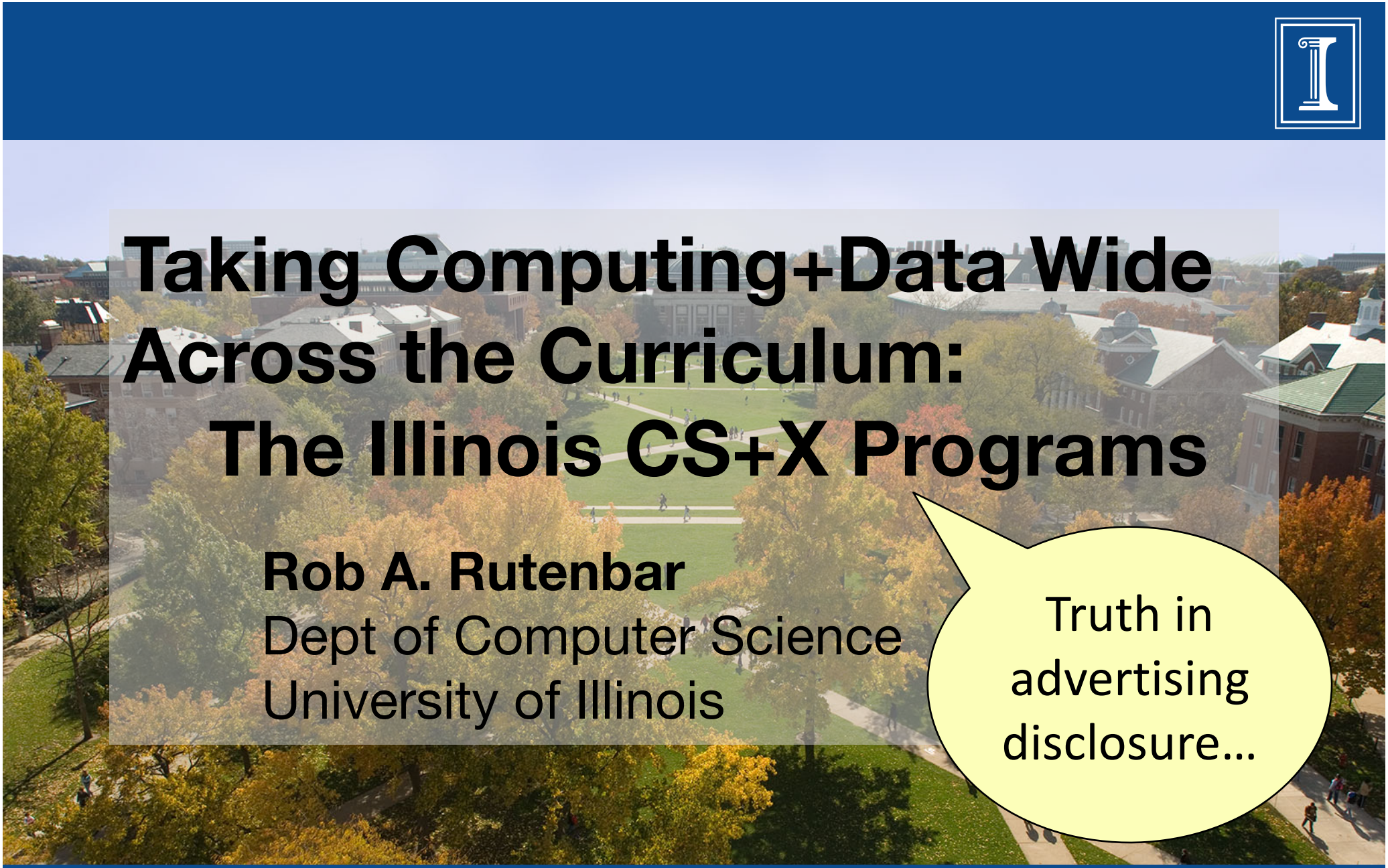
PittResearch
Taking Computing+Data Wide Across the Curriculum: The Illinois CS+X Programs
Rob A. Rutenbar
Sr VC Research
Professor, CS & ECE,
University of Pittsburgh



Taking Computing+Data Wide Across the Curriculum: The Illinois CS+X Programs

Rob A. Rutenbar
Dept of Computer Science
University of Illinois

Truth in advertising disclosure…

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Some Context Setting…

- **Apologies in advance for schizophrenic pronouns**
  - "Our", "We", "My", etc
  - All should de-reference to **Illinois**

- **Chronology**
  - Core of this talk is a 2017 "How We Did It" overview
  - Updates from 2019 included herein

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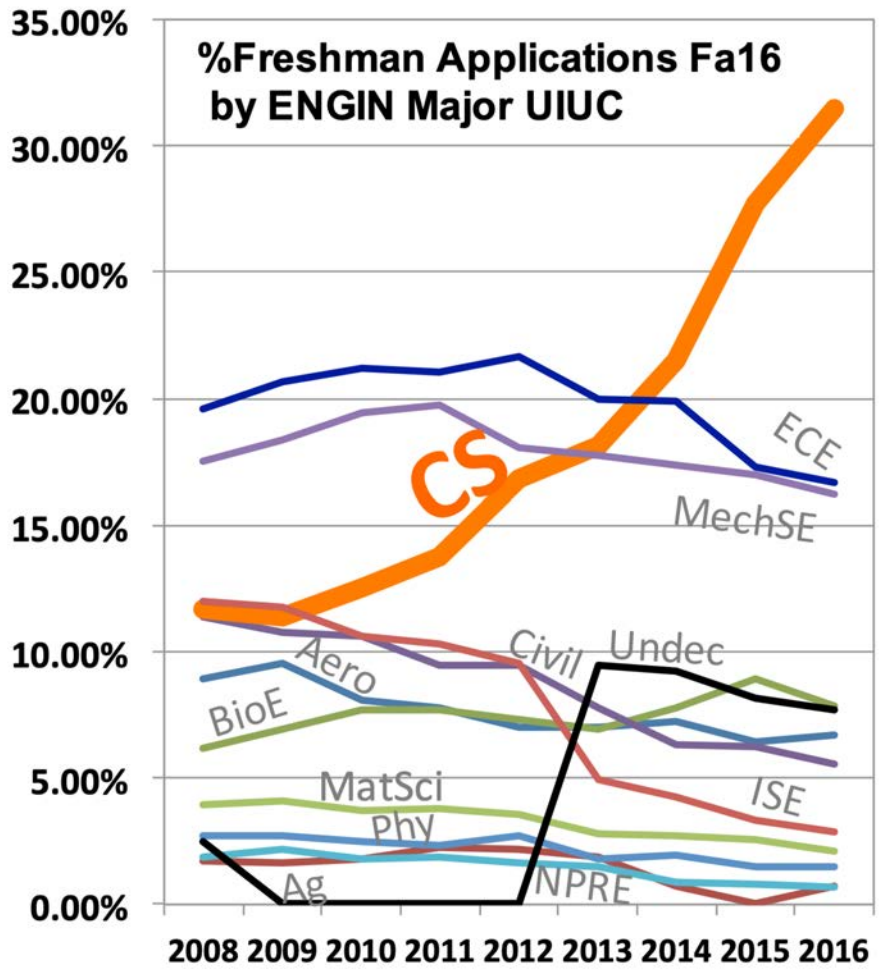
Yes, They Are Coming In Front Door…

