Introduction
Introduction to the introduction

CSCI E 45a: The Cyber World – part A

Welcome to
CSCI E 45a: The Cyber World – part A

The cyber-world @ Harvard Extension

- This is one of a pair of courses we teach
- Each course stands alone
- They can be taken in either order

Not just security!

E45a focuses on the foundational building blocks: hardware, software, networks, security fundamentals, and history

E45b focuses on the real world: privacy, trust, surveillance, threats, conflict, commerce, etc.

The cyber-world @ Harvard Extension

- These two courses are on the optional list for the Harvard Extension Cybersecurity Certificate
  - With these two courses, you are half-way to the certificate.
  - To complete the certificate you need two courses from the list of required courses taken within three years, scoring B or better

Learning goals

- This module is for you to:
  - Get to know us, the instructors
  - Understand what this course is about
  - Understand what our goals are for teaching this course
  - Understand the logistics, and practical aspects of taking this course
  - Get an overview of the content of the course

Topics

- Scott - O
  - A brief introduction to Scott
- Ben - O
  - A brief introduction to Ben
- Course logistics - R
  - All the practical details you should know about this course
- Exams - R
  - Details on the exams
- Course content - R
  - An overview of the content we will cover in the course

Topics, contd.

- Cyber world actors - R

  Highlights on some of the most important participants in the cyber world

- The realities of the cyber world - R

  Some interesting observations on the realities of the cyber world and its interaction with the "real" world

Topics, contd.

- CSCI e45b recap - O

  A run through all the modules of e45b, for those who were and were not there

Image credits

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4	Cartoon of Scott from the Boston Globe
4	Cartoon version of Ben from madmenyourself.com
4	DCE shield
5	http://sweetclipart.com/theater-masks-silhouette-908
5	https://www.pinterest.com/pin/145100419217897323/

Introduction

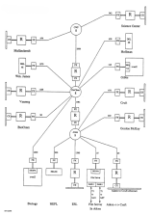
Scott Bradner

CSCI E 45: The Cyber World

Scott Bradner

- Retired in late 2016 from Harvard Office of the University CTO
- Senior Technical Consultant
- ~25 in Harvard central IT
- ~25 years at Harvard Psychology Department
- Created and managed Network Device Test Lab

Scott Bradner, networking



- Installed Harvard's first inter-building data network
- Harvard's initial ARPANET & NSFNet technical contact
- Co-founded NEARnet
  - New England Regional Data NETwork
  - Chair of NEARnet technical committee

Scott Bradner, IETF

- Involved in IETF between 1989 and 2016
- Started attending in 1990
- Co-director of multiple areas
  - Operational Requirements
  - IP Next Generation
  - Transport
  - Sub-IP
- On IESG for 10 years
- Authored 43 RFCs
- Chaired 7 working groups

Scott Bradner, teaching

- Senior preceptor – Computers in Psychology for ~8 years
- Instructor – Networld+Interop & private classes
- Instructor – Harvard Extension school since 1995
  - Petra T. Shattuck Excellence in Teaching Award

Scott Bradner, other

- Consultant, expert witness in Communications Decency Act, Wikimedia v NSA, and patent cases
- Harvard's ARPANET & NSFNET technical contacts
- Active as part of the "first wave" of the Internet

  Got my first email address in about 1972

sob@harv10
sob@harvard.edu
*!genrad!wjh12!sob

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2	Boston Globe
4	IETF logo - https://www.ietf.org/logo/
5	Harvard Shield
	Networld + Interop logo
	Harvard extension school logo
6	supreme court logo
	ARPANET MAP

Introduction

Ben Gaucherin

CSCI E 45: The Cyber World

Ben

- CIO for Harvard Campus Services
- Formerly
  - Deputy CIO for Harvard University
  - CIO & CTO for Harvard Law School
- Participate in other people's courses
  - CS50 Hack-a-thon and seminars
  - IGA 236M Technology, Security, and Conflict in the Cyber Age, etc.

Ben, contd.

Sapient

- Many years with Sapient Corp.
  - CTO for the last 6 years
  - Involved in many major business transformations
  - Across many industries: federal government, energy services, financial services, casino, retail, telecommunication, etc.
  - Building lots of large/complex systems, leveraging a wide variety of technologies

Ben, contd.

- Senior advisor to technology companies, and consultant/expert witness on large global technology litigation cases
- And a few other things:
  HR software product, French Air Force, nuclear research center, Ad agency, coal mines, etc.

Ben, contd.

