

# Why Get an M.Eng. in CS or Anything Else?

Prof. Charlie Van Loan  
CS M.Eng. Program Director

# Some Questions to Answer

---

- Do I need a fifth year?
- Is Entrepreneurship part of the deal?
- Is the MEng a stepping stone towards a PhD?
- What about the new 4-semester MS in CS?
- What about NYC programs at Cornell Tech?
- How do I put together a strong application?
- Should I have majored in CS?

# In a Nutshell...

- There is a 2-semester CS MEng in Ithaca
- There is 3-semester "Medical Track" that involves work at the Cornell Medical Center in NYC.
- There is a 4-semester CS MS in Ithaca.

Gates Hall



Open  
Jan '14

# In a Nutshell at Cornell Tech...

- There is a 1-year CS MEng.
- There is 2-year MS in Connective Media
- Additional 2-year MS programs are coming soon



The Roosevelt  
Island Campus

# In a Nutshell at Cornell Tech...

- There is a 1-year CS MEng.
- There is 2-year MS in Connective Media
- Additional 2-year MS programs are coming soon



For now, in the  
Google Building

# In this Presentation I will ...

---

- Focus on the one-year MEng.
- Discuss the difference between the Ithaca and NYC programs. (Entrepreneurship)
- Emphasize breadth of education and its importance to career development.

# In this Presentation I will ...

---

- Focus on the one-year MEng
- Discuss the difference between the Ithaca and NYC programs. (Entrepreneurship)
- Emphasize breadth of education and its importance to career development.

Although CS-driven, what I say is relevant if  
you are considering ANY  
Masters Program in Engineering

