

Providing Students with Standardized, Cloud-Based Programming Environments at Term's Start (for Free)

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For CS50 at Harvard, we have long provided students with a standardized programming environment, to avoid start-of-term technical difficulties that might otherwise arise if students had to install and configure compilers, interpreters, and debuggers on their own Macs and PCs. (For many students, "hello, world" is challenge enough on day 0, without also encountering "command not found" at the same time!) We originally provided students with shell accounts on a university-managed cluster of systems. We then transitioned to a cloud-based equivalent so as to manage the systems ourselves, root access and all. We transitioned thereafter to client-side virtual machines, to scale to more students and enable GUI-based assignments. We have since transitioned to web-based environments, complete with code tabs, terminal windows, and file explorers, initially implemented atop AWS Cloud9 and now, most recently, GitHub Codespaces, an implementation of Visual Studio (VS) Code in the cloud, free for teachers and students alike. In this workshop, we'll discuss the pedagogical and technological advantages and disadvantages of every approach and focus most of our time, hands-on, on using and configuring GitHub Codespaces itself for teaching and learning. Along the way, attendees will learn how to create their own Docker images and "devcontainers" for their own classes and any languages they teach. Attendees will learn what is possible educationally by writing their own VS Code extensions as well. And how, at term's end, to "offboard" students to VS Code itself on their own Macs and PCs, so as to continue programming independent of Codespaces.

Keywords: CLI; code; code editor; command-line interface; container; Docker; editor; graphical user interface; GUI; integrated development environment; IDE; programming; text editor; terminal window; web app; web application

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