- Academics:
  "Maîtrise" in Computer Science and Mathematics, "Brevet de Technicien Supérieur" (BTS) in Electrical Engineering
- Early form of "digital native"*
- Active in the "second wave" of the Internet

* *Digital Natives, Digital Immigrants* - Mark Prensky - 2001

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3	Sapient logo
4	HayGroup, Trolex ltd., GANIL, and French Air Force logos
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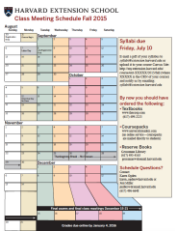
5	"Minitel1980" by Jef Poskanzer Uploader: Joho345 - Flickr http://www.flickr.com/photos/jef/320700986/. Licensed under GFDL via Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Minitel1980.jpg#/media/File:Minitel1980.jpg

Introduction

Course logistics

CSCI E 45a: The Cyber World – part A

Course structure



- Runs over 14 weeks
- One or more modules posted per week (on Sunday mornings)
  - No posting during vacation
- The modules were taped between 2015 and 2016
- But the world changes continuously, so we post updates when necessary

Course structure, contd.

- Each module includes multiple topics
- Most topics are "required"
  - i.e. they are included in the exams
- Some are optional

Teaching Assistants (TAs)

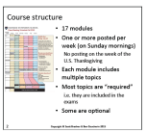
- We have a number of Teaching Assistants who …
  - Are here to help you and answer questions you might have about the course
  - Help prepare and grade the exams
  - See the list of TAs on the course website

Contacting us

- We have a teaching staff email list that includes both instructors and the TAs e45a@sobco.com to be used for:
  - Any question about the course
  - Requests for grading reconsideration
  - Letting us know of interesting world events relating to the course

ALWAYS USE THIS ADDRESS – DO NOT use Canvas to communicate with us

Slides & handouts



- Slides comprise talking points
- Not sufficient by themselves
- Illustrations on the slides attempt to be relevant but are for visual effect not content
- PDF of the handouts posted along with videos
  - For use only with the class, please do not reproduce for other uses – **school rules!!**

Reading


Dr. Betsy Sparrowr


Jenny Liu


Daniel Wegner

- Lots (and lots) of reading
- By design, lots of reading - comes with the territory
- We do not expect you to actually read every word
- We want you to learn how to "read smart"
- Get the gist of the reference and understand where to find the information later

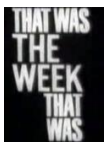
7

Check Your Understanding quizzes

- Short quizzes in some modules
- Meant to help you validate that you understand the material in the module
- Optional
- Do not factor in the course grade

8

Discussions



- Click on Discussion to find discussion topics
  - Module discussions
  - "News you can use" discussions
  - Other topic discussions
- Your participation is not monitored or graded but you may find it useful

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Other things you should know…

Chaucer – Canterbury Tales

- English
  - All readings are in English
- How to use the Internet
  - All readings are on-line
- The basic structure of the U.S. legal system
  - Unless stated otherwise, exam questions are to be viewed in the U.S. legal context

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News You Can Use (NYCU)

- Each week will include "News You Can Use"
- We will report on news items involving Internet technology, security, policy issues or developments to tie the course to current events
- We expect you to follow-up and find out more about these issues

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News You Can Use (NYCU), contd.

- News topics not included in the handouts
- Separate list of article titles posted in an on-line Discussion
  - URLs not posted because we want you to look around at other coverage
- The news topics are part of the course and therefore will be part of the exams
- Please send interesting ones to the teaching staff email list

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News you can use – Follow Bruce!

- https://www.schneier.com/
- Special case
  - Publishes relevant material regular basis
- Some of his postings will be on the exams
  - Postings from the first day of the semester through the opening of the last exam are in-scope for exams. Questions will be on Bruce's own words in his blog, not articles he links to (including his own articles)

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2-3	Harvard Extension School calendar
4	http://www.keepcalm-o-matic.co.uk/p/keep-calm-i-m-a-teaching-assistant/
5	Bradner: Boston Globe
	Gaucjerin: from madmenyourself.com
7	Sparrow: http://www.yalescientific.org/2013/05/is-google-ruining-your-memory-the-science-of-memory-in-the-digital-age/
	Liu: https://ca.linkedin.com/in/liujenny23
	Wegner: http://www.psychologicalscience.org/index.php/members/awards-and-honors/fellow-award/recipent-past-award-winners/wegner
8	http://fcpspart1dentistry.com/quiz-of-dental-materials-1/
9	https://www.youtube.com/watch?v=6NtmGlvHbqA

Introduction
Exams

CSCI E 45a: The Cyber World – part A

Exams and grading

Open 9AM to 9AM a week later

- 4 exams
  - Take on-line at-home, open book/Internet
    - 25 questions each, 4 points max per question
  - Exams are **cumulative**
  - Exams open at 9 AM on a Wednesday and close at 9 AM the following Wednesday
  - You must complete the exam within 5 days of opening it or by the end of the window whichever comes first
  - Verify that you will have time to do the exams or please drop the course

Exams and grading, contd.

- Read exam questions carefully as some of them ~~may~~ will be misleading
- By "misleading" we mean "carefully worded"
  - e.g., might ask *how does x do y* when x does not do y
- The course topics involve precision
  - You need to know just what problem you are trying to solve and be able to say clearly what the solution is

Exams and grading, contd.

