Workshop Title: **A Web-Based IDE for Teaching with Any Language**

Presenters:

David J. Malan (Contact Person)
Harvard University
School of Engineering and Applied Sciences
malan@harvard.edu

Nikolai Onken
Amazon
nonken@amazon.com

Abstract: This workshop introduces participants to CS50 IDE (cs50.io), a web-based integrated development environment based on Amazon's Cloud9 (c9.io). Not only does the IDE enable students to work on programming projects within a browser, without need for local downloads or installations, it also provides students with an integrated terminal window and full sudo privileges. Underneath the hood is a Docker "container" that allows students to experiment with the underlying Ubuntu Linux OS, installing and configuring software at will, adapting it to their particular projects' needs. The IDE supports any compiler, interpreter, or other software that can be installed via a Linux command-line, while the IDE itself provides a fully-featured text editor for text files and source code that reside on the underlying instance. The Cloud9 GUI is fully extensible through a plugin system and is leveraged by CS50 IDE to provide additional functionality for students. Among the additional features implemented through this mechanism are a GUI-based file submission system, an optional "less comfortable" mode that simplifies the GUI to provide a scaffolded experience for students new to programming, and a GUI front end for the GNU Project Debugger, a CLI debugger for many languages, including C. This workshop will highlight useful features of the IDE in the context of classrooms (including the collaborative nature of a workspace to allow pair programming or provide alternative one-on-one instruction), provide tips for writing or adapting assignments based on its architecture, and introduce developing plugins for full customization.

Significance and Relevance of the Topic: Providing a unified development environment to students has long been a problem for computer science courses. Previously, local installations mandated one of several heavy-weight solutions, including a large pre-configured virtual machine (which would have a large download footprint and heavy resource usage, and may be impossible for secondary school teachers with limited installation privileges on lab machines) or mandate that students follow lengthy, difficult installation instructions to ensure a consistent development environment. Introducing a single web-based environment skirts these issues to bring students up to speed very quickly while simultaneously providing new options for collaboration and independence from a single pre-configured machine. Of course, web-based environments also provide new considerations and unique difficulties that we address in the workshop.

Expected audience: Secondary and post-secondary educators who are already comfortable with Linux and eager to provide their students with precisely that environment without the overhead of lab or per-student installations or virtual machines.

Space and Enrollment restrictions: None, so long as projector screen is large and Wi-Fi has adequate bandwidth and low latency.

Expertise of Presenter(s):
David J. Malan teaches CS50, Harvard University's introduction to the intellectual enterprises of computer science and the art of programming for majors and non-majors alike, with or without prior experience, a one-semester amalgam of courses generally known as CS1 and CS2. In years past, CS50 used an on-campus cluster on which students had shell accounts. Thereafter, the course transitioned to a cloud-based cluster atop Amazon Web Services, followed by its own on-campus virtualized cluster. The course then transitioned to client-side virtual machines running on students' own laptops. The course has since settled on CS50 IDE, which provides students

with nearly the same high- and low-level capabilities without nearly as many technical difficulties.

Nikolai Onken is the VP of Engineering at Cloud9, recently acquired by Amazon. He was among the developers of the Cloud9 core code and is the primary point of contact at Cloud9 for CS50 IDE project.

Rough Agenda:

1. Introduction and tour of the IDE and Cloud9, approximately 30 minutes.
    a. Overall GUI layout
    b. Writing, compiling source code
    c. Using the terminal to interact with the underlying Ubuntu instance
    d. Collaboration options
    e. Using the IDE in an offline mode
2. *Break*, 15 minutes
3. Adapting and writing assignments for Cloud9, approximately 60 minutes.
    a. "Gotchas" of local development
    b. Technical details for web-based projects including the Cloud9 HTTP proxy and port forwarding.
4. *Break,* 15 minutes
5. Developing custom plugins with the Cloud9 API, approximately 45 minutes.
6. Time for questions, approximately 15 minutes.

Audio/Visual and Computer requirements: Participants must have wireless Internet access and laptop power at each seat. We will also need a widescreen (16:9) projector for presenters. Attendees' laptops should have the latest version of multiple browsers. **Laptop required:** all participants will need a laptop in order to access the web-based environment.

Other critical information: Wi-Fi must be sufficiently robust and fast to support low-latency browser sessions.