



Computer Science/Internet Lesson Plan

Saturday, February 27, 2010



Note: there are a lot of graphs and diagrams in the power point – make sure that the mentees understand how to read bar graphs, pie graphs, etc and if they don't this is a great opportunity for them to learn how!

1. Opening activity – Why is computer science important?

- a. Ask each student to come up with one way they've used computers this week
- b. Now ask each student what they think life would be like without any computer-based technology – no computers, smart-phones, mp3 players, etc – how much have we learned to take computers for granted?
- c. How do computers impact the world and economy – ex how do they change the way information is distributed? How do they affect media and advertising? What about shopping?
- d. Interesting articles: <http://www.guardian.co.uk/business/2009/may/18/digital-content-expansion>, <http://www.guardian.co.uk/technology/2009/may/14/internet-energy-savings> - fun facts from those articles: Internet enough information to fill a stack of books stretching from earth to Pluto 10 times, estimated that by 2020 internet's energy use will cause the emission of 1.43 billion tons of carbon dioxide a year.

2. Basics of the internet

- a. Internet uses what is called client/server architecture
 - i. Server – a computer runs a server program to make information available. Servers are generally made so that they can be used by many users at one time and hold a lot of data – so they are usually large and powerful computers.
 - ii. Many companies with popular and important websites (ex – Google, Microsoft) keep server computers in a "server farm" which has many server computers.
 - iii. Client – a computer can run a client program to obtain information from a server. Computers that run client programs are the computers actually being directly used by people.
 - iv. The client and server work together to carry out whatever task is being done. This means that there are essentially 2 computers working together on a task instead of one so the task can be achieved faster and with more efficiency
 - v. Look at the power point slide – what are the two different client/server architectures designed to do? – the one on the left is for providing clients with information from a database and the one on the right is for providing clients with the time (a clock is connected to the server and clients then ask the server for the time)
 - vi. More info if you're interested: <http://en.wikipedia.org/wiki/Client-server>

b. nodes of the internet

- i. A node is a connection point in a network or terminal end point
- ii. In the internet one type of node is a host which is something that can communicate with other hosts
 1. A host computer is a computer connected to the internet

2. Can be either a server computer or a user workstation computer (which runs the client program)
 3. All hosts have unique IP addresses to identify them
- iii. Intermediate nodes – include routers and bridges forward information between networks.
 - iv. User workstations are generally connected to only one node but intermediate nodes and host-servers are connected to multiple nodes. This means there are multiple pathways to transfer information over. This means that if one node stops functioning the rest of the internet can still function normally.
 - v. More info: <http://www.rogerclarke.com/II/IPrimer.html#Arch>
- c. Difference between the internet and the web
- i. Contrary to popular belief, the internet and the web are not actually the same thing
 - ii. An easy analogy is a highway and a trucking service
 - iii. The internet is the actual network that connects computers (the highway)
 - iv. The web is a part of the internet that allows users to access information (the trucking service) – so for example the web includes doing something like performing a search on google. The web is the largest and most commonly used portion of the internet which is part of the reason people treat the web and the internet as if they were the same thing.
 - v. Other elements of the internet are email, instant messaging, file sharing, etc.
 - vi. But sometimes these elements are combined – for example Gmail is a web site but it also can send email or files.
- d. Accessing the web
- i. Need 2 things :
 1. connection to internet
 - a. The physical connection to the internet – examples: dial-up, DSL, cable, fios – cable goes through the same wires that deliver cable, fios uses fiber optic cables, dial-up goes through regular phone lines – dial-up is much slower than cable or fios but also less expensive
 - b. Software that can communicate with the internet – the internet uses special languages called protocols (different ones are used for different functions) – this automatically comes with computers and is hidden from the user.
 2. Web browser – a program (an example of a client program) that allows the user to see information on the web – examples: internet explorer, firefox, safari, google chrome, etc – what do you think about the fact that there are so many browsers? Is there any reason to use one over the other? Which do you prefer and why?
- e. Navigating to Web pages
- i. All web pages have a URL (Uniform Resource Locator) – that tells the web browser where to find the web page
 - ii. Parts of url: protocol://www.servername.domainname/page

