

# **Fight the MOOC- opalypse! and Reflections on the Aporia of Learning**

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# plan

- the aporia of learning (physics)
- amnesia of learning
- the rainfall problem
- a personal learning story
- what is a MOOC?
- a MOOC in my “flipped classroom”
- the problem with MOOCs
- re-valuing learning

# Fred's doctoral advisers

- Edith Ackermann
- Seymour Papert
- Donald Schön

# the aporia of learning

- aporia: Greek word meaning “impasse”
- Wolff-Michael Roth: how can we intentionally direct ourselves to learning something new, when by definition we do not yet know it?

*Learning Science: A Singular Plural Perspective (2006).*

# the aporia of learning... physics

- Roth observed a conventional high school physics classroom, with traditional experimental demonstrations
- The teacher was devoted and deeply understood the physical concepts he was demonstrating

$$\underline{L} = 0 = \underline{L}_{me} + \underline{L}_{wheel}$$



*Figure 1.1. While sitting on the rotating chair, the teacher spins the bicycle wheel. When the axis of the wheel is parallel to that of the chair, the latter rotates in the opposite direction of the chair. When the axis of the wheel is perpendicular to that of the chair, no movement should be observed.*

# the aporia of learning... physics

- Students literally did not perceive the effects that the teacher intended the demonstrations to show
- They could not do so because they did not yet have the requisite physical knowledge needed to separate a nearly imperceptible “signal” from the “noise” of everyday experience

# amnesia of learning

- once we have learned something, we forget about how it was, or felt, not to know it
- cognitive psychologists refer to this as “psychogenic amnesia”



a little test...

# what is this about?

## **សម្ងាត់ និងអាថ៌កំបាំង**

មានតែយើងខ្ញុំ និងជំនួយការរបស់យើងខ្ញុំតែប៉ុណ្ណោះ (អ្នកនោះនិងជួយរក្សាទុកនូវខ្សែអាត់) ទើបមានសិទ្ធិថតទុក និងអាចប្រើប្រាស់សម្ភារៈទាំងនេះបាន ។ រាល់ការស្រាវជ្រាវបញ្ជីទាំងអស់ និងដាច់ខាតមានការសម្ងាត់ ។ ឈ្មោះរបស់អ្នក ឬក៏ អត្តសញ្ញាណប័ណ្ណណាមួយផ្សេងទៀត និង **មិនបញ្ចេញឱ្យយើងឡើយ** ។ នៅក្នុងបញ្ជីស្នាម យើងខ្ញុំនឹងធ្វើការគ្រប់បែបយ៉ាង យ៉ាងប្រុងប្រយ័ត្នទុកជាមុន ការពារនូវការសម្ងាត់ និងអាថ៌កំបាំងរបស់អ្នកជានិច្ច ។ ខ្សែអាត់ទាំងឡាយ និងត្រូវបំផ្លាញចោលមិនតិចជាងបីឆ្នាំ បន្ទាប់ពីការបញ្ចប់នូវការស្រាវជ្រាវកម្មវិធីនេះ ។

# what is this about?

## **Privacy and Confidentiality**

Only we and our research assistants (who will help in transcribing the audiotapes) will have an access to recorded materials. All research data will be strictly confidential. Your name or any other identification will ***never be disclosed***. We will take every precaution to protect your privacy and confidentiality in the data collected. Recorded tapes will be destroyed no later than three years after the completion of this research project.

# amnesia of learning

“Can you imagine what it was like before you learned how to read—words, numbers, equations, standard music notation?”

That piece of the past for most of us is simply *wiped out*.”

(Bamberger, *International Journal of Computers for Mathematical Learning*, 1996)

# amnesia of learning

when post-conservation children would view videos of themselves giving pre-conservation answers, they “would simply not accept the idea that it was them. ‘I didn't say that’; someone had to make this up”

(Ackermann, personal communication)

# The Rainfall Problem

- Originally studied by Elliot Soloway in 1980s
- Slides courtesy of Mark Guzdial, from a talk he gave at MIT in January 2013



# The Rainfall Problem

- Problem: Read in integers that represent daily rainfall, and print out the average daily rainfall.
  - If the input value of rainfall is less than zero, prompt the user for a new rainfall.
- When you read in 99999, print out the average of the positive integers that were input other than 99999.



