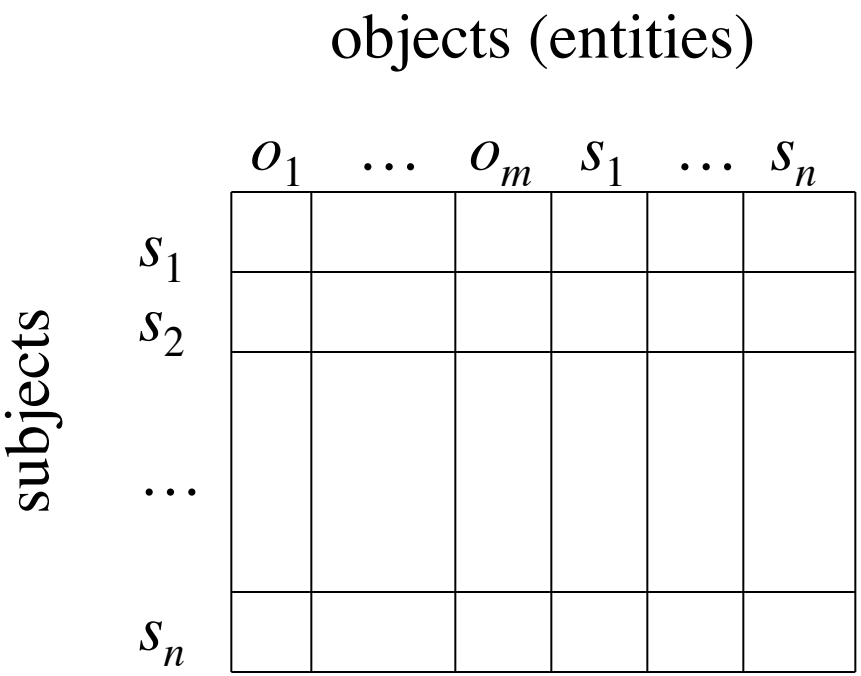
April 3: Access Control Matrix

- Overview
- Access Control Matrix Model
  - Boolean Expression Evaluation
  - History

Overview

- Protection state of system
  - Describes current settings, values of system relevant to protection
- Access control matrix
  - Describes protection state precisely
  - Matrix describing rights of subjects
  - State transitions change elements of matrix

Description



- Subjects $S = \{ s_1, \ldots, s_n \}$
- Objects $O = \{ o_1, \ldots, o_m \}$
- Rights $R = \{ r_1, \ldots, r_k \}$
- Entries $A[s_i, o_j] \subseteq R$
- $A[s_i, o_j] = \{ r_x, \ldots, r_y \}$ means subject s_i has rights $r_x, \ldots, r_y$ over object o_j

Example 1

- Processes p, q
- Files f, g
- Rights r, w, x, a, o

	f	g	p	q
p	rwo	r	$rwxo$	w
q	a	ro	r	$rwxo$

Example 2

- Host names *telegraph*, *nob*, *toadflax*
- Rights *own*, *ftp*, *nfs*, *mail*

	telegraph	*nob*	*toadflax*
telegraph	*own*	*ftp*	*ftp*
nob		*ftp, mail, nfs, own*	*ftp, nfs, mail*
toadflax		*ftp, mail*	*ftp, mail, nfs, own*

Example 3

- Procedures *inc_ctr*, *dec_ctr*, *manage*
- Variable *counter*
- Rights +, –, *call*

	counter	*inc_ctr*	*dec_ctr*	*manage*
inc_ctr	+			
dec_ctr	–			
manager		*call*	*call*	*call*

Boolean Expression Evaluation

- ACM controls access to database fields
  - Subjects have attributes
  - Verbs define type of access
  - Rules associated with objects, verb pair
- Subject attempts to access object
  - Rule for object, verb evaluated, grants or denies access

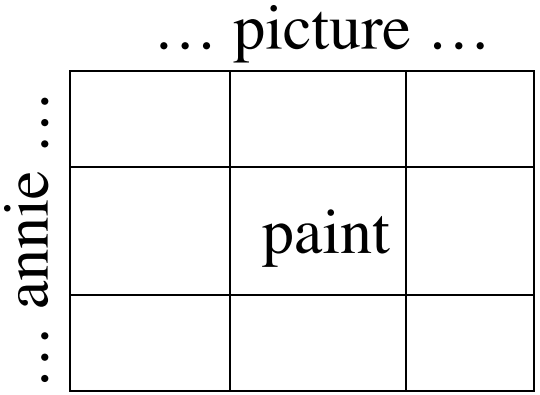
Example

- Subject annie
  - Attributes *role* (artist), *group* (creative)
- Verb paint
  - Default 0 (deny unless explicitly granted)
- Object picture
  - Rule:

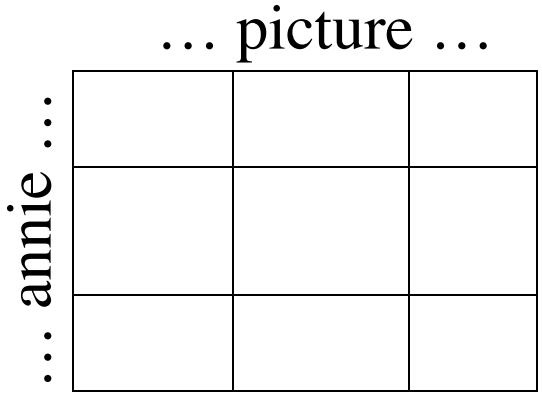
    paint: ‘artist’ in subject.role and
    ‘creative’ in subject.groups and
    time.hour ≥ 0 and time.hour ≤ 4

ACM at 3AM and 10AM

At 3AM, time condition met; ACM is:



At 10AM, time condition not met; ACM is:



History

- Problem: what a process has accessed may affect what it can access now
- Example: procedure in a web applet can access other procedures depending on what procedures it has already accessed
  - S set of *static rights* associated with procedure
  - C set of current rights associated with each executing process
  - When process calls procedure, rights are $S \cap C$

Example Program

```
// This routine has no filesystem access rights
// beyond those in a limited, temporary area
procedure helper_proc()
        return sys_kernel_file

// But this has the right to delete files
program main()
        sys_load_file(helper_proc)
        file = helper_proc()
        sys_delete_file(file)
```

- *sys_kernel_file* contains system kernel
- *tmp_file* is in limited area that *helper_proc*)_ can access

Before *helper_proc* Called

- Static rights of program

	sys_kernel_file	*tmp_file*
main	delete	delete
helper_proc		delete

- When program starts, current rights:

	sys_kernel_file	*tmp_file*
main	delete	delete
helper_proc		delete
process	delete	delete

After *helper_proc* Called

- Process rights are intersection of static, previous "current" rights:

	sys_kernel_file	*tmp_file*
main	delete	delete
helper_proc		delete
process		delete