- a. First protocol the browser should use to read the site (protocols are the languages the internet uses to send information) – the main protocol for the web is http. This is optional to enter b/c the browser will assume http
 - b. www – indicates that the thing you want is part of the world wide web and not some other part of the internet, also optional
 - c. servername – the name of the server computer the web page is stored on
 - d. domainname – indicates what type of website the website is. Common domain names include: .com (commercial web site), .org (not for profit organization), .edu (education institution)
 - e. page – what page on the web site you want to go to. If no page is entered, browser goes to default page for that site.
- iii. Have students identify parts of example urls in powerpoint

3. Spam mail

- a. Where does spam come from?
 - i. Spam mainly comes from people looking to make money
 - ii. They often offer products that are cheap or ask for a donation
 - iii. Most people know that the spam email is only a scam and will not give money to the spammers, but inevitably there will be some people who do pay the money – since emails cost nothing to send spammers will make money on spam
- b. But where do the spammers get the email addresses? -
 - i. some companies will sell email addresses to spammers. The email addresses are found in places like public chat rooms or forums that many people register for and leave their email address accessible to everyone
 - ii. Some spammers create programs that search the web for the @ sign and find email addresses automatically – the programs that do that are called spambots
 - iii. Another way spammers get your email address is if you enter them into one of those “you just won \$1million” pop ups or when you register on a site that is willing to sell your email address
 - iv. Spammers create programs that send emails with many randomized names to a certain email server (ex yahoo, hotmail, aol, etc) and saves the email addresses that were valid – this is called a “dictionary attack”
- c. How do spam filters work?
 - i. Filter out certain key words that are commonly used but slight changes in spelling or inserting special characters in between letters of the key words can cause the filter to miss the spam. This filter also often incorrectly identifies emails as spam.
 - ii. Hueristic and Bayesian filters are more advanced. Identify spam based on patterns and frequency of words. But they don’t work well for short spam emails.
 - iii. Email servers added filters that would block emails being sent from the same email address with the same subject to many people. Now spammers will insert different random letters in the subject of spam emails to avoid this.
 - iv.

- d. More info: <http://www.howstuffworks.com/spam.htm>
<http://www.wired.com/techbiz/it/news/2003/01/57132>

4. Internet Security

a. Cryptography/Cryptology – from the Greek “kryptos” (hidden, secret)

- i. Cryptography is important to the internet because otherwise anyone could see anything you send or receive, including things like passwords, emails you send to people, password protected websites etc
- ii. Encryption – process of putting plain text into ciphertext (which appears to be gibberish unless the reader knows what the cipher is)
- iii. Decryption – process of converting the ciphertext back to plain text
- iv. A cipher is a pair of algorithms (or sequence of operations): one used to create an encryption and the other to do the reverse to decrypt the ciphertext
- v. To work ciphers need a key which is a secret parameter used by the algorithms. The key must be known by both the sender and receiver of the method in order to both encrypt and decrypt the information. A key varies with each use of the cipher to prevent easy decryption by someone who is not supposed to be able to read the information.
- vi. Before computers cryptology's main function was to send secret messages that couldn't be read by other people
- vii. Classical ciphers include
 1. Transposition cipher: http://en.wikipedia.org/wiki/Transposition_cipher
 2. Substitution cipher: http://en.wikipedia.org/wiki/Substitution_cipher
 3. Caesar cipher: http://en.wikipedia.org/wiki/Caesar_cipher
- viii. But classical ciphers are easily broken by calculating percentage occurrence of letters and other statistics to figure out how the cipher was created (ex – Cryptoquotes which use a classical cipher in the newspaper can easily be figured out)
- ix. Polyalphabetic cipher is more difficult to decrypt without the key – uses a different cipher for each part of the message, possibly a different one for each letter
- x. Ciphers and computers
 1. Computers make more complex ciphers possible
 2. While classical ciphers can only encode language, computers can encrypt and information that can be stored in binary (which is anything that can be stored on a computer)
 3. Many computer cipher algorithms make use of math operations that are easy to do but very difficult to undo (ex factorial) so that decryption without knowing the key would take too long to be practical, although as computer processors are becoming more powerful its becoming more feasible.
 4. Symmetric-key cryptography – both sender and receiver have same key:
 - a. Block cipher – used for: ATM encryption and email privacy
 - i. Takes a block of a set size and encrypts the block using one key

