Access Control

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Computer Security and Networks

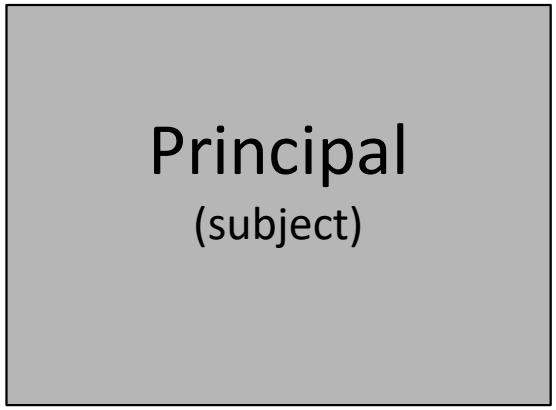
Today’s Lecture

- Access control models
  - Access Control Matrix
  - Access Control Lists
- Linux/Unix access control
- Confused Deputy Problem

Model of Access Control

- Files on VM

Model of Access Control



Model of Access Control

Principal
(subject)
e.g. a user
or program.

Model of Access Control

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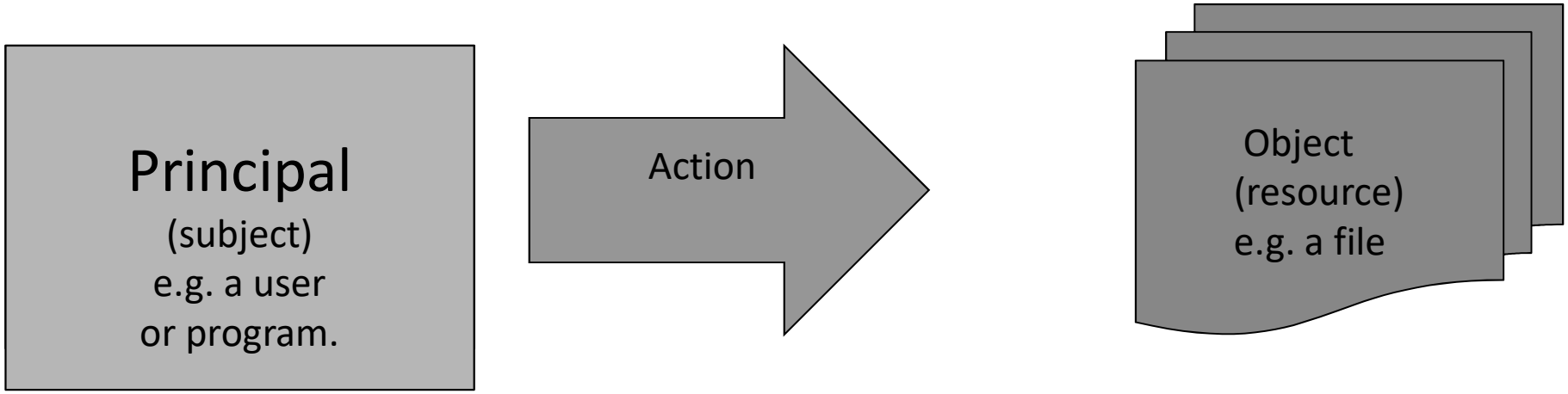

