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Modeling*

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Computational Neurogenetic Modeling
Lubica Benuskova and Nikola Kasabov

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Computational Neurogenetic Modeling

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Dedication

To the memory of my parents.

Lubica

To my mother and the memory of my father.

Nikola

Preface

It is likely that future progress in many important areas of science (e.g. brain science, bioinformatics, information science, physics, communication engineering and social sciences) can be achieved only if the areas of computational intelligence, brain science and bioinformatics share and integrate their methods and knowledge. This book offers some steps in this direction. The book presents the background knowledge and methods for the integration of gene information and brain activity information with the purpose of the creation of biologically plausible computational models aiming at modeling and understanding the brain.

The book is aiming at encouraging research in information sciences in the direction of human-like and human-oriented information processing. In this context, “human-like” means that principles from the brain and genetics are used for the creation of new computational methods. “Human-oriented” means that these machines can be used to discover and understand more about the functioning of the brain and the genes, about memory and learning, about speech and language, about image and vision, and about ourselves.

This work was partially supported by the research grant AUTX02001 “Connectionist-based intelligent information systems”, funded by the New Zealand Foundation for Research, Science, and Technology – FRST, through the New Economy Research Fund - NERF.

There are a number of people whom we would like to thank for their encouragement and contribution to the book. These are several colleagues, research associates and postgraduate students we have worked with at the Knowledge Engineering and Discovery Research Institute in Auckland, New Zealand, in the period 2002- 2006: Dr Qun Song, Dr Zeke S. Chan, Dr Paul S. Pang, Dr Liang Goh, Vishal Jain, Tian-Min Ma (Maggie), Peter Hwang, Paulo Gottgroy, Natalia Bedran, Joyce D’Mello and especially Simeu Gomes Wysoski, who did the technical edition of the book and developed specialized simulation tools we used for our computer experiments.

We appreciate the discussions we had with a number of colleagues from different laboratories and countries. Among them are Walter Freeman from University of California at Berkeley; Takeshi Yamakawa – Kyushu

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When one of the authors, N. Kasabov, presented his talk at the ICONIP 2002 in Shanghai and suggested that gene interaction information should be used in biologically plausible neural network models, Walter Freeman commented “Yes, that makes sense, but how do we do that?” Michael Arbib when visiting Auckland in 2004 made a remark that integrating genes (molecular level) into neural networks may require to go to atom (quantum) level. This book is presenting some initial answers to these questions. It presents the foundations and the concepts of computational neurogenetic modeling (CNGM), initially introduced by the authors in 2004 (Kasabov and Benuskova 2004).

The book was written by the two authors in a close collaboration, where Lubica Benuskova wrote chapters 2, 3, 8, 9, 10 and compiled Appendix 1, while Nikola Kasabov wrote chapters 1, 4, 5, 6, 7 and compiled Appendix 2 and 3. Each of the authors also had a smaller contribution to the other chapters as well.

The book is intended for postgraduate students and researchers in the areas of information sciences, artificial intelligence, neurosciences, bioinformatics, and cognitive sciences. The book is structured so that every chapter can be used as a reading material for research oriented courses at a postgraduate level. Additional materials, including: data, simulation programs, lecture notes, color figures, etc. can be found on the web site www.kedri.info.

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1 September 2006

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