Project Title: Deep Risk Management in Finance

Research Guide:
Professor Neelesh Shankar Upadhye
Indian Institute of Technology Madras (IIT Madras)
neelesh@iitm.ac.in

Background and Motivation

Risk management and hedging are central to financial markets, particularly in environments characterized by market frictions, high dimensionality, and model uncertainty. Classical hedging approaches, such as delta hedging, rely on restrictive assumptions including complete markets, known dynamics, and continuous trading. In practice, these assumptions frequently break down, resulting in significant hedging errors and residual risk.

Recent advances in deep learning offer a powerful alternative by enabling flexible, data-driven modeling of complex stochastic systems. The Deep Hedging framework introduced by Buehler et al. proposes an end-to-end learning approach in which hedging strategies are optimized directly with respect to risk-adjusted objectives under realistic market constraints. This shift from model-based to learning-based risk management provides strong motivation for a systematic study of deep learning methods in modern financial risk management, especially in settings where traditional analytical solutions are unavailable or unreliable.

Research Objectives

The primary objective of this project is to study and implement advanced deep learning techniques for financial risk management, with a particular focus on the Deep Hedging framework. The initial phase of the project will involve a detailed implementation and empirical evaluation of the paper "Deep Hedging," which will serve as the foundation for subsequent research extensions.

The specific objectives are to:

- Develop a PyTorch or TensorFlow implementation of the Deep Hedging model.
- Reproduce and analyze key experimental results using risk-adjusted performance metrics.
- Compare deep hedging strategies with classical hedging and traditional risk management approaches.
- Design a modular, production-ready codebase suitable for future integration and extension.

Expected Contribution

The project is expected to deliver a rigorous and well-documented implementation of deep learning-based hedging strategies, integrating theoretical insights from the literature with practical considerations relevant to real-world deployment. The study will provide a structured framework for evaluating learning-based risk management methods under realistic market frictions, transaction costs, and risk constraints, thereby enhancing understanding of their applicability and limitations.

Beyond replicating existing results, the project will investigate the robustness of deep hedging strategies to changes in model architecture, choice of risk measures, and market assumptions. It will also examine potential extensions to portfolio-level and multi-asset settings, laying the groundwork for future research in high-dimensional risk optimization. The outcomes are expected to be valuable for both academic research and practitioners seeking to deploy data-driven risk management systems in institutional financial environments.