RING - Cybersecurity Curriculum

Debasis Bhattacharya, JD, DBA
University of Hawaii Maui College
debasisb@hawaii.edu
maui.hawaii.edu/cybersecurity

Agenda

1. What is RING?
2. How do teachers access RING?
3. What are the modules within RING?
4. Sample Module - Unit 2 - Establishing Trust
5. Sample Activity - Caesar Cypher
6. Implementation of RING in Hawaii Dept of Education
7. Reflections!

What is RING?

RING (Regions Investing in the Next Generation) is a free online high school cybersecurity course that offers interesting and engaging content specifically for rural students, homeschool students, and students attending schools without an existing cybersecurity program.

RING is structured for high school students, grades 9-12. The curriculum has been developed through the National Security Agency's RING program grant to The University of Alabama in Huntsville (UAH).

University of Hawaii Maui College is part of a coalition of colleges across the US, supported by funds from the NSA, to teach RING to high school teachers and students.

Abstract

The objective of this presentation is to -

1. Provide a Course Overview of RING

2. Outline the Key Concepts of RING

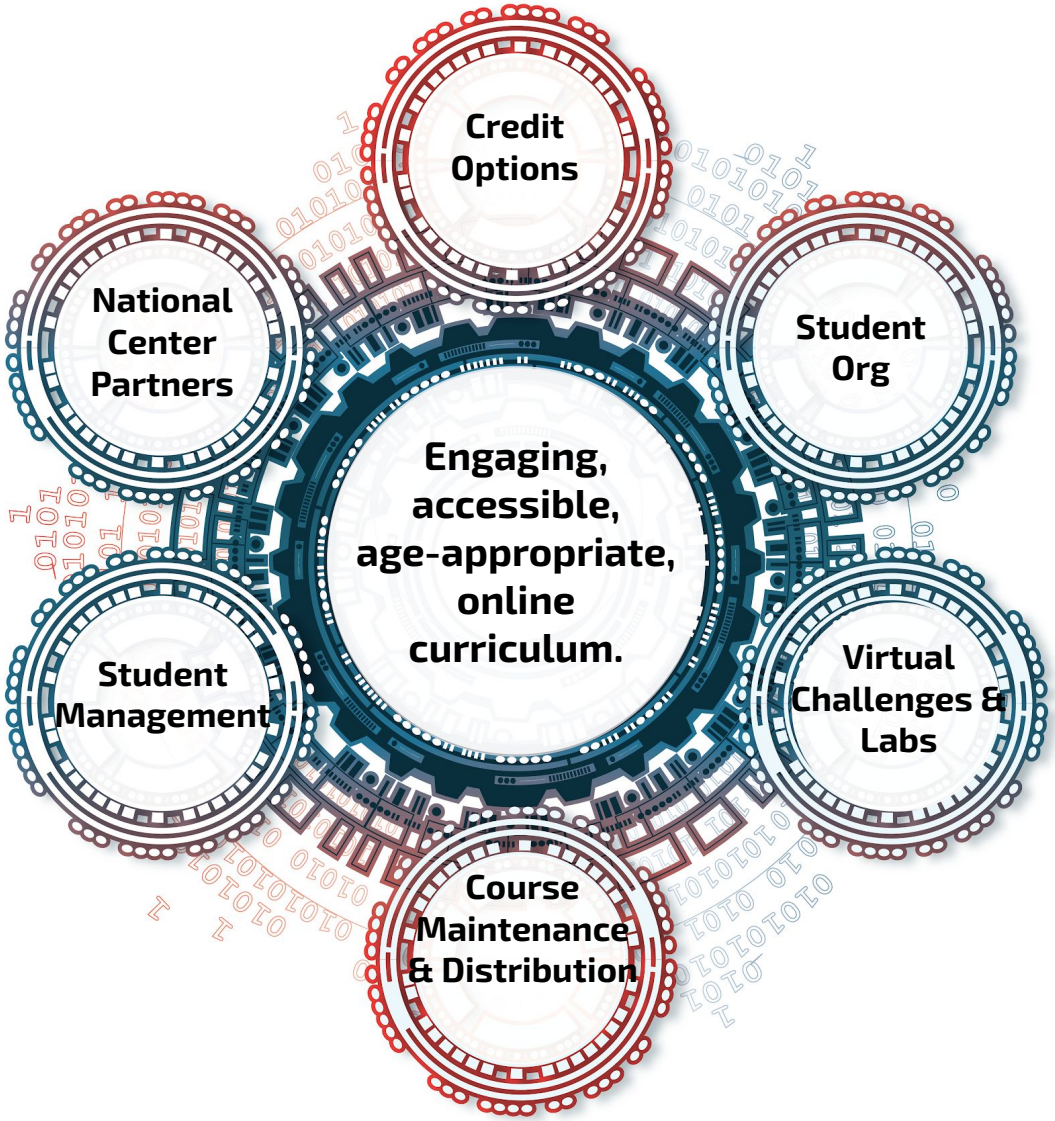
3. Demonstrate a Sample Lesson - Establishing Trust, Caesar Cipher and Steganography

The audience will learn about the core modules in RING, how it applies to students who are new to cybersecurity, and how RING can be an inclusive and friendly space for newcomers to learn about cybersecurity. The presentation will provide live examples from the RING curriculum using the Canvas learning module system.

