Discretionary Access Control (DAC)

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Lecture 2

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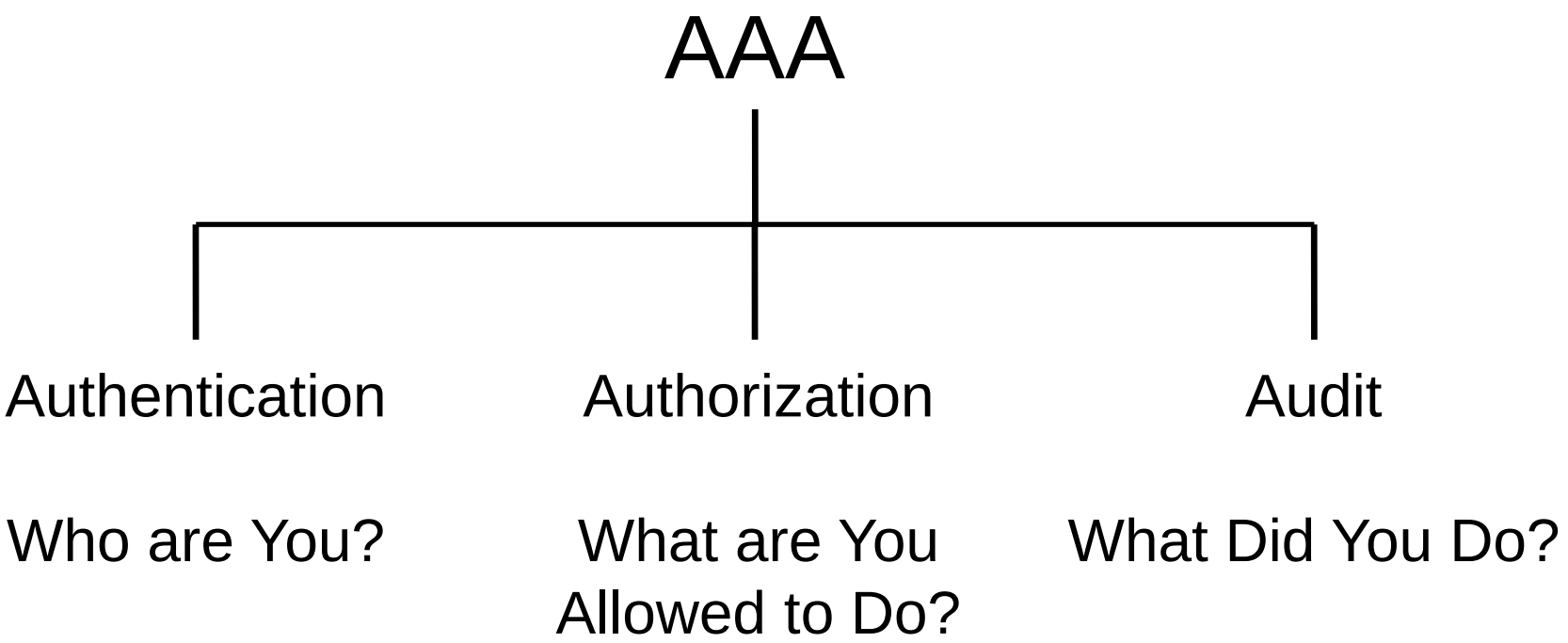
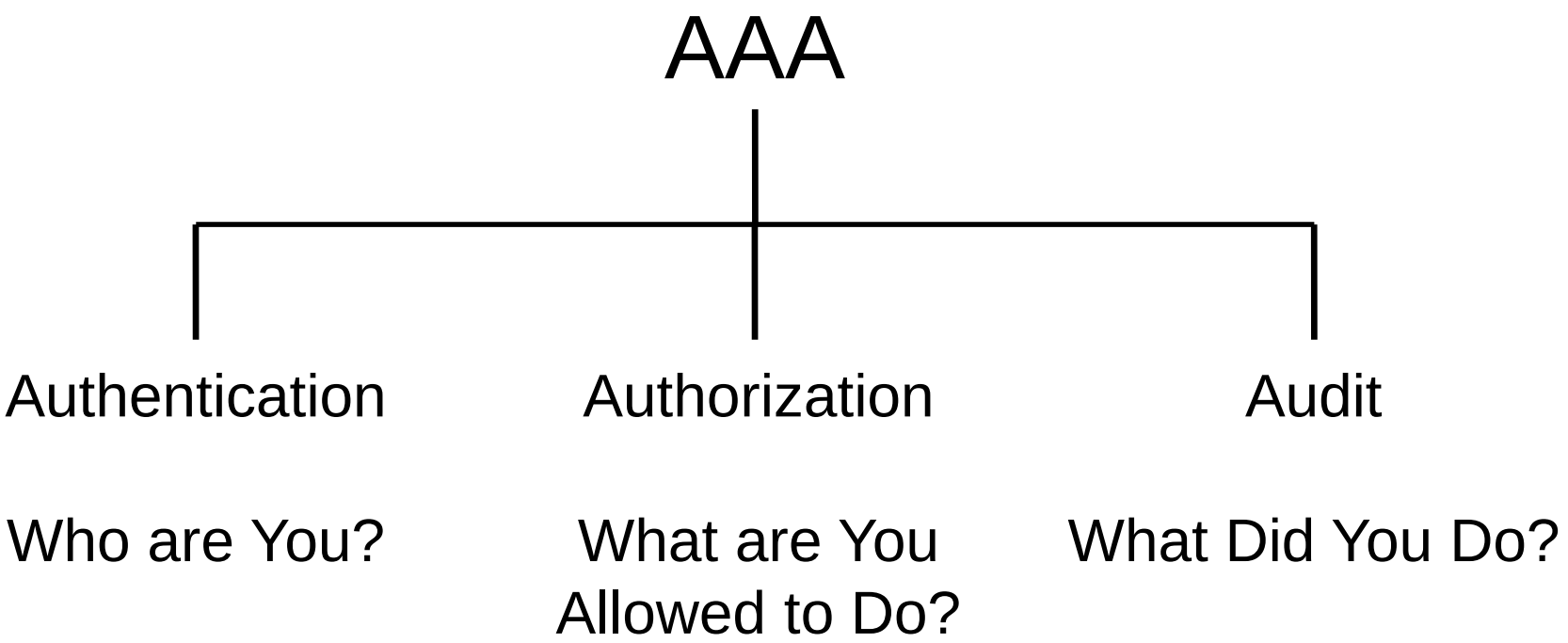
Authentication

