

PROCESS A NON-GENERAL EDUCATION ~ CURRICULUM PROPOSAL
LIBRARY RESOURCE FORM REQUIRED

917
SCC #03-04-~~416~~

Deadlines

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

PROPOSAL TITLE: _Theory and Applications of Pattern Recognition_

Sponsor(s): Robi Polkar _____ E-Mail: polkar@rowan.edu _____ Ext: 5372 -
Stephen Hartley _____ E-Mail: hartley@rowan.edu _____ Ext: 3895_

DEPARTMENT: _Electrical and Computer Engineering_ & Computer Science

COLLEGE: _College of Engineering & Liberal Arts & Sciences_

If Liberal Arts & Sciences CHECK : ___ History/Humanities _(x)_ Math/Sciences ___ Social/Behavioral Sciences
__X__ UNDERGRADUATE ___ GRADUATE

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

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

THE FOLLOWING SIGNATURES REPRESENT APPROVAL

Department Chair: [Signature] Date: 2/11/05 / 01 Feb 2005
Department Curriculum Chair: [Signature] Date: 2/1/05 / 2/1/05
Academic Dean: [Signature] Date: 2-1-05
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 requested

EXECUTIVE VICE PRESIDENT/PROVOST Signature: [Signature] Date: 2/4/05

Cross-Checked Approved Not Approved

Date: 2/14/05 Course Description Received & Approved ~ Hegis Taxonomy & Course #: 0909455
0707470
Registrar Signature: [Signature]

NOTIFICATION FORWARD

SCC Chair Academic Dean Department Chair Registrar IR CAP
 VP Student Affairs Others

Per Request
the departments
must indicate the
~~the~~ courses are
cross listed & max #
of students the first
time it is offered.
(Course note m) 3/11/05 Bonnie

Cross listed
0909.455 Engineering
0707.470 - Computer
Science

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.

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Robi Polikar, Ph.D.
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E-Mail: polikar@rowan.edu
On the Web: <http://engineering.rowan.edu/~polikar>

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Steve
cross list

0909.455 Eng.
+

0707.470 Comp Sci



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
attach

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: Theory and Applications of Pattern Recognition

Sponsor(s): Robi Polkar 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 GRADUATE

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

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: [Signature] Date: 10/23/2004

Department Curriculum Chair: [Signature] Date: 02/10/2004

Academic Dean: [Signature] Date: 2/10/04

COLLEGE CURRICULUM COMMITTEE

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

COLLEGE CURRICULUM CHAIR: [Signature]

Senate Curriculum Chair Signature: [Signature] Date: Senate Announcement 6/30/2004

Comments: All 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

Course Proposal

cross listed

1. Details:

- a) Course Title: Theory and Applications of Pattern Recognition (0909.455) cross listed as Theory and Applications of Pattern Recognition (0707.470)
- b) Sponsor: Dr. Robi Polikar, Electrical and Computer Engineering Curriculum Committee and Dr. Stephen Hartley, Computer Science Curriculum Committee.
- c) Credit Hours: 3 credit hours
- d) Course Level: Senior
- e) Curricular Effect: Elective course for senior engineering students, also open to qualifying computer science 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 (or other colleges') 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, voice and speaker identification or even 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, 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.

Pattern recognition, by the very nature of its theory and applications, is a very multidisciplinary topic, covering broad spectrum of topics in electrical and computer engineering (ECE) and computer science (CS). Therefore, it is being offered as a cross listed course between ECE and CS. The particular topics of the course, are however geared more towards engineering (such optimization, signal processing based feature extraction and dimensionality reduction, etc.) as it is designed to meet the acute needs of students as well as the that of active scholarly efforts in the electrical and computer engineering program.

3. Essence of the Course:

a) Objectives:

The proposed course has 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
- 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 real world 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 contemporary issues in pattern recognition.

b) Topical Outline:

- Mathematical foundations, review of pertinent topics of probability and random variables;
- Bayes decision 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 (Fourier, wavelet, etc.) based feature extraction
- Optimization in pattern recognition: The perceptron rule, gradient descent optimization rule, least mean square / Widrow – Hoff optimization.
- Linear discriminant functions and perceptron based classification
- 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++.
- Self organizing maps, Kohonen networks
- Issues related to hardware implementation of the algorithms

c) Evaluation and Grading Procedures:

Student grades will be based on quizzes, examinations, homework, laboratory reports and various forms of technical communication. A final project will be assigned that will allow students to apply their new knowledge to a variety of engineering applications; and compare, contrast and assess the performance of different algorithms on a given application.

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 senior level ECE students, and will also be open to qualified students that may come from other departments (primarily such as Computer Science). The class will be taught every other year. While the class is cross-listed, it will be offered by an ECE faculty, at least for the foreseeable future due to current faculty and student interest and capabilities. Since this class will be offered as an elective, it will not replace any other course, nor any other specific course will consequently be offered less often. This course has already been offered twice, to a full capacity student audience, and hence demonstrated its relevance as well as its future enrollment prospect. No major additional resources are required for offering this course. Most library needs, current at the time of initial submission 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: Computer Science Dept.

The Computer Science department was previously consulted, and their consult was provided to the provost’s office.

6. Additional Information: This proposal replaces the earlier proposal of the same name which was sponsored by ECE, as well as the proposal “Introduction to Pattern Recognition” jointly sponsored by ECE and CS. Per request and suggestion of the provost, the cross-listed “Introduction to Pattern Recognition” course proposal is being withdrawn, and replaced with this cross-listed course whose original prerequisites are reinstated.

7. Catalog Description (for ECE):

0909.455 Theory and Applications of Pattern Recognition (3 sh) – Cross listed as 0707.470

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, with particular emphasis to engineering applications. 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 a review of mathematical and statistical techniques commonly used in pattern recognition, Bayes decision theory for optimum classifiers, density estimation techniques, discriminant analysis, basic optimization techniques, introduction to basic neural network structures, unsupervised clustering techniques and more state of the art algorithm independent techniques.

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

7. Catalog Description (for CS):

0707.470 Theory and Applications of Pattern Recognition (3 sh) – Cross listed as 0909.455

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, with particular emphasis to engineering applications. 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 a review of mathematical and statistical techniques commonly used in pattern recognition, Bayes decision theory for optimum classifiers, density estimation techniques, discriminant analysis, basic optimization techniques, introduction to basic neural network structures, unsupervised clustering techniques and more state of the art algorithm independent techniques.

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

Shoemaker, Bonita

From: Shoemaker, Bonita
Sent: Monday, March 14, 2005 4:00 PM
To: Polikar, Robi; Hartley, Stephen J.
Cc: Mosto, Patricia; Kessel, Steven J.; 'Muriel Frierson'; Schmalzel, John L.; Kay, Jennifer S.; Shoemaker, Bonita
Subject: Approved curriculum 03-04-417

Hi Folks,

Your curriculum proposal for a course **Theory and Applications of Pattern Recognition 0909.455 cross listed with 0707.470 has been approved.** The registrar has asked that the first time you schedule this class that you make a note on the schedule to the registrar that the two courses are cross listed (both departments need to do this). They will also need you to indicate the maximum number of students who will be allowed to register for the class and if there are a limited number of students allowed to register from either department. They will need you to do this only the first time the cross listed classes are scheduled.

You may contact this office if you have any questions.

Thank you,

Bonnie Shoemaker