The New CS Major

Prof. Charles Van Loan
January 28, 2009
What Prompted the Change?

Expanded research horizons within CS.

Broadened connections to other fields.

Anticipation of the future job market for CS majors.

Make the Cornell CS major the best CS major in the country.
Executive Summary

**Decrease** the volume of required core courses.

**Increase** the volume of required electives by a comparable amount.

**Encourage** the systematic study of a CS subarea.

**Preserve** the “product” of intellectual breadth times depth.
Talk Outline

Review the Old Major

The New Core and Elective Structure

Vectors  Similar to Tracks

Transition Issues

Summary
Acknowledgements

Professor Lillian Lee
Director of Undergraduate Study
Chair of the Curriculum Committee

Nicole Roy
Undergraduate Major Coordinator

http://www.cornell.edu/ugrad/
CSMajorTransition08-09.htm
First...

- Review the Old Major
- The New Core and Elective Structure
- Vectors
- Transition Issues
- Summary
The Old Major

CS 2110 Java II
CS 2111 Java Practicum
CS 2800 Discrete Struct
CS 3110 Functional Prog
CS 3220 Sci Computing
CS 3410 Digital Systems
CS 3810 Theory of Comp
CS 4410 Operating Sys
CS 4820 Algorithms

CS 4000+
CS 4000+
CS Proj
Technical
Technical
Math

Core Plus
Extern Special
Extern Special
Extern Special

Electives
Advisor Approved
Advisor Approved
Advisor Approved
The Old Major

CS 2110 Java II
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Advisor Approved
Advisor Approved

Basically Free
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Non-CS, must be related, 3000+
The Old Major

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Application area
or CS, 3000+
The Old Major

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3000+ / Math
2940 / OR2700
The Old Major

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CS 4000+
CS 4000+
CS Proj

No independent Study 4999s
Next...

Review the Old Major

- The New Core and Elective Structure
  Vectors (Tracks)
  Transition Issues

Summary
The Old Major

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CS 4000+
CS 4000+
CS Proj
Technical
Technical
Math
The New Major

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CS 4000+

CS Proj

Technical

Technical

Technical

Vector

Prob/Stat

Major App
The New Core

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CS 2111 Java Practicum
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CS 3110 Functional Prog
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To be Discontinued.
Continues as an elective.
Continues as an elective one/two more years. Content folded into 2800 and 4820.
Group the Technical Electives and the Math Elective

Rationale:

 Creates more flexibility.

 The Prob/Stat checkbox ensures that the CS Major has sufficient mathematical rigor.
The Major-Approved Elective

One or more courses that sum to at least three credit hours.

CS 2111 allowed.

Minicourses allowed.

CS 2022 (C), CS 2024 (C++), CS 2026 (C#),
CS 2042 (Unix), CS 2044 (Adv Unix).

Some courses not allowed.

10XX, P.E., certain ROTC
One of these courses must be among your chosen electives:

- ORIE 2700: Engineering Prob/Stat
- ECE 3100: Prob & Random Signals
- BTRY 4080: Theory of Probability
- ECON 3190: Intro Stats and Prob
- MATH 4710: Basic Probability
Note!

*CS Majors can use ECE 3100 as an Engineering distribution course.*

*Just like ORIE 2700.*
The Vector Check Box

A requirement that encourages you to coordinate the selection of electives.

Permits focus on that part of CS you like.

Better metaphor than “track”:

The set of available vectors “spans the space.”

A vector has a direction and a magnitude.
Next...

Review the Old Major

The New Core and Elective Structure

• Vectors

Transition Issues

Summary
The General Form of a Vector

4-5 courses that represent a line-of-inquiry

They can involve non-CS courses.

Some vectors require 1-2 particular courses.

Almost all vectors involve menus of courses from which you select “vector electives”.
Examples/Scheduling

Let's step through the vectors illustrating possible course selection and scheduling.

What follows are JUST EXAMPLES. For precise rules and a full appreciation of the options see

http://www.cornell.edu/ugrad/vectors.htm
Artificial Intelligence

Understanding and creating intelligent systems

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Example:

- **CS 4700** Foundations of A.I.
- **CS 4701** Practicum in A.I.
- **CS 4300** Information Retrieval
- **CS 3220** Scientific Computing
- **BTRY 4790** Probabilistic Graphical Models
# Computational Sci & Engin.

