Appendix C: Glossary of Terms

AI-Based Detection of Hedge Fund Fraud

Comprehensive Terminology Reference

Machine Learning and AI Terms (1/2)

AUC (Area Under the Curve)

- Performance metric for classification models
- Area under the ROC curve
- Range: 0–1 (0.5 = random, 1.0 = perfect)

Autoencoder

- Neural network learning compressed representations
- Trains to reconstruct its input
- Used for anomaly detection via reconstruction error

BERT (Bidirectional Encoder Representations from Transformers)

- Transformer-based language model
- Generates contextualized word embeddings
- FinBERT: variant fine-tuned on financial text

Class Imbalance

- One class (fraud) substantially less frequent
- Requires specialized sampling or algorithms
- Critical challenge in fraud detection

Concept Drift

- Statistical properties of target change over time
- Requires model retraining or adaptive learning
- Common in fraud detection due to adversarial behavior

DBSCAN (Density-Based Spatial Clustering)

- Unsupervised clustering algorithm
- Groups densely packed points
- Identifies outliers as potential anomalies

Ensemble Methods

- Combine multiple base models (e.g., decision trees)
- Improve predictive performance and robustness
- Examples: Random Forest, XGBoost

F1 Score

- Harmonic mean of precision and recall
- Formula: $F_1 = 2 \cdot \frac{\text{precision} \cdot \text{recall}}{\text{precision} + \text{recall}}$
- Particularly useful for imbalanced datasets

Key

ML/AI concepts for understanding fraud detection methodologies.

Machine Learning and AI Terms (2/2)

GNN (Graph Neural Network)

- Deep learning for graph-structured data
- Captures node features and topology
- Subtypes: GCN, GAT

GCN (Graph Convolutional Network)

- Neural network operating on graphs
- Aggregates features from neighboring nodes
- Convolutional operations on graph structure

GAT (Graph Attention Network)

- GNN with attention mechanism
- Learns importance weights for neighbors
- Selective information aggregation

Gradient Boosting

- Ensemble method building models sequentially
- Each model corrects errors of previous ones
- Popular: XGBoost, LightGBM

Isolation Forest

- Anomaly detection algorithm

LSTM (Long Short-Term Memory)

- Recurrent neural network architecture
- Gating mechanisms for long-range dependencies
- Used for time series analysis

Random Forest

- Ensemble of multiple decision trees
- Outputs mode (classification) or mean (regression)
- Robust to overfitting

XGBoost (eXtreme Gradient Boosting)

- Optimized gradient boosting implementation
- Regularization, parallel processing
- Widely used in fraud detection competitions

SHAP (SHapley Additive exPlanations)

- Explainability framework from game theory
- Assigns feature importance for predictions
- Model-agnostic approach

LIME (Local Interpretable Model-Agnostic Explanations)

Financial and Regulatory Terms

Hedge Fund

- Pooled investment vehicle with diverse strategies
- Long/short equity, global macro, event-driven
- Limited regulatory oversight and investor restrictions

NAV (Net Asset Value)

- Total assets minus liabilities
- Typically calculated per share
- Primary metric reported to investors

Ponzi Scheme

- Fraudulent operation paying returns from new capital
- Not from legitimate profits
- Collapses when new investments slow

Serial Correlation

- Correlation at different time lags
- High serial correlation may indicate return smoothing
- Fraud detection red flag

Survivorship Bias

- Failed/closed funds excluded from databases

Backfill Bias

- Artificial inflation of historical performance
- Funds report past returns after track record
- Selective reporting problem

Benford's Law

- Leading digits follow logarithmic distribution
- "1" appears as first digit 30% of time
- Deviations suggest manipulation

AIFMD (Alternative Investment Fund Managers Directive)

- European Union regulation
- Registration, disclosure, oversight requirements
- Applies to hedge funds and private equity

Dodd-Frank Act

- U.S. financial reform legislation (2010)
- Hedge fund registration with SEC
- Periodic disclosure of positions and risk metrics

Form ADV

Adversarial ML and Explainability Terms

Adversarial Machine Learning

Techniques for robust models in adversarial environments where fraudsters actively evade detection.

Adversarial Training

- Train on genuine and perturbed examples
- Improves robustness against attacks
- Critical for fraud detection systems

Data Poisoning

- Inject malicious data into training set
- Corrupts model learning
- Supply chain attack on ML systems

Evasion Attack

- Fraudsters modify behavior to avoid detection
- Exploit knowledge of detection model
- Primary threat in deployed systems

FGSM (Fast Gradient Sign Method)

Explainability and Interpretability

Techniques to understand and explain model predictions, critical for regulatory compliance.

SHAP (Revisited)

- Game-theoretic approach to feature importance
- Consistent, locally accurate explanations
- Regulatory-friendly interpretability

LIME (Revisited)

- Local linear approximations
- Explains individual predictions
- Model-agnostic approach

SupTech (Supervisory Technology)

- Technology-based regulatory solutions
- Data collection, risk assessment, surveillance
- Enables scalable regulatory oversight

EU AI Act

References and Further Resources

Key Reference Sources

This glossary synthesizes terminology from academic literature, regulatory documents, and industry practice.

Academic Literature:

- Getmansky et al. (2004) - Serial correlation
- Brown et al. (2009) - Statistical features
- Bollen & Pool (2009) - Discontinuity at zero
- Amiram et al. (2015) - Benford's law
- Zhang et al. (2022) - Graph neural networks
- Chen et al. (2023) - FinBERT applications

Regulatory Sources:

- SEC (Securities and Exchange Commission)
- ESMA (European Securities and Markets Authority)
- FINRA (Financial Industry Regulatory Authority)
- FSA (Financial Services Authority, UK)

Technical Resources:

- Goodfellow et al. (2016) - Deep Learning textbook
- Bishop (2006) - Pattern Recognition and ML
- Murphy (2022) - Probabilistic Machine Learning
- Lundberg & Lee (2017) - SHAP paper
- Ribeiro et al. (2016) - LIME paper

Industry Standards:

- Alternative Investment Management Association (AIMA)
- CFA Institute standards
- International Organization of Securities Commissions (IOSCO)

Additional Context:

- Full reference list in main paper
- Appendices A & B provide methodological details