User Click Modeling on a Learning Management System

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ABSTRACT

Clicking behavior is of prominent interest in many research fields. When accessing resources in a Learning Management Systems (LMS), clicks represent implicit feedbacks and carry precious information to improve content and layout, so to increase both the overall user experience (UX) and the resource effectiveness. As differences in age and cultural background are well known to affect the clicking behavior, the study of a homogeneous population allows to fully characterize it within a precisely delimited task. In the following, the pattern of access to learning resources of a group of graduated students involved in a specialized course is derived from log data, estimating its main behavioral stages, called orientation, evaluation and assimilation, and the transition rate from the first one to the next. Some statistics (average session time, total time of fruition and number of sessions) are also derived from the clicking distribution.

KEYWORDS

Clicking Behavior, Clicking Distribution, Learning Management Systems, Log Analysis, Session Estimation

INTRODUCTION

It is an acknowledged fact that clicking behavior is influenced by biological, cultural contextual and situational constraints, to the point that personalization is one of the key issues in the close future of multimedia, well beyond the e-learning arena (see Kang & Yoon (2008) for a study on the effect of age and experience on the behavior of users of electronic devices). Even if clicks in form of logs are a precious source of information, the combination of age, cultural background and purpose of a generic user navigating a generic web page can easily generate thousands of profiles and make hard to recommend items or to isolate meaningful patterns (see Maratea and Petrosino (2009) or Liu et al. (2010)). In this scenario, the case of BS or MS graduated students from a University accessing learning resources is exceptional in many ways: the learning environment is without commercial distractions or out of scope content and it is reasonable to assume a more focused interest, a stronger and more stable concentration ability and a more effective strategy of study. Such a homogeneous population makes possible to isolate meaningful interaction patterns and to use them for personalizations, recommendations or even to monitor the total time spent on resources as an essential feedback on the effectiveness of the resource itself. While Log data and user click modeling have been deeply investigated, mainly in areas of internet marketing, banner effectiveness evaluation, website navigation, implicit feedback and personalized recommendations, estimating the time spent on the resource is nontrivial, due to log data commonly tracking only clicks and not actual starts and ends of sessions.
In this paper a model for user clicking behavior of a homogeneous population and a method based on it to estimate the session time, the number of sessions and the total time of fruition of a resource are proposed. It is an extension of (Maratea et al. 2016), where the transition rate from the first to the second stage has been estimated through a log-log regression model and a peak analysis.

RELATED WORK

User click modeling is a relevant topic of many different fields, going from marketing to forensic, hence related work is genuinely interdisciplinary and very broad. Even within the e-learning field it is relevant for Educational Data Mining, personalized learning, tailored didactical assistance, content recommendation, classifying or clustering students, predicting scores or failure rates, and similar tasks. Especially in education, if from one side the availability of Virtual Learning Environments (VLE) and LMS has the potential to improve effectiveness of learning and reduce costs, from the other side the available data and the functionalities of popular LMS are acknowledged not to suffice for many high valued educational related analytics. For this reason, most of recent and related literature aims to enrich the available data integrating different information sources and to exploit Data Mining algorithms for developing high level tools that improve LMS user experience of learners and course designers, for example designing adaptive resources, predicting user performance or dropout, recognizing learning style, etc. Common requirement of all these tasks and of the foremost importance is using, designing and enriching feedback measurement strategies.

From a general perspective, it is possible to recognize some trends strictly related to feedback strategies in the related literature. The first research area here outlined is to expand conventional LMS with powerful analytics.

Zorrilla et al. (2008, 2010), starting from the inadequacy of the standard reporting tools in LMS and the scarcity of the feedbacks, first developed a tool called MATEP for monitoring and analyzing the behavior of users in VLE, exploiting the data in a log-based data warehouse, and then a Decision Support System (DSS) built on top of this enriched LMS to help instructors to analyze the academic progression of students.

Similarly, in Blagojević and Micić (2013) an OLAP engine with the aim of improving LMS effectiveness by predicting behavioral patterns of students and adapting accordingly the structure of the courses is proposed. The system was created based on logs from the Moodle platform.

In Psaromiligkos et al. (2011) first the requirements to provide data mining facilities in LMSs are described, then a new approach supported by a tool for analyzing learners’ behavior in LMSs is proposed. Apart from standard SCORM metadata, logs, statistics, possible association rules and questionnaires are gathered and analyzed. Finally, preliminary results arising from the use of the tool in two undergraduate courses are described.

The second research area is the partially or totally automated building of Adaptive Learning Environments on top of a conventional LMS.

In De Bra et al. (2013) an integrated framework, called GRAPPLE, with many modules for the management of the whole learning process is described. The framework tries to transform a traditional LMS into an Adaptive Learning Environments. A learner who is logged in on the LMS of his institute (university or company) can directly “click through” to an in-line presentation of the adaptive course text and can receive in-line visualizations of his progress. The key idea is to express each concept in the presentation with the anchor tag <a> and to adaptively change the linked resource, depending on what the learner studied before.
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