Authentication, Authorization, Audit

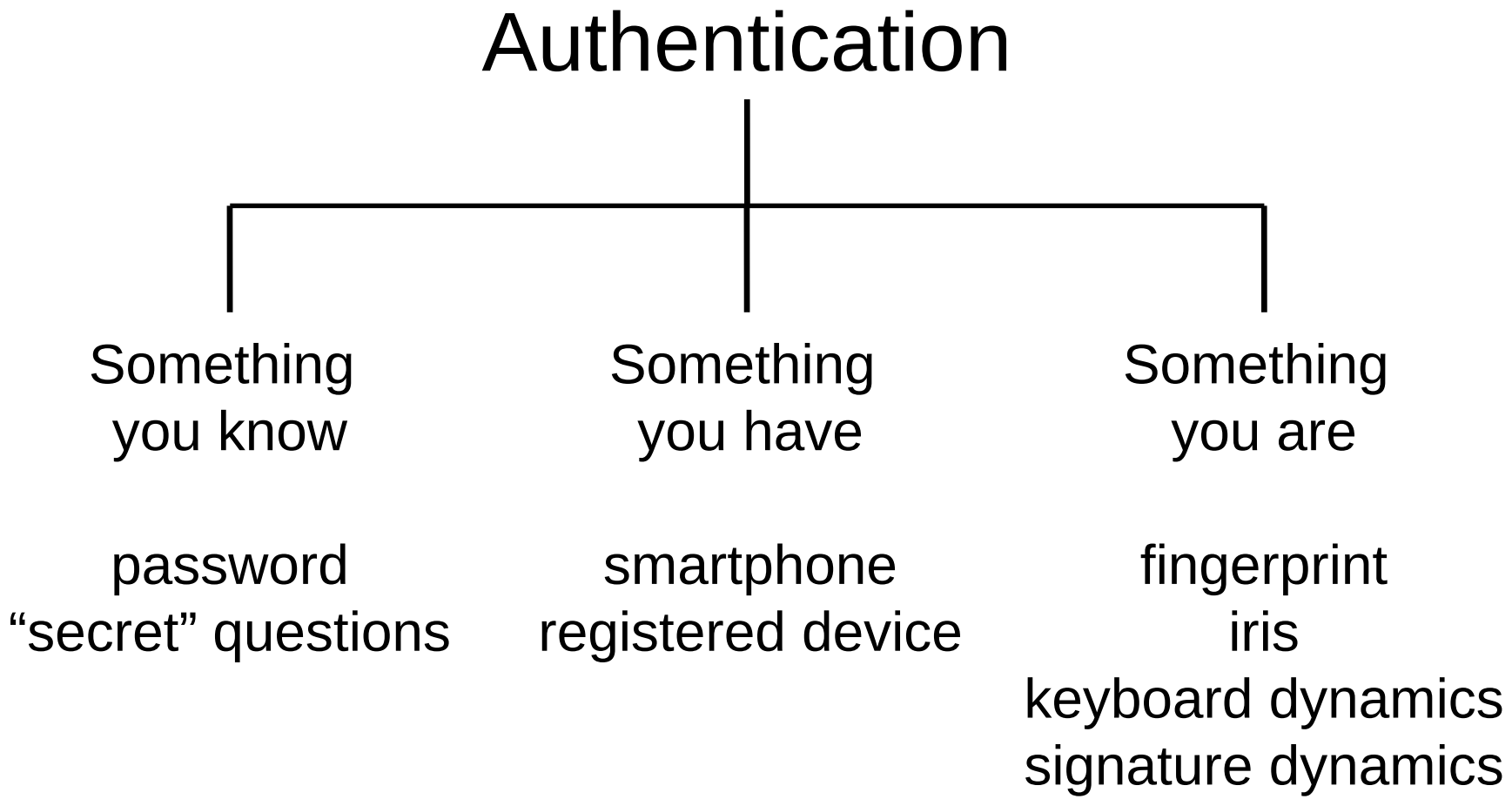


Authentication, Authorization, Audit



siloed → **integrated**

Authentication Techniques



Authentication Techniques

Authentication

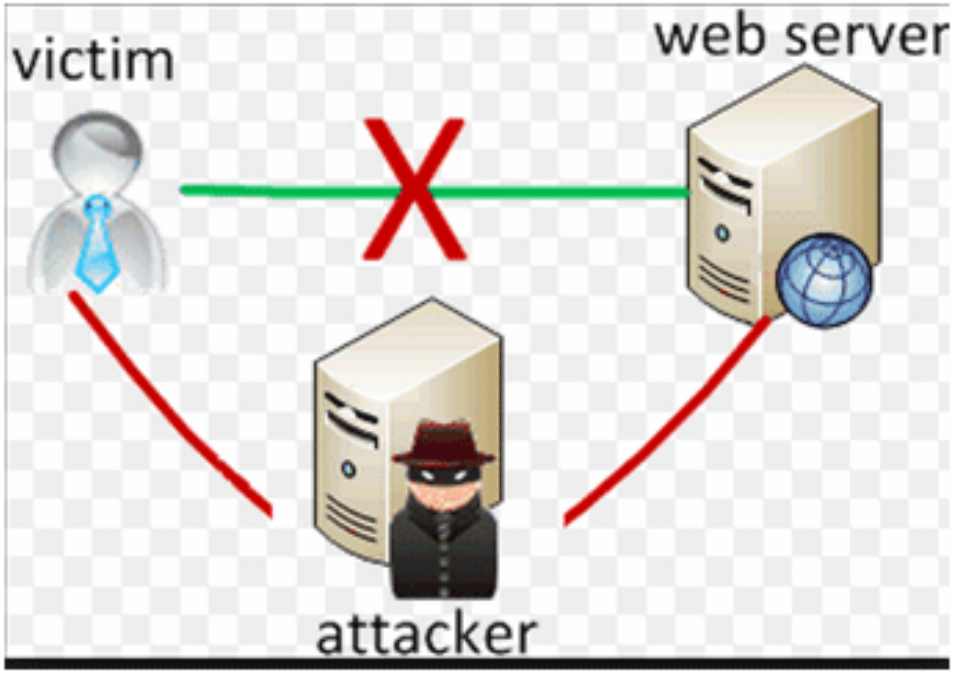
Something you know	Something you have	Something you are
password “secret” questions	smartphone registered device	fingerprint iris keyboard dynamics signature dynamics

