Security and Trust II: Information Assurance Part 1: Introduction

Peter-Michael Seidel

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Outline

Security examples

- Securing resources: authorization
- Securing information: secrecy
- Securing information: authenticity
- Securing social interactions and networks

What is computer security?

Structure of the course

Securing resources: authorization

Digital Rights Management (DRM)

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Securing resources: authorization

Digital Rights Management (DRM)

- art used to be bound to an artist
  - music was available only from a musician
  - a story from a storyteller
  - a painting could only be seen in one place

Securing resources: authorization

Digital Rights Management (DRM)

- mass reproduction bound art to copiable media
  - copying technologies led to *copyright*-based markets
  - artists could sell lots of books and records
  - **Copyright Management**: branding, celebrities

Securing resources: authorization

Digital Rights Management (DRM)

- digital networks freed art (science, religion...) from physical tokens (books, CDs...)
  - copying of digital content is essentially costless
  - Copyright Management becomes unviable
  - **Digital Rights Management**: seeks to
    - prevent (sandboxing, Vista...)
    - detect (watermarking ...)
    - deter (lawyers ...)

  unauthorized copying of digital content

Securing information: secrecy

Task: Fair deal of virtual cards

Design a P2P application for mobile devices to deal virtual cards.

Securing information: secrecy

Problem

The players mistrust each other's device. The dealing device must not see the cards that it is dealing.

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Hint

Each device can *encrypt* messages, i.e. make them unreadable for others.

Securing information: secrecy

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Hint

Each device can *encrypt* messages, i.e. make them unreadable for others. Encryptions can be removed in any order.

Securing social computation

Special case: Virtual coin flipping

Flip a virtual coin (without using a physical coin).

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Variations: Millionaires' Problem

Two millionaires need to truthfully find out which one is richer, without telling how rich they are.

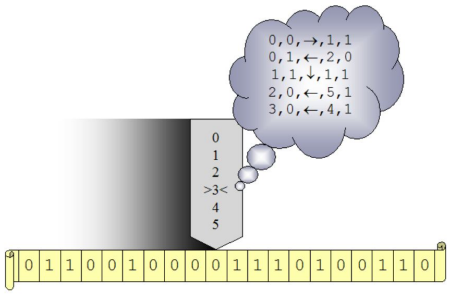
Securing information: authenticity

Task

Spammers need lots of webmail accounts. They write bots who visit Hotmail, Yahoo! etc, to open disposable accounts, to distribute spam.

Design a protocol for setting up a webmail account which will be able to tell apart bots from humans.

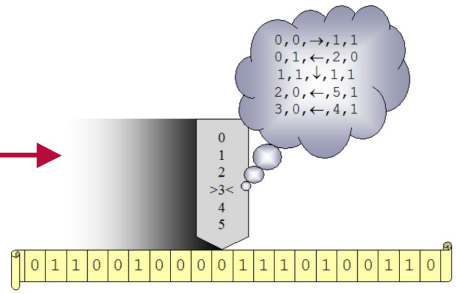
First computer



Turing machine

First authentication protocol

challenge



Turing test

First authentication protocol

Turing test

First authentication protocol

challenge

response

Turing test

CAPTCHA


Google
dmoz
YAHOO!
altavista
excite
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0,0,→,1,1
0,1,←,2,0
1,1,↓,1,1
2,0,←,5,1
3,0,←,4,1
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CAPTCHA


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2,0,←,5,1
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Agent Bot Smith in the Middle