- The real world does not present clear questions, neither do we
- We use the exams to see if you understand & can explain the material
- Answer the exam questions as you would answer technical questions from your boss
  - Clear and to the point

Exams and grading, contd.

- Hints
  - If the question includes "true or false?" your answer needs to have the word "true" or the word "false" in it for full credit
  - If the answer to the question is "ICMP" then "ICMP" or "Internet Control Message Protocol" must be in your answer.
  - If the question has two parts, so must your answer
  - Think about why we asked the question – what did we want to know?

Exams and grading, contd.

- Extraneous information
  - Unless the question asked you to explain ICMP, any explanation of ICMP will be "extraneous information"
    - One student provided a 320 word answer where "ICMP" was enough
  - Extraneous information makes it hard to tell if you know what you are talking about
  - One point will be taken off for any extraneous information
    - E.g., how TCP works, how the IETF makes standards, vulnerabilities in a protocol … unless the question asks for it

Exams and grading, contd.

- i.e., answer the **actual question that was asked and only answer that question**
  - Most questions can be answered in less than a dozen words – many in one or two words
- Goldilocks principle applies to your answers - **your answers should be as short as they can be without missing any key points**
- By the way, there is no need to repeat the question in the answer

Exams and grading, contd.

- The answers to all questions can be found in the lectures or reading (including NYCU)
  - Google (or Bing) does not rule
- essay question concurrent with the last exam
  - essay optional for undergraduates
  - essay mandatory for graduates
  - grade: 0-5 points

course grade
undergraduates = ((e1 + e2 + e3 + e4)/4) + essay
graduates = (((e1 + e2 + e3 + e4)/4) *.95) + essay

Grade Mapping

A:	93-100
A-:	90-92
B+:	87-89
B:	83-86
B-:	80-82
C+:	77-79
C:	73-76
C-:	70-72
D+:	67-69
D:	63-66
D-:	60-62
E:	0-59

- scores are mapped into grades only at the end of the semester, and then only after any optional essay score is added as well as any possible curve
- fractional values rounded up
  - 92.4999 = 92
  - 92.5 = 93

Exams and grading, contd.

- Give **proper attribution** to any supporting citations
- Answers have to be in **your own words**
- Be smart!
  Individual not collaborative effort
- We are **required** to report potential plagiarism & collaboration to DCE

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Use Your Own Words!

Use your own words!

(If more than ~5 words)
Do not just cut & paste
We want to know if you understand

9A

Sample question #1

- Pirate Jill, who lives in the U.S., likes to download movies from her favorite torrent site. Due to lawsuits, the site will no longer service any host with a US IP address. Without moving out of the country, how can Jill continue to access this site?
- Use a VPN with server located outside the US
- Use a proxy located outside the US

10

Sample question #2

- Does a TCP acknowledgment guarantee that data has been received by the end user? Briefly explain.
- No, only that the receiving node's TCP stack has assumed the responsibility to deliver it.

The making of exam questions

- Try to test understanding of concepts
- Try to test thinking not just fact recall (but some fact recall)
- Answer not Googleable
- Test ability to see details (e.g., in the question itself)

  Note – if you have a hard time breaking a problem into logical parts you will not do well in this field

PS

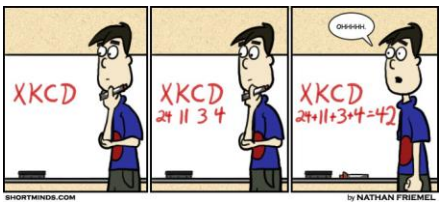

Image credits

Slide#	credit
2	http://firearmsafetycanada.com/?page_id=12
3	http://ecatalog.mitutoyo.com/Micrometers-C1066.aspx
4	http://4suitcases.com/2010/05/what-exactly-is-the-real-world/
5	https://www.youtube.com/watch?v=-5Jy0mn2M4c
5A	https://worldartsme.com
6	http://slideplayer.com/slide/10716853/ slide 5
7	https://cottagedoorpress.com/products/goldilocks-and-the-three-bears-board-book
8	http://humancapitalist.com/is-open-book-management-a-good-fit-for-your-company/
9	https://www.pantone.com/pci/minion-yellow?from=hp
10	https://geology.com/world/world-map.shtml
11	http://clipart-library.com/man-computer-cliparts.html
12	http://www.principalspage.com/theblog/archives/you-need-more-than-the-ability-to-take-tests
13	https://knowyourmeme.com/photos/313299-the-answer-to-life-the-universe-and-everything

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Introduction
Course content

CSCI E 45a: The Cyber World – part A

Course origins

- Initially two courses taught by Scott:
  - E132 – Advanced topics in Data Networking Protocols and Network Architectures
  - E170 – Security, Privacy and Usability
- Scope now entire "cyber world"
- Updating old content and adding new content
  - Hardware, Software

Who is this course for?

