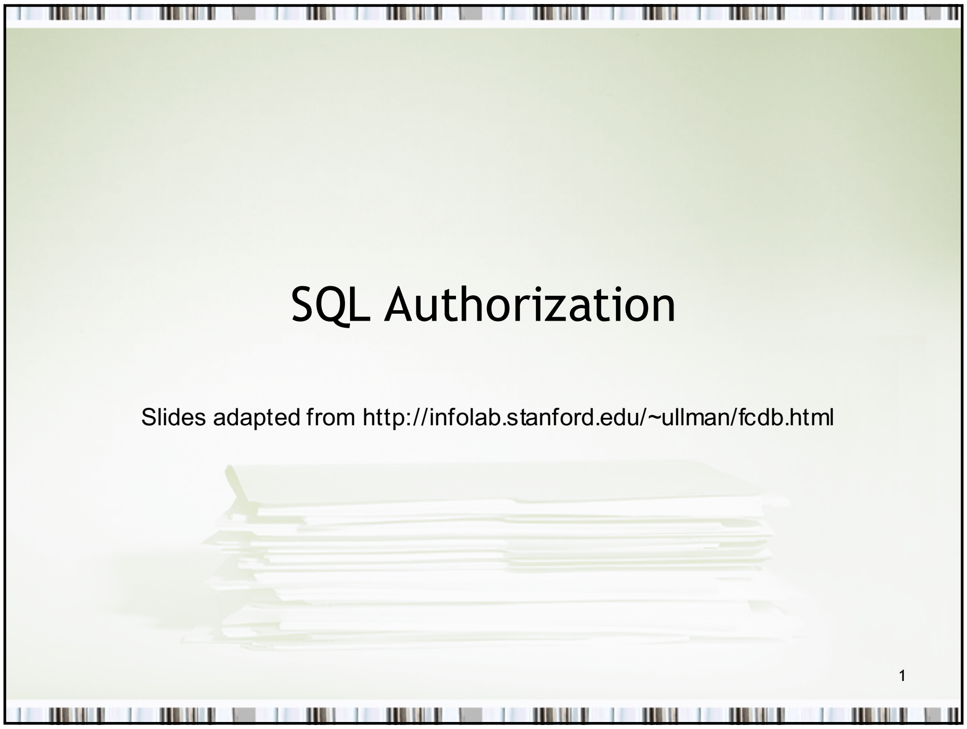
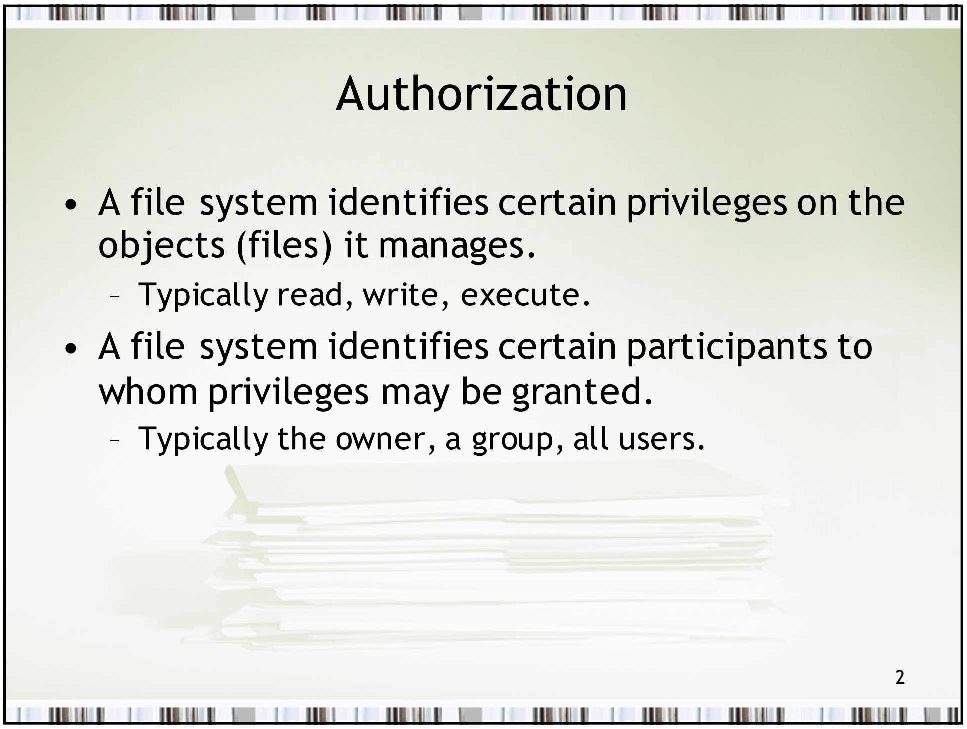


