ECE 8463: Fundamentals of Speech Recognition
AOCE Approval

1. CATALOG DESCRIPTION

(Prerequisite: ECE 4413/6413 or consent of instructor). Three hours lecture. Acoustic Phonetics; Linear Prediction; Feature Extraction; Dynamic Programming and Time-Warping; Hidden Markov Models; Statistical Language Modeling; Decision Trees; Introduction to Natural Language Processing; Implementation Issues.

2. JUSTIFICATION

The Department of Electrical and Computer Engineering requests approval to offer ECE 8463 Fundamentals of Speech Recognition through AOCE. This course is offered through Campus 1 and Campus 5. This course is an important component of a research thrust within the department and typically has drawn students from Computer Science and Engineering as well as Electrical and Computer Engineering.

3. LEARNING OUTCOMES

- Understanding of the basics of a speech signal
- Understanding of the statistical approach to speech recognition
- Understanding of the three basic components of modern speech recognition systems: feature extraction, acoustic modeling and language modeling
- Understanding of the integration of speech and natural language processing

4. DETAILED CAMPUS 1 COURSE OUTLINE

I. Fundamentals of Speech (7 contact hours)
- Introduction
- Speech Physiology
- Speech Production Models
- Hearing Physiology
- Perception and Masking
- Phonetics and Phonology
- Syntax and Semantics

II. Signal Processing (10 contact hours)
- Sampling / Resampling
- Acoustic Transducers
- Temporal Analysis
- Frequency Domain Analysis / Cepstral Analysis
- Linear Prediction
- LP-Based Representations
- Spectral Normalization
- Differentiation
- Principal Components
- Linear Discriminant Analysis

III. Acoustic Modeling (8 contact hours)

Dynamic Programming
Fundamentals of Markov Models
Parameter Estimation
HMM Training
Continuous Mixture Densities
Practical Issues
Decision Trees
Limitations of HMMs

IV. Language Modeling (4 contact hours)
Formal Language Theory
Context Free Grammars
N-gram Models and Complexity
Smoothing

V. Search Algorithms (5 contact hours)
Basic Search Algorithms
Time Synchronous Search
Stack Decoding
Lexical Trees
Efficient Trees

VI. Advanced Topics (6 contact hours)
Adaptation
Discriminative Training
Neural Networks
Evaluation Metrics
Common Evaluation Tasks
State of the Art

VII. Exams (2 contact hours)

5. DETAILED CAMPUS 5 COURSE OUTLINE

The course will typically be taught for Campus 5 live via interactive video technologies simultaneously with the live Campus 1 course. Video recordings are available from the university web site. Exams are submitted and graded electronically and scheduled to accommodate distance-learning student schedules.

I. Fundamentals of Speech (7 contact hours)
Introduction
Speech Physiology
Speech Production Models
Hearing Physiology
Perception and Masking
Phonetics and Phonology
Syntax and Semantics

II. Signal Processing (10 contact hours)
Sampling / Resampling
Acoustic Transducers
Temporal Analysis

Frequency Domain Analysis / Cepstral Analysis
Linear Prediction
LP-Based Representations
Spectral Normalization
Differentiation
Principal Components
Linear Discriminant Analysis

III. Acoustic Modeling (8 contact hours)
Dynamic Programming
Fundamentals of Markov Models
Parameter Estimation
HMM Training
Continuous Mixture Densities
Practical Issues
Decision Trees
Limitations of HMMs

IV. Language Modeling (4 contact hours)
Formal Language Theory
Context Free Grammars
N-gram Models and Complexity
Smoothing

V. Search Algorithms (5 contact hours)
Basic Search Algorithms
Time Synchronous Search
Stack Decoding
Lexical Trees
Efficient Trees

VI. Advanced Topics (6 contact hours)
Adaptation
Discriminative Training
Neural Networks
Evaluation Metrics
Common Evaluation Tasks
State of the Art

6. METHOD OF EVALUATION

The Campus 1 and Campus 5 offerings will use the same method of evaluation:

Mid-term:	50%
Final:	50%
Special Projects:	10% extra credit per project

Grades are determined on the following scale:

A: 90-100%
B: 80-89%

C: 70-79%
D: 60-69%
F: below 60%

7. METHOD OF INSTRUCTION

Lecture

8. METHOD OF DELIVERY

I (interactive video) and O (on-line, web, Internet, web-based)

9. DELIVERY STATEMENT

This ACOE course will not violate the Provost's policy on Campus 5 offerings.

10. SUPPORT

This ACOE course will be taught by existing personnel in the Department of Electrical and Computer Engineering as has been the corresponding Campus 1 course since 1996. Current library holdings and electronic access to materials are adequate to meet the needs of this course for both Campus 1 and Campus 5 students.

11. CROSS-LIST

NONE

12. EFFECTIVE DATE

FALL 2009

13. EFFECT ON OTHER COURSES

NONE

14. CONTACT

Joseph Picone, 662-312-4209, joseph.picone@gmail.com