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Creating a system to administrate the Concept Inventory instrument in the educational programming learning context

Raysa M. Benatti*, Ricardo E. Caceffo

Abstract

This undergraduate research project is part of the Computer Science Concept Inventory (CSCI) initiative, in which professors, students and researchers from the Institute of Computing of the University of Campinas are involved. The group's main purpose is to build a reliable method, based on an online Concept Inventory (a multiple-choice questionnaire), in order to assess beginner students' misconceptions when learning programming – for example, in which situations, during the learning process, comprehension difficulties arise and why they occur, giving better understanding about the students' mistakes. This particular project aimed at building and documenting a web-based system to allow programming instructors from different universities and places to access and administrate the Concept Inventory among their students. Such system is also a tool for researchers to catalog and access general and specific results. By the end of this undergraduate research period (12 months), we achieved as a result a preliminary version of the system and its documentation. The web-based system has key functionalities such as allowing professors to create instances of the Concept Inventories and generating results reports. Therefore, the system has an essential role for the administration and consolidation of the CSCI project.

Keywords:

Concept Inventory, Computer Science Education, Database Systems, Active Learning

Introduction

A Concept Inventory (CI) is "a set of multiple choice questions used to reveal students' misconceptions related to some topic"[1]; it is a survey covering the most important concepts of a field, in which some of the multiple choice answers are misleading and suggest, when chosen by the respondent, a certain kind of misunderstanding.

This research project aimed at building and documenting a tool that should allow professors from any place to administrate an introductory programming CI to his or her students. The research group at University of Campinas developed different templates of Concept Inventories to fit this purpose, which should be made available in a web-based system that should also allow instructors to register, log in and keep track of statistics related to answers submitted by students.

This work describes some of the features found in the system, as well as its importance in the context of the Concept Inventory project – which is a part of broader Computer Science Education initiative, focused on redesigning introductory programming courses[2].

Results and Discussion

The web-based system was built upon the LimeSurvey free software tool to use and manage surveys, together with DBMS MySQL Oracle for data persistence. It can be accessed through http://edu.ic.unicamp.br/limesurvey.

Any instructor interested in creating and managing its own survey must enter the website and either register or log in. Then, the user can view the list of concept inventories linked to his or her account and create up to 10 surveys. The website currently offers two survey templates: C language (English) and C language (Portuguese). Python and Java templates will be available soon.

When a user creates a new template, a new instance of the survey backend entity is created, along with its questions and multiple-choice answers. The user will then receive a test link – to verify if everything is working properly – and a students' link, that s/he will be able to send to his or her students in order for them to take the survey. The answers given by students will be recorded in the web-based system backend and retrieved when the user demands for statistics reports, which the website will provide. A complete documentation of the website's frontend and backend functionalities was published as a Technical Report[3].

Conclusions

The Concept Inventory is an important instrument to assess students' comprehension difficulties and support the identification of misconceptions. Based on that information, the instructors are able to make adjustments in their teaching approach, thus enhancing the learning environment. The system developed on this study allows instructors to administrate CIs to their students in an easy and accessible way, as well as getting statistics reports. This is crucial for the Computer Science Concept Inventory (CSCI) project dissemination and adoption.

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