2016 CRA Conference at SNOWBIRD

JULY 17 – 19 • Snowbird, Utah

PROGRAMS FOR HIGH ACHIEVING STUDENTS

Speakers:
Marie desJardins (UMBC)
Maggie Johnson (Google)
Bruce Porter (UT Austin)
Jennifer Rexford (Princeton)
Moderator:
Nancy Amato (Texas A&M)

CRA
Computing Research Association

FORMAT OF THIS SESSION

- Each speaker will describe programs at their institution (~8 minutes + 2 minutes Q&A)
- 15 minutes joint Q&A at the end

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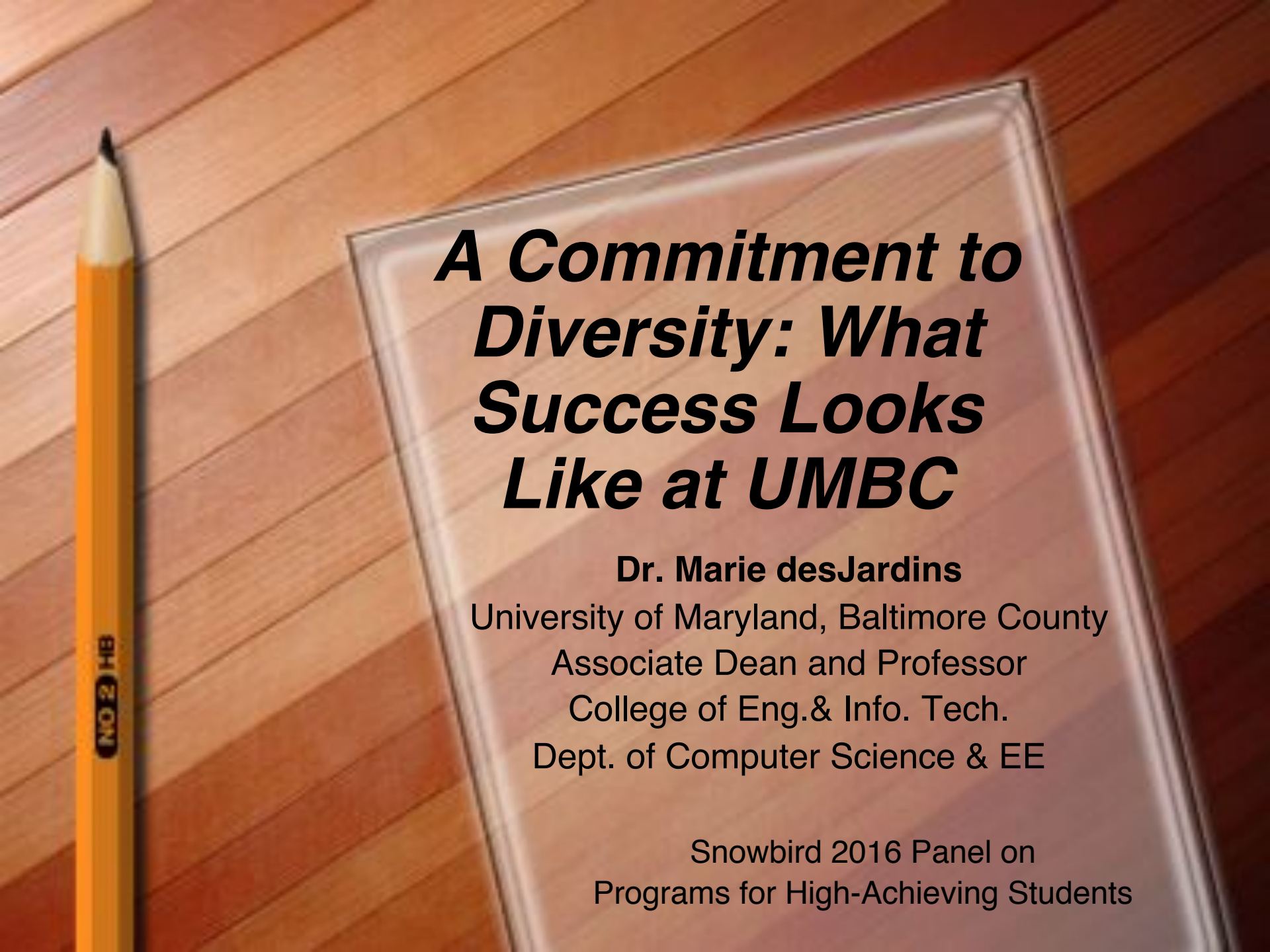
MARIE DESJARDINS
UNIVERSITY OF MARYLAND BALTIMORE COUNTY



A Commitment to Diversity: What Success Looks Like at UMBC

Dr. Marie desJardins
University of Maryland, Baltimore County
Associate Dean and Professor
College of Eng.& Info. Tech.
Dept. of Computer Science & EE

