M.Eng Program Overview and Information Session

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Professor of Practice
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Agenda

- Discuss the ECE Program at Cornell University
- Highlight some recent enhancements
- Review the objectives of the M.Eng program
- Explain the M.Eng degree components
- Describe the project requirement
- Answer your questions
The M.Eng is a premiere degree designed to prepare students to begin a career in industry.

The M.Eng is a competitive program with high admission standards.

When you start your first job, the M.Eng degree is intended to help you hit the ground running “with track shoes on.”

You should expect to work hard.
ECE @ Cornell University

- Cornell is an innovator in ECE education and research
- Project-based program
- Network with future industry leaders
- Flexible format
- Ivy League institution with top 10 ranking in ECE
Basic Goals of the M.Eng Degree

- Gain Advanced Technical Knowledge
- Master Professional Advancement Skills
- Gain Project Design Experience:
  - Take a design from start to finish
  - Make mistakes, solve unexpected problems
  - Deal with real deadlines, real colleagues
Seven New ECE Faculty Members

Jayadev Acharya: information theory, algorithmic statistics, machine learning, and understanding the trade-offs between resources for problems in statistical learning.

Christina Delimitrou: computer architecture, computer systems and efficiency of large datacenters

Vikram Krishnamurthy: statistical signal processing, stochastic control & optimization with applications in social networks, radar systems and dynamics of protein molecules in biological ion channels.
Seven New ECE Faculty Members

**Francesco Monticone**: applied electromagnetics, metamaterials, plasmonics, and nanophotonics, with applications ranging from microwaves to optical frequencies.

**Kirstin H. Petersen**: design and coordination of bio-inspired robot collectives and studies of their natural counterparts; especially in relation to construction.

**Mert Sabuncu**: Biomedical image analysis, with application focus in neurology/neuroscience, applied machine learning in bio-medicine, probabilistic modeling of genetic data, Image processing, computer vision
Seven New ECE Faculty Members

**Mahsa Shoaran**: Low-power circuit design for biomedical applications, brain-computer interfaces, biomedical signal processing, on-chip classification and machine learning, neuromodulation therapies for neurological disorders
Technical Knowledge Advancement

- The Ithaca campus offers over 40 ECE courses at the 4000 and 5000+ levels
  - Your chance to take leading-edge courses in subjects like Information Theory, GPS, computer architecture, machine learning...
  - You can also take senior-level courses in areas you might have missed during your B.S. degree.

- Outside ECE, you can choose from a broad set of electives in subjects such as advanced mathematics, computer software, business, advanced materials, ...

- Your project lets you drill down and become expert in a specific area
New Courses

Eleven (11) new courses in key areas of student interest including computing, embedded systems and robotics have been added over the last two years:

- Computational & Software Engineering – Edwin Kan
- Principles of Embedded Operating Systems – Joe Skovira
- Data Center Computing – Christina Delimitrou
- Bio-inspired Coordination of Multi-Agent Systems – Kirstin Petersen
- Theoretic Toolbox for Massive Data – Jayadev Acharya
- Advanced Computer Networking – Kevin Tang
- Computer Systems Programming – José Martínez
- Machine Learning and Pattern Recognition – Jayadev Acharya
- Introduction to Parallel Computing – Adam Bojanczyk
- Data Science for Engineers – Aaron Wagner
- Foundation of Robotics – Ross Knepper
New Courses, continued

Other new courses include:

- Principles in Neuroscience and Medical Imaging – Peter Doerschuk
- Filtering to Controlled Sensing (CTECH) – Vikram Krishnamurthy
- Watermark Identification in Rembrandt’s Etchings – C. Richard Johnson
- Power Systems Economics and Markets – Lang Tong
- Modern Power Dynamics, Stability and Control – Hsiao-Dong Chiang

Additionally, we have changed the requirements to allow one (1) ECE undergraduate course to be used as a Technical Elective.
Professional Advancement Skills

- Through coursework and presentation opportunities you will:
  - Enhance your oral and written communication skills with particular emphasis on project planning and presentations
  - Be coached in the interviewing cycle to increase your attractiveness to recruiters
  - Meet and interact with entrepreneurs
  - Compete for significant project awards
- Develop a network among your fellow M.Eng students
- Plan, design, execute and present a project by the end of the year
Project Design Experience

- Spend part of the first semester talking to faculty and graduate students, identifying an interesting design project.
- In ECE 5010, you will learn how to:
  - Articulate the project and develop a project proposal
  - Write a project plan outlining resources, schedule and objectives
  - Work interactively with your project supervisor to develop a sound written plan and project proposal.
- In the remaining time you drill down and complete the project, becoming a master in that subject.

Past projects can be viewed at: https://www.ece.cornell.edu/academics/graduate/meng/project-list.cfm
Examples of M.Eng Projects

- 3 to 8 credit hours: max of 4 in each semester.
  - typically 120 hours to 400 hours total.
- Project can be individual or group.
- Project can be faculty-specified or student-specified.
- Project must be device, software or simulation—*not just a paper design*.
- You own the IP of your project (with a few limitations).
- Collaborative projects available.
  - JGSB, CS, MAE, BME and other fields
Capacitive Touch Piano with Automatic Notation System

Wendian Jiang
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Introduction
The goal of this project is to build a capacitive touch piano with an automatic musical notation system based on PIC32 microcontroller. For the piano part, it has 37 keys which can respond to human’s touching. The function of the notation system is recording the notes generated by the piano keyboard and displaying them on a staff shows on LCD screen under the rules of musical notation.

