Lizards in the Street! Introducing Cybersecurity Awareness in a Digital Literacy Context

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Abstract

Learning cybersecurity awareness builds on basic information technology concepts and digital literacy skills. This paper describes a series of three different interactive sessions introducing cybersecurity awareness through presentation of actual breaches and incidents, demonstrations of open source intelligence tools (OSINT), and a capture the flag style competition where students applied their knowledge of OSINT to solve cybersecurity puzzles. The extra-curricular sessions were open to students enrolled in any undergraduate information technology course. This qualitative research study evaluates comments in blog posts and interviews after these sessions and concludes that cybersecurity awareness is relevant in students' daily lives and that they have a general sense of surprise, amazement and concern at how much personal information is readily available online.

Keywords: cybersecurity awareness, digital literacy, open source intelligence tools, hacking competition

1. INTRODUCTION

The increased number of cybersecurity attacks on individuals, companies, and government agencies in recent years has resulted in breaches, loss, or theft of personal data, intellectual property, and other damages (Singer & Friedman, 2014). As a result, individuals must be trained to protect their digital presence, and organizations are seeking employees with basic cybersecurity skills. Despite the perception that today's digital natives (Prensky, 2001) are tech savvy and have been born with a security mindset, having a baseline set of knowledge, skills, and abilities can go a long way toward developing core cybersecurity competencies common to many work roles (Dawson & Thomson, 2018).

Some universities have introduced baseline cybersecurity awareness competencies in courses or degree programs designed to meet industry demand for graduates with cybersecurity skills. These may include digital, computer, or information literacy programs, or as elements of life-long learning (Ala-Mutka, Punie, & Redecker, 2008; *AP Computer Science Principles*, 2017; Chinien & Boutin, 2011).

Raising cybersecurity awareness requires developing skills, focusing on basic competencies such as good password management (using different secure passwords, storing passwords safely using a password manager, two-factor authentication), recognizing phishing attempts, detecting malicious emails, and using open source intelligence (OSINT) tools. Combining intuition, curiosity and the ability to search and analyze data gathered from the Internet and other open sources is a powerful skill to detect fake news, scams, and social manipulation in the world (Bada, Sasse, & Nurse, 2019; Wells, Conflict, & Gibson, 2017). These "21st Century Skills" (van Laar, van Deursen, van Dijk, & de Haan, 2017) are vital at home, at the workplace and to function in society.

Digcomp, a digital competence framework for European citizens, (Carretero-Gomez, Vuorikari, & Punie, 2017) presents competencies to protect devices and personal data from risks and threats in digital environments, and applies cybersecurity skills to realistic employment scenarios, such as the use of social media in a corporate environment. While the United States National Cyber Strategy ("National-Cyber-Strategy.pdf," 2018) points out the need to protect networks, services and information, and secure critical infrastructure, Despite all of the technology precautions in place in the workplace, organizations are realizing that humans are still the weakest link in cybersecurity (Boulton, 2017; Postimees, 2019; Zimmermann & Renaud, 2019). As an example, one recent study found that most novice users do not know how to encrypt their email messages (Ruoti et al., 2016).
"Some say that the average computer user simply lacks knowledge and awareness of cybersecurity issues and of the secure behaviors they ought to be carrying out… [and] other researchers argue that users do not care about possible consequences, [and] are unmotivated to take responsibility" (Zimmermann & Renaud, 2019, p. 4).

Given the impact and frequency of cybersecurity incidents in recent years, universities must find innovative ways for students to develop cybersecurity awareness, knowledge, and skills through coursework and extracurricular educational activities. Industry and society will demand these skills of future business professionals.

Guiding Questions
The purpose of this qualitative study is to gain an understanding of a cybersecurity pedagogy that best serves information technology students.

Considering the importance of raising cybersecurity awareness among students from both technology and general backgrounds, the following guiding questions for this study emerge:

- What concepts, skills, and applications must students know to demonstrate cybersecurity awareness?
- What tools can students use to prepare for the cybersecurity challenges that they will face?
- How can these be presented in ways that introduce or reinforce digital literacy concepts and skills that students learn in an introductory IT course?

2. LITERATURE REVIEW: RELATING CYBERSECURITY AWARENESS AND DIGITAL LITERACY

Cybersecurity awareness relies on individuals knowing basic ways that they can protect themselves, their data and their devices. The foundation of that awareness may be found in developing basic technology and digital literacy skills.