- Attempting to address a growing need/demand
  - No longer sufficient to be a "good computer user"
- Targeted at geeks, lawyers and other curious minds
- People who want to understand:
  - The technologies involved
  - Important ideas and concepts behind the technologies
  - Laws, policies, information security, etc.

What this course is about

- Understanding of how the technical and policy elements of the cyber world work
- Promote critical thinking
- Promote multi-faceted views/approaches
- Learn from failure

"There is no success like failure, and failure is no success at all"
Bob Dylan: *Love Minus Zero/No Limit*

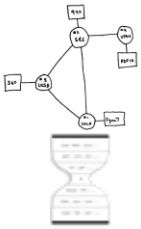
4

What this course is NOT

- A detailed technology practitioner's course
  - You don't need to be an engineer
  - And it's definitely fine if you are one
  - And it's okay if you don't want to become one
- In-depth in any one area – you won't become a topic expert from this course

5

Overview of the modules



- Digital technology and computing devices
  - From bits to bytes, and how a generic computing device works
- History of the Internet and concepts
  - Key ideas and people that led us to the Internet of today
- Internet protocols
  - IP, TPC, UDP, etc. the "dial tone" of the Internet

6

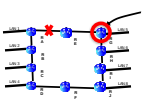
Overview of the modules, contd.



- Software – simple software
  - Making, running, and abusing software
- Network technologies
  - Layer 2 & 3 technologies, SDN, MPLS, etc.
- Designing and building the infrastructure
  - From the network jack to the large scale ISP

Overview of the modules, contd.





- Software – distributed systems
  - Composing simple software into bigger systems
- Middleware
  - The essential, and (sometimes) transparent things in the network that make it work
- Routing
  - How do packets get from one end of the globe to the other, or to the computer down the hall

Overview of the modules, contd.


- The cloud
  - Beyond the hype, what is it and how to think about it
- Managing the infrastructure
  - When you are in charge of a large infrastructure, how do you manage it?
- Security fundamentals
  - From Confidentiality, Integrity, Availability to encryption, and digital trust systems

Overview of the modules, contd.

- Security tools
  A walkthrough the landscape of security tools
- Internet regulation & governance
  From the regulation of telephone networks, to the current messy landscape of Internet governance
- Technology standards
  How do technology standards get developed, contrast and compare between ITU and IETF

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3	channel4.com
4	www.musee-rodin.fr
5	https://ia802505.us.archive.org/zipview.php?zip=/33/items/olcovers6/olcovers6-L.zip&file=61922-L.jpg

Introduction
Cyber world actors

CSCI E 45a: The Cyber World – part A

Individuals

- You as an individual
  - As a person
  - Independently from any organization affiliation
- Other individuals (activists)
  - Disclosers/Whistleblowers
  - Hackers (white and black hat)
  - Crooks
  - Idealists

Governments

- National security
- Law enforcement
- National infrastructures
- Social order
- Technology governance
- International issues
  - espionage, cyber conflict

- Provide services to citizens
- Collect large volumes of data

Internet Service Providers (ISPs)

- Providers of Internet connectivity
- Some publically traded, some privately owned
- Increasingly concentrated
- Primary focus is on revenue and profit

4

ISPs, contd.

- Are increasingly The communications infrastructure
- Often a relationship of convenience with governments

5

Technology providers

Google

Microsoft

- Hardware, Software, etc.
- Primary focus is on revenue and profit
- Often a relationship of convenience with governments
- What's really in the box?
  Un-documented "bits" and "hooks"

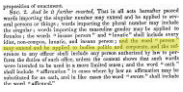
6

Other businesses, commercial entities

amazon.com

- Users of the Internet
- "Stuff" sellers, content sellers/providers, advertisers
- Primary focus is on revenue and profit
- Often a relationship of convenience with governments
  - e.g., data to NSA from Microsoft, Google, …
- Collect a lot of data about everyone "who comes in contact"

Natural Persons vs. Artificial Persons



1871 version

- Corporations are often treated as people in US law
  - *In determining the meaning of any Act of Congress, unless the context indicates otherwise …*
  - *the words "person" and "whoever" include corporations, companies, associations, firms, partnerships, societies, and joint stock companies, as well as individuals*
  - US Code, Title 1, Chapter 1, Section 1

Corporations as Persons

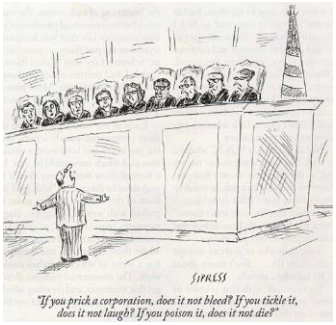
DARTMOUTH
VOX CLAMANTIS IN DESERTO
1769

CITIZENS UNITED

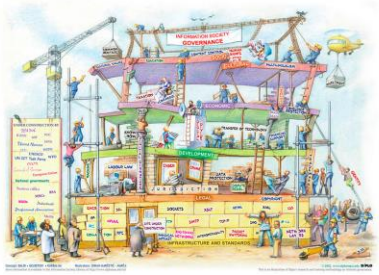
HOBBY LOBBY

- 1st case: corporations can enter into contracts
  - Dartmouth College v. Woodward 1918
- More recent cases: corporations have first amendment rights
  - Citizens United v. Federal Election Commission 2010
  - Burwell v. Hobby Lobby 2014

