Part 4: Reflection & Workflow Diagram

Reflection (5 points)

1. Most Challenging Part of the Workflow

**Challenge: Balancing Model Performance with Ethical & Regulatory Constraints**

❿   **Why?**

❿   Healthcare data is highly sensitive (HIPAA/GDPR), limiting data sharing and feature engineering options.

❿   Ensuring **fairness** while maintaining accuracy requires iterative testing (e.g., bias audits, reweighting data).

❿   Clinicians demand **interpretability**, which can conflict with using high-performance black-box models (e.g., deep learning).

2. Improvements with More Time/Resources

Constraint	Improvement
Limited Data	Partner with multiple hospitals for **federated learning** (train model across institutions without sharing raw data).
Bias Concerns	Conduct **real-world bias testing** with clinicians to identify blind spots (e.g., underrepresented populations).
Computational Limits	Use **cloud-based AutoML** (e.g., Google Vertex AI) to test multiple models efficiently.
Explainability	Develop **interactive dashboards** (e.g., Plotly + SHAP) to show why patients are flagged.

AI Development Workflow Diagram (5 points)

Flowchart: Patient Readmission Prediction System
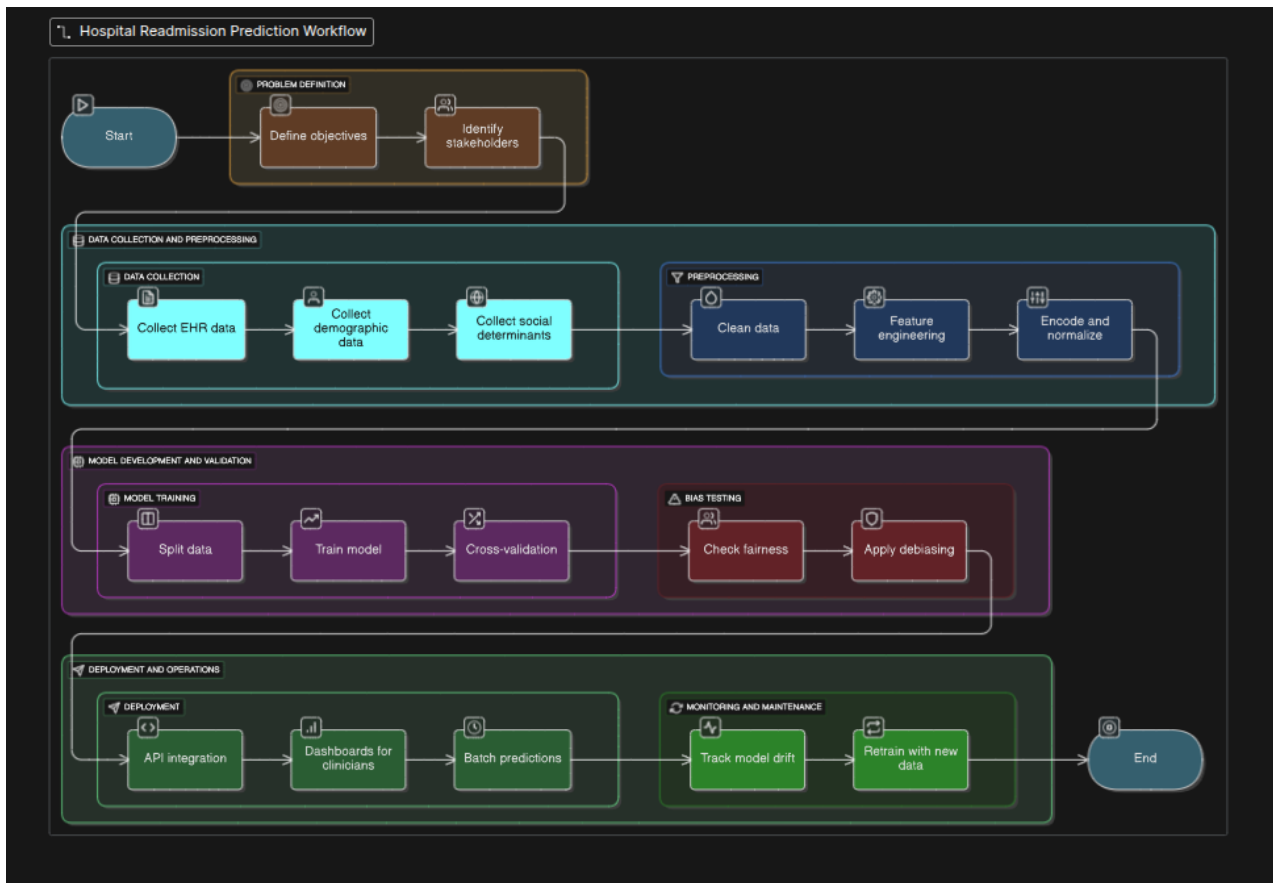
[Start]
　　|
　　▼
[1. Problem Definition]
　　| → Define objectives (reduce readmissions, cost savings)
　　| → Identify stakeholders (doctors, admins, patients)
　　|
　　▼
[2. Data Collection]
　　| → EHRs (labs, diagnoses)
