University of Tehran
School of Electrical and Computer Engineering

<table>
<tr><td>Course:</td><td>8101882 – Speech Processing.</td></tr>
<tr><td>Course type:</td><td>
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<tr><td></td><td colspan="6">EE*</td><td colspan="4">CE*</td><td rowspan="2">Credit:

3</td></tr>
<tr><td></td><td>Com</td><td>E</td><td>P</td><td>B</td><td>Con</td><td>D</td><td>SW</td><td>HW</td><td>IT</td><td>MI</td></tr>
<tr><td>Required</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
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<tr><td>Level:</td><td>Undergraduate ☐
Graduate ☒</td></tr>
<tr><td>Co-requisite(s):</td><td>None.</td></tr>
<tr><td>Prerequisite(s):</td><td>Signal and Systems (8101538), Fundamentals of probabilities (8101005).</td></tr>
<tr><td>Prerequisite by topic:</td><td>None.</td></tr>
<tr><td>Textbook(s):</td><td>[1] Spoken Language Processing - Huang, Acero, Hon.
[2] Discrete-Time Processing of Speech signals - Deller, Hansen, Proakis.
[3] Speech and Language Processing: An introduction to natural language processing - Jurafsky, James.</td></tr>
<tr><td>Coordinator:</td><td>Dr. Hosseini, Assistant professor, School of ECE.</td></tr>
<tr><td>Goals:</td><td>1. To understand the human speech system and modeling;
2. To understand the linguistic structures;
3. To introduce the signal processing tools and their applications in speech processing;
4. To introduce the dynamic programming and its applications in speech recognition;
5. To introduce the hidden markov model and its applications in speech recognition;
6. To improve speech recognition systems by means of noise cancellation, and modeling of grammatical and linguistic structures.</td></tr>
<tr><td>Outcome:</td><td>Upon successful completion of the course, students will be able:
1. To understand the required basics and fundamentals of speech processing, text to speech conversion and speech analysis;
2. To generate signals similar to human voice;
3. To recognition speech, including both vocabularies and sentences.</td></tr>
<tr><td>Topics:</td><td>1. SOUND AND HUMAN SPEECH SYSTEMS
• Sound
• Articulators
• Speech Perception</td></tr>
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	• Frequency Analysis • Source of voices 2. PHONETICS AND PHONOLOGY • Introduction • Category • Phonetic Typology • Syllables and Words 3. SIGNAL PROCESSING • Fourier and Z-Transform • Fast Fourier Transform and Circular Convolution • Digital Filters and Windows • Sampling Theorem • Stochastic Processes 4. SPEECH SIGNAL REPRESENTATIONS • Short-Time Fourier Transform • Source-Filter Model of Speech Production • Linear Predictive Coding • Spectral Analysis Via LPC & The Prediction Error • Cepstral Processing • Mel-Frequency Cepstrum & Perceptual Linear Prediction 5. DYNAMIC TIME WARPING (DTW) APPLIED TO SPEECH RECOGNITION • Dynamic Programming • DTW Problem and Its Solution • DTW Search Constraints • Application and Drawbacks 6. THE HIDDEN MARKOV MODEL (HMM) • Introduction To Estimation Theory • EM Algorithm • The Discrete Observation HMM • The Continuous Observation HMM • Training a HMM 7. ADVANCED TOPICS • Combining multiple HMM models • Language Modeling with N- grams • Grammatical (Structural) Feature Extraction • Context-Dependent Acoustic Models • Environmental Variation and Noise • Introduction To Neural Network Based Speech Recognition
Computer usage:	Implementing the homeworks and projects using Matlab Software.
Assignments:	5 to 6 homeworks, covering different topics.
Projects:	Implementing a paper, developing an existing code, or proposing a new method.
Grading:	Assignments: 25% Projects: 15% Midterm exams: 25%

	Final exam: 35%
Further readings:	None.
Prepared by:	Dr. Reshad Hosseini.
Date:	November, 5, 2017.

*EE: Electrical Engineering		CE: Computer Engineering	
Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics	MI	Machine Intelligence and Robotics
Con	Control		
D	Digital System		