

CSc 466/566

Computer Security

0 : Administrivia

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Department of Computer Science
University of Arizona

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Christian Collberg

Outline

- 1 Introduction
- 2 Course Outline
- 3 Materials
- 4 News Stories
- 5 Graduate Student Lectures
- 6 Assessment Scheme
- 7 Policies
- 8 \LaTeX and friends
- 9 Discussion

Contact Information

Class: 466/566 — Computer Security

Instructor: Christian Collberg

WWW: <http://www.cs.arizona.edu/~collberg/Teaching/466-566/2014>

Office: Gould-Simpson 758

Office Hours: Tuesday 09:00-09:50, or by appointment

Phone: 621-6612

Lectures: TTh 15:30-16:45, GS 701

Course Communication

Here are ways to communicate with me and the rest of the class:

Email: collberg@gmail.com.

Sign up for the class on: d2l.arizona.edu.

Teaching Assistants

TAs: Sabrina Nusrat

Email: sabrinanusrat@email.arizona.edu

Office: TBA

Office hours: TBA

Prerequisites

- You should be a proficient C programmer. Some knowledge of Java may also be necessary.
- You should have some background in an assembly language. It doesn't matter which one.
- You should have a functional understanding of Unix, i.e. shell commands, editing (`emacs`, `vi`), compiling (`gcc`), makefiles, etc.

Syllabus

You are responsible for reading
and understanding this syllabus.
If you have any concerns or issues
about the information in this document
you should bring them up during the
first week of class.

Exam-schedule

- Midterm:** The midterm exam is scheduled for Thu Oct 16.
This may change, so pay attention in class and check the web site.
- Final:** The final exam is scheduled for TBA.

Office hours

- Office hours: Tuesday 09:00-09:50, or by appointment
- I use an open door policy:



Collberg's Café

- Please come and see me to chat, ask questions, or snack:



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Course Description

Course Description

This is an introductory course covering the fundamentals of computer security. In particular, the course will cover basic concepts of computer security such as threat models and security policies, and will show how these concepts apply to specific areas such as communication security, software security, operating system security, network security, web security, and hardware-based security.

Course Objectives and Expected Learning Outcomes

Expected Learning Outcomes

At the end of the course you should be able to recognize potential threats to confidentiality, integrity, and availability, and have a basic understanding of the tools and techniques available to adversaries to violate the security of a system as well as the tools and techniques available to defend against such attacks.

Topics I

Communication security: cryptography and cryptographic protocols, including encryption, message authentication codes, hash functions, one-way functions, public-key cryptography, digital signatures, cryptographic protocols.

Software security: secure software engineering, defensive programming, control-flow hijacking attacks (buffer overflows, format string bugs, integer overflows, heap attacks), exploitation techniques (string analysis, fuzzing, bug finding), analysis of code for security errors, safe languages, sandboxing techniques, and tools for writing secure code.

Topics II

Operating system security: memory protection, access control, authorization, authenticating users (something you know, something you have, something you are, password cracking).

Network security: firewalls, port scanning attacks, intrusion detection systems, denial of service attack and defense, VPNs.

Malware: worms, spyware, rootkits, botnets, key-loggers, and defenses against them.

Web security: same-origin policy, cross-site scripting attacks, SQL injection attacks.

Hardware-based security: The trusted computing architecture and its applications.

Topics III

Intellectual property protection: digital rights management, copy protection, software tamper-resistance.

Advanced topics: privacy, mobile code, electronic voting, phishing, cybercrime, cyber-terrorism, financial security, spam, covert channels.

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Textbooks

- *Introduction to Computer Security*, by Goodrich and Tamassia.
- <http://www.securitybook.net>

Handouts & Other Material

- ① Various web resources.
- ② I always make copies of my transparencies available to students on the class website. Note that
 - I do this to relieve you of having to take notes during class,
 - they are not a substitute for reading the textbook,
 - their primary purpose is to remind you of what you need to study for the exam.
- ③ Various manuals and papers may be handed out during class.

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Undergraduate Student News Stories Presentations

- At the beginning of every class 1-2 students will present a security-related story they've found in the news.
- Each undergraduate student has to present one story during the course of the semester.
- I will pass around a signup sheet at the beginning of the semester.

Topics

- Ideally, you should find a story that you can relate to what we're talking about in class, but it's not absolutely necessary.
- Stories about computer security are preferred, of course, but stories about failed physical security are fine too (TSA security, nuclear power station security, military security, . . .).
- You don't necessarily have to talk about something technical — security is as much about politics as anything else.
- Try to find a topic that engages you, and is likely to engage the class.
- Register the story you're going to talk about on by sending an emails to the TA to make sure that no one else will talk about the same topic!

Structure of the Presentation

- Each presentation should be no longer than 5 minutes. I will cut you off mercilessly if you go over time.
- Since you only have 5 minutes, it's important that you think through what you are going to say, and plan out your presentation in some detail.
- Try to engage the class by asking them questions during the presentation.

Presentation Slides

- Put together a few slides to help structure the presentation:

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 - ➌ 1-3 slides with the meat of the presentation;
 - ➍ a slide discussing/summarizing the story, asking a few poignant questions.

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- To make sure we're not wasting any time, please put your slides on the web so that we can quickly fire them up at the beginning of class.

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- To make sure we're not wasting any time, please put your slides on the web so that we can quickly fire them up at the beginning of class.
- Also email the slides to the TA.

