



Keynote

Availability and Integrity of Cloud Course Assessments

Computation
World
2021

Cloud Improves Availability but does it also allow us to improve Integrity of learning

Aspen Olmsted, Fisher College & New York University, USA aolmsted@fisher.edu



- During COVID, K-12 and Higher Education Moved to Cloud and Remote
- News Media Focuses on challenges and Failures
- NYU has created an Online Cybersecurity MS degree with connections that cannot be offered in brick and mortar
- edX MicroBachelors offers undergraduate credits for high-quality low-cost education in the cloud
- This is a model for how many businesses can improve the integrity and confidentiality in other domains

→ → COVID and Cloud will change how we do business
→ Integrity and confidentiality will be higher utilizing cloud and remote
→ Old models were inefficient

About Aspen

Dr. Aspen Olmsted is the information technology program director at the Fisher College. He obtained a Ph.D. in Computer Science and Engineering from The University of South Carolina. In addition to his academic career, he is the CEO of Alliance Software Corporation. Alliance Software develops N-Tier enterprise applications for the performing arts and humanities market. Dr. Olmsted's research focus is on the development of algorithms and architectures for distributed enterprise solutions that can guarantee security and correctness while maintaining high-availability.

Agenda

- NYU Cyber Fellows
- MOOCs
- Scalable Assessments
- Headed vs Headless Autograders
- Programming Labs - Prerequisite Knowledge
- Coding Course Labs - Database and Operating Systems Examples
- Tool Course Labs - Networking Examples
- Derivate Labs
- Scripting Synchronization
- Peer Review
- Derivative Quiz Pools
- Dividing Up Work
- Programming Links
- Questions

NYU Cyber Fellows

- MS Degree in Cyber Security
- 75% tuition discount
- Certificate by NSA in Cyber Operations and Cyber Defense
- Many Industry Partners provide applied Badges
- 1st Year – 150 Students
- 2nd year – 250 Students
- 3rd Year – 400 Students
- 4th Year – 800 Students

MOOCs

Massive Open Online Courses (MOOCs) are free online courses available for anyone to enroll. MOOCs provide an affordable and flexible way to learn new skills, advance your career and deliver quality educational experiences at scale.

- edX MicroBachelors (22 classes over last 14 months)
- Coursera Certificates (8 classes over last 3 months)

edX MicroBachelors

- All programs sponsored by New York University (NYU)
- Credit Granted from Thomas Edison University (NJ)
- Students can apply credits to NYU AS or BS in Information Systems
- Audit users get access to lectures and discussion forums
- Verified users get graded assessments and certificate & undergraduate credit
- Each program is attracting between 500-750 verified users/year
- Computer Science Fundamentals
 - 3 Undergraduate Credits (Python Programming, OS Intro, Networking)
 - Used for prerequisite knowledge in several MS CS programs

edX MicroBachelors (continued)

- Programming and Data Structures
 - 8 Undergraduate Credits (C++)
 - Used for prerequisite knowledge in several MS CS programs including NYU Cyber Fellows
- Introduction to Databases
 - 3 Undergraduate Credits (SQL Coding)
- Cybersecurity Fundamental
 - 9 Undergraduate Credits (tools)

Coursera

- Done as a consultant for Learn Quest
 - Low Integrity/High Availability
 - I show students how to solve programming challenges
 - Organizations have subscription for employees, individual pay around \$50/month
 - 50 users/week
 - Two four course specializations
 - Intro to Programming with Visual Basic
 - DevOps and Build Automation with Python

Scalable Assessments

Our goal is to have assessments in the online courses that provide integrity while not requiring large number of TAs to support the assessments

- Autograded Labs
- Peer Review Projects
- Derivative Quiz Pools

Current Ratios

- Cyber Fellows - 1 Teacher/100 Students/2 TAs
- Prerequisite Knowledge - 0 Teachers/100 Students/0 TAs
- edX - 1 Teacher/750 Students/0 TAs

Headed Auto-graders

In Computer Science, Information Technology and Cybersecurity our inclination is to create autograded labs that simulate the operating system or application experience.

Headed Grader Platforms:

- Codio - www.codio.com
- Vocareum - <https://www.vocareum.com/>
- Practice Labs - <https://www.practice-labs.com/>

Headless Auto-graders

Gradescope provides a docker container that allows students to upload file and scripts run and return the results to the student

- Programming Labs - Students upload their code (programs, classes or functions) and they are unit tested
- Tool Labs - Students upload a file demonstrating their use of tool (i.e. pcap file)

Prerequisite Knowledge Programming Labs

Adult students may have gained their programming prerequisite knowledge a long time ago. In Cyber Fellows we provide lectures and labs with auto-graders for

- Python
- C++ (Beta)
- Data Structures (September)
- x86 Assembler (Future)

Example C++ Lab

- BMI Metric Function

Description

Body mass index (BMI) is a number calculated from a person's weight and height. According to the Centers for Disease Control and Prevention, the BMI is a fairly reliable indicator of body fatness for most people. BMI does not measure body fat directly, but research has shown that BMI correlates to direct measures of body fat, such as underwater weighing and dual-energy X-ray absorptiometry. The formula for BMI is: $\text{Weight}/\text{Height}^2$

Where weight is in kilograms and height is in meters.