## Results at Yale in Pascal in 1983

|   | <b>% of Students who got it right</b> |
|---|---------------------------------------|
| Novices (3/4 through first course)            | 14%                                   |
| Intermediates (3/4 through second course)     | 36%                                   |
| Advanced (Jrs and Srs in Systems Programming) | 69%                                   |





## Not an anomaly

- Elliot Soloway and his students replicated this study many times.
- Others have used this same problem with similar results (Most recently: Venable, Tan, and Lister, 2009)
- Anecdotally, every institution I've been at has attempted this problem, with similar results.



# MIMN Studies

- “Is it just Yale? Is it just Yale and Pascal?”
- In 2001, Mike McCracken et al. gathered data from 216 students in 5 institutions in 4 countries: “Build a calculator.”
  - Out of a possible 110 points, average score was 22.89.

# Why is the Rainfall Problem hard?

- Writing code is a design problem.
- Students may understand the pieces, but they might not know how to put them together.
- We have learning amnesia, and we have forgotten what it's like to not know how to code.

# let's talk about MOOCs

- what is a MOOC?
- a MOOC in my “flipped classroom”
- the problem with MOOCs

# **MOOC = massive open online course**

- initial concept and acronym by David Cormier, whose model involved many collaboratively contributing to learning
- burst into public view with courses launched by three Stanford Univ. faculty in Fall 2011
- features of these courses: series of mini-lectures; interactive quiz questions; auto-graded homeworks and tests; discussion forums

# Thrun/Norvig Fall 2011 ai-class.com

Welcome Fred [Sign out](#)



## INTRODUCTION TO Artificial Intelligence

In partnership with



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Next

- ▶ 12. MDP Review
- ▶ 11. HMMs and Filters
- ▶ Homework 5(closed)
- ▶ 10. Reinforcement Learning
- ▼ 9. Planning under Uncertainty
  - ✓ 1. Introduction
  - ✓ 2. Planning Under Uncertainty MDP
  - ✓ 3. Robot Tour Guide Examples
  - ✓ 4. MDP Grid World
  - ✓ 5. Problems with Conventional Planning 1
  - ✓ 6. Branching Factor Question ?
  - ✓ 7. Problems with Conventional Planning 2
  - ✓ 8. Policy Question 1 ?
  - ✓ 9. Policy Question 2 ?
  - ✓ 10. Policy Question 3 ?
  - ✓ 11. Policy Answer 3 Question 4 ?
  - ✓ 12. MDP and Costs
  - ✓ 13. Value Iteration 1
  - ✓ 14. Value Iteration 2

ENVIRONMENTS - CONVENTIONAL PLANNING

|   |     |      |   |        |
|---|-----|------|---|--------|
|   | 1   | 2    | 3 | 4      |
| a |     |      |   | (+100) |
| b |     | //// |   | -100   |
| c | ( ) |      |   |        |

Tree diagram showing actions N, S, W, E from state c, leading to states b1, c1, c1, c2, etc.

- BRANCHING FACTOR LARGE

QUIZ: HOW MANY STATES CAN WE REACH FROM b3?

Done

For this problem (and only this problem) assume actions are stochastic in a way that is **different** than described in 4. MDP Gridworld. Instead of an action north possibly going east or west, **an action north will possibly go northeast or northwest** (i.e. to the diagonal squares).

Likewise for the other directions e.g. an action west will possibly go west, northwest or southwest (i.e. to the diagonals).

# great things about MOOCs

- famous, expert teachers using informal style
- complex topics in “bite size” chunks
- engaging, frequent quiz questions
- immediate auto-grading is motivating and helpful

# MOOC in “flipped classroom”

- 16 students
- half grad, half upper-div ugrad
- met once weekly, seminar-style
- went through MOOC together
- discussed HW problems around when they were due

but also...

