Grad Education in CSE

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Institute for Computational & Mathematical Engineering
Stanford University

ICME Institute anno 2004 (or '88)

Design models and algorithms

Advance disciplinary fields

Train students and scholars

MSc and PhD degrees

50+ affiliated faculty

160 graduate students

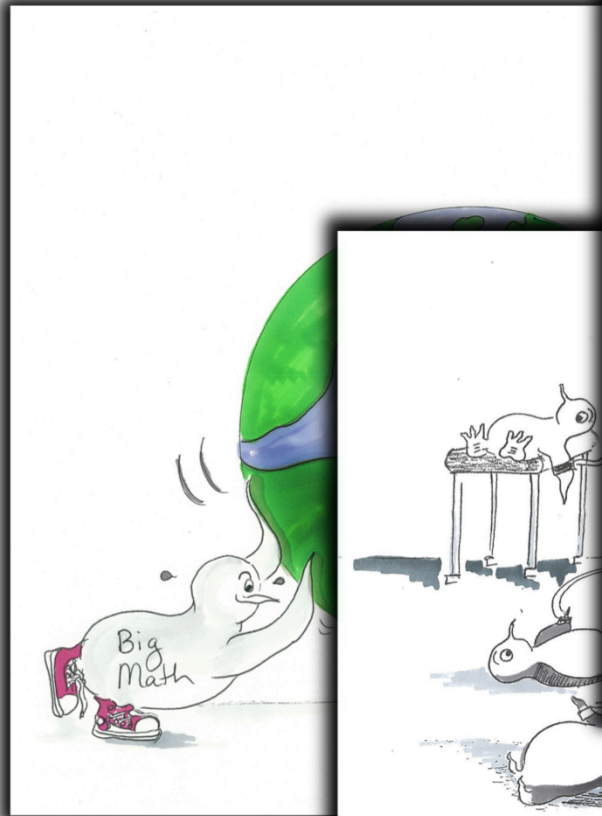# Great fun in more ways than one

Inspired by

- Ubiquity and criticality of our field

- Unique opportunities in Masters & PhD programs

- (Exciting) challenges in teaching and learning

  Engagement

  Empowerment

  Rapidly evolving field

Pillar, elixir, glue and student recognize this

MSc PhD

MSc lifts students to 10,000 ft

A time of application, analysis, and evaluation

- Deepen foundations
- Understand connections – multidisciplinary expertise
- Explore complex applications
- Start probing larger research questions

- Instill love of life-long learning
    continue with PhD/learn on job

Overarching goals: **agility, with (some) domain expertise**

PhD lifts students to 20,000 ft

A time of application, analysis , evaluation and creation

- Deepen foundations further

- Synthesize ideas across disciplines

- Gain deep research experience

- Become excellent communicator/teacher

Overarching goals: **agility, domain expertise, grit**

Professional development equally important

Employers, in all areas, look for demonstrated ability to

- think critically

- communicate clearly

- solve complex real-life problems

- thrive in multi-disciplinary settings

and seek candidates with

- agility

- ethical judgement & integrity

- intercultural skills

- zest for continued new learning

ICME Xtrapolate 2016

MSc   Short period, many deliverables

MSc program prepares for

- PhD in our field of computational math

- PhD in application areas

- Industrial career

Breadth vs depth

Skills vs agility

Courses vs research

Expectations vs reality

MSc program prepares for

- PhD in our field of computational math

- PhD in application areas

- Industrial career

Moved to

- MS specialized tracks

- Project-based learning

- Capstone projects

- Internships

Industry or academia after graduation?

Finish or leave early (for the Valley)?

Postdoc (and for how long) or assistant prof?

