A Hands-on Approach to Cloudifying Curriculum in Computing and Engineering Education

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***Abstract*—The term cloud computing is used to describe a pool of configurable virtualized computing resources (databases, software, storage, network, servers, etc.) delivered as a service via the Internet. The demand for cloud computing professionals continues to increase, yet academic institutions make little effort to integrate cloud computing into the computing curriculum. Lack of cloud computing resources has been identified as a major hindrance to teaching and learning cloud computing in higher education. This workshop aims to explore resources that could help computing educators teach cloud computing to students. Through hands-on activities, participants will learn about the various resources, tools, and technologies that are freely available for teaching and learning cloud computing.**

Keywords—Cloud Computing, Computing Curriculum, Cloudification, Computing

I. GOALS OF THE PRE-CONFERENCE WORKSHOP

Cloud computing has emerged as an efficient and cost-effective paradigm for deploying and managing IT resources (server, network, storage, etc.). In contrast to the traditional on-premises data centers, cloud computing model allows users to access expensive and highly available IT resources at a reduced cost. As result of this and many other benefits such as reliability and security, organizations are adopting cloud computing at an accelerating rate [1]. Consequently, the demand for professionals with cloud computing skills has increased exponentially within the last five years [1].

Knowledge of cloud computing is listed as top job skill in many job portals and are now required by 14% of all computing job posting in LinkedIn [2]. However, many universities and colleges are yet to incorporate cloud computing in their curricula while other are struggling to teach cloud related courses due to lack of resources such as trained faculty and cloud platforms [1].

Consistent with FIE goals of re-defining computing education to prepare students for the future, the goal of this workshop is to help computing educators develop curriculum and teach cloud computing concepts to students. Through this workshop we aim to achieve the following goals:

- Broaden access to cloud computing education, by making available a various resources and contents to create a cloud computing curriculum aligned to specific careers and their associated competencies.
- Provide opportunities for educators to evaluate their existing programs and identify courses that can be 'cloudified' (integrate cloud technology concepts).
- Present learning technologies to help educators cloudify existing courses or build and teach new cloud technology courses; thereby helping to close the current skill gaps in cloud computing.

II. DESCRIPTION OF TOPICS COVERED DURING THE WORKSHOP

To achieve our goals in this workshop, we plan to cover various education enablement topics and hands-on activities. We will use Amazon Web Services (AWS), one of the leading cloud providers, as a case study for the hand-on activities. The summary of the topics to be covered are as follows:

- **AWS Learner Labs** – In this topic, participants will learn how to use the virtual lab environment to grant students access to the AWS Management Console free of charge to learn about cloud computing in a hands-on environment.
- **Cloud Career Pathways & Badges** - This topic will help participants to learn about key cloud competences and skills required for in-demand cloud jobs through self-paced learning content.
- **AWS Educate Content** - This topic covers access to various course contents contributed by educators and AWS. Participants will have the opportunity to identify, select, and export desired content into the Learning Management System (LMS) used by their respective institutions.
- **AWS Cloud Competency Framework (CCF)** - Through this topic, participants will review the AWS Cloud Competence Framework (CCF), learn about the research used to develop the CCF, and

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how to use CCF to assess and cloudify a course or entire program of study.

- **AWS Management Console** - This topic provides an overview of AWS Management Console, the technology used to build the cloud, using the AWS Learner Lab. Participants configure a simple cloud architecture using the AWS Management Console to develop foundational cloud computing knowledge.

III. Workshop Agenda and Expected Interaction during the Workshop

We created an interactive workshop agenda that includes some hands-on activities to engage participants. The activities are shown in Table 1.

