DESIGN OF CONCEPTUAL MAPS FOR MASSIVE OPEN ONLINE COURSES (MOOCS)

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Abstract

Massive Open Online Courses have opened a new perspective for learning. The fragmentation of their contents made them easier to follow and permits a faster access to each single video where a content is presented. Nevertheless, this fragmentation is also a handicap in order to set the connections between different contents.

We propose the use of concept maps for showing the interconnection of the contents of the course. These maps are elaborated by the teachers and offered as a material of the course. We also expect that these maps will facilitate a deeper learning and the retention of the students in the course.

Keywords: MOOC, concept mapping, online education.

1 INTRODUCTION

After the release of the online course on Artificial Intelligence by Sebastian Thrun and Peter Norvig in 2011, Massive Open Online Courses (MOOCs) have attracted the interest of students and universities across the world. MOOCs are changing the paradigm that specialized and advanced knowledge, in particular the technical and scientific one, can only be acquired through the enrolment into a tertiary institution and, in general, paying huge fees.

First, some web sites of projects released their class notes. Later the OpenCourseWare initiative powered by the MIT since 2002 went one step further uploading to internet all the materials used in lots of their courses, and in some of them even the videos of the lectures were also available *(MIT, 2015)*. Many universities around the world followed this initiative *(Open Education Consortium, 2015).* Then MOOCs went even further sectioning the classes in small videos with follow up questions and exams, and permitting to create communities of students studying synchronously the same contents around the world. Moreover, students can even obtain a certificate by the most important universities in the world for free as long as they fill the questionnaires and tasks and declare that they have done it on their own respecting an honour code. Several conferences analyse the impact of MOOCs in education. See for instance the LINC 2013 Conference (2013), MOOC Research Workshop and Conference (2013), Learning with MOOCs: A Practitioner's Workshop (2014), and European MOOCs Stakeholders Summit (2014). An interesting and detailed report of the influence of MOOCs in Spain can be found in (Cátedra Telefonica – UPF, 2014).

Nevertheless, not everything is perfect. On the one hand, the rate of students who finish a MOOC is quite low respect to the total number of students that decide to enrol in one of these courses. There is no compulsory fee to be paid, unless the student wants a certificate that verifies that he has been the one doing the tasks of evaluation. Therefore, usually less than 10% of students who do not pay for a certificate with an authentication of identity finally finish the course. Then the commitment of the student with finishing the course was quite loose. This can be understood from the point of view of the liquid times we are living today (Bauman & Mazeo, 2012). On the other hand, it is quite hard to follow and relate the contents of different videos. Moreover, the evaluation system, that in many cases consists on questionnaires, does not contribute to a deep learning by the student either.

In order to make it easier for the students to follow the course and to obtain a more comprehensive and deep learning we have proposed a solution based on the design of concept maps, see for instance (Novak & Cañas, 2006), by the teachers to be added as a supplementary material to the contents of the course. This experience was taken in the development of a MOOC entitled

Aplicaciones de la Teoría de Grafos a la vida real -- Applications of Graph Theory to real life problems (Conejero & Jordán 2015). For each unit a concept map was designed including all the concepts and applications, and showing the connections among all of them along each lesson. Its use was acknowledged by the students as very useful guide to follow the course.

The paper is organized as follows: In Section 2 we review the different type of contents that are provided to the students by the teaching staff in a MOOC. In Section 3, we recall the main aspects about the design of concept maps. Section 4 is devoted to explain how these maps have been used in the MOOC *Applications of Graph Theory to real life problems.* Finally, we include the conclusions and some future lines of research in Section 5.

2 FORMATS OF CONTENTS IN A MOOC

The structure of a MOOC is quite standard. A course is taught on a weekly basis with a length that goes from 4-5 weeks up to 13 weeks (a whole semester). MOOCs are tending to be shorter in order to improve the finalization rate.