single factor → **multi factor**

Phishing

Personalized image to authenticate webserver to user

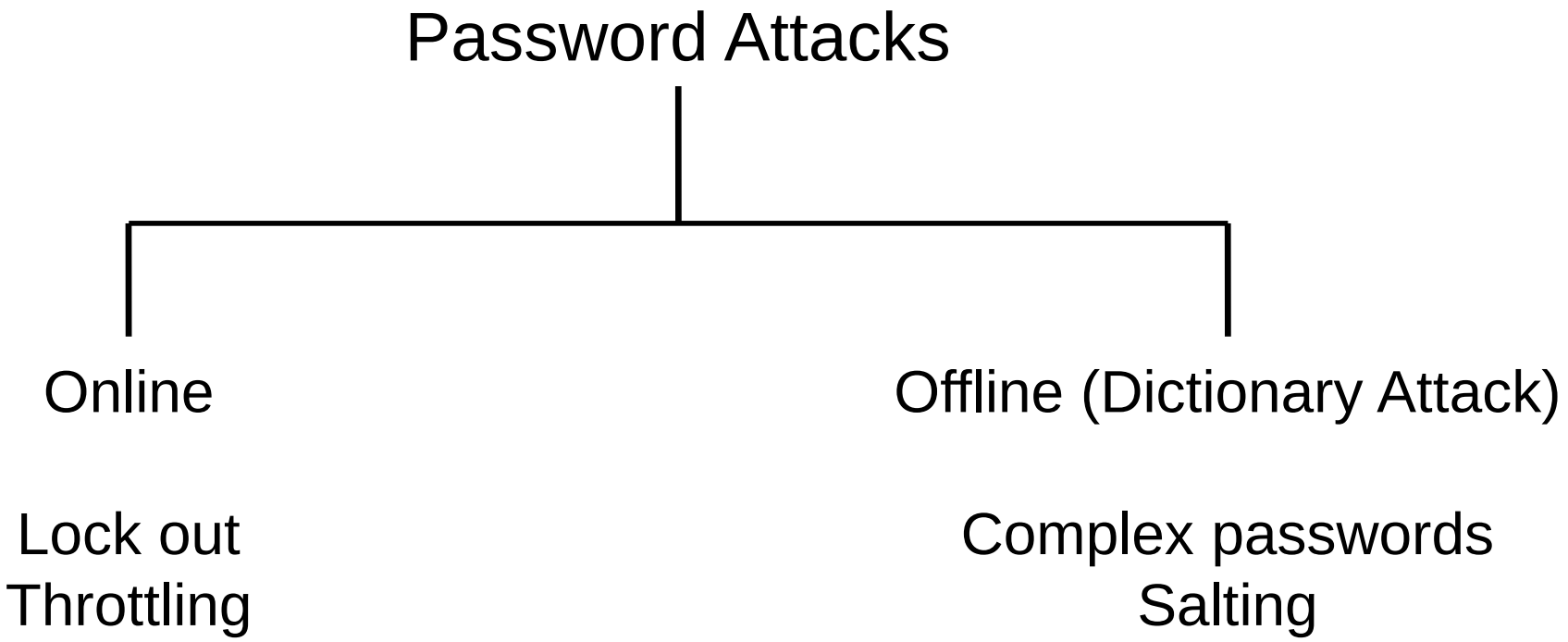
Phishing Man in the Middle



Personalized image passed through

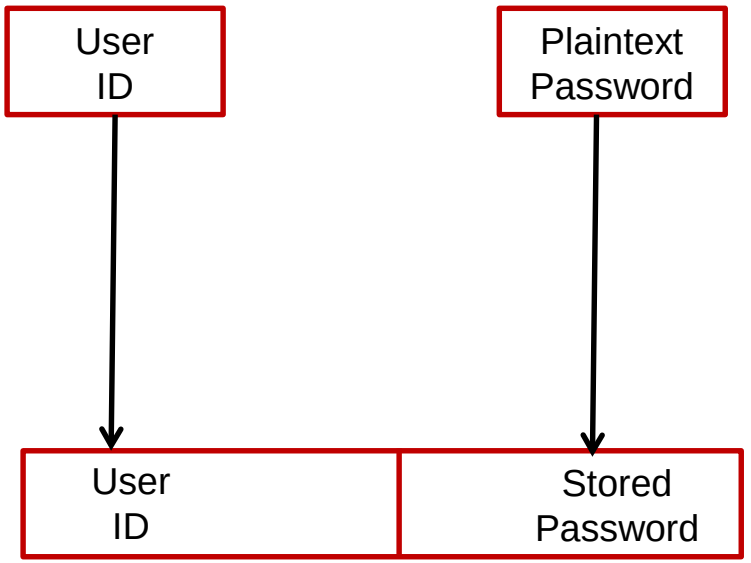
Passwords

Password Attacks

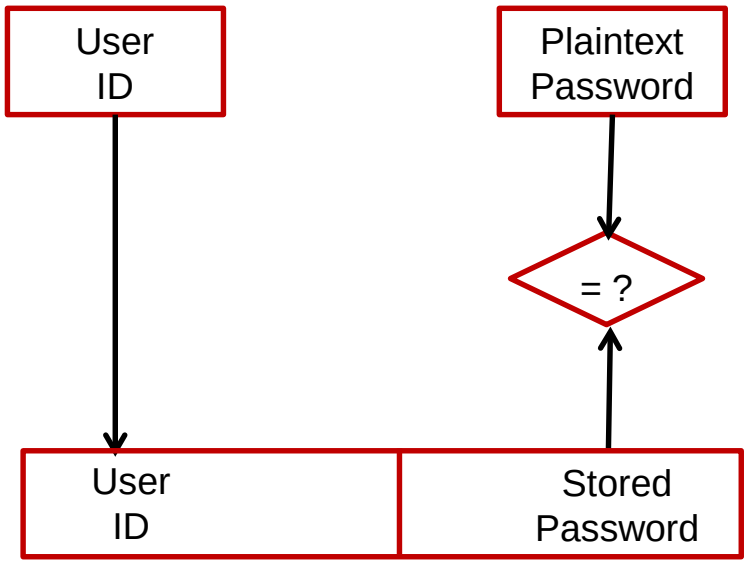


Password Storage and Verification

Password Storage



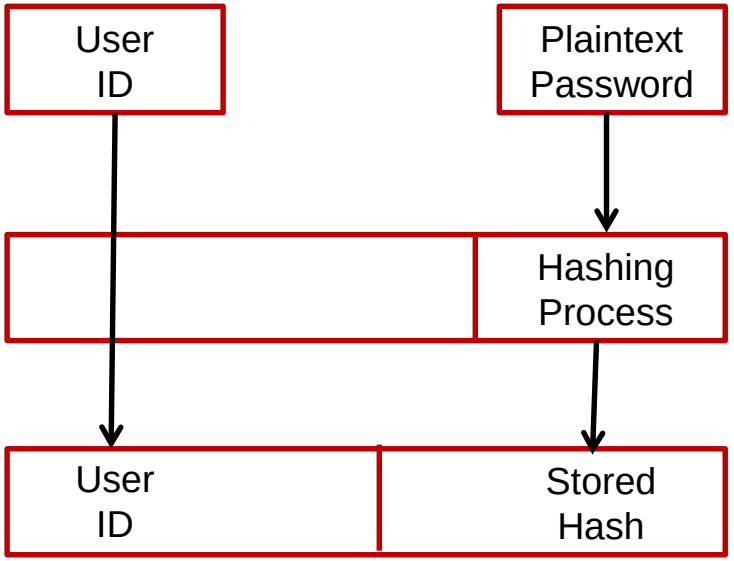
