ROWAN UNIVERSITY CURRICULUM PROPOSAL

0909.560

PROPOSAL TITLE:
ARTIFICIAL NEURAL NETWORKS (97-98 proposal)

CH K APPROPRIATE: ___ UNDERGRADUATE ✓ GRADUATE ___ SEMESTER HOURS

SPONSOR(S): DR. SHREEKANTH MANDAYAM, DR. JOHN L. SCHMALZEL, DEPT. OF ELECTRICAL ENGINEERING

DEPARTMENT/TELEPHONE # ELECTRICAL ENGINEERING / 4612

CHECK ONE: X COURSE __MINOR PROGRAM __CONCENTRATION __SPECIALIZATION
__ACHIEVEMENT CERTIFICATE __CERTIFICATION PROGRAM __MAJOR PROGRAM

Step #1 (Department)	Step #2 (Receipt)	Step #3 (School)
24OCT97 Approved (Date)	SCC# 97-98-212	Reviewed Date: 10/30/97
___ Not Approved (Date)		✓ Recommend to Approved
		___ Recommend NOT to Approve
[signature] Dept. Curriculum Chr.	11-7-97 Date Received Senate	Forward for Open Hearing: ✓ WITHOUT Reservations
24OCT97 Reviewed (Date)		___ WITH Reservations: Comments:
[signature] Dept. Chr.	Senate Curriculum Chr.	Robert P. Hesketh School Committee Chr.

Step #4 (Academic Dean): ✓ Recommended ___ NOT Recommended ___ Conditionally Recommended (See Comments)

Comments:

Dean Signature/Date [signature] 10/30/97

Step #5 (Senate Curriculum Committee): Open Hearing Date: 3/3/98 Approved by Curriculum Committee Date______

Returned to Sponsor(s) for the following reason:

clarify prerequisites, + computer science consult. (Received 3/15/99) (Rec'd 5/17/99)

Step # 6 (Senate) Date announced/voted on at Senate 3/29/99 If voted on: ___Approved ___NOT Approved

Dat warded to Executive Vice President/Provost 5/17/99

Senate Curriculum Committee chair Signature/Date: Ranetta Reeves 3/31/99 ep #7 (Executive Vice President/Provost): Date Received ___________

__ Approved

__ NOT Approved If no, reasons are as follows:

udent Credit Hours _________

aculty Load Hours ________

qualized Credit Hours _______

fficial Copy & Approval Sheet Filed (Date) ________

xecutive Vice President/Provost Signature [signature] 5/26/99

egistrar

ate Approved Course Description Received ________

egis Taxonomy and Course Number Assigned 0909.560

ate/Signature of Registrar Robert A. Kulot 6/16/99

otification Forward:

✓ Senate Curriculum Committee Chairperson

✓ Department Chairpersons

✓ Academic Dean(s)

✓ Registrar

______ Sponsor(s)

7/1/99

urr.new(course)

Course Proposal

1. Details:

a) Course Title:	Artificial Neural Networks (0909.560)
b) Sponsor:	Dr. Shreekanth Mandayam and Dr. John L. Schmalzel, Electrical Engineering
c) Credit Hours:	3 credit hours
d) Course Level:	Graduate / Senior Elective
e) Curricular Effect:	Graduate electrical engineering course / available to electrical engineering seniors as an elective
f) Prerequisites:	1701.242 Math Engineering Analysis II
g) Suggested Time/ Scale of Implementation	Spring 1998 One section
h) Resources	Faculty will be hired and laboratory equipment obtained consistent with Engineering School multi-year budget. Library acquisitions will be required.

2. Rationale:

The proposed course is a graduate level Engineering course, that is also available as a senior level elective to Electrical Engineering students.

Artificial neural networks have emerged as viable computational models for a variety of problems, including automatic pattern classification, signal and image interpretation, forecasting and prediction, combinatorial optimization, non-linear systems modeling and process control. The recent developments of an array of commercial artificial neural network-based software, along with dedicated neural network IC chips, portend that this technology is here to stay and may be at the frontiers of future developments in science and technology. Furthermore, a flurry of research activity in this area has contributed significantly to diminish the "black-box" heuristic aspect of traditional neural network paradigms of the 70s. Artificial neural networks can be viewed as special cases of digital filters, amenable to design and analysis using "respectable" classical filter design techniques. They are fast becoming the method of choice for analyzing and controlling systems which are associated with vast amounts of data.