- ii. When there is more information than can fit in one block there are various ways it can be encrypted – the simplest is Electronic Codebook – each block encrypted separately with different key – but patterns are still present in data (see images on power point)
- iii. For other methods of combining blocks read : http://en.wikipedia.org/wiki/Block_cipher_modes_of_operation

b. Stream Cipher

- i. Plaintext digits encrypted one at a time
- ii. The key used is a pseudorandom keystream (the characters in the key appear random but are not actually random)
- iii. Used for: wireless connection, military ciphers
- iv. More info: http://en.wikipedia.org/wiki/Stream_ciphers

5. Public key –

- a. the problem with Symmetric Key cryptography is that both the sender and receiver must have the same unique key, this means that many keys must be created
- b. one solution was to have a public key that is freely distributed and private keys that are secret
- c. private keys are mathematically related to the public key but it is impossible for a person to calculate the private key only knowing the public key.
- d. Public key used for encryption and private key used for decryption
- e. Info about how exactly the information is exchanged: <http://en.wikipedia.org/wiki/Diffie-Hellman>

- xi. More info: <http://en.wikipedia.org/wiki/Cryptography>

b. Computer viruses

- i. Malware – general name for malicious software
- ii. Viruses – replicate themselves by hiding in existing files in the computer. Can change things about the computer without the user's consent.
- iii. Trojans – pretend to do one thing but actually steal information or cause other problems
- iv. Spyware – spy on computer, can monitor keystrokes or take screenshots – this is one way identity theft can happen
- v. Worms – replicate over a whole computer network
- vi. Bots – take over computer or network and use their resources without authorization
- vii. Adware – displays or downloads ads – this is how you can end up with constant annoying pop-ups
- viii. Viruses and other malware target the most users possible – because the most commonly used web browser is Internet Explorer and the most common operating system is Windows, most malware is specifically targeted to Windows computers using IE, this is why you are safer from malware on a Mac or running Firefox, Safari, or

Chrome as your web browser. The more up-to-date your browser is the less likely you are to get a virus.

5. Specific kinds of websites

a. Google and other search engines

i. Crawler based search engines – most search engines are this type

1. A part of the search engine program called a “spider” “crawls” through web pages to find what words are on each page. Spiders crawl through all web pages frequently so that the web browser is up to date
2. Everything the spider finds gets sent to another part of the program called the index which stores the lists of words found on each website
3. The third part of the search engine program is the actual search engine software which takes the users entry and goes through the index to find all pages that match what the user is searching for. Then the software ranks how relevant it thinks the pages are to what the user is searching for.
4. Web pages’ relevancy is mainly ranked on two factors: location and frequency of the word. If the word is located in the name of the web page or near the top of the page, that page is judged to be more relevant. Also if the frequency of the word is higher, the page is judged to be more relevant

ii. Why do you think google is so much more popular than other search engines? (look at pie graph to see just how much more). What search engine do you use and why?

iii. For more info go to: <http://computer.howstuffworks.com/search-engine1.htm> or <http://searchenginewatch.com/2168031>

b. Social Networking/Facebook

i. Social Networking sites are what are called Web 2.0 applications.

1. Web 2.0 applications include sites that facilitate sharing and communication between people across the web. They are **interactive** websites designed so that users can change what is displayed on the websites.
2. Web 2.0 is viewed as a revolution in the way the web is used
3. If you’re interested in the technical side of web 2.0:
http://en.wikipedia.org/wiki/Web_2.0

ii. Facebook was created (by students at Harvard) in February 2004 and now has over 350 million active users (which is more than an average of 150,000 users a day!) – what do you think made facebook so popular so quickly?

