RADemics

# Scalable Deep Learning Frameworks for Large Scale Predictive Decision System

Prof.Katha Kishor Kumar, Kurapati Sravanthi, Mani Vannan M
KAKATIYA UNIVERSITY, UNIVERSITY COLLEGE OF ENGINEERING (KAKATIYA UNIVERSITY) Alpha College of Engineering

# Scalable Deep Learning Frameworks for Large Scale Predictive Decision Systems

[1]Katha Kishor Kumar, Professor, Department of Computer Science and Engineering, Kakatiya University, Warangal -506009. k_kishorkunmar@yahoo.com

[2]Kurapati Sravanthi, Associate professor, Department of Computer Science and Engineering, University College of Engineering (Kakatiya University), Kothagudem – 507118. sravanthi.k1982@gmail.com

[3]Mani Vannan M, Assistant Professor, Department of Mechanical Engineering, Alpha College of Engineering, Poonamallee, Chennai-600124. mmvmech@gmail.com

## Abstract

The growing demand for intelligent, low-latency, and automated decision-making has accelerated the adoption of event-driven architectures within large-scale predictive systems. This chapter explores the integration of event-driven processing, distributed deep learning, cloud-native infrastructure, and real-time analytics to establish scalable frameworks for predictive decision automation. The proposed conceptual framework connects continuous data ingestion, stream processing, model inference, business-rule evaluation, and automated action execution through loosely coupled computational components. Particular attention focuses on asynchronous event communication, distributed workload management, dynamic resource allocation, and fault-tolerant processing mechanisms that support high-throughput analytical operations. The chapter also examines the integration of edge computing and serverless execution environments to reduce response delays and improve resource utilization across geographically distributed applications. Model monitoring, drift detection, security controls, data governance, and auditability receive consideration as essential requirements for maintaining predictive reliability and operational accountability. Applications across industrial monitoring, financial fraud detection, intelligent transportation, supply chain management, and adaptive resource allocation demonstrate the broader relevance of event-driven predictive systems. The discussion establishes a comprehensive architectural perspective for developing responsive, resilient, and cost-aware decision automation environments capable of supporting continuous intelligence in increasingly dynamic digital ecosystems.

**Keywords:** Event-Driven Architecture; Predictive Decision Automation; Real-Time Analytics; Distributed Deep Learning; Serverless Computing; Edge Intelligence.

## Introduction

The digital technologies, connected devices, and data-intensive applications has increased the demand for intelligent systems capable of delivering timely and reliable decisions [1]. Traditional decision-making architectures frequently depend on periodic data collection and centralized processing, which can introduce delays when operational environments generate continuous streams of information [2]. Event-driven architectures offer an alternative by

initiating computational activities in response to specific events, enabling predictive models to evaluate changing conditions and support immediate actions [3,4]. This approach creates opportunities for integrating real-time analytics, distributed deep learning, cloud computing, and automated decision mechanisms within scalable digital infrastructures [5].

Predictive decision automation combines historical knowledge, continuously generated data, and trained analytical models to identify emerging patterns and recommend appropriate operational responses [6]. Event-driven processing strengthens this capability by connecting data sources, message brokers, processing services, and model-serving components through asynchronous communication [7]. Incoming events can trigger feature extraction, prediction generation, rule evaluation, and subsequent actions without requiring continuous manual intervention [8]. Applications include fraud detection, equipment failure prediction, demand forecasting, traffic management, and intelligent inventory control [9]. The effectiveness of these applications depends on processing speed, prediction accuracy, system reliability, and the ability to coordinate analytical tasks across distributed computational environments [10].

Scalability represents a fundamental requirement for event-driven predictive systems because event volumes, processing complexity, and response expectations frequently change over time [11]. Distributed processing frameworks support parallel event consumption, while cloud-native services provide flexible computational resources for fluctuating workloads [12]. Serverless computing enables event-triggered execution without continuous server administration, whereas edge computing facilitates preliminary analysis near data-generation sources [13]. Combining these technologies supports workload distribution according to latency requirements, computational intensity, and network availability [14]. Effective architectural design also requires suitable mechanisms for event ordering, duplicate detection, fault recovery, and resource allocation to maintain consistent processing performance during demand surges and infrastructure interruptions [15].