Unit 02: Digital Citizenship & Cyber Hygiene

2.1: Digital Footprint

Key Terms:	**Notes:**
Digital Footprint	

Summary:

- Understand how their online activity contributes to a permanent and public digital footprint
- Articulate their own social media guidelines to protect their digital footprint

Digital Footprint

Corresponding Material
Digital Citizenship and Cyber Hygiene: Digital Footprint and Reputation

Discussion
Most of us use the Internet as a way to connect with friends, explore topics, or study for school. Many are connected to multiple social media platforms including Facebook, Twitter, and Instagram. We share various pieces of our lives online, from our weekend plans to photos of the last food we ate. While it appears that you're just keeping your friends updated on the important (and unimportant) events in your life, you are actually creating the foundation for your online reputation. That means that anything you have posted online is creating a digital trail that can last a lifetime.

If the digital footprint you are creating lasts a lifetime, is it one you'll be proud to share? Even more immediate, is your online reputation one you're willing to share with college admissions or future employers?

Class Exercise
Today you will view your own online reputation and create a plan to improve your online reputation (if necessary).

1. Search your full name on google.com. Does any information about you appear in the search results? If so, what information displayed is positive? What information displayed is negative? If not, try searching for your name and your school or your name and your city. For example, search for "John Doe Los Angeles" or "John Doe Alan Turing High School".

2. According to CareerBuilder's annual social media recruitment survey, 49% of employers stated that they've found information online about that caused them to not hire a candidate.

The following are the top pieces of content that dissuaded employers from hiring a candidate:

- Provocative or inappropriate photographs, videos or information – 46%
- Information about candidate drinking or using drugs – 43%
- Discriminatory comments related to race, religion, gender, etc. – 33%
- Candidate bad-mouthed previous company or fellow employee – 31%
- Poor communication skills – 29%

Do any of your social media profiles have items on this list? If so, is any of the content worth deleting? Please share (if comfortable) what you've decided to keep or delete.

3. According to the same annual social media recruitment survey done by CareerBuilder, 32% of employers have found information that caused them to hire a candidate.

The following are the top pieces of content that convinced employers to hire a candidate:

- Candidate's background information supported job qualifications – 44%
- Candidate's site conveyed a professional image – 44%
- Candidate's personality came across as a good fit with company culture – 43%
- Candidate was well-rounded, showed a wide range of interests – 40%
- Candidate had great communication skills – 36%

Thinking about your future prospects, do your social media platforms contain any of the content above? Consider: Do you post about your hobbies or interests? Do you use proper grammar and punctuation? Do you maintain a professional presence online at all times?

Are there any you can start implementing today?

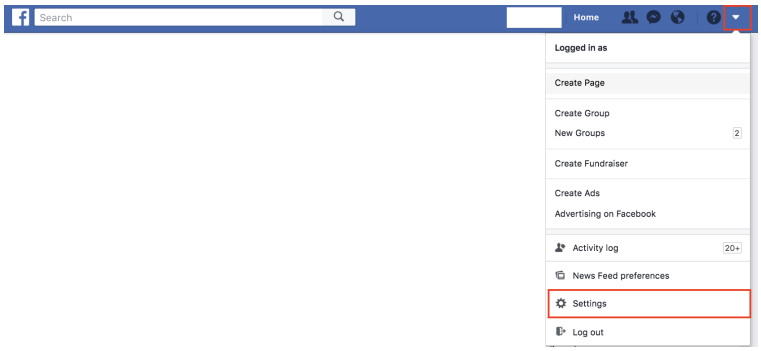
4. 41% of employers say they are less likely to interview job candidates if they are unable to find information about that person online. So, it is a better idea to make your online reputation positive rather than non-existent. However, you should limit the amount of information the public has access to using the guides on the next page. Discuss what changes you made to your existing profiles.

5. Are there any other social media accounts you use? If so, look up how to make these services more private. Write about what you found below.

Make Your Facebook Profile More Private

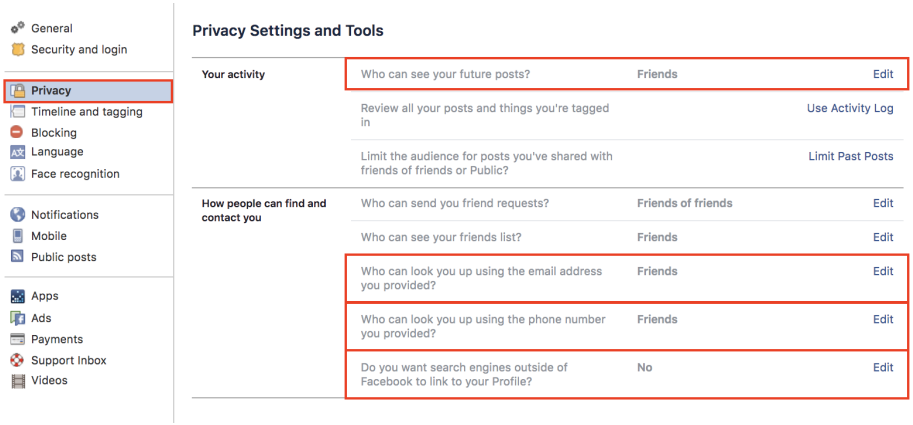
Step 1: Navigate to Facebook.com on a browser and log in.

Step 2: Click the down arrow in the right corner and select **Settings.**



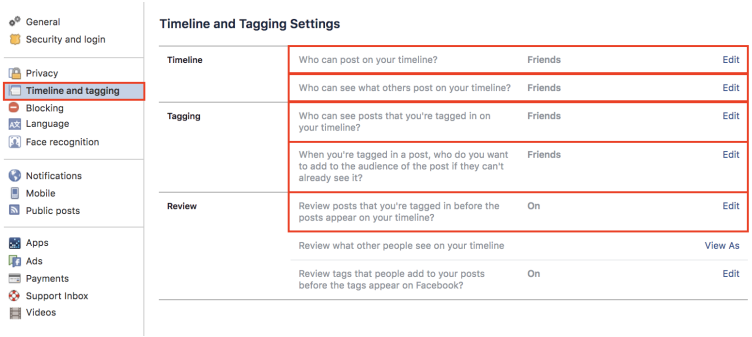
Step 3: In the panel on the left side, click **Privacy** and fix your settings to match the picture below by following these steps:

1. Set "Who can see your future posts?" to **Friends.**
2. Set "Who can look you up using the email address you provided" to **Friends.**
3. Set "Who can look you up using the phone number you provided" to **Friends.**
4. Set "Do you want search engines out of Facebook to link to your Profile?" to **No.**



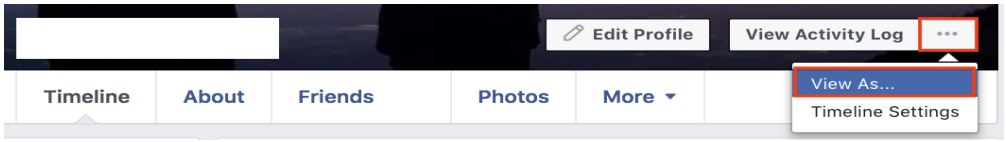
Step 4: In the panel on the left side, click **Timeline and tagging.** Fix your settings to match the picture below by following these steps:

1. Set "Who can post on your timeline?" to **Friends.**
2. Set "Who can see what others post on your timeline? to **Friends.**
3. Set "Who can see posts that you're tagged in on your timeline?" to **Friends.**
4. Set "When you're tagged in a post, who do you want to add to the audience of the post if they can't already see it?" to **Friends.**
5. Set "Review posts that you're tagged in before the posts appear on your timeline?" to **On.**
   Note: This allows you to ensure that posts made by friends are appropriate for your timeline.



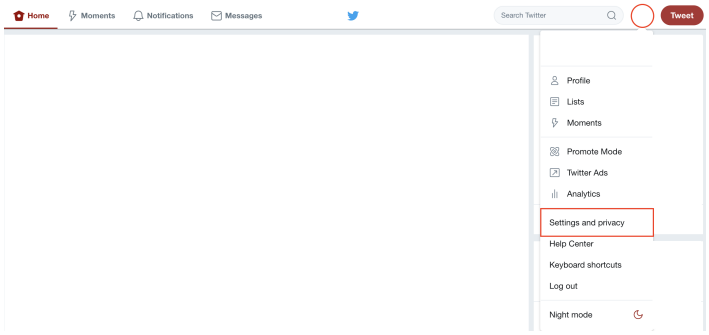
Step 5: Once you have updated these settings, navigate to your profile by clicking your profile picture on the blue bar at the top.

Step 6: Click the three horizontal dots in the top right corner of your profile and select **View As...** Once selected, your profile will display how it appears to the public.



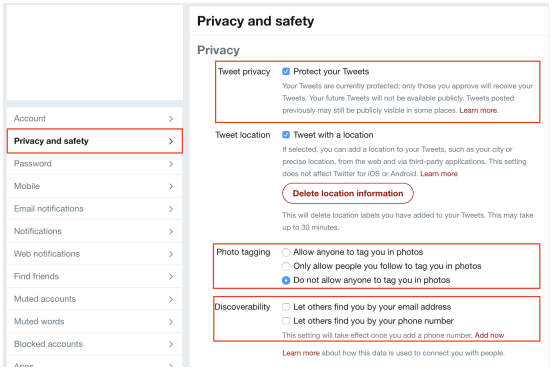
Make Your Twitter Profile Private

Step 1: Navigate to Twitter.com on a browser and log in to your account.
Step 2: Click your profile picture in the top right corner and select **Settings and Privacy.**



Step 3: In the left panel, select **Privacy and Safety.**

1. Select the checkbox next to **Protect your Tweets.**
2. Under **Photo Tagging,** select "Do not allow anyone to tag you in photos".
   Note: This will ensure that photos of you on Twitter that are posted by others will not be linked to your social media account in case they are inappropriate.
3. Under **Discoverability,** make sure that both "Let others find you by your email address" and "Let others find you by your phone number" are deselected.



With these settings, if a future employer finds your twitter profile, they will only be able to view your profile picture and bio.

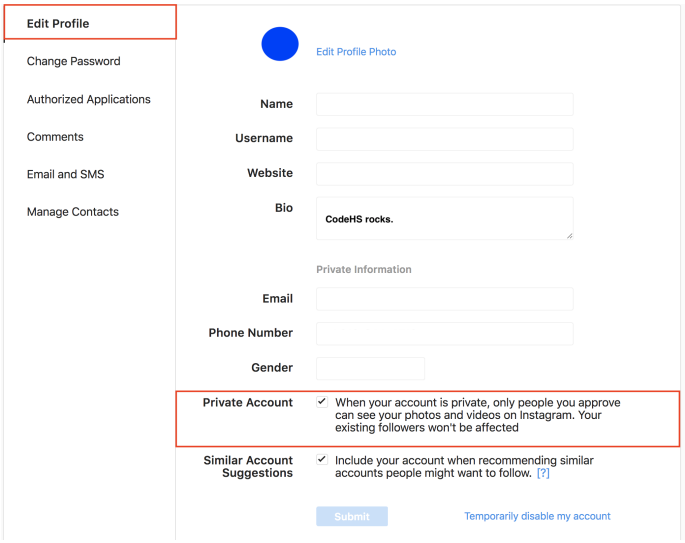
Make Your Instagram Profile Private

Step 1: Navigate to Instagram.com and log in to your account.

Step 2: Go to your profile by tapping in the top right corner.

Step 3: Go to your settings by tapping Edit Profile in the middle of the page.

Step 4: Check the checkbox next to **Private Account** as seen in the picture below.



With these settings, if a future employer finds your Instagram profile, they will only be able to view your profile picture and bio.

Name: _____ Class: _____

Social Media: What's Not to Like?

By Alison Pearce Stevens
2017

Social media allows users to create online communities for sharing ideas, personal messages, and other content. Can social media usage be positive for today's teens, or should they steer clear of it? In this text, Alison Pearce Stevens explores both sides of the teenage social media experience. As you read, take notes on how the author makes connections between the positive and negative aspects of social media.

[1] Teens sneak a peek at the internet every chance they get. In fact, the average U.S. teenager spends almost nine hours a day on digital devices. Much of that time is on social media, such as Instagram, Snapchat and Facebook. The sites have become important places for students to interact. But sometimes these connections lead to disconnections.

