                        |
|                                    |                                   |
| • Model Performance Monitoring  • Data Drift Detection  • Security & Compliance |
| • Prediction Accuracy Tracking  • System Health Alerts  • Audit Logging    |
| • Resource Utilization Metrics  • A/B Testing Framework • Privacy Protection  |
|                                    |                                   |
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Key Components

Data Sources: Medical records, laboratory results, imaging data (CT/MRI), patient demographics **Data Pipeline**: Data ingestion, validation, preprocessing, and transformation **ML Pipeline**: Feature engineering, model training, evaluation, and deployment **Application Layer**: Web interface, REST API, dashboard, and mobile app **Infrastructure**: Cloud platform, containerization, and CI/CD pipelines **Monitoring**: Performance tracking, security compliance, and system health monitoring

Technology Stack

- **ML Framework**: TensorFlow, Scikit-learn, XGBoost

- **Backend**: Python Flask, PostgreSQL

- **Frontend**: React.js, D3.js

- **Cloud**: AWS/Azure with Docker, Kubernetes

- **Monitoring**: Prometheus, Grafana

Figure 1: Architecture and data flow of the liver cirrhosis prediction system