Password Verification



Loss of stored passwords = Catastrophic failure

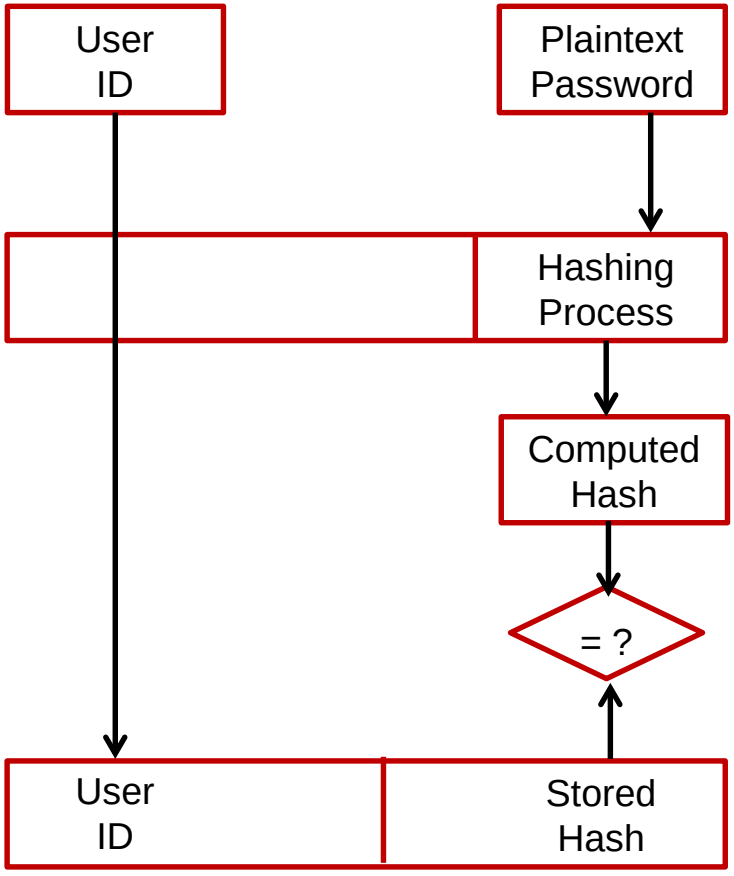
Password Storage and Verification

Password Storage



Loss of stored hashes =
Attack by single dictionary

Password Verification



Password Storage and Verification

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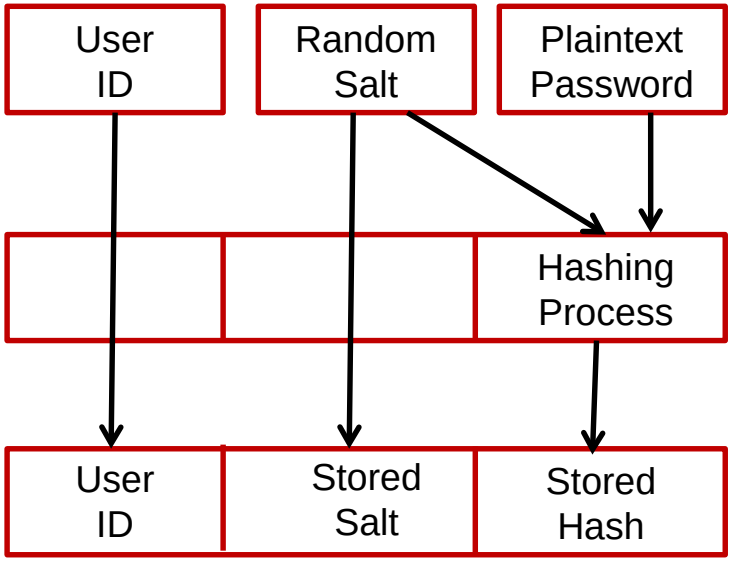
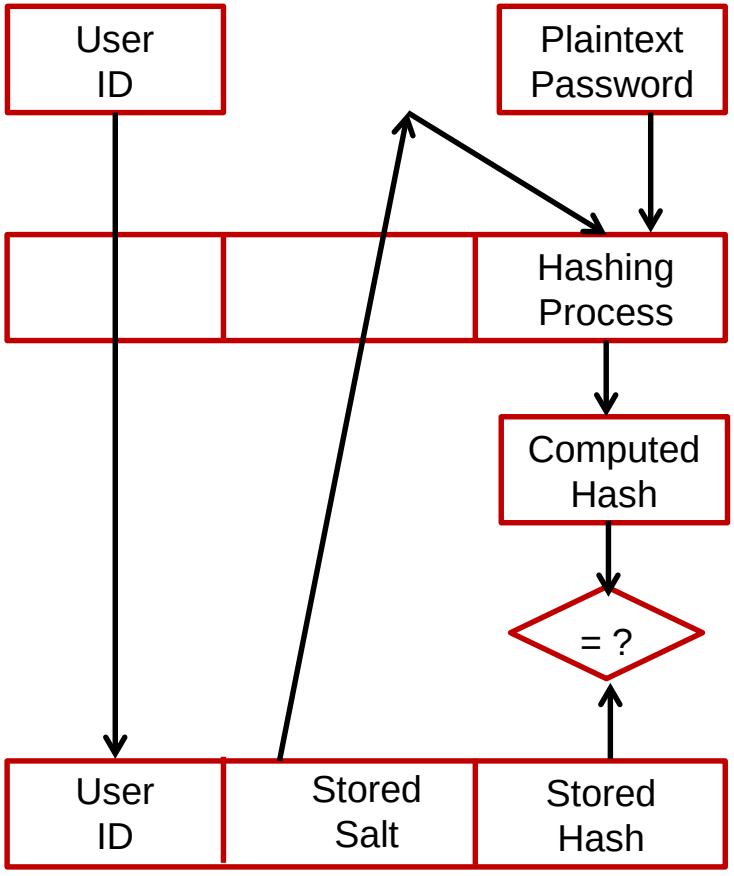