"Black iPhone4 on brown wood" by dole777 is licensed under CC0.

Depending on whether people notice your posts — and how positively they respond — your online interactions may be quite positive. Or not. Social media can make some teens feel depressed and isolated. They can feel cut out of social interactions. They may feel judged. In fact, people who visit social media sites to feel connected to friends may end up caught in online drama, or even cyber-bullying.

But being glued to your phone or engrossed in a Snapchat story isn't all bad. Social media provides an important place for people to connect. The feedback that users get from their peers can boost self-esteem. And social media can even boost relationships among family members.

A filtered view

The average teen has about 300 online friends. When people post to their social media account, they're speaking to that large audience — even if their posts aren't publicly available. That same audience can see the responses other people provide through comments or "likes."

[5] Those likes and comments influence the kinds of posts teens put up — and leave up. A 2015 study by researchers at Pennsylvania State University in University Park found that teens were more likely than adults to remove Instagram posts within 12 hours of posting. They took down posts that had few likes or comments. This suggests that teens try to make themselves look

good by only keeping up popular posts.

Peer feedback plays a big role in how teens view themselves and each other, note Jacqueline Nesi and Mitchell Prinstein. These psychologists at the University of North Carolina in Chapel Hill study how teens use social media.

More than adults do, teens present idealized versions of themselves online, the researchers find. Teens may only share photos that show them having fun with friends, for example. This filtered view of their lives makes others believe all is well — even when it's not.

All teens compare themselves to others. That's an important part of figuring out who you are as you grow up. But social media makes this experience more extreme. You can actually measure how popular a person or a photo is, for example. And those carefully crafted profiles can make it feel like everyone else is living a better life than you are.

Students' use of social media "may form distorted perceptions of their peers," Nesi says. Teens compare their own messy lives to the highlight reels that their peers present. This can make life feel unfair.

[10] Such comparisons can be a problem, especially for unpopular people.

In a 2015 study of eighth- and ninth-graders, Nesi and Prinstein found that many teens who used social media experienced symptoms of depression. That was particularly true for those who were unpopular. Nesi speculates that unpopular teens may be more likely than popular kids to make "upward" comparisons. Those are comparisons with someone who seems better in some way — more popular, for example, or wealthier.

Those findings fit with previous studies that found unpopular teens get less positive feedback on their posts. That may happen because they simply have fewer real-life friends — and therefore fewer online connections. Or it may have to do with the types of things those teens post. Other researchers have found that unpopular teens write more negative posts than their peers. These people are more likely to post about unhappy events (such as having a phone stolen) than happy ones. Together, these factors can lead to low self-esteem and symptoms of depression.

A place to connect

Social media sites are important places to socialize, observe Alice Marwick and danah boyd.[1] Marwick is a culture and communications researcher at Fordham University in New York City. boyd is a social media researcher at Microsoft Research, also in New York.

1. danah boyd chooses to spell her name without capitalization

The two interviewed hundreds of teens from across the United States. Since teens spend so much of each day connecting online, many adults worry that kids no longer know how to communicate in person. In fact, boyd and Marwick found the opposite was true.

[15] Teens want to hang out together, boyd says. Social networks let them do that, even when their lives are too busy — or too restricted — to meet up in person. Even teens who have the time and freedom to hang out with their friends may have a hard time finding places to do so. Teens used to head to malls, movie theaters or parks. But many of these places discourage kids from hanging out. Changes like these make it much harder for teens to keep up with each others' lives. Social media can help to fill that gap.

But, the researchers add, there are important differences between hanging out on social media and spending time together in person.

Unlike a face-to-face conversation, online interactions can stick around. Once you post something, it's out there for the long term. Even posts you delete aren't always gone for good. (Think you're in the clear with Snapchat, where every post disappears after 10 seconds? Not necessarily. Those temporary posts may stick around if someone takes a screenshot before they vanish.)

Depending on someone's privacy settings, certain social media posts can be visible to anyone who scrolls or clicks around enough. Sites such as Facebook are also searchable. Some users may be able to easily share a post you make, spreading it beyond your control. And teens (and adults) who connect with people from different areas of their lives might run into awkward moments — like when a friend leaves a joking comment on your post that your grandmother doesn't find funny at all.

Online 'drama'

Those features can lead to what teens might call "drama." Marwick and boyd define drama as conflict between people that is performed in front of an audience. Social media seems to turn up the drama. That's because others can watch the performance simply by hopping online. And they can encourage that drama by liking particular posts or comments.

[20] Online drama, and the attention it attracts, can be hurtful. But the teens that boyd and Marwick interviewed usually did not call these interactions "bullying."

"Drama is a word that teens use to encompass a lot of different behaviors," Marwick says. "Some of these behaviors might be what adults call bullying. But others are pranks, jokes, entertainment." Bullying, she notes, takes place over a long time and involves one teen exerting power over another.

Calling these behaviors drama "is a way for teens to avoid the language of bullying," she notes. Bullying creates victims and perpetrators. Teens don't want to be seen as either. Using the term "drama" removes those roles. It "allows them to save face even when drama is hurtful," Marwick

says.

Such hurtful interactions can lead to depression and long-term mental-health problems. Teens use the word “drama” to minimize serious behavior by their peers. So it’s important for both adults and other teens to listen when teens talk about drama, Marwick says.

Keeping it in the family

Social media is not just for teens, of course. People of all ages interact on Facebook, Snapchat and more. Indeed, many teens “friend” family members, including their parents, notes Sarah Coyne. She is a social scientist at Brigham Young University in Provo, Utah. Such online relationships can actually improve family dynamics at home, she observes.

[25] In one 2013 study, Coyne and her colleagues interviewed families with at least one 12- to 17-year-old. Interviewers asked about each family member’s social-media use. They asked how often family members communicated with each other on these sites and how connected each felt to the others. They also probed other behaviors. For instance, how likely were the participants to lie or cheat? Did they try to hurt people with whom they were angry? And how likely they were to make kind gestures online toward family members.

About half of these teens connected with their parents on social media, it turns out. Most didn’t do so every day. But any social-media interaction made teens and parents feel more connected. This may be because families could respond to posts with likes or words of encouragement, Coyne says. Or perhaps social media gave parents a more in-depth look at their children’s lives. That helped parents better understand their kids and what they were going through.

This sense of connection might have other benefits, too. Teens who connected with their parents online were more likely to help out family members. They were less likely to lash out at them when angry. And kids were less likely to feel depressed or to attempt to lie, cheat, or steal.

The relationship between online connections and better behavior is a *correlation*, Coyne points out. That means she doesn’t know what causes what. It’s possible that friending their parents makes teens behave better. Or perhaps teens that choose to friend their parents are already better-behaved.

Using social media can have real benefits, Prinstein says. It lets us connect with new friends and stay in touch with old ones. Both of these activities can make other people like us more, he says. And that “has been shown to have long-term benefits for our happiness and success.”

[30] Unfortunately, many people tend to get caught up in other aspects of social media. They focus on how many likes or shares they have, or how many people see their posts, Prinstein says. We use these numbers to measure our status. “Research shows that this kind of popularity leads to negative long-term outcomes,” he says. Studies that measure changes in behavior over time suggest that people who are too focused on these measures of popularity can begin to drink or use drugs. They can become more aggressive. And they’re unhappier in their relationships, he

says.

It's easy to get dragged into the drama and other negative aspects of social media. But between strengthening family ties, boosting self-esteem and maintaining friendships, there's a lot to like about these online interactions.

2.2: Cyberbullying

Key Terms:	**Notes:**
Cyberbullying	

Summary:

- Understand the impact of cyberbullying, and identify unacceptable bullying behavior
- Identify proper actions to take if they are victims of cyberbullying or if they observe someone being cyberbullied

Do the Right Thing

Corresponding Material
Digital Citizenship and Cyber Hygiene: Cyberbullying

Discussion
The internet has provided tremendous value. It provides a potential for learning, socializing, and leisure. However, with these advancements, also comes new problems, including cyberbullying. Cyberbullying is the use of electronic communication to bully a person, typically by sending messages of an intimidating or threatening nature. It is the most common online risk for teenagers and can occur to any young person online. Unlike bullying, there are no common risk factors. It really can happen to anyone.

What to do if you encounter cyberbullying:

- Tell a trusted adult (i.e. a parent or a teacher)
- Contact host/website provides if inappropriate material is being posted on their website.
- Save all evidence if bullying is taking place online.
- Do not respond to rude messages. This only encourages the bully.
- If the cyberbullying is directed at another person, stand up for the victim!

Class Exercise
Read each scenario below. For each scenario, discuss with a classmate how well you think the person in each story handled cyberbullying and how you might have handled it differently.

Scenario 1:
Sami began receiving rude emails from an email address she did not recognize. The emails ridiculed her hairstyle and the clothes she wore to school, so she assumed that the emails were from someone she knew. Sami decided to delete the emails and not tell her parents because she did not want to lose internet privileges.

Did Sami handle the incident well? If not, how could she have handled the situation differently?

Scenario 2:
David received a friend request from Charlie. He had met Charlie once or twice but did not know him very well. To add to his growing number of friends, David accepted the friend request. Soon after, Charlie started posting strange photographs on David's timeline. David quickly consulted his parents who advised him to send Charlie a private message asking him to stop. When Charlie continued to post these photos on David's timeline, David "unfriended" Charlie on Facebook and blocked Charlie from seeing his Facebook account. He then reported the photographs Charlie had posted to Facebook.

Did Charlie handle the incident well? If not, how could he have handled the situation differently?

Scenario 3:
Patricia Brown received an Instagram follow from Fatricia Brown, a fake Instagram account aimed at making fun of Patricia. Patricia began to scroll through the photos and cry. Instantly she became enraged. She had been having an ongoing problem with Mary, a girl at school, and realized right away Mary was the one behind the fake Instagram account. To get back at Mary, Patricia made a fake Instagram named Hairy Mary and started posting photos of Mary. This only escalated the problem and both fake accounts continued to post horrible photos.

Did Patricia handle the incident well? If not, how could she have handled the situation differently?

Scenario 4:
Kyle and Mark were really great friends. They had a non-stop group chat where they texted all day long. One day, Kyle had an argument with another student in his class named Ryan. Kyle was pretty annoyed with Ryan and texted Mark mean comments about Ryan. Since Mark was good friends with Ryan, Mark chose not to respond and finally Kyle stopped making rude remarks.

Did Mark handle the incident well? If not, how could he have handled the situation differently?

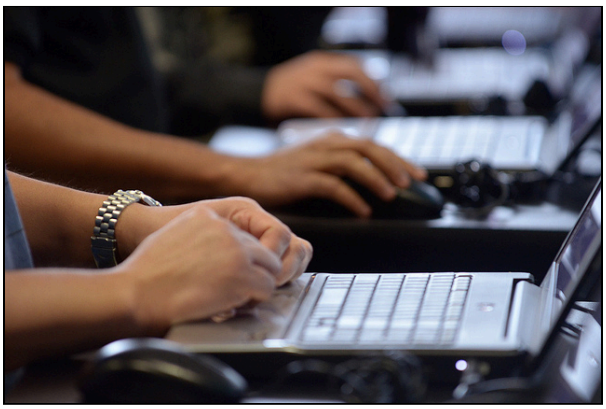
Name: _____ Class: _____

Online Identity

By CommonLit Staff
2014

Consider the different ways we express ourselves, especially in the new age of technology. The Internet has heavily shaped our notion of identity. On the Internet, people can create a multitude of personas, some of which can be created with false information. As you read, take notes on the ways in which people express their identity on the Internet.

Online Identities



"Sisters" by Stephen Harlan is licensed under CC BY 2.0.

[1] An online identity, sometimes called an Internet persona, is an identity established by a user to interact with others through social media such as Facebook, Twitter, blogs, or multi-player games. Although some people use their real names online, many Internet users prefer to be anonymous, identifying themselves by pseudonyms[1]. Some users can be deceptive[2] about their identity.

Users express online identity both explicitly and implicitly. Users express themselves explicitly through usernames, pictures, and the information about themselves that they choose to give others, such as their hometown. They can also explicitly express their identity by choosing an avatar, an icon-sized graphic image, or by creating user profiles in social media networks, such as Facebook. Implicitly, users express their identity through what they say to other users and the opinions they express. As other users interact with an established online identity, it gains a reputation, which enables them to decide whether the identity is worthy of trust.

