Digital Libraries

Access Management

W. Arms, Cornell

The Access Management Problem

The manager of a collection of information provides access subject to policies

- Library – donor restrictions, privacy, copyright
- Medical records – need to know
- Government – secrecy and classification
- Vendor – payment

Copyright

United States copyright law:

- Applies to literary works

  e.g., text, photographs, computer programs, musical scores, videos, audio tapes

- Initially, the creator of a work or the employer of the creator owns the copyright

  Exception: materials created by government employees

- Intellectual property -> can be bought and sold like any other property

Copyright

Copyright gives the owner the exclusive right to:

- reproduce
- distribute
- perform
- display
- license to others

Nominally for a fixed period, but the period has been steadily lengthened

Derivative work: new work uses any part of another work:

- New parts are owned by new author
- Conditions that apply to old work apply to derived work

Copyright

Rights of users

- First sale

  e.g., can sell used books

- Fair use

  e.g., can quote short sections in scholarly articles or reviews

International differences -- moral rights

- In Canada: author has rights to

  attribution of authorship

  integrity

- Moral rights cannot be transferred

Fair use

Factors to consider

- the purpose and character of the use, including whether such use is of a commercial nature or is for nonprofit educational purposes
- the nature of the copyrighted work
- the amount and substantiality of the portion used in relation to the copyrighted work as a whole
- the effect of the use upon the potential market for or value of the copyrighted work

Contracts, licenses and derivative works

Contracts allow intellectual property to be sold or licensed

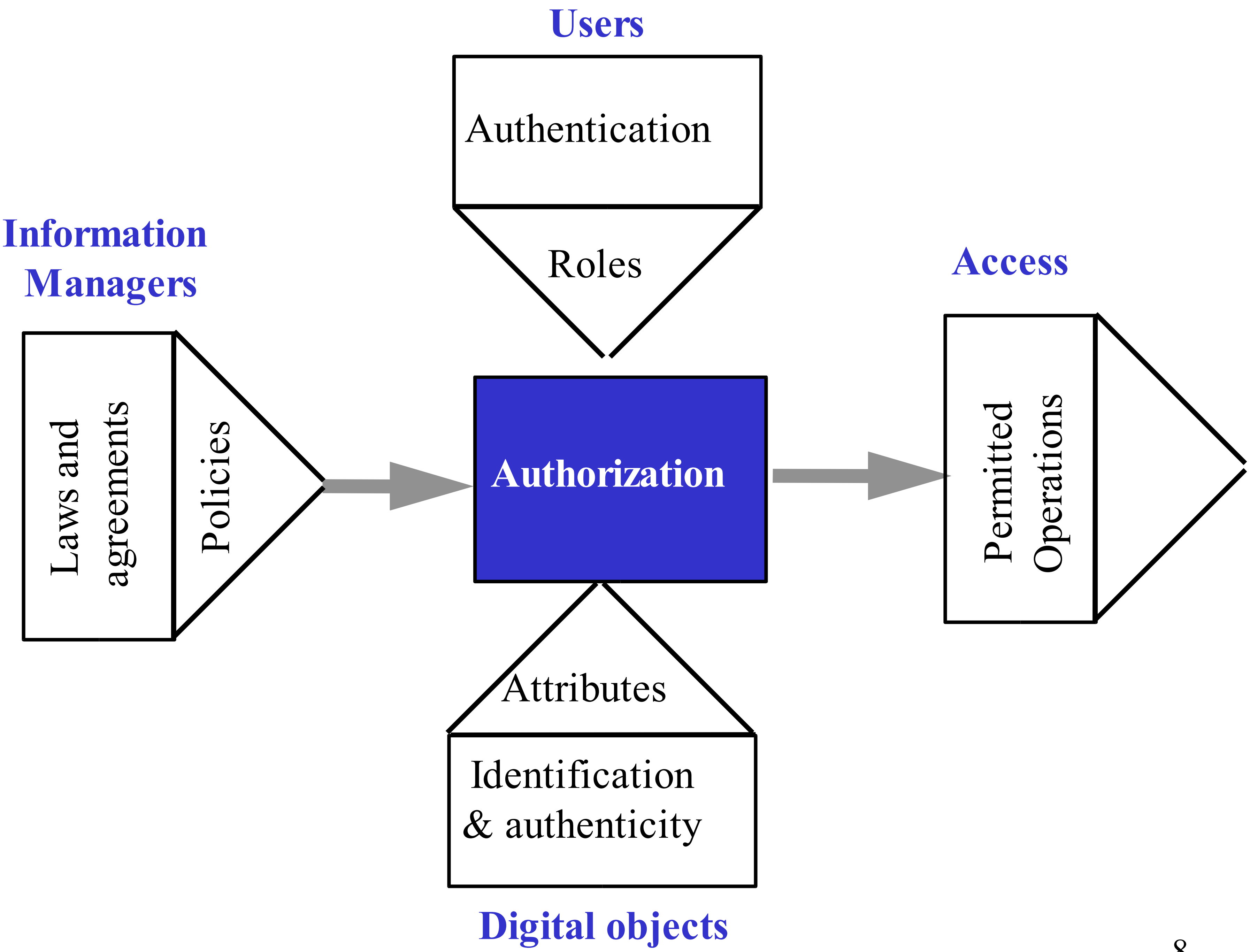
- Almost any terms and conditions can be agreed

