

Providing Social Navigation within Annotated Examples

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ABSTRACT

Social navigation is a promising way to guide users in hypermedia environments. In this paper we present Social WebEx, a system that provides social navigation to line-by-line annotated code examples. Social WebEx is a version of “plain” WebEx that only provides access to annotations of lines of code. In social WebEx users are able to see their own code browsing traffic of examples as well as the traffic of their peers. The social version of the system has been used for over a year as an optional learning tool in both graduate and undergraduate programming courses in a number of schools.

Categories and Subject Descriptors

D.3.0 [Programming Languages], H.5.4 [Hypertext/Hypermedia]

General Terms

Design, Human Factors, Languages.

Keywords

Adaptive hypermedia, social systems, example-based learning.

1. INTRODUCTION

Using code examples is the key activity in learning a programming language. Every programming language book includes a collection of code snippets accompanied by explanations. Every instructor has a collection of examples to demonstrate different aspects of the language. We have developed Web Examples – WebEx – a system that would serve interactive examples to the students online [1]. By using WebEx teachers can reuse code snippets from the book or come up with examples of their own and make them available online. In addition to the bare code, WebEx allows instructors to supply annotations to the individual lines. Students can browse examples and teacher annotations at their own pace in their spare time.

The first version of WebEx came out in 2003 and was quite a success with the students. But, as the number of examples and courses grew, students had more troubles navigating between and within examples. To address the problem of selecting the best example to explore next, we introduced an adaptive navigation support system tool called NavEx [6]. NavEx used concept-based and progress-based navigation to aid students in finding what examples to focus on. Nevertheless, the problem of within example navigation remained unsolved. Some examples were quite large (20 lines of code or more) and it was hard for the

students to decide which lines are really important to explore and which are of a secondary value.

This is when we turned to social navigation [3, 4], a technique that has been known to work well in the context of content abundance and lack of guidance. Social navigation attempts to harness the power of the community. It extracts the experience of those who navigate through previously not browsed content and makes this experience available to those who follow them. This is often done by supplying the links to the content with annotations denoting how many other users have followed the link. The higher the traffic through the link – the higher the chance that the content behind the link is worth visiting.

In social WebEx for each annotated line of code a student is able to see whether his/her peers have already reviewed the annotation to it. Annotations would change as the traffic through them increases, giving students the feedback on how significant the annotation was to the understanding of the whole example.

The further sections are organized in the following way. Section 2 provides a description of the Social WebEx system. Section 3 reports system usage data and some results we obtained analyzing it.

2. SOCIAL WEBEX SYSTEM

Social WebEx is an extended version of the legacy WebEx system [1]. Legacy WebEx presents examples, where some (potentially all) lines of code are annotated by the teacher. Annotated lines are marked with green bullets (Figure 1, left). Users explore teacher’s comments by clicking on these bullets. A line in a question is highlighted and the annotation is displayed below.

Social WebEx preserves the basic example exploration principle. In addition it allows users to see their own navigation trace, as well as the navigation of their peers. Green bullets of legacy WebEx are replaced by transparent check boxes. Once the user has explored an annotation for the line of code, a check mark is placed in the previously empty box (Figure 1, right). This gives user a feedback on annotations to what lines s/he has already seen.

The shade of the check box background shows how many of the other users in the class have also explored the annotation to a given line. White background means none of the user’s peers did that, Light green background means few other people explored the annotation, darker shades of green – higher number of annotation exploration clicks.

Currently WebEx has over 400 annotated examples that cover C, Java, Visual Basic .NET, and SQL languages. The code examples in [Social] WebEx are grouped into “bins” or “scopes”. Each bin/scope contains examples relevant to one course.

In terms of tracking users' individual and group performance WebEx relies on CUMULATE user modeling server [2]. WebEx sends reports of individual user clicks to CUMULATE, that tracks the clicks and computes the average group traffic for the example lines. It makes information about the user and the group navigation through examples available to WebEx via a set of HTTP based protocols.

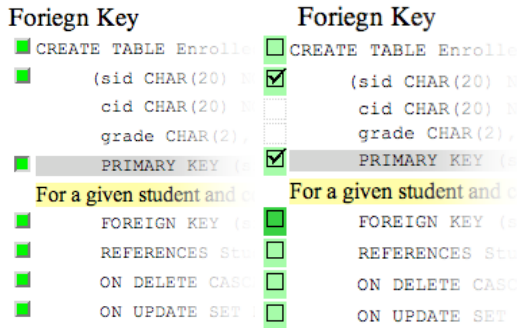


Figure 1. SQL code example in regular WebEx (left) and social WebEx (right).

3. CLASSROOM STUDIES OF SOCIAL WEBEX

Social WebEx has been deployed in 3 schools and used in several undergraduate and graduate programming courses for one year. Class sizes ranged from 4 to 25 students (for details see Table 1). Students were quite active in exploring annotated examples. Their average clicks traffic ranged from about 40 to over 200 clicks per semester, covering from 25% to 50% of examples available to them.

Table 1. Summary of Social WebEx course activity

School *	Semester	Language	Class size	Avg. clicks	Avg. coverage
U.Pitt	Spring'07	C	15	214.47	27%
U.Pitt	Spring'07	Java	19	81.53	46%
IUP	Spring'07	.NET	11	123.55	49%
CCAC	Summer'07	C	4	39.25	35%
CCAC	Summer'07	C	8	104.88	25%
CCAC	Fall'07	C	9	127.33	24%
CCAC	Fall'07	C	5	185.60	25%
U.Pitt	Fall'07	SQL	25	210.44	56%
U.Pitt	Fall'07	Java	18	66.72	37%
U.Pitt	Fall'07	SQL	22	104.64	44%
IUP	Fall'07	.NET	9	134.56	48%

* U.Pitt – University of Pittsburgh, IUP – Indiana University of Pennsylvania, CCAC – Community College of Allegheny County.

It is difficult to estimate the contribution of WebEx to the students' learning, since WebEx does not perform knowledge

evaluation. Additionally, in most classroom studies Social WebEx was accompanied by a set of other adaptive learning systems. This is why it was not possible to distill its contribution to student success in the course. However, using the system was not a requirement and high user participation can be a sign of WebEx overall usefulness.

When used in two undergraduate courses on .NET taught at Indiana University of Pennsylvania in Spring 2007 and Fall 2007 semesters, social WebEx was the only adaptive tool available to students.

During these two semesters social WebEx was used for preparing to the final examination, tangible part of which was related to the code examples covered in WebEx. Our analysis has shown that the amount of interaction students had with WebEx prior to the exam significantly influenced their grade (p-value =.027, F=6.045).

In the first of these studies we have also found that the more actively students were working with WebEx, the higher was their relative improvement of the final grade compared to the midterm grade [5]. Highly active students were able to improve their grades by up to 25%, moderately active – by 15%, less active by 5%.

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