- Teacher Training Program

- Consulting opportunities

- Summer internships

- Sabbaticals

- External advisors

MSc and PhD　Shared challenges

Time of adjustment

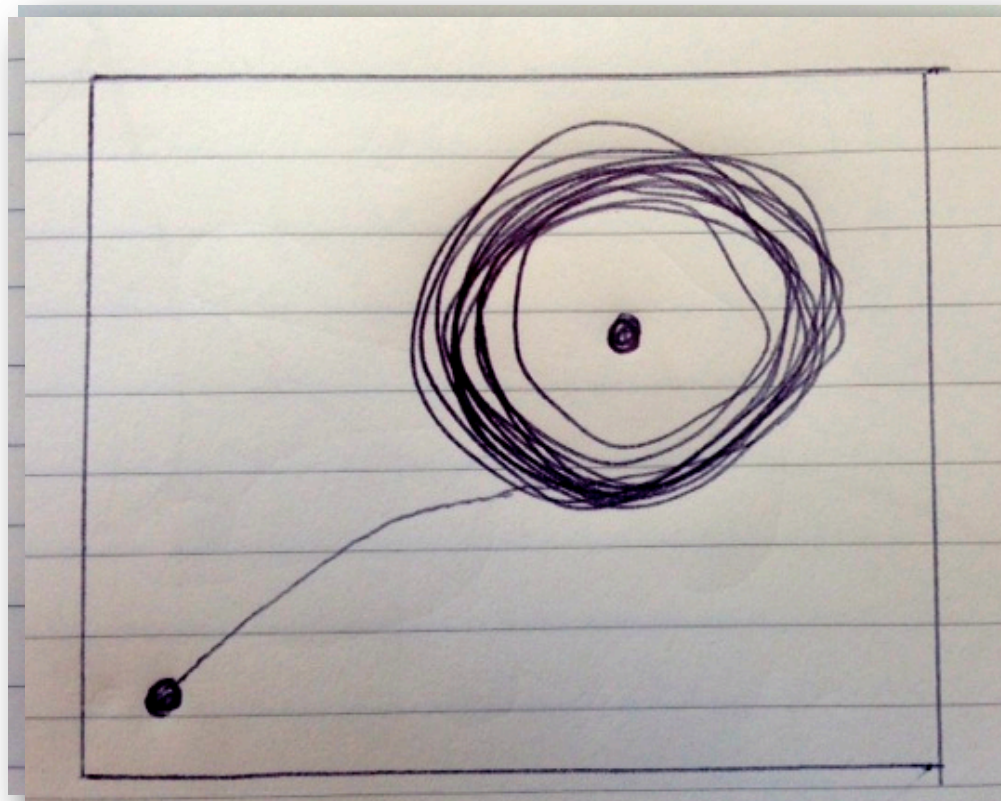- Learning culture (creativity, interdisciplinary)

- Lake Wobegon effect

Insufficient preparation in primary, secondary education

- Teaching to the test, regurgitation

- Over-emphasis on grades, not learning

Mindset challenges

- Fear of "failure", belief in innate abilities

Mindset Musings

"I'm just not any good at mathematics"

"Innate ability" stated early on & reinforced repeatedly
For women may be worsened by stereotype threat

Just because some can do it with little or no training,

does not mean that others can not do it with training

Symptoms of (partially) fixed mindset

- *"This one low score shows I just cannot do it"*
  Midquarter crisis, attrition

- *"My low score is your fault"*
  Strong resistance to admitting lack of understanding

- *"There's no point in studying"*
  Need for study would show lack of innate ability
  Also fear of failure after studying

- *"I'm good in calculus, just not in algebra"*
  Confidence in one ability, not in another

IMPOSTER syndrome

I am not as capable as people think I am

and they will find out sooner or later

It is
more luck than talent
that got me where I am

Stanford Survey

Conducted via Facebook friends and emailing lists

220 responses in 24 hours (80 male, 140 female)

Over 90% of answers from engineering/science fields

I'm afraid to be found out

I think that ....

often/always

43% male, 62% female

never/rarely

30% male, 15% female

I'm afraid to disappoint

I think that ....

Often/always

40% male, 60% female

never/rarely

18% male, 6% female

Others are more capable

I think that ....

often/always

50% male, 71% female

never/rarely

22% male, 6% female

If you have such feelings, is performance affected?

Male
- 52%   yes, negatively   ("scared","avoidance behavior")
- 27%   yes, positively   ("work harder")
- 21%   no

Female
- 87%   yes, negatively ("scared", "avoidance behavior", "exhaustion", "negative impacts on personal life")
- 7%   yes, positively ("work harder")
- 7%   no

Can anything be done?

Male

 45% advisor/mentor/instructor can help

 5%   nothing can be done by anyone

 50% I need to do this myself

Female

 76% advisor/mentor/instructor can help

 2%   nothing can be done by anyone

 11% I don't know

 11% I need to do this myself

What can be done?

Frequent suggestions for advisors

Male

- Give honest and regular feedback
- Give students a sense of importance of their work
- Be more involved

Female

- Set students up for (small) confidence building successes
- Be open about stress, I.S., own failures
- Give regular encouragement and positive reinforcement

Why do students drop out?