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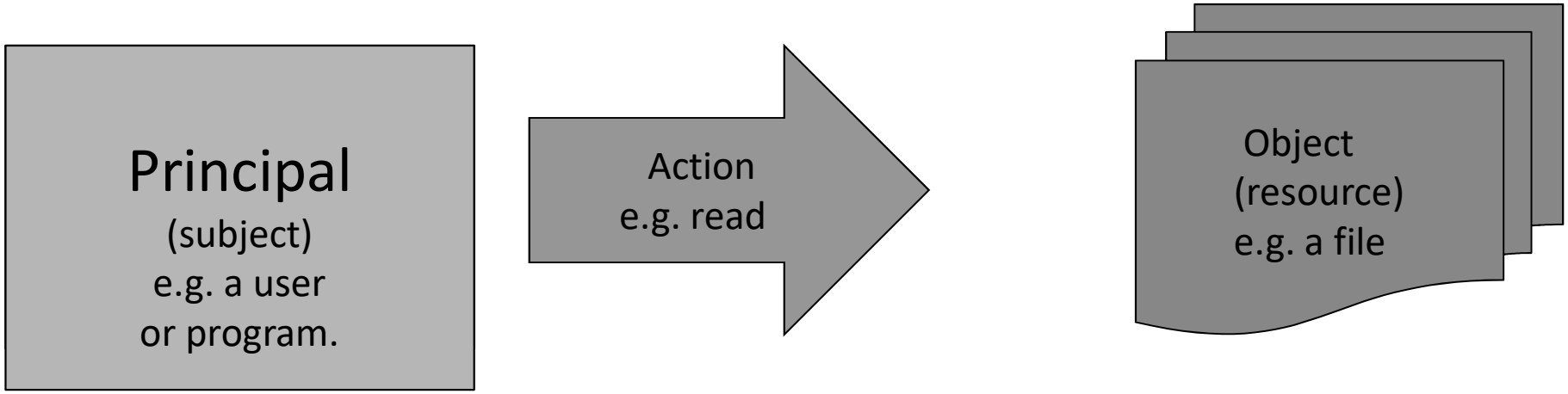
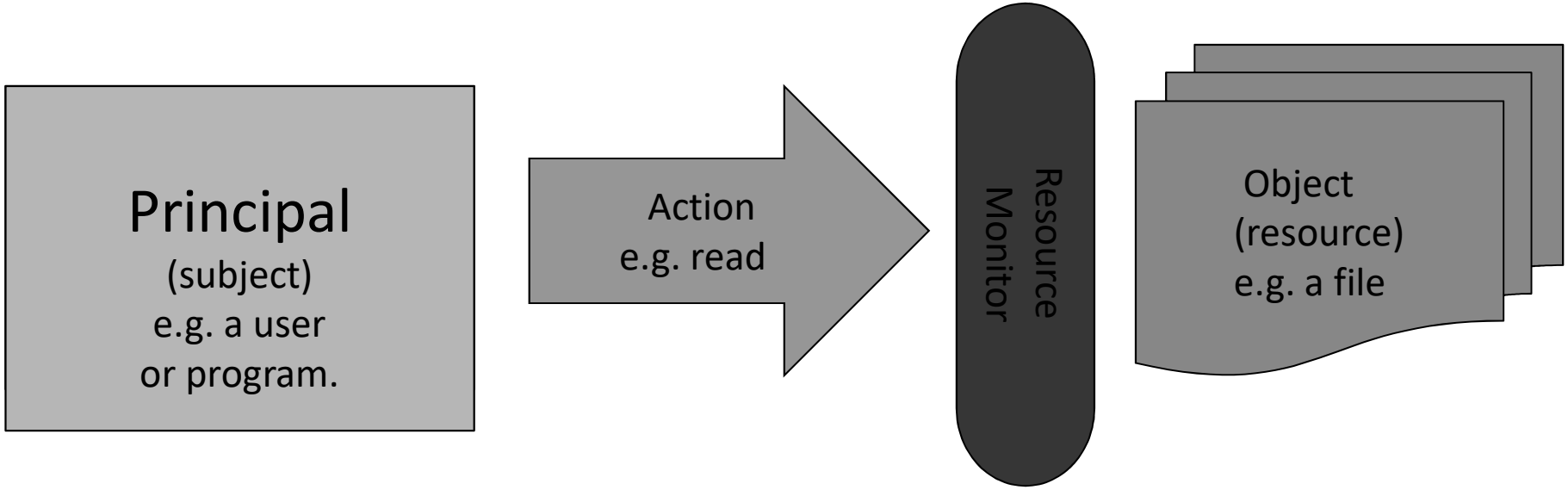


Model of Access Control



Access Control Matrix

	Operating System	Accounts Program	Accounting Data	Audit Trial
Alice (manager)				
Bob (auditor)				
Accounts Program				
Sam (sys admin)				

Permissions: x: execute, r: read, w: write

Access Control Matrix

	Operating System	Accounts Program	Accounting Data	Audit Trial
Alice (manager)	x	x	-	-
Bob (auditor)	rx	r	r	r
Accounts Program	x	r	rw	w
Sam (sys admin)	rwx	rw	-	-

Permissions: x: execute, r: read, w: write

Access Control Matrix

- ACM is a matrix of all principals and objects.
- The matrix entries describe the permissions.