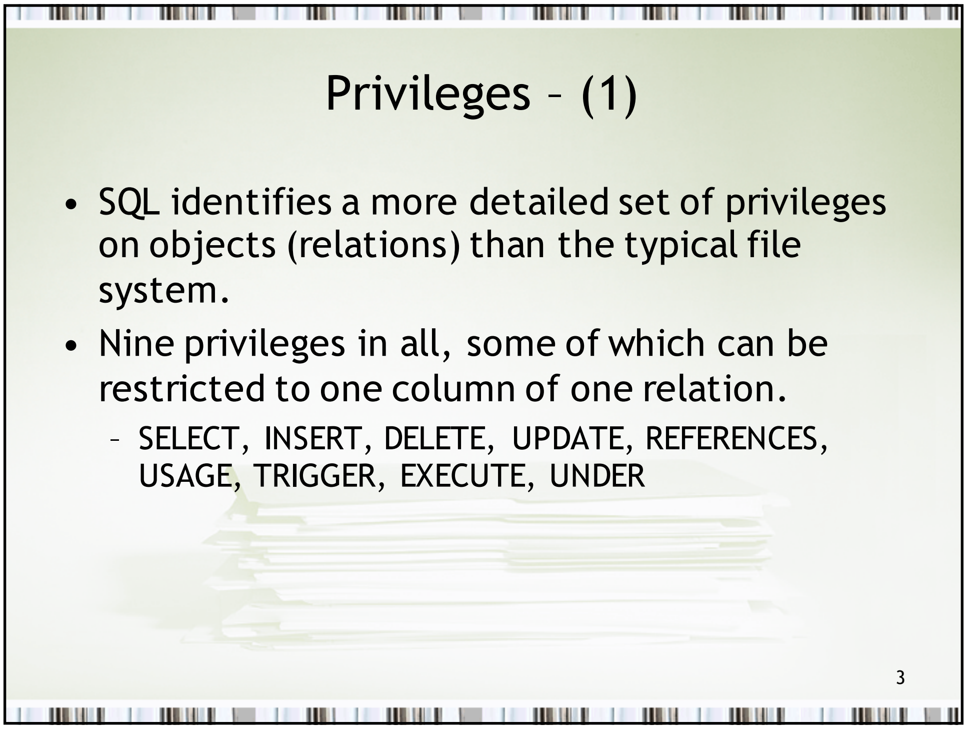
SQL Authorization

Slides adapted from http://infolab.stanford.edu/~ullman/fcdb.html



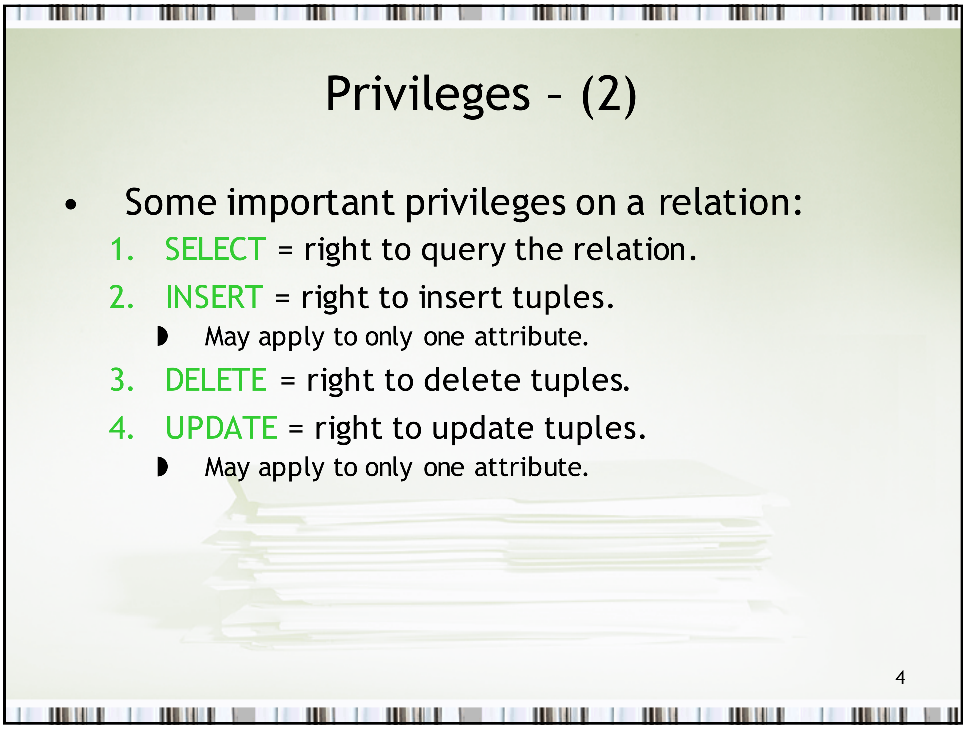
Authorization

- 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.