1. Some fun facebook stats to share:

- a. 50% of active users log in every day
- b. More than 35 million users update status in a day
- c. Average user spends an average of more than 55 minutes on facebook each day!
- d. 70% of facebook users are outside the US
 - i. korea, mexico
 - ii. other social networking sites more pop in other countries, e.g. myspace

- iii. Twitter for 30+ population
 - e. People that use facebook on mobile devices are twice as active on facebook than people who don't
 - f. For more facebook fun statistics:
<http://www.facebook.com/press/info.php?statistics#!/press/info.php?statistics>
- 2. Do these facts surprise you? Which ones and why or why not?
- iii. Discuss graphs on power point slide. What makes facebook more popular than other social networking sites? Which one(s) do you use and why? What do you do with social networking sites? How do they change the way you live and communicate?
- iv. Effects on advertising and politics
 - 1. Advertising
 - a. Information on public profiles helps marketers figure out what their target demographic is – research can be done to see what kind of people become fans of certain companies, which allows these companies to better target their product to their customers. Read more: <http://www.wired.com/epicenter/2009/04/your-facebook-profile-makes-marketers-dreams-come-true/>
 - b. When you become a fan of a company's page or use a company's facebook app it could show up in your friend's newsfeed. This associates you and your picture with the company for all of your friends that see it in their newsfeed – so if you're friends like you they may automatically associate the company with a good thing. This can be very powerful advertising:
<http://www.wired.com/epicenter/2008/01/facebook-ads-ma/>
 - c. Facebook ads are targeted meaning that when an advertiser creates an ad they are able to select what kind of demographic they want to see the add. Then facebook gives them data about what kind of people have been clicking on their link so that they can tell who their customers are and change their target group so that their ads are more effective.
 - d. Facebook ads can be extremely targeted – one example – a company called CM Photographic created an add targeted to women 24-30 whose relationship status was listed as engaged. In one year the company made \$400,000 from the \$600 ad. See power point for the ad.
 - e. Do you think marketers using public information that people post is a violation of privacy?
 - 2. Politics
 - a. Many political facebook groups exist.
 - b. Facebook data can provide politicians information about the demographic of people who use facebook

- c. Facebook has yet to play a really big part in American politics but it has made a large impact on other countries.
- d. Facebook (as well as twitter and youtube) played a big part in the protests in Iran after their most recent election (both facebook and youtube added support for the Persian language shortly after the protests began). Facebook was actually banned in Iran because so many protestors were using it. Protesting on facebook and youtube helped people in Iran get information about the violence occurring to the rest of the world. To read more:
<http://www.wired.com/dangerroom/2009/06/facebook-google-go-persian-helping-irans-activists/>
- e. A similar thing happened in Moldova to protest an election that their Communist party won:
<http://www.scientificamerican.com/blog/post.cfm?id=twitter-revolution-10000-protesters-2009-04-08>

c. Hulu + Youtube

i. Youtube

1. Question – What is the name for websites that users can interact with and use to share information – like videos? (answer: Web 2.0 – talked about when discussing social networking)
2. How youtube works:
 - a. Videos are a type of video file called Adobe Flash Video (it converts the video file type for the users from whatever valid type they submit it as), which has the following advantages/disadvantages:
 - i. Flash videos are easily compressed
 1. this means they take up less space on youtube's server and can be transferred more quickly
 2. videos are made up of many pictures that when played one after another look like a movie. Because so many pictures must go into making the movie, video files are often very large. But flash chooses certain images in the movie and calls them "keyframes" which it stores all the information about. But then for images that are in between the keyframes it only stores information about the parts of the picture that from the keyframe.
 3. For more info on video compressing:
http://en.wikipedia.org/wiki/Video_compression
 - ii. Flash videos use what is called an applet to play. Applets can be put into a website, this way you don't have to open a separate video player and can just watch the video on the site.