The Reliability of Online Identity and the "Mask" Effect

Social networking services and online avatars have made the notion of identity far more complex, because the identities that people define in the social media are not necessarily the

1. **Pseudonym** ***(noun)*** a false name
2. **Deceptive** ***(adjective)*** meant to trick or deceive someone

identities that they actually have. For example, several studies have shown that people lie about themselves in online dating profiles, or in communication with potential partners.

A person may feel that she is able to lie about her identity on the Internet because it creates a "mask" effect, where no one can see her "true self." Social theorists believe that whenever an individual interacts with others online, she portrays a mask of her identity, not her true identity. This is partly due to the fact that in some online contexts, such as Facebook, she must answer specific questions to create an online profile. Further, as she begins to interact with others, she adds more and more layers to her mask through the vocabulary she uses and the topics she writes about.

[5] The kind of mask one chooses reveals at least something about the person who chooses it. While the online mask does not reveal the actual identity of the person, it does reveal an example of what lies behind the mask. For instance, if a person chooses to act like a rock star online, this may mean that he or she has an interest in rock music. Even a person choosing to hide behind a totally false identity says something about the fear and lack of self-esteem he or she may be experiencing.

Relation to real-world physical and sensory constraints

Online identity offers potential social benefits to those with physical and sensory[3] disabilities, because others cannot see them. These users can free themselves from their disabilities by creating online personas that are not disabled. This is called "disembodiment," and gives these users the opportunity to operate outside the constraints of social stigmatization. They can be treated on their merits as a person, rather than being seen as someone inferior due to a disability.

Concerns

Most concerns about virtual identity revolve around the contrast between online and offline existence. The ability to challenge the notion of what "real" means has raised questions about how virtual experience may affect one's offline emotions.

3. **Sensory** ***(adjective)*** something that can be felt by the five senses

2.3: Internet Safety

Key Terms:	**Notes:**

Summary:

- Identify predatory behavior and how to respond to it online

COMMONLIT

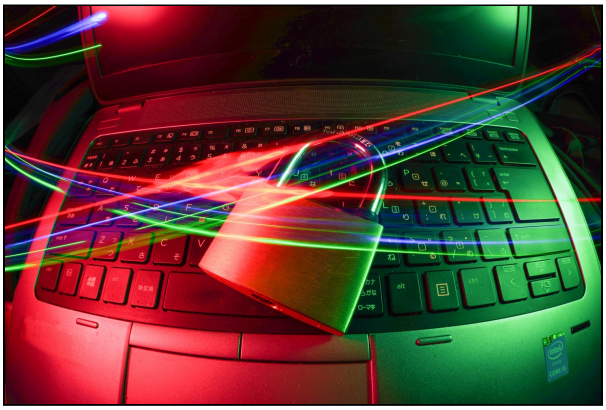
Name: _____ Class: _____

10 Things You Can Do to Avoid Fraud

By Federal Trade Commission

Whether they come in the form of an email claiming that you've won the lottery, or someone charging something in your name, scams are everywhere. It's important to know how to recognize scams and how to avoid them. In this informational text, the Federal Trade Commission provides 10 tips on how to do just that. As you read, take notes on how scammers can trick people into giving up money or information.

[1] International scam artists use clever schemes to defraud[1] millions of people across the globe each year, threatening financial security and generating substantial profits for criminal organizations and common crooks. They use phone, email, postal mail, and the Internet to cross geographic boundaries and trick victims into sending money or giving out personal information.



"Untitled" by FLY:D is licensed under CC0.

While con artists can be clever, many can be foiled[2] by knowledgeable — and equally canny[3] — consumers. Here are 10 things you can do to stop a scam.

1. Keep in mind that wiring[4] money is like sending cash: once it's gone, you can't get it back. Con artists often insist that people wire money, especially overseas, because it's nearly impossible to reverse the transaction or trace the money. Don't wire money to strangers, to sellers who insist on wire transfers for payment, or to someone who claims to be a relative in an emergency (and wants to keep the request a secret).

2. Don't send money to someone you don't know. That includes an online merchant you've never heard of — or an online love interest who asks for money or favors. It's best to do business with sites you know and trust. If you buy items through an online auction, consider a payment option that provides protection, like a credit card. Don't send cash or use a wire

1. to illegally obtain money from someone
2. **Foil** ***(verb)*** to prevent from succeeding
3. **Canny** ***(adjective)*** having or showing good judgement
4. to send funds electronically

transfer service.

[5] 3. Don't respond to messages that ask for your personal or financial information, whether the message comes as an email, a phone call, a text message, or an ad. Don't click on links in the message, or call phone numbers that are left on your answering machine, either. The crooks behind these messages are trying to trick you into giving up your personal information. If you get a message and are concerned about your account status, call the number on your credit or debit card — or your statement — and check it out.

4. Don't play a foreign lottery. First, it's easy to be tempted by messages that boast enticing[5] odds in a foreign lottery, or messages that claim you've already won. Inevitably, you'll be asked to pay "taxes," "fees," or "customs duties" to collect your prize. If you send money, you won't get it back, regardless of the promises. Second, it's illegal to play foreign lotteries.

5. Don't agree to deposit a check from someone you don't know and then wire money back, no matter how convincing the story. By law, banks must make funds from deposited checks available within days, but uncovering a fake check can take weeks. You are responsible for the checks you deposit: When a check turns out to be a fake, it's you who is responsible for paying back the bank.

6. Read your bills and monthly statements regularly — on paper and online. Scammers steal account information and then run up charges or commit crimes in your name. Dishonest merchants sometimes bill you for monthly "membership fees" and other goods or services you didn't authorize. If you see charges you don't recognize or didn't okay, contact your bank, card issuer, or other creditor immediately.

7. In the wake of a natural disaster or another crisis, give to established charities rather than one that seems to have sprung up overnight. Pop-up charities probably don't have the infrastructure[6] to get help to the affected areas or people, and they could be collecting the money to finance illegal activity. Check out ftc.gov/charityfraud to learn more.

[10] 8. Talk to your doctor before buying health products or signing up for medical treatments. Ask about research that supports a product's claims — and possible risks or side effects. Buy prescription drugs only from licensed U.S. pharmacies. Otherwise, you could end up with products that are fake, expired or mislabeled — in short, products that could be dangerous. Visit ftc.gov/health for more information.

9. Remember there's no such thing as a sure thing. If someone contacts you promoting low-risk, high-return investment opportunities, stay away. When you hear pitches that insist you act now, guarantees of big profits, promises of little or no financial risk, or demands that you send

5. **Enticing** ***(adjective)*** attractive or tempting
6. the basic physical and organizational structures needed to operate an organization

cash immediately, report them to the FTC.

10. Know where an offer comes from and who you're dealing with. Try to find a seller's physical address (not just a P.O. Box) and phone number. With VoIP[7] and other web-based technologies, it's tough to tell where someone is calling from. Do an internet search for the company name and website and look for negative reviews. Check them out with the Better Business Bureau at bbb.org.

One bonus tip: Visit OnGuardOnline.gov to learn how to avoid internet fraud, secure your computer and protect your personal information.

7. technologies that send voice communication and multimedia over the internet

2.4: Privacy & Security

Key Terms:	**Notes:**
Data privacy	
Data security	
https	
Privacy Policy	

Summary:

- Use best practices in personal privacy and security, including strong passwords, using https, and reading privacy policies

I've Been Phished!

Corresponding Material
Digital Citizenship and Cyber Hygiene: Privacy and Security

Discussion
Phishing is a fraudulent attempt, usually made through email, to steal your personal information. The goal is to trick the email recipient into believing that the message is something they want or need so that they will click a link or download an attachment. Phishing is a play on the word "fishing", as it is a way of "throwing out bait" to see who bites. The best way to protect yourself from phishing is to learn how to recognize it.

How to identify phishing scams:

1. **Generic greeting -** Phishing emails are sent in large quantities in hopes that a percentage of recipients will not realize it is fraudulent. Do a quick check of how the sender addressed you!
2. **Generic body -** Phishing emails normally tend to have a generic body in the email. By keeping the information nonspecific, the internet criminals hope that the user believes that at least some of the information applies to them. Take a quick moment to assess whether the information is actually about you!
3. **Incorrect Company Information -** Many phishing emails do not send the email from an email address with the correct domain (i.e. from the correct company). Some sender emails will try to trick you by having the correct subdomain, but not the correct domain (i.e. @am.amazon.com instead of @amazon.com)
4. **Request for personal information -** Companies do not request personal information over email since it email is insecure. If an email is asking for personal information, it is most likely a phishing email.
5. **Sense of urgency -** Internet criminals want to get your personal information now so they can move on to another victim. To do this, phishing emails normally make you think that something needs to happen fast to fix the situation. If an email is asking you to act fast, don't! Slow down and assess the situation.
6. **Poor grammar -** Internet criminals are not dumb. They prey on the uneducated because they are easier targets. An email from a legitimate organization should be well written. Any email with poor grammar should be enough to cause you to pause and evaluate the email.
7. **Still can't tell?** Call the company and ask!

I've been phished! Now what?

- Do not click on any links or open attachments.
- Do not reply to the sender.
- Report the scam (forward the email to the FTC - spam@uce.gov)
- If you do legitimate business with the spoofed company, you may inform the company of the phishing email in circulation.
- Delete the email.

Uh oh. I fell for a phish! What now?

- Don't panic!
- Change passwords to any website you have logged into since the phish.
- Scan your computer for viruses.
- Contact the company who has been spoofed so they can alert other people!
- If this happened on a school computer, let an administrator know as soon as possible.

Class Exercise

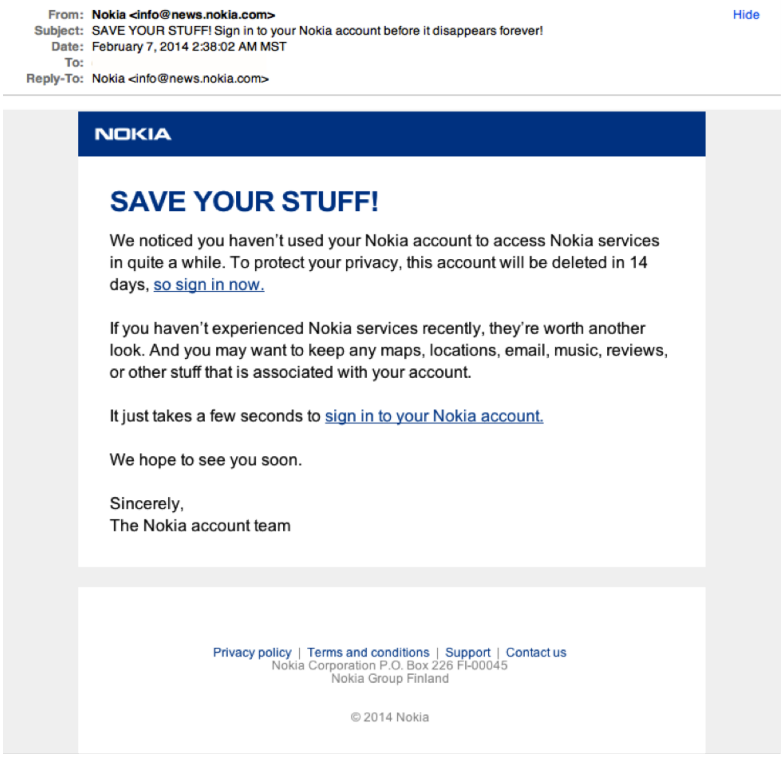
Observe the following real-world phishing examples. For each example, explain how you can tell that it is a fraudulent email.

Example:

Notes:

- Generic greeting - This email has a generic greeting and does not address the recipient by name.
- Incorrect company information - This email address is missing an "A", so is clearly not from an Amazon employee. Also, the link reveals that it points to a non-Amazon site, which should not be the case if this was a legitimate email from Amazon.
- Sense of urgency - The email is stating that the user needs to click a link in the next 36 hours or else their Amazon account will be terminated.
- Poor grammar - The grammar in this email is not professional. The misspelling of "believe" should be a red flag.