Fragile confidence – fear of failure

- Belief that they are just not any good

- Belief that they just cannot be any good, ever

Unsupportive environment

- Classroom atmosphere of judgment, not trust

- Lack of peer support, discouraging culture

- Inadequate mentoring/guidance

Uninspired teaching

- Teachers unmotivated

- Relevance of material not clear
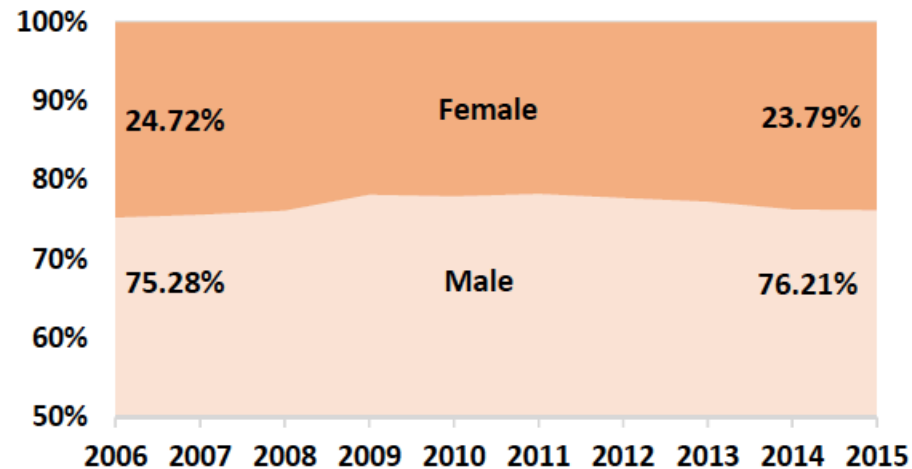
We try to help

- Trust, don't judge – allow for (frequent) failure

- Understand and cater to different learning styles

- Reward progress – what matters is final mastery

- Set high standards and show students how to reach them

- Emphasize that growth does not happen without effort

- Create supportive environment

- Instill lifelong love of learning

- Show relevance – involve alumni/external partners

Where are the women?

Known Nonstudent Gender Breakdown

Female: 10.88% (2006) → 15.06% (2015)
Male: 89.12% (2006) → 84.94% (2015)
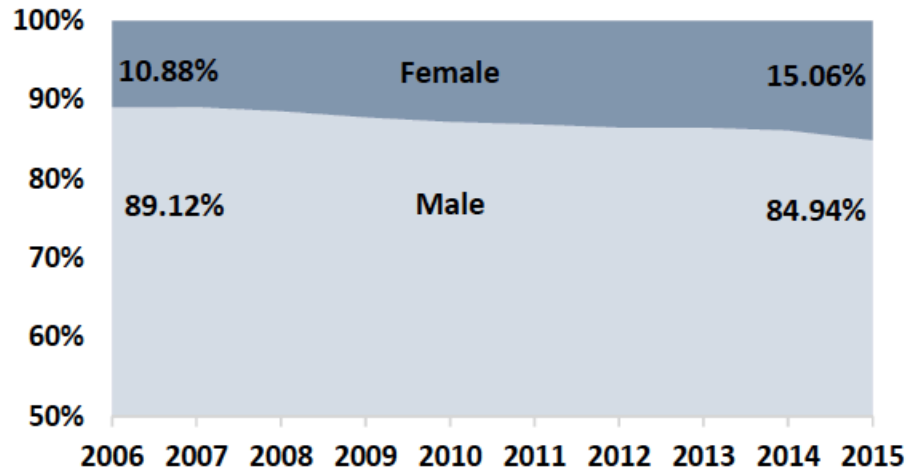
Known Student Gender Breakdown

Female: 24.72% (2006) → 23.79% (2015)
Male: 75.28% (2006) → 76.21% (2015)

SIAM membership 2006-2015

Why attrition?

- stereotype threat, imposter syndrome;
- environment unsupportive, (un)conscious bias;
- subcritical mass, lack of role models

Women in Data Science

widsconference.org

Live-streaming

25+ satellite events

WOMEN IN **DATA SCIENCE**
FEBRUARY 3, 2017
@ STANFORD UNIVERSITY

Contact Judy.Logan@stanford.edu
if interested in organizing a satellite event

Faculty are people too

Teaching often undervalued

- Not a significant part of tenure or promotions

- Few resources available for (re)design course material

- Best teaching practices infrequently shared

- Career instructors do not have a clear promotion path

Teacher training rarely made integral part of PhD

Keeping up with Everything

Pascal	R
F77	Multi-core
MATLAB	Python
MPI	CUDA
OpenMP	MapReduce
C++	Julia

To MOOC and Flip, or not?