  -> Permanent or temporary, whole or part

  -> Exclusive or non-exclusive

  -> Restrictive license or broad

- Enforceable by courts



Users

Authentication

Roles

Information Managers

Laws and agreements

Policies

Authorization

Access

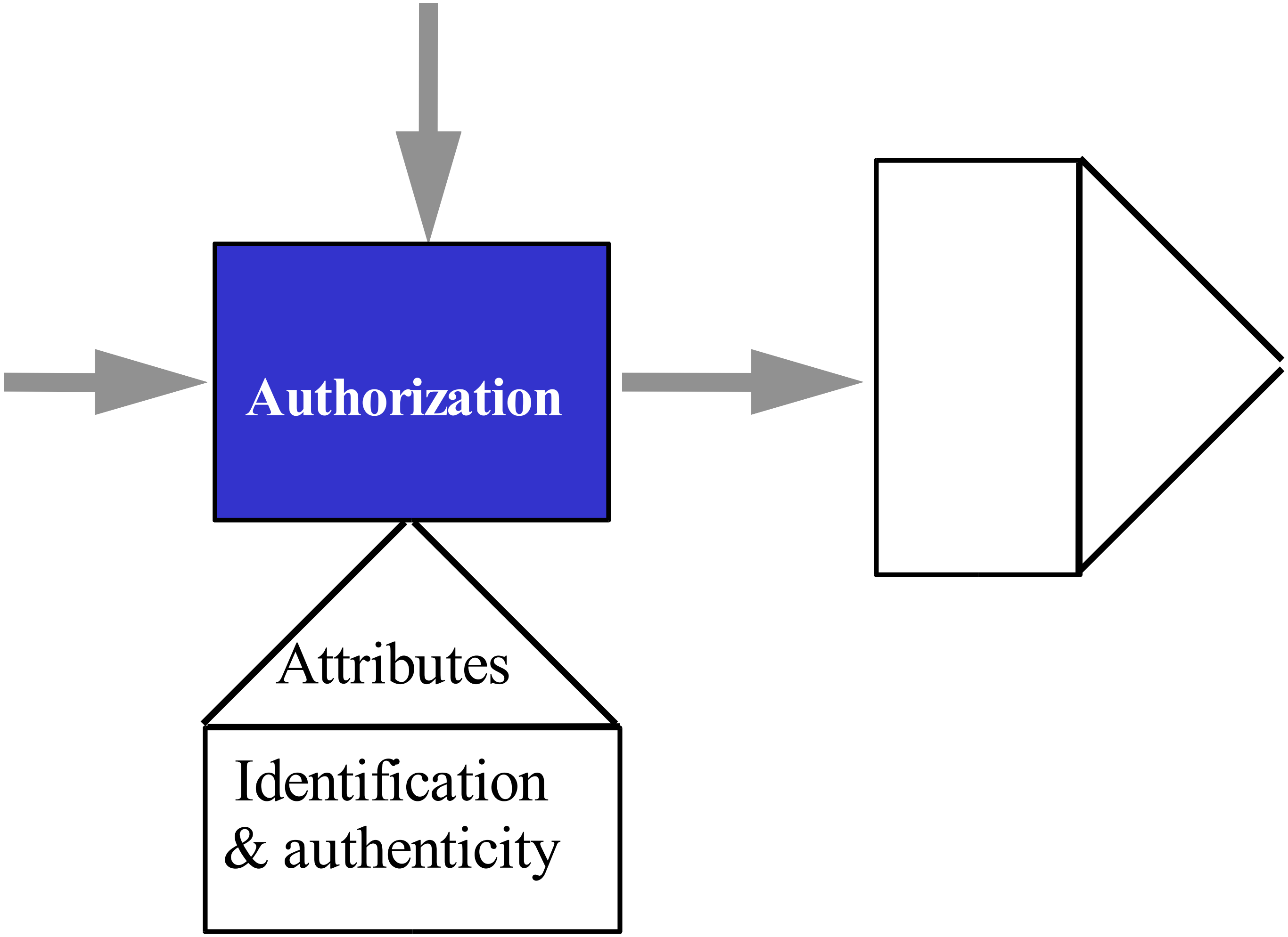
Permited Operations

Attributes

Identification & authenticity

Digital objects

Digital material



Authorization

Attributes

Identification & authenticity

Digital objects

Digital objects

Digital objects

Digital objects contain information that users may wish to access subject to policies. Properties of the digital objects that are important for access are encoded as attributes.

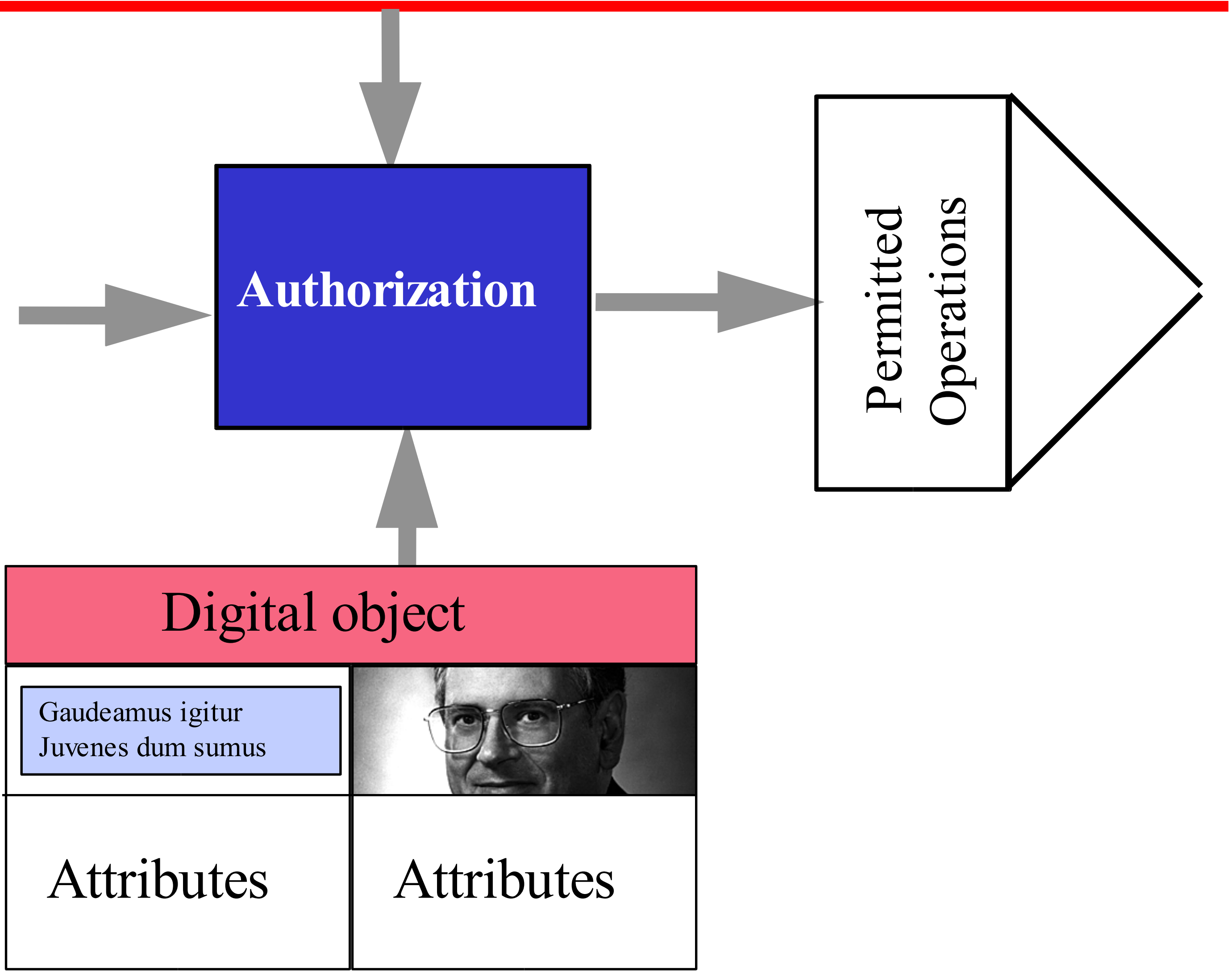
Examples: attributes

Attributes

Administrative metadata describes properties of the digital object, e.g.

