Preface

Artificial intelligence (AI) has become a ubiquitous technology. Artificial neural networks (ANNs) as a central AI methodology are now being used in numerous fields of our technological society, in general, and in the fields of architectural engineering, in particular. However, the opportunity for students to learn how to use AI and ANNs in the fields of architectural engineering is limited by the lack of appropriate books and courses, particularly for non—computer science majors. This book aimed to provide missing education for students, equipping them with the knowledge and skills to apply AI-based technology to their engineering problems. In addition to the paucity of courses, AI books that are appropriate for readers without a background in computer science are also rare. This book introduces fundamentals to both artificial neural networks (ANNs) and ANN-based designs of concrete structures for readers including undergraduate and graduate engineering students who are not familiar with ANNs. This book will also help readers quickly learn to formulate ANNs applicable to their engineering problems, presenting basic but fundamental issues in ANNs and their application to engineering issues. Readers will learn both deep learning and machine learning theories that will bridge an engineering knowledge gained from their coursework to how to find fast and accurate solutions, helping to perform versatile AI-based designs, and hence, to overcome the challenges in their design projects.

The author wishes this book to serve as a study guide on how to work with ANNs having multiple layers and neurons for readers. There are important concepts including neurons, weights, biases, and activation functions that should be understood before formulating ANNs. This book describes what ANNs are, how ANNs are trained, and how ANNs are tested and validated. Important theories and concepts such as activation functions (refer to Section 3.5) and backpropagation (refer to Section 4.2) for ANN-based engineering applications are presented. It is also very important to prepare well-initialized and normalized ANN inputs to train ANNs better on large datasets generated from an area of interest. Brief concepts of ANNs are introduced for an engineering application by which real-world designs of diverse structures are performed to assist readers in solving their own specific design interests. As a result of studying materials in this book, readers will fully understand ANN's technologies relevant to engineering design applications.

This book provides what readers need to begin for their study with ANN-based structural engineering even if they are novices in the topic as it relates to engineering. This book can be used for independent classes of ANN-based engineering area combined with conventional engineering topics, such as statics, mechanics of materials,

structural analysis, reinforced concrete design, and steel design. ANNs are described as concisely and thoroughly as possible applicable for both the analysis and design of structural systems. There are also accompanying PDF materials provided for instructors, with many useful illustrations and summaries of all chapters. The author also runs a YouTube channel (Won-Kee Hong, Kyung Hee University) on how ANN-based structural designs are performed based on this book.

This volume is the first in a series of forthcoming books on ANN-based structural engineering topics. The author cordially hopes his book to be extended further for an ANN-based data-centric engineering and science. The author would like to thank for the support of the National Research Foundation of Korea (NRF) grant funded by the Korean government [MSIT 2019R1A2C2004965]. The author would like to appreciate his students, Nguyen Dinh Han, Tien Dat Pham, Thuc-Anh Le, Manh Cuong Nguyen, and Van Tien Nguyen for their contribution to the birth of this book. Finally, the author could not have published this book without the unflagging spiritual support of his wife Debbie, his son David, and daughter in law Sharon. God has been a pillar of clouds to guide and a pillar of fire to light during the tough time of the preparation of this book, having me travel day and night.

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