Assessment

You will be assessed on

- 1 the relevance of your story to the class;

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- ⑤ the quality of your slides (use of illustrations, language, structure, etc.);

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- ④ your use of slides, blackboard, computer, etc. during the presentation;
- ⑤ the quality of your slides (use of illustrations, language, structure, etc.);
- ⑥ how well organized your presentation was;

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- ③ how well you've prepared and rehearsed your presentation;
- ④ your use of slides, blackboard, computer, etc. during the presentation;
- ⑤ the quality of your slides (use of illustrations, language, structure, etc.);
- ⑥ how well organized your presentation was;
- ⑦ if you timed your presentation well;

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- ④ your use of slides, blackboard, computer, etc. during the presentation;
- ⑤ the quality of your slides (use of illustrations, language, structure, etc.);
- ⑥ how well organized your presentation was;
- ⑦ if you timed your presentation well;
- ⑧ if you spoke clearly and at the right pace.

Resources

Here are some web sites you can check for newsworthy stories:

- <http://seclists.org>
- <http://www.schneier.com>
- <http://computersecuritynews.us>
- <http://www.securityfocus.com>
- <http://www.securityweek.com>
- <http://news.yahoo.com/security>
- http://www.sciencedaily.com/news/computers_math/encryption
- <http://news.cnet.com/defense-in-depth>

Feel free to check with me if a particular story is suitable for presentation.

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Graduate Student Lectures

- Masters and PhD students enrolled in the class will pair up to research a topic and present it to the class.
 - This is not the normal “read a paper and present it in class” type of assignment. Rather, you will be given a fairly broad topic that you will research thoroughly throughout the semester. At the end of the semester you will have
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- Thus, the last few lectures will be given by graduate students.

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 - ① collected a comprehensive set of resources (books, papers, tools, etc.) relevant to the topic;
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 - 2 become an expert on your chosen topic,
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 - 1 collected a comprehensive set of resources (books, papers, tools, etc.) relevant to the topic;
 - 2 become an expert on your chosen topic,
 - 3 written a 5-page paper summarizing the topic,
 - 4 created a 15-20-slide presentation on the topic,
- Thus, the last few lectures will be given by graduate students.

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 - ① collected a comprehensive set of resources (books, papers, tools, etc.) relevant to the topic;
 - ② become an expert on your chosen topic,
 - ③ written a 5-page paper summarizing the topic,
 - ④ created a 15-20-slide presentation on the topic,
 - ⑤ delivered a 15-minute (+ 5 minutes for questions) presentation on the topic.
- Thus, the last few lectures will be given by graduate students.

Due dates

- ➊ **Topic selection:** 21:59, Sep 4
- ➋ **Resources:** 23:59, Sep 16
- ➌ **First draft:** 23:59, Oct 17
- ➍ **Second draft:** 23:59, Oct 31
- ➎ **Third draft:** 23:59, Nov 14
- ➏ **Peer review:** 23:59, Nov 21
- ➐ **Final submission:** 23:59, Nov 28
- ➑ **Presentations:** Dec 2, 4

The paper

- The paper should give a thorough introduction to your chosen topic, suitable for someone with no previous background (such as your classmates).
- It should not be organized as a survey paper (“and in this paper they said the following. . .”), but rather as a chapter in a textbook, say.
- Obviously, you still need to reference relevant works. This can be done in a separate section at the end, or throughout the report.
- **Illustrations** and **examples** are very important, and should help the reader grasp the subject.

Topic Selection

- Select your preferred presentation topics.
- Send email to sabrinanusrat@email.arizona.edu immediately after 21:59, Sep 4 (emails received before will be ignored) consisting of
 - 1 the subject line 566 presentation topic;
 - 2 GROUP: student1, student2;
 - 3 RANKING: topic preference (most desired topic first).
- For example, an email 5,4,1,6 indicates to me that you most prefer topic 5, then 4, then 1, then 6, and after that, you don't care.
- Topics will be assigned on a first-come-first-served basis.

Resources I

- Start your research on your assigned topic by collecting a list of references that you plan to use in the presentation. This can include books, papers, web sites, tools, etc.
- Download the file `template.zip` from the course website.
- Follow the instructions in the README file.
- Edit the BIB_TEX file `topic-name/report/bibs.bib` with all the resources, each resource annotated with a paragraph, describing the contents.
- Make sure that the report builds.
- Zip everything up into a file `topic-name-resources.zip` and upload to [d21](#).
- You may, of course, add additional resources during the semester, as your research progresses.

Resources II

- Make an appointment with me to discuss your progress so far. Together we will go over the resources you've collected, the direction in which your research is taking you, and possibly steer you in a different direction.

First Draft I

- At this stage, you should have produced
 - 1 About half your slides, and most of those should include an illustration;
 - 2 About half your of your paper, with at least 3 drawings/illustrations.

Don't include the bibliography annotations!
- The first draft should take into account previous feedback from the instructor.
- Don't plagiarize text/images/drawings from any resource!
- A README file that should now also include
 - 1 an outline of how you intend to run/organize your presentation;
 - 2 some ideas of in-class exercises you intend to run, tools you intend to demonstrate, etc.
- Zip everything up into a file `topic-name-first-draft.zip` and upload to [d21](#).

First Draft II

- Make an appointment with me to discuss your progress so far.

Second Draft I

- Meet with the TA to discuss your progress.
- Bring your slides, resources, paper to the review.
- If he/she determines you are not making progress at this point, he/she may suggest a meeting with me.