- Registered for copyright on 1/1/1996.
- French government publication.
- Letter from donor, dated 1/1/1893, states "I donate my collected papers to the nation."

Complex digital object



Authorization

Permitted Operations

Digital object

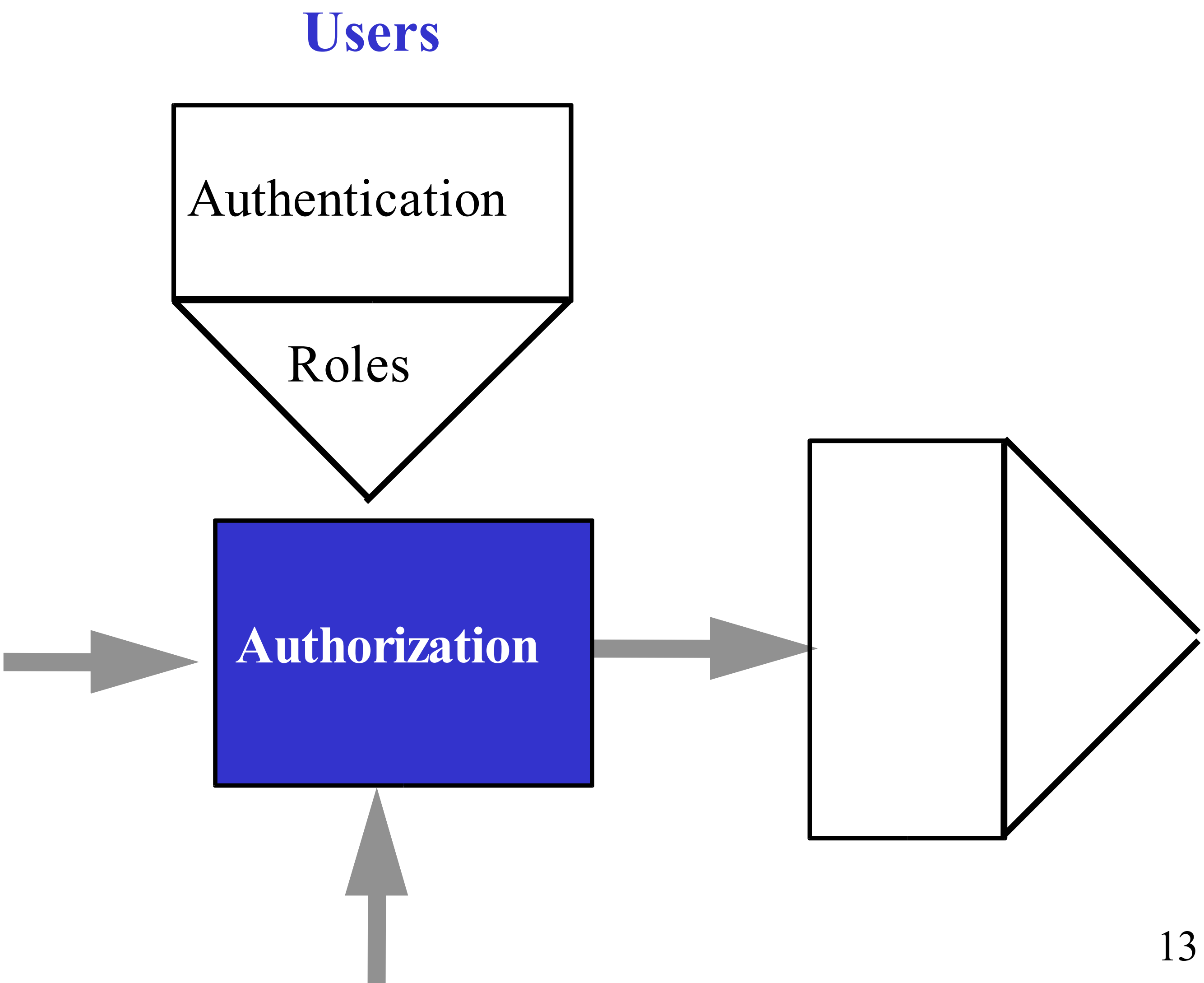
Gaudeamus igitur
Juvenes dum sumus

Attributes

Attributes

Different attributes may be associated with different elements of a digital object.

Users and roles



Users and roles

User

A user is a computer system, or a person using a computer system, that wishes to access digital objects. Characteristics of users are encoded as roles.

