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### Book Review

## *Book Review on* A Practical Guide to Quantum Machine Learning and Quantum Optimization


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Abstract	Manuscript Information
<p>This review critically evaluates <i>A Practical Guide to Quantum Machine Learning and Quantum Optimization</i> by Elias F. Combarro and Samuel González-Castillo, a comprehensive and timely resource aimed at bridging the theoretical and practical dimensions of quantum computing. With a pragmatic focus on hands-on implementation, the book covers essential quantum algorithms and applications in optimization and machine learning, requiring only a foundational understanding of Python and linear algebra. The work is notable for its integration of rigorous theoretical exposition, executable code examples, and practical exercises, making it accessible to both academic and industry professionals. Despite some gaps in coverage, such as the omission of certain foundational algorithms and limited discussion of cloud-based platforms, the book excels in pedagogical clarity and practical relevance. This review highlights the strengths, limitations, and critical reception of the book, affirming its value as a key reference for computer science professionals engaged in quantum technologies.</p>	<ul style="list-style-type: none"> <li>▪ <b>ISSN No:</b> 2583-7397</li> <li>▪ <b>Received:</b> 19-03-2025</li> <li>▪ <b>Accepted:</b> 05-04-2025</li> <li>▪ <b>Published:</b> 25-04-2025</li> <li>▪ <b>IJCRM:</b>4(2); 2025: 327-329</li> <li>▪ <b>©2025, All Rights Reserved</b></li> <li>▪ <b>Plagiarism Checked:</b> Yes</li> <li>▪ <b>Peer Review Process:</b> Yes</li> </ul>
	<p><b>How to Cite this Book Review</b></p> <p>Tambe MV. A Practical Guide to Quantum Machine Learning and Quantum Optimization. Int J Contemp Res Multidiscip. 2025;4(2):327-329.</p> <p><b>Access this Article Online</b></p>  <p><a href="http://www.multiarticlesjournal.com">www.multiarticlesjournal.com</a></p>

### INTRODUCTION

Quantum computing is emerging as a transformative paradigm in modern computation, offering revolutionary capabilities in optimization and machine learning. As the field rapidly evolves, the need for educational resources that effectively combine theoretical foundations with practical implementation has become increasingly urgent. *A Practical Guide to Quantum*

*Machine Learning and Quantum Optimization* by Elias F. Combarro and Samuel González-Castillo directly addresses this need, presenting complex quantum concepts in a hands-on, accessible format tailored for students, educators, and practitioners. The book's structured approach—organized into foundational theory, optimization strategies, and machine learning applications—provides a progressive learning path

reinforced by code snippets and problem-solving exercises. This review examines the book's content, instructional design, and real-world applicability, while also considering its limitations and broader impact within the context of quantum computing education.

## BOOK DETAILS

**Authors:** Elias F. Combarro, Samuel González-Castillo

**Foreword:** Alberto Di Meglio

**Publisher:** Packt Publishing (2023)

**Pages:** 680

**ISBN:** 9781804613832

**Price:** \$50

## SYNOPSIS AND EVALUATION

This book serves as a timely and comprehensive resource for professionals seeking to bridge the gap between quantum computing theory and practical applications in optimization and machine learning (ML) [3]. Adopting a distinctly hands-on approach, the authors successfully demystify complex quantum algorithms while requiring only basic linear algebra and Python programming as prerequisites [5]. The inclusion of detailed appendices provides valuable reinforcement of foundational concepts for readers needing additional support [8].

## CONTENT AND STRUCTURE OF THE BOOK

The book's carefully organized content is divided into three core sections:

1. **Foundations of Quantum Computing:**
  - Provides essential introductions to quantum circuits and popular tools, with content structured to allow advanced readers to skim familiar material [4].
  - Includes practical guidance for installing and setting up quantum programming environments, though it notably omits coverage of AWS Braket [7].
2. **Quantum Optimization:**
  - Thoroughly examines key algorithms including QUBO, QAOA, Grover Adaptive Search (GAS), and Variational Quantum Eigensolver (VQE) [2].
  - Demonstrates quantum advantages, such as GAS's  $\sqrt{N}$  efficiency improvement over classical  $N/2$  operations for unsorted data searches [6].
  - Combines rigorous theoretical explanations with immediately applicable code snippets [9].
3. **Quantum Machine Learning:**
  - Explores cutting-edge applications including quantum support vector machines and neural networks, with particular emphasis on hybrid architectures using PyTorch [1].

Features an especially valuable chapter on Quantum Generative Adversarial Networks (QGANs), praised for its exceptional clarity in explaining quantum-classical adversarial training processes [10].

## STRENGTHS OF THE BOOKS

**Educational Value:** Each chapter incorporates carefully designed exercises with solutions, "Important Notes" sections

highlighting key concepts, and references to appendices for mathematical reinforcement [12].

**Comprehensive Framework Coverage:** The comparative analysis of Qiskit and PennyLane provides readers with valuable flexibility across different quantum platforms [11].

**Practical Focus:** Well-chosen case studies demonstrate realistic quantum solutions for NP-hard problems, offering immediate value to researchers [13].

## LIMITATIONS OF THE BOOK

**Organization:** While exhaustive in coverage, the reference-style organization may challenge readers seeking guided learning pathways for specific applications [14].

**Content Gaps:** The limited discussion of cloud platforms like **AWS Braket** and the omission of foundational algorithms (e.g., Shor's) may disappoint some readers [15].

## Author Credentials

**Elias F. Combarro:** An established academic authority with over 50 publications in computability theory and quantum applications, and a key participant in CERN's Quantum Technology Initiative [16].

**Samuel González-Castillo:** An emerging researcher with significant CERN experience, specializing in innovative applications of quantum ML to high-energy physics [17].

## Critical Reception

Alberto Di Meglio of CERN praises the work for its "exceptionally clear formal explanations" and practical coding examples [18].

Industry reviewers consistently highlight its value as an "indispensable desk reference" despite acknowledging its challenging density [19].

## CONCLUSION

This volume stands out as both rigorous and accessible in its treatment of modern quantum algorithms, making it ideally suited for academic and professional audiences alike [20]. Its masterful integration of theory, executable code, and practical exercises positions it as a leading resource in the rapidly advancing field of quantum computing [21]. Highly recommended for those implementing quantum solutions in optimization and ML, though readers may benefit from supplemental materials for complete algorithmic coverage [22].

## IN THE AUTHOR'S OWN WORDS

As an academic exploring quantum computing's practical application, I find this book to be an invaluable bridge between complex theory and real-world implementation. The authors' clear presentation of quantum machine learning and optimization algorithms, combined with executable code examples, provides exactly the kind of hands-on guidance I need to bring these cutting-edge concepts into both my research and classroom teaching. This work stands out for making quantum computing's transformative potential accessible to computer science professionals and educators alike.

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## About the Reviewer



**Minakshi Vasant Tambe** is an Assistant Professor in the Department of Computer Science at Agasti Arts, Commerce, and Dadasaheb Rupwate Science College, Akole. With 11 years of teaching experience in Computer Science, she is deeply committed to advancing both education and research in the field. She holds a Master's degree in Computer Science (First Class) and have qualified the NET in Computer Science, reflecting her academic rigor. Her research contributions include numerous articles published in reputed journals, focusing on artificial intelligence, data mining, and GEN AI. Passionate about fostering innovation, she actively engages in scholarly discussions through FDPs, Conferences, and Workshops, aiming to bridge theoretical knowledge with practical applications. Her teaching philosophy emphasizes student-centric learning, critical thinking, and the transformative potential of technology.