4/16

PROCESS A NON-GENERAL EDUCATION ~ **CURRICULUM PROPOSAL** SCC #03-04- ~~417~~

LIBRARY RESOURCE FORM REQUIRED

Deadlines
October 3, 2003 to be implemented Fall 2004 ~ February 13, 2004 to be implemented Spring 2005

PROPOSAL TITLE: _Advanced Topics in Pattern Recognition _____

Sponsor(s): Robi Polikar_____ E-Mail: polkar@rowan.edu_____ Ext: 5372 _____

_____ E-Mail: _____ Ext. _____

DEPARTMENT: _Electrical and Computer Engineering_____

COLLEGE: ___College of Engineering _____

If Liberal Arts & Sciences CHECK : **___ History/Humanities ___Math/Sciences ___Social/Behavioral Sciences**

_____ UNDERGRADUATE ___X___ GRADUATE

THE ATTACHED ***NON-GEN-ED*** PROPOSAL IS BEST DESCRIBED BY THE ITEM(s) CHECKED

__X___ New non-gen-ed course
_____ Short-term non-gen-ed course

_____ Minor curricular changes (fewer than three) to:
_____ Existing non-gen-ed course
_____ Non-gen-ed degree requirements
_____ Major
_____ Minor, specialization, concentration, track, certificate program

THE FOLLOWING SIGNATURES REPRESENT APPROVAL

Department Chair: _____ Date: 01 FEB 2005
Department Curriculum Chair: _____ Date: 2/1/05
Academic Dean: _____ Date: 2-1-05

COLLEGE CURRICULUM COMMITTEE

OPEN HEARING Date: _____ Approved _____ Not Approved _____
COLLEGE CURRICULUM CHAIR: _____
Senate Curriculum Chair Signature: _____ Date: Senate Announcement _____
Comments: _____
Revised as required

EXECUTIVE VICE PRESIDENT/PROVOST Signature: _____ Date: 2/4/05

✓ Approved _____ Not Approved

REGISTRAR

Date: 2/11/05 Course Description Received & Approved ~ Hegis Taxonomy & Course #: 0909555
Registrar Signature: _____

NOTIFICATION FORWARD

___ SCC Chair ___ Academic Dean ___ Department Chair ___ Registrar ___ IR ___ CAP
_____ VP Student Affairs _____Others

Course Proposal

1. Details:

Course Title:	Advanced Topics in Pattern Recognition (0909.555)
) Sponsor:	Dr. Robi Polikar, Electrical and Computer Engineering Curriculum Committee
c) Credit Hours:	3 credit hours
d) Course Level:	Graduate
e) Curricular Effect:	Elective course for engineering graduate students
f) Prerequisites:	Digital Signal Processing (0909.351) and Electrical Communications (0909.331), or permission of the instructor.
g) Suggested Time/ Scale of Implementation	Fall 2005 / One section
h) Resources	Existing faculty will teach this class. Laboratory equipment (computers) will be obtained consistent with College of Engineering multi-year budget. Most library acquisitions have already been acquired.

2. Rationale:

Pattern recognition deals with automated classification, identification, and / or characterizations of unknown systems. Virtually unlimited number of engineering applications benefits from pattern recognition, as a result of which it enjoys significant attention from the research community including active efforts from the engineering faculty. Pattern recognition employs very elegant and sophisticated mathematical and statistical analysis techniques, as well as optimization methods, not covered in any other course within the engineering curriculum. Furthermore, although pattern recognition is built on the foundations of an elegant theory, it is nevertheless a very application driven field. Identification of biological disorders from various bioelectric signals, hand written character recognition, finger print analysis, gas transmission and power plant pipeline inspection, face recognition, iris scan based recognition, financial data predictions, or automated determination of whether one should get a credit card based on his/her past credit history are just a few of such applications that call for pattern recognition techniques.

The course will therefore expose students to many theoretical concepts of pattern recognition, such as random variables, multivariate probability distributions, parametric and nonparametric distribution estimation, and optimization algorithms, as well as various pattern recognition algorithms – particularly as they apply to engineering – developed using such theoretical concepts. The course will also expose students to many applications of pattern recognitions, including, but are not limited to those mentioned above.

As a graduate level course, this course will cover additional material, but more importantly, it will have significantly different evaluation procedure then its undergraduate version. One of the main goals of this course is also to serve many graduate students actively working on cutting edge engineering pattern recognition topics as part of the engineering faculty's externally supported and actively on-going research efforts. Students enrolled in this graduate level course will be expected to conduct their own independent research as part of a class project and will be encouraged to publish their results in related conferences and journals. The faculty member proposing this course have taught this course as a special topics in the past, and several conference publications and presentations have already resulted from this approach. See course content and evaluation procedure for more details.