Examples of users and roles

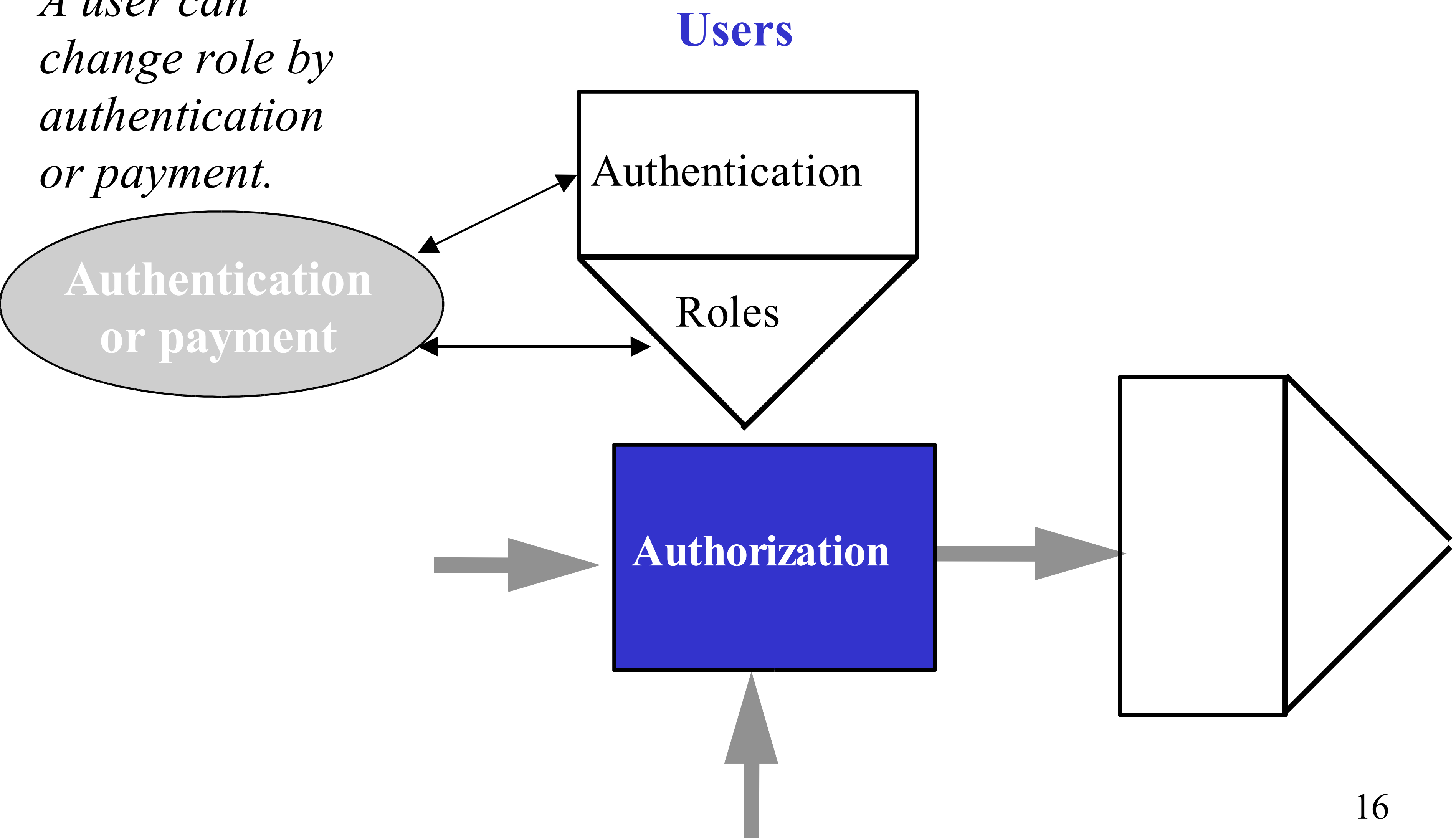
Roles

Verifiable facts about a user, used in access management, e.g.,

- The user is a subscriber to all ACM publications.
- The user is a minister of religion.
- The user is a high school student.
- The user is physically located within the Library of Congress.

Payment and authentication

A user can change role by authentication or payment.



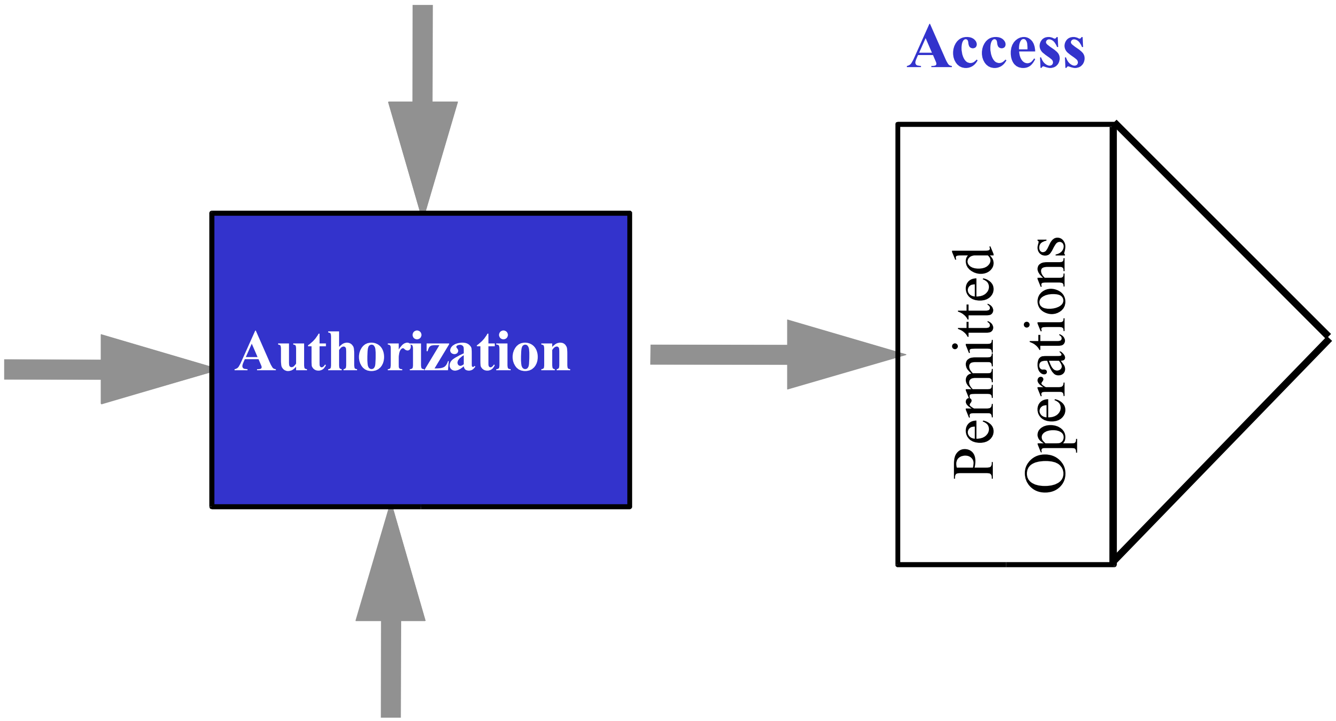
Examples: authentication and payment

Authentication and payment

User's roles can be modified by authentication and payment, e.g.,

- The user provided the login and password associated with William Y. Arms.
- The user has paid a fee of $10 to Visa.
- The user is verified to be located within a high school.