Third Draft I

- At this stage, you should have produced
 - 1 Almost all your slides, and most of them should contain illustrations;
 - 2 Your complete L^AT_EX paper, with at least 5 drawings/illustrations.
Don't include the bibliography annotations!
- The third draft should take into account feedback from the instructor on the first draft.
- A README file that should now also include
 - 1 detailed, step-by-step, instructions for how you intend to run/organize your presentation;
 - 2 detailed, step-by-step, instructions for the 1-2 in-class exercises you intend to run.
- Zip everything up into a file **topic-name-third-draft.zip** and upload to **d21**.

Third Draft II

- Make an appointment with me to discuss your progress so far.

Peer Review

- Update your slides and your paper based on the feedback you've received from the instructor.
- Exchange your slides and paper with another group.
- Give the other group a few days to read your material.
- Meet with the other group, give your presentation to them, they give theirs to you.
- Each group should write up a peer-review report (no less than a page of text) with actionable feedback on the presentation, the slides, and the paper. Submit the report to the other group, the TA, and to me.
- Update your slides and your paper based on the feedback you've received.

Final Version

- Submit final presentation, slides, exercises, etc.
- Zip everything up into a file `topic-name-final.zip` and upload to [a21](#).
- **Note that this is a hard deadline**. I won't accept any late submissions.
- Make sure to adjust your paper and slides based on any feedback you have received from the instructor.
- You can't make any changes to the presentation slides after the submission. (This is so that every group has the same amount of time to prepare their presentation.)

Presentation Rehearsal

- Make an appointment with the TA to give the presentation to him/her.
- The TA will time the presentation — if you are way long or short, you will have to prepare again, and repeat the rehearsal with the TA.
- The TA will also check your slides to make sure they are conforming.

Presentations

- Presentations, 15-minute (+ 5 minutes for questions);

2014 Topics I

① Hardware hacking

Starting point: www.cl.cam.ac.uk/techreports/UCAM-CL-TR-630.pdf

2014 Topics II

② Critical infrastructure security (SCADA)

Starting point: *Sandia Report: Advanced Metering Infrastructure Security Considerations,*

www.oe.energy.gov/DocumentsandMedia/20-AMI_Security_Considerations.pdf;

F. M. Cleveland, *Cyber security issues for Advanced Metering Infrastructure,*

www.blackhat.com/presentations/bh-usa-09/MDAVIS/BHUSA09-Davis-AMI-SLIDES.pdf;

Ross Anderson and Shailendra Fuloria, *Who controls the off switch?*

2014 Topics III

③ Digital Cash

Starting points:

- Bitcoin, <http://en.wikipedia.org/wiki/Bitcoin>.
- Chaum, Fiat, Naor, *Untraceable Electronic Cash*,
http://blog.koehtopp.de/uploads/chaum_fiat_naor_ecash.pdf

2014 Topics IV

4 Inlined Reference Monitors

Starting point: Kevin Hamlen, *A Service-oriented Approach to Mobile Code Security*.

2014 Topics V

5 Digital Forensics

Starting point: Eoghan Casey, *Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet*

Subtopics: computer forensics, network forensics, database forensics and mobile device forensics.

2014 Topics VI

6 Fuzzing Techniques

Starting point: Michael Sutton, Adam Greene, Pedram Amini,
Fuzzing: Brute Force Vulnerability Discovery,

<http://www.fuzzing.org>

2014 Topics VII

7 Software-based Fault Isolation (SFI)

Starting points:

- Robert Wahbe, Steven Lucco, Thomas E. Anderson, Susan L. Graham, *Efficient software-based fault isolation*, SOSP '93: Proceedings of the fourteenth ACM symposium on Operating systems principles, 1993,
<http://doi.acm.org/10.1145/168619.168635>.
- Steven Lucco, Oliver Sharp, Robert Wahbe, *Omniware: A Universal Substrate for Web Programming*, WWW4, 1995,
<http://www.w3.org/Conferences/WWW4/Papers/165>.
- Robert Wahbe, Steven Lucco, *Methods for safe and efficient implementation of virtual machines*, US Patent 5761477, Microsoft Corporation, 1995,
http://www.patents.ibm.com/details?pn=US05761477__.

2014 Topics VIII

- A. Adl-Tabatabai, G.Langdale, S. Lucco, R. Wahbe, *Efficient and Language-Independent Mobile Programs*, PLDI'96, pp. 127-136,
<http://www.cs.cmu.edu/~ali/pldi96-omniware.html>.
- Google native client,
http://en.wikipedia.org/wiki/Google_Native_Client

2014 Topics IX

⑧ State sponsored advanced persistent threat (APT)

Starting point:

- *Advanced Persistent Threats: A Symantec Perspective*, http://www.spyders.ca/pdfs/symantec_apt.pdf.
- Operation Aurora,
http://en.wikipedia.org/wiki/Operation_Aurora

2014 Topics X

9 Security Economics

Starting point: Ross Anderson, *Economics and Security Resource Page*, <http://www.cl.cam.ac.uk/~rja14/econsec.html>

2014 Topics XI

10 Tor: Anyonymizing and De-Anonymizing

Starting point: Steven J. Murdoch and George Danezi,
Low-Cost Traffic Analysis of Tor,

<http://www.csl.mtu.edu/cs6461/www/Reading/08/Murdoch-sp05.pdf>

2014 Topics XII

Covert Timing Channel

Starting points:

- *Covert channel*,
http://en.wikipedia.org/wiki/Covert_channel
- Steven Gianvecchio and Haining Wang,
Detecting Covert Timing Channels: An Entropy-Based Approach,
<http://www.cs.wm.edu/~hnw/paper/ccs07.pdf>

2014 Topics XIII

12 Privilege escalation attacks on Android

Starting point: Lucas Davi, Ra Dmitrienko, Ahmad-reza Sadegh, Marcel Win, *Privilege escalation attacks on Android*,

https://www.informatik.tu-darmstadt.de/fileadmin/user_upload/Group_TRUST/PubsPD

2014 Topics XIV

13 Static/Dynamic Malware detection techniques

Starting points:

- EGELE et al., *A survey on automated dynamic malware-analysis techniques and tools*,
<http://dl.acm.org/citation.cfm?id=2089126>
- Dube et al., *Malware target recognition via static heuristics*,
<http://www.sciencedirect.com/science/article/pii/S0167404811001131>
- Islam, et al., *Classification of malware based on integrated static and dynamic features*,
<http://www.sciencedirect.com/science/article/pii/S1084804512002214>

14 Security Through Diversity with Virtual Machines

Starting points:

- Daniel Williams, Wei Hu, Jack W. Davidson, Jason D. Hiser, John C. Knight, Anh Nguyen-Tuong, *Security through Diversity: Leveraging Virtual Machine Technology*,
<https://www.cs.unm.edu/~forrest/classes/readings/Williams09.pdf>
- Sudeep Ghosh, Jason Hiser, Jack W. Davidson, *Replacement attacks against VM-protected applications*, <http://dl.acm.org/citation.cfm?id=2151051>

2013 Topics I

1 Tempest

Starting point: www.cl.cam.ac.uk/~mgk25/ih98-tempest.pdf ;
en.wikipedia.org/wiki/TEMPEST

2013 Topics II

② Security of Electronic Medical Records (EMR)

Starting point: Kai Wang and yan Sui and Xukai Zou and Arjan Durresi and Shiao fen Fang, *Pervasive and Trustworthy Healthcare*; Vince Stanford, *Pervasive Health Care Applications Face Tough Security Challenges*

2013 Topics III

③ Insider attacks

Starting point: Angelos Keromytis, Salvatore J. Stolfo, Sara Sinclair, Sean W. Smith, Shlomo Hershkop, Steven M. Bellovin, *Insider Attack and Cyber Security. Beyond the Hacker*

2013 Topics IV

4 Rootkits

Starting point: Greg Hoglund, Jamie Butler, *Rootkits: Subverting the Windows Kernel*, Addison-Wesley Professional, 2005.

2013 Topics V

5 Digital Cash

Starting points:

- Bitcoin, <http://en.wikipedia.org/wiki/Bitcoin>.
- Chaum, Fiat, Naor, *Untraceable Electronic Cash*,
http://blog.koehtopp.de/uploads/chaum_fiat_naor_ecash.pdf

2013 Topics VI

6 Bug-checking Software Techniques

Starting points:

- Al Bessey, Ken Block, Ben Chelf, Andy Chou, Bryan Fulton, Seth Hallem, Charles Henri-Gros, Asya Kamsky, Scott McPeak, and Dawson Engler, *A Few Billion Lines of Code Later - Using Static Analysis to Find Bugs in the Real World*, Communications of the ACM, Vol. 53, No. 2, 2010;
- Dawson Engler, Bencjamin Chelf, Andy Chou, and Seth Hallem, *Checking System Rules Using System-Specific, Programmer-Written, Compiler Extensions*;
- Nathaniel Ayewah, William Pugh, David Morgenthaler, John Penix, YuQian Zhou *Evaluating Static Analysis Defect Warnings On Production Software*

2013 Topics VII

- David Hovemeyer, William Pugh, *Finding More Null Pointer Bugs, But Not Too Many*
- David Hovemeyer, Jaime Spacco, and William Pugh, *Evaluating and Tuning a Static Analysis to Find NullPointerExceptions*

Software: FindBugs, Coverity.

2013 Topics VIII

7 Digital Forensics

Starting point: Eoghan Casey, *Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet*

Subtopics: computer forensics, network forensics, database forensics and mobile device forensics.

2013 Topics IX

8 Steganography

Starting point: I. J. Cox and M. L. Miller and J. A. Bloom,
Digital Watermarking: Principles and Practice,
Morgan Kaufmann, 2002.

2013 Topics X

9 The Java/.NET Security Model

Starting point:

- Paul, Evans, *Comparing Java and .Net security: Lessons learned and missed*,

<http://www.cs.virginia.edu/~evans/pubs/cs06/cs06.pdf>

- Java Security,

<http://www.amazon.com/Java-Security-2nd-Scott-Oaks/dp/0596001576>

Subtopics: Bytecode verification, class loading, security manager, stack inspection.

2013 Topics XI

10 Cloud Service Provider Security

Starting point: T. Ristenpart, E. Tromer, H. Shacham, and S. Savage, *Hey, You, Get Off My Cloud: Exploring Information Leakage in Third-Party Compute Clouds*, Proc. 16th. ACM Conference on Computer and Communication Security, 2009.

2012 Topics I

① Hardware game console hacking

Starting point: *Hacking the XBOX*, hackingthexbox.com/

② Hacking networked games

Starting point: Greg Hoglund, Gary McGraw, *Exploiting Online Games: Cheating Massively Distributed Systems*

③ Phishing

Starting point: Markus Jakobsson, Steven Myers, *Phishing and Countermeasures: Understanding the Increasing Problem...*

④ Password cracking

Subtopics: Cracking, rainbow tables, alternatives (graphical passwords, etc.)

