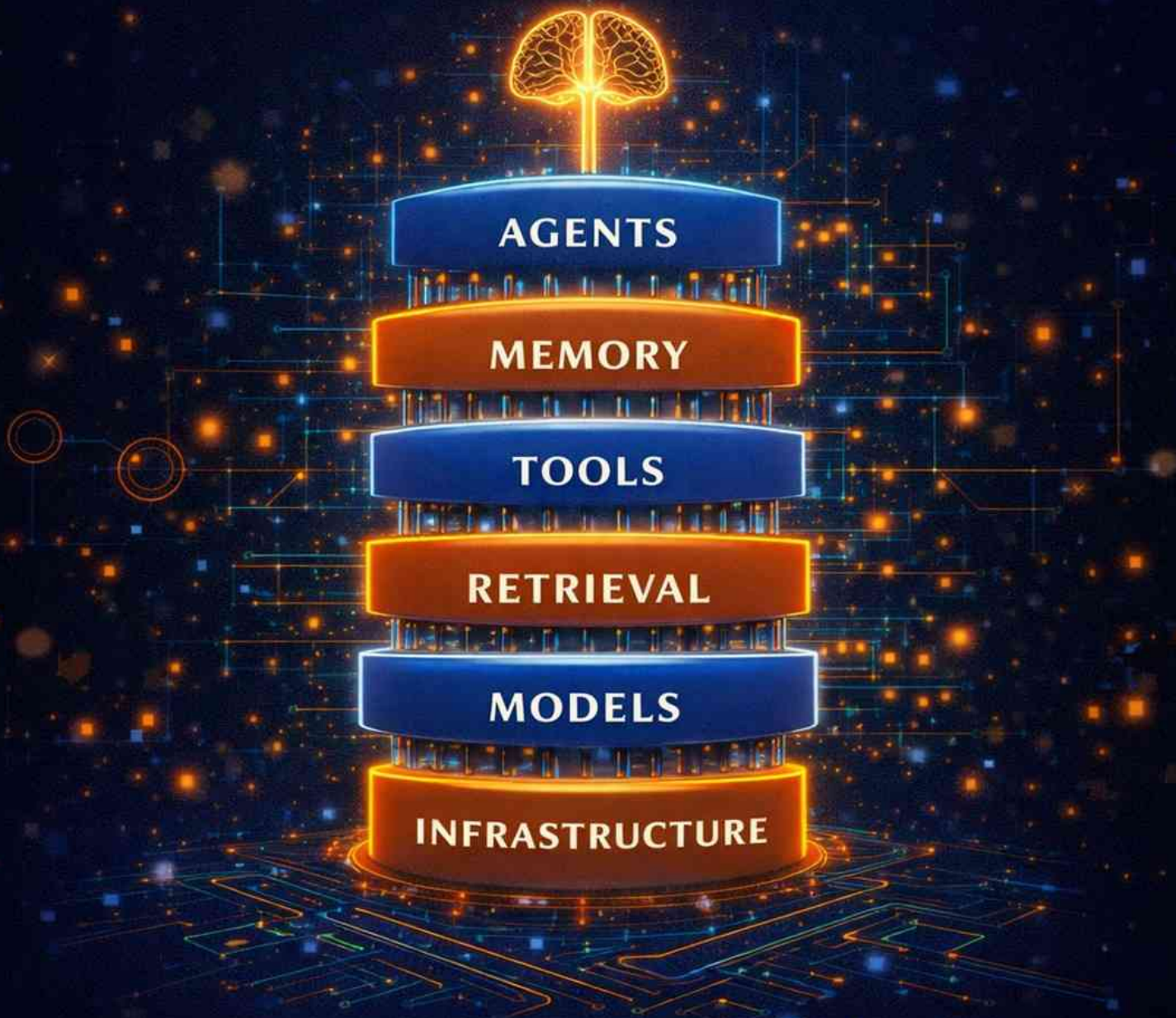
Engineering the Agentic AI Stack



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ENGINEERING THE AGENTIC AI STACK

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Author

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PREFACE

This book is a comprehensive technical guide to agentic artificial intelligence, AI systems capable of perceiving their environment, reasoning about complex goals, planning multi-step solutions, taking autonomous action, and learning from outcomes. It is written for practitioners, researchers, policymakers, and informed technologists who need to understand not just what agentic AI can do, but also how it works, how to build it, and how to govern it responsibly.

The field of agentic AI is evolving at an extraordinary speed. Between the time this manuscript was completed and the time you read it, new models will have been released, new benchmarks achieved, new frameworks published, and new regulations proposed. This book is designed to provide durable understanding rather than ephemeral news: the formal foundations, architectural patterns, safety principles, and governance frameworks described here will remain relevant even as specific implementations evolve.