Snowbird 2016 Panel on
Programs for High-Achieving Students

UMBC at a Glance

- One of eleven University System of Maryland campuses, one of three USM research universities
- About 13,000 students, including 2500 grad students
  - CSEE has the second most majors (after Biological Sciences)
  - About 15% of undergraduates major in CS, CE, or IS
  - **6th largest producer of computing majors in the country (of not-for-profit institutions)**
- Founded in 1966, Carnegie “Research Doctoral Extensive” by 2002
- **Famous for diversity, and chess, but not football!**

Programs of Interest

- **Scholars (and Affiliates) Programs: Meyerhoff, CWIT, Cyber, T-Site (and others)**
- **Strong emphasis on undergraduate research**
- **Grand Challenge Scholars Programs**
- BS/MS programs (in all COEIT BS degrees)
- Pedagogical innovation:
  - Freshman course: COMP 101
  - Differentiated instruction: CMSC 201
  - ACTIVE Center
- BRAID
- Student organizations – SWE, NSBE, SHPE, ACM, CyberDawgs, game design club, student-led hackathons and other events

Scholars Programs

- Center for Women in Technology
  - Goal: increase gender diversity in computing and engineering
- CyberScholars
  - Goal: Increase gender and racial diversity in cybersecurity
- T-SITE
  - Goal: Improve transfer experience for computing majors, especially women and minorities
- Meyerhoff Scholars
  - Goal: Increase the number of minority students receiving PhDs in the sciences
  - UMBC is the #1 generator of African American MD/PhD students in the country

- All programs provide mentoring, focused advising, academic career development programs; most also provide services for affiliated students (non-scholars)

Undergraduate Research

- Undergraduate Research Awards and
- URCAD (Undergraduate Research & Creative Achievement Day) – over 250 student presentations
- UMBC Review – student journal
- Many (most?) CSEE faculty who are active in research work with undergraduates (often with NSF REUs)
- 7% of CS majors participate in undergraduate research (based on climate survey data)
  - 10% of students with GPA above 3.0, 12% of students with 4.0 GPA

Grand Challenge Scholars Program

- Train a future generation of engineers who are prepared to work on the NAE Grand Challenges
- >100 universities have committed to creating GCSPs
  - UMBC's is the 26th approved program
  - 17 students in 1st cohort (icludes three CS majors and two CS minors)
- Five "threads":
  - Research
  - Interdisciplinarity
  - Entrepreneurship
  - Global dimensions
  - Service

NAE Grand Challenges

- 14 “Grand Challenges” identified and developed by an international team of experts, in four broad areas:
  - Sustainability
  - Health
  - Security
  - “Joy of Living” and the human mind
- Solutions to these challenges will need:
  - Sustained commitment over 10-20+ years
  - Interdisciplinary collaboration
  - Public policy and economic considerations
  - Effective communication with diverse users

Sustainability
(aka “Energy and Environment”)

Make solar energy economical

Provide energy from fusion

Develop carbon sequestration methods

Manage the nitrogen cycle

Provide access to clean water

Health

Advance health informatics

Engineer better medicines

Security

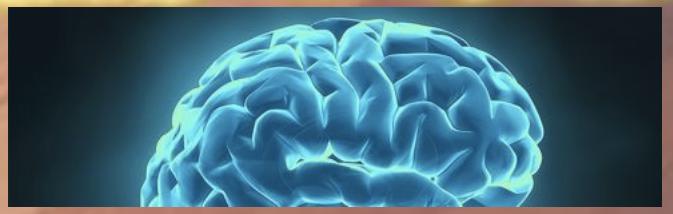
Prevent nuclear terror

Secure cyberspace

Restore and improve urban infrastructure

Joy of Living
(aka “Learning and Computation”)

Reverse engineer the brain



Enhance virtual reality

Advance personalized learning

Engineer the tools of scientific discovery

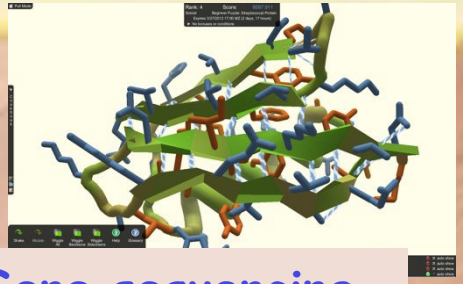
Images: engineeringchallenges.org

Learning Objectives

- **Program-wide learning objectives** (core set, plus personalized objectives): In their GC activities, students should exhibit:
  - **Integrity**
  - **Perspectivism**
  - **Realistic vision**
  - **Teamwork**
  - **Persistence**
  - **Flexibility**

- **Learning objectives for each area** (core set, plus personalized objectives)

Helping People with Computing



Gene sequencing and protein folding

Political modeling and forecasting

Self-driving cars

Urban planning

Teaching!

Assistive devices

Ideas for the Future

- Improved departmental honors program
  - Offer honors classes more regularly
  - Make it more feasible for top students to earn honors
- Connect computing more effectively to real-world problems and challenges
  - GCSP, course content, cocurricular activities, Entrepreneurship Center

MAGGIE JOHNSON
GOOGLE

Programs for College Students

Maggie Johnson
Director of Education and University Relations
Google, Mountain View CA

Internships

Technical Internships

Build new features and improve our products (and get some extra guidance along the way). Start dates are flexible and are offered year-round, but you'll need to commit to at least three months of full-time work.

