Developing a Remote Sensing and Cloud Computing Curriculum for the Association of Computer/Information Sciences and Engineering Departments at Minority Institutions (ADMI)

Keywords: *Cloud Computing, Storage area networks, Virtual private networks, Computer networks, Google, Web services, Digital video broadcasting, Remote sensing, Curriculum development, Educational programs*

In the past decade, online learning initiatives have become increasingly comprehensive and have allowed students to be unburdened from learning complex subjects in a traditional teach-learn environment. Universities have recognized the need to adapt new teaching-learning approaches for meeting students' diverse inadequacies. Cloud computing, which offers a scalable and flexible approach to storing, processing, and analyzing big data, has benefited from a variety of science applications except for remote sensing. The research explored the potential for a cloud computing and remote sensing curriculum through the use of video resources and hands-on assessments. This research discusses a curriculum for coupling two diverse research areas, cloud computing and remote sensing. The solution acquired information about cloud computing and remote sensing in order to develop five 15-20 minute self-contained modules. Understanding the challenges recognized by minority serving institutions in adapting from a teaching-learning environment to an online environment was also explored.

In fall 2006 19.6% of students were learning online and in fall of 2011 that percentage was increased to 32.0%. Online education is slowly increasing. According to previous research, findings show that in 2012 56.4% of students taking online courses had the same learning outcome compared to students taking courses face to face with professors. With the increasing of technology, online education will continue to increase [1]. Online education has the ability to teach subjects that some professors cannot teach at minority serving institutions. Some institutions have limit to no resources to teach cutting edge research options like cloud computing. If the institutions have resources to teach subjects like cloud computing, the downfall is not having the teachers who can communicate the subjects effectively. Producing cutting edge online courses for Massive Open Online Courses (MOOC) allows students at ADMI institutions to experience cutting edge education in virtual time and train the next generation of engineers.

This project used two highly known online educational services as a reference for the courses, MIT OpenCourseWare (OCW) and Stanford Online. Massachusetts Institution of Technology (MIT) has developed online courses on a cloud called MIT OpenCourseWare (OCW). OCW allows materials that are being taught in MIT's classrooms available on the Internet for no charge. MIT OpenCourseWare currently has 2,150 courses and about 125 million people who have visited the site [4]. Stanford Online is an educational tool for people to experience Stanford University's high quality education by unleashing innovation in online learning.

Remote Sensing is the art and science of obtaining information about an object without being in direct physical contact with the object. Cloud Computing is the next big

thing in computing and Internet evolution because it is allowing you to have access to the services wherever and whenever you need it. Cloud computing includes three main services, they include: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Infrastructure as a Service supplies resources to data centers that hold large pools of information. The customer can use the Internet or dedicated virtual private networks. Examples of IaaS include networks, virtual machines, servers, and storage. Software as a Service is a delivery method for software that provides access to software and its functions remotely as a Web-based service [2]. Examples of Software as a Service include email, virtual desktop, and games. Platform as a Service allows IT to develop, test, deploy, host and also update from a single streamline environment [3]. Examples include execution runtimes, development tools, and webservers. With the use of these services school can freely access, edit and develop with for teaching, learning etc. The services also allow businesses to have full control of the business documents because they have ability to process, store, and analyze all documents.

Remote sensing creates a plethora of data, which creates difficulty with storing, processing, and analyzing the big data. The cloud's scalable and flexible environment produces a simple way for storing, processing, and analyzing. One of the biggest problems with remote sensing is processing, taking the raw remote sensing data and putting them to images. Using infrastructure as a service a developer can use MapReduce to process the data. MapReduce is a programming model for processing large data sets with a parallel, distributed algorithm on a cluster. Many companies such as Google, Netflix, and Facebook use MapReduce to make their websites user friendly.

We have created modules to introduce cloud computing. Some of the topics covered were Big Data, Parallel and Distributed Computing, Cloud Computing and MapReduce. Modules were designed to appeal to multiple learning styles (i.e. auditory). In further production of the remote sensing and cloud-computing curriculum the modules will be expanded and user experience studies will be conducted with students who attend ADMI institutions (i.e Spelman College, Norfolk State University, and Elizabeth City State University). The user study will allow the student to take the course online; feedback will be gathered to see how the curriculum is effective. A Message Passing Interface (MPI) and Hadoop virtual appliance will be developed so students can apply theoretical concepts gained from the curriculum.

References

[1] Allen, E., & Seaman, J. (2013). Changing course: Ten years of tracking online education in the united states. (pp. 24-41). Retrieved from http://www.onlinelearningsurvey.com/reports/changingcourse.pdf

[2] Waggner, S. (2010). Cloud computing: Managing data in the cloud. UC Berkeley iNews, Retrieved from http://inews.berkeley.edu/articles/Oct-Nov2010/cloud-computing-EQ3

[3] Sriram , I., & Khajeh-Hosseini, A. (n.d.). *Research agenda in cloud technologies*. Retrieved from http://arxiv.org/pdf/1001.3259.pdf

[4] Abelson, H. (2007). The creation of opencourseware at mit.Journal of Science Education and Technology, Retrieved from http://link.springer.com/article/10.1007/s10956-007-9060-8/fulltext.html