Permitted operations



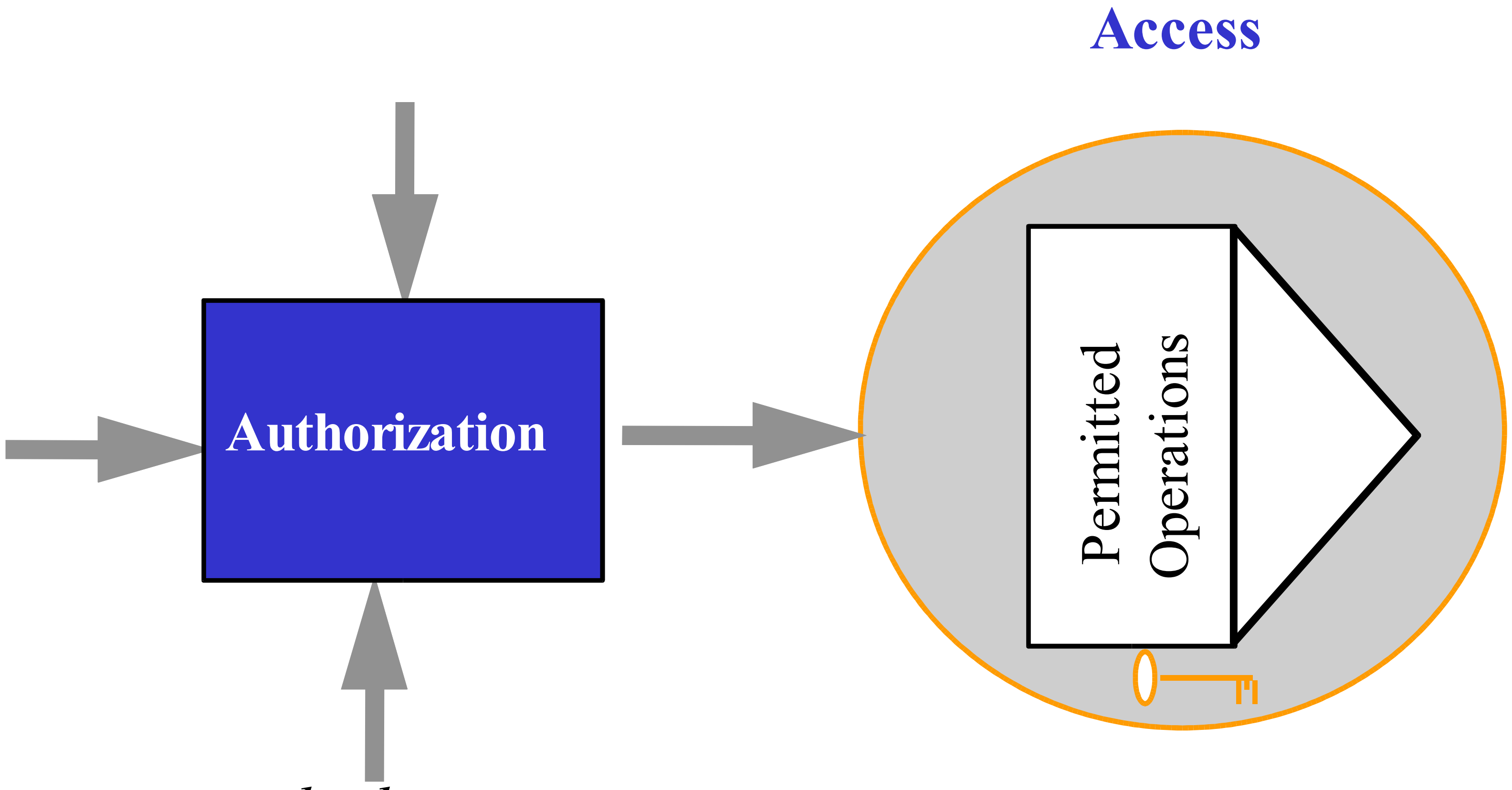
Permitted operations

Permitted operations

Formally defined actions that a user may take to access digital objects, e.g.,

- Replicate from one computer to another.
- Render an image on a screen.
- Extract 2 minutes from a video program.
- Create a derivative work.
- Perform in public for profit.
- Export to Australia.

Permitted operations



Encryption and other security measures ***may*** *by used to enforce the permitted operations.*

Enforcement

Enforcement

Methods to ensure that the permitted operations are the only actions carried out on digital objects.

Enforcement may be:

technical (*e.g., encryption*)
legal (*e.g., damages for violation*)
contractual (*e.g., revocation of license*)
social (*e.g., isolation from peers*)

Subsequent use

Access management policies frequently restrict the subsequent use that a user may make of digital objects, e.g.,

- No redistribution without attribution.
- Display on screen, but not print.
- Use on a specified computer only.

Enforcement of subsequent use policies by technical methods is rarely possible without great inconvenience.

Policy

Policy

A rule that associates attributes of digital objects with user roles to permit operations, e.g.,

- Access to subscribers only.
- May be used for any non-commercial purposes.
- Prints may be made at $1 per print.
- For use only within the Cornell Library.

if (*attribute*) and (*role*) then (*operation*)

