Explorations in Bibliometric Historiography: The (Re)Emergence of Neural Networks, 1980-1991

Katherine McCain

Kate.McCain@cis.drexel.edu
Drexel University, College of Information Science & Technology, 3141 Chestnut Street.
Philadelphia, PA, 19104 - USA

Introduction
Artificial Neural Networks (ANN) emerged from exile in the early 1980s as an interdisciplinary field drawing on findings from biology, psychology, and computer science (McCain & Whitney, 1994). An earlier generation of research had essentially foundered when Rosenblatt's Perceptron (an early neural network) was shown by Minsky & Papert to suffer from substantial limitations (Jain & Mao, 1996). Beginning around 1984, ANN became a visible presence with dedicated conferences, a professional society, and several journals focusing on ANN theory and applications (McCain & Whitney, 1994).

Contents
This poster examines the early history of the current ANN revival, as represented in the published literature 1980 – 1991, using several complementary bibliometric approaches. These include:

1. *Research Front Specialty (RFS) cluster string mapping* (Small & Greenlee, 1986; Small, 1977). Neural networks research is represented in the 1984-1991 ISI annual files as a set of connected clusters of heavily co-cited documents linked by a small number of persistently cited papers. The early years are characterized by two parallel streams of development–research on ANN and on simulated annealing (an algorithm for solving minimization problems based on the metaphor of how annealing of metals works). The transition from 1989 to 1990 is marked by an 8-fold expansion in the number of RFS clusters representing neural networks research.

2. *Document co-citation mapping*. One RFS cluster (89-174) is mapped at the document level to illustrate the major themes in ANN research just prior to the expansion. The cluster consists of 7 groups of documents representing research topics in ANN and related areas:
   a. ANN proper: Founding Papers, Perceptron/Backpropagation Models, Connectionist Models, Boltzman Machines/Network Architectures
   b. Spin Glass Models of Neural Networks
   c. Optical Implementation of the Hopfield Model
   d. Cellular Automata
   e. 2 isolates, one single author and one highly distant pair.

3. *Algorithmic historiography* (Garfield et al. 2003). Garfield's HistCite software is used to explore the ANN literature over the period 1980-1991. At a Local Citation Score setting of 100 (all network documents must receive 100 or more citations over the 12 year period), ANN research consists of a network of 18 documents, ranging in age from 1943 to 1988. Most papers in the network are also persistent papers in the RFS string. Several works, including Minsky's & Papert's book, are sufficiently highly cited to make the cut but are not cited by any other documents in the historiograph.

Graphics include overviews of the timeline of ANN research and maps and cluster networks (1-3 above). Discussion focuses on how complementary bibliometric methods can contribute to historical studies.

References
Garfield, E., Pudovkin, A.I. & Istomin, V.S. 2003. Why do we need algorithmic historiography? *JASIST* 54(5):400-412.

Jain, A.K. and Mao, J. 1996. Artificial Neural Networks: A Tutorial. *Computer* 29(3): 31-44.

McCain, K.W. and Whitney, P.J. 1994. Contrasting assessments of interdisciplinarity in emerging specialties. *Knowledge: Creation, Diffusion, Utilization* 15(3):285-306.

Small, H.G. 1977. Co-citation model of a scientific specialty: Longitudinal study of collagen research. *Social Studies of Science* 7(2):139-166.

Small, H & Greenlee E. 1986. Collagen Research in the 1970s. *Scientometrics* 10(1-2): 95-117.

.