The audience will also benefit from a pathway, that extends the learning from RING to more advanced topics in Networking and Computer Security. The presentation will provide a sample lesson plan for teachers, that has been created by high school teachers in Hawaii, to demonstrate how RING can be taught to high school students.

RING Overview

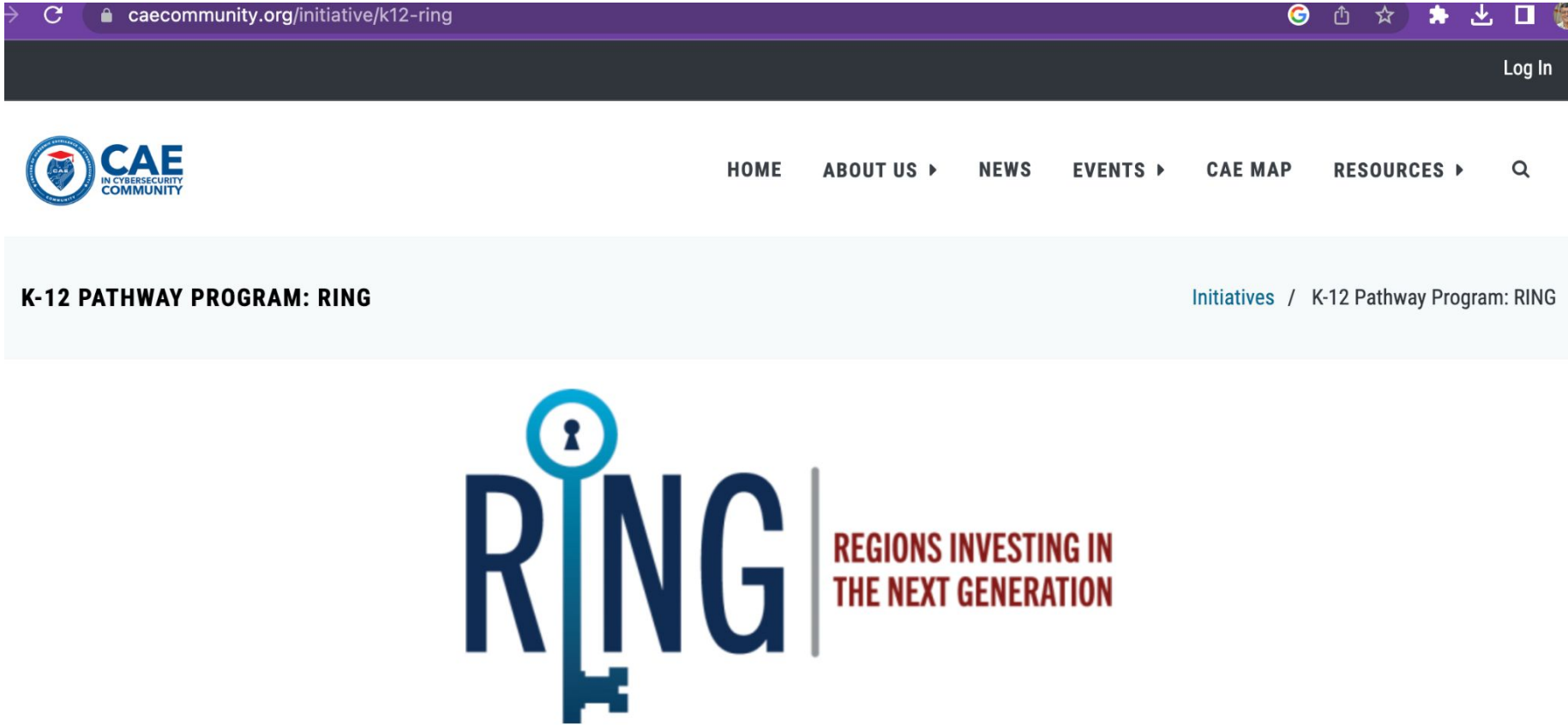
Regions
Investing in the
Next
Generation



RING is…
Cybersecurity for students without access to a cyber program.

- **Rural**
- **Homeschool**
- **Under-resourced**

RING site!



https://caecommunity.org/initiative/k12-ring

RING sign up

Resource Links

- RING Curriculum Request Form for Educators
- RING Student Enrollment Request Form
- RING Guest Speaker Registration Form
- Affiliated Public Resource - Interactive E-Mates
- Affiliated Public Resource - Interactive Virtual Escape Rooms

Files

No Files Found.

Contacts

Jesse R. Hairston
Initiative Co-Primary POC
Email: ring@caecommunity.org

Dr. John Sands
Initiative Co-Primary POC
Email: sands@morainevalley.edu

Link for Teachers to sign up - here!

Teach with RING!