Digital Literacy Skills
Digital literacy skills have evolved from gaining proficiency with productivity tools, email, the World Wide Web, social media, collaboration tools, mobile devices and the cloud (Dijk & Deursen, 2014; Frydenberg & Press, 2010) to creating, organizing, sharing, and reusing online content, accessing information across devices and platforms, and maintaining privacy and identity online (Wheeler, 2010).

When learning about cybersecurity, introductory IT courses often cover the importance of communicating safely online, demonstrating the use of computers safely and responsibly, making judgments about digital content when evaluating repurposing it for a given audience, demonstrating responsible use of online services; selecting, combining, and using Internet services; understanding the potential of information technology for collaboration when computers are networked; using online services securely; recognizing that persistence of data on the Internet requires careful protection of individual online identities; understanding ethical issues surrounding the application of information technology (*AP Computer Science Principles*, 2017; Harris & Patten, 2015). These digital literacy skills are crucial for mastering cybersecurity awareness.

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Cybersecurity Skills

Stenmap (Mäses, Randmann, Maennel, & Lorenz, 2018) is a model to classify cybersecurity-related skills. Competencies range from non-cybersecurity specific to cybersecurity-specific skills along the horizontal axis, and non-technical to technical skills along the vertical axis.

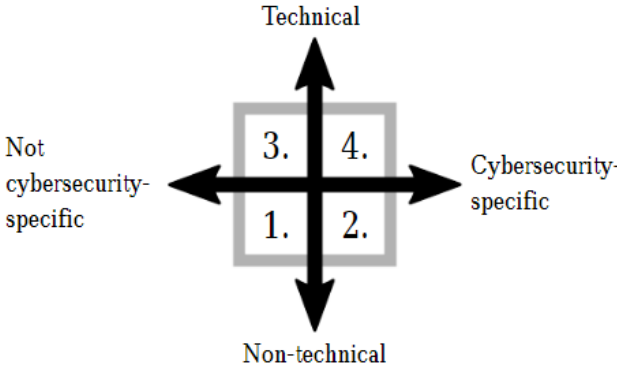

Figure 1. Classifying Cybersecurity Skills

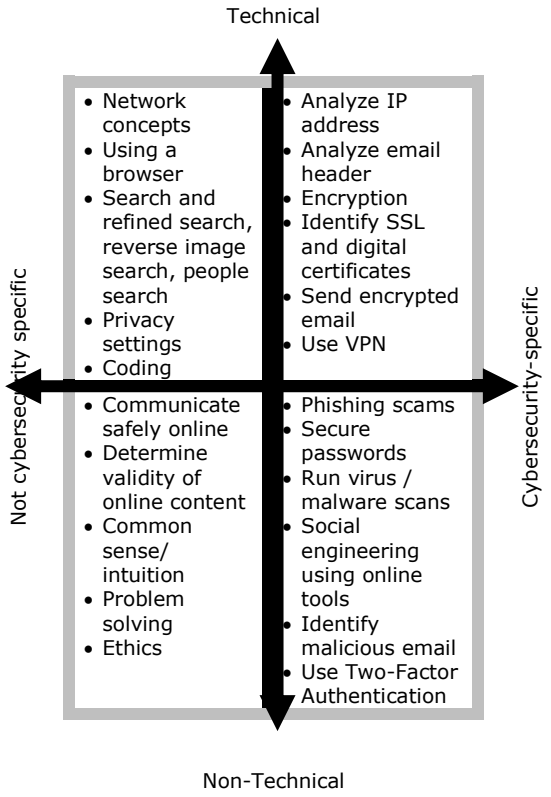

Figure 2. Relating Digital Literacy Competencies to Cybersecurity Skill Classifications

Quadrant 1 includes skills that are non-technical and not cybersecurity-specific, such as leadership and communication skills. Team and group exercises require these highly valued skills. Quadrant 2 includes skills that are cybersecurity-specific, but non-technical, such as identifying phishing emails or the importance of secure passwords. Quadrant 3 includes technical skills that may not be cybersecurity related, such as coding and basic understanding of browsers or the Internet. Quadrant 4 requires skills that are both technical and cybersecurity-specific, such as implementing encryption or an SQL injection attack.

Mäses notes that "it is not always easy to position a skill in this Cybersec-Tech window. For example, skills related to reporting could be general nontechnical or very specific and technical. Nevertheless, this Cybersec-Tech window can help to facilitate a discussion about which skills a cybersecurity exercise should target"(Mäses et al., 2018, p. 9).