Every week the lessons are split into several short videos. Some tests are included in the middle and/or at the end of each video in order that the student can verify if she is understanding the content that has been explained. Later, some tasks are proposed in order to evaluate each lesson. The most common options are tests and open questions that are later revised by the students themselves using rubrics. The evaluation in this way does not differ so much from an evaluation by the teachers and it permits to give feedback to a huge number of students.

The student has access not only to the videos but also to the slides used by the teachers and to a transcription of what the teacher is saying in order to facilitate the comprehension of the content. The teachers usually provide one or two books as a main reference of the course in order that the student can deepen in the content.

Since the content of the course is divided into such small pieces, the course is easy to follow. However the students in some cases lack of a general vision of the inner structure of the course and the interrelationship of the contents. When a student has to look for a specific content sometimes is hard to remember exactly in which video or slides it can be found. Moreover, the interconnection between different videos does not necessarily follow the sequential order in which the videos are arranged.

3 CONCEPT MAPS

A proposed solution to this last problem is the design of concept maps (Novak & Cañas, 2006) by the teachers to be added later as a supplementary material to the contents of the course. Concept maps are based on the Assimilation Theory of Ausubel (1968,2000) and on the Learning Theory of Novak (1984). For further information regarding concept maps we refer to (IHMC, 2015).

This experience was taken in the development of the MOOC *Aplicaciones de la Teoría de Grafos a la vida real -- Applications of Graph Theory to real life problems* (Conejero & Jordán 2013).

There is a really nice connection between concept maps and graphs, since concept maps are nothing else but a particular type of graphs. Both of them consist on nodes and edges. In concept maps we have notions or concepts in the nodes and the edges represent words that connect the notions. In graphs we usually labelled the edges with numbers, called weights, that have some mathematical meaning in terms of the problem that is modelled by the graph. In our maps we have used as labels the number of the videos in which the notions are applied. This is a difference respect the usual way in which concept maps are designed.

From the pedagogical point of view, it will much more profitable for the students to try to do these maps by themselves. In fact, its elaboration could also be part of the evaluation of the course. Nevertheless, due to the loose commitment of the students we have considered that the best use we can obtain from the concept maps was to facilitate the students to follow up the course.

