“If we can scale to 100 students, why not 100,000?”

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Background: “new” CS169

- 2009-2011: enrollment 35=>50=>75=>110=>175 (Fall12)
- Feb 2011: start textbook
- Nov 2011: agree to offer first 5 weeks on Coursera
- Same quizzes, HWs, deadlines (lag by 5 weeks) as UCB

http://saasbook.info
tinyurl.com/about-saas
## What’s a MOOC? (Massive Open Online Course)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>What we did</th>
<th>A plausible alternative</th>
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<tbody>
<tr>
<td>Content delivery</td>
<td>7-10 minute lecturelets</td>
<td>60-90 minute lectures</td>
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<tr>
<td>Assessment</td>
<td>Deep autograding</td>
<td>Peer grading; self-assessment only</td>
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<tr>
<td>Forum monitoring</td>
<td>TA assigned to help</td>
<td>You’re on your own</td>
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<tr>
<td>Content capture</td>
<td>Screencast of live lecture</td>
<td>Studio + postproduction</td>
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<tr>
<td>Pacing</td>
<td>Synchronous deadlines</td>
<td>Self-paced</td>
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<tr>
<td>On-campus course</td>
<td>Traditional lectures</td>
<td>“flipped classroom”</td>
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</table>
Key Changes for MOOC

- Nontrivial autograders for programming assignments (open source)
- Adapting lectures to 7-10 min segment + peer learning/self assessment question
  - 7-10 min segment + peer learning question
  - 8-10 hrs/week ugrad to convert & format videos
- TA support to monitor question forums
- No final project
- Non-change: same HWs, quizzes, deadlines
Who are these students?

- 12% female, 88% male
- Median: 27 years old
- 75% of class: 21 to 38
- From 10 to 106
Who are these students?

- 75% Baccalaureate or higher; 7% instructors
- 60% do SW dev/maint at job

Busy people, many with high expectations
Funneling & Stratification

50,000 “registered”

90% “attrition” confirmed by 3 other MOOCs, including MITx

3,500 “passed”

• “Better than any course available at my university”
## Autograding Strategies

<table>
<thead>
<tr>
<th>Submission</th>
<th>Grading strategy</th>
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<tbody>
<tr>
<td>Upload code file (s)</td>
<td>• RSpec (correctness)</td>
</tr>
<tr>
<td></td>
<td>• [soon] reek/flay (code style)</td>
</tr>
<tr>
<td>Upload test case files</td>
<td>• Mutation testing (Amman &amp; Offutt): app with inserted bugs should fail tests</td>
</tr>
<tr>
<td>Submit URI of cloud-deployed app (Heroku)</td>
<td>• Remote (cloud-based) integration test using Mechanize</td>
</tr>
<tr>
<td>Interactive short-answer/multiple-choice</td>
<td>• Our tools emit both printed &amp; Coursera-compatible (online) quizzes</td>
</tr>
</tbody>
</table>

![Diagram showing the flow of submission, grading strategy, and feedback with a rubric.]
Neutralizing direct costs

- $0.30 Hosted download of large VM file
  - Google & Microsoft donation: $20K credits
- <$1 cloud-based autograding
  - Amazon donation: $8K credits
- $10 Cloud computing (AWS credits)
  - Amazon donation: $500K credits
- $20 Private GitHub repo for 90 days
  - GitHub donation: $1M in account credits
- $10 E-textbook (in our case)
- Free but could improve with donation: app hosting on Heroku, cloud-based integration testing
MOOC Lessons for Classroom

• Zero-config courseware works
  – downloadable or EC2-deployable VM image
  – hosted dev tools (Tracker, Heroku, GitHub…)

• Autograding works
  – *Demands* bug-free assignments up front
  – Frontloaded work to create autograders, many improvements planned
  – Easier to create new autograding *scripts*

• MOOC improved on-campus course
  – and MOOC >> recording on-campus course!
New Opportunities

- Which students are making similar mistakes?
- Can we find exemplar of *good* solution and use for hint?
- How do ad-hoc communities impact learning outcomes?
- Can autograding technology also assist manual grading?
- Yes, we’re open sourcing everything