2012 Topics II

Starting point: Simon Marechal, *Advances in password cracking*, *Journal in Computer Virology*, 2008,

[dx.doi.org/10.1007/s11416-007-0064-y](https://doi.org/10.1007/s11416-007-0064-y);

en.wikipedia.org/wiki/Rainbow_table

5 Stuxnet

Subtopics: Who-dunnit?, techniques used

Starting point: en.wikipedia.org/wiki/Stuxnet ; <http://youtu.be/fVNHX1Hrr6w>

6 Botnets

Starting point: Evan Cooke, Farnam Jahanian, Danny McPherson, *The Zombie Roundup: Understanding, Detecting, and Disrupting Botnets*, USENIX SRUTI '05

7 Honeypots

2012 Topics III

Starting point: Niels Provos, *A virtual honeypot framework*;

[en.wikipedia.org/wiki/Honeypot_\(computing\)](http://en.wikipedia.org/wiki/Honeypot_(computing))

8 Network security visualization

Starting point: Greg Conti, *Security Data Visualization: Graphical Techniques for Network Analysis*

Assessment

You will be assessed on

- 1 the depth of the research you've done on your chosen topic;

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- ① the depth of the research you've done on your chosen topic;
- ② how well you've prepared and rehearsed your presentation;

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- ⑤ how well organized your presentation was;

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- ⑤ how well organized your presentation was;
- ⑥ if your presentation had the right level of technical detail;
- ⑦ if you timed your presentation well;

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- 5 how well organized your presentation was;
- 6 if your presentation had the right level of technical detail;
- 7 if you timed your presentation well;
- 8 if you spoke clearly and at the right pace;

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- 3 your use of slides, blackboard, computer, etc. during the presentation;
- 4 the quality of your slides (use of illustrations, language, structure, etc.);
- 5 how well organized your presentation was;
- 6 if your presentation had the right level of technical detail;
- 7 if you timed your presentation well;
- 8 if you spoke clearly and at the right pace;
- 9 the quality (structure, language, organization) of your report.

FAQ

Can I

- 1 change the standard formatting provided in the template?

FAQ

Can I

- ① change the standard formatting provided in the template?
- ② work alone/with 3 people rather than in a pair?

FAQ

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- ④ copy pictures/illustrations from papers I read rather than make my own?

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- ⑥ make really boring slides with lists-of-lists-of-lists...?

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- ⑦ not rehearse my presentation?

FAQ

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- ⑥ make really boring slides with lists-of-lists-of-lists-...?
- ⑦ not rehearse my presentation?
- ⑧ improve the presentation slides after the final submission?

FAQ

Can I

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- ❻ make really boring slides with lists-of-lists-of-lists-...?
- ❼ not rehearse my presentation?
- ❽ improve the presentation slides after the final submission?
- ❾ go over time, just a little, I only have a few more slides, and there's so much more to say, and...?

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No.

Outline

- 1 Introduction
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- 3 Materials
- 4 News Stories
- 5 Graduate Student Lectures
- 6 Assessment Scheme**
- 7 Policies
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- 9 Discussion

Course Work and Assessment

- There will be 6 take-home assignments.
- Masters and PhD students will research and present a topic of their choice.
- Undergraduate students will each give a 5-minute presentation on a security-related news story.
- Assessment for undergraduate students: Assignments 40%, news story presentation 10%, Midterm 25%, Final 25%.
- Assessment for Masters and PhD students: Assignments 40%, Topic presentation 20%, Midterm 20%, Final 20%.

Curving

- All grades (for exams, quizzes, assignments, etc) will be curved up by throwing away the highest grade in the class and scaling up such that the second highest grade is 100.
- The curving is done to adjust for particularly difficult tests/assignments, and to prevent an outlier from skewing the grade distribution.
- You cannot, after scaling, receive more than 100 on any exam, quiz, assignment, etc.

Grade Assignment

- You will fail the class if you get less than 50 (after curving) on the final exam.
- Otherwise, a curved total grade of $[90,100]$ gives you an A, $[80,89]$ a B, $[70,79]$ a C, $[60,69]$ a D, and 59 and below an E.

Detailed Grading Scheme

- To avoid any ambiguities, I have formalized the informal rules given above.
- The rules below should be considered *minimum* requirements to achieve a particular grade. The instructor reserves the right to do additional adjustments, as necessary.
- Any contradictions, omissions, errors, or ambiguities in the grading scheme will be resolved by the instructor.
- Any issues or concerns regarding the grading scheme should be brought to the attention of the instructor within the first week of class.

Curving I

- All raw scores range from 0 to 100.
- Each individual score (final, midterm, quizzes, assignments) will be curved using the function

$$\text{curve}(\bar{x}, s) = \min(100, (100.0 / \max(\bar{x} - \max(\bar{x})))\bar{x}_s)$$

where \bar{x} is a set of scores (for an assignment, a test, etc.) and s is a student.

- Note: $-$ is set subtraction.
- $\text{curve}(\bar{x}, s)$ returns s 's score, curved up by $100.0 / 2nd_highest_class_score$.