Capacitive Sensor
The main part in the piano is capacitive sensor. The principle of it is simple and straight-forward. Human ourselves have capacitance. So when we touch these metal pads with finger, the capacitance will increase due to human’s capacitance. Therefore, we can take full use of this characteristic to trigger a sound when people touch it.

Automatic Notation
As the notation process start, a arrow which indicates the current place moves rightward at the configured speed. When input signals come, corresponding notes will be drawn at the recent location of the line. After each bar complete, the notes in a bar will be rearranged to what they should be. This process will follow the rule of music notation.

The staff with recorded notes is shown on a TFT screen, which connected with PIC32 microcontroller through SPI. Also, PIC32 is hooked up with the touch piano. The input signal generated by the keyboard will be periodically sampled by PIC32. Then the sound generation and note displaying will be executed.

Result
Before the system start, the screen shows like this. We have totally 8 bars to display what people play. The system will pause on this menu and waits for the input.

The system starts at the same time with the first note. As person continue playing the piano. More notes shows on the screen. After each bar’s done, all notes contains in this bar will be rearranged according to related notation rules automatically.

Acknowledge
Special thanks to Bruce Land, advisor of this Masters of Engineering Design Project, for helping me in completing this project. His support has been outstanding throughout the project implementation.
Figure 4: Accelerometer data (top) and weather (bottom) from intake of 1998 Pontiac Firebird during race. Note: Data collected by prototype weather station.
This project entails the development of a microcontroller board and PC graphical user interface that together comprise a prototype of a portion control and diet aid scale designed by a group of Cornell students. The microcontroller board will process electrical signals from a strain gauge, convert the signals to weight data, and send the data wirelessly to a Bluetooth enabled device. A graphical user interface running on a remote PC will allow the user to interpret this weight data in terms of the nutritional value of the food item weighed.
Separation of Singing Voice and Music

Tengli Fu (tf236@cornell.edu) Advisor: Dr. Bruce R. Land
School of Electrical and Computer Engineering, Cornell University

Overview
Separation of singing voice and music is an interesting research area since singing voice contains abundant information, such as melody, singer’s characteristic, lyrics, emotion, etc. All of these resources in singing voice are useful for music information retrieval, singer identification, melody extraction, audio content analysis, or even karaoke gaming.

Motivation
There are many ways to do separation:
- Non-negative matrix factorization;
- Robust principal component analysis;
- Predominant pitch detection.
However, repeating pattern is a significant difference between background music and foreground voice.

Implementation
Identify the repeating period of mixture and use it to construct repeating spectrogram, with which we could do separation through time-frequency mask.

Result

Conclusion
1. This algorithm could find the repeating pattern of background music and separate singing voice.
2. From the separated vocal signal, we could clearly hear that music is filtered.
3. This algorithm still assigns some music in separated vocal.
4. Only parts that have highly repeating pattern of music get separated.
5. This algorithm is fast and automateable.
What are Course Requirements?

- A minimum of **12 credits** must be taken each semester to be considered a full-time student at Cornell.

- Complete a total of **four (4) ECE Core Courses**, with two (2) of them at the ECE 5000 level, in technical areas related to your interests.

- Plan courses to gain in-depth knowledge in one or more areas of specialization.

- Two (2) ECE courses must be taken **each** semester.
## Typical Course Schedule

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<td><strong>ECE 5010</strong></td>
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<td><strong>DESIGN</strong></td>
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<td>2-4</td>
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<tr>
<td><strong>ELECTIVE</strong></td>
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<td>3-4</td>
<td>6-8</td>
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<tr>
<td><strong>TOTAL</strong></td>
<td>12-17</td>
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* Shown as credits
Where will the M.Eng take YOU?

- The ECE M.Eng degree is the best degree of someone who wants to go to industry. Here are a few Cornell ECE M.Eng graduates:
  - Justin Rattner, Former CTO, Intel
  - Jim Weisenstein, VC, Sunnyvale, CA
  - Dave Thompson, VP of Exchange, Microsoft
  - Mike Matthews: Founder, Electro Harmonix

- Thinking of a job somewhere other than industry?
  - ECE M.Eng degree is a great stepping stone for medicine, law, ...
  - Many M.Eng graduates became successful entrepreneurs in businesses based on technology
  - One can argue that the “liberal arts” degree of the 21st century is closer to ECE than any other traditional degree

- Coupling scholarship with hands-on experience is the most effective way to learn for the vast majority of people. At Cornell, you will learn ECE better than you ever have before.
Our Primary Objective is to prepare you to get a Great Job!
Graduate salaries average over $100K

* May 2014 – January 2017
ECE Should Also Be Fun!
Thank You! Any Questions?