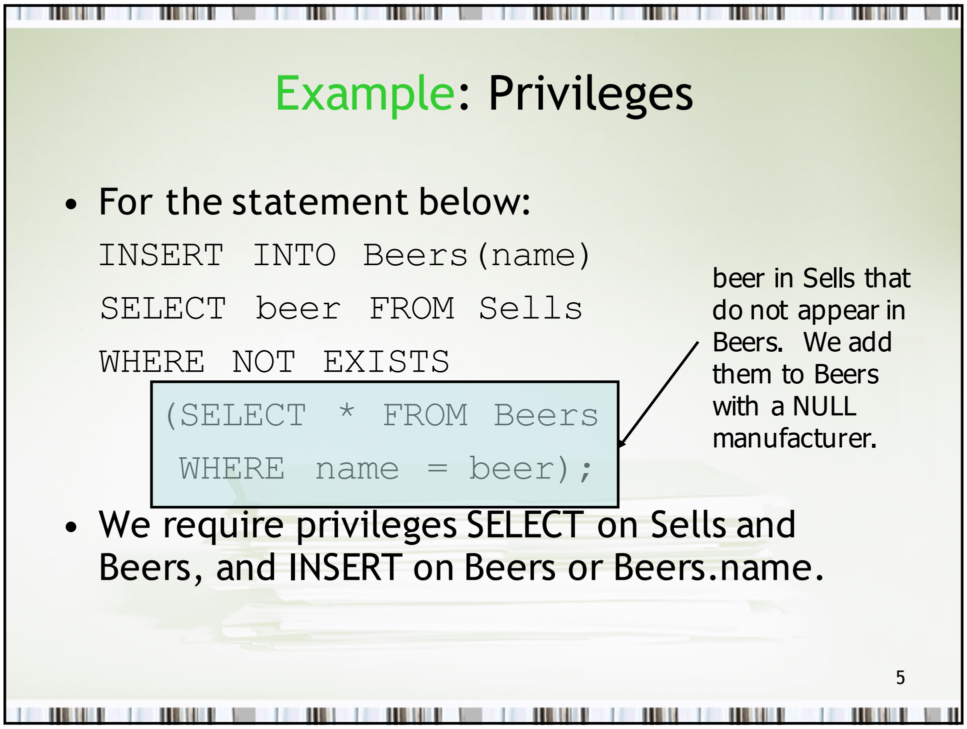
Privileges – (1)

- 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.
  - SELECT, INSERT, DELETE, UPDATE, REFERENCES, USAGE, TRIGGER, EXECUTE, UNDER



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.