Corporations as Persons



Information society governance



Non Government Organizations (NGOs)

- Internet Corporation for Assigned Names and Numbers (ICANN)
- Internet Governance Forum (IGF)
- Internet Society (ISOC)
- Number Resource Organization & Regional Internet Registries (RIRs)

Regulators

- U.S.
  - Federal Communications Commission (FCC)
  - Individual states' Public Utility Commissions (PUCs)

- France
  - Autorite de Regulation des Communications Electroniques et des Postes (ARCEP)

- International
  - International Telecommunications Union (ITU/UN)
  - World Intellectual Property Organization (WIPO)

Standards Development Organizations

- International Telecommunications Union (ITU)

- Internet Engineering Task Force (IETF)

- European Telecommunications Standards Institute (ETSI)

- Worldwide Web Consortium (W3C)

- International Organization for Standardization (ISO)

SDOs, contd.

- American National Standards Institute (ANSI)

- Institute of Electrical and Electronics Engineers (IEEE)

Notable non-profit

- Electronic Frontier Foundation (EFF)
- Center for Democracy and Technology (CDT)
- The Heritage Foundation
- European Digital Rights (EDRI)
- Association Electronique Libre (AEL)
- Bits of Freedom (BoF)

... and many more

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2	blackhat logo
	E Snowden photo
3	logos - http://en.wikipedia.org/wiki/File:US_Intelligence_Community_members.gif
4	isps - http://www.redcondor.com/solutions/success-stories.htm
5	isps http://www.redcondor.com/solutions/success-stories.htm
6	internet in a box - http://encosia.com/6953-reasons-why-i-still-let-google-host-jquery-for-me/
	apple logo
	google logo
	microsoft logo
7	amazon logo

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9	Dartmouth shield
	Citizens United logo
	Hobby Lobby logo
10	The New Yorker Mar. 14, 2011
11	http://www.diplomacy.edu
12	ICANN logo
	IGF logo
	Internet Society logo
	NRO logo

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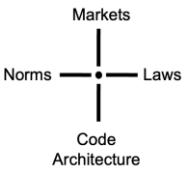
Introduction

The realities of the cyber world

CSCI E 45a: The Cyber World – part A

1

The Lessig model



- The laws of cyberspace
  - Essay written by Larry Lessig
  - Aimed at debunking early days hype about cyberspace
    - *"[cyberspace] has the potential to be the antithesis of a space of freedom."* (1998)
  - Points out the four forces regulating behavior in cyberspace
  - Contrasts real world regulations to regulations in cyberspace

2

Impacts and responses

- Let's look at a collection of factoids to understand
  - The dynamic of things in the cyber world
  - Interactions with the "real" world
  - Society
  - Business
  - Etc.

3

States


Moxie Marlinspike

- Difference between totalitarian regime and social democracy—harder to figure out
- The "nanny state"
  - Protecting you from all the bad things you could be exposed to
- The "security state"
  - Protecting the state from you

4

Freedom and oppression

- Hacktivists
  - Egotistical view of what is important
- The Internet, for freedom and oppression
  - Effective tool for dissenters
  - Effective tool for governments to track "trouble makers"

5

The business of data and information

- Ever larger commercial entities:
  - Running large portions of global infrastructures
  - Amassing large amounts of information on everyone
  - Benefiting from cyber-espionage
    - Governmental and private

6

Business challenges & emerging responses

- Difficulty in mapping real world constructs to the cyber world: legal jurisdiction, taxation, trademarks, etc.
- Virtual currencies threatening old economies
- Development of "darknets" and the crime "service sector"

7

Law Enforcement/Counter-terrorism

- Abilities they never had before
- Total information awareness
  - Traditional government view: the more information you have the safer you are
- Worried about the bad guys "going dark"
  - Crypto-wars still going strong
- Ability to bypass national legal frameworks through multi-national agreements

8

Regulatory power plays

- Nations still think in nationalistic terms
  - Regulations to protect the nation state
  - International covert collaboration rising
- Myopic industry groups
  - One's industry should dictate/constrain priority and fundamental architecture elements of the Internet

9

Underlying tussles

- "Bell Heads" vs. "Net Heads"
- Net neutrality
- Social norms and culture clashes
- Cyber conflicts
- Data accessibility v. privacy

10

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11

Introduction

E45b review

CSCI E 45a: The Cyber World – part A

What you should remember from the second semester, even if you haven't been there yet