The name of the function should be named `bmimetricf` and the function should take two parameters which are the weight in kilograms and the height in meters to use to calculate the BMI.

Example C++ Lab Continued

Here is an example call to the function

```
int weight = 50;  
float height = 1.58;  
printf("BMI is: %3.2f",bmimetricf(weight, height)) ;
```

The output of the code above would be: BMI is: 20.03

File Name

bmimetricf.cpp

Function Signature

```
float bmimetricf(int weight, float height);
```

Score

There are five tests each worth 2 points

Course Programming Labs

Similar labs have been used in the following courses

- Operating Systems Course - Students upload function implementations in C - Stub compiled and linked - Students given one test case in documentation and code has several test cases
- Database Course - Students upload SQL queries. A python executer takes the query and sends to a database

Tool Labs

In Networking, Network Security and Penetration Testing students use tools such as Wireshark, TCPDump, etc

- Questions about the lab file - In Networking Students fill out Google Form that answers questions about the pcap file. They upload the pcap file and the answers are compared (show demo)
- Parse File - A parser can be written that scores the students from the output file

Derivate Labs

A derivative lab changes the lab so each student requires a different solution

- Utilize email, location, time to change the question and required solution
- For tools lab - send student to a site that requires they identify themselves so the user is in the pcap or output file.

This increases learning because you can encourage discussion instead of trying to dissuade discussion

Example Derivate Lab on edX

Week 5 - Lab1
Lab due Aug 31, 2020 20:00 EDT
[Bookmark this page](#)

Write an INSERT statement that adds this row to the Userstable with the following field values:

- user: ao56
- email: ao56@nyu.edu

Store the query in a file named query.sql and upload to GradeScope below

STAFF DEBUG INFO

Week 5 - Lab1 (External resource) (10.0 points possible)

Gradescope Lab

[View resource in a new window](#)

STAFF DEBUG INFO

< Previous Next >

Type here to search 4:17 PM 8/21/2020

Scripting Grade Synchronization

- Gradescope matches roster based on email
- Allows for self-service account merge
- Push Grades from Gradescope to Sakai/edX
- Script from UI.Vision RPA/iMacros/headless Chrome

Peer Review

Peergrade allows a scaffold scailable project such as a research paper or report.

- Information Security and Privacy and Operating Systems - Students build a short research paper where they solve a problem for a specific use case
- Penetration Testing - The students build a penetration testing report

4 Opportunities for learning:

- Webinar, Implementation, Peer Review, Reaction

Peer Review Scaffolding Example

- Week 4 - Define Problem Domain and 3 Papers (Research Review)
- Week 5 - Threat Model
- Week 6 - Define Hypothesis and Differences from Current Solutions
- Week 8 - Metric and Chart - Empirical Evidence
- Week 11 - Related Research Write-up
- Week 12 - Introduction Write-up
- Week 13 - Empirical Evidence Write-up
- Week 15 - Paper and Recorded Presentation

Derivative Quiz Pools

Sakai Testing Tool/Qualtrics/Britespace

- Allows you to have a pool of questions that it will randomly select x number from for each quiz. In operating systems, I have multiple choice questions that take around 10-15 per question to answer and the students randomly are assign 5 of the 30 questions. They can take the quizzes as many times as they like and I take their last score.

Derivative quizzes

- Allow you to specify multiple correct answers and multiple incorrect answers. For example if a question has 4 correct and 8 incorrect and each student is assigned one correct and 3 incorrect there are 224 derivatives of the same question.
- edX and OpenEdX support this feature.

Dividing Up Work

- Document Lab Test Cases
- Write Python Code or Command Line code to parse or compile uploaded file
- Develop Autograder

Programming Lab Links

- Programming Lab Documents - Programming assignments can be built that either:
 - Executes a program from a command line in Python - The grader compares the output returned from a set of command line parameters passed to the program. Examples of these types of assignments can be seen in the [Python Lab](#) or [CSharp Lab](#) up to lesson 7.
 - Calls a Python function - The grader passes parameters to a function specification called from the test code. This can currently be done from three programming languages (Python, Java and CSharp). Examples of these types of assignments can be seen in the [Python Lab](#) and [CSharp Labs](#) from lesson 8 and up.
 - Compile a program in another programming language and execute the program from Python testing the output returned from a set of command line parameters passed to the program. The first two assignments in the [C operating systems](#) programming assignments show examples of this type of testing. More examples can be found interspersed with in the [C++ labs](#)
 - Compile a program in another programming language with a test stub that calls functions in the programming language. The separate C operating system labs show examples of this type of testing:
 - [Disk Scheduling Lab](#)
 - [CPU Lab](#)
 - [Memory Allocation Lab](#)
 - [Virtual Memory Lab](#)More examples can be found interspersed with in the [C++ labs](#)
 - Send uploaded code to an external system via a Python Library. This type of lab could be used for HTML, XML, or database labs. Examples can be found in the [MySQL Database Labs](#)

Thanks for reading!

Questions?

Questions: to aolmsted@fi.edu