Engaging with
Massive Online Courses

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Jon Kleinberg, Jure Leskovec
massive online courses

over 1,000 moocs offered
across many platforms
10 million students and counting
massive online courses

potential to revolutionize higher education

...and our understanding of how people learn
massive online courses

but first:

how do students engage with moocs?

can engagement be incentivized?
the data

we studied 6 coursera classes:

3 machine learning (Andrew Ng)
3 probabilistic graphical models (Daphne Koller)

(Thanks to Coursera and the Stanford Lytics Group for sharing the data with us!)
### the data

#### Basic course statistics

<table>
<thead>
<tr>
<th>Class</th>
<th>Students</th>
<th>HWs</th>
<th>Quizzes</th>
<th>Lectures</th>
<th>Posts</th>
<th>Start</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML1</td>
<td>64,536</td>
<td>432,052</td>
<td>1,486,566</td>
<td>3,222,074</td>
<td>15,274</td>
<td>4/2012</td>
</tr>
<tr>
<td>ML2</td>
<td>60,092</td>
<td>488,554</td>
<td>1,563,301</td>
<td>3,066,189</td>
<td>15,763</td>
<td>8/2012</td>
</tr>
<tr>
<td>ML3</td>
<td>112,897</td>
<td>681,569</td>
<td>2,076,354</td>
<td>4,742,864</td>
<td>32,200</td>
<td>4/2013</td>
</tr>
<tr>
<td>PGM1</td>
<td>30,385</td>
<td>398,314</td>
<td>794,290</td>
<td>1,564,87</td>
<td>14,572</td>
<td>3/2012</td>
</tr>
<tr>
<td>PGM2</td>
<td>34,693</td>
<td>210,199</td>
<td>427,209</td>
<td>1,059,464</td>
<td>7,044</td>
<td>9/2012</td>
</tr>
<tr>
<td>PGM3</td>
<td>25,930</td>
<td>172,539</td>
<td>337,657</td>
<td>686,899</td>
<td>4,320</td>
<td>7/2013</td>
</tr>
</tbody>
</table>
engaging with massive online courses

1. participation
2. performance
3. interaction
4. intervention
engaging with massive online courses

1. participation
2. performance
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4. intervention
engagement styles

are different students using moocs differently?

can we classify students by their engagement styles?
engagement styles

Histogram over students' assignment fractions
engagement styles

Same for all courses
engagement styles

Viewers + Collectors

All-rounders

Solvers

Not many actions: Bystanders
# engagement styles

<table>
<thead>
<tr>
<th>Class</th>
<th>Bystander</th>
<th>Viewer</th>
<th>Collector</th>
<th>All-rounder</th>
<th>Solver</th>
</tr>
</thead>
<tbody>
<tr>
<td>ML1</td>
<td>28,623 (.47)</td>
<td>15,246 (.25)</td>
<td>8,850 (.15)</td>
<td>8,067 (.13)</td>
<td>378 (.01)</td>
</tr>
<tr>
<td>ML2</td>
<td>27,948 (.49)</td>
<td>13,920 (.21)</td>
<td>7,314 (.11)</td>
<td>9,298 (.19)</td>
<td>550 (.01)</td>
</tr>
<tr>
<td>ML3</td>
<td>62,020 (.54)</td>
<td>24,411 (.21)</td>
<td>15,282 (.13)</td>
<td>13,417 (.12)</td>
<td>786 (.01)</td>
</tr>
<tr>
<td>PGM1</td>
<td>13,486 (.47)</td>
<td>6,742 (.23)</td>
<td>6,147 (.21)</td>
<td>2,365 (.08)</td>
<td>25 (.00)</td>
</tr>
<tr>
<td>PGM2</td>
<td>22,767 (.62)</td>
<td>6,689 (.18)</td>
<td>5,727 (.16)</td>
<td>1,507 (.04)</td>
<td>116 (.00)</td>
</tr>
<tr>
<td>PGM3</td>
<td>15,920 (.61)</td>
<td>4,816 (.19)</td>
<td>3,772 (.15)</td>
<td>1,287 (.05)</td>
<td>157 (.01)</td>
</tr>
</tbody>
</table>

Number (fraction) of students of each style
engagement styles

eventual engagement style vs. registration time
engagement styles

we find a large fraction of archaeologists, students who register after the class ends.
engagement styles

we find a large fraction of archaeologists, students who register after the class ends
engaging with massive online courses

1. participation
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performance

Grades received
Distribution of activities for high-achievers
engaging with massive online courses

1. participation
2. performance
3. interaction
4. intervention
interaction

the discussion forums provide a mechanism for students to interact with each other
interaction

what types of students are active on the forums?

how are the forums being used?
interaction

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<tbody>
<tr>
<td>$P(S</td>
<td>F)$</td>
<td>0.106</td>
<td>0.277</td>
<td>0.192</td>
<td>0.408</td>
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</table>

$P(S|F)$ : given forum usage, which engagement style all-rounders and viewers make up most of the forums
interaction

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<tr>
<td>$P(F</td>
<td>S)$</td>
<td>0.050</td>
<td>0.334</td>
<td>0.369</td>
<td>0.894</td>
</tr>
</tbody>
</table>

