**Hybrid Model Approaches**

**1. GNN + LSTM for Sequential Transaction Analysis**

**Why?**

* GNN captures **network-based fraud patterns** (e.g., money laundering chains).
* LSTM models **time-series behavior** of users (e.g., sudden spending spikes).

**Architecture**:

* **Graph Neural Network (GCN/GAT)** → Extracts relationships from transaction graphs.
* **LSTM** → Captures temporal transaction sequences per user.
* **MLP Classifier** → Final fraud detection layer.

**2. GNN + Transformer for Enhanced Pattern Recognition**

**Why?**

* **GNN** models transaction networks and user connections.
* **Transformer** learns long-range dependencies in transaction sequences.

**Architecture**:

* **Graph Attention Network (GAT)** → Learns fraud patterns from transaction graphs.
* **Transformer Encoder** → Processes transaction sequences for deeper insights.
* **Dense Layer** → Outputs fraud probability.

**3. GNN + Autoencoder for Anomaly Detection**

**Why?**

* **Autoencoder** detects rare fraud patterns in transactions.
* **GNN** enhances feature extraction by considering user relations.

**Architecture**:

* **GCN** → Learns structural fraud patterns.
* **Autoencoder** → Reconstructs normal transactions and flags anomalies.
* **Anomaly Score Calculation** → Identifies fraudulent activities.

**Datasets (Easily Available)**

1. **IEEE-CIS Fraud Detection (Kaggle)** – Large-scale credit card fraud dataset.
2. **Elliptic Bitcoin Dataset** – Blockchain fraud transactions dataset.
3. **PaySim** – Mobile money transaction fraud dataset (synthetic).