Email #1:



From: **Nokia <info@news.nokia.com>** Hide
Subject: SAVE YOUR STUFF! Sign in to your Nokia account before it disappears forever!
Date: February 7, 2014 2:38:02 AM MST
To:
Reply-To: Nokia <info@news.nokia.com>

NOKIA

SAVE YOUR STUFF!

We noticed you haven't used your Nokia account to access Nokia services in quite a while. To protect your privacy, this account will be deleted in 14 days, so sign in now.

If you haven't experienced Nokia services recently, they're worth another look. And you may want to keep any maps, locations, email, music, reviews, or other stuff that is associated with your account.

It just takes a few seconds to sign in to your Nokia account.

We hope to see you soon.

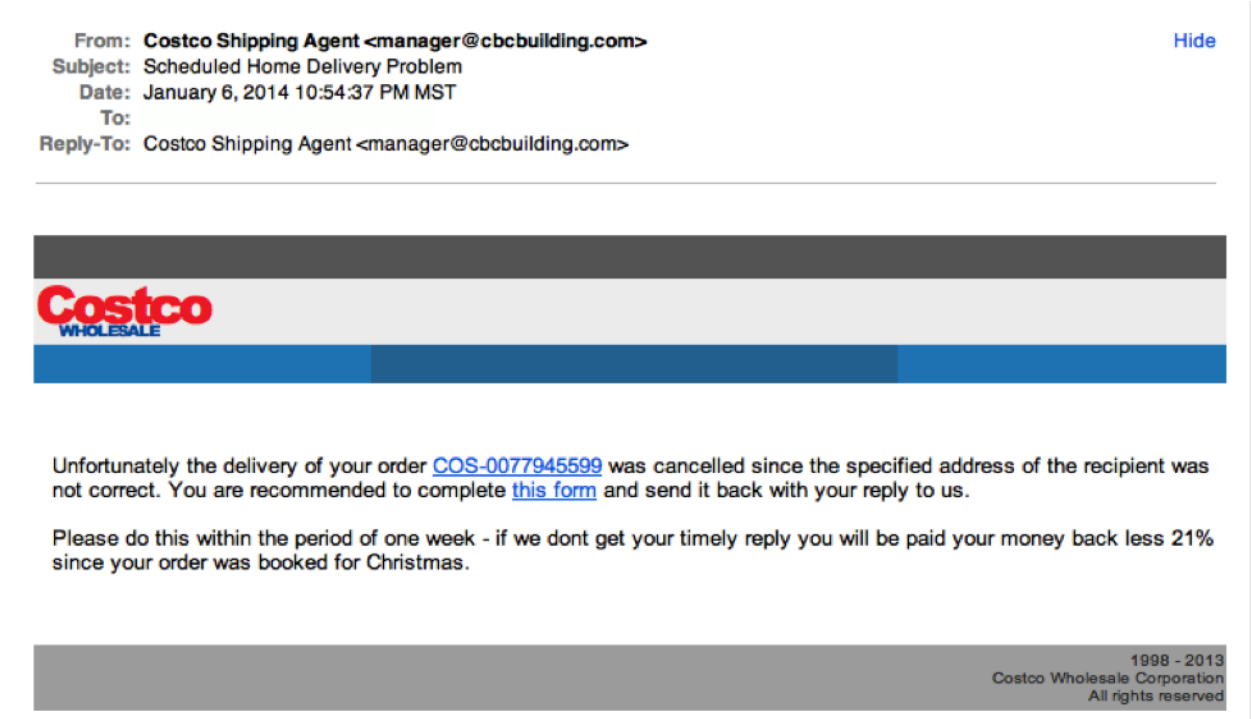
Sincerely,
The Nokia account team

Privacy policy | Terms and conditions | Support | Contact us
Nokia Corporation P.O. Box 226 FI-00045
Nokia Group Finland

© 2014 Nokia

Notes:

Email #2:



From: **Costco Shipping Agent <manager@cbcbuilding.com>** Hide
Subject: Scheduled Home Delivery Problem
Date: January 6, 2014 10:54:37 PM MST
To:
Reply-To: Costco Shipping Agent <manager@cbcbuilding.com>

Costco WHOLESALE

Unfortunately the delivery of your order COS-0077945599 was cancelled since the specified address of the recipient was not correct. You are recommended to complete this form and send it back with your reply to us.

Please do this within the period of one week - if we dont get your timely reply you will be paid your money back less 21% since your order was booked for Christmas.

Notes:

Email #3:

From: "Bank"<payment@epayment.com>
Subject: **Re: new payment on your account**
Date: March 24, 2014 10:39:01 AM MDT
Reply-To: <bankwiretransferdepartment@gmail.com>

Please find attached bank slip for new payment on your account.

Regards,

Account Department.

new payment.zip

Notes:

Is Your Head in the Cloud?

Corresponding Material

Digital Citizenship & Cyber Hygiene, Lesson 2: The CIA Triad

Discussion

A crucial decision that affects the security of your information is where you decide to store your data. Deciding to put your data on a cloud storage system or an external hard drive requires being informed on the substantial tradeoffs that exist between the different systems. Like other topics in cybersecurity, we can apply the **principles of CIA** to each storage method to determine which one is right for our needs.

Fill in the chart based on the principles of CIA. Some have been filled in for you:

Principle	**External Devices** *(Flash Drive, Hard drive, CDs)*	**Local Storage** *(Keeping data on your computer or mobile device)*	**Cloud Storage** *(Upload data to shared storage service or NAS system)*
C **(Confidentiality)**	Very low risk. Unless someone steals the device, there isn't a way for anyone to extract the data.		
I **(Integrity)**			Vulnerable to hacking and security breaches, so data is at highest risk of being manipulated.
A **(Accessibility)**		Easy to access on a single device, but if lost, there is no way to retrieve data.	

Exercise

Imagine you are a data storage consultant. Given the following scenarios, make a recommendation for which type of storage each client of yours should use based on their needs.

1. **Your grandmother has a lot of photographs that she just added to her computer. She doesn't want to look at them often, but wants them accessible on occasion.**

2. **A freelance graphic designer who is constantly on the move needs a way to access their data immediately from their phone and computer.**

3. **A software company has remote workers that work in different cities around the country and need to share documents with one another.**

4. **A government agent is working on a sensitive project that needs to be secure and accessible.**

2.5: Information Literacy

Key Terms:	**Notes:**
Information Literacy	

Summary:

- Effectively search for and evaluate resources

Internet Scavenger Hunt
(Student Version)

Corresponding Material
Digital Citizenship and Cyber Hygiene: Information Literacy

Discussion
Information Literacy is the set of skills required to identify, retrieve, organize, and analyze information. Since students no longer go to an encyclopedia or other books at the library to look up information, it is important to be literate on the Internet. Though the internet is a quick source to retrieve information, anyone can publish content for others to access. This means that there is a lot of incorrect information to sort through when performing research.

When looking at a website, consider the following questions:

- How recently was this article published?
- Are scholarly sources cited?
- Is the site .edu or .gov? If not, who is the author? Is this a credible source?
- Is the site well-designed?
- Does this site follow spelling and grammar rules?

Class Exercise
You are about to partake in a scavenger hunt to see who can search the internet and find correct and reliable information the fastest. For each question listed below, you must search for the answer using a search engine of your choice. Once you find the answer, record it, what the search terms were, the website in which you found the answer, and a rating of how reliable the source is (1-5; 1 is not reliable and 5 is very reliable).

Example:
Which university in the United States was the first to establish a computer science department?

Answer: Purdue University
Search Terms: first computer science department + U.S.
Website: Purdue's University Website (https://www.cs.purdue.edu/history/)
Is the website credible? Yes

Race:
Note: Answers may vary.

1. **What are the high and low temperatures tomorrow in San Francisco, CA?**
   Answer:

   Search Terms:
   Website:
   Is the website credible?

2. **What does the word *pandiculation* mean?**
   Answer:

   Search Terms:
   Website:
   Is the website credible?

3. **If you purchased a "ordinateur" from a french store, what would you have just purchased?**
   Answer:

   Search Terms:
   Website:
   Is the website credible?

4. **Who is considered to be the "father of Computer Science"?**
   Answer:

   Search Terms:
   Website:
   Is the website credible?

5. **Research one famous computer scientist. What did they contribute to the field?**
   Answer:

   Search Terms:
   Website:
   Is the website credible?

6. **What does CLI (computer term) stand for? What is the purpose of it?**
   Answer:

   Search Terms:
   Website:
   Is the website credible?

7. **How tall is the Statue of Liberty?**
   Answer:

   Search Terms:
   Website:
   Is the website credible?

8. **Whose inauguration was the first to be nationally radio broadcasted?**
   Answer:

   Search Terms:
   Website:
   Is the website credible?

9. **What is a *netizen?***
   Answer:

   Search Terms:
   Website:
   Is the website credible?

10. What was Google’s search engine originally called?

Answer:

Search Terms:
Website:
Is the website credible?

2.6 Creative Credit & Copyright

Key Terms:	**Notes:**
Copyright Public domain	

Summary:

- Explain what copyright laws are and why they are important
- Find images they are legally allowed to use in their projects
- Accurately attribute images they find and want to use

CodeHS

Copyright Licenses

Corresponding Material
Digital Citizenship, Creative Credit and Copyright

Discussion
This is a fill in the blank activity for practice with the 3 general types of copyright licenses with specific examples.

Class Exercise
For each scenario, fill in the columns on the right with the corresponding copyright license and a brief explanation.

- All rights reserved
- Some rights reserved
- Public domain

Scenario	Copyright License	Explanation
An original documentary that Celeste wants to own completely in case it makes money		
A photo that Emily wants others to share and use however they want to create new artwork		
An original song that Joaquin doesn't want anyone to copy or share without his permission		
An animated GIF that Mariana wants credit for but doesn't mind if others use without her permission		
A set of photos that Sean wants credit for but doesn't really care if others use		
A research article that Zach finds in a government database		

2.7: Hacking Ethics

Key Terms:	**Notes:**
Black Hat hacking	
White Hat hacking	

Summary:

- Identify the difference between white hat hacking and black hat hacking
- Explain career opportunities in cybersecurity

AP COMPUTER SCIENCE A

UNIT 7

ArrayList

2.5–7.5%
AP EXAM WEIGHTING

~10–12
CLASS PERIODS

SUGGESTED SKILLS

1.B

Determine code that would be used to complete code segments.

3.D

Write program code to create, traverse, and manipulate elements in 1D array or `ArrayList` objects.

AVAILABLE RESOURCES

- Java Quick Reference (see Appendix)
- Runestone Academy: AP CSA—Java Review: 9.7—The ArrayList Class
- Practice-It!: BJP4 Chapter 10: ArrayLists—Self-Check 10.2

TOPIC 7.1 Introduction to `ArrayList`

Required Course Content

ENDURING UNDERSTANDING

VAR-2

To manage large amounts of data or complex relationships in data, programmers write code that groups the data together into a single data structure without creating individual variables for each value.

LEARNING OBJECTIVE

VAR-2.D

Represent collections of related object reference data using `ArrayList` objects.

ESSENTIAL KNOWLEDGE

VAR-2.D.1

An `ArrayList` object is mutable and contains object references.

VAR-2.D.2

The `ArrayList` constructor `ArrayList()` constructs an empty list.

VAR-2.D.3

Java allows the generic type `ArrayList<E>`, where the generic type `E` specifies the type of the elements.

VAR-2.D.4

When `ArrayList<E>` is specified, the types of the reference parameters and return type when using the methods are type `E`.

VAR-2.D.5

`ArrayList<E>` is preferred over `ArrayList` because it allows the compiler to find errors that would otherwise be found at run-time.