Flipped classroom – mixed responses

MOOCs – impact on campus students

Create more flexible, smaller teaching units

(1-unit classes and short courses, often online)

- Improves efficiency and reduces overlaps

- Allows for professional education, life-long learners

- Provides low-risk teaching opportunities for graduate students

Data Data Data Data Data Data Data Data

Strong and fast move to data driven research

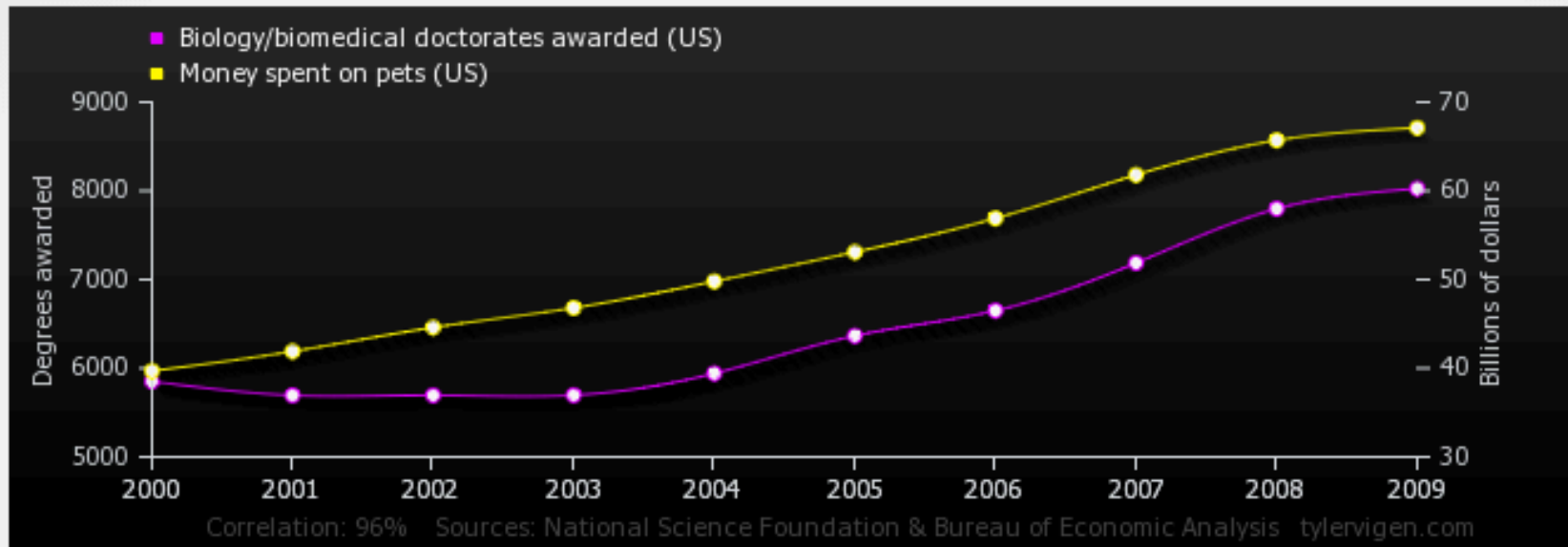Largest research area in our PhD and MS program

Increasing numbers of non-STEM students/professionals in foundational math and stats courses

Extremely strong pull from industry (Silicon Valley)

Biology/biomedical doctorates awarded (US)
correlates with
Money spent on pets (US)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Biology/biomedical doctorates awarded (US) Degrees awarded (National Science Foundation)	5,853	5,694	5,695	5,696	5,942	6,366	6,649	7,187	7,798	8,026
Money spent on pets (US) Billions of dollars (Bureau of Economic Analysis)	39.7	41.9	44.6	46.8	49.8	53.1	56.9	61.8	65.7	67.1

Correlation: 0.95544

Life long Learning

Professional Education

- Very strong demand for continuing education
- Technology moves fast, also for professionals

Universities increasingly look beyond traditional programs

External partner programs

- Consulting professors
- Joint research
- Internship programs

Inspire to
- love challenges
- be intrigued by mistakes
- enjoy effort
- keep on learning

Mindset, Carol Dweck

Collaborate across universities

- Share best practices and resources

- Mentor and network

- Attract and retain diverse talents

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