This is an overview of the terminology and concepts covered in the second semester – this material will not be included in the exams except where explicitly covered in this semester

E45b Review: Internet governance

Internet governance

- Many issues influence Internet governance
- Jurisdictional disconnect
  - Network and legal boundaries different
- Trademark global rather than local
- Copyright holders trying to figure out a profit mechanism

E45b Review: Internet governance

- State security
  - Protect the government from disruption
- Cyber attackers
- Support for emergency use
- ISP business model
  - Do they need a piece of the action?
- Privacy
  - From governments, from companies
- Technology constraints on lawmakers

E45b Review: Internet governance

- Morality
  - Governments know what is good for you (better than you do)
- Players
  - Regulators, cops, SDOs
- Legal concepts
  - Openists v Deregulationists
  - Network neutrality
- Some US laws
- International pressure

regulation of the Internet is a "moral imperative"

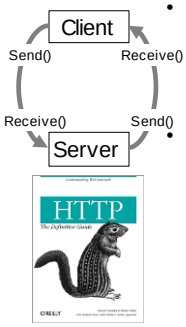
E45b Review: Internet application protocols


DIALOGO
DI
GALILEO GALILEI LINCEO
MATEMATICO SOPRAORDINARIO
DELLO STVDIO DI PISA.
E Filosofo, e Matematico primario del
SERENISSIMO
GR. DVCA DI TOSCANA.
Doue ne i congressi di quattro giornate si discorre
sopra i due
MASSIMI SISTEMI DEL MONDO
TOLEMAICO, & COPERNICANO,
Proponendo indeterminatamente le ragioni Filosofiche, e Naturali
tanto per l'vna, quanto per l'altra parte.
CON PRI VILEGI.
IN FIORENZA, Per Gio: Batista Landini MDCXXXII.
CON LICENZA DE' SVPERIORI.

Internet application protocols

- Internet applications listen on a network port and expect a specific protocol
- Protocol:
  - Structures, and sequence of network messages required to implement an application
  - Methods, Header fields, and Error codes
  - Most IETF protocols plain text

E45b Review: Internet application protocols



- Client/server
  - Client – the machine/software from which requests originate
  - Server – the machine/software fulfilling the request
  - System can be both
- Examples:
  - Finger – get status of users on another system
  - SMTP – email exchange
  - HTTP – web data transfer
    - Can use "cookie" for state information
  - SIP – Voice over IP
  - SSH – remote login & tunneling

E45b Review: Identity and authentication

123-45-6789

Identity and authentication

- An identity
  - Uniquely specify an individual person - e.g., SSN
- Authentication
  - Bind a physical person to an identity
  - Done with an authenticator
    - Know – e.g. password, SSN
      - Lots of problems
    - Have – ID card, smartphone
    - Are – fingerprint
    - Can do - signature

E45b Review: Trust and privacy

Trust and privacy

- Trust:
  - Belief in the predictability of behaviors and outcomes within a given scope of activity
- Trust and the Internet:
  - Essential for people to do things online
  - Internet magnifies real world's abuses of trust
  - Many point solutions to trust on the Internet
  - But, no general solution to trust on the Internet

E45b Review: Trust and privacy


Samuel Warren


Louis Brandeis


Justice William O Douglas

constitutional right to privacy under threat

- Privacy:
  - The ability to keep your personal information from being known by others
  - Not same as anonymity
- Limited right to privacy read into U.S. Constitution
  - Privacy not explicitly mentioned in the constitution – penumbra right
  - "zone of privacy" in areas of making decisions and keeping personal matters confidential
- Katz v U.S. key case for privacy:
  - Privacy only where there is a "reasonable assumption"

10

E45b Review: Trust and privacy

- Different approaches
  - E.U. – principle-based related to use of data
  - U.S. – point solutions driven by events
- E.U. and California trend setters
- U.S. laws and privacy:
  - Freedom from disclosure
  - Laws requiring disclosure of private information
  - Freedom from nuisance

11

E45b Review: Security threats

Security threats I

- Malware: software that does things the user does not expect
  - *Includes worms, viruses, spyware, Trojan horses, adware, and other software that installs programs without user knowledge* www.stopbadware.org
- Functions
  - Propagate virus
  - Adware
  - Ransomware
  - Backdoor/RAT
  - Spyware

12

E45b Review: Security threats

- Mechanisms:
  - Worm - Autonomous propagation technical attack
  - Virus - Requires user action to propagate – social attack
  - Trojan – malware hidden in legit program
- Other threats
  - Network monitoring
  - Man in the Middle
  - DoS, DDoS
  - Buggy software

13

E45b Review: Security threats

Security threats II

- Attacks on websites
  - Defacement
  - Data stealing, causing actions
    - SQL injection, cross-site scripting
  - Browsers are attack facilitators
    - E.g., Flash Player