Curving II

- For example, assume the following final exam scores:

34 45 66 88 98

After the curve has been applied, the scores will be

38.6 51.1 75 100 100

Details — Exams

final exam:

- Let \bar{f} be the set of final exam scores.
- Let \bar{f}^s be the final exam score for student s .
- Let \mathcal{W}^f be the weight of the final exam (25% (ugrad)/20% (grad)).
- $\bar{t}_f^s = \text{curve}(\bar{f}, s)\mathcal{W}^f$ is the curved final score for s .

midterm exam:

- Let \bar{m} be the set of midterm exam scores.
- Let \bar{m}^s be the midterm exam score for student s .
- Let \mathcal{W}^m be the weight of the midterm exam (25% (ugrad)/20% (grad)).
- $\bar{t}_m^s = \text{curve}(\bar{m}, s)\mathcal{W}^m$ is the curved midterm score for s .

Details — Presentation

- Let \bar{p} be the set of presentation scores.
- Let \bar{p}^s be the presentation score for student s .
- Let \mathcal{W}^p be the weight of the presentation (10% (ugrad)/20% (grad)).
- $\bar{t}_p^s = \text{curve}(\bar{p}, s)\mathcal{W}^p$ is the curved presentation score for s .

Details — Assignments

- Let \bar{a}_i be the set of scores for the i :th assignment.
- Let \bar{a}_i^s be the score for student s on the i :th assignment.
- Let \mathcal{W}_i^a be the weight of the i :th assignment ($\sum_i \mathcal{W}_i^a = 40\%$ (ugrad)/40% (grad)).
- Let $\bar{\alpha}_i^s$ be the assignment score after late penalties have been applied:

$$\bar{\alpha}_i^s = \begin{cases} \bar{a}_i^s & \text{if the assignment is handed in on time} \\ 0.9\bar{a}_i^s & \text{if the assignment is } > 0 \text{ and } \leq 24 \text{ hours late} \\ 0.8\bar{a}_i^s & \text{if the assignment is } > 24 \text{ and } \leq 48 \text{ hours late} \\ 0 & \text{if the assignment is } > 48 \text{ hours late} \end{cases}$$

Details — Assignments. . .

- $\bar{t}_a^s = \sum_i (\text{curve}(\bar{\alpha}_i, s) \mathcal{W}_i^a)$ is the total curved assignment score for student s .
- If, for whatever reason, the actual number of assignments is less than the planned number, the \mathcal{W}_i^a 's will be scaled up uniformly.

Details — Total Scores

- The raw total score for student s is

$$\bar{t}_s = \bar{t}_f^s + \bar{t}_m^s + \bar{t}_p^s + \bar{t}_a^s$$

- We round up to the nearest integer:

$$\text{total}_s = \lceil \bar{t}_s \rceil$$

Details — Grade Assignment

- The final grade assignment for student s is

$$\text{grade}_s = \begin{cases} E & \text{if } t_f^s < 50 \\ \begin{cases} A & \text{if } \text{total}_s \in [90, 100] \\ B & \text{if } \text{total}_s \in [80, 89] \\ C & \text{if } \text{total}_s \in [70, 79] \\ D & \text{if } \text{total}_s \in [60, 69] \\ E & \text{if } \text{total}_s < 60 \end{cases} & \text{otherwise} \end{cases}$$

- In other words, a student with a curved final exam score $t_f^s < 50$ will fail the class, regardless of their results on the other assessment categories.

Outline

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Attendance Policy

- My goal is to keep class attendance high so that we can get good discussions going in the class.
- You are not required to attend lectures, but. . .

you cut class at your own risk.

Anything covered in class or in any of the required readings is fair game on tests and exams.

- All holidays or special events observed by organized religions will be honored for those students who show affiliation with that particular religion. Absences pre-approved by the UA Dean of Students (or Dean's designee) will be honored.

Subject to Change Policy

- The information contained in this course syllabus, other than the grade and absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.
- The instructor reserves the right to
 - ① add, drop, or change topics;
 - ② change exam or homework dates, etc.
- Changes will be announced in class and on the class web site and/or on d2l.arizona.edu!
You are responsible for checking these sites regularly.

Notification of Objectionable Materials

- There is no objectionable material in this class.

Students with Disabilities

- If you anticipate barriers related to the format or requirements of this course, please meet with me so that we can discuss ways to ensure your full participation in the course.
- If you determine that disability-related accommodations are necessary, please register with Disability Resources (621-3268; drc.arizona.edu) and notify me of your eligibility for reasonable accommodations. We can then plan how best to coordinate your accommodations.

Student Code of Academic Integrity I

- Assignments in this course require individual attention and effort to be of any benefit. All work is expected to be that of each student alone. You may not consult with others, except in ways specifically authorized by the course instructor. You also may not plagiarize another person's work or copy another person's code.
- Students are responsible for understanding and complying with the University's Code of Academic Integrity. A synopsis of the Code is attached; the full text is available from the Office of the Dean of Students in Room 203 Old Main. Among other provisions, the Code demands that the work you submit is your own, and that graded papers and exams will not subsequently be tampered with. Copying of another student's programs or data, or writings is prohibited when they are part

Student Code of Academic Integrity II

of a published class assignment; it is immaterial whether the copying is by computer, xerox, pen or other means. Witting collaboration in allowing such copying is also a Code violation.

- Assignments in this course require individual attention and effort.
- You may not share material from this class (including code you wrote, exams and quizzes that you took), before or after the due date.
- Violations of the Code will, at minimum, result in loss of credit for a graded item. An egregious first violation or any second violation will minimally result in failure of the entire course.
- See also <http://studpubs.web.arizona.edu/policies/cacaint.htm> the University of Arizona Code of Academic Integrity.