# It's a Crowded Space

---

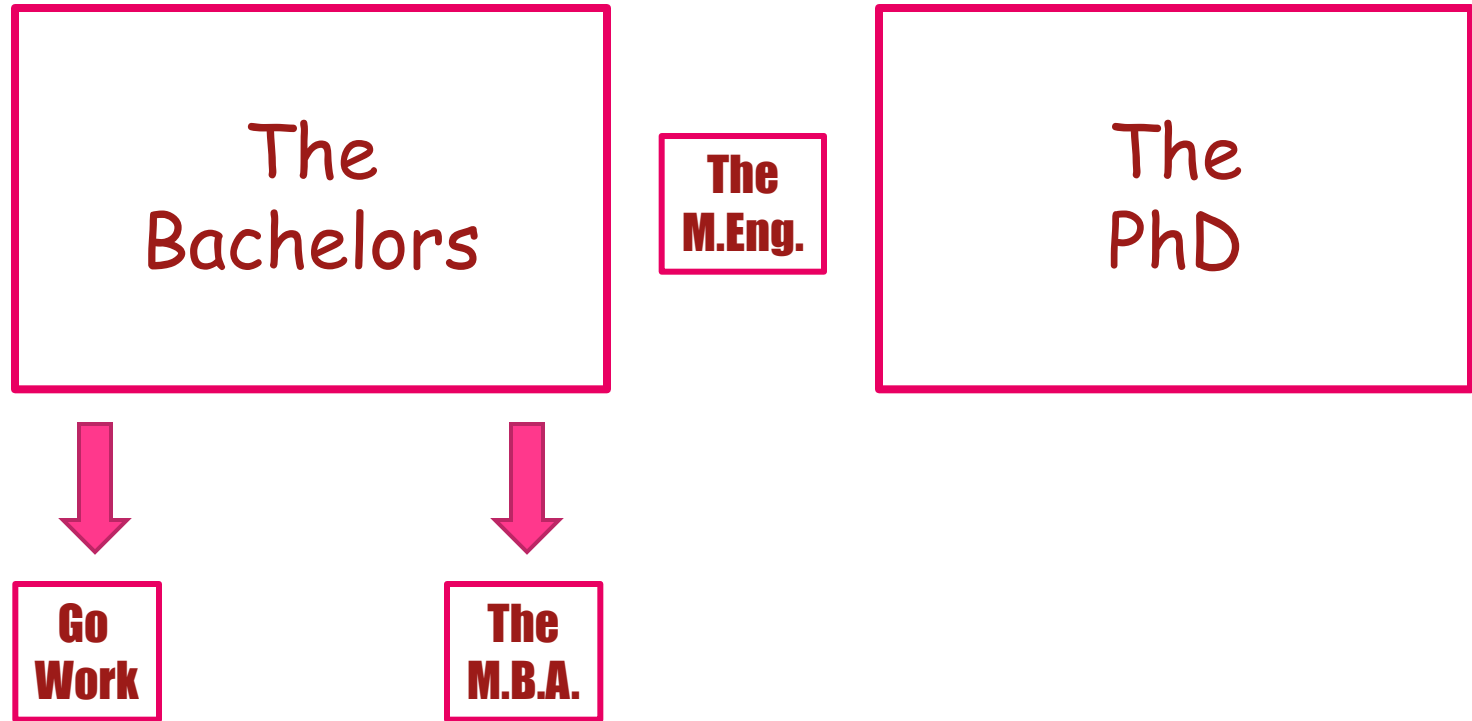
The  
Bachelors

**The  
M.Eng.**

The  
PhD



# It's a Crowded Space



# Two Bits of History

- Up until the 1960s, most ugrad degrees in Engineering were 5 years in length.
- Cornell's first Master's degree was awarded to David Starr Jordan. He became the first President of Stanford University (1891-1913).



# What is an M.Eng. Degree?

---

An MEng in X is a professional degree program that emphasizes the practical application of ideas from X.

# What is an M.Eng. Degree?

An MEng in X is a professional degree program that emphasizes the practical application of ideas from X.

True but...

- Being professionally strong means more than just being technically strong.
- The MEng is an occasion to refine your communication skills and your ability to work with others.

# What is an M.Eng. Degree?

An MEng in  $X$  is a professional degree program that emphasizes the practical application of ideas from  $X$ .

True but...

- Practical applications sometimes require theoretical foundations.
- Pay attention to your mathematical, statistical, and logical talents.

# M.Eng. Mindsets

---

## The Entrepreneurial Mindset...

Being able (a) to identify CS problems of interest to society and (b) to develop solutions that have economic value.

Think: Start-Up Company

# M.Eng. Mindsets

---

## The Algorithmic Mindset...

Being able (a) to identify CS problems of interest to scientists and engineers and (b) to develop efficient algorithms for their solution.

Think: Being the CS person in a lab.

# M.Eng. Mindsets

---

## The Intrapreneurial Mindset...

Being able (a) to identify CS problems of interest to your company and (b) to develop solutions that have economic value.

Think: Working in development for a big company



# M.Eng. Mindsets

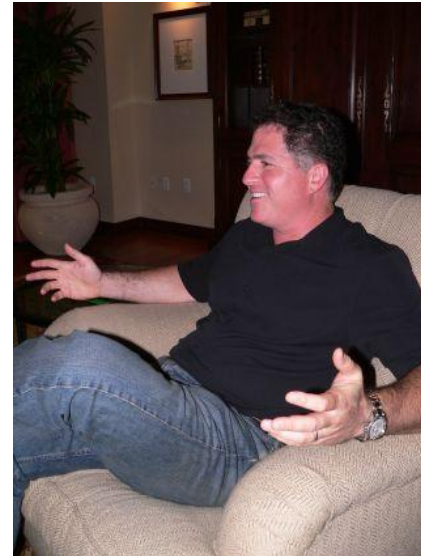
---

## The Social Entrepreneurial Mindset...

Being able (a) to identify CS problems of interest to society and (b) to develop solutions that have social value.

Think: Laptops for education in poverty areas.

# The Dropout Mindset is OK Too!



# Entrepreneurism & Basic Research

---

Not polar opposites!

What it takes to apply technology is very similar to what it takes to discover something new.

# Entrepreneurism & Basic Research

---

1. The entrepreneur's job is to identify a problem worth solving.

# Entrepreneurism & Basic Research

---

1. The entrepreneur's job is to identify a problem worth solving.

1'. A PhD student's job is to define a research problem worth solving.