Product Management Internships

Get a head start on learning how to drive product development while working at Google speed. Start dates are flexible, but you'll need to commit to at least three months of full-time work over the summer.

Guide to Technical Development

Having a solid foundation in Computer Science is important in being a successful Software Engineer. This guide is a suggested path for University students to develop their technical skills academically and non-academically through self-paced hands-on learning.

Residencies

Make the transition

The professional engineering environment is constantly evolving. Google's Engineering Residency is specifically designed to accelerate the transition from school to industry - enabling you to have an impact right away.

Learn new skills

At Google, our infrastructure is really complex. As an Engineering Resident, you'll learn the things that are harder to teach in school - from large-scale distributed processing and Google-style test-driven development, to applied theory and code reviews, to developer workflow and beyond.

Residencies

Applied CS with Android

Resources

Google Capacity Award Program

Internships

Engineering Residency

Brain Residency

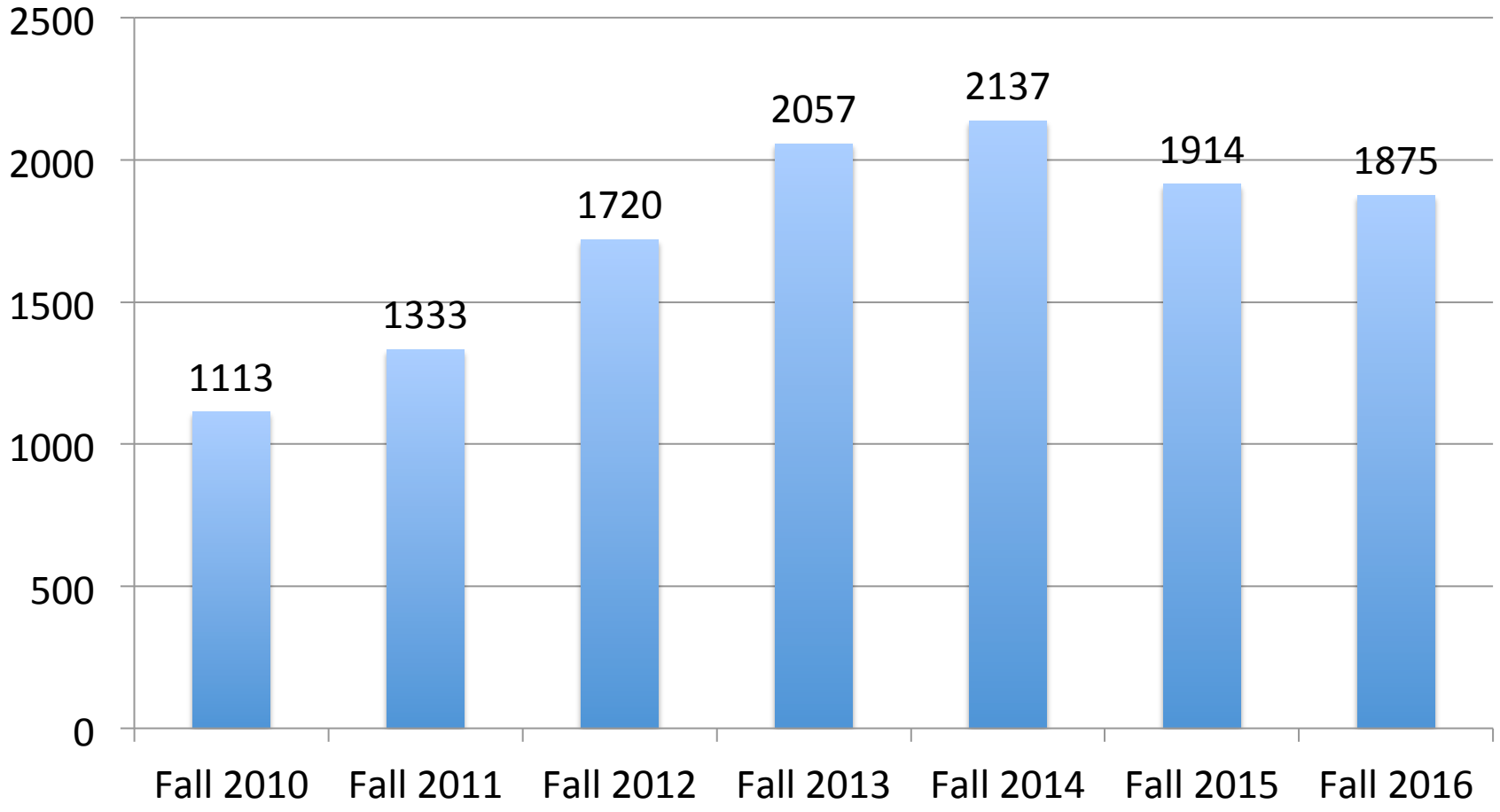
Applied CS with Android

BRUCE PORTER
UNIVERSITY OF TEXAS AT AUSTIN

Student Enrichment Programs

Bruce Porter
Professor and Chairman
Department of Computer Science
University of Texas at Austin

