



Michael Ball



The Beauty and Joy of Computing

Lecture #13 CS Education Research



Google's AlphaGo AI Beats World's Best in Game 1

"AlphaGo, a program developed by Google's DeepMind unit, has defeated legendary Go player Lee Se-dol in the first of five historic matches being held in Seoul, South Korea. Lee resigned after about three and a half hours, with 28 minutes and 28 seconds remaining on his clock."



<http://www.theverge.com/2016/3/9/11184362/google-alphago-go-deepmind-result>



Who am I?

- **I took CS10 Fall 2011**
 - Graduated L&S CS Spring 2015
 - (Hopefully) MS CS Spring 2016!
 - TA'd CS10 for 3 years, and was Co-Instructor past summer
- **Research + Work in CS Education**
 - Labs Autograder
 - Developing Snap!
 - Writing curriculum
 - Keeping websites running....
- **Why CS?**
 - Lots of challenging, useful problems!
 - Connections to other fields — I love photography!



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Admin: Autograded Labs

- **Snap! Labs: Can submit through bCourses now!**
- **You can get checked off either way**
 - EXCEPTION: Lab 11 is required through bCourses
- **Sorry if there's bugs in the score posting!**
 - All the submissions are logged, and I'll fix bCourses
- **Demo**
 - <https://bcourses.berkeley.edu/courses/1408649/assignments/7531220>
- **Hopefully: extra autograded practice problems**
 - Just for fun, not really for a grade.





Outline

- **What is CS Education Research?**
 - How can we use CS, technology to teach better?
 - How can we learn to teach CS better?
 - Recently: How can we scale CS? Increase diversity?
- **Where does CS10 come in?**
 - History
 - Where we are now
 - The Future
- **How can you get involved?**



CS Education



Computer Science ... A UCB view

- **CS research areas:**

- Artificial Intelligence
- Biosystems & Computational Biology
- Database Management Systems
- Education
- Graphics
- Human-Computer Interaction
- Networking
- Programming Systems
- Scientific Computing
- Security
- Systems
- Theory
- ...



Education Research (with a CS lens)

- Goal: Improve teaching & learning for “all” disciplines (if possible)
- Why get computer scientists involved?
 - Unique position to build tools
 - edX, bCourses (Canvas) were started by ‘CS people’
 - CS overlaps with relevant fields
 - Human-Computer Interaction
 - Cognitive Science
 - More Recently: Artificial Intelligence
- Best research requires collaboration!!



What Questions Do We Ask?

- **What is the best use for lecture time?**
 - “Flipped Classroom” where students watch videos for HW and do ‘homework’ in lecture
 - “Active Learning” — techniques to keep you involved in a lecture, like iClickers.
- **How can we leverage new data to understand students better?**
 - “MOOCs”– Massive Open Online Courses
 - What changes when 100,000 people take a course together?



iClicker: Meta Question

Have you taken a class (other than CS10) that:

- A) Uses iClickers (or similar) during lecture?
- B) Uses a 'flipped' classroom style
- C) Both A and B (can be multiple courses)
- D) Neither A nor B





iClicker: Meta Question 2

How helpful do you find iClickers in CS10?

- A) Very Unhelpful
- B) Somewhat Unhelpful
- C) Neither helpful or unhelpful
- D) Somewhat helpful
- E) Very helpful





Improving CS Education

- Goal: Make learning and teaching CS easier, and more accessible
- CS students dropout and struggle more than other majors.
- Lower percentage of women studying CS today than were 20 years ago.
- UNI: Enrollments are booming, and we don't know what to do...
- HS: Very few teachers are ready to teach CS in High Schools.





Retention and Dropout

- 2012 PCAST Report [[Read](#)]
 - Fewer than 40% of students who enter college intending to major in a STEM field complete a STEM degree.
 - High-performing students frequently cite uninspiring introductory courses as a reason for switching majors.
- Possible solutions:
 - Create new classes! (like CS10)
 - Connect CS to other disciplines
 - DATA8 is doing this for Stats / Data Science
 - More support programs on campus
 - Berkeley: HKN / UPE, CS Mentors, CS Scholars, AWE, WISE, Peer Advising, Hackers@Berkeley, others?





Diversity in CS

- Major focus of past few years!
- Goes beyond gender – race / ethnicity, disabilities, more all lacking representation
- CS10: First CS course at Berkeley with gender parity!
- What can we do?
 - Do everything on the previous slide!
 - Recruit people we want
 - Work on the environment — train TAs and teachers
 - Work on the environment — Use ‘neutral’ décor
 - Create a pipeline – We’ll get to this later.