# Entrepreneurism & Basic Research

---

2. Problem complexity is changing faster than technology.

# Entrepreneurism & Basic Research

---

2. Problem complexity is changing faster than technology.

2'. Research problems are changing faster than field-specific education and can no longer be solved by homogeneous teams of look-alike experts.

# Entrepreneurism & Basic Research

---

3. Great entrepreneurs are able to describe a problem clearly, precisely, and with an economic description that talks about a customer and a price.



# Entrepreneurism & Basic Research

---

3. Great entrepreneurs are able to describe a problem clearly, precisely, and with an economic description that talks about a customer and a price.
- 3'. Great researchers are able to describe the "nut they cracked" in terms that can be understood by the public.

# Entrepreneurism & Basic Research

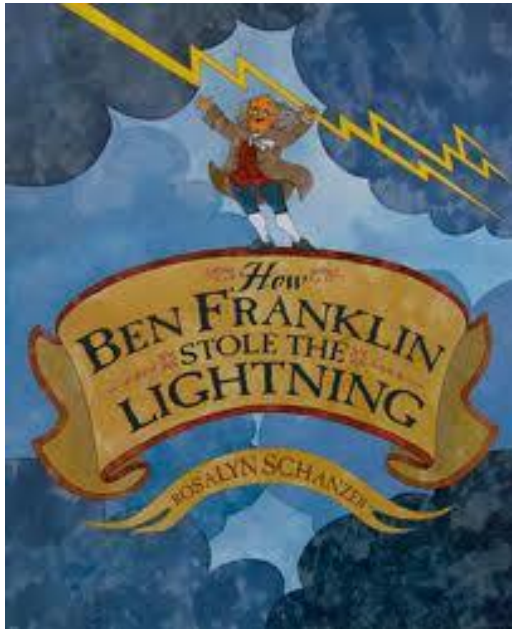
---

4. As an entrepreneur you need humility to know what you do not know because customers think differently, often in ways that have nothing to do with science, logic, or evidence.

# Entrepreneurism & Basic Research

4. As an entrepreneur you need humility to know what you do not know because customers think differently, often in ways that have nothing to do with science, logic, or evidence.
- 4'. As a researcher, you need humility to know what you do not know because colleagues outside your area often think in ways that are orthogonal to the traditions of your field.

# Entrepreneurism & Basic Research



## The Message of Ben Franklin



# The Ben Franklin Message

---

Properly practiced, there is no difference  
between

“Curiosity-Driven” Research

and

“Product-Driven” Research.

# The CS M.Eng.

---

Now for a Few Details...

# Who is it for?

---

- CS Majors who are hungry for more.
- Ugrads who major in X and (sort of) minored in CS.

# Who is it for?

---

- CS Majors who are hungry for more.  
Need five years to be fully prepared for the work force.
- Ugrads who major in X and (sort of) minored in CS.  
X + CS is a powerful combination for students interested in a career in X or graduate study in X.



# What a CS Minor Looks Like

|         |                       |
|---------|-----------------------|
| CS 2800 | Discrete Math         |
| CS 2110 | Object-Oriented Prog. |
| CS 3410 | Computer Systems      |

*Required*

|         |                            |
|---------|----------------------------|
| CS 4220 | Scientific Computing       |
| CS 4320 | Databases                  |
| CS 4700 | Artificial Intelligence    |
| CS 4620 | Computer Graphics          |
| CS 4780 | Machine learning           |
| CS 4830 | Cryptography               |
|         | <i>(many more options)</i> |

*3 courses of  
your choosing*

# CS MEng Req'ts--Briefly

---

A total of at least 30 credit hours that includes a 3-6 credit hour project and at least 15 credit hours of CS coursework.

Roughly six courses and a project.

All courses at the 4000-level and 5000-level. No specific course is required.

