Submitty: An Open Source, Highly-Configurable Platform for Grading of Programming Assignments

Presenters
Matthew Peveler, Rensselaer Polytechnic Institute, pevelm@rpi.edu (Primary Contact)
Jeramey Tyler, Rensselaer Polytechnic Institute, tylerj2@rpi.edu
Samuel Breese, Rensselaer Polytechnic Institute, breess@rpi.edu
Barbara Cutler, Rensselaer Polytechnic Institute, cutler@cs.rpi.edu
Ana Milanova, Rensselaer Polytechnic Institute, milanova@cs.rpi.edu

Abstract
Submitty is an open source programming assignment submission system from the Rensselaer Center for Open Source Software (RCOS) at Rensselaer Polytechnic Institute (RPI). Students can submit their code by drag-and-drop, zip upload, or version control, where it is then tested with a highly configurable and customizable automated grader. Students receive immediate feedback from the grader, and can resubmit to correct errors as needed. Through an online interface, TAs can access detailed grading results and supplement the automated scores with manual grading (numeric and written feedback) of overall program structure, good use of comments, reasonable error checking, etc. and any non-programming components of the assignment. The instructor can also configure the system to allow for a configurable late day policy on a per assignment and per student basis. We currently use Submitty in eight different courses (spanning from introductory through advanced topics) serving over 1500 students and 35+ instructors and TAs each week. We will present a range of "case study" assignment configurations, from simple through complex, using a variety of different automated grading methods including per-character and per-line output difference checkers, external unit testing frameworks (such as JUnit), memory debugging tools (Valgrind and DrMemory), code coverage (e.g., Emma), static analysis tools, and custom graders. Submitty can be customized per test case as appropriate to apply resource limits (running time, number of processes, output file size, etc.) and to display or hide from students the program output, autograding results, and testing logs.

Relevance and Significance
As enrollment rates continue to increase for CS programs across the country, a greater strain is placed upon the instructors that run CS courses. More time is spent on grading, to a detriment of providing help and assistance to the students. To combat this, much work has been done on creating a variety of autograding interfaces to cut down on the time spent grading [1]. However, as the paper notes that at the time that "It is surprising, and quite disappointing, to see how few systems are open-source, or even otherwise (freely) available. In many papers, it is stated that a prototype was developed but we were not able to find the tool. In some cases, a system might be mentioned to be open source but you need to contact the authors to get it." In addition, some of these available systems are built in such a way so as to be "one size fits all" or require hosting student's code off the school's systems which lead to potential FERPA concerns. Submitty, by virtue of its design, allows installation on the school's local machines and

ensures that all confidential student information is contained within their secure system. We will demonstrate that the system, which has been polished well beyond the prototype stage and is freely available, can be complementary to homegrown or commercial solutions a school might currently use.

Intended Audience

The Submitty system and our presentation is targeted for instructors and teaching assistants of courses with regular, programming-intensive assignments. We will also emphasize the advantages of open-source software to course administrators and department heads who are looking for tools to automate or streamline grading and course management through use of local hardware and infrastructure. Finally, we hope to appeal to other developers interested in contributing to this open source project.

Presenters Biographies

Matthew Peveler is a PhD student in Computer Science, has served as TA for the CS 1 course at RPI for two years, and is one of the primary developers of Submitty. Jeramey Tyler is a PhD student in Computer Science at RPI, has served as TA for both CS 1 and Data Structures courses, and is a developer for the TA grading interface of Submitty. Barbara Cutler is an Associate Professor in Computer Science at RPI, teaches Data Structures and Computer Graphics courses, and is one of the primary developers of the autograding features for Submitty. Ana Milanova is an Associate Professor in Computer Science at RPI, teaches Programming Languages and Principles of Software, and helped develop testing infrastructure for Java, Prolog, and Scheme.

Agenda for the Demo

0-5 minutes: Introduction to Submitty and motivation for different autograding features
5-30 minutes: Case study examples of autograding configurations used in a variety of course spanning introductory programming through advanced topics.
30-40 minutes: TA grading interface, managing late submissions, and integration with other components of course grades through Submitty
40-45 minutes: Questions from the audience
Attendees who bring their own laptop will be invited to "test drive" Submitty during our demo presentation [optional]. We will provide sample student submissions with typical errors, a variety of autograding configuration ranging from simple to complex, and a typical rubric form for manual TA grading. The presentation and test drive materials will be permanently hosted on our website [2].

Audio/Visual and Computer Requirements

1. Wireless/Ethernet access and power socket required
2. Projector to display the screen of laptop (laptop will be provided by presenters)

References

1. Petri Ihantola, Tuukka Ahoniemi, Ville Karavirta, and Otto Seppälä. 2010. Review of recent systems for automatic assessment of programming assignments. In *Proceedings of the 10th Koli Calling International Conference on Computing Education Research* (Koli Calling '10).
2. Submitty, Rensselear Center for Open Source Software, https://github.com/Submitty/, http://submitty.org.