In this course, students will gain familiarity with both established and emergent paradigms for artificial neural network architectures. Artificial neural network techniques will be employed for analysis and control in a variety of contemporary engineering applications (speech, face, fingerprint recognition, process control, machine vision, etc.). State-of-the-art software tools will be used for accomplishing these tasks.

3. Essence of the Course:

a) Objectives:

The proposed course has a number of objectives:

(i) Provide a comprehensive foundation in the various artificial neural network paradigms.

(ii) Provide a comprehensive foundation in various neural network achitectures – in particular, the multilayer perceptron, radial basis function and Hopfield neural networks.

(iii) Provide a working knowledge of the mathematical tools and software packages for designing artificial neural networks.

(iv) Provide a working knowledge of the state-of-the-art algorithms for training artificial neural networks.

(v) Continually demonstrate the applications of artiticial neural networks, for example, in signal and image processing (speech/face recognition, nondestructive evaluation, handwriting recognition), process control, robotics, machine vision, etc.

b) Topical Outline:

The general topical outline is described below; however, prior to each semester's offering, the instructor will assess any technology advances in the course subject matter or in teaching resources prior to the course and make changes deemed appropriate to maintain requisite content and currency.

Introduction to Neural Networks
Neuron models
Feedback
Network architectures
Represenattion of knowledge
Artificial intelligence

Learning Paradigms
Error-Correction
Hebbian learning
Boltzmann learning

Supervised and unsupervised learning
Statistics of learning

The Perceptron
Maximum-likelihood Gaussian classifier

LMS algorithms
Wiener-Hopf equations

Multilayer Perceptrons
Backpropagation and variations
Engineering applications

Radial basis function networks
Regularization theory
Fuzzy neural networks
Engineering applications

Hopfield networks
Stochastic neurons
Engineering applications

Self organizing systems
Hebbian learning
Competitive learning
Information theoretic models
Engineering applications

Modular networks
Temporal processing
Neurodynamics
Engineering applications

VLSI Implementations
Design considerations
Neurocomputing hardware

c) Evaluation and Grading Procedures:

Student grades will be based on projects, examinations, homework, and written and oral technical communication.

d) Course Evaluation:

The proposed course will be evaluated based on student evaluations and critical review by engineering faculty.

4. Results of Consultations:

a) Consulted Departments: None
b) Consultants and Consultant Statements: (N/A)
c) Written Consultations: (N/A)

5. Additional Supporting Information:

Example textbooks that could serve as primary or supplemental references for this course:

1. Simon Haykin, *Neural Networks: A Comprehensive Foundation*, Macmillan College Publishing /IEEE Press, 1994.
2. Robert Schalkoff, *Artificial Neural Networks*, Mc Graw-Hill, 1997.
3. Sied Mehdi Fakhraie, *VLSI-Compatible Implementations for Artificial Neural Networks*, Kluwer Academic Publisher, 1997.

Example software that could be used in conjunction with the course:

1. *Matlab Neural Network Toolbox*, The MathWorks Inc., Natick, MA.

Catalog Description

ARTIFICIAL NEURAL NETWORKS

Prerequisite: 1701.242 (Math Engineering Analysis II)

Artificial Neural Networks covers the design of a variety of popular neural network architectures and their contemporary engineering applications. Neural network architectures that will be studied in detail include the multilayer perceptron, radial basis function, and the Hopfield networks. State-of-the-art software will be used for network design. VLSI implementations of neural networks will be discussed.

Computer Science Department
Don C. Stone, Ph.D., Chair

To: John Schmalzel, Electrical and Computer Engineering
From: Don Stone, Computer Science DCS
Date: 3 May 1999
Re: Course proposal

Thank you for consulting with the Computer Science Department on your graduate course proposal entitled Artificial Neural Networks. It looks reasonable to us, and we support it.

We wish you the best of success in implementing this course!

201 Mullica Hill Road • Glassboro, New Jersey 08028-1701 • Phone 609-256-4806 • Email stone@rowan.edu