- supervised indiv. student projects
- students presented their work in a public poster/demo session to dep't
- grade was 2/3 Stanford, 1/3 project



# student projects

- Video Game AI: Manipulating the A\* Algorithm
- Optimal Path Planning with A\* Search Algorithm
- Impersonating Myself on Chat
- Characterization of User Input on iSENSE Using Bayes Nets
- DNA read assembly using A\* Search
- LMS Adaptive Filter Vs RL Q-Learning Algorithm
- Electrical Power Network Fault Response System
- Bot for the Google AI Challenge
- Collaborative Q-learning
- Markov Melody Generator
- Using AI to Improve Hajj Experience
- Using AI to Win Dots & Boxes
- Smart Surveillance: Object Tracking and Classification of Moving Pedestrians
- Reinforcing Conversation

**my version of the AI class...**

adding the discussion  
and project transformed it:

**From a class about AI**

**To a class on doing AI.**

# what's the problem?

- pedagogy
- quality
- access
- cost

# pedagogy

- MOOCs have some innovations (mini-lectures; quizzing; autograding) but essential pedagogy is still didactic
- don't try encouraging productive confusion (e.g, Baker, D'Mello, Rodrigo, & Graesser, 2010)
- don't try encouraging vicarious learning (e.g, Chi, Roy, & Hausmann 2007)

# quality

- created by elite universities; ergo, high quality; e.g.:

@aiclass: “Advanced students will complete the same homeworks and exams as Stanford students. So the courses will be equal in rigor.”—September 28, 2011

- but what do faculty really believe?



# access

- big hype about providing access—after all, now, all you need is a web browser to access an education of the highest quality!
- based on pedagogy of MOOCs, what is profile of MOOC completers?

(hint: it might be those who already have advanced educational backgrounds)

# online courses could widen achievement gaps among different types of students

## Online Courses Could Widen Achievement Gaps Among Different Types of Students

By JAKE NEW

Low-cost online courses could allow a more-diverse group of students to try college, but a new study suggests that such courses could also widen achievement gaps among students in different demographic groups.

The study, which is described in a working paper titled "Adaptability to Online Learning: Differences Across Types of Students and Academic Subject Areas," was conducted by Columbia University's Community College Research Center. The researchers examined 500,000 courses taken by more than 20,000 community and technical-college students in Washington state. They found that students in demographic groups

whose members typically struggle in traditional classrooms are finding their troubles exacerbated in online courses.

The study found that all students who take online courses, no matter the demographic, are less likely to attain a degree or do as well as they would in physical versions of the same courses. However, some groups—including black, male, and younger students, and those with lower grade-point averages—are particularly susceptible to that pattern.

Shanna Smith Jaggars, assistant director of the Community College Research Center and one of the paper's authors, said the widening gap in troubling, as it could imply that online learning is weakening—not strengthening—education equality.

"We found that the gap is ro-

ger in the underrepresented and underprepared students," Ms. Jaggars said. "They're falling farther behind than if they were taking face-to-face courses."

Online learning can still be a great tool, she said, particularly for older students who juggle studying and raising a family. For those students, as well as for female and higher-performing students, the difference between online and physical classrooms was more marginal, according to the study.

"So for older students, you can sort of see the cost-benefit balance in favor of taking more courses online," Ms. Jaggars said. "They might do a little worse, but overall it's a pretty good trade-off for the easier access. But where a student doesn't need online courses for their access, it's un-

clear if that is a good trade off."

Kathy R. Enger, executive director of the Northern Lights Library Network, a cooperative in Minnesota, and an online educator for a decade, said online learning isn't only about access; it can also offer an environment that encourages minority students to speak up without worrying about microaggression, like eye-rollers or rollings of the eyes, in a predominantly white classroom, Ms. Enger said. "There's more freedom for students to express themselves and feel validated in an online environment," she added.

The study suggested several ways to improve online courses, including screening students first and allowing only higher-performing students to take courses online, Ms. Jaggars said. However, that such a

strategy could put some students at a disadvantage, especially older students who enroll in the courses specifically for easier access and who do fairly well in them.