The expected audience for this elective course includes graduate students who are particularly interested in this area within electrical and computer engineering, and / or students who are actively involved in pattern recognition related research.

3. Essence of the Course:

a) Objectives:

The proposed course the following objectives:

- Provide a strong background in many fundamental mathematical, statistical, data analysis and optimization techniques that are not only cornerstones of pattern recognition, but of many other engineering topics as well

Faison, Christy

From: Polikar, Robi
Sent: Wednesday, February 02, 2005 5:30 PM
To: Faison, Christy
Cc: Dorland, Dianne; Harper, Jay A.
Subject: Pattern recognition course proposals
Follow Up Flag: Follow up
Flag Status: Red

Dear Dr. Faison:

Per your memo dated Jan 3, 2005 regarding the pattern recognition proposals SCC#03-04-415, 416 and 417, I have made the following changes:

- Proposal for Introduction to Pattern Recognition (415) is being withdrawn
- Theory and Applications of Pattern Recognition (416) is being cross-listed with Computer Science (and with its original prerequisites)
- Advanced Topics in Pattern Recognition course (graduate, ECE only) also has its original prerequisites instituted.

I have made the changes, obtained all the necessary signatures (including those of CS and LAS for the cross listed course), and would like to bring them to you for your approval so that we can offer these courses in Fall 2005. Is there any time I may be able to visit you on Thursday or Friday (it should not take anymore then 5 minutes)?

In case you would like to go over them for a second time, they are attached to this e-mail as well.

Thank you very much for your diligent efforts in resolving this matter.

Warm regards,

Robi.

==========

Robi Polikar, Ph.D.
Assistant Professor of Electrical and Computer Engineering
136 Rowan Hall
Rowan University
201 Mullica Hill Road,
Glassboro, NJ 08028-1701
Phone: (856) 256-5372
Fax: (856) 256-5241
E-Mail: polikar@rowan.edu
On the Web: http://engineering.rowan.edu/~polikar

==========

PROCESS A NON-GENERAL EDUCATION ~ **CURRICULUM PROPOSAL** SCC #03-04- 116

LIBRARY RESOURCE FORM REQUIRED

Deadlines

October 3, 2003 to be implemented Fall 2004 ~ February 13, 2004 to be implemented Spring 2005

PROPOSAL TITLE: Advanced Topics in Pattern Recognition

Sponsor(s): Robi Polikar E-Mail: polkar@rowan.edu Ext: 5372

E-Mail: Ext.

DEPARTMENT: Electrical and Computer Engineering

COLLEGE: College of Engineering

If Liberal Arts & Sciences CHECK : ___ **History/Humanities** ___**Math/Sciences** ___**Social/Behavioral Sciences**

_____ **UNDERGRADUATE** ___X___ **GRADUATE**

THE ATTACHED ***NON-GEN-ED*** PROPOSAL IS BEST DESCRIBED BY THE ITEM(s) CHECKED

__X___ New non-gen-ed course

_____ Short-term non-gen-ed course

_____ Minor curricular changes (fewer than three) to:

_____ Existing non-gen-ed course

_____ Non-gen-ed degree requirements

_____ Major

_____ Minor, specialization, concentration, track, certificate program

THE FOLLOWING SIGNATURES REPRESENT APPROVAL

Department Chair: _____ Date: 10/3/2004

Department Curriculum Chair: _____ Date: 02/10/2004

Academic Dean: _____ Date: 2/10/04

COLLEGE CURRICULUM COMMITTEE

OPEN HEARING Date: 3/4/04 Approved X Not Approved _____

COLLEGE CURRICULUM CHAIR: _____

Senate Curriculum Chair Signature: _____ Date: Senate Announcement 4-30-2004

Comments: _____

See Attached Letter

EXECUTIVE VICE PRESIDENT/PROVOST Signature: _____ Date: _____

_____ Approved _____ Not Approved

REGISTRAR

Date: _____ Course Description Received & Approved ~ Hegis Taxonomy & Course #: _____

Registrar Signature: _____

NOTIFICATION FORWARD

___ SCC Chair ___ Academic Dean ___ Department Chair ___ Registrar ___ IR ___ CAP

_____ VP Student Affairs _____Others

ROWAN UNIVERSITY

Rowan University Senate

November 19, 2004

TO; Christy Faison, Interim Provost

FROM: Phillip A. Lewis

RE: Curriculum Proposals

Attached is the following proposal for your review and approval:

SCC# 03-04-415 Introduction to Pattern Recognition
SCC# 03-04-416 Advanced Studies in Pattern Recognition
SCC# 03-04-417 Theories and Applications of Pattern Recognition

After extended discussions between the Electrical and Computer Science Department and the Computer Science Department, these proposals proceeded through the curriculum process during the 2003-2004 academic year.

After one request, I have not received a confirmation that these proposals fully address the concerns originally expressed by the Computer Science Department. However, the proposals have been approved by the appropriate committee and are ready for your review.