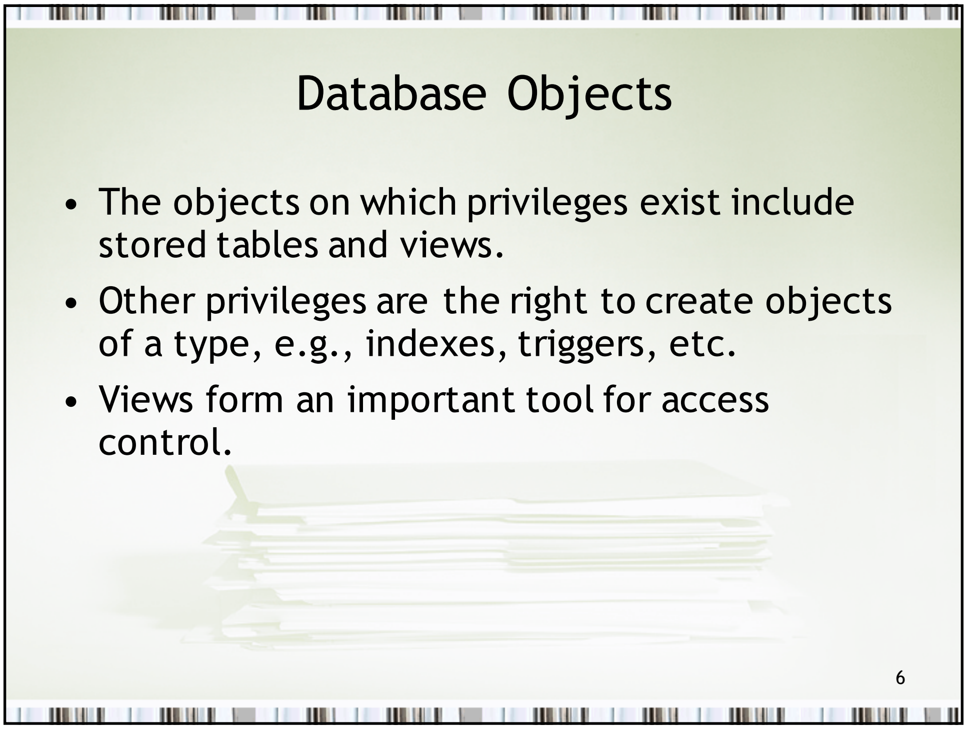
Example: Privileges

- For the statement below:

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

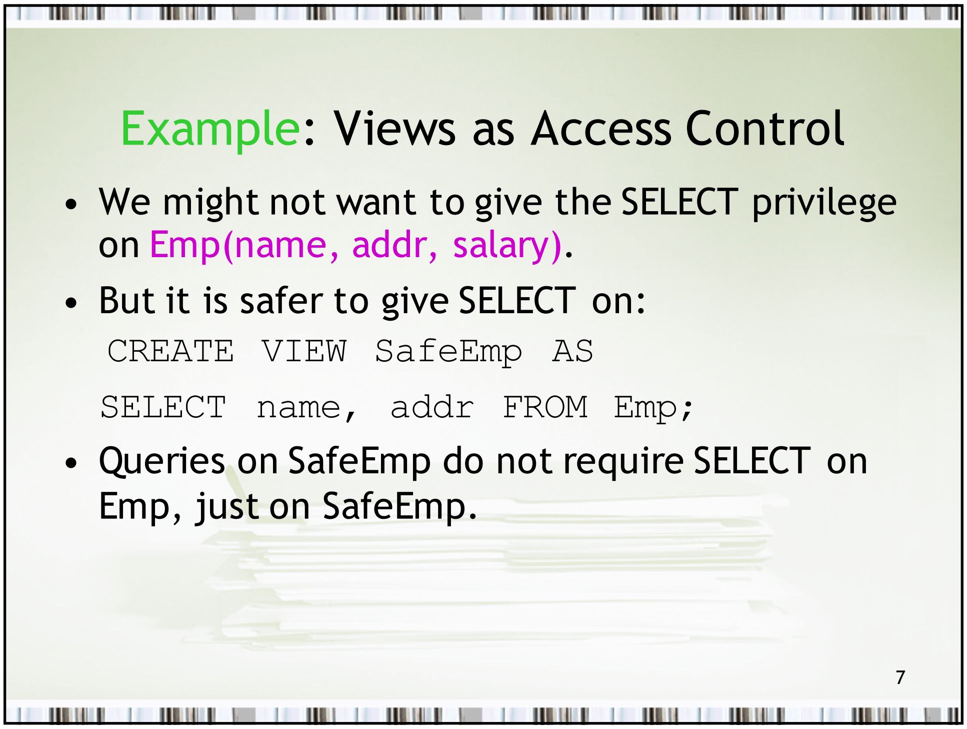
beer in Sells that do not appear in Beers. We add them to Beers with a NULL manufacturer.

- 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., indexes, triggers, etc.
- Views form an important tool for access control.