Booming University Enrollments

- CS61A – ~200 → 1,400 students in 4 years
- CS10 – ~80 → 320 students in 4 years
- Not enough faculty or TAs (most places!)

- What tools do we need to handle this many students?
- How do we train TAs?
- What else changes? Assignments? Cheating?





Creating High School CS Environment

- **About 1 in 10 high schools offer a CS course**
 - Growing quickly in recent years!
- **Equity and access issues**
 - Computing can be expensive!
 - Gender and Racial diversity has been low in HS too.
- **NSF: CS10K Project, ~5 years to get 10,000 High School CS Teachers**
- **Creating new curriculum**
 - AP Computer Science Principles, BJC
- **LOTS of Professional Development / Training**





The CS10K Project



CS10's Place



iClicker Question: History

How early can we trace the history of CS10?

- A) 1920's
- B) 1940's
- C) 1960's
- D) 1980's
- E) 2000's



Robot Turtles

- The turtle was an early educational robot introduced in the 1940's



[http://www.bfoit.org/Intro to Programming/images/mindstorms_turtle.jpg](http://www.bfoit.org/Intro%20to%20Programming/images/mindstorms_turtle.jpg)
<http://neoparaiso.com/logo/imagenes/historia-logo-01.jpg>

Logo, Etoys, Scratch and BYOB

- **Seymour Papert creates Logo in 1967**
 - Key educational feature is “turtle graphics”
 - Current most popular implementation is UCBLogo
- **Many visual versions of Logo exist**
- **Etoys – 1990’s environment for kids**
- **Scratch – 2002-now: blocks programming for everyone**
- **BYOB – 2009, a version of Scratch to teach CS**
 - BYOB was renamed Snap! And re-written to work in the browser





CS10 at Berkeley

- 2009: Dan Garcia and Brian Harvey replace CS3 with CS10
- CS3 was (old school) CS61A-lite
 - No graphics / media, no additional topics, no social implications
- CS10 : “The Beauty and Joy of Computing”
 - Survey course w/ lots of programming!
 - Individual, custom projects
 - A writing assignment (say wat.)





Computer Science Principles and BJC

- Same time: new AP Course, “CSP”
- CSP – a mash up of courses like CS10
- BJC becomes a pilot
 - Students make good guinea pigs! <3
- Collaboration with many others
 - NC State, U Alabama
- BJC4NYC
 - 3 years, 100 NYC classrooms
 - Rewriting *everything* (basically)
- edX MOOC
 - 16,000 Students!



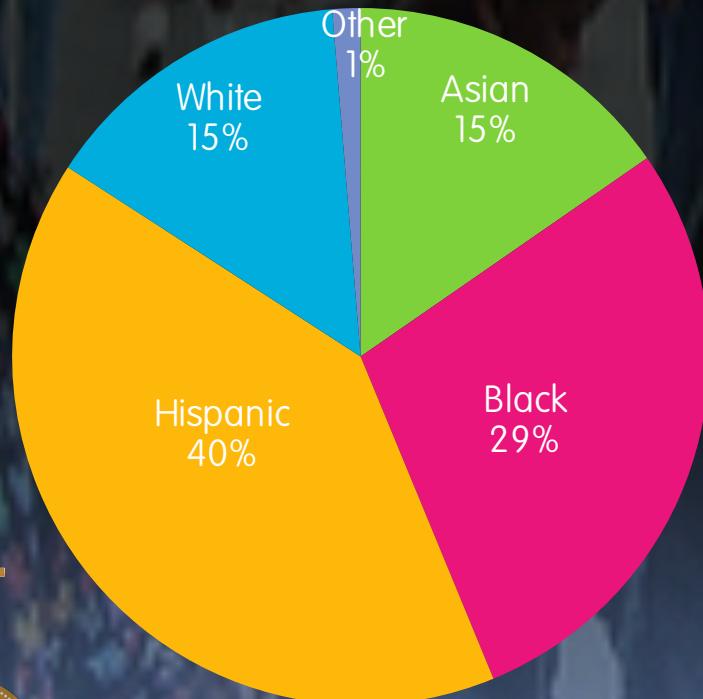


NSF's STEM-C: BJC4NYC



- We're working with the NYC school district to bring BJC to 100 NYC teachers by 2020!

NYC School Demographics



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Join CS10 and / or Do Research

- TAs at Berkeley have LOTS of responsibility
 - Path: Lab Assistant → Reader → TA
- You can make design / scheduling / grading decisions
- edX development, Snap! Development





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