Access Control Matrix

- ACM is a matrix of all principals and objects.
- The matrix entries describe the permissions.
- Problem: maintaining such a matrix can be difficult.
- If the matrix is corrupted then all controls is lost.

Access Control Lists (ACLs)

- We don’t want to store one massive matrix.
- Instead we can store each column of the matrix with the object it refers to. e.g.

Access Control Lists (ACLs)

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- Instead we can store each column of the matrix with the object it refers to. e.g.

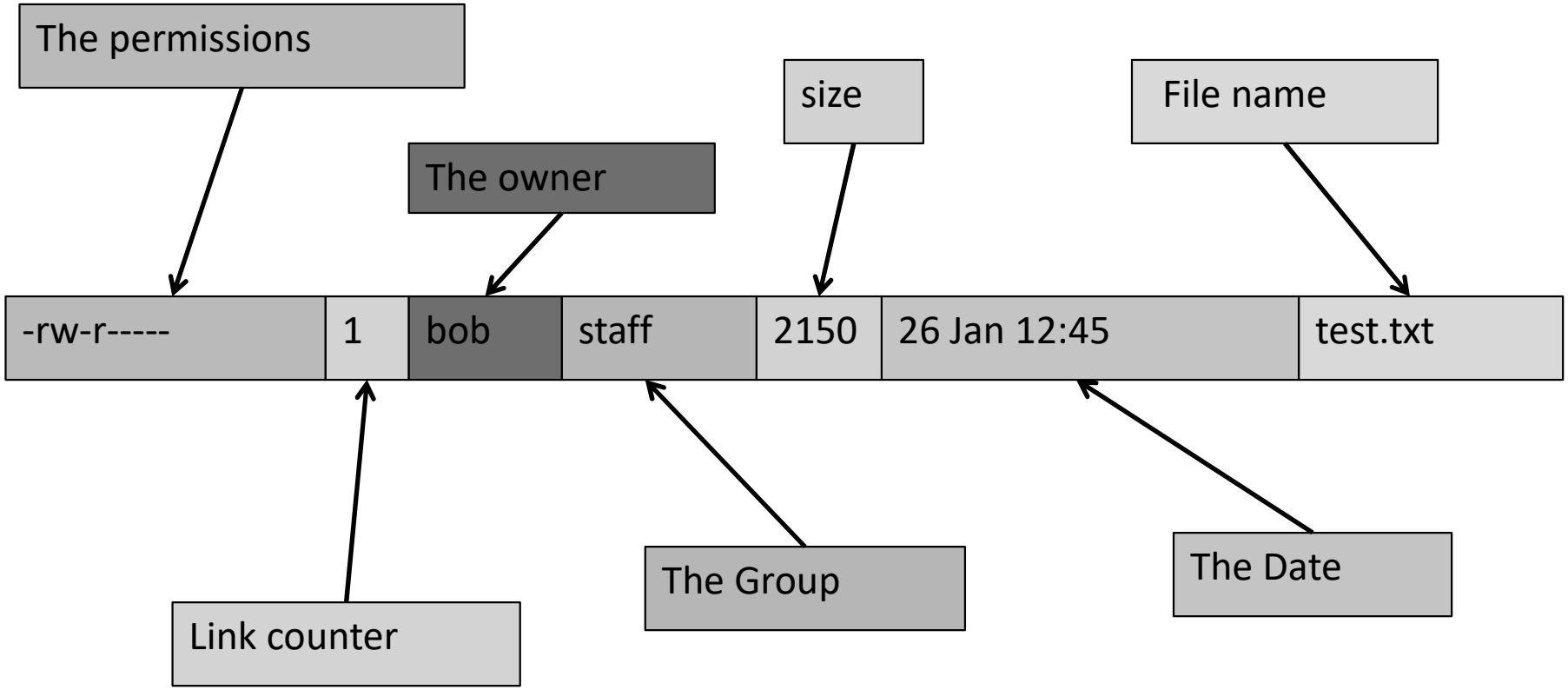
(Accounts data,
[(Sam,r), (Bob,r),(Accounts program, rw)])