- Social engineering
  - Hacking wetware (people)
    - Crimes of persuasion
  - Can not be stopped by technology alone

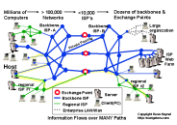
14

E45b Review: Security threats

- Facilitators
  - People do not fully appreciate the importance of security controls and their role in following them
- General types:
  - People acting "normal"
    - Normal for the situation
    - Are often not verified
  - Believable communications
    - Correspondence that "looks right"
    - E.g. phishing
- Hard to protect against
  - Paranoia useful, as are clear policies & management support

15

E45b Review: Protecting the infrastructure



Protecting the infrastructure

- Threats via the Internet
  - Espionage, theft, disruption & extortion
  - Generally, protection is end site responsibility
  - Ad-hoc approach, few regulations
- Threats to the Internet
  - Attack core services (e.g. DNS & routing) or devices (e.g., routers)
  - Physical layer generally redundant and resilient
    - Fibers, etc.
  - Ad-hoc approach, few regulations
    - Blocked by politics

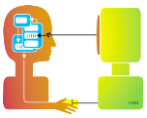
E45b Review: Protecting the infrastructure

YouTube

SIDR

- DoS & DDoS
  - Overload link or service
  - DNS servers can be protected against DoS with anycast
- Protecting routing
  - For misrouting, technology available, little deployment
    - Only protects against some threats
- Protecting against DNS corruption
  - Technology available, some deployment

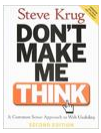
E45b Review: Usability accessibility



Usability accessibility

- Human Computer Interaction
  - Study of interaction between people and computers
- Not just about pretty colors and fonts
- "user friendly" is context dependent
- Overall process
  - Discover, Design, Evaluate
- Complex process
  - User's mental model of tasks, cultural norms, function over form, etc.

E45b Review: Usability accessibility



- Different ways to discover
  - Focus groups - asking users/customers what they want
  - Ethnography – observing people performing the work/task
  - Let users hack the product
  - Or rely on superior design beings
- Usability principles
  - Don't frustrate the user
  - Learnability, Flexibility, Robustness
- The human body is a "human processor", with an interface with its own limitation

E45b Review: Usability accessibility

- Security often in conflict with usability
- Accessibility:
  - Need to make cyber accessible to all
  - As it pertains to the American with Disability Act (ADA), web sites considered places of public accommodation
  - W3C's Web Accessibility Content Guidelines (WCAG) 2.0 is the prevalent standard for accessibility

E45b Review: Cyber conflict

Cyber conflict

- War: A contention by force; or the art of paralyzing the forces of an enemy to achieve strategic objectives
- Laws of war:
  - jus ad bellum – "justice to war"
  - jus in bello – "justice in war"
  - In the U.S.
    - DoD directive 5100.77, USC Title 10, USC Title 50
- Sherman's "scorched earth" policy
  - Paralyze the enemy by destroying their infrastructure

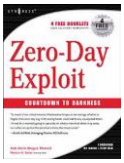
E45b Review: Cyber conflict

- Traditional doctrine, concepts of conflict/war do not map well to cyber
  - Internet mostly ignores national borders
  - Attribution near impossible
  - Arms control near impossible
  - Conflict management made difficult
- Cyber weapons can kill or incapacitate
  - Industrial Control Systems, life safety control systems, AI controlled weapons systems

E45b Review: Cyber conflict

- Actors:
  - Governments, businesses, crime, individuals
- Different activities:
  - Cyber crime
  - Hacktivism
  - Cyber exploitation
  - Cyber attacks
- Multiple cyber conflicts
  - But is cyberwar war?

E45b Review: Cyber conflict




Ryan Ellis

- Zero days:
  - Unpatched exploit
  - Product of humans writing software
- Market for zero days
  - Unregulated, black market, like drug deals
- Disclosure models
  - Limited: disclose to vendor
  - Full: disclose to force a patch
  - Coordinated: tell vendor first
  - No disclosure: sell vulnerability

E45b Review: Commerce DRM

Commerce DRM

- E-commerce
  - B2B half or more of total
  - B2C: small but growing segment
- Payment systems for B2C
  - Card-based: credit & debit cards
    - Card present mode
      - Token (card) based authentication
    - Card not present mode
      - Knowledge based authentication
    - Employ anti-fraud techniques
  - Non-card systems
    - Apple, Android & Samsung pay
      - Tokenized – merchant does not get card number - safer

E45b Review: Commerce DRM

© May 21, 1928

- Copyright
  - Author/creator can control use "for a limited time"
  - Many special case in laws
    - E.g. first sale, fair use
- All works automatically copyrighted when created
- Length of protection varies between countries
  - U.S. life of author + 70 years
- Digital world has made copyright much harder
  - E.g., copies are perfect

