SQL Authorization

Privileges

Grant and Revoke

Grant Diagrams

Authorization

- A file system identifies certain privileges on the objects (files) it manages.
  - Typically read, write, execute.
- A file system identifies certain participants to whom privileges may be granted.
  - Typically the owner, a group, all users.

Privileges – (1)

- SQL identifies a more detailed set of privileges on objects (relations) than the typical file system.
- Nine privileges in all, some of which can be restricted to one column of one relation.

Privileges – (2)

- Some important privileges on a relation:
  1. SELECT = right to query the relation.
  2. INSERT = right to insert tuples.
     - May apply to only one attribute.
  3. DELETE = right to delete tuples.
  4. UPDATE = right to update tuples.
     - May apply to only one attribute.

Example: Privileges

- For the statement below:

```
INSERT INTO Beers(name)
   SELECT beer FROM Sells
   WHERE NOT EXISTS
      (SELECT * FROM Beers
       WHERE name = beer);
```

beers that do not appear in Beers. We add them to Beers with a NULL manufacturer.

- We require privileges SELECT on Sells and Beers, and INSERT on Beers or Beers.name.

Database Objects

- The objects on which privileges exist include stored tables and views.
- Other privileges are the right to create objects of a type, e.g., triggers.
- Views form an important tool for access control.

Example: Views as Access Control

- We might not want to give the SELECT privilege on Emps(name, addr, salary).
- But it is safer to give SELECT on:

```
CREATE VIEW SafeEmps AS
  SELECT name, addr FROM Emps;
```

- Queries on SafeEmps do not require SELECT on Emps, just on SafeEmps.

Authorization ID's

- A user is referred to by *authorization ID*, typically their login name.
- There is an authorization ID PUBLIC.
  - Granting a privilege to PUBLIC makes it available to any authorization ID.

Granting Privileges

- You have all possible privileges on the objects, such as relations, that you create.
- You may grant privileges to other users (authorization ID's), including PUBLIC.
- You may also grant privileges WITH GRANT OPTION, which lets the grantee also grant this privilege.

The GRANT Statement

- To grant privileges, say:

```
GRANT <list of privileges>
ON <relation or other object>
TO <list of authorization ID’s>;
```

- If you want the recipient(s) to be able to pass the privilege(s) to others add:

```
WITH GRANT OPTION
```

Example: GRANT

- Suppose you are the owner of Sells. You may say:

```
    GRANT SELECT, UPDATE(price)
    ON Sells
    TO sally;
```

- Now Sally has the right to issue any query on Sells and can update the price component only.

Example: Grant Option

- Suppose we also grant:

```
GRANT UPDATE ON Sells TO sally
WITH GRANT OPTION;
```

- Now, Sally not only can update any attribute of Sells, but can grant to others the privilege UPDATE ON Sells.
  - Also, she can grant more specific privileges like `UPDATE(price)ON Sells`.

Revoking Privileges

```
REVOKE <list of privileges>
ON <relation or other object>
FROM <list of authorization ID's>;
```

- Your grant of these privileges can no longer be used by these users to justify their use of the privilege.
  - But they may still have the privilege because they obtained it independently from elsewhere.

REVOKE Options

- We must append to the REVOKE statement either:
  1. CASCADE. Now, any grants made by a revokee are also not in force, no matter how far the privilege was passed.
  2. RESTRICT. If the privilege has been passed to others, the REVOKE fails as a warning that something else must be done to "chase the privilege down."

Grant Diagrams

- Nodes = user/privilege/grant option?/is owner?
  - UPDATE ON R, UPDATE(a) on R, and UPDATE(b) ON R live in different nodes.
  - SELECT ON R and SELECT ON R WITH GRANT OPTION live in different nodes.
- Edge *X* -> *Y* means that node *X* was used to grant *Y*.

Notation for Nodes

- Use *AP* for the node representing authorization ID *A* having privilege *P*.
  - *P** = privilege *P* with grant option.
  - *P*** = the source of the privilege *P*.
    - I.e., *A* is the owner of the object on which *P* is a privilege.
    - Note ** implies grant option.

Manipulating Edges – (1)

- When *A* grants *P* to *B*, We draw an edge from *AP* * or *AP* ** to *BP*.
  - Or to *BP* * if the grant is with grant option.
- If *A* grants a subprivilege *Q* of *P* [say UPDATE(a) on R when *P* is UPDATE ON R] then the edge goes to *BQ* or *BQ* *, instead.

Manipulating Edges – (2)

- Fundamental rule: User *C* has privilege *Q* as long as there is a path from *XP*** to *CQ*, *CQ**, or *CQ***, and *P* is a superprivilege of *Q*.
  - Remember that *P* could be *Q*, and *X* could be *C*.