Terms and conditions digital object

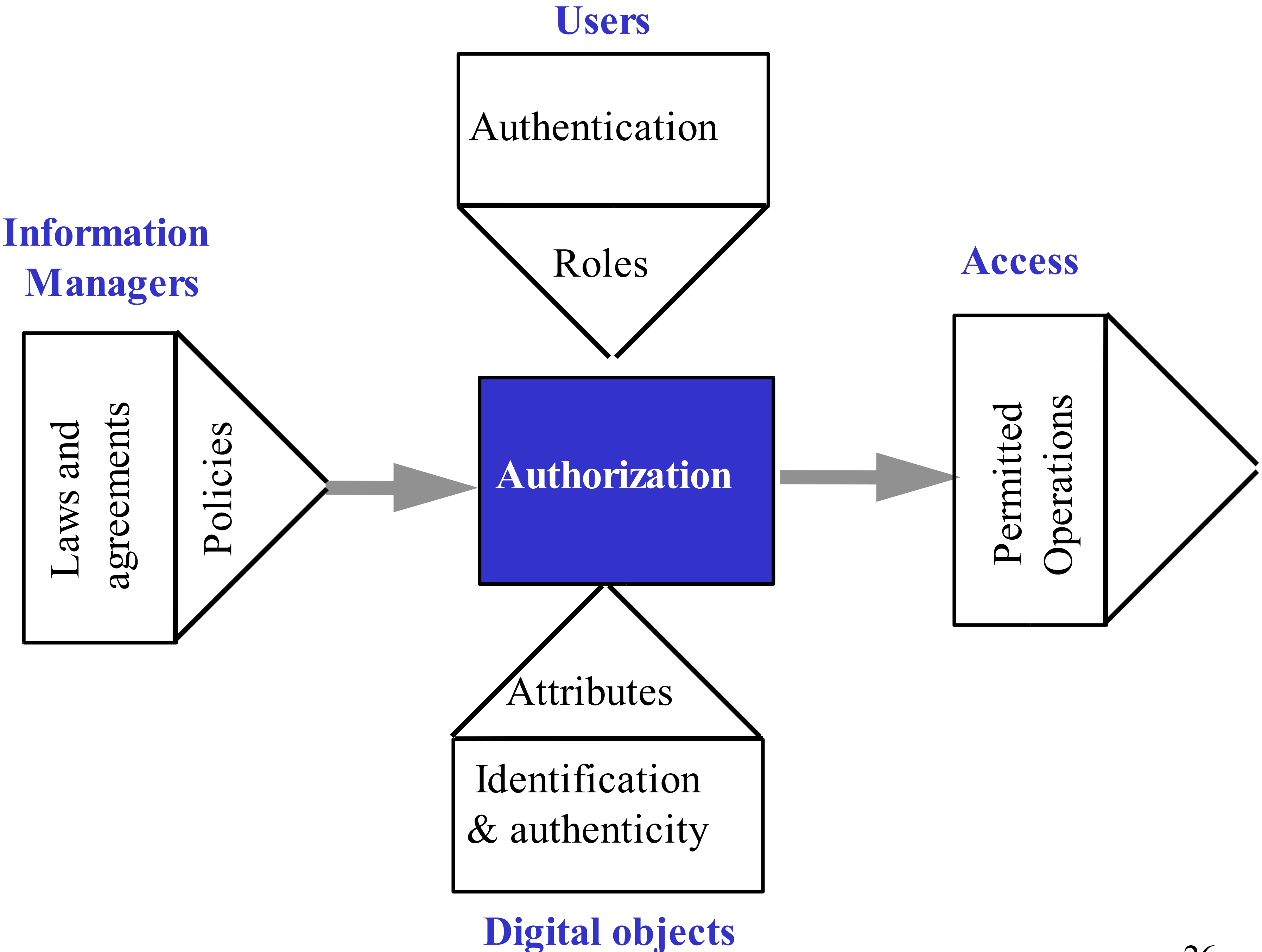
A Terms and Conditions digital object is a standard set of policies that are applied to many digital objects

Example:

- T&C object, CUL1, represents the standard policies for digital materials licensed by Cornell University.
- Material received by Cornell has the attribute CU1.
- If the standard policies change, only CU1 is changed.

Techniques of Access Management

- Roles and permitted operations
- Policies
- Encryption
- Authentication
- Subsequent use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Identification & authenticity
Digital objects

A publishing example

Collection consists of:
current journals, back list, promotional materials

Subscribers have access:
current and back list - general, no redistribution

Other users have access:
current - list price, no redistribution
back list - 50% of list price, no redistribution

Promotional materials - unlimited access

Attributes of digital objects

Attributes	
current	Current
back	Back list
promo	Promotional

Roles of users

Roles	
subscriber	User is a subscriber
other	Other user
list	Has paid list price
discount	Has paid 50% of list price

Permitted operations

Operations	
general	General access
dist	Redistribution

Policies

Attribute	**Role**	**Operations**
current or *back*	*subscriber*	*general,* not *dist*
current	*other* and *list*	*general,* not *dist*
back	*other* and *discount*	*general,* not *dist*
promo	*any*	*general, dist*

Each row of the table represents a policy.

Revision

The publisher changes its policies.

Current and back list will be treated the same, with a 20% discount on all journals.

Example: Revised Role

Define a new **role**:

standard	Has paid 80% of list price

Revised policies

Attribute	**Role**	**Operations**
current or *back*	*subscriber*	*general*, not *dist*
current or *back*	*other* and *standard*	*general*, not *dist*
promo	*any*	*general*, *dist*

The basic decisions

Providing access is harder than blocking access

- Intrusive technology drives people away
- People value their privacy

It must be clear what the technology is trying to achieve

- Technology serves economic or organizational goals

Every technical question has an organizational context

Technical strategies

Technology can support alternative market strategies:

Strong enforcement:

Emphasis is on strict control by technical means.
Subsequent use is barred by technology.

Weak enforcement:

Emphasis is on customer satisfaction and market growth.
Technology augmented by economic and social forces.

Trade-offs in enforcing access management

Convenience to users ↔ Strength of enforcement

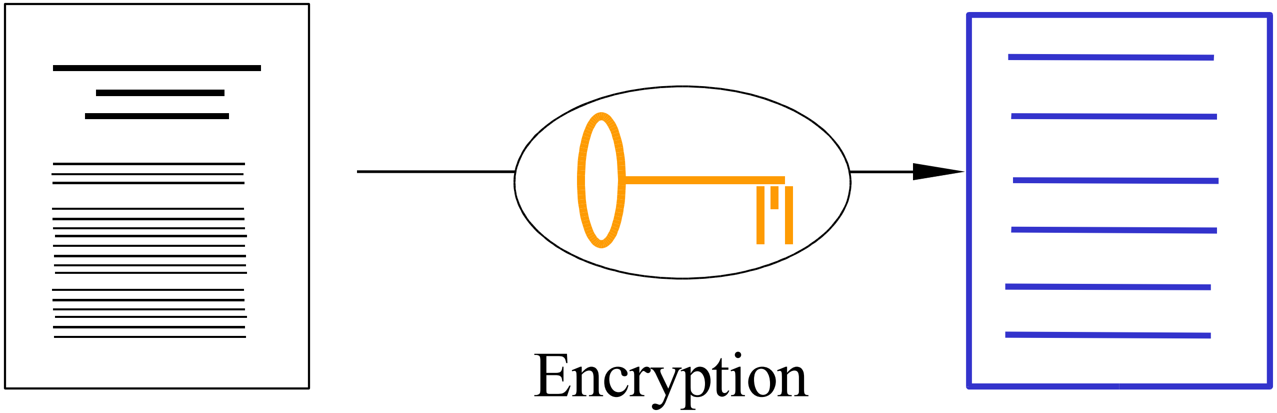
What is the cost of failure of authorization systems?