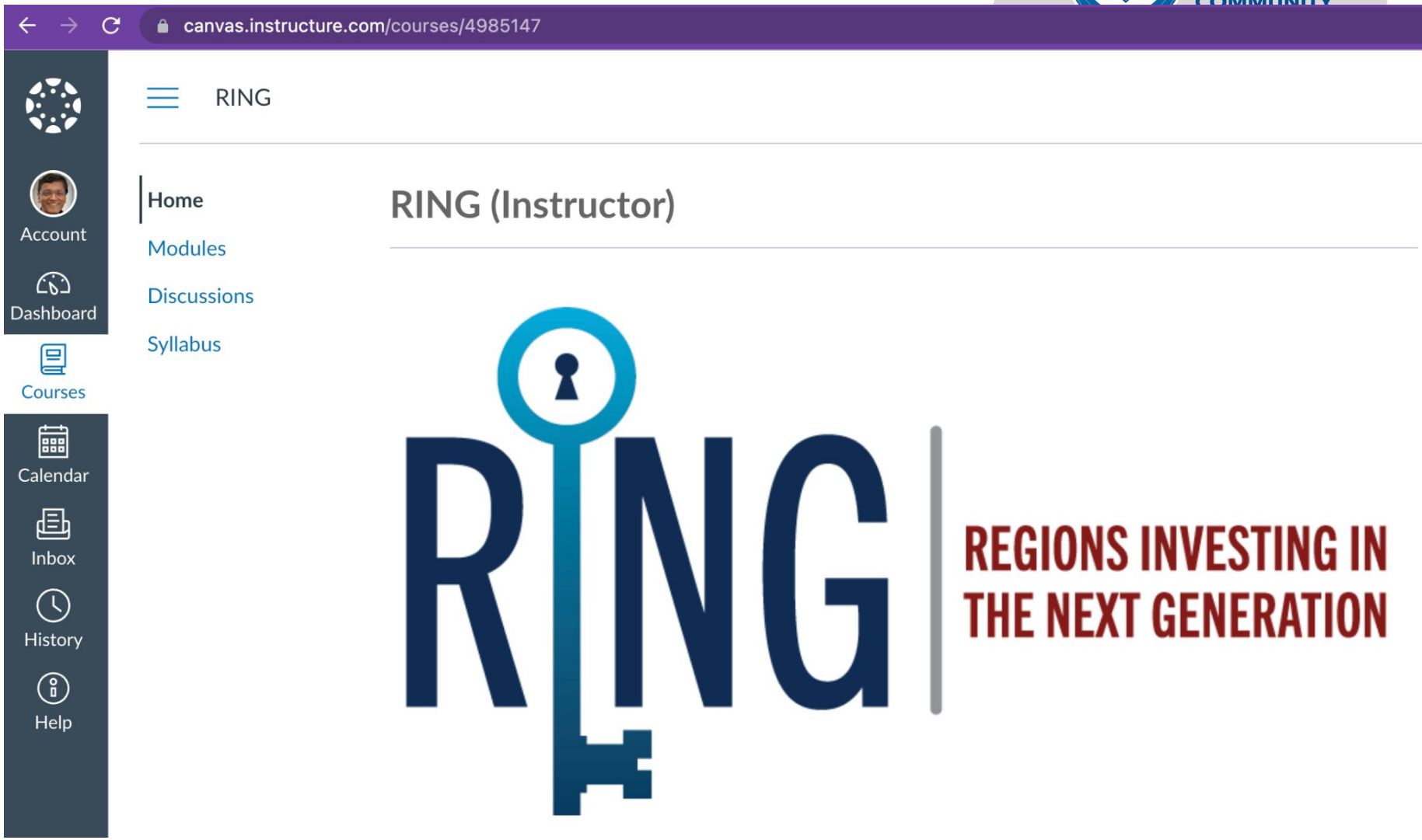
Teacher Curriculum Request Form

Educators* can gain full access to the curriculum package

- All Units available
- Gain access to virtual labs
- RING Student Org events
- Provide feedback

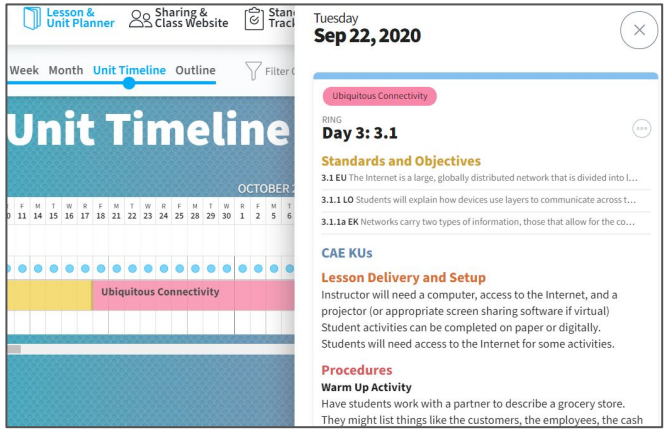
*Educators who request access must provide proof of their school/homeschool affiliation.