This study expands on the classification shown Figure 1, listing specific digital literacy skills and where they fall within the Stenmap model. Figure 2 relates digital literacy competencies to cybersecurity skill classifications.

The AP College Board, in its computer science principles course, posits that "cybersecurity is an important concern for the Internet and the systems built on it" (*AP Computer Science Principles*, 2017, p. 34). Students should be able to identify existing cybersecurity concerns and potential options to address them. Issues of awareness mentioned include impact of DDoS attacks, hardware, software, and human components of cybersecurity; phishing, viruses, and other attacks; foundations and applications of cryptography; digital certificates. In the AP College Board Computer Science principles course, the focus on cybersecurity awareness is from an Internet-based perspective.

Open Source Intelligence Tools

Open source intelligence (OSINT) tools have emerged as important components for locating, organizing, and differentiating recognizing new types of relevant information online (Glassman & Kang, 2012). OSINT information and data include social media sites and online social networks, public records databases, photos, maps, and images, online surveillance cameras, code repositories, media websites. OSINT tools include special purpose search engines and other applications that can quickly gather and analyze data from hundreds of websites, perform fact-checking, scan files for viruses and malware, and determine the technology platforms used on a website (Kissiah & eInvestigator.com, 2019).

Knowing the appropriate tools makes it possible to perform tasks such as determining which social networks have a given username registered, searching for photos and images to determine their authenticity, evaluating a user's Twitter habits; identifying common patterns in user passwords, encoding messages and files, obtaining information from an IP address search, and analyzing email headers. Knowing about several of these tools is one way to demonstrate cybersecurity awareness and digital literacy skills.

3. METHODOLOGY

Some universities and organizations partner with an online cybersecurity awareness training provider to offer online instruction for their students and employees ("Security Awareness Training | KnowBe4," 2019). These lessons often take the form of interactive lessons and games.

To answer the guiding questions for this study, the authors developed three 80-minute interactive sessions on cybersecurity awareness topics. The biweekly sessions, held between February 5 and March 5, 2019, at Bentley University, a business university in Waltham, MA, focused on the topics shown in Table 1.

Session 1	Cybersecurity Stories
Session 2	Open Source Intelligence Tools and How to Hack through Search
Session 3	Capture the Flag (CTF) Style Hacking Competition

Table 1. Cybersecurity Awareness Session Topics

While the cybersecurity awareness sessions were not tied to any course, instructors of introductory IT, web design, database, cybersecurity, and other undergraduate CIS courses encouraged their students to attend. Two instructors and two campus technology administrators attended two sessions.

Participants self-selected to attend and used their own devices (laptops, tablets or mobile devices). Some instructors offered extra credit to students in their classes who wrote a short report after attending. An average of 20 participants attended each session, with 24 participants attending the final CTF session. Most students participating were first-year students enrolled in IT 101, an introductory technology concepts course, or CIS students taking a database or introductory web design course.

Session 2 on OSINT Tools was recorded, and the video posted online for the benefit of students who were unable to attend, or who wanted to review prior to the competition in Session 3. The study used an action research method (Johnson, 2012) where the presenter was actively participating in the lectures as a facilitator and as the source of cybersecurity facts.

Each session took place in a technology lab where students sat at tables to facilitate group work; the room had two projection screens for participants to see the presenter's slides. The first two sessions were methodologically lecture with hands-on practice exercises and the final CTF session was structured as a team competition.

Session 1: Cybersecurity Stories

The first session provided a general overview of cybersecurity concepts and actual cybersecurity incidents, including photos, videos, and recent statistics. Participants played a card game called CyberSec Stories 1 (Lorenz, 2018) and reflected on their experience in open discussion. CyberSec Stories is a card game focusing on various security cases in the digital world. The game was developed by students, scientists, lecturers, and researchers at Tallinn University of Technology Centre for Digital Forensics and Cyber Security. The game consists of 54 cases that help to raise overall awareness of cybersecurity through descriptions of actual incidents. Players take turns reading a short headline on the card (such as, "Lizards in the street!") and then try to guess what happened. The reverse side of each card contains a short summary of the case for members to read to give clues to their teammates, or the team can search online to find out more information.