- **At Illinois, this is the CS major in Engineering**



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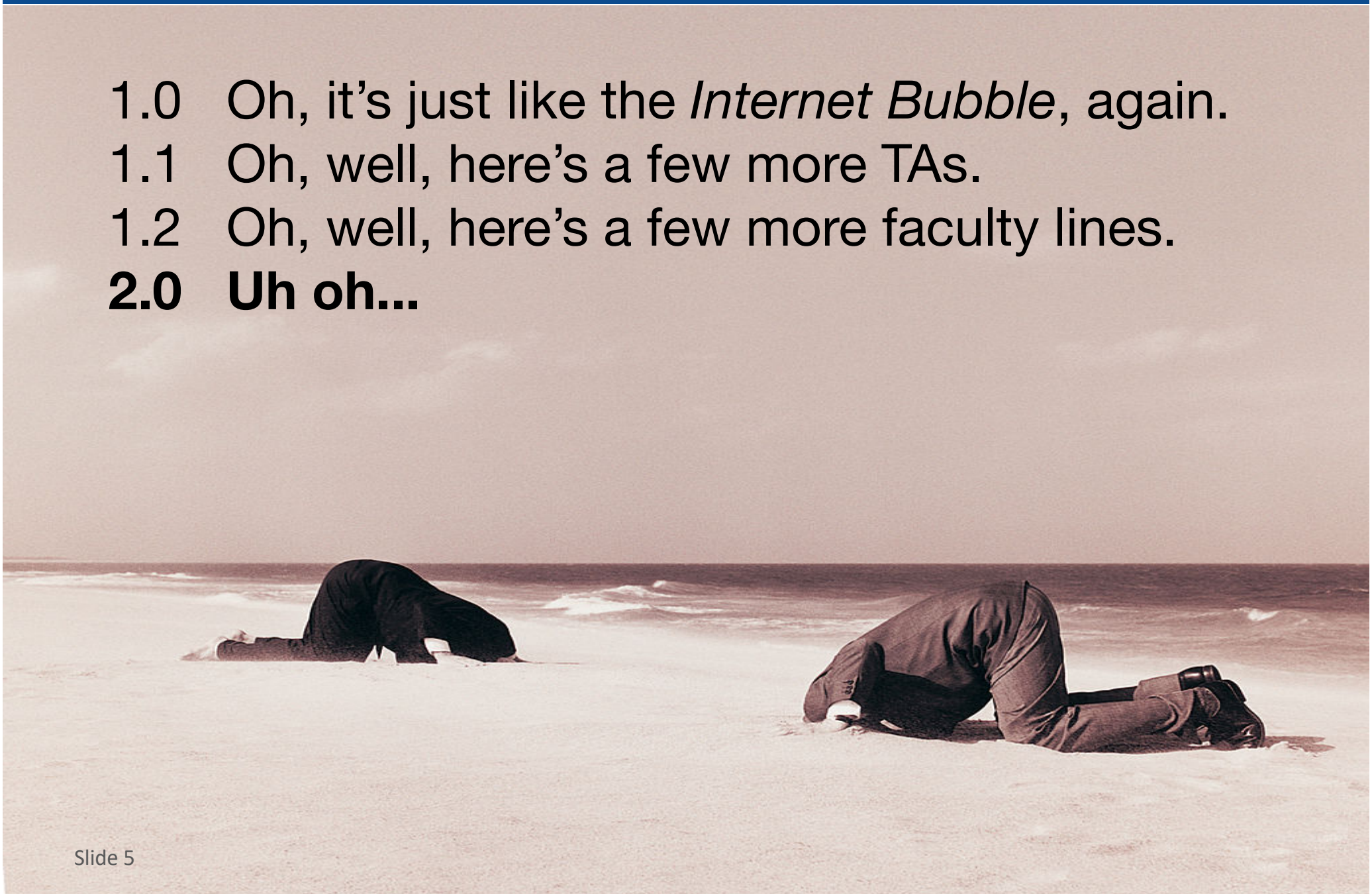
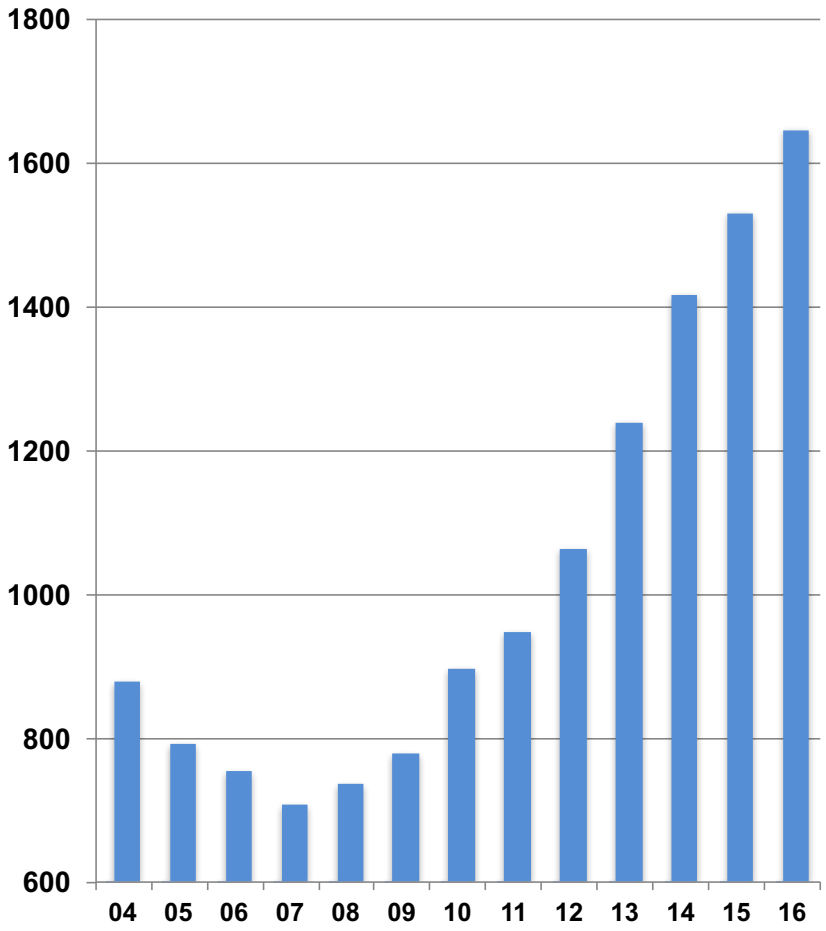
Classical Institutional Responses

1.0 Oh, it's just like the *Internet Bubble*, again.
1.1 Oh, well, here's a few more TAs.
1.2 Oh, well, here's a few more faculty lines.
2.0 Uh oh...