Numerical methods for modeling and simulation

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Example:

- **CS 4210**: Numerical Analysis I
- **CS 4220**: Numerical Analysis II
- **Math 2930**: Differential Equations
- **ORIE 3330**: Optimization I
- **CS 2024, 2042, 2044**: (C++.Unix, Adv Unix)
Data Intensive Computing

Managing, processing, analyzing large datasets

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Example

CS 4320  Database Systems
CS 4321  Practicum in Databases
CS 5300  Large-scale Information Systems
ORIE 4740 Statistical Data Mining
CS 4302  Web Information Systems
Graphics

Computing with visual images

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Example

- **CS 4620**  Introduction to Graphics
- **CS 4621**  Practicum in Graphics
- **CS 3220**  Scientific Computing
- **CS 5620**  Interactive Graphics
- **CIS 4002** Game Design
Human-Language Technologies

Creating information retrieval systems that process natural language

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Example:

- **CS 4740**: Natural Language Processing
- **CS 4110**: Programming Languages
- **CS 4700**: Foundations of A.I.
- **CS 4701**: Practicum in A.I.
- **Psych 4280**: Connectionist Psycholinguistics
Network Science

Develop and understand predictive models of physical, biological, and social networks

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Example

- **CS 2850**  Networks
- **CS 4780**  Machine Learning
- **CS 4850**  Math Foundations Inform Age
- **ORIE 4350**  Introduction Game Theory
Programming Languages

Logic, semantics, language design, compilation, and optimization

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Example
- **CS 4110**: Programming Languages and Logics
- **CS 4120**: Introduction to Compilers
- **CS 4121**: Practicum in Compilers
- **CS 4860**: Applied Logic
- **CS 2024**: C++
## Security & Trustworthy Systems

Ensuring security and reliability of the global critical computing infrastructure.

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**Example**

- **CS 4411**: Practicum in Operating Systems
- **CS 4830**: Introduction to Cryptography
- **CS 5410**: Intermediate Computer Systems
- **CS 5430**: System Security
- **ECE 4450**: Computer Networks & Telecom
Systems

Design/implementation of fundamental software systems that support the computing infrastructure

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Example:

- **CS 4411**  Practicum in Operating Systems
- **CS 4120**  Compilers
- **CS 5410**  Intermediate Systems
- **CS 4320**  Database Systems
Theory

Efficient computation, models of computational processes and their limits

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Example

**CS 3810** Theory of Computing
**CS 4830** Introduction to Cryptography
**CS 4850** Math Foundation Information Age
**CS 4860** Applied Logic
Software Engineering

Fundamentals of software design via extensive implementation experience. Supports multiple pursuits.

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CS 5150  Software Engineering
CS 4621  Practicum in Graphics
CS 4700  Foundations of A.I.
CS 4701  Practicum in A.I.
CS 5300  Large-scale information systems
## Renaissance

Breadth of study including education in fundamentals beyond the core. Supports multiple pursuits.

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**Example**
- **CS 3810**  Theory of Computing
- **CS 3220**  Scientific Computing
- **CS 4320**  Database Systems
- **CS 4780**  Machine Learning
Renaissance (Sr Yr Version)

Breadth of study including education in fundamentals beyond the core. Supports multiple pursuits.

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Specialty Vectors Collectively Span "CS Space"
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AI
Network Science
Theory
Computational Sci Eng
Graphics
Systems
Security
Data-Intensive
Programming Languages
Human Language Tech.
Cross-cutting Vectors Individually Span “CS Space” (But Differently)

Renaissance
Breadth in fundamentals in the style of the old major.

Software Engineering
Breadth through implementation experience across the field.
Vector Advising Tips

Think early about possible vectors, e.g., just after you affiliate.

Go for two, at least initially. E.g., pair of “adjacent” specialty vectors or a specialty vector plus Renaissance or a specialty vector plus Software Engineering.

Plan ahead to compensate for the fact that some courses are not offered every year.
To Ensure On-Time Graduation...

You must commit to a vector in writing before the start of your senior year.
Approval Being Sought...

Designation of vectors on transcript.

This will help the reader of your transcript interpret your choice of electives.
Next...

Review the Old Major
The New Core and Elective Structure
Vectors

• Transition Issues

Summary
Old vs. New (Seniors)

Seniors who satisfy the new requirements with the Renaissance vector can elect to graduate under the new rules.

May/August graduates must let us know by February 16, 2009.
Old vs. New (Others)

Current students can choose between the old major and the new major.

You must let us know by May 1, 2009.
The 2800/3810 Issue

If you have already completed CS 2800, then you must take CS 3810.

The new CS 2800 starts S09. Key material is missed if you take old CS 2800 and skip CS 3810.

CS 3810, a core course in the old major, can be used as an elective in the new major.
Next...

Review the Old Major
The New Core and Elective Structure
Vectors
Transition Issues

• Summary
Remember the Reason

To maximize the opportunity for students to experience more deeply those aspects of computer science that they find interesting.
Remember the Attributes

The overall amount of course work required to complete the major does not increase.

The “intellectual product” of breadth times depth remains the same.
Remember to be Vigilant

Does the credo "come and discover your interests" remain in force?

Are there side effects that discourage taking electives outside CS or new courses within CS?

Is the vector “space” evolving with the field?
Remember the Dialog

The CS Major is a joint venture between students and faculty.

We want to hear from you.

We expect to hear from you.