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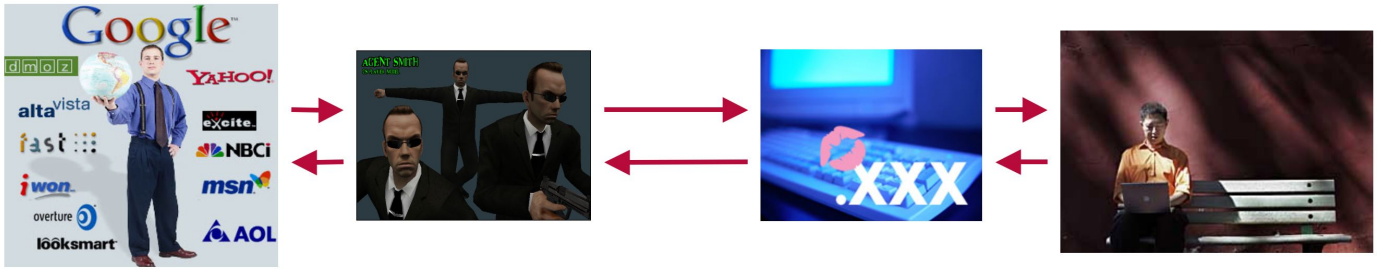
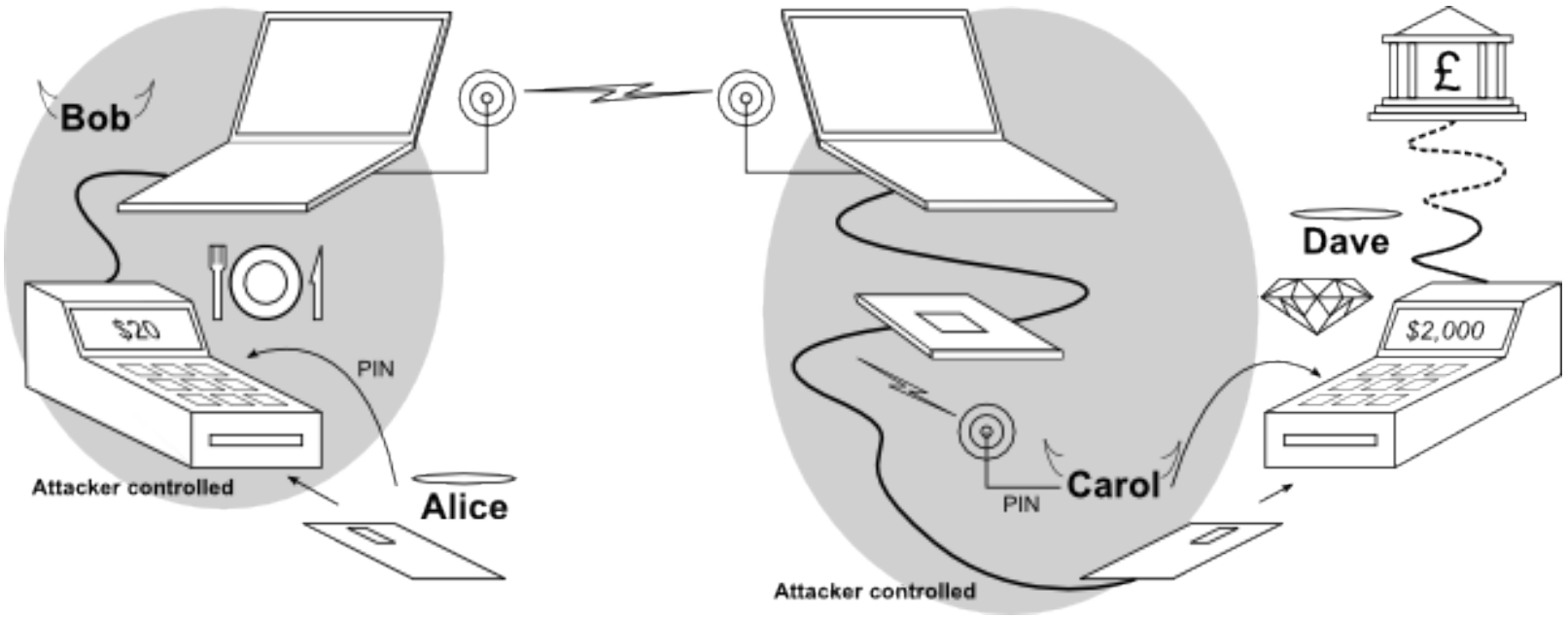