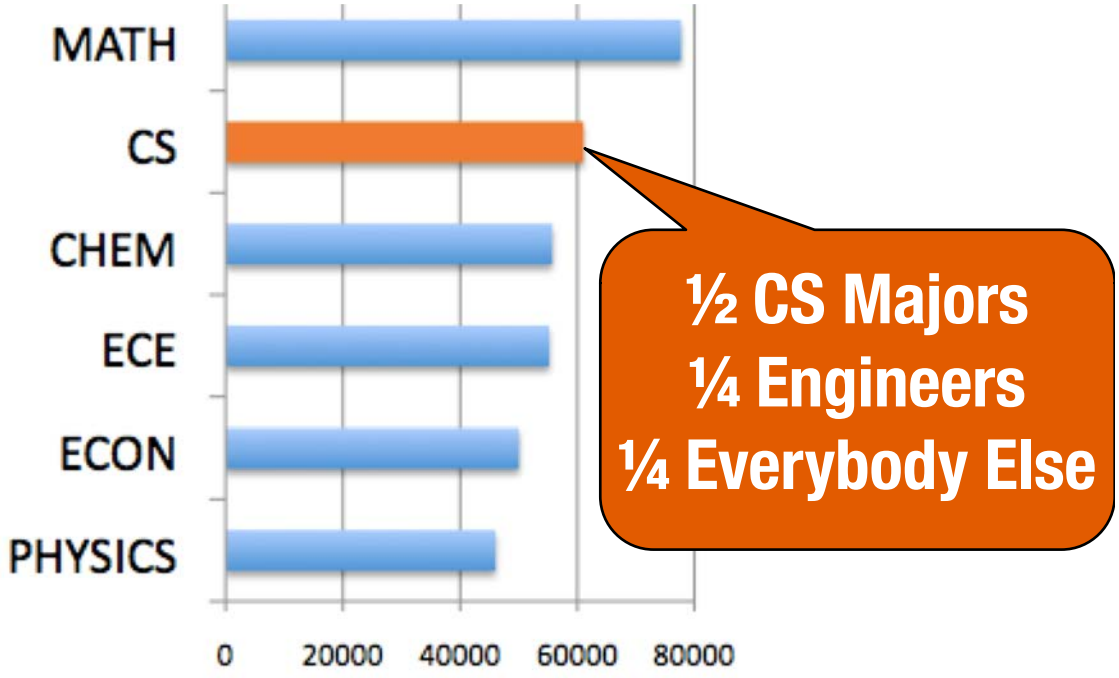


The Wave Keeps Growing

Illinois CS Majors



~ Illinois CS Class Seats



Instructional Units '15-16

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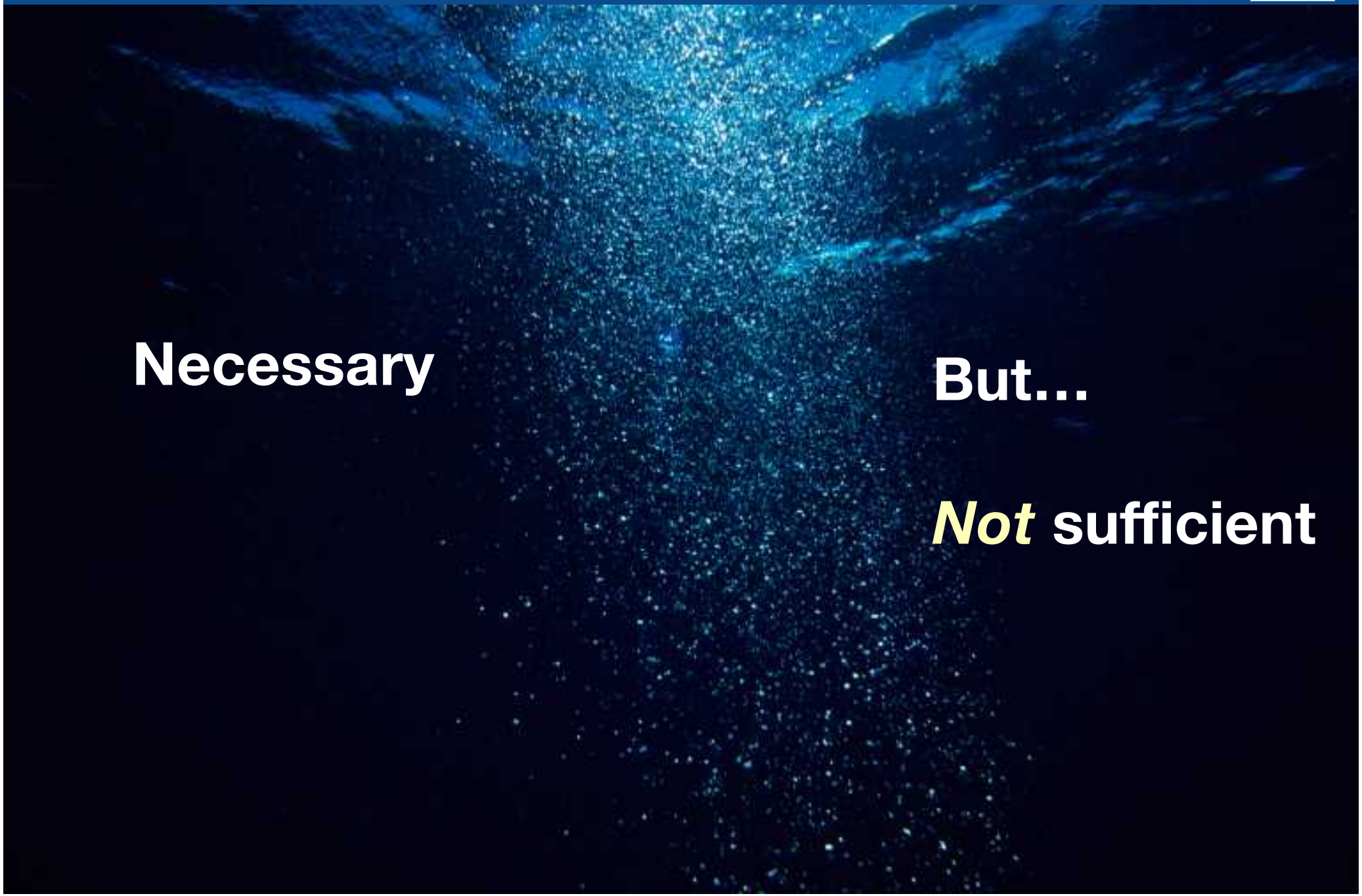
Response the First: Go **Deep**

Add ...

- **More Teaching Staff**
- **More TAs**
- **More Undergrads**
- **More Classes**
- **More Seats/Sections**
- **More Faculty…**

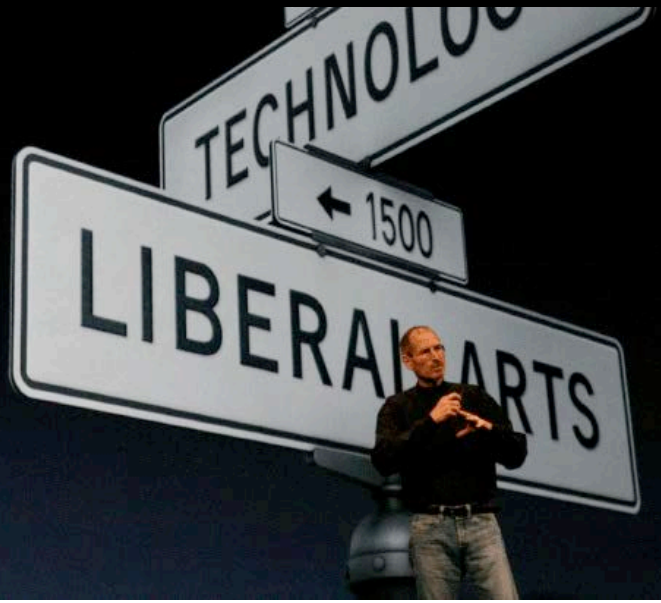
Response the First: Go **Deep**



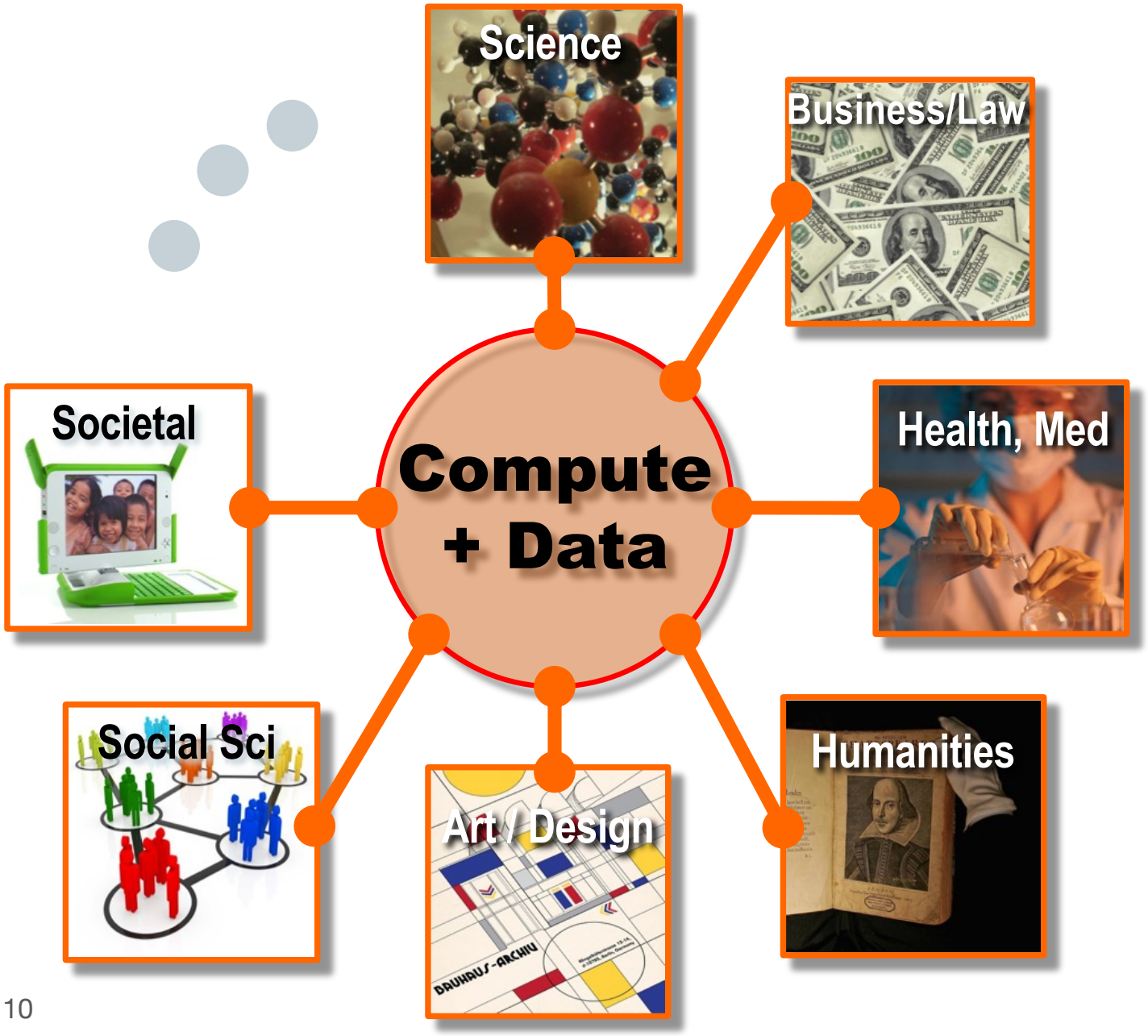
Response the Second: Go **WIDE**

"It's technology married with liberal arts, married with the humanities, that yields the results that make our heart sing."