"But then we have to figure out how to help other students succeed in these classes," she said. "We need a lot more teacher training, showing them tactics to use to try and reach out. I think it's difficult for faculty to know how to do that online. Not that they don't want to. It's just hard."

Ms. Enger said that if students are falling behind in online courses, it's generally because the professor teaching the course is not reaching out in the right ways.

"If it's not working, find out what's not working," she said. "Then make it work." ■

March 8, 2013

Chronicle of Higher Education, March 8, 2013



# cost of education

in USA (2012 stats),

- 15.5M students in *public* higher ed (71%)
- 6.1M students in *private* higher ed (29%)

source: National Center for Educational Statistics, [Projections of Education Statistics to 2021](https://nces.ed.gov/fastfacts/display.asp?id=372), summarized at [nces.ed.gov/fastfacts/display.asp?id=372](https://nces.ed.gov/fastfacts/display.asp?id=372)

# replace access courses with MOOC?

- February 7, 2013: American Council on Education's College Credit Recommendation Service (ACE CREDIT) recommended college credit for five courses on Coursera:

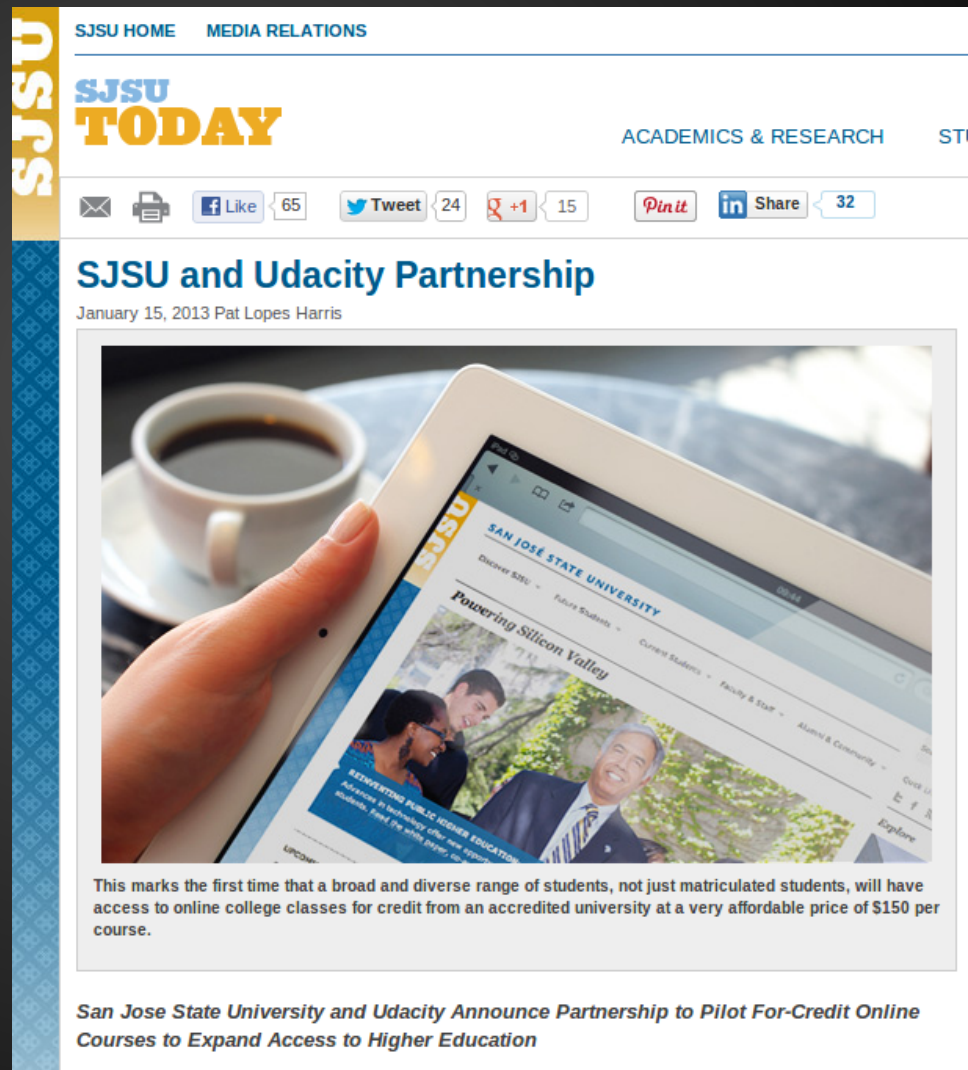
“Many students face enormous financial obstacles in pursuit of their degrees. We want to help more students enter college with credit already accrued and exit college on time, on budget and with a degree in hand.”