A sample game card is shown in Figure 3. "Lizards in the street!" refers to an electronic road sign in San Francisco that was hacked to read "Godzilla Attack! Turn back!" (Rosenblum, 2014). Other cards present cases including how to crash a car with piece of paper; how to become a professional by typing only spaces; why a digital company might need to force everyone to use paper systems for six months; why companies in Ukraine infected their own systems with a virus; whether or not to trust people simply because they wear a uniform; how to deal with ransomware, and what can happen when you answer spam email. All of the game cards for CyberSec Stories 1st Edition are available at https://sites.google.com/view/tty-csgame/

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Playing the game helped students get into a hacker mindset and promoted critical thinking skills. In a debrief discussion at the end of the game, students reflected on the minimal cybersecurity skills that they need to function in the world and shared their own cybersecurity stories and experiences.

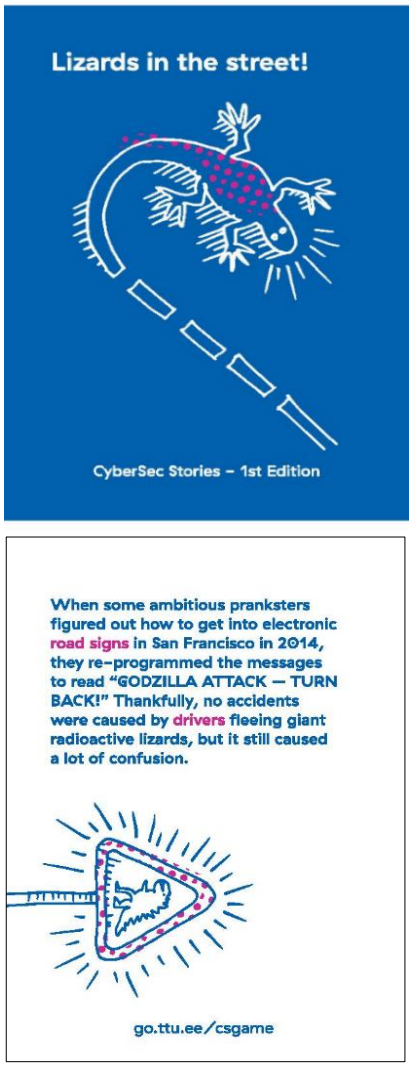

Figure 3. Front and back of a CyberSec Stories game card.

Session 2: Open Source Intelligence Tools
The second session featured a presentation on Open Source Intelligence (OSINT) tools to find and determine the validity of online information. The presentation included slides, videos, small group exercises, and open discussion. Topics included three different hacker types (white, gray, and black); the term *OSINT*; and several OSINT tools to locate and analyze online data. Appendix I, Table 1 contains several OSINT tools, many of which were demonstrated during this session.

Students worked in small groups, completing exercises which required the use of OSINT tools to create a fake online persona, using websites to generate fictitious names, locations, occupations, and profile photos. They also completed a phishing quiz; analyzed information available from their IP address, and determined if their personal account information has been compromised in a recent data breach.

Session 3: Capture the Flag Competition
The series concluded with a Capture the Flag (CTF) style competition where participants worked in self-selected teams to solve cybersecurity-related challenges or evaluate truthful information online. The puzzles were of varying difficulty and required participants to use different skill sets to solve them. Many of the solutions involved using OSINT tools presented in the previous session.

"In the cybersecurity world, 'capture the flag' competitions are the simulated crucible in which the curriculum lessons are tested and validated by the students. Instead of a playing field with physical flags to capture, … teams defend and attack computer networks and the flags are data and services that are either preserved or disabled."(Serapiglia, 2016, p. 28) Some CTF competitions may last for a few hours, a day or more; participants may be students, enthusiasts, or professionals. Players attempt the various challenges individually, or they work with team members to attempt to score the highest number of points. Once an individual challenge is solved, a flag, or code value, is given to the player and they submit this flag to the CTF server to earn points.

Challenges included looking at secret data contained in a file (GPS address, additional text inside the picture); detecting problems such as missing hardware components in a computer; analyzing pictures to find a password; decrypting code or solving puzzles using a mobile phone, a base64 encoder, and a book; analyzing email headers; and finding an alternative way to access websites that have been geoblocked. (Geoblocking is a means of refusing incoming requests for web content that originate in specific countries.)

Many of the solutions relied on the students' grasp of digital literacy skills and technology concepts: understanding parts of a URL, recognizing an IP address, using a search engine

effectively, evaluating social media posts; using productivity software, and other topics. Students were given hints as needed once the competition was underway.