Steve Jobs



Wider Response: Become a **Hub** For…



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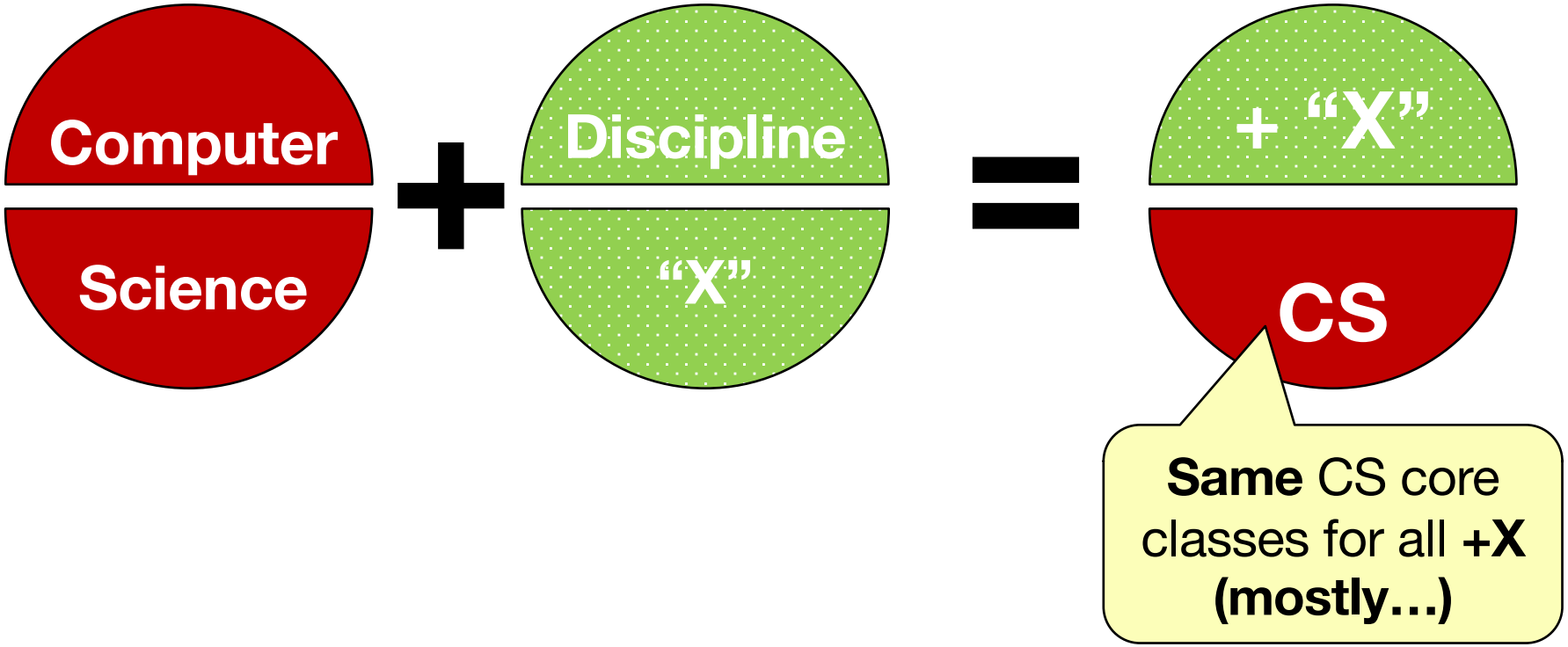
Our Response: Illinois **CS+X** Degrees

- **They are *not*: Minor in CS/X. Dual degree.**
- **They are: CS(1/2) + X(1/2)= Bachelors Degree in X**



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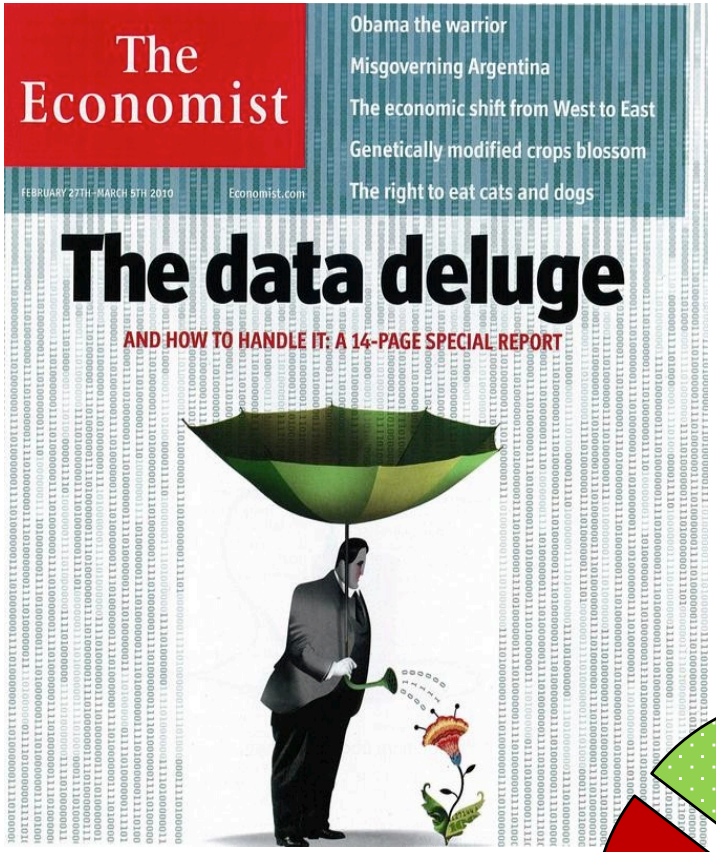
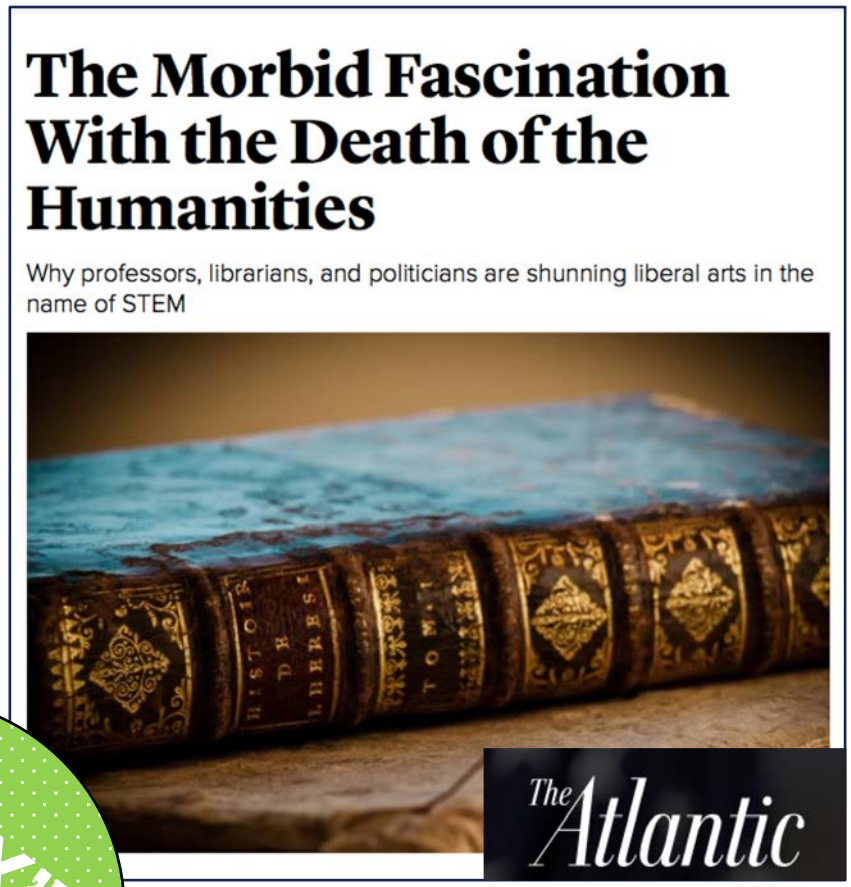
Illinois **CS+X**: Why Go **WIDE**?

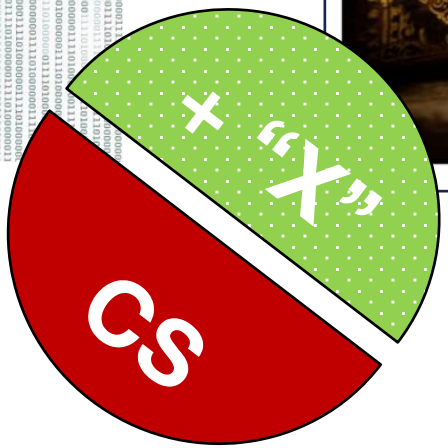
Positive pressure



Negative pressure



http://www.theatlantic.com/education/archive/2014/06/the-morbid-fascination-with-the-death-of-the-humanities/372216/



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This Sort of Outreach Gets **Noticed**

IDEA LAB

Should Colleges Let Ailing Majors Die or Revamp Them?

By Bianca Quilantan | MAY 20, 2018 ✔ PREMIUM

Ted Schurter for The Chronicle

Morgan Wessel (center) is a sophomore in the combined computer science and linguistics program at the U. of Illinois at Urbana-Champaign. The major was developed in part by Leonard Pitt (left), a computer scientist at Illinois, and Roxana Girju (right), a linguist there.

When majors aren't thriving, you can soup them up or let them go. Both tactics are complicated, and neither carries a guarantee. But, say administrators, doing nothing is not an option.