If you have any questions, please do not hesitate to contact the sponsors, the Computer Science Department, or me.

Cc: Eric Milou
Bruce Caswell
Jennifer Kay
Robi Polikar
attch

201 Mullica Hill Road • Glassboro, New Jersey • 08028-1701 • Phone (856) 256-4515 • Fax (856) 256-4924

7. Catalog Description:

0909.555 Advanced Topics in Pattern Recognition (3 sh)

This class will introduce a broad spectrum of pattern recognition algorithms along with various statistical data analysis and optimization procedures that are commonly used in such algorithms. Although mathematically intensive, pattern recognition is nevertheless a very application driven field. This class will therefore cover both theoretical and practical aspects of pattern recognition. The topics discussed will include Bayes decision theory for optimum classifiers, parametric and nonparametric density estimation techniques, discriminant analysis, basic optimization techniques, introduction to basic neural network structures, and unsupervised clustering techniques. As a graduate level course, several advanced and contemporary topics will also be covered, including fuzzy inference systems, support vector machines, adaptive resonance theory, incremental learning and online learning and particle swarm optimization. Students will be expected to conduct independent research for possible publications, as part of the class project.

Prerequisites: (Digital Signal Processing 0909.351 and Electrical Communications Systems 0909.331, or permission of the instructor)

- Introduce participants to a variety of pattern recognition algorithms, along with pointers on which algorithms work best under what conditions;
- Expose participants to broad spectrum of – primarily engineering – applications of pattern recognition;
- Provide the opportunity to apply pattern recognition algorithms to new applications that are of particular interest to participants;
- Expose participants to more advanced contemporary issues in pattern recognition.
- Help students develop a research culture by allowing them to work on meaningful projects as part of a class project and publish their results in related conferences and journals.

b) Topical Outline:

- Mathematical foundations, review of Bayes theory and parametric density estimation
- Non parametric density estimation, Parzen windows, probabilistic neural networks, nearest neighbor density estimation
- Feature extraction and dimensionality reduction: principal component analysis, Fisher linear discriminant, transform based feature extraction
- Optimization in pattern recognition: The perceptron rule, gradient descent optimization rule, least mean square / Widrow – Hoff optimization
- Nonlinear classifiers: multilayer and feed-forward neural networks: The multilayer perceptron, backpropagation learning rule, radial basis networks.
- Algorithm Independent techniques for engineering applications: Occam's razor, no-free lunch theorem, bias- variance dilemma, resampling techniques such as bagging, boosting.
- Ensemble of classifiers based approaches: Adaboost, Learn++.
- Non-supervised Learning: Clustering algorithms, self organizing maps, Kohonen networks
- Stochastic methods: simulated annealing, Boltzman machine, heuristic approaches
- Other advanced and contemporary topics:
    - Conjugate gradient optimization
    - Support vector machines,
    - Fuzzy logic and fuzzy inference systems,
    - Online learning and incremental learning,
    - Adaptive resonance theory, ARTMAP networks,
    - Independent component analysis,
    - Particle swarm optimization.

c) Evaluation and Grading Procedures:

Apart from examinations, homework, laboratory reports and other written and oral technical communications, graduate students will be expected to do independent research and write a conference (or possibly journal) paper on the outcomes of their class project. The research may consist of one or more of the following:

i. A new application, that is of engineering interest, of the pattern recognition techniques discussed in class;
ii. Developing a novel pattern recognition technique, possibly by suitably modifying an existing procedure to overcome its existing limitations
iii. An extensive review of the literature for the most recent developments in the pattern recognition field and produce a review / tutorial article.

d) Course Evaluation:

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

Texts:

Richard O. Duda, Peter E. Hart, and David G. Stork, *Pattern Classification, 2nd Edition,* John Wiley and Sons, New York, 2001.

A. Webb, *Statistical Pattern Recognition*, Wiley, New York, 2002.

4. Curricular Effects:

This class will be offered as an elective to primarily graduate level ECE students, and will also be open to qualified students that may come from other departments, institutions or the industry. The class will be taught every other year. The class will be offered by an existing ECE faculty whose research area includes pattern recognition. Since this class will be offered as an elective, it will not replace ' other course, nor any other specific course will consequently be offered less often. This course has already been offered twice, to a ı capacity student audience, including from the industry, and hence demonstrated its relevance as well as its future enrollment ›spect. No major additional resources are required for offering this course. Most library needs, current at the time of initial ubmission of this proposal, have already been acquired by the library. A letter to this effect was also provided by the original submission of this proposal.

5. Results of Consultations:

Consulted Departments: Mathematics Dept. and Computer Science Dept.
The Computer Science department was previously consulted and their support letter was provided with the original submission of this proposal.

6. Additional Information: N/A