- Loss of revenue
- Harmful effects of security failure
- Loss of privacy
- Local compromise of security
- Global compromise of security

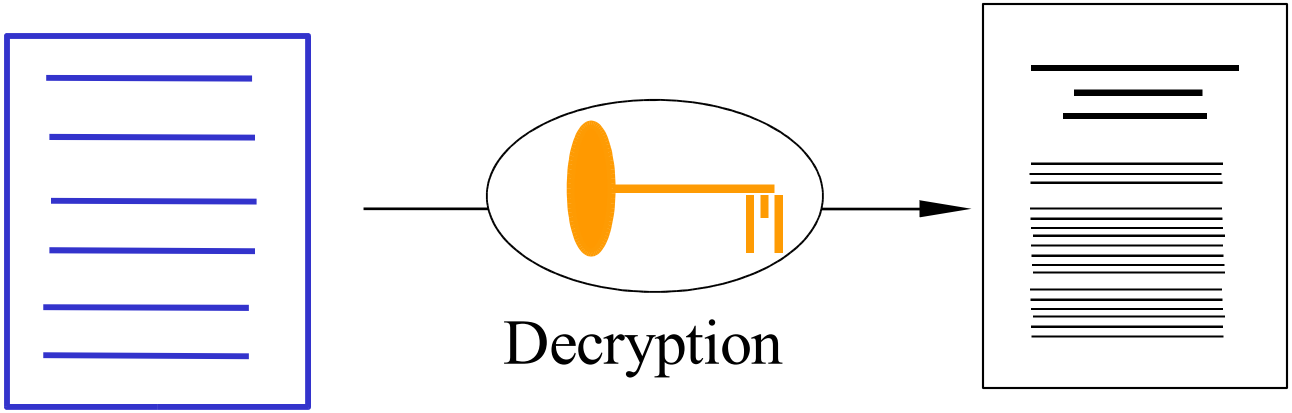
In digital libraries, the harm from security failures may be small

The loss from unhappy customers may be great

Encryption

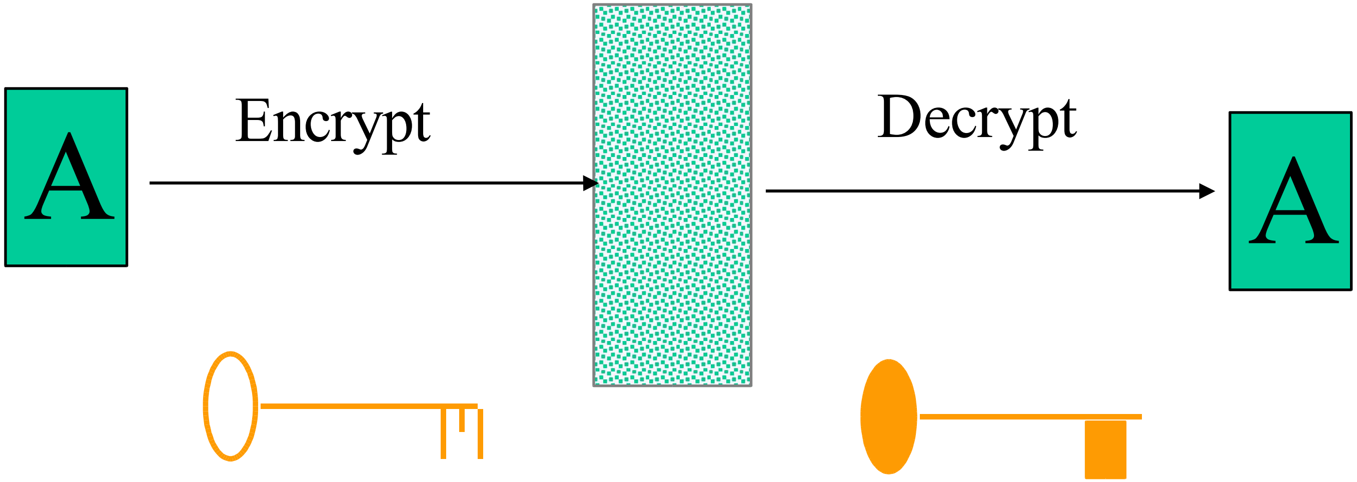


Encryption



Decryption

Dual key encryption



Each individual is given a key pair:

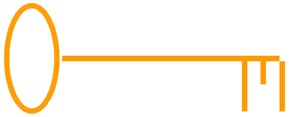
public key -- known to the public

private key -- kept private

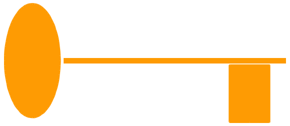
You wish to send me an encrypted message

1. I tell you my public key (public information)

2. You encrypt the message using my public key and send it to me



3. I decrypt the message using my private key



Encryption in practice

Key management is difficult

Single key encryption needs shared private keys.
Dual key encryption needs public key infrastructure.

One-time keys are good for secure transmission.

Government policies are misguided

Authentication of users

The issue: Cornell University has a site license to ACM journals.
Is this user a member of Cornell University?

Approaches:

- IP address of user
- IP address of proxy
- login ID and password

  -> separate for each application or system
  -> campus authentication (e.g., Kerberos)

Authentication of users

Approaches to authentication

- What you know -- password
- What you have -- smart card, IP address
- Who you are -- finger print

Trade-off

Simple, but insecure

- Address of computer
- ID and password

Expensive and intrusive

Authenticity of digital objects

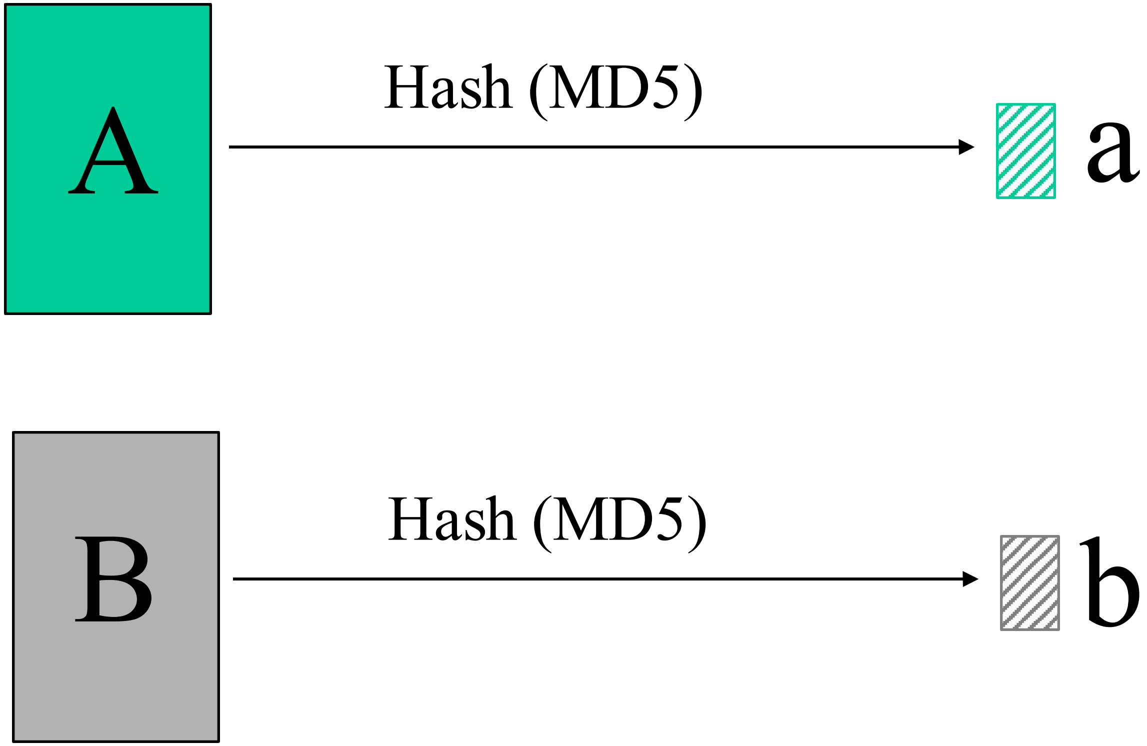
The issue:

- Content can easily be changed by error or maliciously.
- Authentication systems based on digital signatures fail if one bit changes.
- Authentication of content should be invariant over changes of font, format, encoding, and layout.

Examples:

- Copyright registration.
- International document delivery.

Hashing as test of identity



A

Hash (MD5)

a

B

Hash (MD5)

b

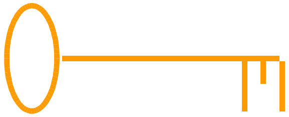
a and **b**
are each
128 bits

If a = b then A is identical to B.
Chance of error is tiny.

I wish to prove a message came from me

1. I calculate a hash of the message.

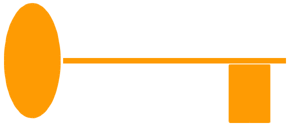
2. I encrypt the hash using my private key.



3. I send you:

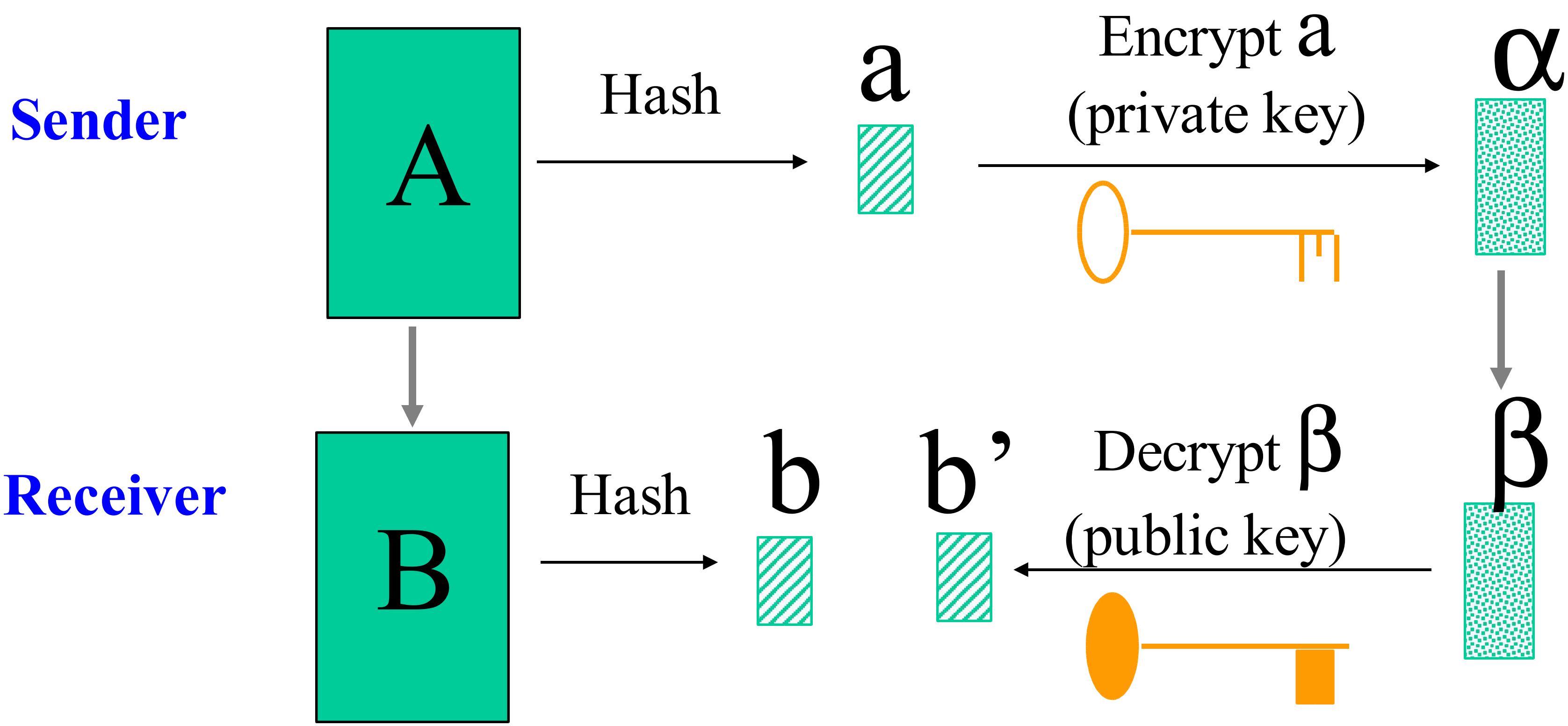
   the message
   the encrypted hash

4. You decrypt the hash using my public key.



5. You calculate the hash on the received message.

Digital Signature



Sender

A

Hash

a

Encrypt a (private key)

α

Receiver

B

Hash

b

b’

Decrypt β (public key)

β

If b = b’ then:

(a) Message is unaltered, A = B.

(b) Encryption used correct private key.

Subsequent use

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Secure container (Cryptolope)

Bill of Materials	
Clear Text	
Encrypted fingerprinting and watermarking instructions	
Encrypted document part	Key record
Encrypted document part	Key record
Encrypted document part	Key record
Terms and Conditions	
Integrity protection and signatures	

Trusted systems

If all computers in a system can trust each other, powerful and flexible access management is possible.

General purpose personal computers are unlikely to be trusted.

Special purpose computers may be trusted, e.g., smart cards, printers.