"The University of Illinois at Urbana–Champaign is updating and reinvigorating a number of traditional majors by combining them with computer science. The reasoning is that liberal-arts, arts, and agricultural fields increasingly encompass data analysis that requires computer-science skills."
The Chronicle of Higher Education

https://www.chronicle.com/article/Should-Colleges-Let-Ailing/243447

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Credit for Coinage: Alfred Spector

- **Alfred Spector, former VP Research Google, coined name "CS+X" around 2004**
- **Name widely circulated in Xconomy blog post Jan 12**

In Feb 12, I bought all the csplusx.* domain names…**

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CS+X @ ILLINOIS

2019 CS+X webage

Home » Academics » Undergraduate » Degree & Program Options » CS + X Degree Programs

ACADEMICS

UNDERGRADUATE

- Degree & Program Options
  - B.S. in Computer Science
  - B.S. in Mathematics & Computer Science
  - B.S. in Statistics & Computer Science
- CS + X Degree Programs
  - CS + X Degree Requirements & Planning Forms
  - Computer Science + Advertising
  - Computer Science + Anthropology
  - Computer Science + Astronomy
  - Computer Science + Chemistry
  - Computer Science + Crop Sciences
  - Computer Science + Economics
  - Computer Science + Geography & Geographic Information Science
  - Computer Science + Linguistics
  - Computer Science + Music
- Minor in Computer Science

CS + X Degree Programs

Always at the forefront of computer science education, the University of Illinois has designed a new degree option, called **CS + X**, that allows students to pursue a flexible program of study incorporating a strong grounding in computer science with technical or professional training in the arts and sciences.

Computing is ubiquitous, with application areas in virtually any field imaginable – from developing gene-sequencing algorithms, to designing methods for high frequency trading, creating computer-generated graphics and special effects, analyzing social data from internet communications, and creating embedded real-time systems for medical devices.

In fact, according to the National Science Foundation, "[K]nowledge of computer science and computer programming is becoming a necessary skill... in marketing, advertising, journalism, and the creative arts."

After earning their CS + X degrees, our graduates are poised to launch their careers or pursue graduate studies in a wide variety of fields.

APPLY NOW!

"The University of Illinois at Urbana–Champaign is updating and reinvigorating a number of traditional majors by combining them with computer science. The reasoning is that liberal-arts, arts, and agricultural fields increasingly encompass data analysis that requires computer-science skills."
The Chronicle of Higher Education

"Like a number of colleges across the country, the University of Illinois is ramping up its efforts to equip students with the ideal combination of strong technology acumen and solid creative and interpersonal skills – a combo that many employers say they want in their new hires."
U.S. News & World Report

Also: CS+X @ STANFORD

Stanford University

UNDERGRAD | Majors

Advising Academic Planning Progra

Art Practice+CS

Faculty Contact: Camille Utterback

Staff Contact: Linda Esquivel

CS+Iberian

can Cultures

Daub

Stanford | News

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Search Stanford news...

JANUARY 24, 2019

CS+X pilot to be discontinued end of spring quarter

Currently declared CS+X students and those who declare by the end of spring quarter, will have the opportunity to complete the joint major.

BY JOY LEIGHTON

Stanford Schools of Engineering and Humanities and Sciences have announced that they will not renew the CS+X Joint Major Program (JMP), which was approved by the Faculty Senate in 2014 and began as an experimental pilot program in fall quarter that year.

The decision was presented to the Committee on Undergraduate Studies and Policies (CUSP) on January 22 by Susan Weersing, associate dean for graduate and undergraduate studies in the School of Humanities and Sciences. The School of Engineering presented their decision to CUSP in fall 2018.

All currently declared CS+X students have the opportunity to complete their joint major. Students who plan to declare the CS+X joint major must do so by June 18, 2019, which is the end of spring quarter. After that date, no new joint major declarations will be approved.

Languages and Literatures

Faculty Contact: Professor Adrian Daub

Staff Contact: Denise Winters

CS+History

Faculty Contact: Professor James T. Campbell

Staff Contact: Priscilla Tojino

CS+Spanish

Faculty Contact: Professor Adrian Daub

Staff Contact: Denise Winters

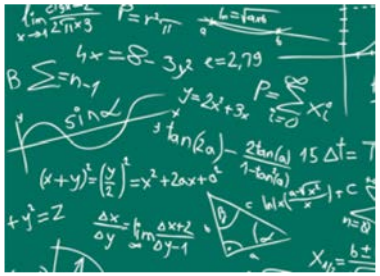
The new , which will lead to conferral

keynote d Joint Major is integrative learning. These p

leading to mastery in two fields by blending the vibrant i

Illinois **CS+X:** Portfolio

CS+Math



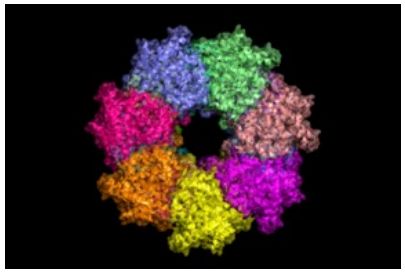
CS+Statistics

Legacy degrees, decades old

CS+Anthropology

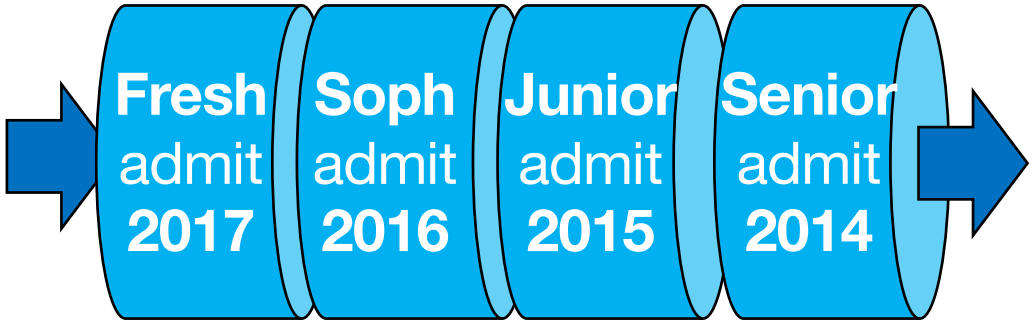
CS+Astronomy

CS+Chemistry



CS+Linguistics

Design started in 2010, approved 2013, admits 2014



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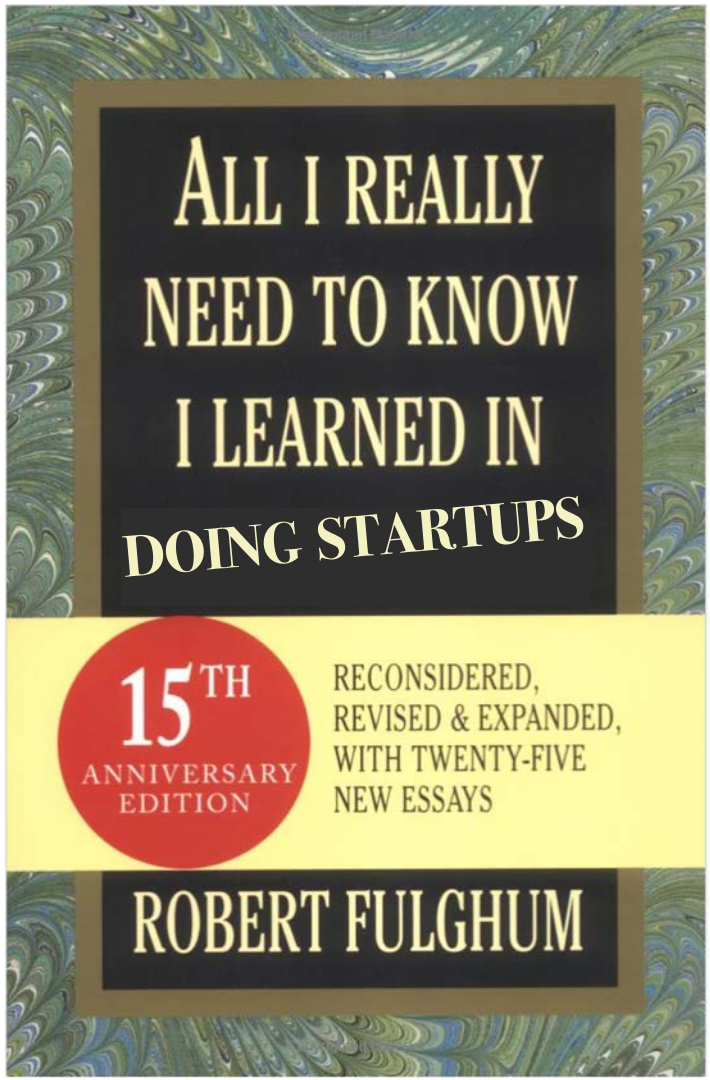
From 2010-2013: UI **Regulatory** Steps