Table 2: Workshop Agenda

Activity	Title	Facilitator	Time (mins)
Presentation	The Cloud Competency Framework	Myra	30
Q & A		Terry	05
Hands-on 1	Cloud Career Pathway	Myra & Joshua	30
Break			10
Hands-on 2	AWS Console and Contents	Myra Joshua Nwokeji, &Michael	45
Break			15
Hand-on 3	Develop Cloud Curriculum, Course or Cloudify Existing Course	Myra Joshua &Michael	45
Q & A		Terry	10

IV. Description of Anticipated Audience

We intend to reach a wide audience to broaden access to and participation in cloud computing education and accomplish the workshop's goals. Although the workshop's primary audience is educators interested in or currently teaching cloud computing courses, we also encourage industry practitioners to participate. Industry practitioners are necessary because they can provide graduates with specific cloud computing competences to aim for [3]. These competences will serve as input in the design of cloud computing curricula and learning objectives. The anticipated audience will be similar to the participants of the cloud computing panel [3] held in FIE 2020, namely:

- Instructors, lecturers and professors interested in or already teaching cloud computing skills to students.
- Curriculum design experts willing to contribute their expertise in the design of cloud computing curriculum.
- Cloud computing researchers, academics, and professionals working in the industry.

V. Explanation of the Qualification of Each Workshop Organizer

This workshop stems from an on-going collaboration between academia and the industry. Consequently, the workshops organizers are drawn from experienced cloud computing practitioners and academics who currently teach cloud computing courses. The qualifications of the organizers are described in Table 2.

Table 1: Qualification of Pre-Conference Organizers

Name	Qualification
Joshua C. Nwokeji	Joshua C. Nwokeji (Ph.D.) is an associate professor at the department of computer and information science (CIS), Gannon University, USA. He has authored many publications in computing and engineering education. Joshua has participated and contributed to every FIE conference since 2016 and has led panels in every FIE since 2017. Currently, he is an AWS Certified Cloud Practitioner, a member of AWS Educate and teaches cloud computing courses at Gannon University. This workshop was motivated by the Cloud Computing Panel [3] held during FIE 2020 conference.
Myra Roldan	Myra Roldan is the Technical Program Manager for AWS Education to Workforce Solutions with over 20 years of technology and education experience. She is the primary researcher of the AWS Cloud Competency Framework. Myra provides technical and consultative services for higher education and workforce development institutions globally. She collaborates with institutions to evaluate and assess existing programs of study for cloudification readiness and provides guidance and inputs on the development of cloud computing comprehensive credentials, 2-yr and 4-yr degrees, and workforce development programs.
Michael Soltys	Michael Soltys (Ph.D.) is a professor and chair of Computer Science at California State University, Channel Islands campus. Before coming to California State in 2014, he was a professor at McMaster University for 14 years. He has authored over 70 papers, written 2 books, and specializes in Algorithms, Cybersecurity and Cloud Computing. He is currently an AWS ambassador, and is passionate about introducing the Cloud into the Computer Science curriculum and research.
Terry Holmes	Terry S Holmes (J.D., MBA) is an assistant professor at the Dahlkemper School of Business, Gannon University, USA. He has authored numerous publications in computer and engineering education. Further, he has participated in numerous FIE conferences both presenting papers and participating on panels including FIE 2020 Cloud Computing Panel [3]. Prior to teaching, he was a partner in an Internet Provider Service.

VI. DESCRIPTION OF TAKE AWAY SKILLS

At the end of this workshop, participants should be able to:

- Understand the cloud computing competencies demanded by employers
- Integrate cloud computing technologies into existing courses
- Locate cloud technology content for use in a course on the AWS Educate and the AWS website
- Demonstrate how to leverage AWS Educate badges & pathways, classrooms, and general AWS resources
- Cloudify or build courses that map to the Cloud Competency Framework

VII. SPECIAL REQUIREMENTS AND FEES

This workshop is free of charge, participants will not be required to pay any fees for attending the workshop. Participants are expected to come along with the following equipment and materials:

- A laptop or any personal computer that can access the internet. This will be helpful during the hand-on activities and will be used to access online cloud computing resources.
- Syllabus and other curricular materials, especially those that participants desire to cloudify. For instance, if a participant is planning to integrate cloud computing skills into a course, it will be helpful to come along with the course materials.

REFERENCE

[1] D. Foster *et al.*, "Toward a cloud computing learning community," in *Proceedings of the Working Group Reports on Innovation and Technology in Computer Science Education*, 2019, pp. 143–155.

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