7.1: ArrayList

Key Terms:	**Notes:**
ArrayList	

Summary: Represent collections of related object reference data using ArrayList objects

7.1: ArrayList

```
import java.util.ArrayList;
public class ArrayVsArrayList
{
    public static void main(String[] args)
    {
        String[] array = {"This ","Array ","Has ","Five ","Values "};
        printArray(array);

        // arrays need to be initialized w/ total # of values to be stored
        String[] expandedArray = new String[6];

        // to expand arrays, we need to create a new array with a bigger size
        //and copy values from original to the new one:

        for(int i =  0; i < array.length; i++)
        {
            expandedArray[i] = array[i];
        }
        expandedArray[expandedArray.length-1] = "Now it has six!";

        printArray(expandedArray);

        //=============================================================

        //ArrayLists can be initialized without determining the size:
        ArrayList<String> arrList = new ArrayList<String>();

        //We can add an unlimited number of String values to arrList
    }


    public static void printArray(String[] array)
    {
        for(String elem: array)
        {
            System.out.print(elem);
        }
        System.out.println();
    }
}
```

Introduction to ArrayList Quiz

1. Consider the following statement, which is intended to create an `ArrayList` named `theater_club` to store elements of type `Student`. Assume that the `Student` class has been properly defined and includes a no-parameter constructor.

```
ArrayList<Student> theater_club = new /* missing code */;
```

Which choice can replace `/* missing code */` so that the statement compiles without error?

(A) `Student()`

(B) `Student ArrayList()`

(C) `ArrayList(Student)`

(D) `ArrayList<Student>()`

(E) `ArrayList<theater_club>()`

2. Consider the following statement, which is intended to create an `ArrayList` named `values` that can be used to store `Integer` elements.

```
/* missing code */ = new ArrayList<>();
```

Which of the following can be used to replace `/* missing code */` so that the statement compiles without error?

I. `ArrayList values`
II. `ArrayList<int> values`
III. `ArrayList<Integer> values`

(A) I only

(B) II only

(C) III only

(D) I and III only

(E) II and III only

3. Consider the following statement, which is intended to create an `ArrayList` named `years` that can be used to store elements both of type `Integer` and of type `String`.

```
/* missing code */ = new ArrayList();
```

Which of the following can be used to replace `/* missing code */` so that the statement compiles without error?

(A) `ArrayList years`

(B) `ArrayList years()`

(C) `ArrayList years[]`

(D) `ArrayList<Integer> years`

(E) `ArrayList<String> years`

TOPIC 7.2
ArrayList Methods

Required Course Content

ENDURING UNDERSTANDING

VAR-2

To manage large amounts of data or complex relationships in data, programmers write code that groups the data together into a single data structure without creating individual variables for each value.

LEARNING OBJECTIVE

VAR-2.D

Represent collections of related object reference data using `ArrayList` objects.

ESSENTIAL KNOWLEDGE

VAR-2.D.6

The `ArrayList` class is part of the `java.util` package. An import statement can be used to make this class available for use in the program.

VAR-2.D.7

The following `ArrayList` methods—including what they do and when they are used—are part of the Java Quick Reference:

- `int size()` – Returns the number of elements in the list
- `boolean add(E obj)` – Appends `obj` to end of list; returns `true`
- `void add(int index, E obj)` – Inserts `obj` at position `index` (`0 <= index <= size`), moving elements at position `index` and higher to the right (adds 1 to their indices) and adds 1 to size
- `E get(int index)` – Returns the element at position `index` in the list
- `E set(int index, E obj)` — Replaces the element at position `index` with `obj`; returns the element formerly at position `index`

continued on next page

SUGGESTED SKILLS

2.C

Determine the result or output based on the statement execution order in a code segment containing method calls.

3.D

Write program code to create, traverse, and manipulate elements in 1D array or `ArrayList` objects.

AVAILABLE RESOURCES

- Java Quick Reference (see Appendix)
- Practice-It!: BJP4 Chapter 10: ArrayLists—Exercises 10.2–10.17
- The Exam > 2017 AP Computer Science A Exam Free-Response Question #1, Part A (Digits)

LEARNING OBJECTIVE

VAR-2.D

Represent collections of related object reference data using `ArrayList` objects.

ESSENTIAL KNOWLEDGE

- `E remove(int index)`—Removes element from position `index`, moving elements at position `index + 1` and higher to the left (subtracts 1 from their indices) and subtracts 1 from size; returns the element formerly at position `index`

7.2: ArrayList Methods

Key Terms:	**Notes:**
ArrayList	

Summary: Use methods associated with ArrayLists

7.2: ArrayList Methods

```
import java.util.ArrayList;

public class ArraysvArrayLists
{
    public static void main(String[] args)
    {
     //Arrays & ArrayLists have different methods for altering
data:

        //Creating:
        String[] arr = new String[4];
        ArrayList<String> array = new ArrayList<String>();

        //Adding a value:
        array.add("This ");
        arr[0] = "This ";
        array.add("Is ");
        arr[1]= "Is ";
        array.add("An ");
        arr[2] = "An ";
        array.add("Array");
        arr[3] = "Array ";

        //Set the value of an ArrayList:
        array.set(3, "ArrayList");



        //Finding the size:
        System.out.println("Array length: " + arr.length);
        System.out.println("ArrayList size: " + array.size());

        //Accessing a value:
        System.out.println("\nType: " + arr[3]);
        System.out.println("Type: " + array.get(3));

    }
}
```

ArrayList Methods Quiz

1. Consider the following code segment.

```
ArrayList<String> animals = new ArrayList<>();
animals.add("fox");
animals.add(0, "squirrel");
animals.add("deer");
animals.set(2, "groundhog");
animals.add(1, "mouse");
System.out.println(animals.get(2) + " and " + animals.get(3));
```

What is printed as a result of executing the code segment?

(A) `mouse and fox`

(B) `fox and groundhog`

(C) `groundhog and deer`

(D) `fox and deer`

(E) `squirrel and groundhog`

2. Consider the following code segment.

```
ArrayList<Integer> oldList = new ArrayList();
oldList.add(100);
oldList.add(200);
oldList.add(300);
oldList.add(400);
ArrayList<Integer> newList = new ArrayList();
newList.add(oldList.remove(1));
newList.add(oldList.get(2));
System.out.println(newList);
```

What, if anything, is printed as a result of executing the code segment?

(A) `[100, 300, 400]`

(B) `[200, 300]`

(C) `[200, 400]`

(D) Nothing is printed because the code segment does not compile.

(E) Nothing is printed because an `IndexOutOfBoundsException` will occur.

ArrayList Methods Quiz

3. Consider the following code segment.

```
ArrayList<Double> conditionRating = new ArrayList<Double>();
conditionRating.add(9.84);
conditionRating.add(8.93);
conditionRating.add(7.65);
conditionRating.add(6.24);
conditionRating.remove(2);
conditionRating.set(2, 7.63);
System.out.println(conditionRating);
```

What is printed when this code segment is executed?

(A) `[9.84, 7.63, 6.24]`

(B) `[9.84, 7.63, 7.65, 6.24]`

(C) `[9.84, 8.93, 7.63]`

(D) `[9.84, 8.93, 7.63, 6.24]`

(E) `[9.84, 8.93, 7.65, 7.63]`

TOPIC 7.3
Traversing ArrayLists

Required Course Content

ENDURING UNDERSTANDING

VAR-2

To manage large amounts of data or complex relationships in data, programmers write code that groups the data together into a single data structure without creating individual variables for each value.

LEARNING OBJECTIVE

VAR-2.E

For `ArrayList` objects:

a. Traverse using a `for` or `while` loop

b. Traverse using an enhanced `for` loop

ESSENTIAL KNOWLEDGE

VAR-2.E.1

Iteration statements can be used to access all the elements in an `ArrayList`. This is called traversing the `ArrayList`.

VAR-2.E.2

Deleting elements during a traversal of an `ArrayList` requires using special techniques to avoid skipping elements.

VAR-2.E.3

Since the indices for an `ArrayList` start at 0 and end at the number of elements − 1, accessing an index value outside of this range will result in an `ArrayIndexOutOfBoundsException` being thrown.

VAR-2.E.4

Changing the size of an `ArrayList` while traversing it using an enhanced `for` loop can result in a `ConcurrentModificationException` being thrown. Therefore, when using an enhanced `for` loop to traverse an `ArrayList`, you should not add or remove elements.

SUGGESTED SKILLS

2.C

Determine the result or output based on the statement execution order in a code segment containing method calls.

3.D

Write program code to create, traverse, and manipulate elements in 1D array or `ArrayList` objects.

AVAILABLE RESOURCES

- Runestone Academy: AP CSA—Java Review: 9.14—Looping through a List
- Practice-It!: BJP4 Chapter 10: ArrayLists—Exercises 10.2–10.17
- The Exam > 2018 AP Computer Science A Exam Free-Response Question #2 (WordPair)

7.3: Traversing ArrayLists

Key Terms:	**Notes:**
ArrayList	

Summary: Students will be able to:

- Traverse ArraysLists using a for or while loop
- Access elements in an ArrayList using iteration statements
- Remove elements in an ArrayList

7.3: Traversing ArrayLists

```
import java.util.ArrayList;
public class WhileLoopArray
{
    public static void main(String[] args)
    {
        //Create new String ArrayList
        ArrayList<String> pyramid = new ArrayList<String>();
        pyramid.add("*");
        pyramid.add("**");
        pyramid.add("***");
        pyramid.add("****");
        pyramid.add("***");
        pyramid.add("**");
        pyramid.add("*");

        //Create counter to traverse array
        int index = 0;
        while(index < pyramid.size())
        {
            System.out.println("Value at Index " + index +":");
            System.out.println(pyramid.get(index));
            //increase value of index to get new value
            index++;
        }
    }
}
```

7.3: Traversing ArrayLists

```
// Don't forget to import ArrayList!
import java.util.*;

public class ReadingList
{
    public static void main(String[] args)
    {
        ArrayList<String> readingList = new ArrayList<String>();

        // Add four books to the list and print it out
        readingList.add("The Great Gatsby");
        readingList.add("The Catcher in the Rye");
        readingList.add("Animal Farm");
        readingList.add("Tom Sawyer");
        printArrayList(readingList);

        // Now decide that we want to read Lord of the Flies first
        readingList.add(0, "Lord of the Flies");
        printArrayList(readingList);

        // Now decide that Walden should actually be third.
        readingList.add(2, "Walden");
        printArrayList(readingList);

        // Now decide we don't actually want to read Animal Farm
        readingList.remove("Animal Farm");
        printArrayList(readingList);

        // Now decide we also want to remove the second book.
        readingList.remove(1);
        printArrayList(readingList);

        // How many books are in our reading list now?
        System.out.println("Number of books: " + readingList.size());

        // Let's get the first book
        String firstBook = readingList.get(0);
        System.out.println("First book: " + firstBook);

        // And what index is Tom Sawyer now?
        int indexOfTomSawyer = readingList.indexOf("Tom Sawyer");
        System.out.println("Tom Sawyer is at index: " + indexOfTomSawyer);


    }
```

7.3: Traversing ArrayLists

```
 private static void printArrayList(ArrayList<String> list)
    {
        System.out.println("Reading List:");
        int counter = 1;
        // This uses the for each loop.
        for(String s: list)
        {
            System.out.println(counter + ": " + s);
            counter++;
        }

        for(int i = 0; i < 20; i++)
        {
            System.out.print("=");
        }
        System.out.println();
    }
}
```

What is the output of this program?

Traversing ArrayLists Quiz

1. In the following code segment, assume that the `ArrayList wordList` has been initialized to contain the `String` values `["apple", "banana", "coconut", "lemon", "orange", "pear"]`.

```
int count = 0;
for (String word : wordList)
{
     if (word.indexOf("a") >= 0)
     {
         count++;
     }
}
System.out.println(count);
```

What is printed as a result of executing the code segment?

(A) `1`

(B) `2`

(C) `3`

(D) `4`

(E) `5`

2. In the following code segment, assume that the `ArrayList data` has been initialized to contain the `Integer` values `[4, 3, 4, 5, 3, 4]`.

```
int j = 0;
while (j < data.size() - 1)
{
     if (data.get(j) > data.get(j + 1))
     {
         System.out.print(data.get(j + 1) + " ");
     }
     j++;
}
```

What, if anything, is printed as a result of executing the code segment?

(A) `3 3`

(B) `4 5`

(C) `4 5 4`

(D) Nothing is printed because the code segment does not compile.

(E) Nothing is printed because an `IndexOutOfBoundsException` occurs.

Traversing ArrayLists Quiz

3. In the code segment below, assume that the `ArrayList` object `numbers` has been properly declared and initialized to contain `[0, 2, 4, 5]`.

```
for (int k = numbers.size() - 1; k >= 0; k--)
{
     if (numbers.get(k) > k)
     {
         System.out.print(k + " ");
     }
}
```

What, if anything, is printed as a result of executing the code segment?