RING Canvas site



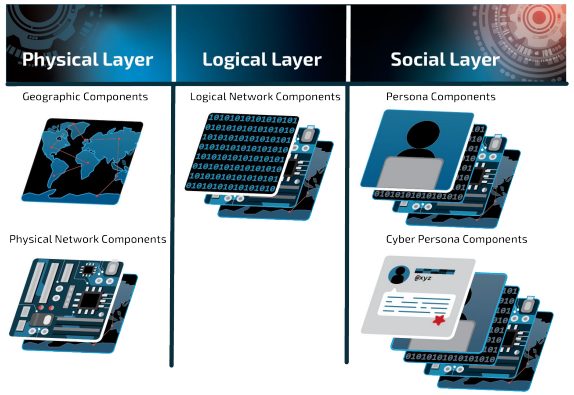
Curriculum Package

Lesson Plans & Instructor Slides

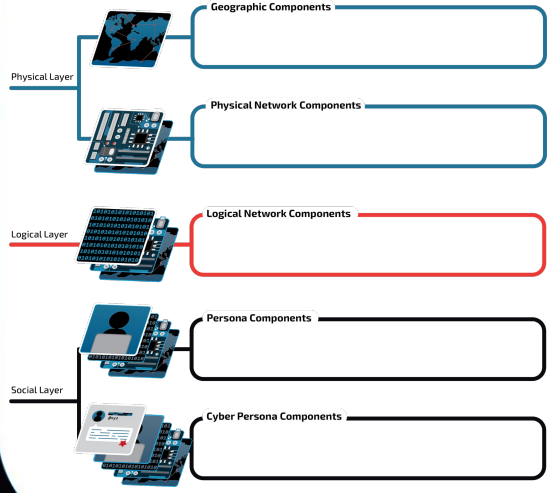


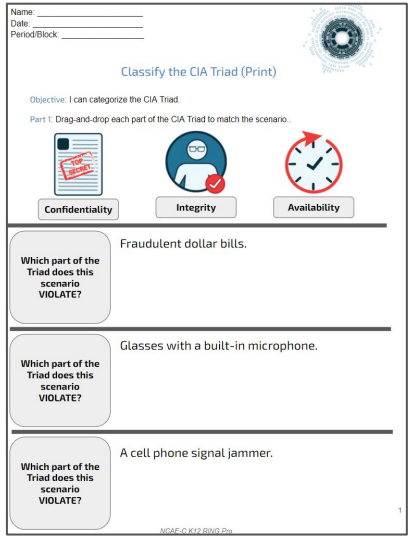
Labs & Games

Visually-Rich Content

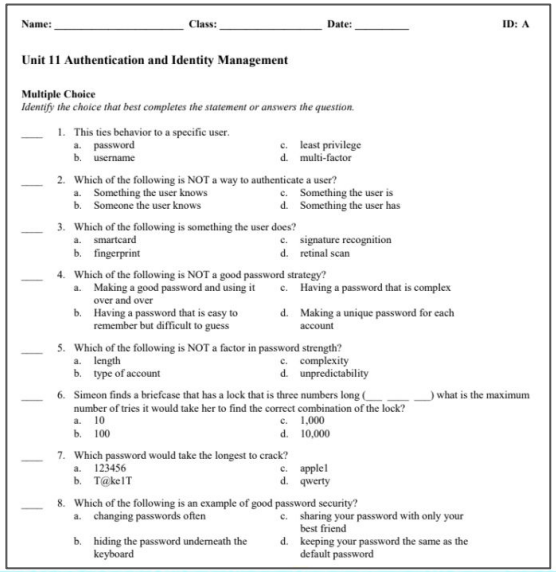


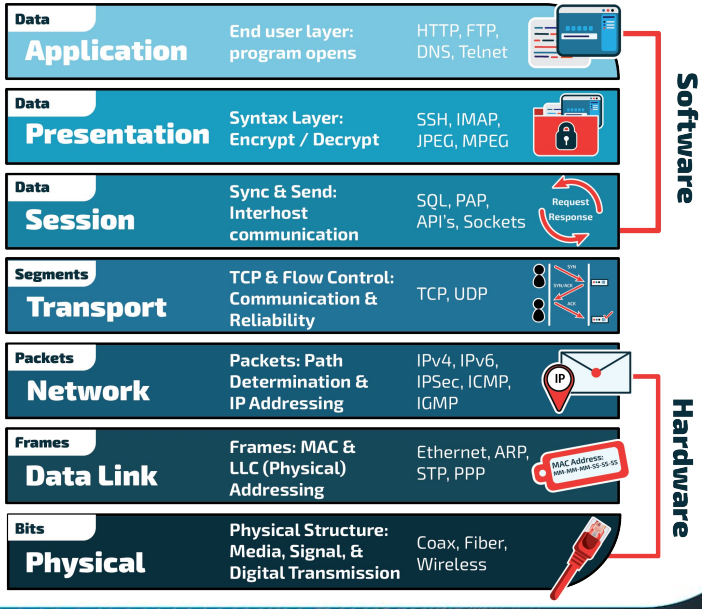
Graphic Organizers





Assessments



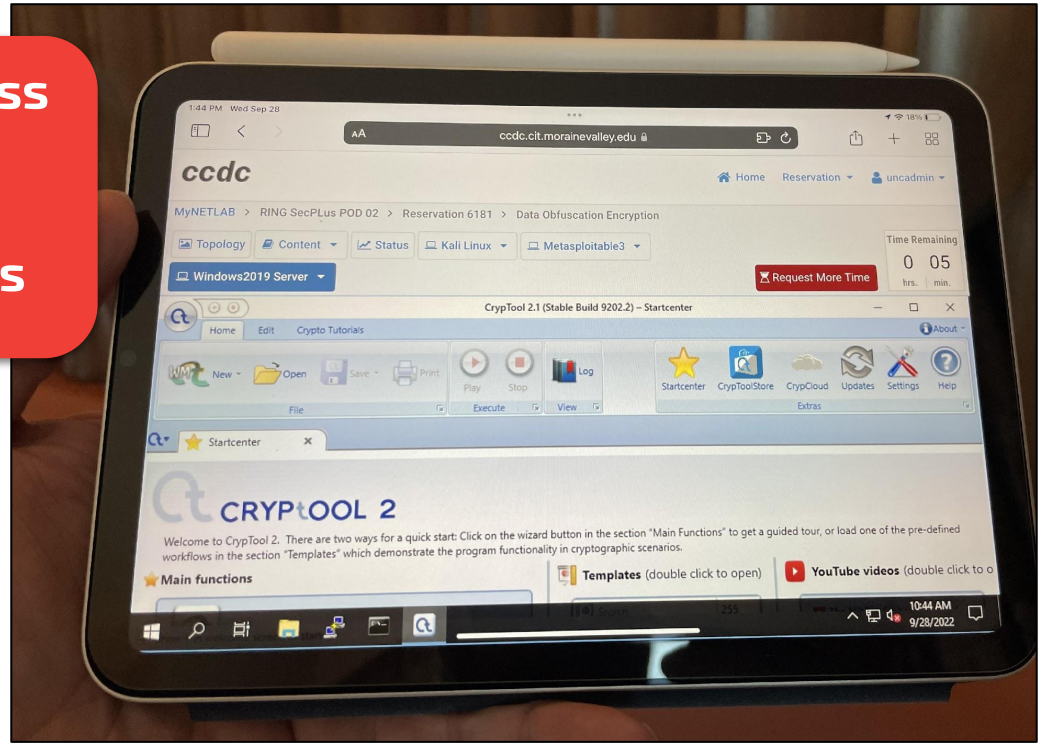


Lab Access

Netlabs offer virtual machines on any device.
Coastline Community College hosts Netlab access for RING teachers across the country.

RING Netlab Access

- 18 teachers
- 12 states
- 350 students

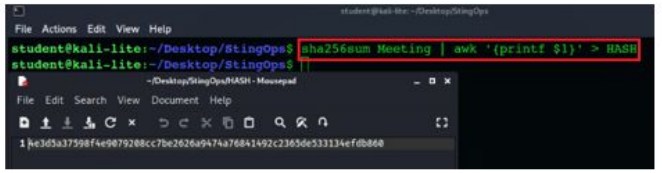


Competency Lab 3 – Hashing, Encryption, and Password Cracking

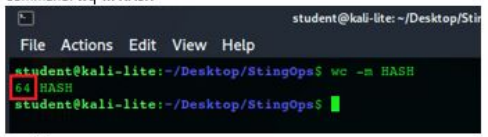
After your excellent work on the network, the agency is loaning you to help law enforcement to take down a ransomware group. As part of the sting operation, we have to send the file 'Meeting' from the StingOps folder located on Kali Linux desktop. We suspect that the group will try to change the contents of the message in-transit so your job is to make sure our agent inside has a way to verify the integrity of the document he receives.