Total Undergraduate Enrollment by Year



5-Year BS/MS Programs

- In 5 years, a BS in CS and an MS in one of:
  - CS
  - Information Science (UI/UX)
  - Computational Science, Engineering and Math
- About 10 new students/year in each program
- Students begin graduate courses in year 4, and take only graduate courses in year 5

Fringe Benefits

- Reduce load on upper-division CS classes
- Improve relations with other departments
- A repeatable way to address the proliferation of CS across campus: “for every X, computational X”

Turing Scholars Honors Program

- Created in 2004
- Started with ~30 students/year, almost exclusively from Texas
- Expanded to ~55 students/year, recruited broadly
- Students progress as a cohort

BS-CS Curriculum

- Core classes:
  - Introduction to Programming
  - Data Structures
  - Computer Organization and Architecture
  - Principles of Computer Systems
  - Discrete Math for CS
  - Algorithms and Complexity
- 5 Upper-division CS electives

Honors Curriculum

- Core classes:
  - ~~Introduction to Programming~~
  - Data Structures
  - Computer Organization and Architecture
  - Principles of Computer Systems
  - Discrete Math for CS
  - Algorithms and Complexity
- ~~5~~ 3 Upper-division CS honors electives

Honors Thesis

- *Introduction to Research* (1 hour)
- *Independent Research* (3 hours)
- *Written thesis*, aiming for a publishable result
- *Thesis defense*, presented to *thesis advisor* and *2nd reader*

Fringe Benefits

- Friendly competition among faculty to teach honors classes
- Surprisingly competent Research Assistants
- Control over admissions; e.g. 28% female; median class rank: 5 (out of 500)