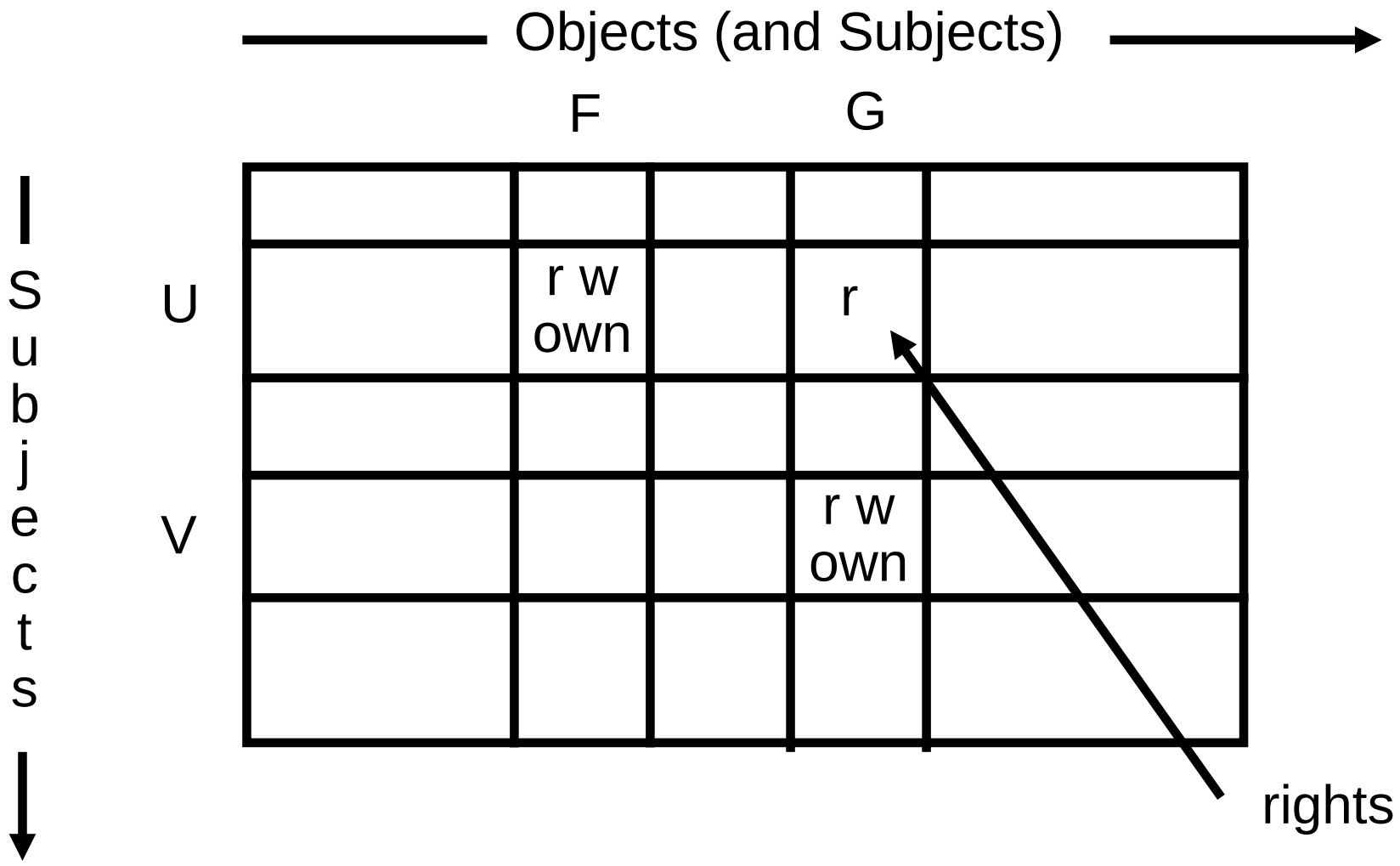
Loss of stored hashes =
Attack by different dictionary
for each salt value

