

From Human Attention to Computational Attention

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Editors

From Human Attention to Computational Attention

A Multidisciplinary Approach

Second Edition

 Springer

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Preface

The purpose of this book is to present a multi-disciplinary perspective on the modelling of human attention which is of great interest for artificial intelligence (AI). While the first edition of the book raised interest in this multidisciplinary approach, there have been many recent developments, especially with the arrival of working implementations of deep learning on the engineering side. Links between AI and Neuroscience are also becoming stronger, thus warranting this update.

This second edition of the book delves into the arrival of deep learning, which has influenced attention models and has in turn been influenced by attention, particularly in architectures such as transformers. It also presents more work on the neuroscience side and emphasises how neuroscience can inform the AI domain and vice versa.

The book structure is organised around four parts which are detailed in Chap. 1. The first part, called “Foundations,” is organised around three chapters, focuses on fundamentals and is a comprehensive introduction to attention modelling.

The second part, called “Attention in the Brain,” is organised around three chapters. It deals with neuroscience and details where attention takes place in the brain, how neurophysiology can inform signal detection and how to fill the gap between the study of a single neuron and higher level tasks such as visual performance.

The third part, called “Attention in Computer Science,” is organised around six chapters and focuses first on how attention is used in engineering, model validation, how attention can be applied on multimodal data and finally a chapter on attention in deep learning architectures and especially in transformers.

The fourth part, called “Convergence: when the brain informs computer science (end vice versa),” organised around three chapters contains first a chapter on how to inform brain research from results in computer science and describes a theory of information seeking in the brain which can explain practical implications of attention. Perspectives on the different fields of attention conclude the book.

This book intends to provide important information for both students and researchers of attention with approaches ranging from engineering to neuroscience domains.

While attention and AI in general claim to be multidisciplinary, it is surprising how little the different research communities know about each other. This is both a visible problem between engineers and neuroscientists, but even among engineers between those who focus on attention to model humans and those who use attention as modules in more generic deep learning models.

This is why this book is a manifesto towards building a NeuroAI community which would be able to better understand both fields and to be updated with the advances of both neuroscience and AI.

Finally, we would like to thank Springer Nature for the proposal to write a second edition of this book after the first edition of 2016. We would also like to pay tribute to John Taylor who was an editor of the first edition of the book and passed away during the editing process and to Fred Stentiford who was an author of a chapter in the first edition and who passed away before the second edition. However, some of the text from Fred Stentiford can be found in the current Chap. 7.

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Contents

Part I Attention Foundations

1	Why Do Computers Need Attention?	3
	Matei Mancias, Vincent P. Ferrera, and Antoine Coutrot	
2	What Is Attention?	9
	Matei Mancias and Vincent P. Ferrera	
3	How to Measure Attention?	21
	Matei Mancias and Vincent P. Ferrera	

Part II Attention in the Brain

4	Where: Fronto-Parietal Attention Networks in the Human Brain and Their Dysfunctions	43
	Tal Seidel Malkinson and Paolo Bartolomeo	
5	Attention and Signal Detection: A Practical Guide	65
	Vincent P. Ferrera	
6	Effects of Attention in Visual Cortex: Linking Single Neuron Physiology to Visual Detection and Discrimination	85
	Vincent P. Ferrera	

Part III Attention in Computer Science

7	Modeling Attention in Engineering	105
	Matei Mancias	
8	Metrics for Saliency Models Validation	129
	Matei Mancias and Nicolas Riche	
9	Study of Parameters Affecting Visual Saliency Assessment	151
	Matei Mancias and Nicolas Riche	

- 10 Attention, Multimodality, and Datasets for Validation** 167
Matei Mancas, Erwan David, Nicolas Riche, and Julien Leroy
- 11 Audiovisual Saliency Models: A Short Review** 259
Antoine Coutrot
- 12 Attention in Machine Learning** 269
Cyprien Gille

- Part IV Convergence: When the Brain Informs Computer Science
(and Vice Versa)**
- 13 Is Attention All You Need?** 297
Patrick Mineault
- 14 Linking Attention with Goals: A Theory of Attentional
Priority Based on Expected Information Gains** 315
Jacqueline Gottlieb
- 15 The Future of Attention Models: Convergence of Deep
Learning with Artificial and Human Attention** 327
Matei Mancas, Vincent P. Ferrera, and Antoine Coutrot

- Index** 337