# CS Courses for MEng Students

Parallel Computing

Software Engineering

Large-Scale Information Systems

Scripting Languages

Defending Computer Networks

Open Source Software Engineering

Heuristic Methods for Optimization

Cloud Computing

Computer Security

Physically-Based Animation

Computer Networking

Building Large-Scale Information  
Systems

Mobile Systems

Signal and Image Processing

Physical Computing

Images and Video

Technology Product Development

Psychological and Social Aspects  
of Connected Media

Big Data/Complex Event Proc.

# The Key Attribute: Flexibility

---

You have the freedom to structure your course selection and project so that what you learn resonates with your career aspirations.

# What You Can Emerge With...

---

- A broader set of CS-related skills.
- A deeper knowledge of an application area.
- An ability to work with others.
- A set of entrepreneurial skills.
- An ability to communicate technical ideas in everyday language.

# Impact of Nearby Degrees

The CS  
Undergraduate  
Program

The CS  
PhD  
Program



The 5<sup>th</sup> year idea.  
Background building.

The CS  
MEng  
Program

Research snapshots.  
How research works.

# The Cornell Environment

---

The University is particularly famous for

1. The way it achieves the aims of liberal education.
2. The way it promotes interdisciplinary research.

Breadth is the common denominator.  
and it can be an attribute of  
YOUR MEng if you choose.

# Using Cornell

Many non-CS courses that you can take to strengthen your MEng record.

- Johnson Graduate School of Management
- Science and Technology Studies
- Information Science
- Statistical Science
- Electrical and Computer Engineering
- Operations Research
- Mathematics



# Johnson School of Management.

---

|          |   |
|----------|---|
| NCC 5500 | Financial Accounting                          |
| NCC 5530 | Marketing Management                          |
| NCC 5560 | Managerial Finance                            |
| NBA 5070 | Entrepreneurship for Scientists and Engineers |
| NBA 5640 | Entrepreneurship and Business Ownership       |
| NBA 6010 | Electronic Commerce                           |

# Science & Technology Studies

|          |   |
|----------|---|
| STS 4071 | Law, Science, and Public Values                 |
| STS 6241 | Science, Technology, and International Security |
| STS 6261 | Seminar in the History of Technology            |
| STS 6321 | Inside Technology                               |
| STS 6661 | Public Engagement in Science                    |

# Statistical Science

---

STSCI 4740 Data Mining and Machine Learning

STSCI 5010 - Applied Statistical Analysis

STSCI 5060 - Database Management and SAS High  
Performance Computing with DBMS

STSCI 5080 - Probability Models and Inference

# Information Science

---

|           |  |
|-----------|--|
| INFO 4400 | Human-Computer Interaction Design          |
| INFO 4500 | Language and Technology                    |
| INFO 5150 | Culture, Law, and Politics of the Internet |
| INFO 6140 | Cognitive Psychology                       |
| INFO 6648 | Speech Synthesis by Rule                   |

# ECE

---

|          |  |
|----------|--|
| ECE 5220 | Nonlinear System Analysis and Computations |
| ECE 5470 | Computer Vision                            |
| ECE 5480 | Digital Image Processing                   |
| ECE 5660 | Fundamentals of Networks                   |
| ECE 5670 | Digital Communications                     |
| ECE 5750 | Advanced Microprocessor Architecture       |
| ECE 5780 | Computer Analysis of Biomed Images         |

# OR&IE

---

|            |                              |
|------------|------------------------------|
| OR&IE 4350 | Introduction to Game Theory  |
| OR&IE 4370 | Computational Optimization   |
| OR&IE 5140 | Applied Systems Engineering  |
| OR&IE 6500 | Applied Stochastic Processes |

# Mathematics

|           |                                  |
|-----------|----------------------------------|
| MATH 4240 | Wavelets and Fourier Series      |
| MATH 4330 | Honors Linear Algebra            |
| MATH 4340 | Honors Introduction to Algebra   |
| MATH 4370 | Computational Algebra            |
| MATH 4410 | Introduction to Combinatorics I  |
| MATH 4420 | Introduction to Combinatorics II |
| MATH 4550 | Applicable Geometry              |

# The MEng Project

---

- Typically an application of computer science techniques to practice.
- All projects must be supervised by a Computer Science faculty member or researcher.
- Illustrate the path from theory to practice, from classroom to product, etc.