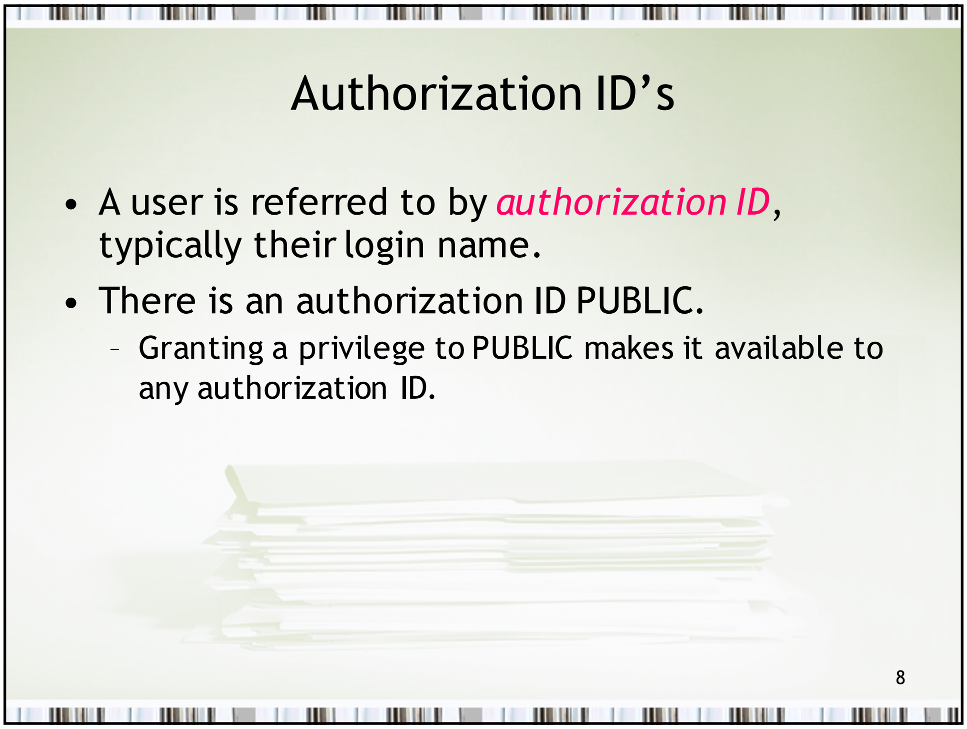
Example: Views as Access Control

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

```
 CREATE VIEW SafeEmp AS
SELECT name, addr FROM Emp;
```

- Queries on SafeEmp do not require SELECT on Emp, just on SafeEmp.