Levels of Governance for Program and Curricular Changes
University of Illinois at Urbana-Champaign

		Program Change	Level	College	Grad College	Provost Office	Ed Pol	UIUC Senate[1]	Senates Conf.	BOT	IBHE
Creating and Eliminating Degree Programs	1	Creation or elimination of a non-credit program or a program of study composed of credit courses that does not result in the formal award of a degree (e.g., certificates of completion, professional development sequences, etc. that do no appear on students' transcripts).[2]	UG	✓							
			Grad	✓	✓						
	2	Addition or elimination of a concentration within an existing major or degree program.	All	✓	*	✓	✓	Consent	✓	Report	List
		Addition or elimination of an organized set of courses within a major (e.g., option, specialization, or sequence) to an existing degree program.	UG	✓		✓	✓	Consent	✓	Report	List
			Grad	✓	✓	✓				Report	List
	3	Creation or elimination of a minor.	All	✓	*	✓	✓	Consent	✓	Report	
	4	Creation or elimination of a certificate program (as defined by IPEDS[3]) in a field in which there is a previously approved degree program.	All	✓	*	✓	✓	Consent	✓	Report	List
	5	Creation or elimination of a certificate program (as defined by IPEDS) in a field or at a level in which there is not a previously approved degree program at that level or higher level.	All	✓	*	✓	✓	Consent	✓	Report	RME
	6	Creation or elimination of a program that results from the reorganization or restructuring of the curricular elements of an existing program that have over time evolved into separate and distinct programs (e.g., split into two or options have evolved into separate programs).	All	✓	*	✓	✓	Action	✓	Action	RME
	7	Creation of a degree program (excluding certificate programs) in a new field or at a new level (based on CIPS or IPEDS definitions).	All	✓	*	✓	✓	Action	✓	Action	Action
	8	Elimination of an existing degree program.	All	✓	*	✓	✓	Action	✓	Action	List
Revising Degree Programs	9	Minor revision of existing degree programs (i.e., minor changes that do not affect the number of hours needed for graduation such as the mix of required/elective courses, minor changes in the list of specifically required courses, etc.)	UG	✓		✓					
			Grad	✓	✓						
	10	Substantial revisions of existing degree programs.	UG	✓		✓	✓	Consent	✓	Report[4]	

CS+X: Design Principles



- **TTM matters**
  - Optimize design to get approvals **fast**
- **Minimum viable degree**
  - **Same** set of CS courses for all X's
- **First pitch: Just like Sand Hill Road**
  - **15mins:** value prop, team, $$, upside
- **Need "early adopter" customers**
  - Find **partner X's** and **faculty inside X** who really, really want **CS+X**
- **Need a business model early**
  - **CS+X** is like ENG: tuition differential is paid. **We split it** (ENG && College[X]).

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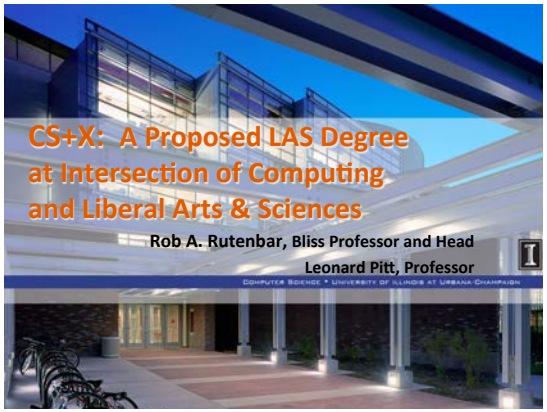
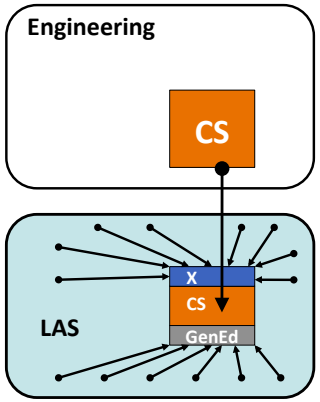
My "**CS+X Pitch**" from Late 2010



COMPUTER SCIENCE

Synopsis of Proposal

- **A new BS degree in LAS: CS+X**
- **3 intellectual components**
  - Foundation in LAS GenEd
  - Foundation in CS
  - Depth in LAS areas (the "X")
- **Business model**
  - CS+X tuition includes the engineering surcharge
  - LAS + COE split this
  - **Net new $ into both COE+LAS**



2

COMPUTER SCIENCE

Mechanics: Proposed Starting Point for CS+LAS

I. LAS REQ'S: up to 47 hours
- Gen-Ed (24), Foreign Lang (0-16), Rhet (0-4), Adv. Comp (0-3)

II. MATH REQ'S: 12 hours
- Calc I, II, ~~III~~, linear algebra (2), prob/stat (3)

III. CS CORE REQ'S: 30 hours
- CS 125,173, ~~210~~, 225, 231, ~~232~~, 241, 242, 373, ~~357~~, 421, 473

IV. *NON-CS* UPPER LEVEL REQ'S: 21-24 hours of X
- a minor, or coherent collection of courses
- a course integrating CS, X (could be indep. study)

TOTAL HOURS = 120 for degree

Slide 15

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CS Part of **CS+X, 1st Edition**

- **To first order, same CS courses in**
  - Intro Programming
  - Software Programming Studio
  - Discrete Math
  - Prob/Stat for CS
  - Data Structures
  - Systems Programming
  - Digital Design & Architecture
  - Programming Languages
  - Algorithms
  - …getting **CS faculty buy-in** on this "spanning basis" is **critical**

- **Basic philosophy: Get solid foundation of CS "stuff" across theory, software, hardware → go do "X"**

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Illinois **CS+X** Notable Side Effects…

Q: Are you *really* making anthropologists take Comp Arch?

A: YES

Unexpected response: Leadership in Liberal Arts very positive that the CS part of CS+X not watered down to accommodate their students. Selling point for them.

2019: CS side of CS+X **Refined…**

- **Not all exactly the same, but pretty close…**
- **Interestingly**
  - **Anthro** kids still taking CompArch
  - **Advertising** kids are not…

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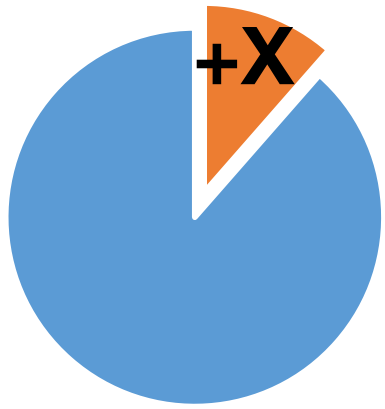
Illinois **CS+X:** Traction (~2016)