(A) `1 2 3`

(B) `2 4 5`

(C) `3 2 1`

(D) `5 4 2`

(E) Nothing will be printed because an `IndexOutOfBoundsException` will occur.

SUGGESTED SKILLS

3.D

Write program code to create, traverse, and manipulate elements in 1D array or `ArrayList` objects.

4.A

Use test-cases to find errors or validate results.

AVAILABLE LAB

- Classroom Resources > AP Computer Science A: Data Lab

AVAILABLE RESOURCES

- Runestone Academy: AP CSA—Java Review: 9.13—Removing an Object at an Index
- Practice-It!: BJP4 Chapter 10: ArrayLists—Exercises 10.2–10.17
- The Exam >
  - 2017 AP Computer Science A Exam Free-Response Question 31, Part B (Digits)
  - Past AP Free-Response Exam Questions on Array/ `ArrayList` on AP Question Bank

TOPIC 7.4
Developing Algorithms Using ArrayLists

Required Course Content

ENDURING UNDERSTANDING

CON-2

Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.

LEARNING OBJECTIVE

CON-2.J

For algorithms in the context of a particular specification that requires the use of `ArrayList` traversals:

- Identify standard algorithms.
- Modify standard algorithms.
- Develop an algorithm.

ESSENTIAL KNOWLEDGE

CON-2.J.1

There are standard `ArrayList` algorithms that utilize traversals to:

- Insert elements
- Delete elements
- Apply the same standard algorithms that are used with 1D arrays

CON-2.J.2

Some algorithms require multiple `String`, array, or `ArrayList` objects to be traversed simultaneously.

7.4: Developing Algorithms / ArrayLists

Key Terms:	**Notes:**
ArrayList	

Summary: Students will be able to:

- Identify standard ArrayLists algorithms such as inserting and deleting elements
- Modify standard ArrayLists algorithms
- Develop an ArrayLists algorithm

7.4: Developing Algorithms / ArrayLists

```
import java.util.ArrayList;
public class TraversingSimultaneousArrays
{
    public static void main(String[] args)
    {
        //Create ArrayLists
        ArrayList<Integer> sum1 = new ArrayList<Integer>();
        sum1.add(5);
        sum1.add(2);
        sum1.add(4);
        sum1.add(5);
        sum1.add(0);
        ArrayList<Integer> sum2 = new ArrayList<Integer>();
        sum2.add(3);
        sum2.add(5);
        sum2.add(6);
        sum2.add(9);
        sum2.add(12);
        System.out.println("Array 1:");
        printArray(sum1);
        System.out.println("Array 2:");
        printArray(sum2);

        //Initialize summed to sumArrays(sum1, sum2)
        ArrayList<Integer> summed = sumArrays(sum1, sum2);
        System.out.println("\nSum of Array 1 and Array 2:");
        printArray(summed);
    }
```

7.4: Developing Algorithms / ArrayLists

```
    public static ArrayList<Integer>
sumArrays(ArrayList<Integer> list1, ArrayList<Integer> list2)
    {
        ArrayList<Integer> summedList = new
ArrayList<Integer>();

 for(int index = 0; index < list1.size(); index++)

          {
              //We can traverse multiple ArrayLists
simultaneously
               int sum = list1.get(index) + list2.get(index);
               summedList.add(sum);
          }

        return summedList;
    }

    public static void printArray(ArrayList<Integer> array)
    {
        for(Integer elem: array)
        {
            System.out.print(elem+ " ");
        }
        System.out.println();
    }

}
```

Developing Algorithms Using ArrayLists Quiz

1. Consider the following method, `remDups`, which is intended to remove duplicate consecutive elements from `nums`, an `ArrayList` of integers. For example, if `nums` contains `{1, 2, 2, 3, 4, 3, 5, 5, 6}`, then after executing `remDups(nums)`, `nums` should contain `{1, 2, 3, 4, 3, 5, 6}`.

```
public static void remDups(ArrayList<Integer> nums)
{
     for (int j = 0; j < nums.size() - 1; j++)
     {
         if (nums.get(j).equals(nums.get(j + 1)))
         {
            nums.remove(j);
            j++;
         }
     }
}
```

The code does not always work as intended. Which of the following lists can be passed to `remDups` to show that the method does NOT work as intended?

(A) `{1, 1, 2, 3, 3, 4, 5}`

(B) `{1, 2, 2, 3, 3, 4, 5}`

(C) `{1, 2, 2, 3, 4, 4, 5}`

(D) `{1, 2, 2, 3, 4, 5, 5}`

(E) `{1, 2, 3, 3, 4, 5, 5}`

2. The `removeElement` method is intended to remove all instances of `target` from the `ArrayList` object `data` passed as a parameter. The method does not work as intended for all inputs.

```
public void removeElement(ArrayList<Integer> data, int target)
{
     for (int j = 0; j < data.size(); j++)
     {
         if (data.get(j).equals(target))
         {
            data.remove(j);
         }
     }
}
```

Assume that the `ArrayList` object `scores` and the `int` variable `low_score` have been properly declared and initialized. In which of the following cases will the method call `removeElement(scores, low_score)` fail to produce the intended result?

(A) When `scores` is `[0, 2, 0, 2, 0, 6]` and `low_score` is `0`

(B) When `scores` is `[2, 4, 0, 5, 7, 0]` and `low_score` is `0`

(C) When `scores` is `[3, 4, 5, 7, 7, 2]` and `low_score` is `1`

(D) When `scores` is `[8, 8, 4, 3, 3, 6]` and `low_score` is `3`

(E) When `scores` is `[9, 9, 5, 9, 7, 7]` and `low_score` is `5`

Developing Algorithms Using ArrayLists Quiz

3. In the following code segment, assume that the `ArrayList numList` has been properly declared and initialized to contain the `Integer` values `[1, 2, 2, 3]`. The code segment is intended to insert the `Integer` value `val` in `numList` so that `numList` will remain in ascending order. The code segment does not work as intended in all cases.

```
int index = 0;
while (val > numList.get(index))
{
     index++;
}
numList.add(index, val);
```

For which of the following values of `val` will the code segment not work as intended?

(A) `0`

(B) `1`

(C) `2`

(D) `3`

(E) `4`

TOPIC 7.5
Searching

Required Course Content

ENDURING UNDERSTANDING

CON-2

Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.

LEARNING OBJECTIVE

CON-2.K

Apply sequential/linear search algorithms to search for specific information in array or `ArrayList` objects.

ESSENTIAL KNOWLEDGE

CON-2.K.1

There are standard algorithms for searching.

CON-2.K.2

Sequential/linear search algorithms check each element in order until the desired value is found or all elements in the array or `ArrayList` have been checked.

SUGGESTED SKILLS

3.D

Write program code to create, traverse, and manipulate elements in 1D array or ArrayList objects.

5.C

Explain how the result of program code changes, given a change to the initial code.

AVAILABLE RESOURCES

- Practice-It!: BJP4 Chapter 10: ArrayLists—Exercises 10.2–10.17
- Runestone Academy: AP CSA—Java Review: 13—Searching and Sorting
- Practice-It!: BJP4 Chapter 13: Searching and Sorting

7.5: Searching

Key Terms:	**Notes:**
ArrayList	

Summary: Students will be able to:
Apply linear search algorithms to search for specific information in array or ArrayList objects

7.5: Searching

```
public class LinearSearch
{

    public static void main(String[] args)
    {
        int[] arr = {9, 5, 7, 6, 3, 1, 4, 8};


        int index1 = linearSearch(arr, 6);
        System.out.print("The value 6 can be found at index: ");
        System.out.println(index1);

        int index2 = linearSearch(arr, 5);
        System.out.print("The value 5 can be found at index: ");
        System.out.println(index2);


        int index3 = linearSearch(arr, 70);
        System.out.print("The value 70 can be found at index:
");
        System.out.println(index3);
    }

    /**
     * This method takes an array called array and a
     * key to search for, and returns the index of
     * key if it is in the array or -1 if it is not
     * found.
     */
    public static int linearSearch(int[] array, int key)
    {
        for(int i = 0; i < array.length; i++)
        {
            int element = array[i];
            if(element == key)
            {
                return i;
            }
        }
        return -1;
    }
}
```

Searching Quiz (MCQs)

1. Consider the following method `countNegatives`, which searches an `ArrayList` of `Integer` objects and returns the number of elements in the list that are less than `0`.

```
public static int countNegatives(ArrayList<Integer> arr)
{
     int count = 0;
     for (int j = 0; j < arr.size(); j++)   // Line 4
     {
         if (arr.get(j) < 0)
         {
            count++;
         }
     }
     return count;
}
```

Which of the following best explains the impact to the `countNegatives` method when, in line 4, `j < arr.size()` is replaced with `j <= arr.size() - 1` ?

(A) It has no impact on the behavior of the method.

(B) It causes the method to ignore the last element in `arr`.

(C) It causes the method to throw an `IndexOutOfBounds` exception.

(D) It reduces the size of `arr` by `1` and the last element will be removed.

(E) It changes the number of times the loop executes, but all indexes in `arr` will still be accessed.

2. Consider the following method `findValue`, which takes an `ArrayList` of `String` elements and a `String` value as parameters and returns `true` if the `String` value is found in the list and `false` otherwise.

```
public static boolean findValue(ArrayList<String> arr, String key)
{
     for (int j = 0; j < arr.size(); j++)     // Line 3
     {
         if (arr.get(j).equals(key))
         {
            return true;
         }
     }
     return false;
}
```

Which of the following best explains the impact to the `findValue` method when, in line 3, `int j = 0` is replaced by `int j = 1` ?

Searching Quiz (MCQs)

(A) It has no impact on the behavior of the method.

(B) It will cause the method to return a different result when the `key` value is not in the list.

(C) It will cause the method to return a different result when the `key` value is found only at the first index in the list.

(D) It will cause the method to return a different result when the `key` value is found only at the last index in the list.

(E) It will cause the method to throw an array index out of bounds exception.

3. Consider the following method, `inCommon`, which takes two `Integer ArrayList` parameters. The method returns `true` if the same integer value appears in both lists at least one time, and `false` otherwise.

```
public static boolean inCommon(ArrayList<Integer> a, ArrayList<Integer> b)
{
      for (int i = 0; i < a.size(); i++)
      {
          for (int j = 0; j < b.size(); j++)    // Line 5
          {
             if (a.get(i).equals(b.get(j)))
             {
            return true;
             }
          }
      }
      return false;
}
```

Which of the following best explains the impact to the `inCommon` method when line 5 is replaced by `for (int j = b.size() - 1; j > 0; j--)` ?

(A) The change has no impact on the behavior of the method.

(B) After the change, the method will never check the first element in list `b`.

(C) After the change, the method will never check the last element in list `b`.

(D) After the change, the method will never check the first and the last elements in list `b`.

(E) The change will cause the method to throw an `IndexOutOfBounds` exception.

SUGGESTED SKILL

2.D

Determine the number of times a code segment will execute.

TOPIC 7.6 Sorting

AVAILABLE LAB

- Classroom Resources > AP Computer Science A: Data Lab

AVAILABLE RESOURCES

- Runestone Academy: AP CSA—Java Review: 13—Searching and Sorting
- Practice-It!: BJP4 Chapter 13: Searching and Sorting—Self-Check 13.29 and 13.30
- Visualgo.net: Sorting
- Sorting.at

Required Course Content

ENDURING UNDERSTANDING

CON-2

Programmers incorporate iteration and selection into code as a way of providing instructions for the computer to process each of the many possible input values.

LEARNING OBJECTIVE

CON-2.L

Apply selection sort and insertion sort algorithms to sort the elements of array or `ArrayList` objects.

CON-2.M

Compute statement execution counts and informal run-time comparison of sorting algorithms.

ESSENTIAL KNOWLEDGE

CON-2.L.1

Selection sort and insertion sort are iterative sorting algorithms that can be used to sort elements in an array or `ArrayList`.

CON-2.M.1

Informal run-time comparisons of program code segments can be made using statement execution counts.