Sample CTF exercises and puzzles are shown in Appendix 2. Please contact the authors for more information.

4. RESULTS AND DISCUSSION

The authors gathered immediate feedback from participants after each session. In addition, within a week after the final session, six students enrolled in an introductory technology concepts course were asked to write a short blog post describing their impressions of the three sessions, lessons learned, and what they think college students should know about cybersecurity. The authors had a discussion with faculty teaching the concepts course about advantages and disadvantages of integrating cybersecurity awareness exercises and topics in their current course.

Sessions 1 and 2 Debrief

The purpose of Session 1 was to raise awareness of the variety of cybersecurity incidents that students learned about or experienced personally and discuss the steps they can take to secure their own information and online presence. Usually, in cybersecurity awareness sessions, people tend to talk about putting personal information on social media and changing passwords. Here the discussion went to a deeper level as students were able to relate their personal and shared experiences via the Cybersec Stories game to the technology skills necessary to respond to them.

Session 2 topics analysis focused more on OSINT possibilities, also how hackers think, phishing techniques and how to detect hacking and malicious content, developing a fake online persona using fake pictures and videos, social engineering and ethics.

Exercises chosen for Session 2 were based on applying common digital literacy skills to demonstrate cybersecurity competencies. OSINT exercises were related to finding information from the Internet, such as identifying photos of real and fake Picasso works of art.

Steganography, the practice of concealing information within a message, image, or video file, was used to demonstrate how one might hide information inside a file, analogous to how hackers might hide malicious code in email attachments. Forensics exercises let participants detect phishing and viruses from the email header or hash analyze changes in the server or website; GPS exercises let participants discover how to find out where a picture was taken. Hardware exercises taught about how the computer is made, how the network is built. Cryptography exercises helped participants understand secret codes and language ciphers.

Most worrisome and interesting to participants were discussions about hackers, viruses and how to analyze malicious emails, OSINT and its techniques and social engineering.

Students' and teachers' feedback centered around how to detect problems, gather evidence and get to know all these cases on a deeper level. Discussions around competencies listed the need to have overall awareness and understanding how the Internet works.

Discussions also showed that most students have not had a conversation about security skills they will require as they become future technology professionals. Instructors identified links between cybersecurity awareness and critical thinking; students were much more practical in wanting to learn tangible skills such as understanding passwords habits and how to deal with a constant flow of emails (spam and phishing attacks), or even whom to turn when something happens without being ashamed. When completing the hands-on activities, participants wanted to know which OSINT tools and websites to use to solve the exercises.

The sessions also brought up ethical discussions of issues such as: Who is to blame when code is insecure? Who is responsible for the security of personal data stored online?

Session 3: CTF Debrief

In Session 3, the CTF competition, of the 80 minutes available, 10-15 minutes were used to give an introduction and organize groups; 50 minutes were available to complete the activity, and 15-20 minutes at the end were available to debrief. The presenters learned that the time available for the exercise (approximately 50 minutes) was insufficient to complete most of the 25 exercises provided. Students solved most of the easier level OSINT exercises as they were most used to using Google or another search engine to find answers.

For example, exercises had students find the default password for a Wi-Fi router or detect a missing word from a news headline. Students

were also successful in completing the visual exercises (such as finding a password from a photo taken in a professor's office). Hardest exercises (most of which were not solved) were related to cryptography, analyzing code form the website or computer screen from server logs. It was interesting that even though the best teams accomplished approximately one-third of the exercises and need to strategize on how to do them, they were so happy that they had used the computer and developed critical thinking skills by solving puzzles, detecting problems and proposing solutions.
Feedback showed that most of the groups (8 groups, 3 people in each) found different exercises that were interesting to them and from what they were empowered the most. A similar theme was that when they worked in a team to help each other rather than working individually, they accomplished more; also solving the most complex exercises on which they spent most of their time were those that impressed them the most. They pointed out various tools and websites they learned about during the session.

Student Comments
After attending at least one of the three sessions, several participants wrote blog posts on "What should the college students know and learn about cybersecurity?" Feedback from student blogs (which were completed within two weeks of the final session) showcased the relevance of cybersecurity awareness in their own lives. The biggest impact topics were how to use search tools, logical filtering and social engineering skills to acquire information about people, places, companies and how to analyze it as a hacker would; and how to analyze data (website, email, personal) legitimacy for updating the defense of being phished.