1. Produce text file 'HASH' that can be sent via secure channel for verification purposes. Please make sure the file ONLY contain the SHA256 hash of the secret file (i.e., get rid of the file's name). Take a screenshot of the open HASH file.

   Command: **sha256sum <filename> | awk '{printf $1}' > HASH**



2. Count the number of characters in the HASH file. Is the number correct? Why?
   Command: **wc -m HASH**



   YES
   SHA256 create 64-character hash

Excellent job. We sent the document and our agent already replied. For security purposes he used the polyinstantiation strategy and sent multiple documents as part of the package. The documents, along with the hash file Verification we received through secure channel were saved to Reply folder on the Linux Kali desktop. We need your help to detect the correct document.

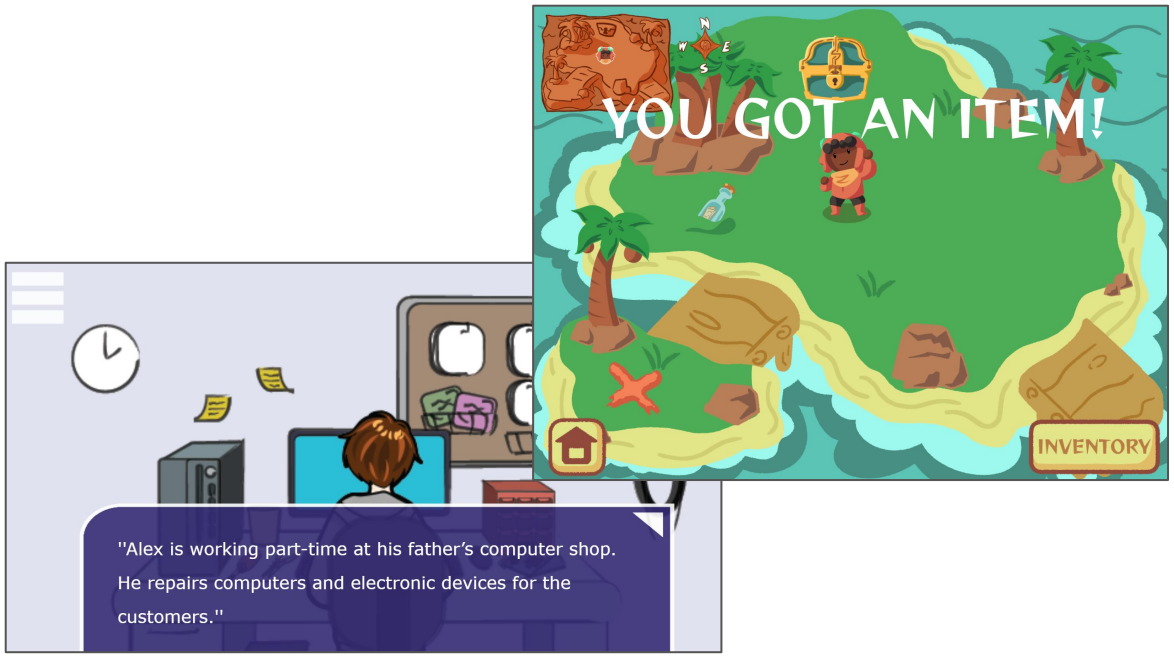
3. Please identify the correct document.

