

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.

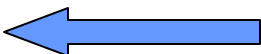
Encourage the systematic study of a CS subarea.

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](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

Advisor Approved

Advisor Approved

Extern Special

Extern Special

Extern Special

Core Plus
Electives

The Old Major

CS 2110 Java II
CS 2111 Java Practicum
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Advisor Approved



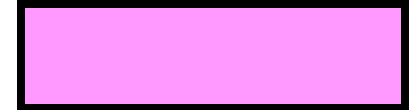
Advisor Approved



Basically Free

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Extern Special

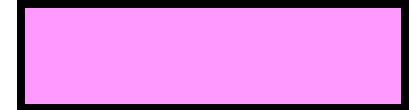
Extern Special

Extern Special

Non-CS, must be related, 3000+

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CS 4820 Algorithms



technical

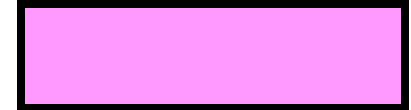
technical



Application area
or CS, 3000+

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Math



3000+ / Math
2940 / OR2700

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CS 4000+

CS 4000+

CS Proj

No independent
study 4999s

Next...

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- The New Core and Elective Structure

Vectors (Tracks)

Transition Issues

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CS 4000+

CS Proj

Technical

Technical

Math



The New Major

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CS 4000+

CS 4000+

CS 4000+

CS Proj

Technical

Technical

Technical

Major App



Vector

Prob/Stat

New

New

The New Core

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



To be
Discontinued.



Continues as
an elective.



Continues as an
elective one/two
more years.
Content folded into
2800 and 4820.

New

New

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.

New

New

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

New

New

The Prob/Stat Check Box

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.

New

New

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...

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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

Soph	Soph
2110	3110
	2800

Junior	Junior
4700	3220
4701	

Senior	Senior
4300	
4790	

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

Soph	Soph
2110	2930
	2800

Junior	Junior
4210	4220
2024	

Senior	Senior
3300	
2042	2044

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

Soph	Soph
2110	3110
	2800

Junior	Junior
4320	5300
4321	

Senior	Senior
4740	4302

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

Soph	Soph
2110	3220
	2800

Junior	Junior
4620	5620
4621	

Senior	Senior
	4002

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

Soph	Soph
2110	3110
	2800

Junior	Junior
4700	4740
4701	

Senior	Senior
4110	
4280	

Example

CS 4740

CS 4110

CS 4700

CS 4701

Psych 4280

Natural Language Processing

Programming Languages

Foundations of A.I.

Practicum in A.I.

Connectionist Psycholinguistics

Network Science

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

Soph	Soph
2110	2850
	2800

Junior	Junior
4350	4780

Senior	Senior
	4850

Example

CS 2850

CS 4780

CS 4850

ORIE 4350

Networks

Machine Learning

Math Foundations Inform Age

Introduction Game Theory

Programming Languages

Logic, semantics, language design,
compilation, and optimization

Soph	Soph
2110	3110
	2800

Junior	Junior
4110	4120
2024	4121

Senior	Senior
	4860

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.

Soph	Soph
2110	3110
	2800

Junior	Junior
4830	4411
4450	

Senior	Senior
5410	5430

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

Soph	Soph
2110	3410
	2800

Junior	Junior
4320	4411

Senior	Senior
5410	4120

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

Soph	Soph
2110	3110
	2800

Junior	Junior
3810	4850

Senior	Senior
4830	4860

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.

Soph	Soph
2110	3110
	2800

Junior	Junior
4700	5150
4701	

Senior	Senior
4621	5300

Example

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.

Soph	Soph
2110	3110
	2800

Junior	Junior
3810	3220

Senior	Senior
4320	4780

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.