One student said: "I feel as though many students are unaware of many issues that come along with cybersecurity or lack thereof in this case. Throughout this year, I and many other students, have received countless phishing emails that cause devices to obtain viruses if you click a certain link. Towards the beginning of this year, it was obvious when an email was a scam, however, more recently it seems like they have been disguised a lot better. For example, I received emails that were from my close friends about topics that we both had sent or received emails about. This made me realize that because a friend of mine was hacked, hackers had some of my information as well. An email about a cheer event was sent to me from my teammate's email account and was very believable until I realized the suspicious layout of the email. Overall, I believe it'd be useful to include one class during the IT 101 course that is devoted to identifying when an email is unsafe and how to prevent viruses from computers."

Students pointed out a better understanding of how to use safety precautions (need for more complex passwords, contained online presence, evaluated use of media tools) and minimize risks as in the process of exercises they could experience being also in the attacker side. At the end of the sessions, they did an audit of their own devices and environments, and passwords to improve their online safety and experience.

Privacy was a concern for students from the point of view of a consumer and a marketer. One future marketing major suggested:

- Discuss clearing cookies how does this have an impact on marketers? Why or why not should cookies be cleared?
- Discuss privacy in terms of social media advertisements. What do timely, relevant ads mean for the consumer?
- Discuss the legality and ethics behind big data and privacy. Why should there be a federal definition of what big data is?
- Discuss privacy - example how can we tell when a job offer is a scam? Is the offer from social media or sent by email legit?
- Should information like our social security number, financial information of other information be submitted on an application?

Students commented on what they thought they knew about cybersecurity before the session, and the lessons they learned: "Before this class I feel like I had the general knowledge of cybersecurity that comes with growing up in my generation. Certainly, always err on the side of caution and assume non trusted sites and emails are not safe. I did know that you were supposed to change your password frequently and that passwords should be a complex variation of numbers, letters, and symbols. I did not know there were sites that you could run emails and other media through to scan for viruses. I also learned a lot about the variations of different viruses and malware. Aside from viruses and malware this is also a whole section of cybersecurity which directly involves protection from hackers and people. People who use the internet to attack others can do so in a variety of ways. Even social hacking can be implemented to steal information about someone from a third party which you assume would be secure."

Students were taken by the amount of information available through social media posts. Said one student: "It can be surprising how much information that someone can find about you just by looking at old tweets or Instagram posts. College students are already aware of employers looking through social media accounts, but they need to be more aware about what they post because cyberhackers can find anything. I believe that this big lesson in here is, do not post things that you do not want strangers to find out about you."
Said another student: "At the cybersecurity workshop, I learned lots of different methods to approach our computers and personal information. The most important one for me is the email with links. Once people click into the links, their personal information would be taken by hackers. We were taught how to distinguish real or fake emails. Basically, we look at the senders and other information in the email to make sure its authority. And if we click into links or accidentally go into random websites, we do not give out any personal information including bank information. I think that is important because it is close to our life. Other things that people should know is how to protect their all kinds of accounts. Such as how to make sure no one logs in their accounts."

Some also got inspired by the exercises to develop decoding experiences for others, others had more inspired by learning more about ethical hacking overall or history of cybersecurity. A few people also asked about career possibilities in the field. Students also wanted to know how hacking works (from the actions of the hacker, providing demonstrations) and how to recover after being hacked, clicking a bad link, or sharing information that should have remained private.

Students' concerns with cybersecurity also had to do with keeping their phones safe, protecting their social media data, not being taken by phishing scams, and determining the validity of online information.

5. CONCLUSIONS AND FUTURE WORK

Developing cybersecurity awareness skills is crucial for preparing students to take their place as information technology workers in their future careers. This section now addresses the guiding questions of this study. To identify skills and applications students must know to demonstrate cybersecurity awareness, the authors analyzed discussions and written reflections from students. The authors conclude that students find the ability to detect spam, phishing, malware, and other attacks, as well as the ability to maintain privacy of their information online and determine the validity of information online to be valuable cybersecurity awareness skills for both their personal and professional lives.

Considering the second guiding question about tools to prepare for cybersecurity challenges, the paper presents several current OSINT tools and their use cases. The rise of cybercrimes, ongoing security breaches, the continuing threats of malware and ransomware, the growth of phishing and other online scams, and the ease in which misinformation can spread online all necessitate making students aware of cybersecurity issues, and teaching students to use OSINT tools to protect themselves and the organizations that will employ them, from cybersecurity attacks.
Students applied their knowledge of many OSINT tools to solve puzzles in a capture-the-flag style competition at the end of the study.