   Command: **sha256sum <file(s)> >> Candidates OR find -type f -exec sha256sum {}\; > Candidates**
   grep -f <sent_hash_file> Candidates

Labs and Games

Labs provide hands-on learning through an online portal.

Games map to Big Ideas that drive the primary learning objectives.



Name: _____

Date: _____

Period/Block: _____

Asymmetric Practice

Objectives:

Explain the relationship between public and private keys in asymmetric cryptography.

Apply an asymmetric cryptographic tool to accomplish confidentiality and integrity in a practical scenario.

Overview

RSA is a popular algorithm used for asymmetric cryptography. It can be used to generate public-private key pairs and both encrypt and decrypt information. You will explore RSA using a simple online tool to encrypt a message to your partner. In a future assignment, we will install and use a more realistic version of RSA.

Setup

1. This is a paired activity. Grab a partner and work together!
2. Both you and your partner visit the website: https://www.javainuse.com/rsagenerator (Note: if the website is down, use the backup site: https://www.codeusingjava.com/tools/rsa)
3. You and your partner will need a way to copy and paste data back and forth (e.g., Zoom, Slack, email).

1. Key Generation

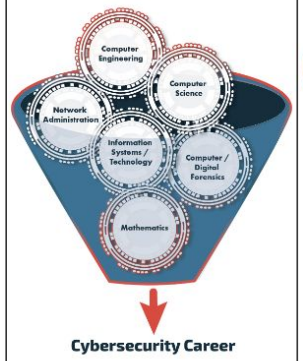
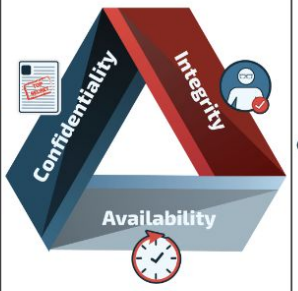
You and your partner will each generate your RSA public and private keys: click **Generate Keys**.

RSA Generate Keys

This tool generates RSA public key as well as the private key of sizes - 512 bit, 1024 bit, 2048 bit, 3072 bit and 4096 bit with Base64 encoded. The generated private key is generated in PKCS#8 format and the generated public key is generated in X.509 format.

RING Modules

RING Modules

 Unit 0: Introduction Content List	 - Unit 1: Ethics Content List	 - Unit 2: Establishing Trust Content List	 Unit 3: Ubiquitous Connectivity Content List	 - Unit 4: Data Security Content List
 - Unit 5: Introduction to Python Programming Content List	 Unit 6: System Security Content List	 Unit 7: Adversarial Thinking Content List	 Unit 8: Risk Content List	 Unit 9: Implications Content List

Unit 2 - Establishing Trust

Unit 2: Establishing Trust

- Unit 2 Instructional Slides (Teacher)
- Unit 2 Instructional Slides (Student)
- **Unit 2 Content List**
- Lesson Plans
- Establishing Trust Game

Section 2.1

- Unit 2 Part 1 Kahoot
- Unit 2 Part 1 Quizlet

Unit 2 - Establishing Trust

Day 1

- Graphic Organizer: Vocabulary Practice 2.1 (Student)
  - Graphic Organizer: Vocabulary Practice 2.1 (Teacher)
- Viewing Guide: "What is the C.I.A. Triad?" (Student)
  - Viewing Guide: "What is the C.I.A. Triad?" (Teacher)
- Extension Activity: (E-mate) McCumber Cube
- Extension Activity: (E-mate) McCumber Cube Challenge
- Extension Activity: Build a Scytale (Physical) (Cryptool.org Site)
- Extension Activity: Digital Scytale (Superm.math.hawaii.edu Site)

Day 2

- Activity: Caesar Cipher (Student)
  - Activity: Caesar Cipher (Teacher)
- Extension Activity: (E-mate) Cryptography