Access Control in Unix/Linux

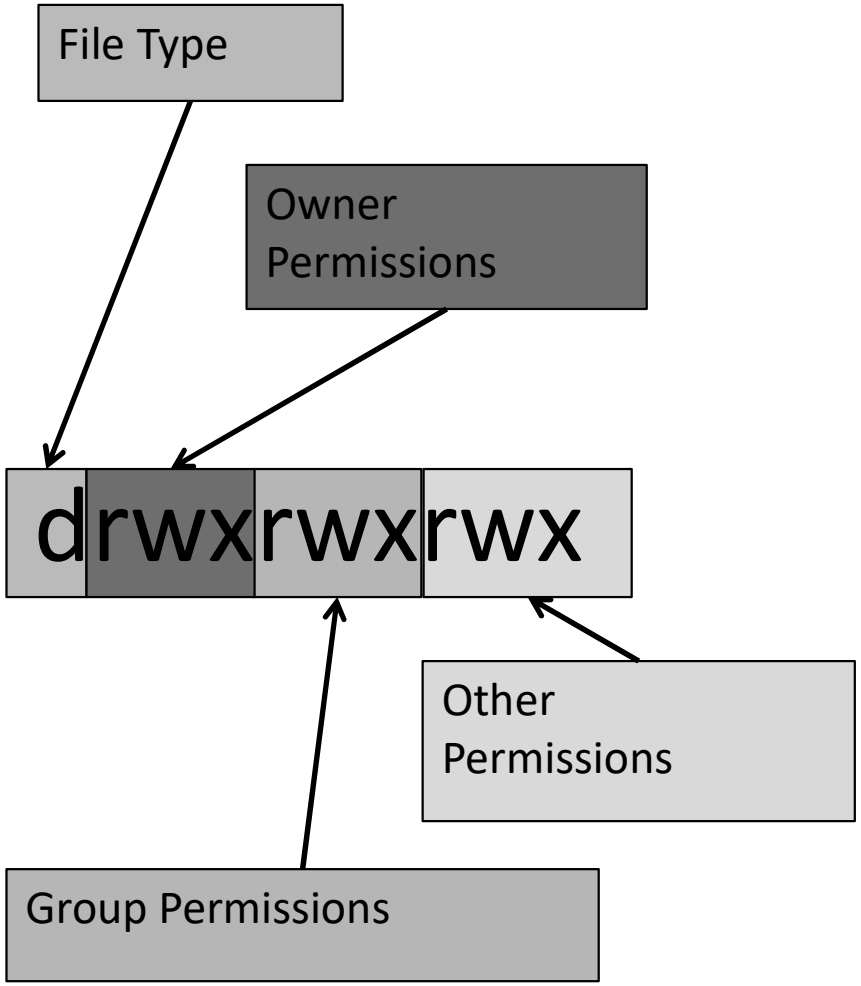
- Unix/Linux/Mac use ACL, with groups.
- “uid” set when you log on.
- Linux Kernel then dynamically enforces the ACLS.
- ls –l displays files with their ACL
- `root` owns everything (“get root” = control the system)

Ls –l on laptop

The UNIX Access Control List



UNIX File Permissions



Permissions:

- r: read permission
- w: write permission
- x: execution permission
- -: no permissions

File Type:

- - : file
- d : directory
- b/c: device file

Access Control for Directories

For directories

- “r” is read only for directory contents
- “x” is permission to traverse, e.g. switch to, run.

No “x”: I can’t run any commands inside the directory

No “r”: I can’t list the files in the directory

Access Control for Process

```
-r-sr-xr-x   1 root   wheel       70352 19 Jun  2009 passwd
```

The “x” permission controls who can run a process

- in the case of `passwd`: anyone.

The “s” permission indicates that the process runs with the permission of its owner.

