

Developmental AI MOOC Assessment

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Abstract: We report lessons learned from our experience creating and administering a MOOC introducing students to developmental artificial intelligence. Our course, entitled Implementation of DEvelopmentAI Learning (IDEAL), covered advanced findings in developmental artificial intelligence spanning the fields of cognitive science and computer science. Its objectives consisted of conveying these findings to the general public, teaching developmental AI techniques to programmers and roboticists, and supporting international multidisciplinary collaboration amongst actors in the domain (academics, industrials, and hobbyists). Teaching materials included textual descriptions, short videos, and programming and writing activities. The course also supported community forums that allowed participants to engage in debates and work in teams. This form proved to be well fitted to the objectives. Participants reported that they found this design more efficient than lectures; and the forums proved useful in creating a productive community and conveying advanced scientific ideas.

Introduction

This paper reports our experience creating and administering the Implementation of DEvelopmentAI Learning Massive Open Online Course (IDEAL MOOC) in the Fall 2014. The goal was to convey the cognitive science background and the programming principles necessary to design robots and virtual agents capable of early-stage autonomous cognitive development (e.g., Weng et al., 2001). We have been conducting active research on this topic for several years at *Université Claude Bernard Lyon 1* (UCBL) with our international partners (e.g., Georgeon & Ritter 2012; Georgeon, Marshall & Manzotti, 2013). This research is situated in the context of France's broader effort to investigate Developmental Artificial Intelligence (DAI) (e.g., Oudeyer, Kaplan & Hafner 2007; O'Regan & Noë 2001).

The MOOC content followed from Olivier Georgeon's course at UCBL (Master degree level). Beyond a mere course, however, this MOOC offered a place to discuss research in DAI. As such, it was a mix of a "professor centric MOOC" (xMOOC), "connectionist MOOC" (cMOOC), and Massive Open Online Research (MOOR). See a description of these categories by Dillenbourg, Fox, Kirchner, Mitchell, & Wirsing (2014).

The level of content corresponds to Master's or PhD level course work, but the MOOC was open to the public without prerequisite. We advertised within our academic networks, scientific and technical mailing lists (AI, robotics, cognitive science, philosophy of mind), social media (Google+ communities, Facebook and LinkedIn groups), and MOOC index. As a result, we gathered a large variety of participants, ranging from software programmers to philosophers of mind. One of the goals of this effort was to facilitate dialog between the community members and thus to help cross-fertilize their respective fields.

Home page and registration: <http://liris.cnrs.fr/ideal/mooc/>

Teaser: <http://youtu.be/kQPz9InHjk>

Syllabus: <http://liris.cnrs.fr/ideal/mooc/syllabus.html>

Lessons: <http://liris.cnrs.fr/ideal/mooc/lesson.php>

Google+ community: <https://plus.google.com/u/0/communities/109445848302721599408>

MOOC Platform: <http://claco.univ-lyon1.fr/>

Architecture

To account for the difference in the participants' intellectual backgrounds, we offered three tracks:

- The *Base Track* consisted of following the lessons and responding to them. The only mandatory activity was to answer a ten-question quiz after each lesson. This track could be followed individually and required about two hours of weekly work.

- The *Programming Track* combined the materials offered in the Base Track with programming activities. It was intended for participants who had a programming background. It could be followed collectively in a team of about 5 participants. A short programming assignment was asked per team every week.
- The *Cognitive Track* combined the materials offered in the Base Track with writing activities to produce short write-ups about a material chosen and shared by the participant in relation to the course. It was intended to participants who had a cognitive-science background. Participants could work in teams. One cognitive assignment was asked per team every week.

To facilitate the dialog between participants of computer science and cognitive science backgrounds, we encouraged them to form mixed teams. Each team would thus return a programming assignment and a cognitive assignment per week, except on the last lesson when we asked for only one common assignment.

The MOOC started on Monday October 13th 2014. It had six lessons plus one concluding week. We asked to form teams by the end of the second week. A break week was introduced after lesson 4. It was initially unplanned but appeared necessary due to the underestimated workload. The overall duration was thus eight weeks, with the MOOC ending on December 14th.