　　| → Demographics (age, ZIP code)
　　| → Social determinants (transportation, income proxy)
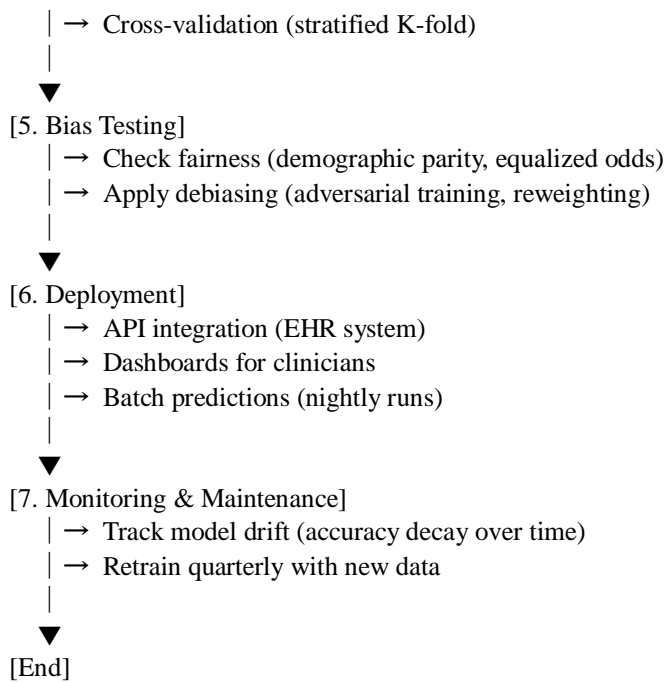　　|
　　▼
[3. Preprocessing]
　　| → Clean data (handle missing values, duplicates)
　　| → Feature engineering (comorbidity scores, time since last admission)
　　| → Encode & normalize (one-hot, scaling)
　　|
　　▼
[4. Model Training]
　　| → Split data (train/validation/test)
　　| → Train XGBoost/LightGBM (optimize for recall)

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    │ → Cross-validation (stratified K-fold)
    │
    ▼
[5. Bias Testing]
    │ → Check fairness (demographic parity, equalized odds)
    │ → Apply debiasing (adversarial training, reweighting)
    │
    ▼
[6. Deployment]
    │ → API integration (EHR system)
    │ → Dashboards for clinicians
    │ → Batch predictions (nightly runs)
    │
    ▼
[7. Monitoring & Maintenance]
    │ → Track model drift (accuracy decay over time)
    │ → Retrain quarterly with new data
    │
    ▼
[End]
```

Key Stages Summary:

1. **Problem Scoping** – Align with hospital goals.

2. **Data Strategy** – Ensure HIPAA-compliant, diverse data.

3. **Preprocessing** – Clean and structure data for ML.

4. **Model Development** – Balance accuracy, interpretability, fairness.

5. **Bias Mitigation** – Actively reduce disparities.

6. **Deployment** – Integrate into clinical workflows.

7. **Monitoring**– Continuously improve with real-world feedback.