Problem

Smart card relay attacks



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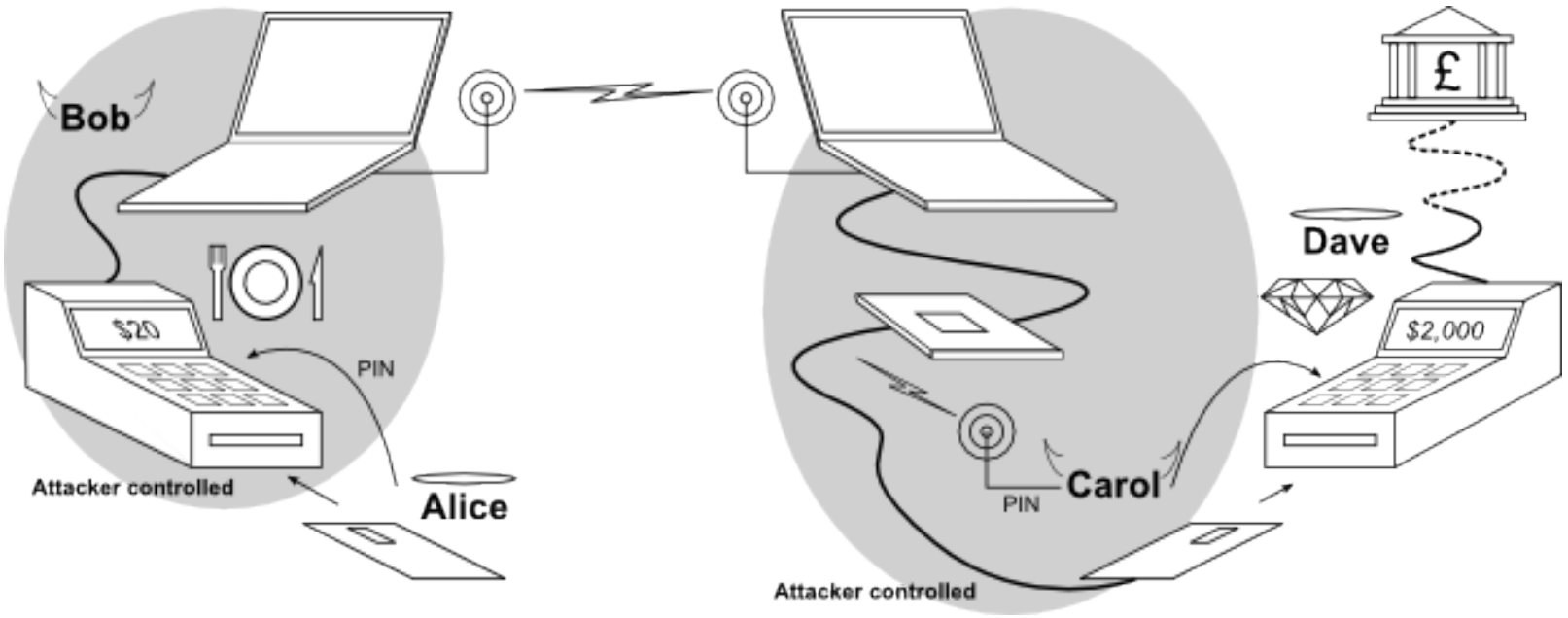

This becomes much easier with NFC phones!

Securing social interactions and networks

Task

There are 11 voters and 3 candidates A, B and C. The voters need to elect one candidate. They have different preferences.

Describe a method to elect the candidate which satisfies most voters.

Securing social interactions and networks

Problem

Suppose the preferences are distributed as follows:

Securing social interactions and networks

Problem

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voters	preference
3	$A \succ B \succ C$
2	$A \succ C \succ B$
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Securing social interactions and networks

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Securing social interactions and networks

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Securing social interactions and networks

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- If each voter casts 2+1 votes, then the tally is 12:11:10 for $C \succ B \succ A$

Outline

What is a computer?

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  - data processing through language, symbols, calculators. . .

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Computation is

- data processing (thinking, gene activation. . .)
- **using tools** (laptops, networks, tRNA. . .).

What is a computer?

Examples of computers

- pocket calculator, brake stabilizer, flight controller
- laptop, desktop, mainframe
- Google cluster, StormWorm botnet
- the Web
- networks: cell, tissue, organism
- social groups and networks. . .

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They all have their

- security requirements
- vulnerabilities
- attackers and adversaries

Software engineering

Program dependability

- **safety:** "bad things (actions) don't happen"
- **liveness:** "good things (actions) do happen"

Software engineering

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In sequential computation

- all first order constraints are dependability properties

Security engineering: Systems

Resource security (access control)

- **authorization:** "bad *resource calls* don't happen"
- **availability:** "good *resource calls* do happen"

In an operating or a computer system

- all resource constraints are security properties

Security engineering: Systems

Information security

- **secrecy:** "bad *information flows* don't happen"
- **authenticity:** "good *information flows* do happen"

In network computation

- all information flow constraints are security properties

Security engineering: Networks

Social choice (voting) and market economy

- **neutrality:** "bad *data aggregations* don't happen"
- **fairness:** "good *data aggregations* do happen"

In social data processing

- all aggregation constraints are security properties

Security vs dependability

processing	dependability	**security**
System	centralized	**distributed**
observations	global	**local**
Environment	neutral	**adversarial**
threats	accidents	**attacks**

Security implementation

Protection and enforcement counter attacks in three phases

- **prevention:** security properties cannot be breached
  - firewalls, cryptography
- **detection:** security breaches are detected
  - intrusion detection, digital forensics
- **policy:** recovery, penalties, incentives
  - legal measures (RIAA, MPAA), economics of security (cost of an attack must be higher than the expected profit of success)

Outline

Structure of the course