The *Base Certificate of Participation* was delivered to participants who completed 5 of the 6 quizzes. The *Advanced Certificate of Participation* was delivered to participants who belonged to teams who returned 4 of the 5 required programming or cognitive assignments.

Figure 1 illustrates the organization of the MOOC.

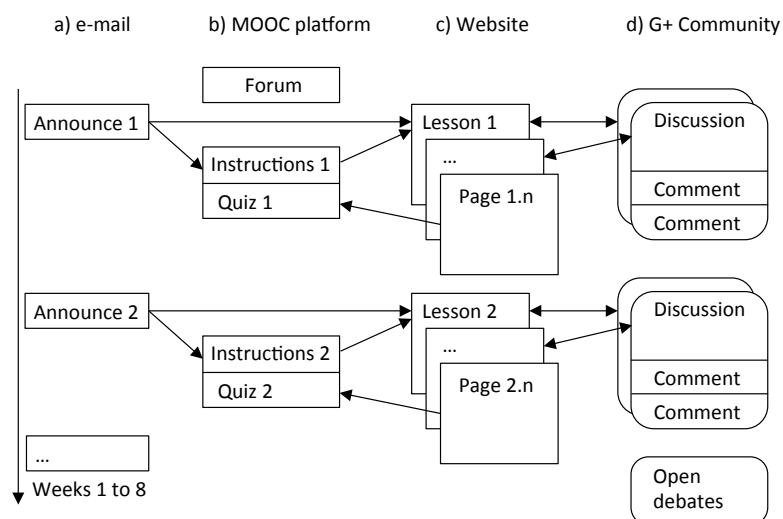


Figure 1: IDEAL MOOC architecture. a) Every week, the participants were notified of the availability of the new lesson by email (optional). This email provided a link towards the instruction page in the MOOC platform (b) and towards the lesson on the website (c). Each lesson consisted of a series of 5 to 8 webpages including short videos and example algorithms. Each page provided a *share button* to start new discussions or to access existing discussions in the Google+ Community (d).

We used the Claroline Connect Platform as a MOOC Platform (Figure 1.b). This platform provided the following services for us: managing the mailing list of participants, hosting a forum, hosting the instructions every week, and hosting the quizzes and the assignments and managing their results.

We chose to host the lessons on a separate website (Figure 1.c) because of the following advantages: 1) creating the course materials is easier with simple HTML and PHP than through the Claroline platform; 2) developing ergonomic formats is easier, especially formats for mobile devices with small screens; and 3) it is open to visitors not registered to the MOOC.

We created a Google+ Community (G+, Figure 1.d) to host discussions. A *share button* on each lesson page allowed the participants to share their comments within the community. We created a specific *hashtag* for each page to help finding the corresponding comments. Participants who preferred to not use a Google account and

not leave publicly available messages on G+ were invited to use the Claroline forum, but G+ proved to be more convenient and ended up hosting all the debates and comments. Notably, a few participants also created a group on reddit.com (*subreddit*).

Participation

Tables 1 and 2 report the participation data.

Table 1: Participation.

Teaser video views	3000 and counting
Registered participants	900
Welcome video (first lesson) views	584
Participants registered in the Google+ Community	445
Participants who answered the first quiz	405
Participants who presented themselves in the forum or the G+ Community	150
Participants who completed at least the <i>Base Track</i> (i.e., total number of certificates of participation delivered)	63
Number of teams formed	21
Participants who completed the advanced track (i.e., number of <i>Advanced Certificate</i> delivered)	41
Participants in official video hangouts	10
Participants who played a leading role in the community	11

Table 2: Acquisition of participants.

Referral	Proportion
Direct (direct email, mailing lists, unknown)	42 %
Social bookmarking and media (Reddit, Google+, LinkedIn, Twitter, Youtube, Facebook)	21 %
Referral sites and blogs (nootrix.com, igorsubbotin.blogspot.ru, generationrobots.com, ...)	20 %
Organic search (Google)	9 %
MOOC index (mooc-list.com, france-universite-numerique.fr)	8 %

Participants came from 78 countries: France (21%), USA (17%), India (7%), UK (6%), Russia (4%), Canada (4%), Germany (4%), Spain (3%), Italy (2%), Brazil (2%), Other 68 countries: 30%.

