GNN Learning Path & Fraud Detection System

An evolutionary journey from Classical ML to Advanced Graph Neural Networks.

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Topics to be covered

1. Classical ML

Building the foundation with supervised learning, evaluation metrics, and algorithms like XGBoost and Random Forests.

2. Deep Learning

Progressing to feature extraction, convolutions, and understanding the limitations of CNNs on non-grid data.

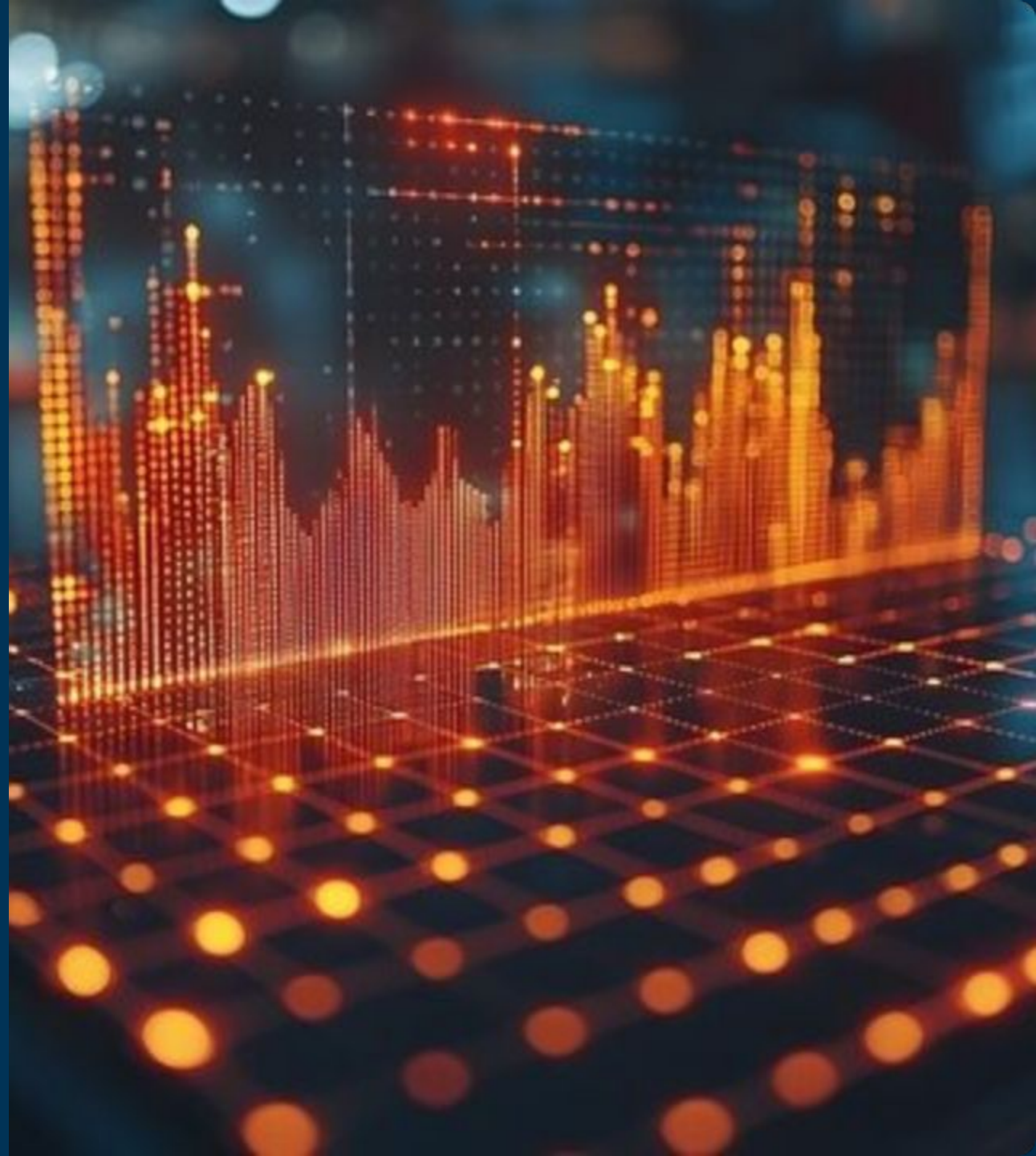
3. Graph Networks

Culminating in GNNs to model relational data and uncover complex patterns hidden in network structures.

Final Project: Fraud Detection

Detecting relational anomalies within financial networks.

- **Graph Modeling:** Accounts are mapped as nodes and money transfers as edges.
- **Hidden Patterns:** The structure reveals fraud rings and multi-hop laundering that tabular models miss.
- **Advanced Logic:** Leveraging GNNs to identify complex relational dependencies.



Phase I: Foundations and basic ML

Linear algebra and ML basic

- Implement foundational math: Vector,matrices , and optimization via Gradient descent
- Transition from regression to deep learning: From simple classifiers to Deep Neural Networks
- Program the learning loop: Code the Backpropagation algorithm and loss functions manually

Intro to ANN's

- Explore convolution, feature maps, and hierarchical feature extraction.
- Train CNNs on MNIST/CIFAR to grasp feature learning dynamics.
- **Key Insight:** Identify why CNNs struggle with non-grid relational data.

Phase II: Deep Learning and Graph Theory

Intro to CNNs

- Explore convolution, feature maps, and hierarchical feature extraction.
- Train CNNs on MNIST/CIFAR to grasp feature learning dynamics.
- **Key Insight:** Identify why CNN's struggle with non-grid relational data.

Graph Theory

- Explore nodes, edges, and Adjacency Matrices to represent connections as structured data.
- Utilize NetworkX to model transaction networks, visualizing clusters and centrality measures.
- **Key Insight:** Understand how Graph topology captures relational dependencies that grid based models miss.

Phase III: Graph Neural Networks

Message Passing

- Deep dive into the Message Passing Neural Network (MPNN) framework to fully grasp its operational mechanics.
- Analyze how nodes within the graph aggregate information from their immediate and multi-hop neighbors to build a comprehensive, contextual understanding.

Architectures

- Implement state-of-the-art Graph Neural Network (GNN) models for fraud detection.
- Utilize the PyTorch Geometric library to deploy models such as Graph Convolutional Networks (GCN), GraphSAGE, and Graph Attention Networks (GAT).