$P(S|F)$: given forum usage, which engagement style

$P(F|S)$: given style, likelihood of forum usage

all-rounders and viewers make up most of the forums

90% of all-rounders are on the forums!
interaction

less-active, lower-graded students start threads, more-active, higher-graded students respond consistent with q&a usage
engaging with massive online courses

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intervention

can we increase engagement?
we designed and implemented a badge system to increase forum engagement on ML3

(Thanks to Pamela Fox and Norian Caporale-Berkowitz for the implementation help!)
<table>
<thead>
<tr>
<th>Badge name</th>
<th>Action</th>
<th>Category</th>
<th>Criteria</th>
<th>Num Badges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supporter</td>
<td>Votes</td>
<td>Cumulative</td>
<td>Awarded once a user votes 3/15/40/100 times</td>
<td>4 (BSGD)</td>
</tr>
<tr>
<td>Reader</td>
<td>Reading threads</td>
<td>Cumulative</td>
<td>Read 10/30/70/200 threads</td>
<td>4 (BSGD)</td>
</tr>
<tr>
<td>Good/Great/Awesome/Incredible</td>
<td>Quality replies</td>
<td>Great</td>
<td>Awarded for contributing a high-quality reply (5/10/25/100 upvotes)</td>
<td>4 (BSGD)</td>
</tr>
<tr>
<td>Good/Great/Awesome/Incredible</td>
<td>Quality threads</td>
<td>Great</td>
<td>Awarded for contributing a high-quality thread (5/10/25/100 upvotes)</td>
<td>4 (BSGD)</td>
</tr>
<tr>
<td>Contributor</td>
<td>“Good” replies</td>
<td>Cumulative</td>
<td>Contributing 3/6/10/25 good reply (where good = 3 upvotes)</td>
<td>4 (BSGD)</td>
</tr>
<tr>
<td>Conversation Starter</td>
<td>“Good” threads</td>
<td>Cumulative</td>
<td>Contributing 3/6/10/25 good threads (where good = 3 upvotes)</td>
<td>4 (BSGD)</td>
</tr>
<tr>
<td>Community Member</td>
<td>Join class</td>
<td>First-time</td>
<td>Awarded when user joins class (as intro to badges)</td>
<td>1</td>
</tr>
<tr>
<td>Forum Newbie</td>
<td>Any</td>
<td>First-time</td>
<td>Awarded once a user takes any action in the forums</td>
<td>1</td>
</tr>
<tr>
<td>Early Bird</td>
<td>Vote/Post/Thread</td>
<td>Activity</td>
<td>Active on forums in first two weeks</td>
<td>1</td>
</tr>
<tr>
<td>All-Star</td>
<td>Vote/Post/Thread</td>
<td>Activity</td>
<td>Being active in all weeks</td>
<td>1</td>
</tr>
</tbody>
</table>
intervention

did the badges have an effect?

implemented badges on ML3, compare observationally with previous runs ML1 and ML2
intervention

5x more likely to get to 100 votes/reads!
intervention

5x more likely to get to 100 votes/reads!
intervention

no qualitative difference in posts/comments
no badges on these actions!
intervention

badgified dimensions ⇒ 5-fold increase in engagement

unbadgified dimensions ⇒ no qualitative difference

not a true experiment, but very strong observational evidence of badge effect

engagement can be increased in targeted ways!
intervention, part 2

a true experiment: variation in badge presentation

what gives badges their power?

compare different badge presentations,
measure which have strongest effects
intervention, part 2

three experiments:

1. top bylines
2. thread bylines
3. badge ladder

factorial design (users randomly assigned to 1 of 8 (=2^3) buckets)
intervention, part 2

experiment 1: top badge byline

header
intervention, part 2

experiment 1: top badge byline

Control:

Treatment:
intervention, part 2

experiment 2: thread badge bylines

Posts are annotated with author name and timestamp
intervention, part 2

experiment 2: thread badge bylines

Posts are annotated with author name and timestamp
intervention, part 2

experiment 2: thread badge bylines

Control:

Patrick Campbell · 23 days ago

Treatment:

Connorelly · 2 months ago

Monday, April 7, 14
intervention, part 2

experiment 3: badge ladder

Control:
intervention, part 2

experiment 3: badge ladder

Treatment:

Badge Series (2 earned)

BRONZE   SILVER   GOLD   DIAMOND

The Reader
To earn the next badge (Silver), you must read 30 threads from your classmates.

The Supporter
To earn the next badge (Silver), you must vote on 15 posts that you find interesting or useful.

The Contributor
To earn the next badge (Bronze), you must post 3 replies that your classmates find interesting.

The Conversation Starter
To earn the next badge (Bronze), you must start 3 threads that your classmates find interesting.

Top Posts
To earn the next badge (Bronze), you must write a post that gets 5 upvotes from your classmates.
intervention, part 2

<table>
<thead>
<tr>
<th>Top byline</th>
<th>Thread byline</th>
<th>Badge ladder</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.095</td>
<td>0.095</td>
<td>0.036</td>
</tr>
</tbody>
</table>

Mann-Whitney rank-sum p-values

Badge ladder most significant
Explicit goal-setting helped more than increased social visibility of badges
Conclusion

A conceptual framework for the quantitative analysis of engagement in MOOCs,

classified users into a taxonomy of engagement styles.

designed and implemented a badge system and a randomized experiment that increased forum engagement.
thank you!