[blog.coursera.org/post/42486198362/five-courses-receive-college-credit-recommendations](http://blog.coursera.org/post/42486198362/five-courses-receive-college-credit-recommendations)

# San Jose State Univ & Udacity

“This marks the first time that a broad and diverse range of students, not just matriculated students, will have access to online college classes for credit from an accredited university at a very affordable price of \$150 per course.”

[blogs.sjsu.edu/today/2013/sjsu-and-udacity-partnership/](http://blogs.sjsu.edu/today/2013/sjsu-and-udacity-partnership/)



The image shows a screenshot of the SJSU Today website. At the top, there are navigation links for 'SJSU HOME' and 'MEDIA RELATIONS'. The main header features the 'SJSU TODAY' logo in blue and yellow. To the right, there are links for 'ACADEMICS & RESEARCH' and 'ST'. Below the header is a social media sharing bar with icons for email, print, Facebook Like (65), Twitter Tweet (24), Google+ (15), Pinterest, and LinkedIn Share (32). The main content area has a blue patterned background on the left. The article title is 'SJSU and Udacity Partnership' in blue, with the date 'January 15, 2013' and author 'Pat Lopes Harris' below it. The article image shows a hand holding a tablet displaying the SJSU website, with a cup of coffee in the background. Below the image is a text block that repeats the quote from the left. At the bottom, there is a caption: 'San Jose State University and Udacity Announce Partnership to Pilot For-Credit Online Courses to Expand Access to Higher Education'.

SJSU HOME MEDIA RELATIONS


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## SJSU and Udacity Partnership

January 15, 2013 Pat Lopes Harris



This marks the first time that a broad and diverse range of students, not just matriculated students, will have access to online college classes for credit from an accredited university at a very affordable price of \$150 per course.

*San Jose State University and Udacity Announce Partnership to Pilot For-Credit Online Courses to Expand Access to Higher Education*

# students and states near 50-50 split on college costs

CHE - March 15, 2013

PUBLIC HIGHER EDUCATION

## Students and States Near a 50-50 Split on College Costs

Public higher education is about to cross a historic threshold, past which students pay a higher percentage of the operating costs of colleges than states do.

Net tuition revenue made up 47 percent of public colleges' educational costs in 2012, an increase of more than six percentage points from the previous year, according to an annual report released last week by the State Higher Education Executive Officers.

In 1987, the report says, net tuition revenue accounted for just 23 percent of those costs. By 2001 it was a little more than a third of the costs.

Tuition has already amounted to more than half of the educational revenue in some systems, including the University of California and the community colleges in Iowa and South Carolina. But passing that threshold nationally is a gloomy milestone, which reflects the deep state-budget cuts that have hit public higher education since the beginning of the economic downturn, despite steady increases in enrollment.

“Public higher education is about to cross a historic threshold, past which **students pay a higher percentage of the operating costs of college than states do.**”

*Chronicle of Higher Education, March 15, 2013*

## so let's be honest

- report numbers of completers, not registrations (completion numbers are still impressive!)
- conduct research and report demographic info about completers
- study learning outcomes

# MOOC reflections

- MOOCs can be a great resource—like a text, only better
- success of MOOCs exposes existing bad teaching practices, especially at univ. level
- MOOCs are probably bad for more-needy students; policy idea to use MOOCs for college-readiness is terrible
- we need to embrace what's good about MOOCs while pointing out their limitations

**about teaching and learning**

# Fred Brooks, SIGCSE 2012, “Teaching as Design”



**The Teacher's Job**  

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**is to**

***Design Learning  
Experiences***

**not principally to  
Deliver Information**