E45b Review: Commerce DRM

- DMCA
  - Digital Millennium Copyright Act
  - U.S law concerning copyright
  - Blocks circumvention of copyright protection systems
    - With some exceptions
  - Requires service providers to respond to take down notices
- DRM
  - Digital Rights Management
  - Copyright protection systems
    - Limit user's use of copyright materials
  - Many problems
  - Some systems really dumb

E45b Review: InfoSec management mindset

Information Security Management and mindset

- Information security strategy
  - Where we are going
  - Why we are going there
  - How to get there
- Data classification
  - Part of risk assessment

- Policies
  - Rules to guide decisions and actions
  - Laws: government policies

E45b Review: InfoSec management mindset

- Policies come from
  - Explicit policy development process
  - Dealing with the un-expected
  - Implied policies
  - Externally imposed
    - Laws, regulations & contracts
- Good policies
  - Goldilocks principle – just right
  - MUST, MUST NOT, SHOULD, and SHOULD NOT
  - Few exceptions
  - Not technology specific
  - Clear, practical & actionable
  - Periodic & after incident reviews

E45b Review: InfoSec management mindset

- Information security program
  - Owned and led by CEO, managed by CISO
  - Includes:
    - Governance & compliance
    - Standard operating procedures
    - Designated security staff
    - Communication & awareness program
    - On-going assessment process
    - Implementation of controls
  - Get users to be part of program & be accountable

E45b Review: InfoSec management mindset

- Security mindset
  - *"Being security conscious means being a criminal, if only in one's head"*
  - Always thinking of ways to subvert the systems
  - Must understand risk
- Hackers
  - Creative engineering minds
  - Ability to un-learn, do away with assumptions
  - Appearances may be misleading

E45b Review: Surveillance

Surveillance counter-surveillance

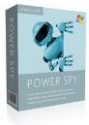
- Governments & private sector
  - NSA: dual mission
  - Google: to serve "better" ads
  - Employers: employees as chattel
- Surveillance much easier in digital world
- Legal limits being developed

E45b Review: Surveillance

- Multiple laws enabling and protecting from surveillance
  - CALEA, National Security Letters, U.S. Wiretap Act, Electronic Communications Privacy Act, …
- Techniques
  - Evesdropping & emmissions monitoring
    - TEMPEST emissions reduction
- NSA
  - Snowden revelations showed how extensive NSA surveillance was
  - Broad brush rather than targeted

Edward Snowden

E45b Review: Surveillance



- Non-government surveillance
  - Ad companies & ISPs to pay for a "free" Internet
    - Try to understand Internet users to feed them "better" ads
- Employers
  - No constitutional protection
    - Can spy on any activity
    - As long as it is not upon request of the government
- Pervasive surveillance changes society
  - By definition

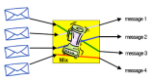
E45b Review: Surveillance

- Anonymity
  - Good and bad people need it
  - Protected for political discussions by U.S. Constitution
  - Outlawing anonymity would change things only for honest people
- Privacy protecting technology
  - Encryption – scramble content
  - Steganography – hide content
  - Device-based
    - Mixers, proxies, onion routing

E45b Review: Surveillance

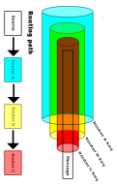
- Encryption
  - The most commonly used encryption good for government top secret communications
  - Encryption not weak point, key handling / end system security are
  - Encryption does not hide who is communicating & can show you have something to hide
  - IETF & others are pushing "Opportunistic encryption" – encrypt all the time so important stuff does not stand out

E45b Review: Surveillance



- Mixer
  - Decrypts/encrypts/permutes messages sent through it
  - Hides who is talking with who
- Proxies
  - Forward traffic through proxy
  - Encrypted connections to and from
  - Traffic looks like destination/source is the proxy
  - Can bypass firewalls

E45b Review: Surveillance



- Onion routing: secret communication
  - Pass messages through random set of relays using layers of encryption, each hop decrypts & forwards message
    - Inside: end-to-end
    - Next: end to last hop
    - Next: end to next to last hop
    - ...
    - Next: end to first hop
- Tor: The Onion Router
  - > 1K relays across Internet
  - Original funding: U.S. Navy

E45b Review: Safe computing

Safe computing

- For enterprises
  - Protecting key data assets, and technologies essential to business operations
  - Few useful standards that provide explicit, detailed guidance
  - PCI-DSS useful outside of credit card business
  - Standards are not a protection against stupidity, or an excuse not to think

E45b Review: Safe computing

- For individuals
  - Don't get phished (or more generally fooled)
    - Think before you act
  - Think about the future
    - Should you be posting this?
    - Should you be going to this sort of site?
  - Stay informed
    - Rules change.
    - What was ok yesterday may not be today

E45b Review: Safe computing

- For people, contd.
  - Practice good hygiene
    - Should you be plugging this in your computer? Should you be clicking on this?
  - It's 10:00 pm, do you know where your data is?
    - Be a good information steward: encrypt, erase securely when disposing of a computing device

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