Integrating Cloud Computing across Existing Computer and Information Science Courses

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Summary

This poster describes the steps our department has taken to integrate cloud computing topics into our existing courses, a process first initiated in our networking and database classes. An overview of the challenges faced in adding and integrating cloud computing topics into these classes and the ways we overcame difficulties along the way are described. Future plans to further integrate cloud computing are also discussed.

Background

The Gartner group [5] notes that most organizations in the IT industry will be using cloud-based resources in 2020 and that future use of cloud computing is only expected to grow. Furthermore, they observe that 75% of surveyed organizations currently using cloud-services plan to adopt a "cloud-first" strategy, in which cloud computing solutions are evaluated first before making new investments.

In order to prepare students for this new world, the ACM 2013 Computer Science curriculum [4] includes a basic set of cloud computing topics in the Parallel and Distributed Computing area. The ACM curriculum leaves these topics as elective, but there have been suggestions that these topics be required [3]. Additionally, we have seen recent proposals for modular frameworks for cloud computing courses [1], an approach which would make it easier to integrate cloud curricula into the greater CS curriculum.

Experience at Westfield State

The integration of cloud computing topics into our courses began in the fall 2018 semester. The affected courses and the cloud computing services used in each is shown in Table 1. Over a two year period our strategy has evolved and grown as described below.

Initial experiences: Our first year with AWS

In fall 2018, after surveying the cloud computing platforms available, we chose to use a commercial public cloud provider so that the students' hands-on experience would translate directly to the environments that they will encounter after graduation. Amazon Web Services (AWS) was selected as the cloud provider for the Introduction to Networking and Client/Server course, as it is both the technological and market share leader. If a college joins the AWS Educate program, students can use substantial AWS resources without the need to supply a credit card. Unfortunately, Westfield State was not an AWS Educate institution during the time of this first course, so the amount of credit available to students was very limited. As a result, during that first term there was a constant worry that students might run out of available credits and be unable to complete their work.

After two semesters, we concluded that to get substantial hands-on experience, students need a larger amount of credit, which is only possible as an AWS Educate institution. An additional benefit from being an AWS Educate institution is the ability to create "classrooms" and get additional credits for each classroom. Fortunately, we were able to get support for AWS Educate from our college dean and obtained approval from our provost and CISO. In summer 2019, Westfield State became an AWS Educate institution.

Second year experience: Expanding technologies

In the current academic year (2019-2020), we have been able to provide hands-on experience for students through AWS Educate classrooms which can be setup with credits that student can use for their assignments. Without these classrooms, students would need to use credit from their AWS Starter account. In addition to AWS, students were also able to gain experience with Google Cloud Service by completing quests from QwikLabs. We plan to continue adding cloud computing topics to our courses as outlined in the future plans section.

Our department has also encouraged students to pursue cloud certification in their own time with support from our faculty and we have had a student successfully accomplish an associate certification in AWS. In this academic year, we also started a lunch and learn talk to make other faculty and students outside of our department aware of the cloud computing resources available through AWS.

Cloud computing use in WSU courses

Course Names	Semesters	AWS Services	GCP Services
Networking & Client/Server (CAIS-0337)	F2018	AWS Lambda, RDS	
	F2019	S3, Static Web Hosting, EC2, Lambda, RDS, API Gateway, DynamoDB	Various - students performed independent quests and presented their experiences.
Database App. Development (CAIS-0210)	F2019	RDS	
Database Management (CAIS-0310)	S2019	RDS	
Database Management (CAIS-0310)	S2020	RDS	Big Query, Cloud Storage
Introduction to Networking (CAIS-0347)	S2020	S3, Static Web Hosting	

Table 1: Cloud computing services used in Westfield State's courses

Discussion

Although we have added coverage of cloud based computing, storage, and networking to our classes, the introduction of these topics remains uneven across the curriculum. The topics covered in our classes are still quite traditional and often do not emphasize the specialized cloud services that are in high-demand in the industry, such as machine learning and big data [2]. In our opinion, many of these topics will need to be covered as separate elective courses.

Not all department faculty have yet committed to adding cloud computing topics to existing courses. This requires a significant up front time investment and training. It will be difficult to get additional faculty buy-in until there is a definite need, such as accreditation or specific resources. One exciting development that may make adoption of specific material easier is the availability of independently developed cloud computing modules, such as those described in [1].

Future plans

We are encouraged by the feedback that we have received so far from students who have appreciated the opportunity to work with cloud services widely used in the industry. Some of our students are also starting to consider using cloud services in their senior projects. Our department would like, however, to achieve a broader adoption across our courses. Future plans include:

- Creating a general Introduction to Cloud Computing course that covers fundamental cloud concepts and topics related to computing, networking, and storage abstraction in the cloud. This will provide students more integrated view of cloud computing and enable them to build additional skills.
- Making Introduction to Networking a required course for the computer science major. This was approved in spring 2020 and will take effect in the fall 2020 semester.
- Making it easier for faculty to learn and get familiar with cloud computing services so that they can both see the benefits and become empowered to add cloud computing topics to their courses. One activity aiming to do this is the continuation of the lunch and learn series.

Bibliography

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