Unit 2 - Caesar Cypher

Caesar Cipher

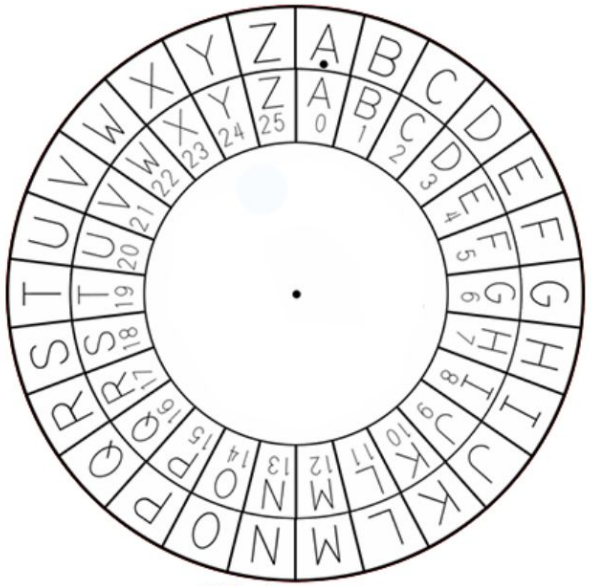
Objective: I can practice confidentiality using the Caesar cipher.

Overview

The Caesar cipher is an early form of cryptography. It is a foundational cipher performed by placing one alphabet on top of another in a circle, then shifting the top alphabet by three spaces to the right.

Setup

1. Visit the InventWithPython website link to use a visual Caesar cipher wheel too.
   http://inventwithpython.com/cipherwheel/

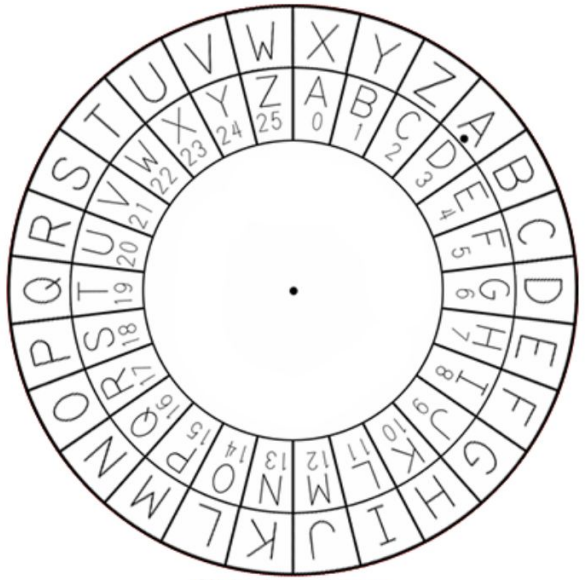


Click wheel to rotate.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

2. Click the wheel, then move your mouse. The outer ring of the cipher wheel will begin rotating. To achieve the Caesar cipher, you must rotate the top wheel three spaces to the right. ‘A’ should now be on top of ‘D.’ Note the ‘A’ has a period under it -- this allows you to see your shift number. When ‘A’ is over ‘D,’ the number 3 indicates the shift. Your wheel should look like the one below.

Unit 2 - Caesar Cypher



Click wheel to rotate.

X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25

Caesar Cipher

First, let's decrypt a simple message: **ULQJ**

To decrypt:

1. Look at the message letter-by-letter
2. Find the letter on the inner ring
3. Change it to the outer ring letter it is touching

For this example:

U -> R

L -> I

Q -> N

J -> G

So, the message is: **RING**

Unit 2 - Caesar Cypher

1. Decrypt the following message: **FDHVDU**

   CAESAR

2. Decrypt the following message: **FRQILGHQWLDOLWB**

   CONFIDENTIALITY

Shifting Things Up

The Caesar cipher uses the shift of three, but any shift is possible to create a new kind of secret message.

Change your cipher wheel to a **shift of 13** to solve the following problems.

3. Decrypt the following message: **FPLGNYR**

   SCYTALE

4. Decrypt the following message: **GEHFG**

   TRUST

Brute Force

For this final activity, you have to figure out the shift value. **It will not be told to you**. You can accomplish this through the brute force method by testing every possible shift value. However, there is a trick that will save you some time. This encrypted message is multiple words.

5. Decrypt the following message: **V NZ PYRIRE**
   If you figure out the trick, explain how you did it.

I AM CLEVER The trick is that there are only two one-letter words in English: A or I. Clever students will notice this, align 'V' with 'A' or 'I' on the cipher wheel, and find the answer within two tries.

