ECS 235B Module 11
Sharing in the Take-Grant Model

can•share Predicate

Definition:

- *can•share*(r, **x**, **y**, G_0) if, and only if, there is a sequence of protection graphs G_0, …, G_n such that $G_0 \vdash^* G_n$ using only *de jure* rules and in G_n there is an edge from **x** to **y** labeled r.

can•share Theorem

- *can•share*(r, **x**, **y**, G_0) if, and only if, there is an edge from **x** to **y** labeled r in G_0, or the following hold simultaneously:
  - There is an **s** in G_0 with an **s**-to-**y** edge labeled r
  - There is a subject **x′** = **x** or initially spans to **x**
  - There is a subject **s′** = **s** or terminally spans to **s**
  - There are islands $I_1, \ldots, I_k$ connected by bridges, and **x′** in I_1 and **s′** in I_k

Outline of Proof

- **s** has *r* rights over **y**
- **s′** acquires *r* rights over **y** from **s**
  - Definition of terminal span
- **x′** acquires *r* rights over **y** from **s′**
  - Repeated application of sharing among vertices in islands, passing rights along bridges
- **x′** gives *r* rights over **y** to **x**
  - Definition of initial span

Example Interpretation

- ACM is generic
  - Can be applied in any situation
- Take-Grant has specific rules, rights
  - Can be applied in situations matching rules, rights
- Question: what states can evolve from a system that is modeled using the Take-Grant Model?

Take-Grant Generated Systems

- Theorem: G_0 protection graph with 1 vertex, no edges; R set of rights. Then $G_0 \vdash^* G$ iff:
  - G finite directed graph consisting of subjects, objects, edges
  - Edges labeled from nonempty subsets of R
  - At least one vertex in G has no incoming edges

Outline of Proof

$\Rightarrow$: By construction; G final graph in theorem

- Let $\mathbf{x}_1, \ldots, \mathbf{x}_n$ be subjects in G
- Let $\mathbf{x}_1$ have no incoming edges

- Now construct G' as follows:

1. Do "$\mathbf{x}_1$ creates ($\alpha \cup \{ g \}$ to) new subject $\mathbf{x}_i$"
2. For all ($\mathbf{x}_i$, $\mathbf{x}_j$) where $\mathbf{x}_i$ has a rights over $\mathbf{x}_j$, do
   "$\mathbf{x}_1$ grants (α to $\mathbf{x}_j$) to $\mathbf{x}_i$"
3. Let β be rights $\mathbf{x}_i$ has over $\mathbf{x}_j$ in G. Do
   "$\mathbf{x}_1$ removes (($\alpha \cup \{ g \} - \beta$ to) $\mathbf{x}_j$"

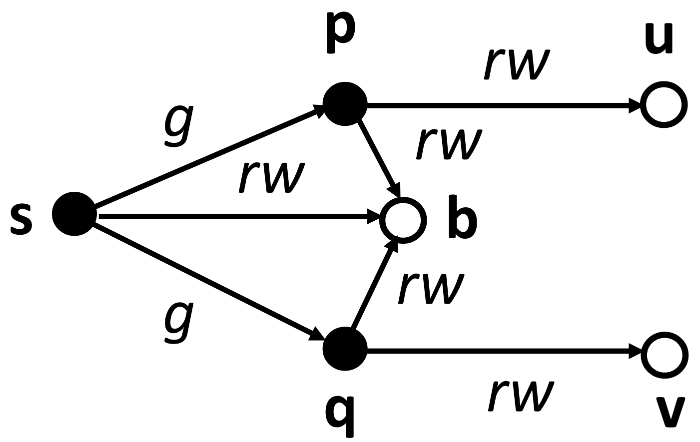
- Now G' is desired G

Outline of Proof

$\Leftarrow$: Let **v** be initial subject, and $G_0 \vdash^* G$

- Inspection of rules gives:
  - *G* is finite
  - *G* is a directed graph
  - Subjects and objects only
  - All edges labeled with nonempty subsets of *R*
- Limits of rules:
  - None allow vertices to be deleted so **v** in *G*
  - None add incoming edges to vertices without incoming edges, so **v** has no incoming edges

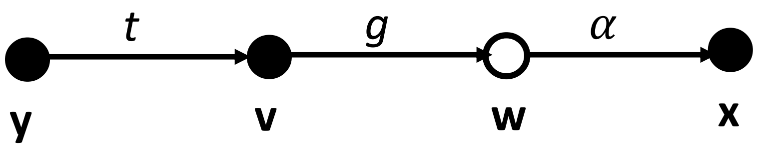
Example: Shared Buffer



- Goal: **p**, **q** to communicate through shared buffer **b** controlled by trusted entity **s**
    1. **s** creates ({*r*, *w*} to new object) **b**
    2. **s** grants ({*r*, *w*} to **b**) to **p**
    3. **s** grants ({*r*, *w*} to **b**) to **q**

Quiz

In either 1 or 2 or both, can **x** obtain *r* rights over **y**?

1. 

2.