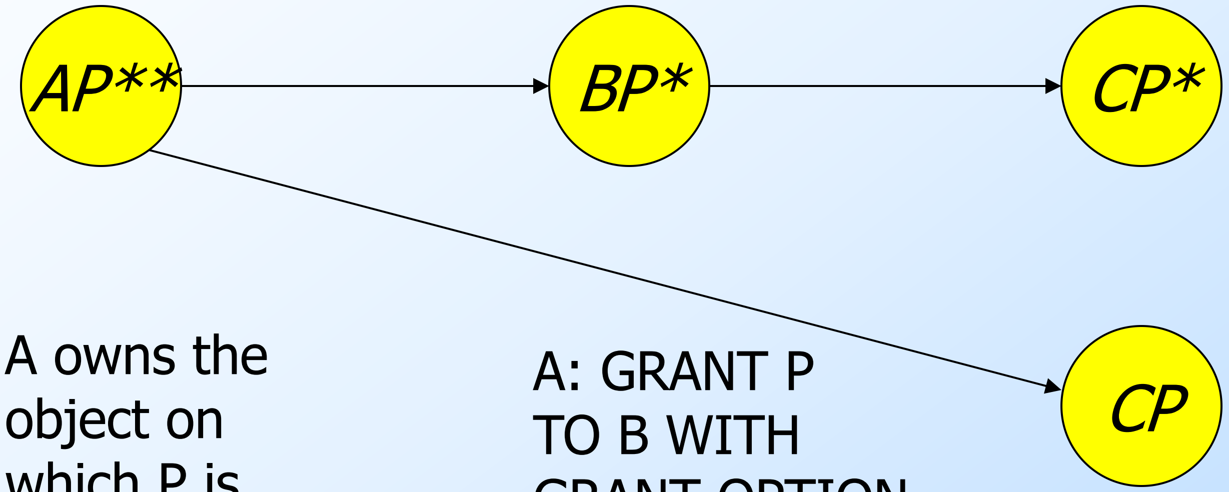
Manipulating Edges – (3)

- If *A* revokes *P* from *B* with the CASCADE option, delete the edge from *AP* to *BP*.
- But if *A* uses RESTRICT instead, and there is an edge from *BP* to anywhere, then reject the revocation and make no change to the graph.

Manipulating Edges – (4)

- Having revised the edges, we must check that each node has a path from some ** node, representing ownership.
- Any node with no such path represents a revoked privilege and is deleted from the diagram.

Example: Grant Diagram



B: GRANT P
TO C WITH
GRANT OPTION

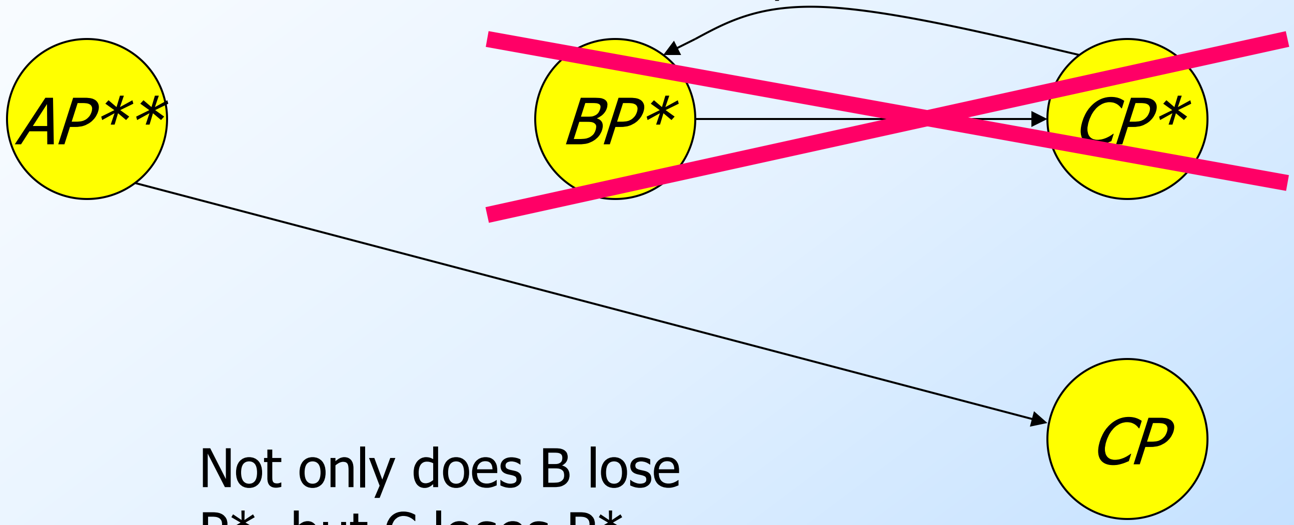
A owns the
object on
which P is
a privilege

A: GRANT P
TO B WITH
GRANT OPTION

A: GRANT P
TO C

Example: Grant Diagram

A executes
REVOKE P FROM B CASCADE;



Even had C passed P to B, both nodes are still cut off.

Not only does B lose P*, but C loses P*. Delete BP* and CP*.

However, C still has P without grant option because of the direct grant.