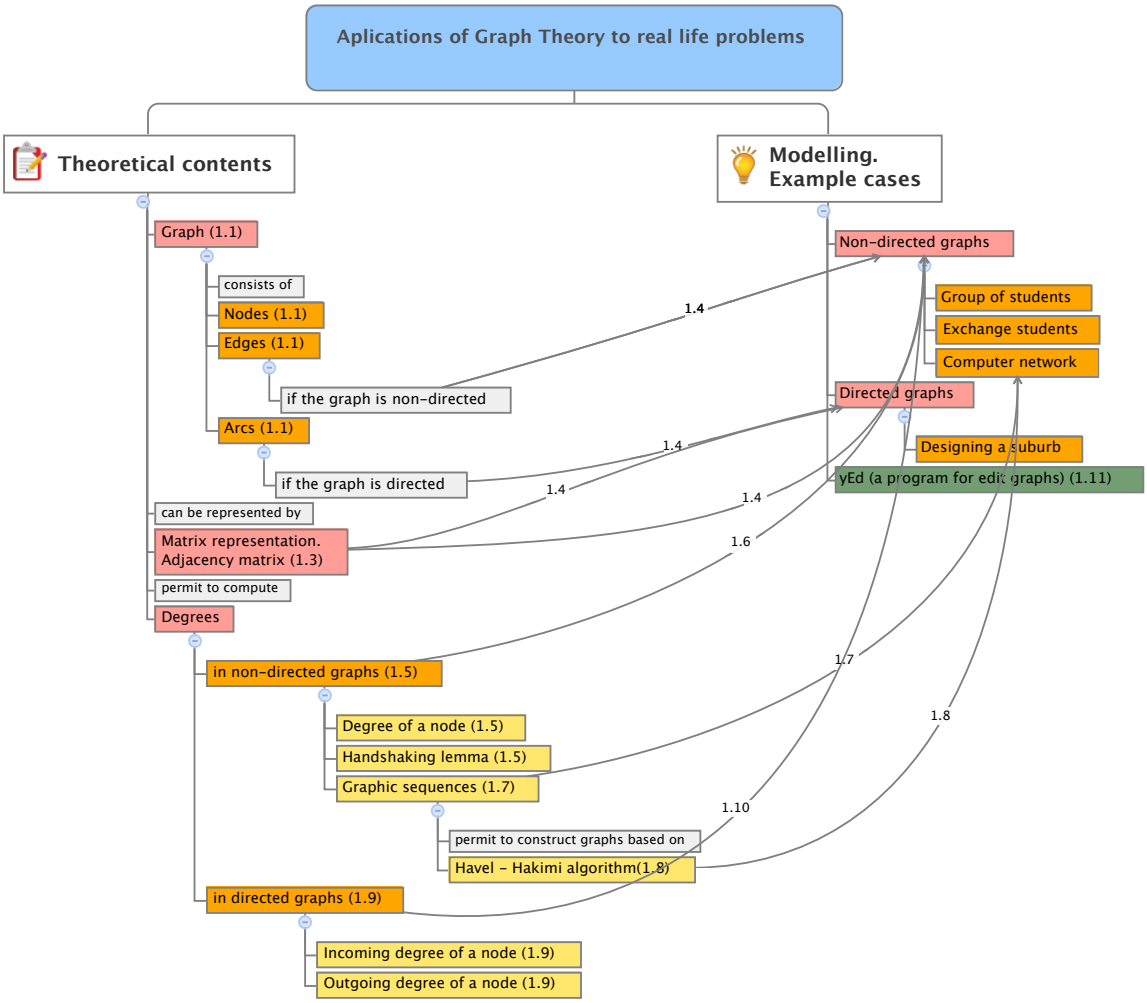
The MOOC *Applications of Graph Theory to real life problems* is structured into 7 units to be attended to on a weekly basis, where the following contents are developed: Basic notions, Accessibility, Weighted graphs, Trees, Matchings, Eulerian and Hamiltonian graphs, and Flows on networks.

4 CONCEPT MAPS IN THE MOOC *APPLICATIONS OF GRAPH THEORY TO REAL LIFE*

The MOOC *Applications of Graph Theory to real life problems* was firstly offered by MiríadaX in 2013, later by UPV[x] in 2013-2014, the MOOC platform by the Universitat Politècnica de València, and from 2015 onwards it will be accessible from edX. There, it will be split into two courses of 4 weeks each, where an additional lesson on colouring of graphs will be added.

The course combines theoretical contents and its application to mathematical models of real life situations. In general, every lesson consists of two types of videos: theoretical ones and study cases of some problems, where the theoretical concepts are illustrated. For each unit of the course a concept map was designed including all the concepts and applications, and showing the connections among all of them along each lesson.

The structure of each one of these maps consists on two blocks, where the concepts and case studies are set into different columns. An example of one of these maps can be found in the following concept map corresponding to the lesson 1 of the MOOC, that deals with basic notions of Graph Theory. These maps were designed using XMind software.



On the left hand side we have the theoretical notions, on the right hand side we have the problems whose models are shown in terms of Graph Theory. To each one of these models we apply and visualize the theoretical contents previously seen. After each theoretical notion we indicate the number of the video between parentheses in which it can be found. For instance (1.5) means the fifth video of lesson 1. We also use this notation to refer to the videos for labelling the edges joining the theoretical concepts with the mathematical models of the case of study.

5 CONCLUSIONS

The use of concept maps was acknowledged by the students as very useful guide to follow the course. In 2013 there were 2682 students who enrolled in the course. The finalization rate was of 11,59%. For most students this course was one of the first MOOCs they have taken so that it is hard for them to quantify the increase in the finalization rate due to the use of concept maps. In future editions we intend to evaluate the real contribution of these maps to students learning and engagement. In the line of the loose commitment of the students, we also intend to study the case of MOOCs as an illustration of the liquid times in the context of education.

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