Different user identifiers

- Have different user identifiers (uids):
  - real uid (ruid) owner of process.
  - effective uid (euid): used for access checks (except filesystem)
  - file system uid (fsuid): used for access checks and ownership of files (usually equal to effective uid)
  - saved user uid (suid): when the euid is changed, the old euid is saved as suid. Unprivileged process may change euid only to ruid or suid.
- provides flexibility for granting higher privileges temporarily
  - eg daemons: start as root (to bind to ports < 1024), then set ruid, euid and suid to unprivileged values. Cannot gain root privileges afterwards
  - Program run as privileged user may set euid to unprivileged value , then execute non-privileged operations, and gain root privileges afterwards

- Shadow
- passwd
- bash set to suid root

The Confused Deputy Problem

Users can run programs with more privileges

If there was a mistake in the `passwd` program we could use it do root only actions.

The Confused Deputy Problem, when a low level attacker gets a high level process to misusing its authority.

Particular problem: race conditions in code like

if can_access file then perform_operations on file

Make sure process have as low a level as possible.

Windows Password Hashes

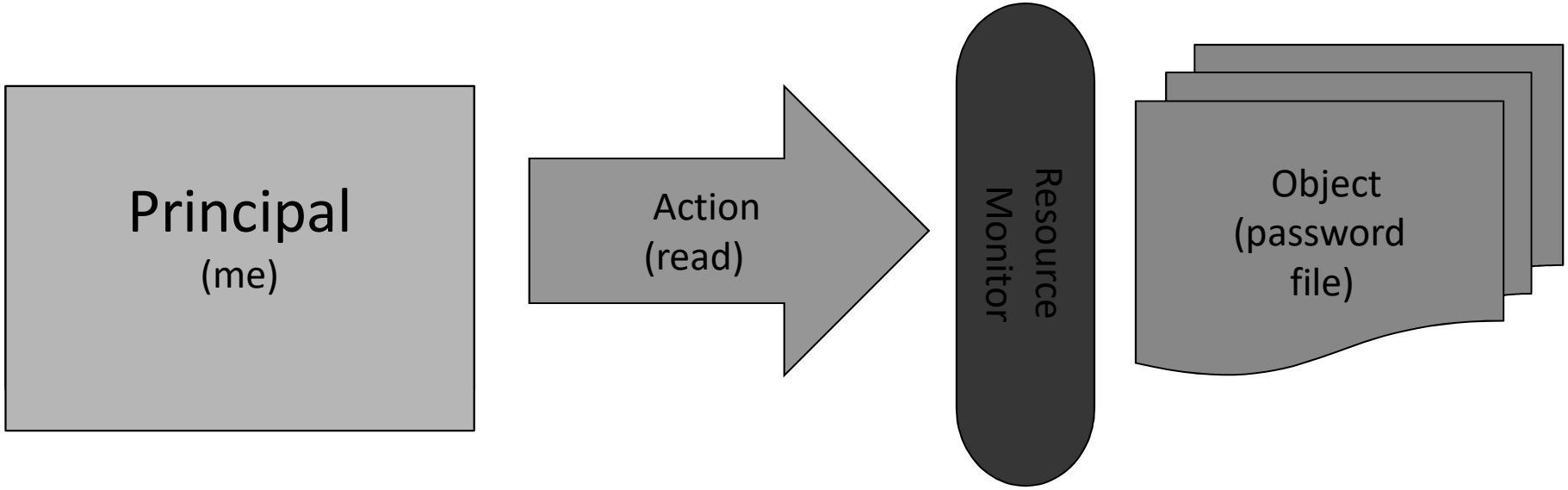
- Windows stores its password hashes in:
  system32/config/SAM

This file requires Admin level to read.

