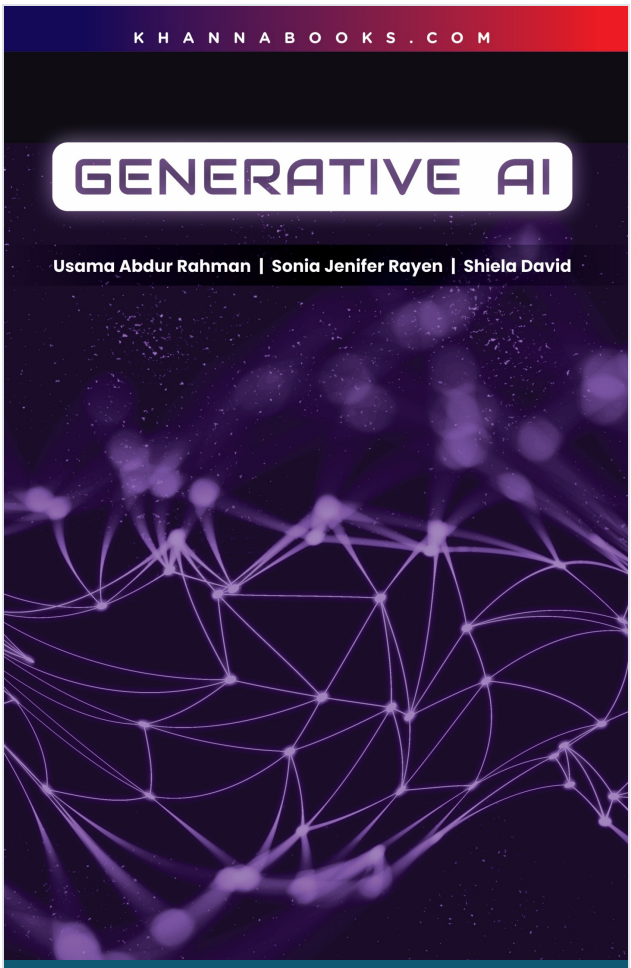

Sonia Jenifer Rayen, Shiela David, Usama Abdur Rahman

Generative AI

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Product Description

Generative AI (Gen AI) has rapidly evolved from a theoretical concept into a transformative technology capable of simulating human creativity, generating content, producing innovative ideas, and enabling autonomous decision-making. This book serves as a comprehensive and structured guide to understanding the foundations, architectures, applications, and future directions of Generative Artificial Intelligence. Designed for students, researchers, professionals, and technology enthusiasts, it provides both theoretical insights and practical perspectives on one of the most influential fields in modern computing.

The text begins by tracing the historical evolution of Artificial Intelligence, highlighting key milestones that shaped the development of machine learning and intelligent systems. It then builds a strong conceptual foundation by introducing Neural Networks and the revolutionary Transformer Architecture, which forms the backbone of modern generative systems. Special emphasis is placed on the Attention Mechanism, encoder-decoder architectures, and the emergence of Large Language Models (LLMs) that power advanced conversational and content-generation systems.

Beyond foundational concepts, the book explores advanced generative techniques such as Generative Adversarial Networks (GANs) and Variational Autoencoders (VAEs), explaining their architectures, workflows, and practical applications. Readers gain insights into how generative models create realistic text, images, and multimedia content, while also understanding the principles behind AI Agents, prompt engineering, and modern AI development frameworks.

The practical relevance of Generative AI is demonstrated through extensive real-world applications across healthcare, finance, manufacturing, software engineering, media, and entertainment. The text also addresses critical contemporary topics including model

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evaluation metrics, ethical considerations, responsible AI development, and emerging innovations such as Quantum AI and Neuromorphic Computing. By combining academic rigor with practical implementation, this book provides a complete roadmap for mastering the rapidly evolving landscape of Generative Artificial Intelligence.

Salient Features:

- Foundational AI Concepts: Provides a detailed overview of the history and evolution of Artificial Intelligence, establishing a strong foundation in neural networks, machine learning, and the development of generative technologies.
- Transformer Architecture Deep Dive: Thoroughly explains Transformer Models, the Attention Mechanism, and the distinctions between encoder-based architectures (such as BERT) and decoder-based Large Language Models.
- Large Language Model Mastery: Covers the principles, architectures, and applications of LLMs, including their use in natural language processing, content generation, summarization, translation, and conversational AI systems.
- Advanced Generative Models: Presents comprehensive coverage of Variational Autoencoders (VAEs) and Generative Adversarial Networks (GANs), detailing their components, workflows, training methodologies, and practical applications.
- Practical AI Agents & Frameworks: Introduces AI Agents and modern development frameworks such as Lang Chain, enabling readers to build scalable and production-ready Generative AI applications.
- Cross-Industry Applications: Demonstrates the transformative impact of Generative AI across multiple sectors, including healthcare, manufacturing, finance, software development, and digital media.
- Model Evaluation Techniques: Explains important evaluation metrics such as Perplexity, BLEU Score, and ROUGE Score, helping readers assess and benchmark the performance of generative and language models.

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- Future & Ethical Directions: Explores emerging topics including Multimodal AI, prompt optimization techniques (Top-K and Top-P sampling), ethical AI practices, Quantum AI, and Neuromorphic Computing.

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