Soph	Soph
2110	3110
	2800

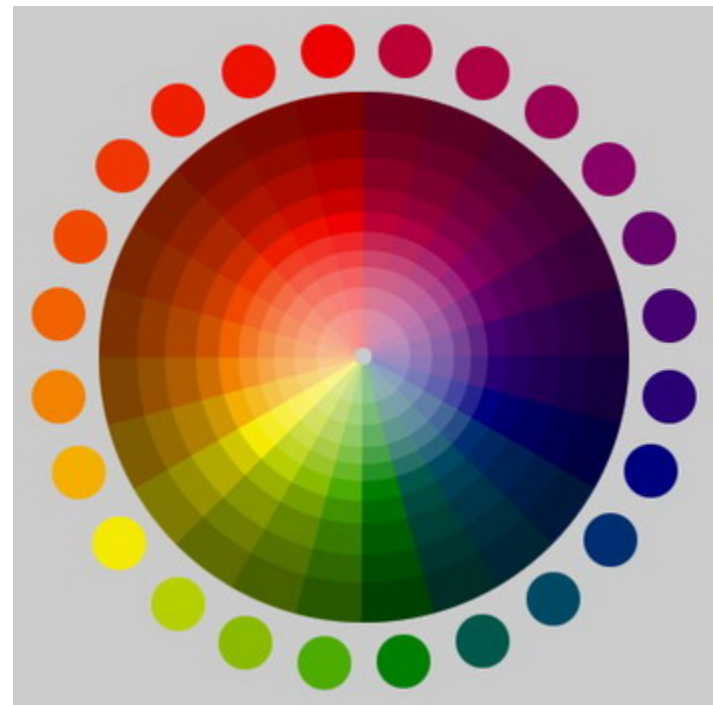
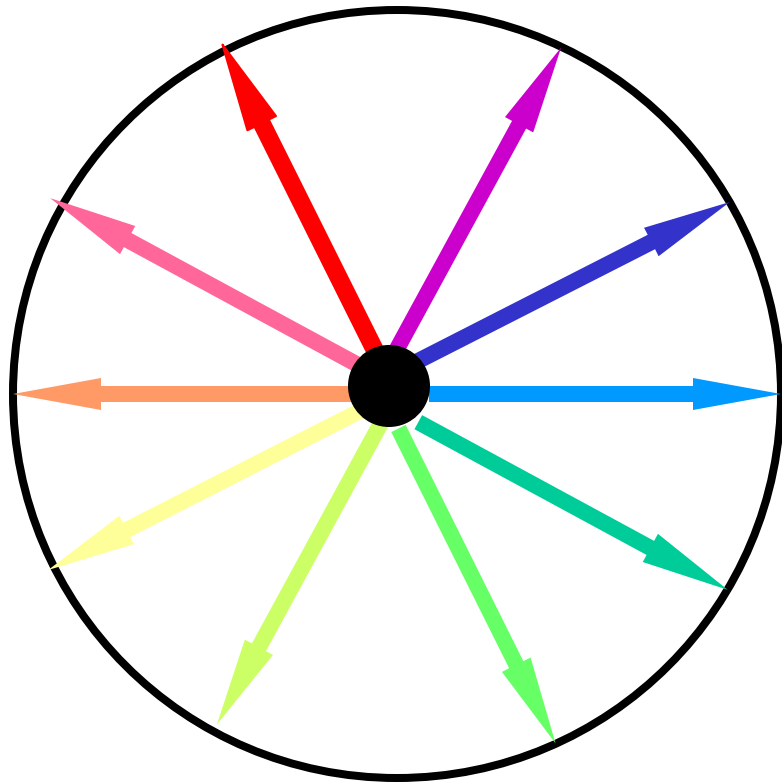
Junior	Junior

Senior	Senior
3810	3220
4320	4780

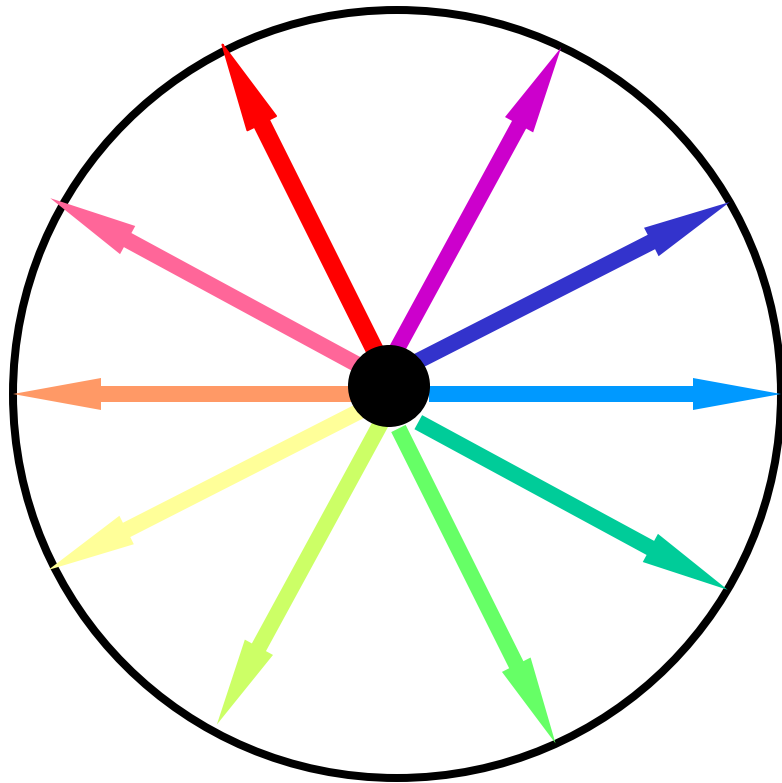
Example

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CS 4320 Database Systems
CS 4780 Machine Learning

Specialty Vectors Collectively Span "CS Space"

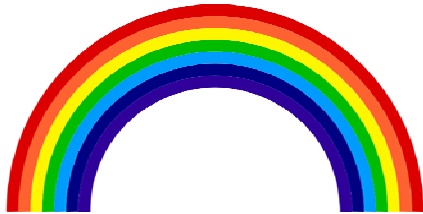


Specialty Vectors Collectively Span "CS Space"



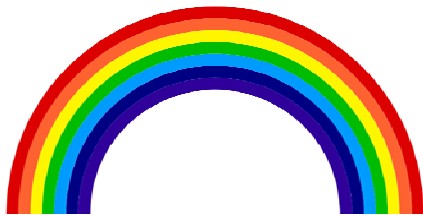
AI
Network Science
Theory
Computational Sci Eng
Graphics
Systems
Security
Data-Intensive
Programming Languages
Human Language Tech.

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.

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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.

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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.