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Lei Huang

Normalization Techniques in Deep Learning

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Preface

I focused my research on normalization techniques in deep learning since 2015, when the milestone technique—batch normalization (BN)—was published. I witness the research progresses of normalization techniques, including the analyses for understanding the mechanism behind the design of corresponding algorithms and the application for particular tasks. Despite the abundance and ever more important roles of normalization techniques, there is an absence of a unifying lens with which to describe, compare, and analyze them. In addition, our understanding of theoretical foundations of these methods for their success remains elusive.

This book provides a research landscape for normalization techniques, covering methods, analyses, and applications. It can provide valuable guidelines for selecting normalization techniques to use in training DNNs. With the help of these guidelines, it will be possible for students/researchers to design new normalization methods tailored to specific tasks or improve the trade-off between efficiency and performance. As the key components in DNNs, normalization techniques are links that connect the theory and application of deep learning. We thus believe that these techniques will continue to have a profound impact on the rapidly growing field of deep learning, and we hope that this book will aid researchers in building a comprehensive landscape for their implementation.

This book is based on our survey paper [1], but with significant extents and updates, including but not limited to the details of techniques and the recent research progresses. The target audiences of this book are graduate students, researchers, and practitioners who have been working on development of novel deep learning algorithms and/or their application to solve practical problems in computer vision and machine learning tasks. For intermediate and advanced level researchers, this book presents theoretical analysis of normalization methods and the mathematical tools used to develop new normalization methods.

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