

Thesis Proposal

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Thesis proposal

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Preliminary outline

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I. Introduction

The field of artificial neural network research currently suffers from several misapprehensions on the part of researchers. First, communication continues to be sketchy and prone to misunderstanding, as no clearcut definitions have been attached to even the most commonly accepted terms and phrases that comprise ANN jargon. Researchers will ignore the interdisciplinary nature of ANN research to promote or denigrate ANN results in a specialized context. Often this is done in such a way that it is not clear that the comments or analysis are only valid in the specialized context. Second, the motivations for research vary wildly, and thus criticisms of models or data often are initiated on the basis of entirely different goal assumptions. Finally, much criticism and infighting occurs not because of any real research related causes, but because of politicking and the quest for personal power or recognition. While Kuhn [History of Scientific Revolutions] may revel in the unfolding byplay, it is a source of annoyance and an obstacle to good work for others

engaged in this research. While these misapprehensions may not be conscious in nature, that does not lessen the negative impact of the misapprehensions.

One misapprehension which remains particularly pervasive is the idea that there exists one 'correct' model for artificial neural networks. The biological reality reflects a complex set of systems which accomplish diverse functions. No one has suggested that all biological neural systems operate in the same manner. Other, more easily apprehensible, biological systems reflect that variation arises both in structures and mechanisms that perform functional tasks. Spiders, insects, fish, birds, and mammals have all developed methods of flight, yet none are quite the same. Other examples can demonstrate that the same mechanism may be coopted for more than one purpose. Certainly the expectation should be that biological neural systems follow this pattern, yet the prevailing attitude in current ANN research denies this.

Different models reflect variation in an approach to a single function, or simply approaches to different functions. Comparisons which should account for this feature often do not. Since various models will have features which make them preferable for classes of problems, solving problems which can be divided into subset problems may be best solved through integration and coordination of differing ANN models. This approach is expected to prove more tractable and productive than attempting to force a solution model to fit a specified problem complex (or changing the problem specification to fit the model).

II. Literature review

Problem solving as McCulloch and Pitts envisioned it [from Levine 83]

As Rosenblatt redefined it [from Levine 83 and Rosenblatt ??]

What Hopfield says about Grossberg [this will be short] [from H-T 86]

What Rumelhart and McClelland say about Hopfield [from PDP]

What Rumelhart and McClelland say about Grossberg [from PDP]

What Grossberg says about everybody else [stated as briefly as possible] [from Applied Optics article, 87 Cognitive Science article]

Evidences for multi-model integration:

PDP Ch. 26, p 541: "A problem with the PDP models presented in this book is that they are too specialized, so concerned with solving the problem of the moment that they do not ask how the whole might fit together. The various chapters present us with different versions of a single, homogeneous structure, perfectly well-suited for doing its task, but not sufficient, in my opinion, at doing the whole task. One structure can't do the job: There have to be several parts to the system that do different things, sometimes communicating with each other, sometimes not."

Of course, McClelland here means to have several variants of the PDP model performing the functions, and is not per se referring to a multi-model approach. But the admission that a single instantiation of a model does not a solution make is very important.

III. Topic proposal

a. Topic description Use the models of Hopfield, PDP, and Grossberg's ART in an integrated manner to solve a problem set that is a complex suite of problem classes. The purpose here is not to develop a general tool for such problems, but to demonstrate the desirability and applicability of using an integrative approach to ANN problem solving.

b. Topic verification (implementation)

i. Application proposal

Possible project 1: Cryptographic example. Small problem that involves transposition, pattern recognition, and feature detection and extraction. Models used as pre- and co-processors for problem-solving.

ii. Description The data set generated for presentation to the solution system may have complex interdependencies which the ANN would have to extract.

iii. Resources needed for accomplishment

Computer: Available currently: Heathkit H-100, MS-DOS, 768K Heathkit H-158, MS-DOS (PC comp), 640K

DEC PDP 11/23, RT-11, 256K

Languages: Available currently: Under MS-DOS: Turbo Pascal

XLISP

PD-Prolog Turbo C

ECO-C88

ICON

MS-FORTRAN

MASM

Under RT-11: MACRO-11 (assembler)

DIBOL