7.6: Sorting

Key Terms:	**Notes:**
ArrayList	

Summary: Students will be able to:

- Apply selection sort and insertion sort algorithms to sort the elements of array or ArrayList objects
- Compute statement execution counts and informal run-time comparison of sorting algorithms

7.6: Sorting

```
    private static void selectionSort(int[] arr)
    {
        for(int curIndex = 0; curIndex < arr.length - 1;
curIndex++)
        {
            // Show current state of array at each pass
            System.out.println(Arrays.toString(arr));

            // Find minimum in the rest of the list
            int minIndex = findMin(arr, curIndex);

            // Swap the minimum into the correct position
            swap(arr, curIndex, minIndex);
        }
    }

    private static int findMin(int[] arr, int startingIndex)
    {
        int minIndex = startingIndex;

        for(int i = minIndex + 1; i < arr.length; i++)
        {
            if(arr[i] < arr[minIndex])
            {
                minIndex = i;
            }
        }

        return minIndex;
    }

    private static void swap(int[] arr, int x, int y)
    {
        int temp = arr[x];
        arr[x] = arr[y];
        arr[y] = temp;
    }
```

7.6: Sorting

```
/*
     * Insertion sort takes in an array of integers and
     * returns a sorted array of the same integers.
     */
    private static void insertionSort(int[] arr)
    {
        System.out.println(Arrays.toString(arr));

        // note: we start with 1 instead of 0
        for (int i = 1; i < arr.length; i++)
        {
            int curNumber = arr[i];

            // Set index to be place to the left
            int curIndex = i-1;

            // We are still inbounds and the current number
            // is less than the current index
            while ( curIndex >= 0 && arr[curIndex] > curNumber)
            {
                // Shift the value at curIndex to the right one
place
                arr[curIndex+1] = arr[curIndex];
                curIndex--;
            }

            // Put this number in the proper location
            arr[curIndex + 1] = curNumber;
            System.out.println(Arrays.toString(arr));
        }
    }
}
```

Sorting Quiz

1. Consider the following correct implementation of the selection sort algorithm.

```
public static void selectionSort(int[] elements)
{
     for (int j = 0; j < elements.length - 1; j++)
     {
         int minIndex = j;
         for (int k = j + 1; k < elements.length; k++)
         {
            if (elements[k] < elements[minIndex])
            {
        minIndex = k;
            }
         }
         if (j != minIndex)
         {
            int temp = elements[j];
            elements[j] = elements[minIndex];
            elements[minIndex] = temp;    // Line 19
         }
     }
}
```

The following declaration and method call appear in a method in the same class as `selectionSort`.

```
int[] arr = {9, 8, 7, 6, 5};
selectionSort(arr);
```

How many times is the statement `elements[minIndex] = temp;` in line 19 of the method executed as a result of the call to `selectionSort` ?

(A) 1

(B) 2

(C) 3

(D) 4

(E) 5

Sorting Quiz

2. Consider the following correct implementation of the insertion sort algorithm.

```
public static void insertionSort(int[] elements)
{
     for (int j = 1; j < elements.length; j++)
     {
         int temp = elements[j];
         int possibleIndex = j;

         {
            elements[possibleIndex] = elements[possibleIndex - 1];
            possibleIndex--;    // Line 10
         }
         elements[possibleIndex] = temp;
     }
}
```

The following declaration and method call appear in a method in the same class as `insertionSort`.

```
int[] arr = {4, 12, 4, 7, 19, 6};
insertionSort(arr);
```

How many times is the statement `possibleIndex--;` in line 10 of the method executed as a result of the call to `insertionSort` ?

(A) 2

(B) 3

(C) 4

(D) 5

(E) 6

Sorting Quiz

3. Consider the following correct implementation of the selection sort algorithm.

```
public static void selectionSort(int[] elements)
{
     for (int j = 0; j < elements.length - 1; j++)
     {
         int minIndex = j;
         for (int k = j + 1; k < elements.length; k++)
         {
            if (elements[k] < elements[minIndex])
            {
           minIndex = k;    // Line 11
            }
         }
         if (j != minIndex)
         {
            int temp = elements[j];
            elements[j] = elements[minIndex];
            elements[minIndex] = temp;
         }
     }
}
```

The following declaration and method call appear in the same class as `selectionSort`.

```
int[] vals = {5, 10, 2, 1, 12};
selectionSort(vals);
```

How many times is the statement `minIndex = k;` in line 11 of the method executed as a result of the call to `selectionSort` ?

(A) 0

(B) 1

(C) 2

(D) 3

(E) 4

TOPIC 7.7
Ethical Issues Around Data Collection

Required Course Content

ENDURING UNDERSTANDING

IOC-1

While programs are typically designed to achieve a specific purpose, they may have unintended consequences.

LEARNING OBJECTIVE

IOC-1.B

Explain the risks to privacy from collecting and storing personal data on computer systems.

ESSENTIAL KNOWLEDGE

IOC-1.B.1

When using the computer, personal privacy is at risk. Programmers should attempt to safeguard personal privacy.

IOC-1.B.2

Computer use and the creation of programs have an impact on personal security. These impacts can be beneficial and/or harmful.

AVAILABLE RESOURCES

- Classroom Resources >
  - Ethical Use of the Computer
  - Ethical Issues: Internet Content Providers and Internet Service Providers

7.7: Ethical Issues / Data Collection

Key Terms:	**Notes:**
Network protocols	
Data privacy	
Data security	

Summary: Students will be able to:

- Explain the risks to privacy from collecting and storing personal data on computer systems
- Explain the role that programmers have considering safeguarding personal privacy
- Explain the beneficial and harmful impacts that computer use and the creation of programs have on personal security

UNIT 08: DIGITAL INFORMATION

8.1 Intro to Digital Information

Key Terms:	**Notes:**
Abstraction Digital Information	

Summary: Explore and explain abstraction and the different ways that we can represent digital information.

8.2: Number Systems

Key Terms:	**Notes:**
Number System Number Base Decimal Number System Binary Number System	

Summary: Represent numbers in different number systems and understand how to convert between the decimal and binary system

Binary Conversions

Corresponding Material
Number Systems

Discussion
There are a lot of different number systems that are used in computer science. There have also been different number systems used in the past such as the Maya Number System and the Babylonian Number System. All number systems have a base. The most common is the decimal system with base ten. Two other systems that are used by computers are the binary system with base two and the hexadecimal system with base sixteen.

Binary to Decimal

Example:

Binary	**1**	**0**	**0**	**1**	**1**	**0**	**0**	**1**
Base	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Math	1 x 128	0 x 64	0 x 32	1 x 16	1 x 8	0 x 4	0 x 2	1 x 1
Decimal	**128**	**0**	**0**	**16**	**8**	**0**	**0**	**1**

Answer: 128 + 16 + 8 + 1 = 153

Exercise:

Binary	**1**	**1**	**0**	**0**	**1**	**1**	**0**	**1**
Base	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Math								
Decimal								

Answer:

CodeHS

Decimal to Binary

Example:

Starting Number: 172

Decimal	**172**	**44**	**44**	**12**	**12**	**4**	**0**	**0**
Base	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Math	172 ÷ 128	44 ÷ 64	44 ÷ 32	12 ÷ 16	12 ÷ 8	4 ÷ 4	0 ÷ 2	0 ÷ 1
Divides?	Yes 172 - 128 = **44**	No **44**	Yes 44 - 32 = **12**	No **12**	Yes 12 - 8 = **4**	Yes 4 - 4 = **0**	No **0**	No **0**
Binary	**1**	**0**	**1**	**0**	**1**	**1**	**0**	**0**

Answer: 1010 1100

Exercise:

Starting Number: 210

Decimal	**210**	**82**	**18**	**18**	**2**	**2**	**2**	**0**
Base	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
Math								
Divides?								
Binary								

Answer:

CodeHS

Further Practice:

Decimal	Binary
250	
	1010 1010
87	
	0111 1100
99	

8.3: Encoding Text with Binary

Key Terms:	**Notes:**
ASCII Binary Number System	

Summary: Understand the binary system and encode various types of information using binary

Numbers, Bits, and You(Tube)

Discussion

Computers store information in binary. Numbers, letters, pictures, and all other data that is stored on a computer is reduced to binary 1s and 0s to be stored in memory. For example, here is the decimal number 23 in binary:

```
10111 in binary
= (1 * 2^4) + (0 * 2^3) + (1 * 2^2) + (1 * 2^1) + (1 * 2^0)
= 16 + 4 + 2 + 1
= 23
```

Storing Numbers

Say that you had a computer that stored numbers using 4 bits. Positive and negative numbers could be stored by essentially using one of the bits to indicate whether the number is positive or negative.

In binary, negative numbers are stored using a system called the ***two's complement***. Instead of just using the first bit as a flag for + or -, the two's complement stores negative numbers by flipping each bit in the binary number, then adding 1. So, to get -5:

```
First find +5:0101
Flip all bits:1010
Add 1:              1011
```

With one of the bits essentially acting as the + or - sign, that leaves 3 bits to actually store the number. What are the maximum and minimum numbers that could be stored?

Max number	Min number
0111 in binary = +7 in decimal	1000 in binary = -8 in decimal

CodeHS

Overflow!

What if you wanted to store a number bigger than +7 with 4 bits, like +8? In this case, the number will *wrap around*. So if we add 1 to +7, we would get binary 1000. But we've already set that number aside as being -8! When a positive number wraps around to negative numbers, it's called ***overflowing***.

Example: *Gangnam Style*

In 2014, the popular video streaming website YouTube ran into an overflow problem with the numbers they were using to count how many people watch a video.

YouTube was using 32 bits to store these counter numbers, so the maximum positive number it could store was 11111111 11111111 11111111 11111111 in binary, or 2,147,483,647 in decimal. In 2014, the video *Gangnam Style* by PSY reached more views than the counter number could store and wrapped around to negative numbers!

Of course, a video can't have been watched -2,147,483,648 times, so YouTube made some changes to the site to have video counters use 64 bits. How big is 64 bits? Very big: 9,223,372,036,854,775,808.

Exercise

Practice converting numbers between decimal and binary:

Decimal	Binary		Binary	Decimal
5	101		111	
11			01101	
18			01110	14
20			101110	
37			1010111	

8.4: Pixel Images

Key Terms:	**Notes:**
Pixel Image Pixel	

Summary: Understand how images can be encoded as data

Binary Numbers Quiz

1. A certain programming language uses 4-bit binary sequences to represent nonnegative integers. For example, the binary sequence `0101` represents the corresponding decimal value `5`. Using this programming language, a programmer attempts to add the decimal values `14` and `15` and assign the sum to the variable `total`. Which of the following best describes the result of this operation?

(A) The correct sum of `29` will be assigned to the variable `total`.

(B) An overflow error will occur because 4 bits is not large enough to represent either of the values `14` or `15`.

(C) An overflow error will occur because 4 bits is not large enough to represent `29`, the sum of `14` and `15`.

(D) A round-off error will occur because the decimal values `14` and `15` are represented as approximations due to the fixed number of bits used to represent numbers.

2. A video game character can face toward one of four directions: north, south, east, and west. Each direction is stored in memory as a sequence of four bits. A new version of the game is created in which the character can face toward one of eight directions, adding northwest, northeast, southwest, and southeast to the original four possibilities. Which of the following statements is true about how the eight directions must be stored in memory?

(A) Four bits are not enough to store the eight directions. Five bits are needed for the new version of the game.

(B) Four bits are not enough to store the eight directions. Eight bits are needed for the new version of the game.

(C) Four bits are not enough to store the eight directions. Sixteen bits are needed for the new version of the game.

(D) Four bits are enough to store the eight directions.

3. Which of the following are true statements about the data that can be represented using binary sequences?

I. Binary sequences can be used to represent strings of characters.
II. Binary sequences can be used to represent colors.
III. Binary sequences can be used to represent audio recordings.

(A) I only

(B) I and II only

(C) II and III only

(D) I, II, and III

4. Consider the 4-bit binary numbers 0011, 0110, and 1111. Which of the following decimal values is NOT equal to one of these binary numbers?

(A) 3

(B) 6

(C) 9

(D) 15

5. The position of a runner in a race is a type of analog data. The runner's position is tracked using sensors. Which of the following best describes how the position of the runner is represented digitally?

Binary Numbers Quiz

(A) The position of the runner is determined by calculating the time difference between the start and the end of the race and making an estimation based on the runner's average speed.