# Some Project Formats

- Participate in a faculty member's research group
- Build upon a project started within an advanced course, perhaps in collaboration with other students from that course
- A few faculty members advertise one-on-one project openings— this might either be a smaller project or a test-run for a larger initiative
- Work as a member of one of the College's large team efforts – there are an increasing number of these relatively high-profile projects

# Some Project Formats

---

- A team project designed to explore an idea for a startup (often from business courses)
- Systems built on behalf of non-CS groups with challenging problems
- Projects brought to Cornell from company or military or government settings, with appropriate permissions
- Ideas of your own, but for this you still need a faculty supervisor.

# The Health and Medicine Track

---

- **Semester 1.** In Ithaca doing courses.
- **Semester 2.** At the Weill Medical Center in NYC, get stipend, work on project.
- **Semester 3.** In Ithaca doing courses.

# The (New) 4-Semester MS

---

## Key Attributes....

- 34 credits including thesis research
- Advanced CS Coursework
- Outside Minor
- Serve as TA and receive full tuition and stipend.

Limited size at the start: about 5 students.

# The MS: Sample Schedules

## Sample Schedules...

|                |                              |                |
|----------------|------------------------------|----------------|
| <b>Term 1:</b> | <b>3 CS</b>                  | <b>(4+4+3)</b> |
| <b>Term 2:</b> | <b>1 CS, 1 nonCS</b>         | <b>(4+3)</b>   |
| <b>Term 3:</b> | <b>1 CS, 1 nonCS</b>         | <b>(4+3)</b>   |
| <b>Term 4:</b> | <b>1 CS, Thesis Research</b> | <b>(3+6)</b>   |
| <br>           |                              |                |
| <b>Term 1:</b> | <b>2 CS, 1 nonCS</b>         | <b>(4+4+3)</b> |
| <b>Term 2:</b> | <b>1CS, 1 nonCS</b>          | <b>(4+3)</b>   |
| <b>Term 3:</b> | <b>1CS, Thesis Research</b>  | <b>(4+3)</b>   |
| <b>Term 4:</b> | <b>Thesis Research</b>       | <b>(9)</b>     |

# The MS: Who is it for?

- Students who wish to deepen their knowledge of computer science through advanced coursework, research, writing, and teaching.
- Students who are self-motivated, have expository skills, enjoy the research environment, and like working with undergraduates in introductory courses.
- Students who might like to teach CS at a 4-year college.
- Students who like research but are anxious about the PhD timeline

# The MS: Admissions Criteria

---

- Must have been a CS major or have a CS minor.
- Must have served as ugrad grader/ta.
- 3 letters of recommendation + essay

# Back to Cornell Tech





# The Cornell Tech CS M.Eng.

---

Same as the Ithaca CS MEng except that the entrepreneurial aspect is very explicit:

- Faculty have entrepreneurial experience.
- Tight coupling to the NYC tech scene.
- Industrial mentors for the project.
- Courses that are interdisciplinary.
- A weekly seminar on the "entrepreneurial life"

# MS in Connective Media

---

A new 2-year program at Cornell Tech that is part of the Technion-Cornell Innovation Institute. Three semesters of courses followed by a one-semester project.

- Digital media data analytics
- Human-centered design.
- Mobile technologies.
- Social networks.

# Building a Strong Application

---

## Transcript

Coursework that is systematic and shows that you can handle the requirements of the grad program to which you are applying.

# Building a Strong Application

---

## Letters of Recommendation

Should speak to your independence, originality, communication skills, and ability to work with others.

# Building a Strong Application

---

## The Statement of Purpose

Should show that you understand what the grad program is all about and justifies your application in terms of past experiences.

# Relevant Experiences For Cornell Tech

- Been part of a startup.
- Belonged to a student organization/club related to entrepreneurship.
- Made intrapreneurial contributions to some project.
- Would like to apply CS to a real world problem.
- Worked in the non-profit/ gov't sector and would like to return with a stronger CS background.

# Hope to See You Here



... Or Here!