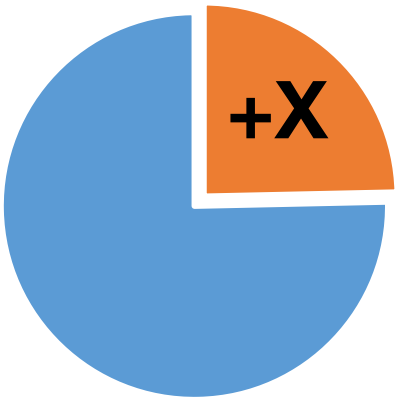
Anthropology



~11%

Of students

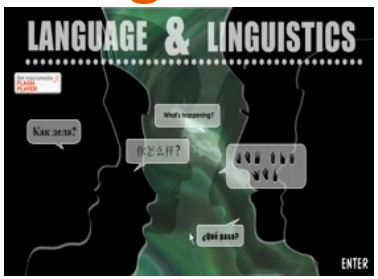
Astronomy

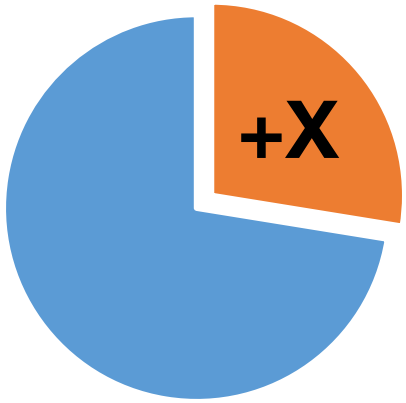


~25%

Of students

Linguistics

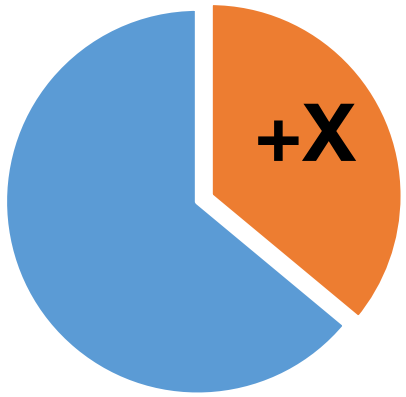




~28%

Of students

Statistics



~36%

Of students

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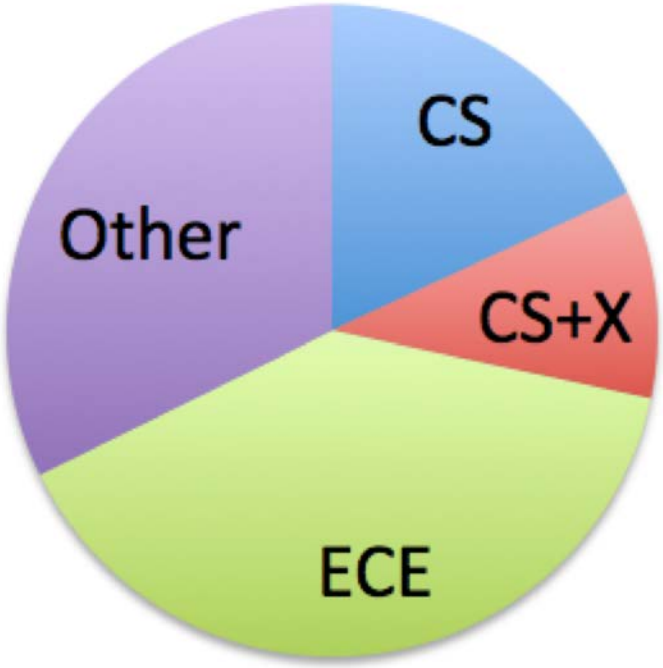
Illinois **CS+X:** '16 Course Demand Examples

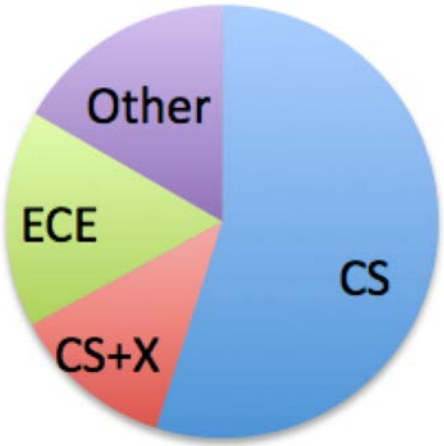
Introductory

CS Data Structures
Enrollment 2016

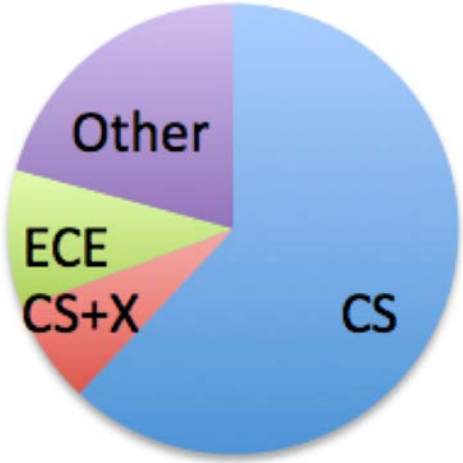


Advanced

CS Databases



CS Datamining



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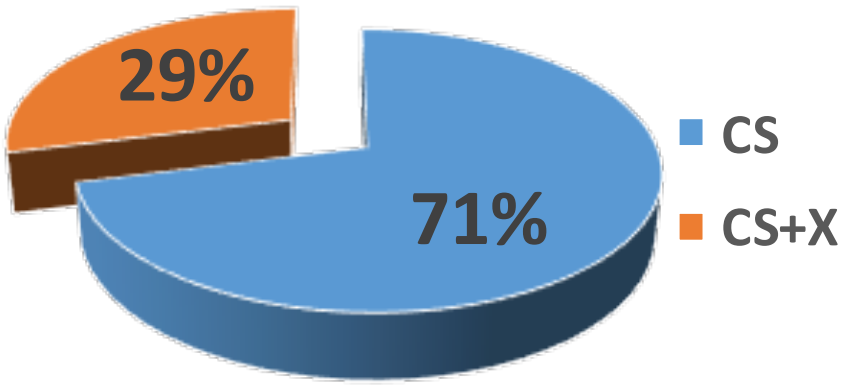
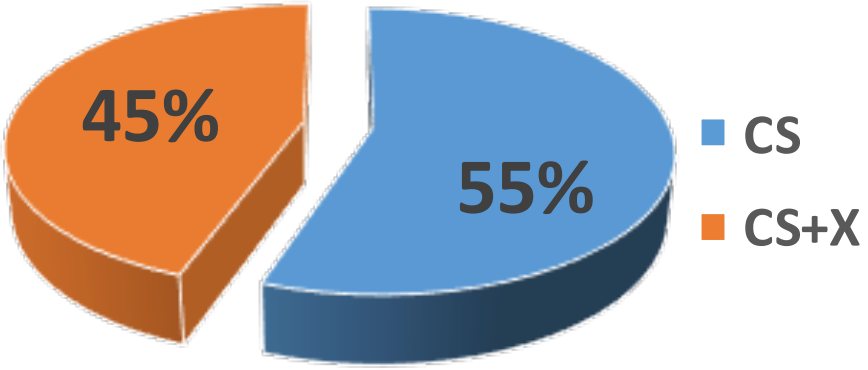
Illinois **CS+X**: 2016 Numbers

- **CS+X approaching 30% of all CS**
- **CS+X approaching 50% of admitted Freshman '16 class**
- **CS+X new degrees now 28% female**



Total CS Enrollment



Freshman 2016 Enrollment

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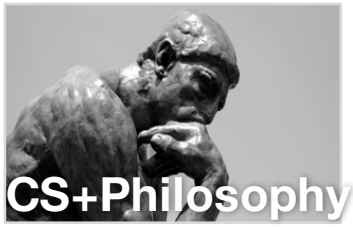
Illinois **CS+X**….

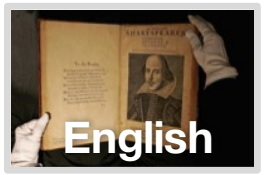
Illinois **CS+X**: Demand Landscape ~2017

- **Huge interest to be "next X" at Illinois**



Next 5 X's -- approved by CS & "X" Units

11 More X's



In discussion

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Illinois **CS+X**: 2019 Numbers

SPRING 2019 ENROLLMENTS

Computer Science	973
Five Year BS/MS	19 / 5
Five Year BS/MCS	26 / 34
Mathematics & Computer Science	265
Statistics & Computer Science	260
CS + Advertising	1
CS + Anthropology	33
CS + Astronomy	40
CS + Chemistry	35
CS + Crop Sciences	5
CS + Economics	10
CS + Geography and GIS	1
CS + Linguistics	71
CS + Music	1
MCS	77
Online MCS / MCS in Data Science	716
MS	115
MS in Bioinformatics	7
PhD	324
Total Undergraduate Enrollment	1,740
Total Graduate Enrollment	1,286

Legacy

Since 2013

New in the last 12-24mo

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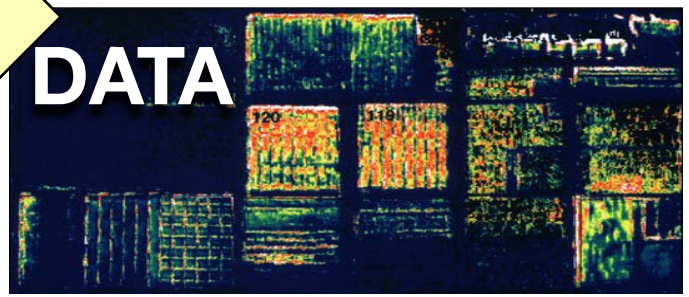
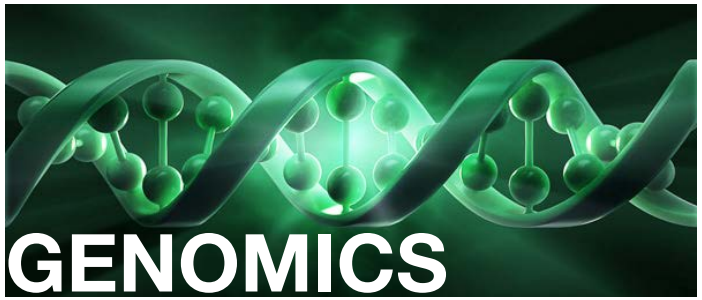
New Illinois **CS+X**: X=**Crop Science**

Crop Sciences Core	
CPSC 112	Introduction to Crop Sciences
Select two of the following:	
CPSC 226	Introduction to Weed Science
CPSC 270	Applied Entomology
PLPA 204	Introductory Plant Pathology
CPSC XXX	**New Course- Data in Bio & Agric**
CPSC 261	Biotechnology in Agriculture
CPSC 265	Genetic Engineering Lab
CPSC 352	Plant Genetics
CPSC 440	Applied Stats Methods I
Select two of the following:	
CPSC 418	Crop Growth and Management
CPSC 452	Advanced Plant Genetics
CPSC 453	Principles of Plant Breeding
CPSC 466	Genomics for Plant Improvement
CPSC 498	Crop Sci Professional Develpmt

CS+X





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Illinois **CS+X**: Lots of New Traction

THE CLIMATE CORPORATION INVESTS IN ILLINOIS' CS + CROP SCIENCES MAJOR

Apr 30, 2019 Lauren Quinn, College of ACES

Technology in the agricultural industry continues to expand, and with it, the demand for employees prepared to work for agricultural companies. In an effort to build a talent pipeline, The Climate Corporation (Climate), a subsidiary of Bayer, made a $500,000 investment in a new major at the University of Illinois.