I take academic integrity seriously! I will report every violation!

Expected classroom behavior

- Be courteous and treat others in the class with respect.
- Please be courteous to other students by refraining from talking, playing loud music in your headphones, etc.
- Silence cell phones, pagers, etc.
- We come to class to learn: don't read the newspaper, solve cross-word puzzles, chat on IM, check FB, etc.
- Treat the TAs with respect: they do their best to grade your assignments on time, help you with software installation problems, help you with assignments, etc. But they have their own class work to attend to, too.

Expected classroom behavior...

- Asking questions and making comments in class is obviously encouraged! However, do it for the right reasons:
 - Ask a question because you want to know the answer **not** because you want to show off how cool you are.
 - Students come to the class with a wide variety of backgrounds—don't show off if you're one of those who have studied security in the past.

Expected out-of-classroom behavior

- Be courteous and treat others in the class with respect.
- Don't post disparaging comments about your classmates and TAs on any forum or social media site.

Personal Electronics Policy

- Unless I indicate otherwise, you **cannot** use your laptop, PDA, tablet, phone, iPod, etc., in class.
- During demos, in-class exercises, etc, this policy may be relaxed.

Policies against threatening behavior

- Read and abide by the following link:

<http://policy.web.arizona.edu/~policy/threaten.shtml>.

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<http://policy.web.arizona.edu/~policy/threaten.shtml>.

Assignment grade complaints/regrades

- You have **72 hours** from when the assignment/quiz/midterm/exam/. . . grades have been returned to you to register a complaint with the TAs or me.
- First approach the TAs with your complaint. If the complaint was not resolved to your satisfaction, please contact me.
- I will not consider any regrade for any assessment if you have failed to register a complaint within the allowed time period.

Late turnins

- Course-work handed in no more than 24 hours late will incur a 10% penalty.
- Course-work handed in more than 24 but no more than 48 hours late will incur a 20% penalty.
- Course-work handed more than 48 hours after the deadline will receive a grade of 0.
- Course-work that has been marked as having a **hard deadline** will receive a grade of 0 if handed in late.

Making up Tests

You cannot make up tests/exams unless

- 1 you have notified the instructor in writing (email is fine) or by phone **prior** to the test that you will be absent, and
- 2 you receive permission from the instructor to take the test at a later date.

Incomplete work policy

- I will not assign incomplete grades except under exceptional circumstances.
- I decide what is an exceptional circumstance.

FAQ

- 1 I overslept and missed the midterm, can I take it later today?

FAQ

- ❶ I overslept and missed the midterm, can I take it later today?
- ❷ I just need a few more points to pass this class, can you regrade assignment 1 from back in September?

FAQ

- ① I overslept and missed the midterm, can I take it later today?
- ② I just need a few more points to pass this class, can you regrade assignment 1 from back in September?
- ③ Can I play flappy bird in class?

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- ③ Can I play flappy bird in class?
- ④ Can I use my electronic device in class?

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- ④ Can I use my electronic device in class?
- ⑤ What if I sit way in the back of class and don't bother anyone?

FAQ

- ❶ I overslept and missed the midterm, can I take it later today?
- ❷ I just need a few more points to pass this class, can you regrade assignment 1 from back in September?
- ❸ Can I play **flappy bird** in class?
- ❹ Can I use my electronic device in class?
- ❺ What if I sit way in the back of class and don't bother anyone?
- ❻ Can I be a jerk to/harass/belittle/. . . my fellow students/TAs in class?

FAQ

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- 2 I just need a few more points to pass this class, can you regrade assignment 1 from back in September?
- 3 Can I play **flappy bird** in class?
- 4 Can I use my electronic device in class?
- 5 What if I sit way in the back of class and don't bother anyone?
- 6 Can I be a jerk to/harass/belittle/. . . my fellow students/TAs in class?
- 7 Can I be a jerk to/harass/belittle/. . . my fellow students/TAs **out of** class?

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No.

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References

- \LaTeX : <http://www.latex-project.org/ftp.html>
- Beamer: <http://www.ctan.org/tex-archive/macros/latex/contrib/beamer/>
- You can download the templates below from here:
<http://www.cs.arizona.edu/~collberg/Teaching/466-566/2014/Resources1>

Article style

```
\documentclass[11pt]{article}
\usepackage[margin=1in]{geometry}

\title{My Title Here}
\author{This is me!}

\begin{document}
\maketitle
\bibliographystyle{annotate}
```

Article style

```
\section{Section 1 Title Here!}  
\begin{itemize}  
  \item One  
  \item Two  
  \item Three  
\end{itemize}
```

```
In reference~\cite{shang10malicious} Shang et al.  
claim\ldots
```

Article style

```
\section{Section 2 Title Here!}
```

```
\begin{enumerate}
```

```
  \item One
```

```
  \item Two
```

```
  \item Three
```

```
\end{enumerate}
```

```
\subsection{Section 2 Subtitle Here!}
```

```
\begin{center}
```

```
  \scalebox{0.6}{\includegraphics{cafe.eps}}
```

```
\end{center}
```

Article style

```
\begin{center}
\begin{minipage}{5cm}
\begin{lstlisting}
if blah then
    boo
else
    blurp
endif
\end{lstlisting}
\end{minipage}
\end{center}
```


Article style

```
\begin{figure}
\begin{center}
\begin{minipage}{5cm}
\begin{lstlisting}
Here's some text in a
floating figure!
\end{lstlisting}
\end{minipage}
\end{center}
\caption{This is the caption of the floating figure!}
\label{floating:figure:label}
\end{figure}
```

In Figure~\ref{floating:figure:label} we show a floating figure. You may have to re-run `\LaTeX` several times to get the figure number right.

