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**

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