Leading the digital agriculture revolution, the Department of computer Science and Department of Crop Sciences last year launched the first-of-its-kind major combining computer science and crop sciences.

Climate's gift, which will provide scholarships to students in the new program, stretches over a five-year period and aims to help it grow.

Assistant Professor Nico Martin, part of the Crop Sciences faculty, works with a student to analyze data.

"In an effort to build a talent pipeline, The Climate Corporation (Climate), a subsidiary of Bayer, made a $500,000 investment in a new major at the University of Illinois."

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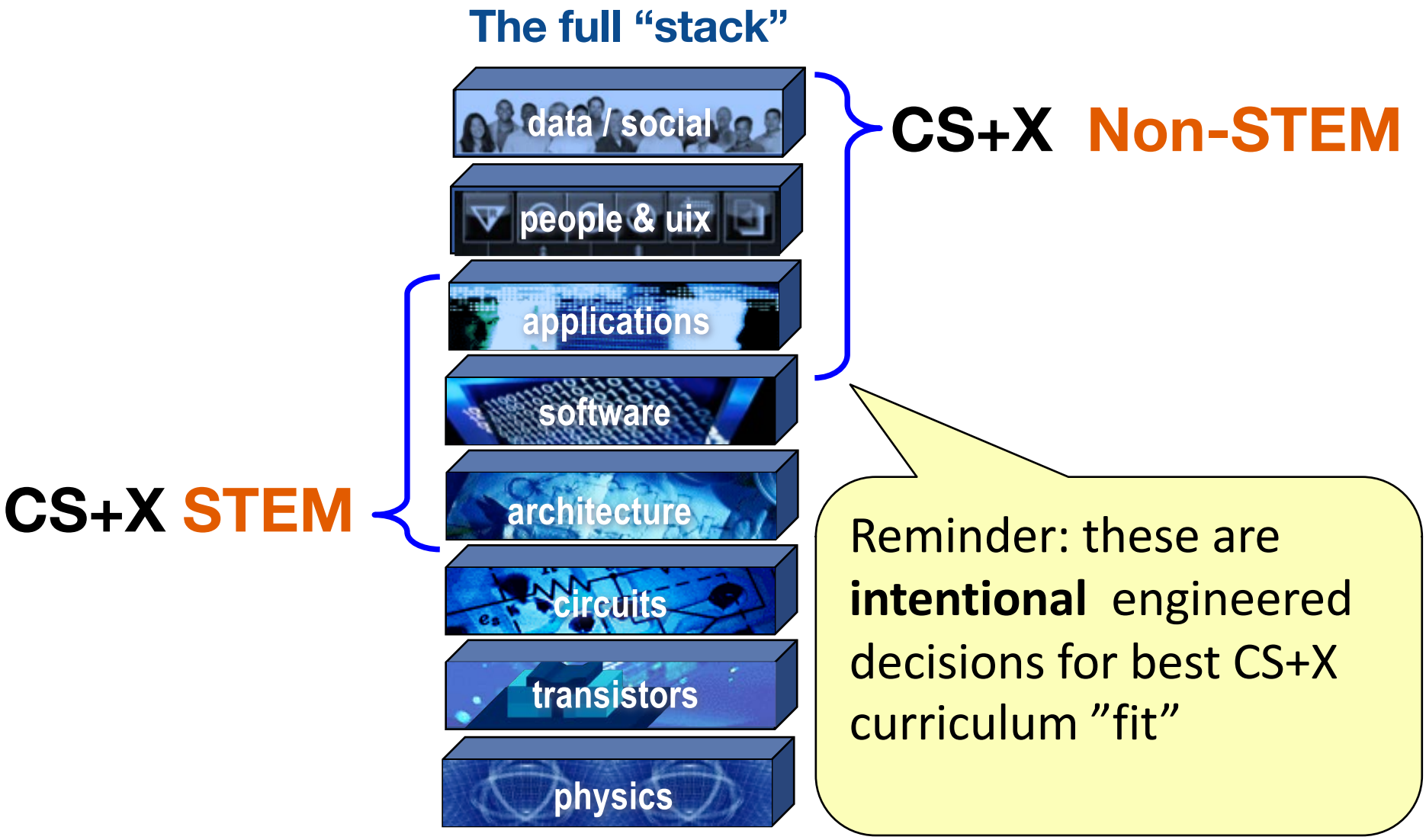
CS+X Convos: Where in the Stack



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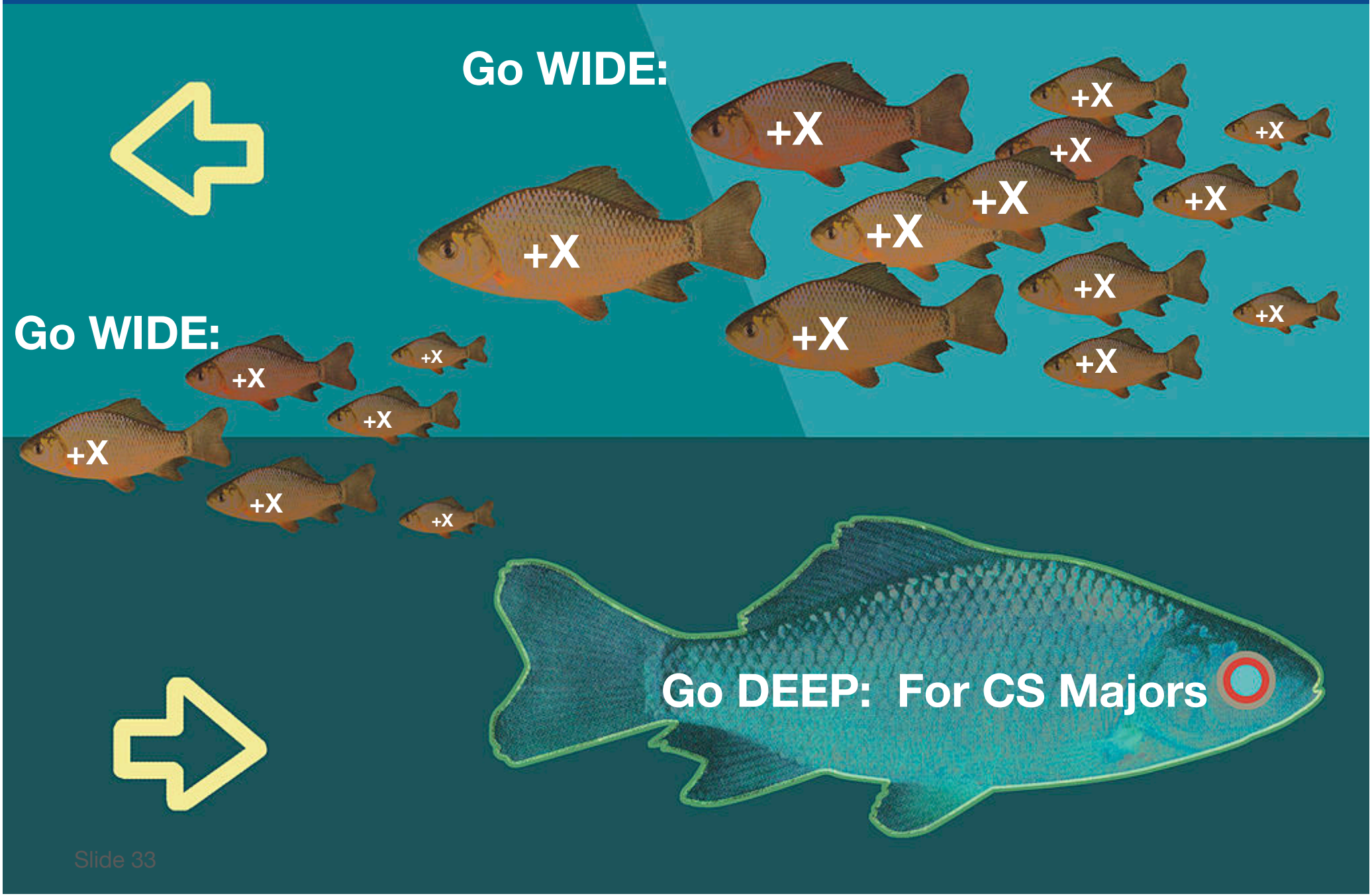
Summary: **Wide** (and Deep)