Considering the third guiding question relating digital literacy concepts to cybersecurity skills, this paper expands the Stenmap model for classifying cybersecurity skills by identifying specific digital literacy competencies to each of the four classifications of cybersecurity skills from non-technical to technical, and non-cybersecurity-specific to cybersecurity-specific. All the skills that students identified in response to the first guiding question require basic digital and technology literacy skills.

The authors describe three different sessions for raising cybersecurity awareness among undergraduate technology students through an interactive game, open source intelligence tools, and a capture the flag style competition. Any of these activities can be incorporated into a technology concepts course or shared in an extracurricular setting to raise cybersecurity awareness. Students' comments suggest that these sessions were informative and increased interest in keeping their data and devices safe.

In future iterations of this project, the authors will ascertain student awareness of cybersecurity topics through pre- and post- surveys. Maintaining a list of current OSINT tools and describing use-cases that demonstrate their application will be necessary. Another goal is to modify the CTF competition exercises to be more attainable given the time allotted and will examine them to ensure a balance between categories in Mäses model for describing cybersecurity skills.

Teaching cybersecurity awareness in the university and training employees in the workplace can be a challenge due to the lack of experts in this field. Developing solutions, tools to automate the process, and activities that will spark students' interest will benefit students, teachers, and society at large. Ethics issues will emerge as users will need to trust systems using current technologies such as artificial intelligence, Internet of Things, or blockchain, that they may not fully understand. Universities also should look beyond their current cybersecurity needs to predict future developments and how to incorporate the impact of these and other current technologies in the cybersecurity awareness curriculum for information technology students.

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Appendix 1. OSINT Tools

Try this tool:	To accomplish this task:	At this web address:
Base64	Encode or decode data to / from base 64	https://www.base64encode.org/
BuiltWith	Determine a website's Content Management System and other technologies	https://builtwith.com
Check Usernames	Check availability of usernames on social networks	https://checkusernames.com/
Decode Ciphers	Encrypt / Decrypt SMS messages with T9 mode	https://www.dcode.fr/t9-cipher
Gaijin	Analyze Email Header to determine sender and recipient	https://www.gaijin.at/en/tools/e-mail-header-analyzer
Google Image Search Tin Eye	Reverse image search	https://images.google.com/ https://tineye.com
Have I Been Pwned?	Determine if your personal data has been compromised	https://haveibeenpwned.com/
IPLocation	Analyze IP address and details	https://www.iplocation.net/find-ip-address
Panopticlick	Determine if you are trackable in your browser	https://panopticlick.eff.org/
Phishing Quizzes	Learn about Phishing	https://phishingquiz.withgoogle.com/ https://www.sonicwall.com/en-us/phishing-iq-test-landing https://www.opendns.com/phishing-quiz/ https://accellis.com/phishing-quiz/
PhoneSpell	Encode a phone number to words	https://www.phonespell.org/
RandomUser UI Faces Fake Name Generator Fake Person Generator	Develop a fake identity online	https://randomuser.me/photos https://uifaces.co/ https://www.fakenamegenerator.com https://www.fakepersongenerator.com
Scam Advisor	Determine if a website is safe (http vs https)	https://www.scamadviser.com/
SleepingTime	Determine sleep patterns based on Twitter usage	http://sleepingtime.org/
Social Catfish	Find a person by a photo or social media information	https://socialcatfish.com/
VirusTotal	Analyze a suspicious file or web address to detect malware	https://www.virustotal.com
Web Mii Pipl	Find information about a person	http://webmii.com/ https://pipl.com/

Table 1. Open Source Intelligence Tools for Cybersecurity Awareness

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Appendix 2. Sample CTF Exercises and Puzzles.

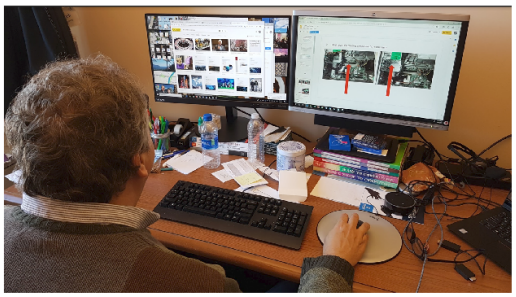
What word is missing?