194 participants answered the optional demographic survey. Of those, 11% participants reported working towards an under graduate degree, 20% a Master's degree or PhD, and 59 % reported being professionals or retirees. The intellectual background represented in the course included: computer programming (69%); cognitive science, psychology, or philosophy (7%); dual expertise in cognitive science and computer programming (12%); and other backgrounds (12%).

Cost in workload for the organizing team

Design and animation: 488h (Olivier Georgeon, Cécile Barbier-Gondras, and Jonathan Morgan: course design, quiz and exercise design, proofreading). This time consisted of free work performed aside from professional work and from job-search activities supported by the French unemployment benefit system. General support from UCBL: 70h (Amel Corny, Solaine Reynaud: teaser video creation and general e-learning technology advice). UCBL students: 140h (Aurélien Kong Win Chang, Rémi Casado, Florian Bernard: preliminary mock-up, exercise testing).

Qualitative feedback

We received very positive feedback from the participants. Here, we report two representative comments.

Diego Escudero: “*When the course started I was surprised of the fact that there were not video lectures, something uncommon for current MOOCs. However, you demonstrated they are not needed to do a great course*”.

Joe Repka: “*Giant thumbs-up and thank you for this course. The ideas presented in the lessons and by the community were highly valuable for me, but even beyond that, I really liked the way the course is structured,*

without the often time-inefficient video lectures and standard approach to lessons and tests of mastery of details that most MOOC have slavishly patterned after the undergraduate university model. Perhaps more logistical support for team formation and maintenance at the beginning would have helped. I had the feeling of getting off to a slow start and then having trouble keeping up approaching the end (I'm still digesting it all), but they may just be the fault of my own time constraints and aging brain. I hope the participants hang around and keep alive a forum for further discussion, especially of implementations and applications of the developmental approach. Thank you all."

Suggestions of improvement:

- Add questions/exercises during the lessons and not only at the end for evaluation.
- Although people was interacting during the course, a teaching assistant that does questions and add news could improve participant interaction.
- Use the simple code as possible for the exercises and a scripting language as Python instead of Java.

Conclusion

We were very happy with the number, the richness, and the engagement of participants. The promotion could still have been more efficient; we failed to advertise to tech blogs or podcasts, to big companies, and to local traditional media. The most represented country was France, perhaps due to local networking and to the audience of Georgeon's lectures in French on Youtube; this shows the importance of local support. 30% of the people who viewed the teaser registered to the MOOC, which indicates good teaser efficiency. 65% of the registered participants did show up; this is a bit below average (70% reported by Dillenbourg et al. 2014), perhaps because of the time (3 months) between the registration opening and the MOOC beginning. 7% of the registered participants (11% of the show-ups) completed the MOOC successfully and received a certificate of participation; which is above the average in the literature.

Team-work played a central role in this MOOC. We felt the need for more efficient team management tools in the MOOC platform. There are a few actions we could have taken to favor team formation. For example, providing open permanent video hangouts or chat, or displaying participants who visit the same page at the same time could generate more encounters by serendipity. Team forming remains nonetheless challenging because of the diversity of interest, availability, and varying backgrounds of the participants.

Designing this MOOC took much more time than expected. We found it analogous to writing a book and then teaching a class. Our motivation came from our passion for the subject, our pleasure doing it, and from the expected professional repercussions.

The 11 participants who played a leading role in the community did impressive work. Some examples include re-programming the exercises in a different programming language, writing long documents to share their vision of developmental AI, and engaging in intense debates. Some were PhD students, professional roboticists, or retirees (anecdotally, we heard amusing complaints that their non-retired team members did not keep up with the workload). We hope that this community will remain active, and that it will play an active role in Developmental AI in the future. We plan to keep the course available as a "permamoooc".

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