JENNIFER REXFORD
PRINCETON UNIVERSITY

Programs for High-Achieving Students
Snowbird Panel

Jennifer Rexford

Gordon Y.S. Wu Professor of Engineering

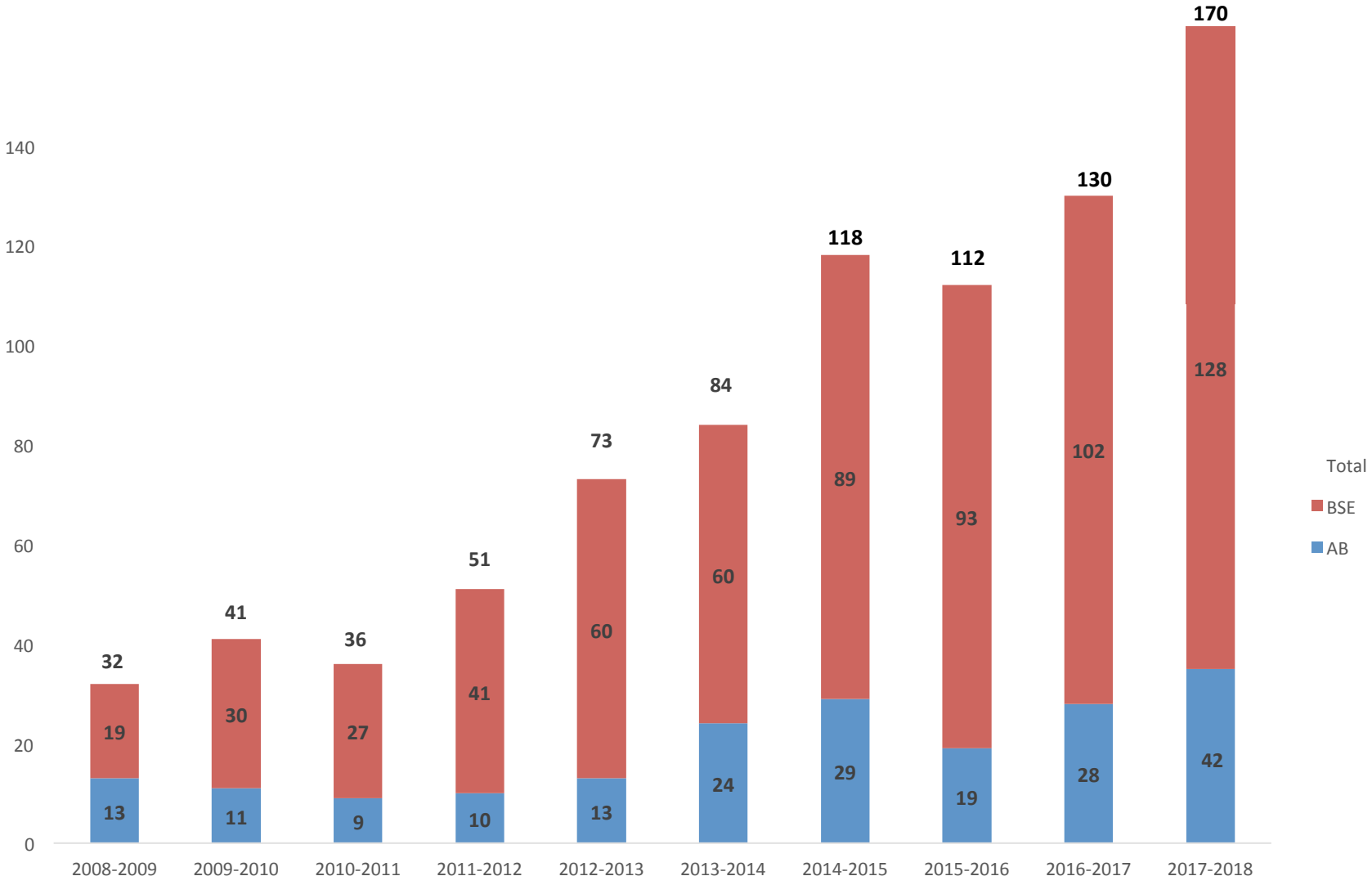
Chair of Computer Science

Boutique Education at Scale

- Princeton model: *boutique*
  - Small classes
  - Preceptorial system in larger classes
  - Low ratio of students to teaching assistants (~25:1)
  - Every student conducts research with faculty

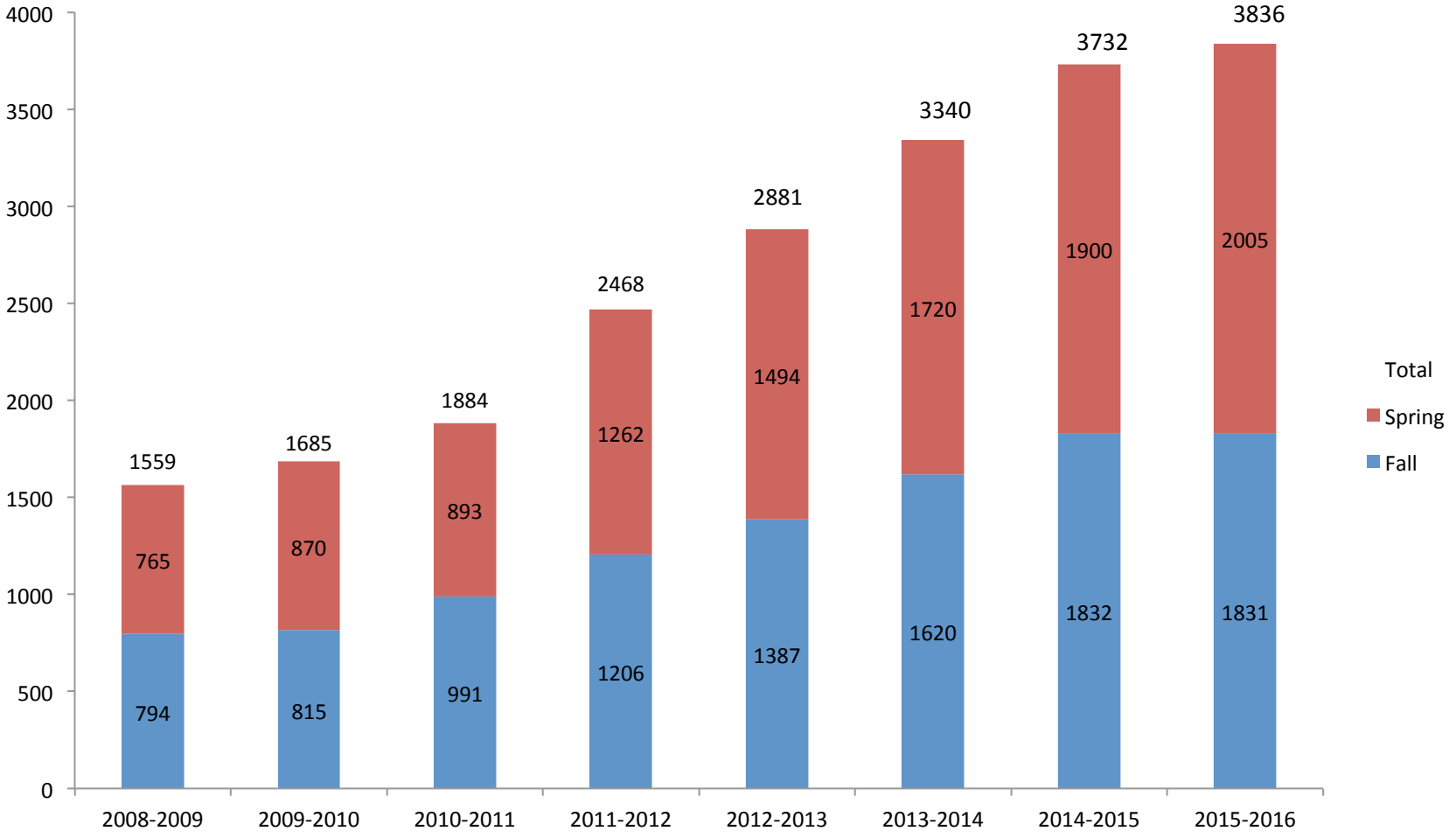
- Meets reality: *scale*
  - Rapidly growing majors and enrollment
  - Large classes, even at the upper level
  - Huge IW advising load per faculty member

