**Project Title:** UCLA Undergraduate Writing Center Serverless Scheduling System

**Submitter:** Dr. Annelie Rugg, Humanities CIO and Director, UCLA Humanities Technology; Email: annelie@humnet.ucla.edu

**Project team:** Dr. Dave Shepard, HumTech (lead); Christine Holten, UCLA Writing Programs; Dr. John Lynch, HumTech; Dan Park, HumTech; Lillian Hawasli, HumTech

**Project Summary:** The project uses AWS Lambda and Amazon Cognito to provide a low-cost, low-infrastructure, high-security system to manage student writing support at UCLA's Undergraduate Writing Center. It is also the first in the UC  functional proof-of-concept for implementing serverless applications integrated with Single Sign On/Shibboleth.

- **Innovation.** First UC production instance of integrating a serverless application with SSO/Shibboleth on AWS.
- **Potential for broad positive change.** This scheduling application is broadly useful to any peer-based tutoring or advising community. The underlying serverless architecture integrated with SSO and running in AWS on UC terms is a model for delivering low-cost/predictable-cost web applications for academic needs.
- **Demonstrates collaboration.** Humanities Technology staff partnered not only with the Undergraduate Writing Center (UWC) as functional partner, but with IAMUCLA and the UCLA Registrar, as well as AWS.
- **Improves operational efficiency and usability.** The serverless architecture running on AWS infrastructure is more secure (can encrypt application data at rest), eliminates the need for UC systems administration time, scales for improved application performance, and lowers cost while eliminating the need for application rewrites to upgrades in PHP and Shibboleth. Serverless also improves usability by separating processes to run more quickly.
- **Shareable and ready to implement elsewhere.** This app is available to any UC campus writing or peer advising center and can be spun up at low cost with no need for local infrastructure beyond a connection with Shibboleth and the student information system.

**Background**

In January 2018, UCLA Humanities Technology (HumTech) began planning for the upgrade of a legacy web application, the UCLA Undergraduate Writing Center (UWC) Scheduling System. The app server used PHP 5.6, which was scheduled to reach its security end-of-life on December 31, 2018. Since the app necessarily stored data covered by FERPA, it was absolutely critical that we keep it as secure as possible. However, actually doing this presented us with a significant challenge.

On the one hand, we knew that we could solve the PHP security vulnerability by upgrading the server to PHP 7.x, but that would require us to spend hundreds of programmer-hours rewriting the application itself to work with the new standard, and we would have to repeat that work

again in a few years. Would that be time well invested? We couldn't use any "off the shelf" applications, because the only vendor that met the UWC's needs wouldn't agree to Appendix DS, UCOP's data security and privacy agreement. Finally, if we simply discontinued the application, it would place a tremendous burden on the staff of the UWC, who are integral to UCLA's teaching mission and currently counsel approximately 3000 students *per quarter*.

In fact, this challenge (or variations thereof) is quite common for academic IT units. We are the home for a variety of interconnected legacy applications that support different aspects of the university's teaching and research missions. These applications are often critical to the work of a particular faculty member or group, but the cost of keeping them secure and functional can easily overwhelm our limited budgets, preventing us from taking on new challenges or causing us to take shortcuts in our maintenance that ultimately makes the problem even worse.

In the case of the UWC Scheduler, we decided that, since none of the obvious options were palatable, it was time to get creative. We'd been hearing how "serverless" technology could reduce the maintenance requirements and the total cost of ownership for web applications. Would that work in this case? Dave Shepard, HumTech's lead programmer, investigated and concluded that there was a very good chance that rewriting the UWC Scheduler as a serverless app using AWS tools *would* produce substantial lifetime cost savings, for three reasons: First, by using AWS Lambda, RDS, and Cognito, HumTech would not be responsible for running security updates on any application or Shibboleth servers, saving us hours of sys admin time each month. Second, the serverless app would scale much easier. E.g. running a report (a necessary administrative task) would no longer slow down students trying to register for appointments (a necessary functional task), since AWS would handle the two processes separately. Third, it would reduce our long-term infrastructure costs, since we would have one less critical application running on aging servers.

However, at the same time, Dave also noted some significant obstacles to running the UWC Scheduler as a serverless application. First and foremost, this was completely uncharted territory at the UC, both technically and administratively. No one had previously successfully connected AWS and SSO/Shibboleth; teams at both UCOP and UCSF had tried and failed, and had given up on it as a viable solution. We would also need to get agreement from the Registrar's Office, Payroll, and Identity and Access Management (IAM) to access all of the necessary data streams and store the data in an unproven technology. *And* we were under serious time pressure: we absolutely needed to have a functional, secure application ready by December 2018, or the UCLA Undergraduate Writing Center would not be able to provide services to its thousands of clients come January 2019.

Given these conflicting data points, we decided to take a calculated risk. Dave estimated that, in a worst case scenario, it would take him three months of focused work to rewrite the current UWC Scheduler application to work with PHP 7. That gave us a drop-dead date of September 2018 to begin work on that project. Meanwhile, starting in May 2018, Dave began focused work on instead rewriting the app using AWS Lambda, RDS, and Cognito. His goal was simple: by September, either demonstrate all of the necessary proofs-of-concept, have the necessary agreements from campus partners, and have confidence in his ability to complete the rest of the

app before December, in which case we would continue to go towards a production serverless app; or not, in which case we would drop the serverless project and switch to the well-understood PHP upgrade.