(B) The position of the runner is measured and rounded to either 0 or 1 depending on whether the runner is closer to the starting line or closer to the finish line.

(C) The position of the runner is predicted using a model based on performance data captured from previous races.

(D) The position of the runner is sampled at regular intervals to approximate the real-word position, and a sequence of bits is used to represent each sample.

6. Consider the following numeric values.

- Binary 1011
- Binary 1101
- Decimal 5
- Decimal 12

Which of the following lists the values in order from least to greatest?

(A) Decimal 5, binary 1011, decimal 12, binary 1101

(B) Decimal 5, decimal 12, binary 1011, binary 1101

(C) Decimal 5, binary 1011, binary 1101, decimal 12

(D) Binary 1011, binary 1101, decimal 5, decimal 12

8.5: Hexadecimal

Key Terms:	**Notes:**
Number System Hexadecimal Hexadecimal Number System	

Summary: Understand how to convert between the hexadecimal and binary system

8.6: Pixel Colors!

Key Terms:	**Notes:**
Pixel Image Pixel RGB Color Encoding	

Summary: Encode colors and encode color images as data

More AP CSP Robot

Accompanying Material

Exam reference sheet:
https://apcentral.collegeboard.org/pdf/ap-csp-student-task-directions.pdf?course=ap-computer-science-principles (pages 19-24)

Discussion

Since AP CSP is language agnostic, meaning it does not designate any particular programming language, it's important to understand the format and meaning of the questions on the exam. The exam reference sheet contains two programming formats: text based and block based.

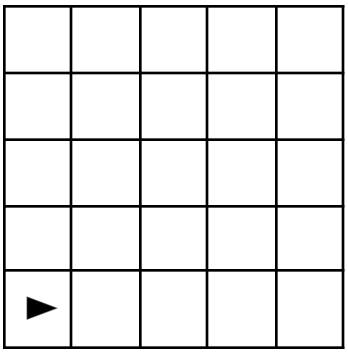
Knowing how to write code in a language agnostic manner is a great skill, too! Oftentimes potential employers during interviews want to see an algorithm, not the actual code, and these kinds of formats can be used for that. Additionally, diving into syntax without thinking through algorithms first can get us into trouble, so using this kind of coding can help with computational thinking.

This handout gives more practice on the robot-on-a-grid type problems using the coding instructions from the exam reference sheet.

Exercise

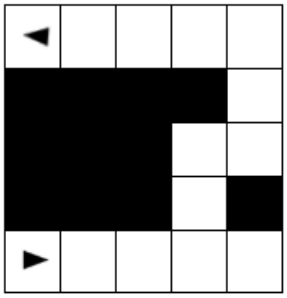
Using the AP CSP exam reference sheet, answer the following questions.

The following questions use a robot in a grid of squares. The robot is represented as a triangle, which is initially in the bottom left square of the grid and facing right when the gridworld opens (as shown below). Some problems will set up the grid world so that the robot starts in a different position, is facing a different direction and/or has squares that are blacked out as barriers to the robot's path.



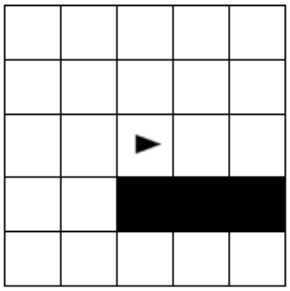
1. Consider the following maze for the robot. Write the code that will get the robot to its final position and direction. You should not repeat any code; use loops and functions instead.

   Program this Maze



2. Consider the following code segment meant to guide the robot through the maze below. Why does it not work as intended for the starting grid world?

```
REPEAT UNTIL (NOT CAN_MOVE(right))
{
      IF (CAN_MOVE(forward))
      {
            MOVE_FORWARD()
      }
      IF (NOT CAN_MOVE(forward))
            ROTATE_RIGHT()
            MOVE_FORWARD()
      }
}
```



3. Consider the following code segment. What are the possible outcomes of the code regardless of the robot's initial position and direction?

```
REPEAT UNTIL (CAN_MOVE(forward))
{
      ROTATE_LEFT()
}
```

8.7: Image Manipulation

Key Terms:	**Notes:**
Pixel Image	
Pixel	
WebImage	

Summary: Include images in their programs and manipulate the stored pixel data arbitrarily

8.8: Data Compression

Key Terms:	**Notes:**
Data Compression Lossless Compression	

Summary: Have a basic understanding of how data can be compressed

8.9: Lossy Compression

Key Terms:	**Notes:**
Data Compression Lossless Compression	

Summary: Understand different types of compressions, and the benefits and drawbacks to each.

Data Compression Quiz

1. Which of the following is an advantage of a lossless compression algorithm over a lossy compression algorithm?

(A) A lossless compression algorithm can guarantee that compressed information is kept secure, while a lossy compression algorithm cannot.

(B) A lossless compression algorithm can guarantee reconstruction of original data, while a lossy compression algorithm cannot.

(C) A lossless compression algorithm typically allows for faster transmission speeds than does a lossy compression algorithm.

(D) A lossless compression algorithm typically provides a greater reduction in the number of bits stored or transmitted than does a lossy compression algorithm.

2. A user wants to save a data file on an online storage site. The user wants to reduce the size of the file, if possible, and wants to be able to completely restore the file to its original version. Which of the following actions best supports the user's needs?

(A) Compressing the file using a lossless compression algorithm before uploading it

(B) Compressing the file using a lossy compression algorithm before uploading it

(C) Compressing the file using both lossy and lossless compression algorithms before uploading it

(D) Uploading the original file without using any compression algorithm

3. A programmer is developing software for a social media platform. The programmer is planning to use compression when users send attachments to other users. Which of the following is a true statement about the use of compression?

(A) Lossless compression of video files will generally save more space than lossy compression of video files.

(B) Lossless compression of an image file will generally result in a file that is equal in size to the original file.

(C) Lossy compression of an image file generally provides a greater reduction in transmission time than lossless compression does.

(D) Sound clips compressed with lossy compression for storage on the platform can be restored to their original quality when they are played.

8.10: Cryptography

Key Terms:	**Notes:**
Cryptography	
Caesar Cipher	
Symmetric Encryption	
Public Key Encryption	

Summary: Explain what cryptography is and how it is used

- Analyze an encryption and determine if it is weak or strong
- Explain the difference between an easy and hard problem in computer science
- Explain the difference between algorithms that run in a reasonable amount of time and those that do not run in a reasonable amount of time
- Explain the difference between solvable and unsolvable problems in computer science
- Explain the existence of undecidable problems in computer science

CodeHS

Can Computers Solve EVERYTHING?

Corresponding Material
Basic Data Structures, Removing an Element From a List
Digital Information, Cryptography

Discussion
There exist algorithms (and programs that implement these algorithms) that solve some really interesting problems. There are algorithms to sort a list of values quickly, algorithms to find the shortest path between two points, algorithms that play checkers perfectly, and even algorithms that analyze the pixel data in images to detect faces!

It's easy to get carried away sometimes and think that computers can do it all. In this activity, we'll put that to the test.

Decidable problem - A problem in which an algorithm can be constructed to correctly answer "yes" or "no" for *all possible inputs.*

Examples:
"Is this input number even?"
"Does this input list contain this input number?"
"Does this input image contain any red?"

Undecidable problem - A problem in which no algorithm exists that can correctly answer "yes" or "no" for *all possible inputs.*

Example:

"If you give this program this input, will it loop forever or eventually stop?"

This is known as the Halting Problem, and it is the classic example of an undecidable problem.

Class Exercise
Let's look at some examples of inputs into the Halting Problem. Do the following programs Halt (yes or no)?

Input program:
`function start(){`
`  var input = readInt("Enter a number: ");`
 	
`  while (input != 0){`
`  input++;`
`  }`
`  println("Done!");`
`}`
	Input value: `10`
	
	Answer (Will this program halt on this input, or loop forever?

Input program:	Input value: `4`

`function start(){`
 	
`  while(true){`
`  var input = readInt("Enter a number: ");`
`  if(input == 4){`
`  break;`
`  }`
`  }`
`  println("Done!");`
`}`
	Answer (Will this program halt on this input, or loop forever?):

Further Discussion

It turns out we can solve specific instances of this problem. Given some programs and some inputs, we can create an algorithm (and a computer that executes this algorithm) that will be able to say "Yes, this program will halt", or "No, this program will loop forever". You just did it above!

However, it is proven that it is impossible to create an algorithm that solves *every single instance of this problem.*

To be clear, this isn't a problem that computers are getting better at, and will maybe someday be able to solve. This problem has been proven to be impossible. There cannot possibly exist an algorithm that solves the Halting Problem!

To see why, watch this video:
https://www.youtube.com/watch?v=92WHN-pAFCs

Discussion Questions

Suppose your little sibling just downloaded Instagram. She is blown away by all the cool things she can do with her pictures. She says "Wow, computers can do everything!"

Is this true? How would you explain to your sibling the existence of undecidable problems in computer science?

Old Time Secret Letters

Corresponding Material
Digital Information, Cryptography

Discussion
A computer virus is a malicious program that can copy itself and gain access to a computer in an unauthorized way. Computer viruses often attach themselves to legitimate programs and start running independently on a computer.

To avoid access to sensitive files, information can be digitally encrypted! There are many ways to digitally encrypt information. You can require a password to open a file. You can filter the text of the message through a cipher. You can encrypt a message using RSA encryption, which involves mathematically manipulating the letters of the message using public and private keys.

But what about physical encryption? Is there such a thing? As a class, come up with some ways that letters can be encrypted to keep the message secret.

Further Discussion
RSA encryption works by using the fact that finding large prime numbers is hard. Two large prime numbers are selected and multiplied together to be one of the variables in the equation. The keys are then computed based on this product. A message is encrypted using a public key and decrypted using a private key. This means anyone can send a message, but only the person who knows the private key can decrypt the message.
A message is encrypted by transforming each of the letters, or blocks of letters, using a mathematical formula involving the public key. Only the exact private key will undo this operation and yield the original message.

Extensions
- Have the students discuss how secure the various methods of digital encryption are
- Have the students discuss how secure the various methods of physical encryption are
- Have the students write messages to another class, and see if the other class can figure out how to read it. You might want to give them the paper and a pencil or markers to get them started in the right direction
- Have the students make pencil rubbings of their desk. Take a piece of blank, white printer paper and rub a pencil across the surface. Any marks on the desk should show up in the rubbing. Are there any "secret messages" hidden in the desk?

Class Exercise
One possible way to send secret messages is by using invisible ink. Invisible ink is only invisible because it blends in with the paper.

Using a white crayon, write a message on a blank, white sheet of printer paper. To reveal the message, use watercolors or markers to gently color over the paper. The message will appear.

Why does this work? Is this really encryption? Can you think of any digital equivalents to this form of secret messages?

Undecidable Problems Quiz

1. A team of programmers is designing software. One portion of the project presents a problem for which there is not an obvious solution. After some research, the team determines that the problem is undecidable. Which of the following best explains the consequence of the problem being undecidable?

(A) The problem can be solved algorithmically, but it will require an unreasonably long amount of time.

(B) The problem can be solved algorithmically, but it will require an unreasonably large amount of data storage.

(C) There is no possible algorithm that can be used to solve all instances of the problem.

(D) There are several different possible algorithms that can solve the problem, but there is controversy about which is the most efficient.

2. A student wants to determine whether a certain problem is undecidable. Which of the following will demonstrate that the problem is undecidable?

(A) Show that for one instance of the problem, an algorithm can be written that is always capable of providing a correct yes-or-no answer.

(B) Show that for one instance of the problem, no algorithm can be written that is capable of providing a correct yes-or-no answer.

(C) Show that for one instance of the problem, a heuristic is needed to write an algorithm that is capable of providing a correct yes-or-no answer.

(D) Show that for one instance of the problem, an algorithm that runs in unreasonable time can be written that is capable of providing a correct yes-or-no answer.

3. Which of the following best explains how algorithms that run on a computer can be used to solve problems?

(A) All problems can be solved with an algorithm that runs in a reasonable amount of time.

(B) All problems can be solved with an algorithm, but some algorithms might need a heuristic to run in a reasonable amount of time.

(C) All problems can be solved with an algorithm, but some algorithms might run in an unreasonable amount of time.

(D) Some problems cannot be solved by an algorithm.