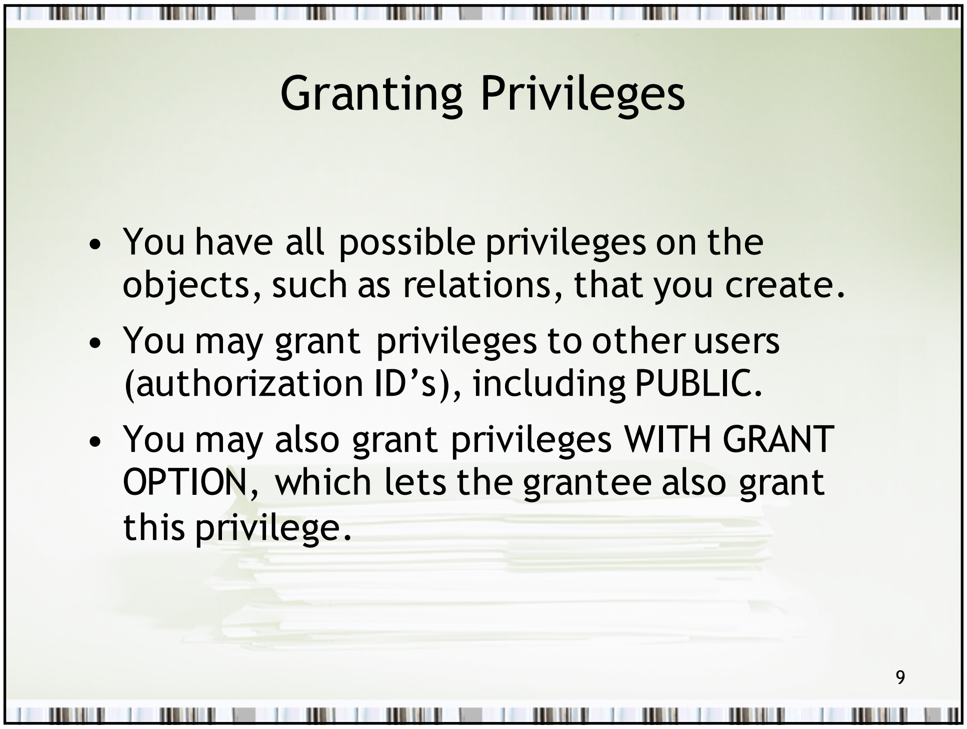
7



Authorization ID’s

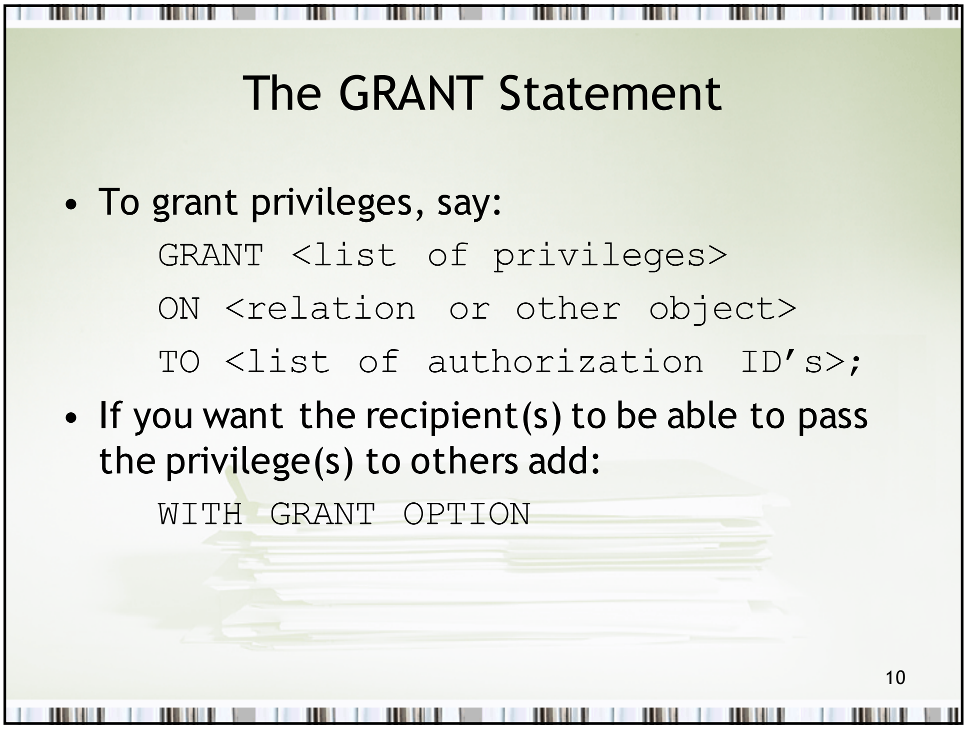
- A user is referred to by *authorization ID*, typically their login name.
- There is an authorization ID PUBLIC.
  - Granting a privilege to PUBLIC makes it available to any authorization ID.

8



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.