Undergrad CS Majors by Class Year



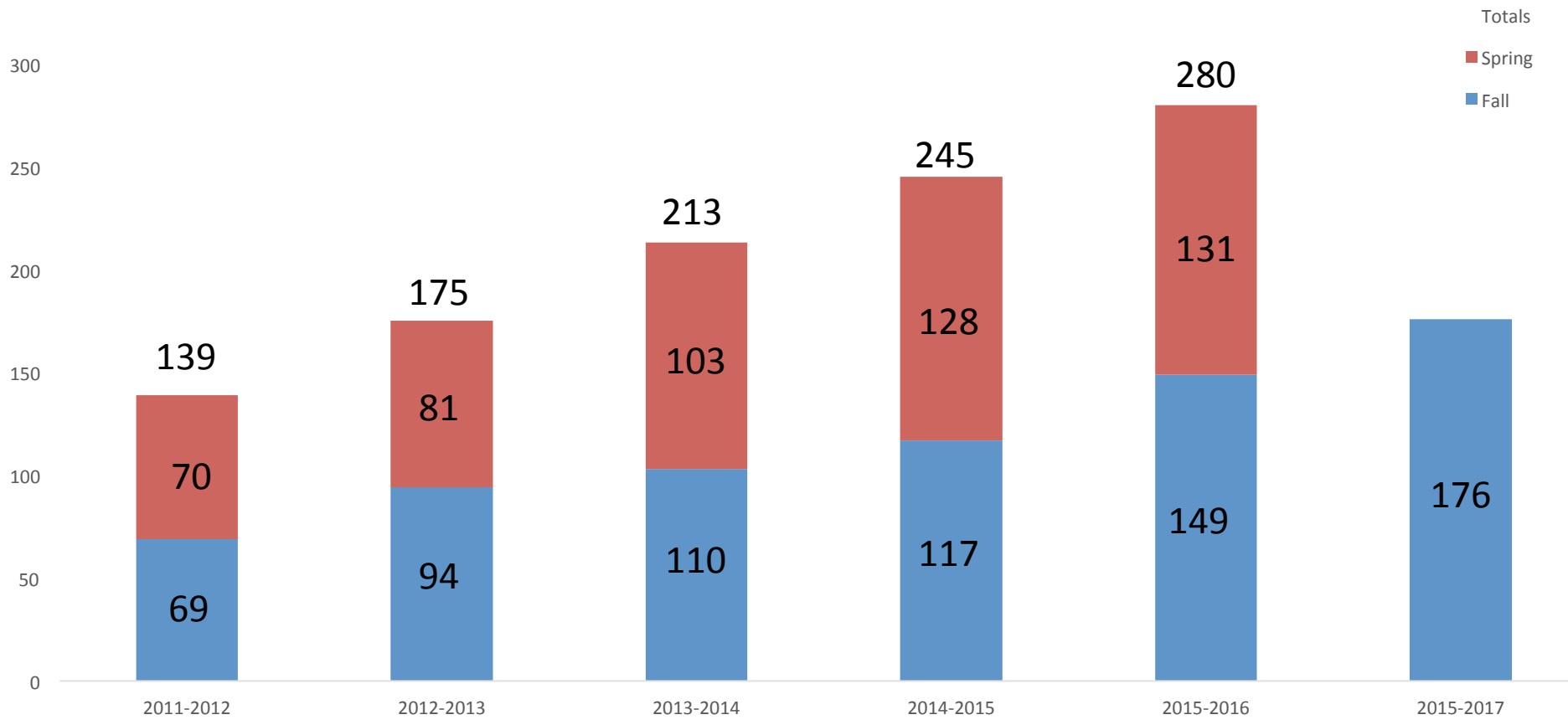
CS has 10-13% of all *majors* on campus

CS Enrollments

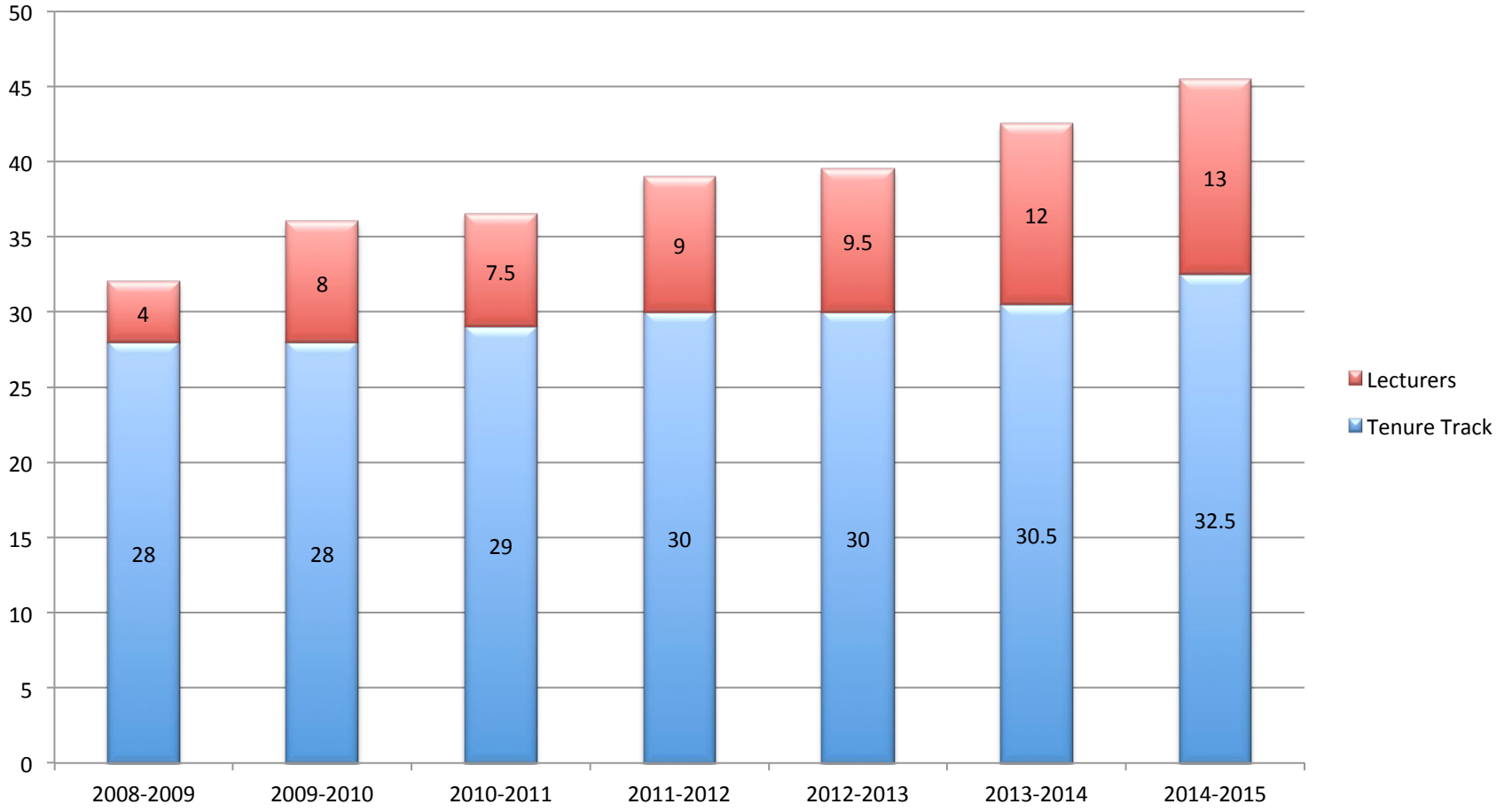


CS has 10% of all *course enrollments* on campus

Independent Work Projects



CS Faculty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2008-2009
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2013-2014
2014-2015
4
8
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9
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12
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28
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29
30
30
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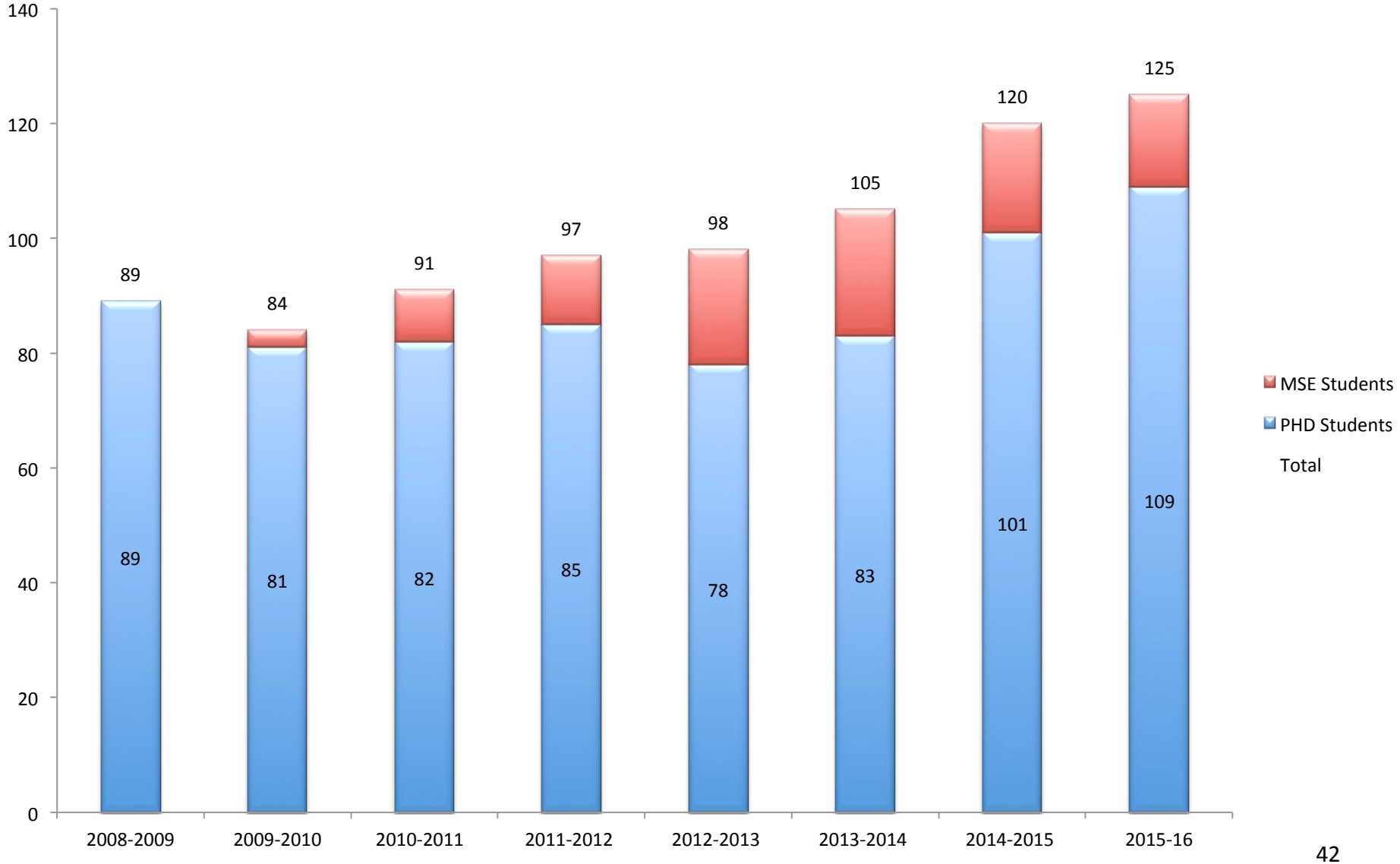
32.5
Lecturers
Tenure Track

Graduate Students



Scaling

- Teaching support
  - Teaching faculty (“Lecturers”)
  - Master’s program (fully funded as TAs)
  - Undergraduate lab TAs and graders
- Independent-work
  - IW seminars (10-12 students per seminar, with a faculty member and a part-time TA)
  - Led by tenure-track or teaching faculty (”count” like teaching 2/3 of a regular course)
  - Especially for students pursing their first IW project

Effect of IW Seminars on Advising