The book is organized into four parts. Chapters 1–4 establish the technical foundations: formal definitions, cognitive architectures, planning algorithms, and multi-agent coordination. Chapters 5–6 examine real-world applications in enterprise and scientific research. Chapters 7–9 address the critical challenges of safety, governance, and societal impact. Chapters 10–12 provide practical guidance for building, deploying, and understanding the long-term trajectory of agentic systems. Every chapter has been written to stand independently while building on concepts introduced earlier. Cross-references are provided throughout to help readers navigate the connections between technical architecture, safety requirements, governance frameworks, and practical implementation. Whether you are an engineer building your first agent, a researcher pushing the frontier, or a policymaker crafting governance frameworks, this book aims to equip you with the understanding needed to contribute to a future where autonomous minds serve humanity’s highest aspirations.

ACKNOWLEDGEMENT

Writing a book on Engineering the Agentic AI Stack has been both a technical and personal journey, and it would not have been possible without the support of many people.

I thank my family for their unwavering patience and encouragement through the countless late nights and weekends that went into this work. Their belief in me was the quiet engine behind every chapter.

I am grateful to my mentors and colleagues, whose conversations, critiques, and shared curiosity helped shape the ideas in these pages. Many of the frameworks and perspectives presented here were sharpened in whiteboard debates, reviews, and the honest feedback that only trusted peers can offer.

A special thanks goes to the broader open-source and research community. The builders, maintainers, and contributors behind the tools, models, and frameworks of the modern agentic stack make work like this possible, and I hope this book contributes something useful in return.

I am indebted to the reviewers and early readers who generously lent their time to examine the manuscript. Their thoughtful suggestions improved both the accuracy and clarity of these pages, and any remaining shortcomings are entirely my own.

To the editorial and publishing team, thank you for believing in this project and for the care you brought to turning a manuscript into a book.

Finally, to you, the reader: Agentic AI is evolving faster than any single book can fully capture. My hope is that the principles and practices in these pages give you a durable foundation to build upon, experiment with, and ultimately surpass. Thank you for picking this up.

Dr. Joseph Aaron Tsapa PD

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ABOUT THE AUTHOR

Dr. Joseph Aaron Tsapa PD is a pioneering leader in Artificial Intelligence, Agentic AI Systems, Data Science, and Machine Learning, with extensive hands-on experience in transforming industries through autonomous technology solutions. With a proven track record of innovation in AI architecture and multi-agent orchestration, Joseph has developed robust agentic frameworks and introduced advanced technologies, including autonomous planning engines and cognitive AI stacks, across sectors such as banking, finance, healthcare, and utilities.

Joseph's expertise spans foundation models, reasoning architectures, tool integration protocols, and a wide array of AI frameworks and programming languages. His forward-thinking approach to Agentic AI leverages cutting-edge tools such as ReAct loops, retrieval-augmented generation, and multi-agent orchestration to automate and streamline complex processes, delivering significant cost savings and dramatic improvements in operational efficiency. Notably, his groundbreaking work on integrating Large Language Models (LLMs) into autonomous decision-making and agentic workflows has set new standards for AI capability and reliability.

Joseph is an accomplished author and researcher with more than 25 internationally published papers exploring the transformative role of artificial intelligence across banking, healthcare, and utilities. He has authored several influential books, including Generative AI: Concepts and Applications, Practical Machine Learning: Real-World Applications and Techniques, Data Science & Machine Learning: The Modern Practitioner's Guide, and Strategic Leadership Velocity.

Throughout his career, Joseph has led major AI transformation initiatives, including the deployment of multi-agent systems that have significantly reduced processing times and increased productivity. His leadership in AI safety, alignment, and governance has redefined compliance practices within regulated industries, bridging the gap between autonomous capability and responsible deployment.

Joseph holds a Professional Doctorate (PD) in Computer Science from European International University – Paris, and a Doctor of Advanced Studies (D.A.S., Honorary Dr. h.c.) in Computer Science from Azteca University. He also earned a Master of Science in Software Engineering from the Birla Institute of Technology and Science (BITS), Pilani. An active editorial board reviewer for several international journals, Joseph remains committed to advancing the field through continuous learning and knowledge sharing.

Recognized with multiple awards for his contributions, Joseph continues to set new benchmarks for Agentic AI integration and autonomous systems across data-driven industries. His visionary leadership and proven track record ensure that he will remain at the forefront of Agentic AI innovation for years to come.

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