**Results**

The serverless experiment has been very successful on multiple fronts. In the first place, we were able to demonstrate the proofs-of-concept, get buy-in from the necessary partners, and roll out a production version of the application in early December 2018. This new app meets all of the same business needs of our UWC as the older app did, the most important criterion for success. As we'd hoped, it doesn't bog down when the UWC staff run a report. And it does all of this more cheaply than our old app did: the app costs HumTech approximately $70/month, which is significantly less than the cost of our sys admins' time for the server maintenance (applying security patches, etc.) that we used to regularly perform on the application server.

However, the biggest benefit from the project, which we didn't foresee when we started, has been its role as a proof-of-concept for integrating serverless applications with SSO/Shibboleth. Using AWS Cognito instead of running Shibboleth locally creates many cost and security benefits. For example, when you use Cognito, local sys admins are no longer responsible for maintaining Shibboleth servers or upgrading them from v2 to v3, a complex and difficult process; this will done by experts at AWS, freeing up our sys admins for other tasks. Unfortunately, when Dave first began the project, no one knew how to do it, and many were convinced that it couldn't be done. By working closely with IAMUCLA, and with a lot of trial and error, however, he was able to figure out the intricacies of the connection. Our success has generated tremendous interest from the UC programming community: since finishing his proof-of-concept, Dave has been asked to give presentations on AWS Cognito and SSO to audiences at UCLA, the UCSF library, and UCOP, and at both the June 2019 [Information Security Summit](#) at UC Davis and at [UC Tech](#) in July 2019. This high demand for his expertise demonstrates the potential significance of Cognito as a security cost savings tool for the UC.

The rest of the app is also a proof-of-concept for other improvements in cost and security. As with Cognito, using RDS for the app database means that our sysadmins don't need to run security upgrades on a database server. It also means that it's trivially easy to have the application data encrypted at rest, a security standard that most current web apps don't meet. Additionally, bug-fixing can now all be done by one programmer, instead of requiring a collaboration between two or three different technical experts to roll changes into production. This has again freed up significant sys admin hours.

In the long run, we anticipate this approach will promote greater cost transparency, which will lead to cost savings through wiser use of resources. On our current infrastructure, it's very hard for us to determine how much individual faculty partners use the resources that we've allocated for them, which in turn makes it hard to conscientiously invest in future capacity. With serverless apps, usage and costs are extremely transparent. We expect that this will help our whole community shift its focus from talking about capacity to talking about impact, a much more useful metric for determining where to invest our resources.

Going forward, we are also hopeful that this project will produce a different kind of benefit, to other UC writing centers. Since the app doesn't require any local infrastructure beyond a student information system and SSO, which all of the UCs have, the cost of spinning up an instance at any other campus should be fairly low. If any other campus tech units are interested in adopting this scheduling app on their campus, we'd be happy to partner with them to realize that. And since they'd be storing the data in their own AWS cloud, they wouldn't need to worry about Appendix DS, either!

**Screenshots from the Undergraduate Writing Center Scheduling App**

Daily Statistics    Term Statistics

Quarter

Fall 2018    ⇕

Students Helped    Appointment Counts    Appointment Focus

Location

All Locations    ⇕

[Download 📄]  [Download list of all appointments 📄]

| | | Site | | | Status | | | | | Unbooked | | Students | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | In Person | Online | Walk-in | Checked in | Cancelled | Cancelled Late | No Show | Complete | Scheduled | Walk-ins | Transfers | Multilingual |
| Nov 7 | 8:00 AM | | 1 | | 1 | | | | | 5 | | | |
| | 9:00 AM | | | | | | | | | 5 | | | |
| | 10:00 AM | | | | | | | | | 5 | | | |
| | 11:00 AM | | | | | | | | | 5 | | | |
| | 12:00 PM | | | | | | | | | | | | |
| | 1:00 PM | | | | | | | | | | | | |
| | 2:00 PM | | | | | | | | | | | | |
| | 3:00 PM | | | | | | | | | | | | |

Daily Statistics    Term Statistics

Pick a day

05/01/2019

| Location | Completed | Total Writers | Walk-ins | Cancellations | Late Cancellations | No-shows | International Students | Multilingual Students | 1st Year | 2nd Year | 3rd Year | 4th Year | Other Years | Transfers | Courses |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A61 Kaplan Location | 14 | 33 | 22 | 4 | 4 | 0 | 9 | 9 | 3 | 11 | 8 | 11 | 0 | 5 | COM LIT 0004CW (1) ENGL 0004W (1) ENGCOMP 0131B (1) |
| The History Writing Center | 6 | 8 | 2 | 2 | 0 | 2 | 0 | 1 | 0 | 6 | 4 | 3 | 0 | 1 | HIST 0002C (7) HIST 0120D (1) PUB HLT 0150 (1) HIST 0010B (2) HIST 0176C (1) HIST 0108A (1) |
| Rieber Hall 115 Location | 6 | 6 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 3 | 1 | 0 | 1 | ASIA AM 0020W (1) COM LIT 0002BW (1) DIS STD 0101W (1) HIST 0146C (1) ENGCOMP 0005W (1) CLUSTER |