Article style

```
\section{Let's look at some tables!}
\begin{center}
\begin{tabular}{|l|p{3cm}|c|}\hline
boo & yo dude, sweet, no, really & duh \\\hline
boo & yo dude, sweet, no, really & duh \\\hline
boo & yo dude, sweet, no, really & duh \\\hline
\end{tabular}
\end{center}
```

In Figure~\ref{floating:table:label} we show a floating table.

Article style

```
\section{Let's include a url!}  
\begin{center}  
\url{http://www.ctan.org/tex-archive/macros/latex/...}  
\end{center}  
\end{document}
```

BIB_T_EX Bibliographies

```
@INPROCEEDINGS{shang10malicious,  
  author      = {Shanhu Shang and Ning Zheng and Jian Xu  
                and Ming Xu and Haiping Zhang},  
  booktitle   = "{MALWARE}",  
  title       = {Detecting malware variants via  
                function-call graph similarity},  
  year        = 2010,  
  month       = oct,  
  pages       = {113 -120},  
  annotate     = {This is an annotation},  
}
```

Annotated bibliographies with BIB_TE_X

- Use this BIB_TE_X style:

www.tex.ac.uk/tex-archive/biblio/bibtex/contrib/misc/annotate.bst.

- Add annotations to the BIB_TE_X file:

```
annotate = {This is an annotation},
```

- Add the `\nocite{*}` command to include all your resources, to produce an annotated bibliography:

```
\documentclass{article}
\begin{document}
\bibliographystyle{annotate}
\nocite{*}
\bibliography{references.bib}
\end{document}
```

Beamer Slides

```
\documentclass[presentation,dvips]{beamer}
\title{My Title Here}
\author{This is me!}

\begin{document}
\maketitle

\begin{frame}[plain]
\begin{center}
  {\Huge Plain slide}
\end{center}
\end{frame}
```

Beamer Slides

```
\begin{frame}\frametitle{Itemized slide}  
\begin{itemize}  
  \item One  
  \item Two  
  \item Three  
\end{itemize}  
\end{frame}
```

Beamer Slides

```
\begin{frame}\frametitle{Enumerated slide}  
\begin{enumerate}  
  \item One  
  \item Two  
  \item Three  
\end{enumerate}  
\end{frame}
```


Beamer Slides

```
\begin{frame}\frametitle{Incrementally revealed}  
\begin{enumerate}  
  \item<1-> One  
  \item<2-> Two  
  \item<3-> Three  
\end{enumerate}  
\end{frame}
```

Beamer Slides

```
\begin{frame}\frametitle{Include postscript}  
\begin{center}  
  \scalebox{0.6}{\includegraphics{cafe.eps}}  
\end{center}  
\end{frame}
```

Beamer Slides

```
\begin{frame}[containsverbatim]\frametitle{Include code}
\begin{center}
\begin{minipage}{5cm}
\begin{lstlisting}
if blah then
    boo
else
    blurp
endif
\end{lstlisting}
\end{minipage}
\end{center}
\end{frame}
```

Beamer Slides

```
\begin{frame}\frametitle{Include table}  
\begin{center}  
\begin{tabular}{|l|p{3cm}|c|}\hline  
boo & yo dude, sweet, no, really & duh \\\hline  
boo & yo dude, sweet, no, really & duh \\\hline  
boo & yo dude, sweet, no, really & duh \\\hline  
\end{tabular}  
\end{center}  
\end{frame}
```

Beamer Slides

```
\begin{frame}\frametitle{Include URLs}  
Lear more about the Beamer class here:  
\begin{center}  
\url{http://www.ctan.org/tex-archive/macros/latex/...}  
\end{center}  
\end{frame}
```

Beamer Slides

```
\begin{frame}\frametitle{Include theorem}
  \framesubtitle{\textit{reductio ad absurdum}.}
  \begin{theorem}There is no largest prime number.
  \end{theorem}
  \begin{proof}
    \begin{enumerate}
      \item<1-| alert@1> Suppose  $p$  ....
      \item<2-> Let  $q$  be the product ....
      \item<3-> Then  $q+1$  is ....
      \item<1-> Thus  $q+1$  is ...  $p$ .\qedhere
    \end{enumerate}
  \end{proof}
\end{frame}
```

Beamer Slides

```
\begin{frame}\frametitle{Include theorem}  
\begin{center}  
\setbeamercolor{postit}{fg=black,bg=yellow}  
\begin{beamercolorbox}[sep=1em,wd=5cm]{postit}  
I am curious, yellow.  
\end{beamercolorbox}  
\end{center}  
\end{frame}
```

Beamer Slides

```
\begin{frame}\frametitle{Split into columns}  
\begin{center}  
\begin{columns}[t]  
  \column{5cm}  
  One fish \\  
  Two fish  
  \column[T]{5cm}  
  Red fish \\  
  Blue fish  
\end{columns}  
\end{center}  
\end{frame}  
  
\end{document}
```


Outline

- 1 Introduction
- 2 Course Outline
- 3 Materials
- 4 News Stories
- 5 Graduate Student Lectures
- 6 Assessment Scheme
- 7 Policies
- 8 \LaTeX and friends
- 9 Discussion

Round up the usual suspects. . .

Alice



Bob



Eve



Carol



Dave