Password Verification



Access Matrix Model

Access Matrix Model



Access Matrix Model

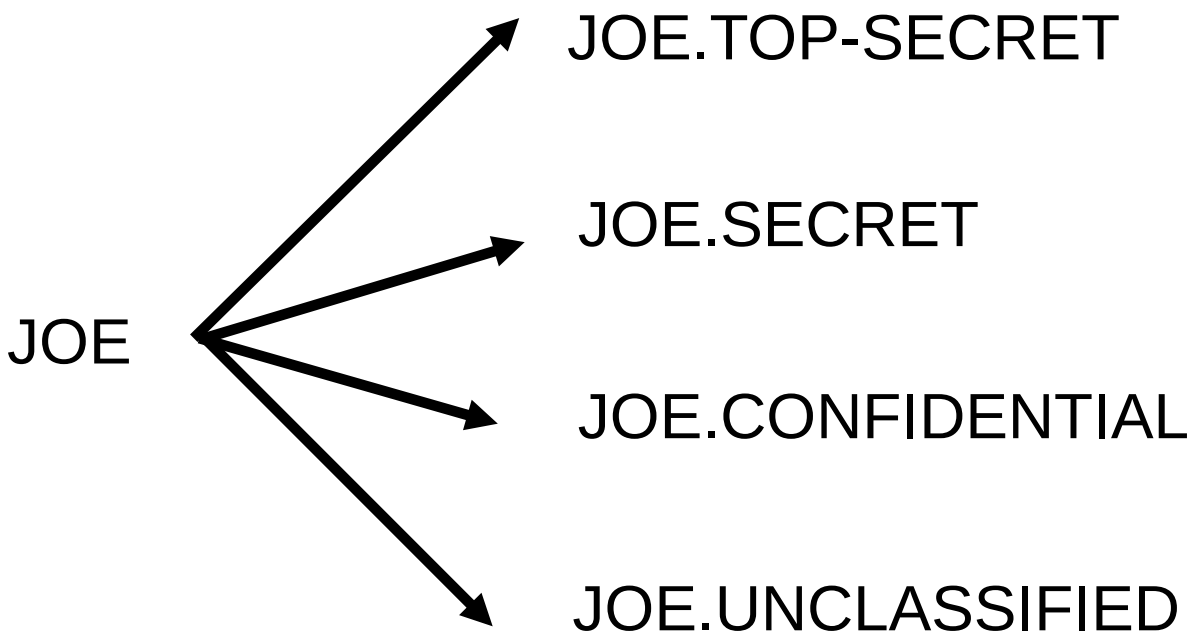
- Basic Abstractions
  - Subjects
  - Objects
  - Rights

- The rights in a cell specify the access of the subject (row) to the object (column)

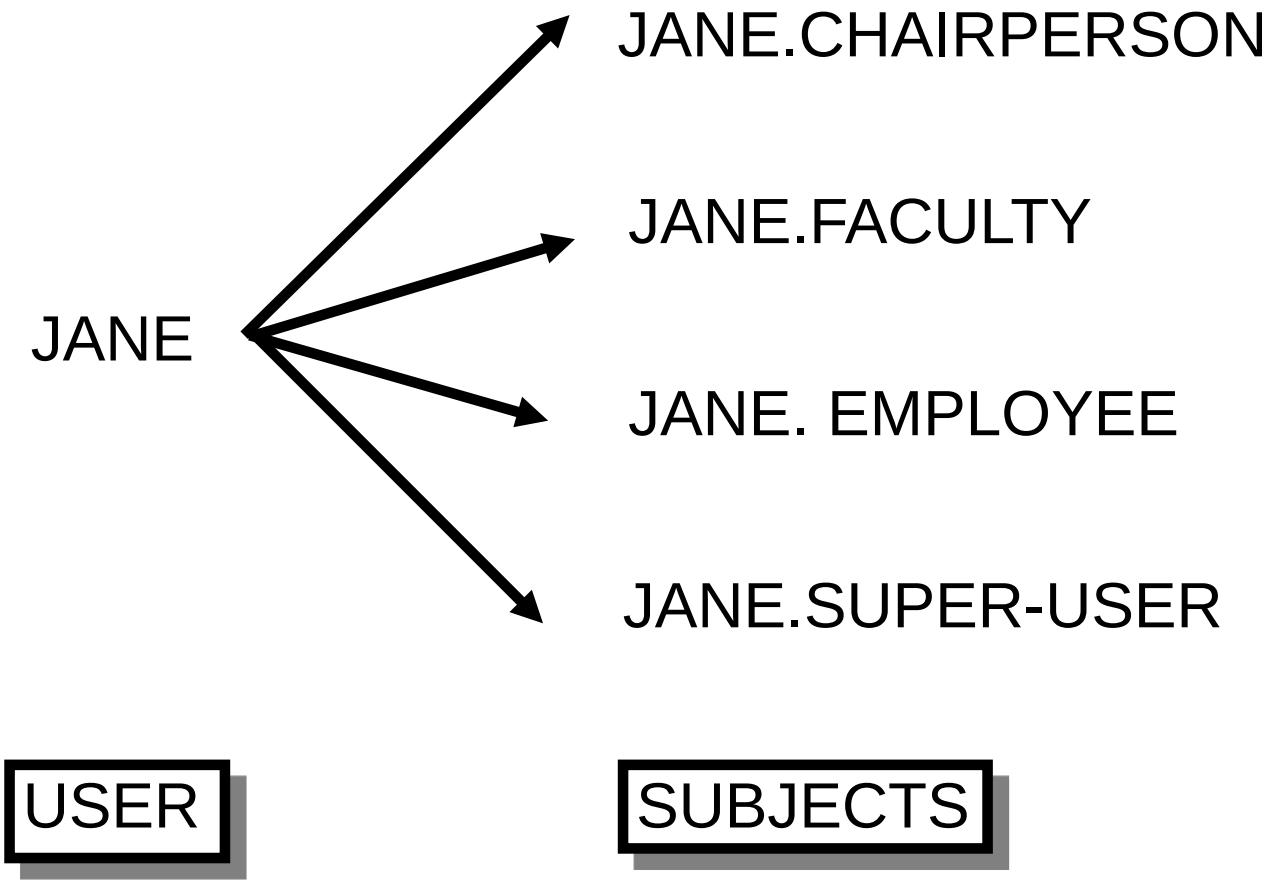
Users and Subjects

- A subject is a program (application) executing on behalf of a user
- A user may at any time be idle, or have one or more subjects executing on its behalf
- User-subject distinction is important if subject's rights are different from a user's rights
  - Usually a subset
  - In many systems a subject has all the rights of a user
- A human user may manifest as multiple users (accounts, principals) in the system