Type	2013-14	2014-15	2015-16	Fall 2016
AB Thesis	48	56	42	29
BSE Thesis	30	20	48	6
IW Individual	135	169	69	21
IW Seminar	0	0	121	100
Unknown	0	0	0	20
Total	213	245	280	176

Outward-Facing IW Seminars (Fall ’15)

- Relationship networks: Social networks and beyond
- Understanding the world with sensors
- Entrepreneurial lessons for computer science
- Online learning and MOOCs
- A brave new data world
- Apps for the environment

Outward-Facing IW Seminars (Spring ’15)

- Deep learning
- Understanding the world with sensors
- Entrepreneurial lessons for computer science
- Using visualization to improve online CS education
- Using publicly available data to learn, explain, evaluate, and improve
- Apps of random kindness

Outward-Facing IW Seminars (Fall'16)

- Policy issues in the Internet of Things
- Information discovery through relationships
- Help future computer scientists learn CS
- Natural language processing
- Apps of random kindness
- CS tools and techniques for digital humanities
- Entrepreneurial lessons for computer science
- Bitcoins, block chains, and smart contracts
- Bioinformatics lab

For High-Achieving Students

- Independent work
  - IW seminars on timely topics
  - One-on-one IW research projects
  - Funding to present papers at conferences
- Graduate courses
- Master's program
  - Get an MSE after the undergraduate degree
  - E.g., finish undergrad in three years, and get paid to stay another 1-1.5 years!

For High-Achieving Students

- Participating in our teaching mission
  - Undergraduate graders and lab TAs
  - IW or summer projects on scaling our teaching (e.g., automated grading, plagiarism detection)
- Educational outreach
  - IW projects on CS education outreach
  - EPICS team on high-school CS education
- Field trips during fall/spring breaks
  - Entrepreneurship trip to Bay Area
  - Technology policy trip to D.C

Conclusion

- Boutique education at scale
  - By engaging more people: Teaching faculty, MSE students, undergraduate graders and lab Tas
  - By leveraging automation: innovation
  - By changing the structure: IW seminars
- Individual opportunities for students
  - Serving in our teaching mission
  - Participating in research with faculty
  - Engaging with the broader community

QUESTIONS

Speakers:

Marie desJardins (UMBC)

Maggie Johnson (Google)

Bruce Porter (UT Austin)

Jennifer Rexford (Princeton)

Moderator:

Nancy Amato (Texas A&M)

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