Innovations

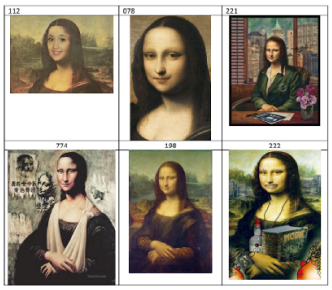
How a ?????????????? helped hack a casino

By Alex Schiffer July 21, 2017

What's my password?



Create the sequence of numbers corresponding to photos that are not fakes.



You have received a letter from your coach in the file list.exe

Hash is:
SHA-256:
24d004a104d4d54034dbcffc2a4b19a11f39008a575a
a614ea04703480b1022c

What does the message say?

We have intercepted a message from a well-known cybercriminal gang... try to decrypt it:

8444447777 4447777 66688777 2224426622233
933 633338 28 83366 76
7777337277733 99966688777777733555333

Crack a Wi-Fi Network

Open Wi-Fi networks can be a security risk. A service provider set up the Wi-Fi at your grandmother's house using an Asus RT-AC66U router.

The device is in the factory settings/configuration.

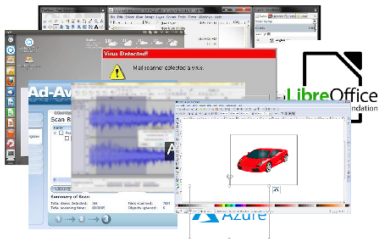
What is the default user name and password?

In a study with 10-12th graders, what is the correct descending order of situations that they have experienced?

A. Friends shared pictures of me in public that I did not agree to
B. I posted publicly information that I should not
C. Never happened anything of that kind
D. My phone is missing or stolen
E. Someone accessed my data without permission
F. Someone hacked my social media account
G. Someone hacked my email

Know your programs
Pair the program topic and the original software name. Flag is the first letters of the programs original names. Be sure to use the original name or the program!!

- Office software
- Virus
- Operating System
- Vector graphic program
- Raster graphic program
- Audio program
- Antivirus
- Removes adware and spyware
- Cloud software



What's the address where this photo was taken?

- Analyze the domain name https://www.betterinternetforkids.eu/
- Who owns it?

- The LA Times website (www.latimes.com) is not visible for EU Citizens because of the GDPR challenges.
- List different ways how one can still see the website and find out news from example 1.09.2018 morning.

What happened?
What was accessed?
What is the name of this type of hack?

```
root@srini:/var/log/apache2# cat access.log.1 | grep "../../../../etc/passwd"
127.0.0.1 - - [27/Oct/2014:04:00:48 -0400] "GET /../../../../../../../../../../../../etc/pa
sswd HTTP/1.1" 400 506 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0)
"
127.0.0.1 - - [27/Oct/2014:04:00:48 -0400] "GET /../../../../../../../../../../../../etc/pas
swd HTTP/1.1" 400 506 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0)"
127.0.0.1 - - [27/Oct/2014:04:00:48 -0400] "GET //../../../../../../../../../../../../etc/p
asswd HTTP/1.1" 400 506 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0
)"
127.0.0.1 - - [27/Oct/2014:04:00:48 -0400] "GET /../../../../../../../../../etc/passwd HTTP
/1.1" 400 506 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0)"
127.0.0.1 - - [27/Oct/2014:04:00:48 -0400] "GET /scripts/fake.cgi?arg=/dir/../../../../../.
./etc/passwd HTTP/1.1" 404 529 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trid
ent/4.0)"
127.0.0.1 - - [27/Oct/2014:04:01:08 -0400] "GET /cgi-bin/pdesk.cgi?lang=../../../../../../
../../etc/passwd%00 HTTP/1.1" 404 530 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1
; Trident/4.0)"
127.0.0.1 - - [27/Oct/2014:04:02:04 -0400] "GET /search?NS-query-pat=../../../../../../../
./../etc/passwd HTTP/1.1" 404 519 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; T
rident/4.0)"
127.0.0.1 - - [27/Oct/2014:04:02:09 -0400] "GET /cfx/LOa../../../../../../etc/passwd HTTP/1.1
" 404 517 "-" "Mozilla/4.0 (compatible; MSIE 8.0; Windows NT 5.1; Trident/4.0)"
root@srini:/var/log/apache2#
```