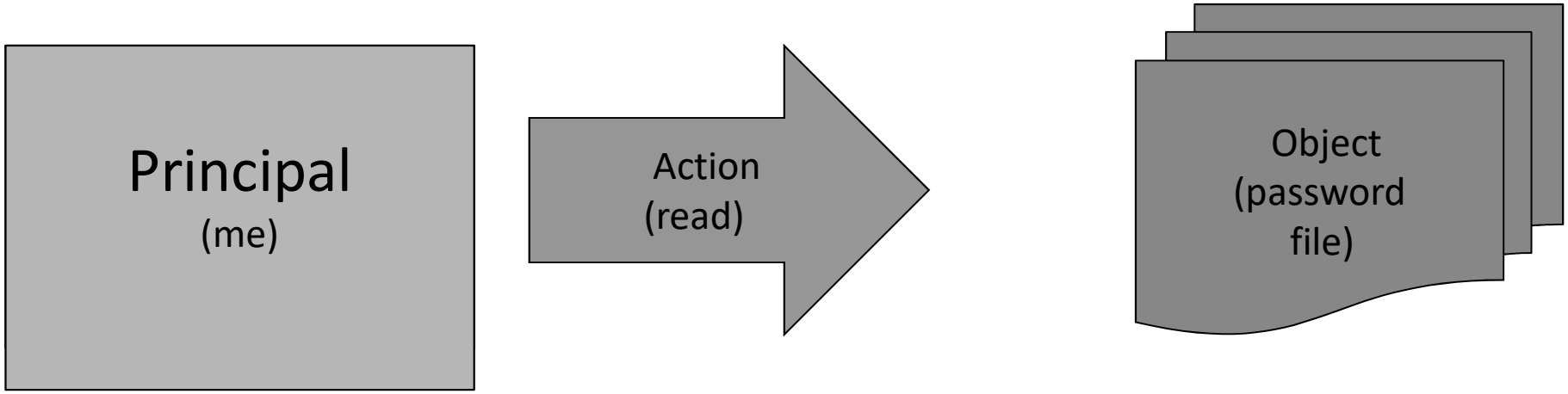
It is locked and encrypted with a key, based on other key values.

  - This adds no real security

Model of Access Control



Model of Access Control



Getting windows pass

- Boot into linux,
- Get SAM file.

Password crackers

- John the Ripper
  - Most common brute force cracker
  - Open source
- Hashcat
  - Claims to be the fastest/best.
- Ophacrack
  - State of the art, free, rainbow table software.

Getting windows pass

- Boot into linux,
- Get SAM file.
- Use password cracker

Password Injection

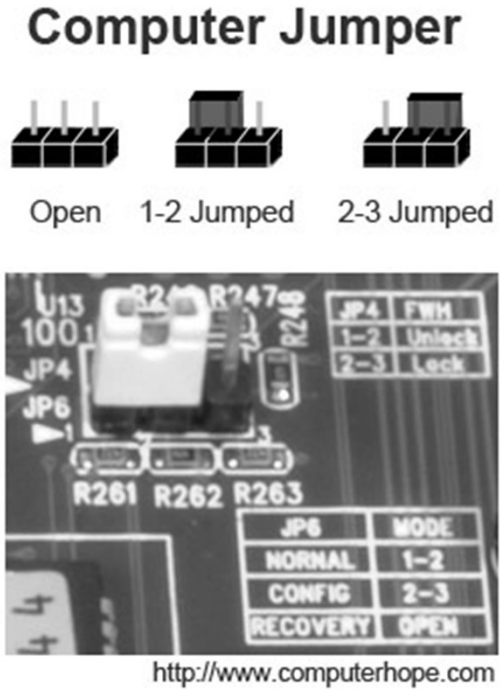
- Want access to the system without cracking the password?
- Have access to the hard disk?
- Add your own account, or replace the hash with one you know.

Better Security: BIOS

- Set a password in the BIOS to stop the computer booting from anything but the hard disk.
- It’s very hard to brute force the BIOS.
- Work around: remove the hard disk from the computer or reset BIOS password.

Resetting the BIOS password

- BIOS password can be reset by opening the box.



Best Security

- Encryption of important file.

- Whole disk encryption
  - Encrypt the whole hard drive
  - Key can be brute forced
  - Not safe if the computer is in sleep mode.

- E.g. BitLocker, FileVault, Luks

Password Hashes in Windows

- In a Windows Domain, passwords hashes are used to authenticate users on hosts in the domain
- Password hashes are cached to avoid asking for the password
- Gives rise to devastating attack (Pass-the-Hash)
  - Obtain user credentials for one host in the domain (eg phishing)
  - Exploit vulnerability to become local administrator
  - Install process which waits for domain administrator to login into this machine
  - Extract cached hash for domain administrator
  - Login as domain administrator
- Defence mechanism exist but are painful to use
- ssh much better: public key on untrusted machine, private key on trusted machine

Further Study

- Security Engineering, Ross Anderson
  - Access Control Chapter

http://www.cl.cam.ac.uk/~rja14/Papers/SE-04.pdf

- Exercise 2.