Users and Subjects



Users and Subjects



Objects

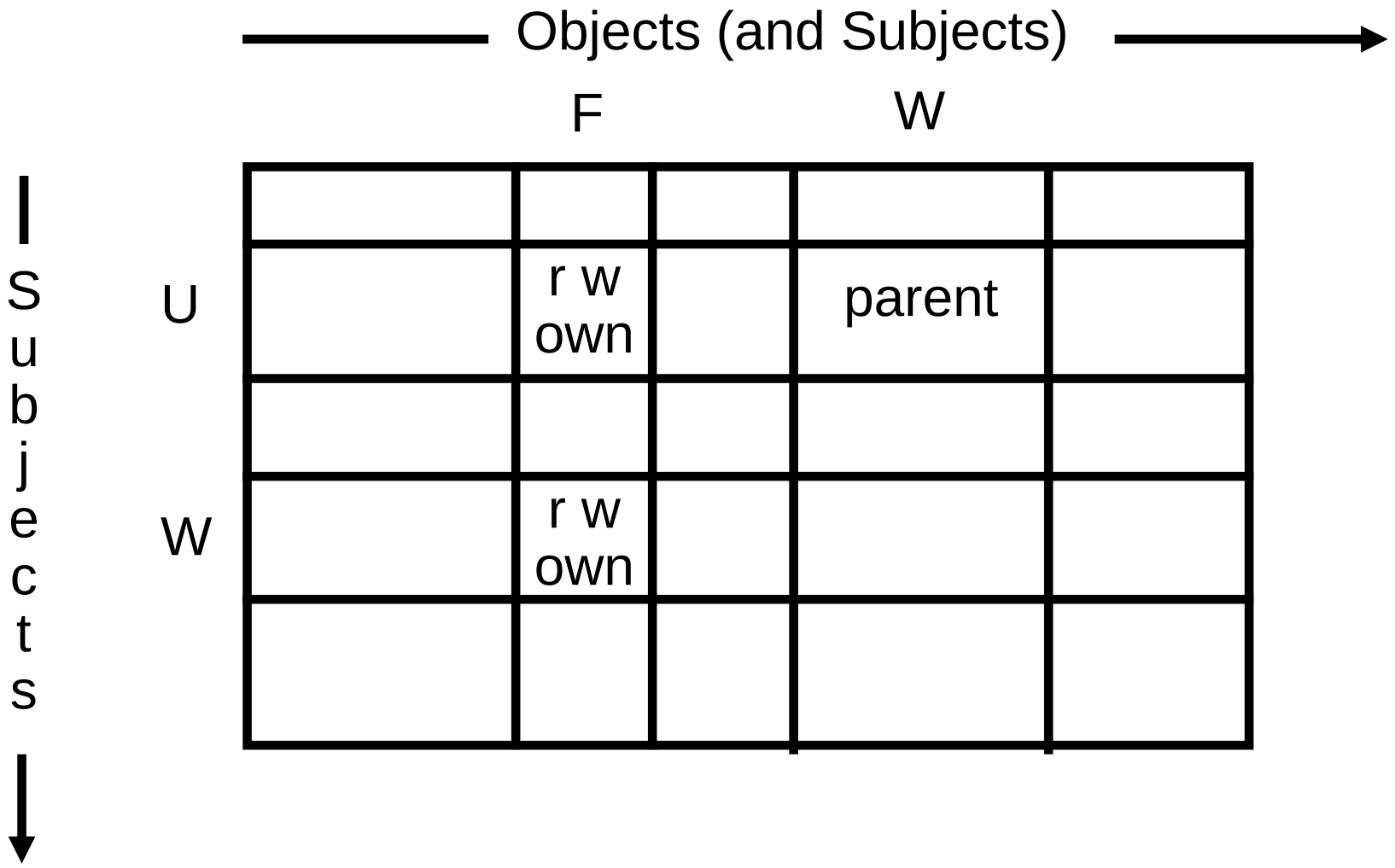
- An object is anything on which a subject can perform operations (mediated by rights)

- Usually objects are passive, for example:
  - File
  - Directory (or Folder)
  - Memory segment

  with CRUD operations (create, read, update, delete)

- But, subjects can also be objects, with operations
  - kill
  - suspend
  - resume

Access Matrix Model



Implementation

- Access Control Lists
- Capabilities
- Relations

Access Control Lists

F

U:r

U:w

U:own

G

U:r

V:r

V:w

V:own

each column of the access matrix is stored with the object corresponding to that column

Capabilities

U | F/r, F/w, F/own, G/r

V | G/r, G/w, G/own

each row of the access matrix is stored with the subject corresponding to that row

Relations

Subject	Access	Object
U	r	F
U	w	F
U	own	F
U	r	G
V	r	G
V	w	G
V	own	G

commonly used in relational database management systems

ACLs versus Capabilities

- Authentication
  - ACL's require authentication of subjects and ACL integrity
  - Capabilities require integrity and propagation control
- Access review
  - ACL's are superior on a per-object basis
  - Capabilities are superior on a per-subject basis
- Revocation
  - ACL's are superior on a per-object basis
  - Capabilities are superior on a per-subject basis
- Least privilege
  - Capabilities provide for finer grained least privilege control with respect to subjects, especially dynamic short-lived subjects created for specific tasks

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Most Operating Systems use ACLs often in abbreviated form: owner, group, world

Content-Dependent Controls

- content dependent controls
  - you can only see salaries less than 50K, or
  - you can only see salaries of employees who report to you

- beyond the scope of Operating Systems and are provided by Database Management Systems