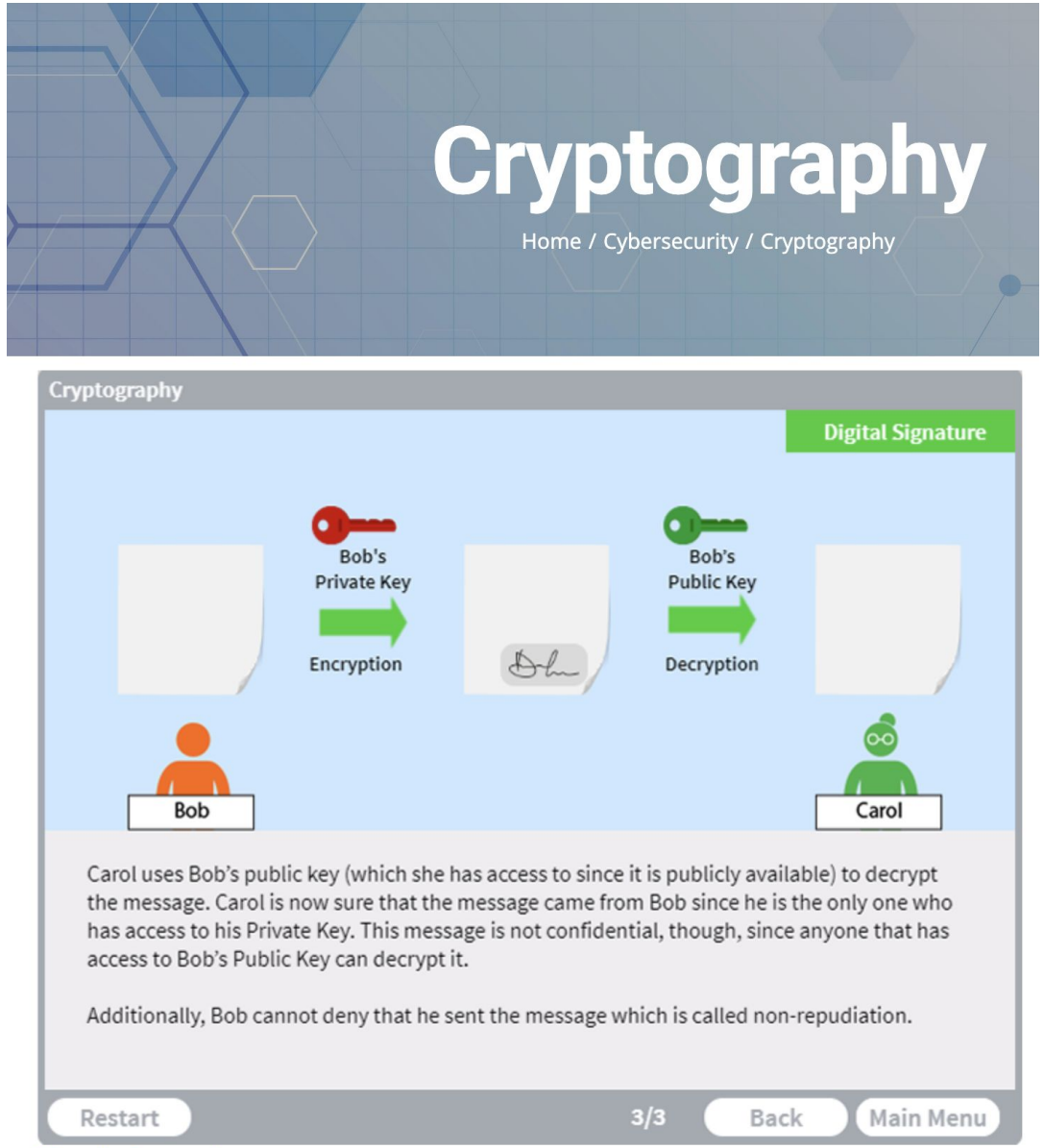
6. You have practiced decryption in this activity. How would you encrypt a message using the Caesar cipher? If time permits, encrypt a message to share with a friend.

When encrypting a message, the process is very similar. The difference is that you transform the outside ring letter into the inside ring letter.

E-Mates from CSSIA

CSSIA
National Support Center for Systems Security and Information Assurance

CAE IN CYBERSECURITY COMMUNITY



View the Interactive

Instructing RING

RING instruction is carried out nationwide within three categories.

RING Instruction in Hawaii

University of Hawaii Maui College is a Educational Pathway Institution (EPI) working under the Educational Pathway National Center (EPNC) - Moraine Valley Community College

- University of Hawaii Maui College - EPI
  - Online College Course that covers RING
  - ICS 169 - Introduction to Information Security (existing course)
  - Available to high school students under Early College
- Training for high school teachers in Hawaii
  - Cyber Summit - hosted by EPNC, UHMC and HI DoE
    - March 1, 2023 - Presentation to HI DoE leadership team
    - Half day workshop on RING by RING instruction from UAH
  - Intensive training in RING - Summer 2023
    - Two days, online training, June 12-13, 2024
    - Target is to teach 30 high school teachers
  - Follow up with high school teachers in School Year 2023-24
  - Repeat summer training in 2024 for 30 additional teachers!
- Expect Hawaii schools to start teaching RING starting Fall 2024
  - Netlabs to be initially hosted at Sinclair Community College, OH

RING is start of existing cyber pathway!

Certificate of Competence (CO) in Information Security (12 credits):

(All courses are taught completely online via the WWW)

- **ICS 101** – Digital Tools for an Information World (3 credits)...introduction to digital technology.
- **ICS 169** – Introduction to Information Security (3 credits)...covers 10 core areas of **ISC2**
- **ICS 184** – Introduction to Networking (3 credits)...covers CompTIA **Network+**
- **ICS 171** – Introduction to Computer Security (3 credits)...covers CompTIA **Security+**

Certificate of Achievement (CA) in Information Security (24 credits):

(All 4 courses required in the above Certificate of Competence, plus 4 below)

- **ICS 281** – Ethical Hacking (3 credits)...covers EC-Council **CEH**
- **ICS 282** – Digital Forensics (3 credits)...covers EC-Council **CHFI**
- **ENG 100 (or higher)** – English Composition I (3 credits)
- **MATH 103 (or higher)** – College Algebra (3 credits)

Questions?
Comments?!

Debasis Bhattacharya
debasisb@hawaii.edu