- iii. You need a special plug-in called Macromedia Flash Player. Users who don't have it must install it, even though this is free it might be a hassle to some users.
 - b. Youtube uses what is called Streaming video to send videos to people's computer
 - i. Streaming means that a user can watch the video as it is downloaded to their computer rather than having to wait until the video has been completely downloaded. The video is buffered which means its downloaded temporarily to the user's computer before they watch it. If the video doesn't buffer enough you might have to pause so that the video isn't choppy.
 - ii. Youtube was one of the first sites to use streaming video, it gave them an advantage over other sites because there is no wait to watch their videos
 - iii. Note – the light red bar shows how much of the video has been downloaded.
 - c. More info: <http://money.howstuffworks.com/youtube.htm>
- ii. Hulu
 - 1. Compared to youtube, Hulu has a much smaller web 2.0 element (users can post comments and rate videos but are incapable of uploading actual videos)
 - 2. Hulu cost approximately \$15 million to develop
 - 3. Has video from over 150 providers including many major networks and has more than 1,000 primetime shows
 - 4. Hulu also uses flash video
 - 5. For copyright reasons, a lot of content is "geo-blocked" which means that only users in the US can view it
 - 6. For more info about hulu:
 - <http://money.cnn.com/2008/03/05/technology/hulu.fortune/index.htm> ,
 - <http://bits.blogs.nytimes.com/2007/10/29/making-sense-of-hulu/>
- iii. Hulu vs Youtube:
 - 1. Which do you use more and why? What things are better about hulu than youtube and vice versa?
 - 2. Hulu is catching up to youtube in terms of profit. Do you think hulu will take the place of youtube or do they serve different enough purposes that they can coexist?
 - 3. Article about hulu catching up to youtube:
 - <http://www.wired.com/epicenter/2008/11/hulu-is-catchin/>
- iv. Battle between cable and online tv
 - 1. Cable providers are not happy with the fact that tv shows are available for free on hulu. Cable providers have leverage over the networks that run hulu because the networks need the cable companies to show their shows.

2. Cable companies are pushing for hulu to charge money for their service. Do you think that this will help cable companies or will more people turn to illegally downloading shows on torrent sites or watching the illegally posted streaming videos that surfthechannel.com provides links to?
 3. Articles about this: <http://www.wired.com/epicenter/2009/05/hulu-victim-success/>
6. Final discussion:
- a. What are the benefits of increased use of the internet and other advanced computer technology?
 - b. What are some of the downsides of increased use of computers?
 - c. Do you think increasing use of communication in writing (ex email, facebook, text messaging) rather than speaking is having a positive or negative affect on the way people communicate? (interesting article about narcissism and facebook profiles: <http://www.scientificamerican.com/blog/post.cfm?id=am-i-a-narcissist-ask-facebook--or-2008-09-26>)
 - d. Here are some funny facebook and other web site parody videos you can show that emphasize how shallow internet communication can be:
 - i. <http://www.youtube.com/watch?v=lvpuT3aoypE>
 - ii. <http://www.youtube.com/watch?v=yu4zMvE6FH4>
 - iii. <http://www.youtube.com/watch?v=nrISkUOTFLs>
 - iv. <http://www.youtube.com/watch?v=rSnXE2791yg&NR=1>
 - v. <http://www.youtube.com/watch?v=iROYzrm5SBM>
 - vi. <http://www.youtube.com/watch?v=rBOFD2JBv0w>
 - e. What do you think the future of the internet is going to be like?

Other interesting internet related articles you might want to share facts from:

<http://www.wired.com/wiredscience/2009/08/facebookclimate/>
<http://www.wired.com/wiredscience/2008/03/the-internet-is/>
<http://www.scientificamerican.com/blog/post.cfm?id=journalists--facebook--scoops-2008-07-21>
<http://www.wired.com/wiredscience/2009/05/food-web-meet-interweb/>
<http://www.wired.com/wiredscience/2009/04/braintweet/>
<http://www.wired.com/dangerroom/2009/08/marines-ban-twitter-myspace-facebook/>
<http://www.scientificamerican.com/blog/post.cfm?id=debate-over-who-owns-your-facebook-2009-02-17>