Context-Dependent Controls

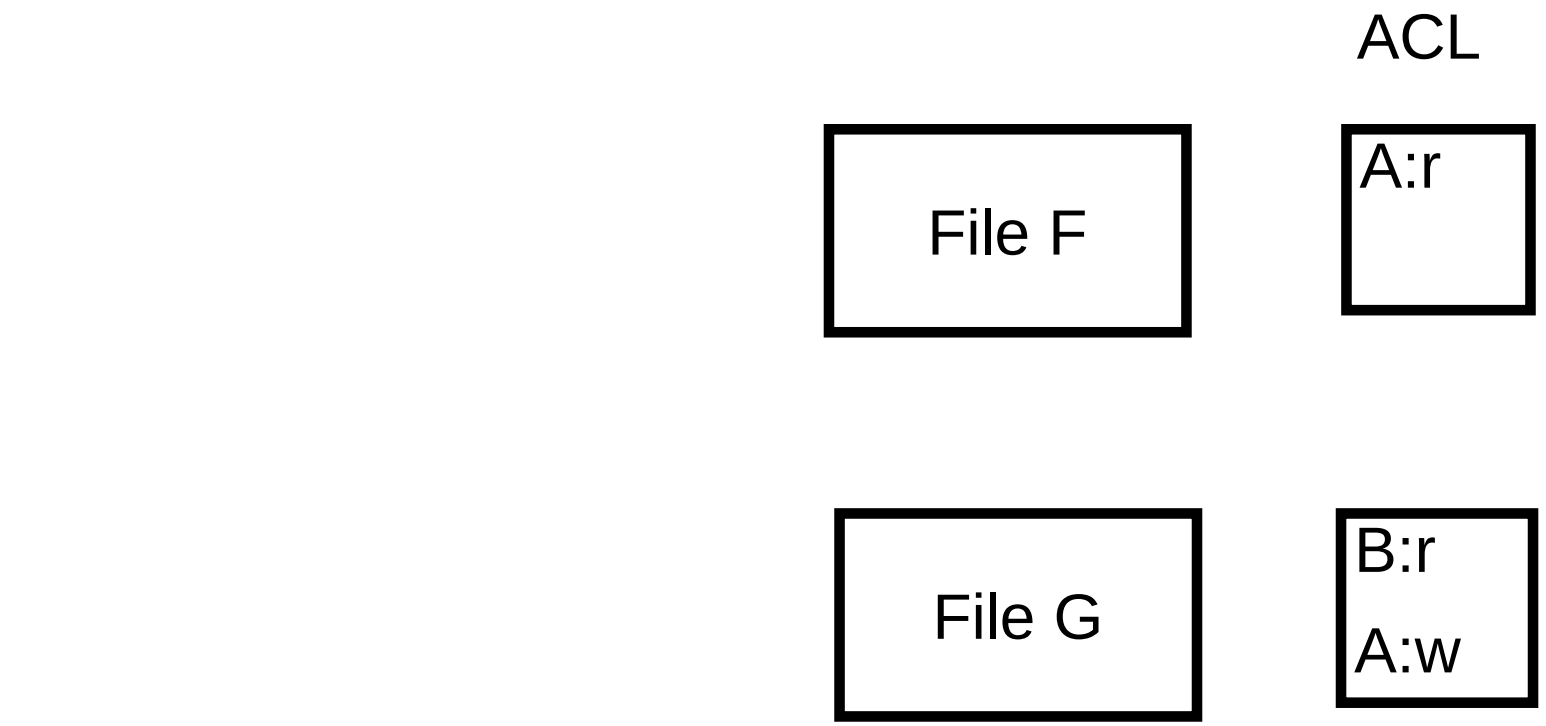
- context dependent controls
  - cannot access classified information via remote login
  - salary information can be updated only at year end
  - company's earnings report is confidential until announced at the stockholders meeting
- can be partially provided by the Operating System and partially by the Database Management System
- more sophisticated context dependent controls such as based on past history of accesses definitely require Database support

Trojan Horse Vulnerability of DAC

- Information from an object which can be read can be copied to any other object which can be written by a subject

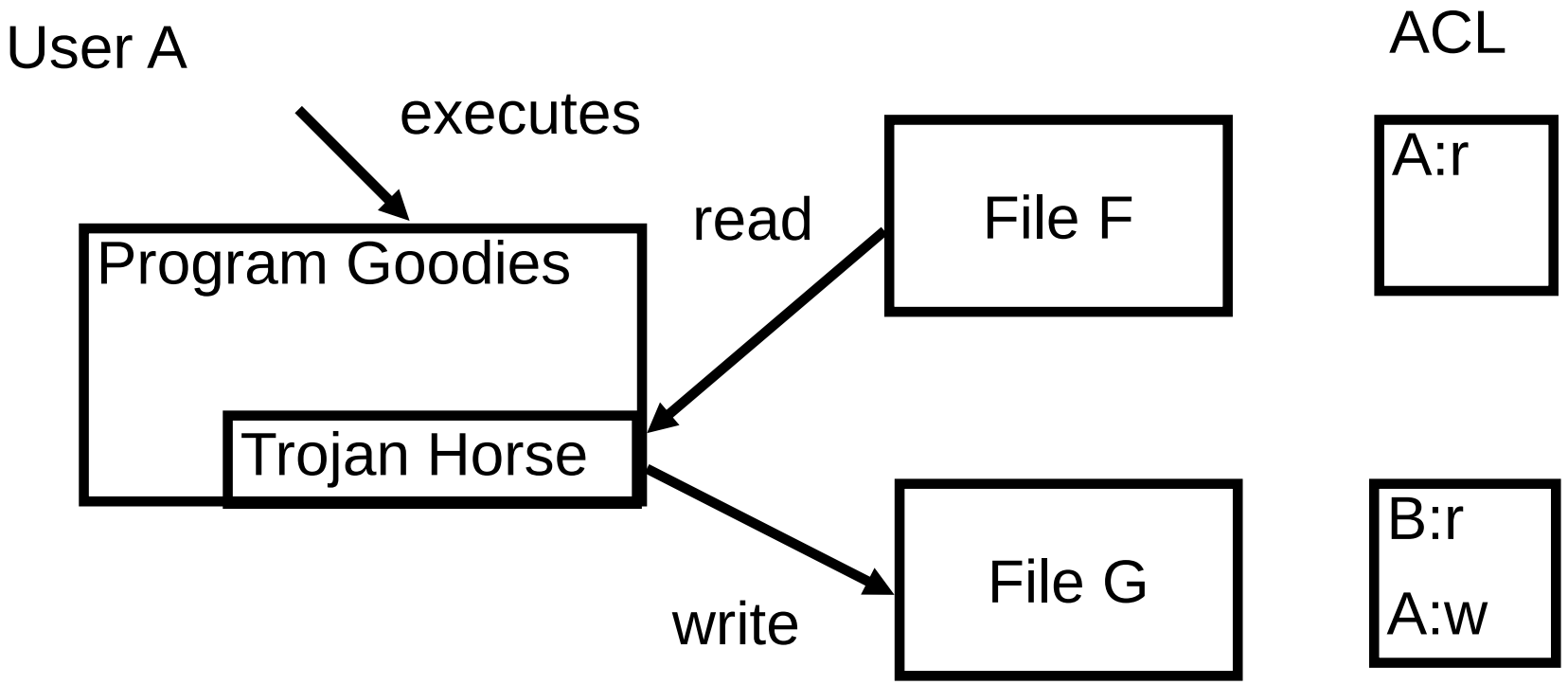
- Suppose our users are trusted not to do this deliberately. It is still possible for Trojan Horses to copy information from one object to another.

Trojan Horse Vulnerability of DAC



User B cannot read file F

Trojan Horse Vulnerability of DAC



User B can read contents of file F copied to file G

Copy Difference for rw

- Read of a digital copy is as good as read of original
- Write to a digital copy is not so useful

DAC Subtleties

- Chains of grants and revokes
- Inheritance of permissions
- Negative rights

HRU Model

Harrison, M. A., Ruzzo, W. L., & Ullman, J. D. (1976). Protection in operating systems. Communications of the ACM, 19(8), 461-471.