RAM-Based Neural Networks

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RAM-Based Neural Networks

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Preface

This book aims to show the state of the art in RAM based networks and to introduce the reader to this mature and developing area of artificial neural networks. It is based on presentations given at the Weightless Neural Network Workshop, Canterbury, in 1995. The authors of the chapters represent the majority of active researchers in RAM based networks through out the world. While some of the papers contain in-depth research results which may only be of interest to specialist workers undertaking research in RAM based networks, many chapters contain introductory material that describe the RAM based methods at a level suitable for workers with a basic knowledge of neural networks.

The area that the book covers is popularly known by at least three names, these being RAM based networks, weightless networks and N tuple networks, and can be used interchangeably. Other terms that can relate to some forms of the networks in this book are Sigma-Pi networks and Binary Networks. The reason for choosing RAM based networks as the title, is because all the networks have some form of a Random Access Memory structure (RAM) in their architecture, where a RAM is the universal storage system used in current computer systems and is the main implementation model for the networks. It also reflects the major strength of RAM based systems which is there simple implementation in dedicated and high speed hardware. The term weightless networks reflects the fact that RAM based networks can be expressed purely as a logic expression with no 'weights' in the conventional neural network sense. In this case learning is seen as determining the logic function required to map the inputs to the outputs of the network under the conditions laid down in the training set. The term N tuple networks comes from the origins of the methods given by Bledsoe and Browning and their approach to selecting inputs for the network.

RAM based networks have existed for some time. Originally termed N-Tuple methods developed by Bledsoe and Browning in 1959 and being studied for some years before loosing favour in the late 1960's. They were then picked up by Igor Aleksander in the UK in the early 1970's where there simple implementation in Random Access Memories was identified and explored. His work, lead to a number of new concepts which some of his students explored and developed. In the 1980's neural networks emerged from the dark ages of the subject and the general interest in all forms of neural networks took off, including research in RAM based systems. The area has mostly been studied in the UK with one or two notable exceptions, and is now an accepted and mature subject with a number of successful commercial applications.

In terms of theory N tuple methods have had a hard time, mainly due to the difficulty in dealing with the combinatorial explosion found in most mathematical approaches to the analysis of the methods. This, along with there unique construction has put off many researchers from studying them. However, this has not stopped others taking a more pragmatic approach to the area, showing how useful problems can be

solved and high performance systems can be implemented. In addition, the book contains many useful pointers to the formal analysis of RAM based networks.

The book is structured into three sections, each introduced by an overview of the papers in the section. Section 1 contains chapters which introduce and/or compare methods known as RAM based. Section 2 presents work that extends the basic RAM based understanding and methods. Finally Section 3 contains chapters that are mainly concerned with applications of RAM based methods. However, many of these also extend the basic techniques and show, for example, how the methods may be implemented.

I would like to thank a number of people who helped in the production of this book. In particular David Bisset and the original panel who reviewed the papers for the Weightless Neural network Conference where many of the chapters saw their first drafts. Thanks goes to Aaron Turner, who checked all the latex of the chapters, my secretary, Christine Linfoot for chasing all the Authors, and finally the members of the Advanced Computer Architecture Group for reading and helping with comments on the chapters.

Jim Austin,
York, May 1997

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