



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-alpha-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!




UC Berkeley "The Beauty and Joy of Computing" : Functions (2)






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.




UC Berkeley "The Beauty and Joy of Computing" : Functions (3)





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?**



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CS Education




Computer Science ... A UCB view



www.eecs.berkeley.edu/~edw/Resour ch/Arc oss/

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





UC Berkeley "The Beauty and Joy of Computing" : CS Ed Research (6)

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!!**

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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?

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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

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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

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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.**

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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?

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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



Goal: get engaging, rigorous computing curricula into computing courses in 10,000 high schools, taught by 10,000 well-prepared teachers by 2016.

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

bjc Robot Turtles

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



<http://www.bjc.org> <http://www.bjc.org> <http://www.bjc.org> <http://www.bjc.org> <http://www.bjc.org> <http://www.bjc.org> <http://www.bjc.org> <http://www.bjc.org> <http://www.bjc.org> <http://www.bjc.org>

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bjc Logo, Etoys, Scratch and BYOB

- Seymour Papert creates Logo in 1967
 - Key educational feature is "turtle graphics"
 - Current most popular implementation is UCLogo
- 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



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bjc 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.)



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bjc 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!



UC Berkeley "The Beauty and Joy of Computing" : CS Ed Research (22)

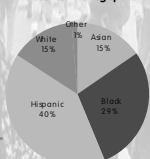


bjc NSF's STEM-C: BJC4NYC

EDC Learning transforms lives.

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

NYC School Demographics



Grant #1440776

UC Berkeley "The Beauty and Joy of Computing" : Functions (23)



bjc Join CS10 and / or Do Research

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



UC Berkeley "The Beauty and Joy of Computing" : CS Ed Research (24)





Join CS10 and / or Do Research

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