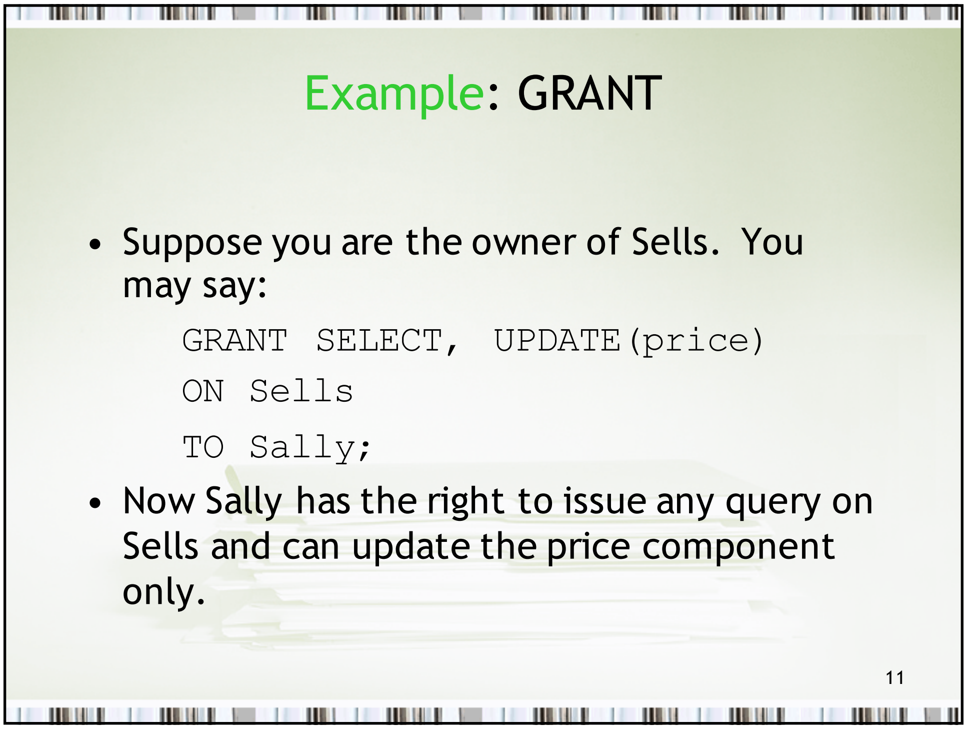
The GRANT Statement

- 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
```

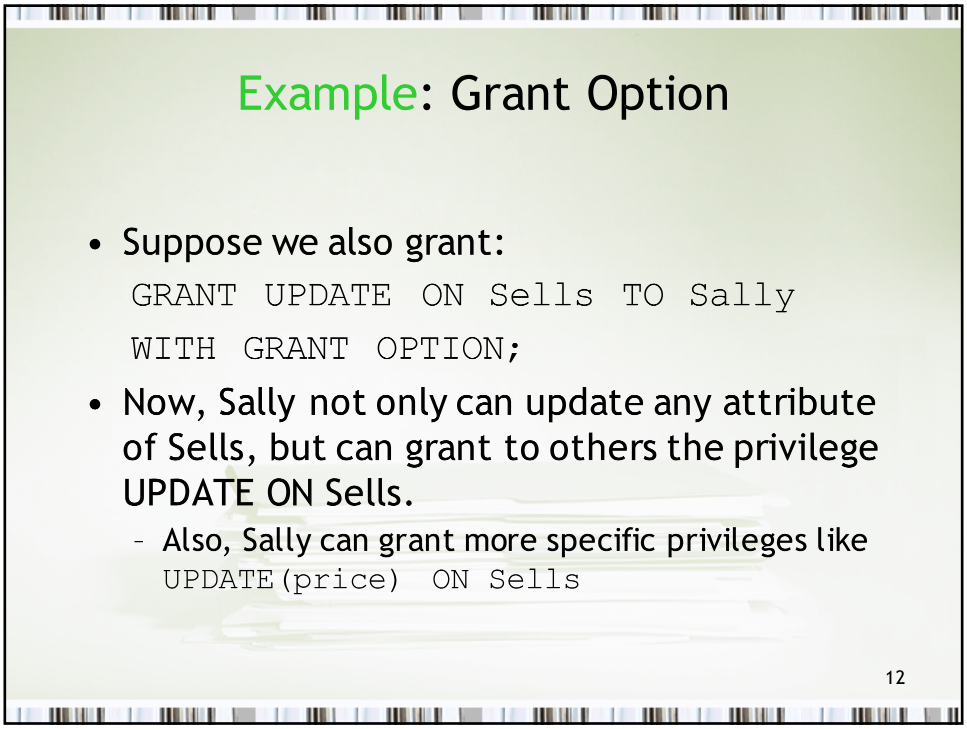


Example: GRANT

- 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.

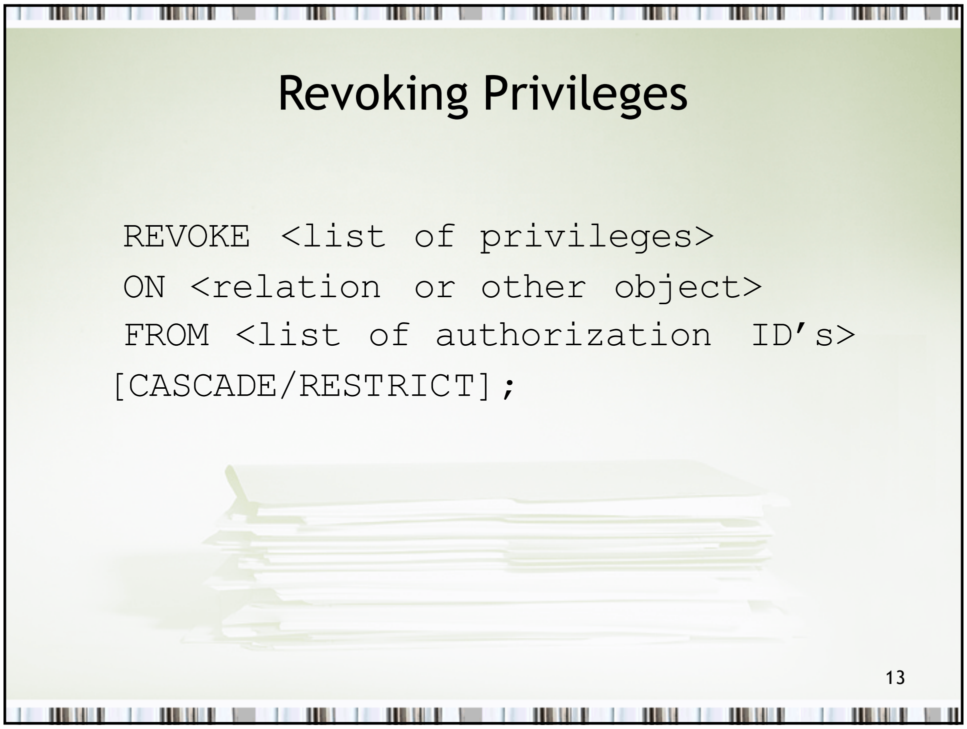


Example: Grant Option

- Suppose we also grant:

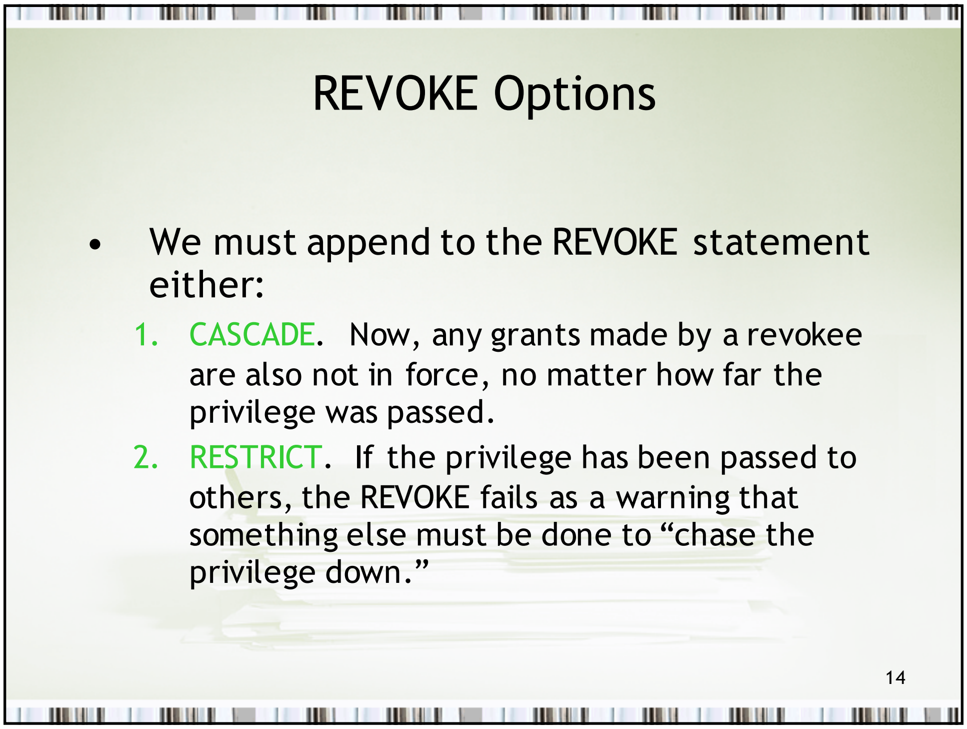
```
GRANT UPDATE ON Sells TO Sally
WITH GRANT OPTION;
```

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



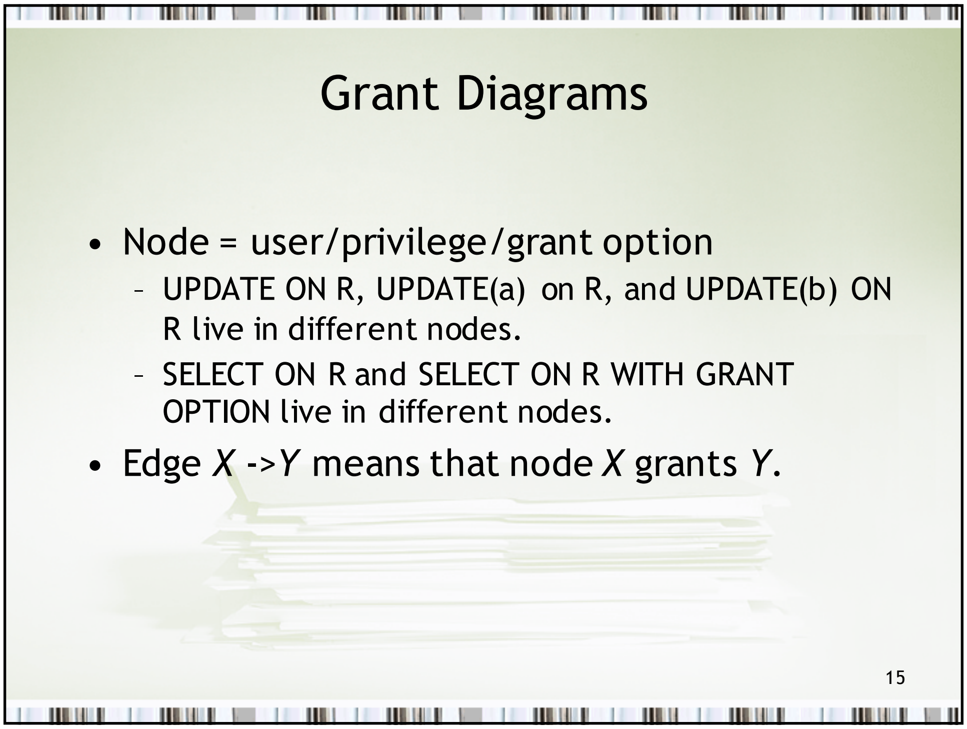
Revoking Privileges

```
REVOKE <list of privileges>
ON <relation or other object>
FROM <list of authorization ID’s>
[CASCADE/RESTRICT];
```



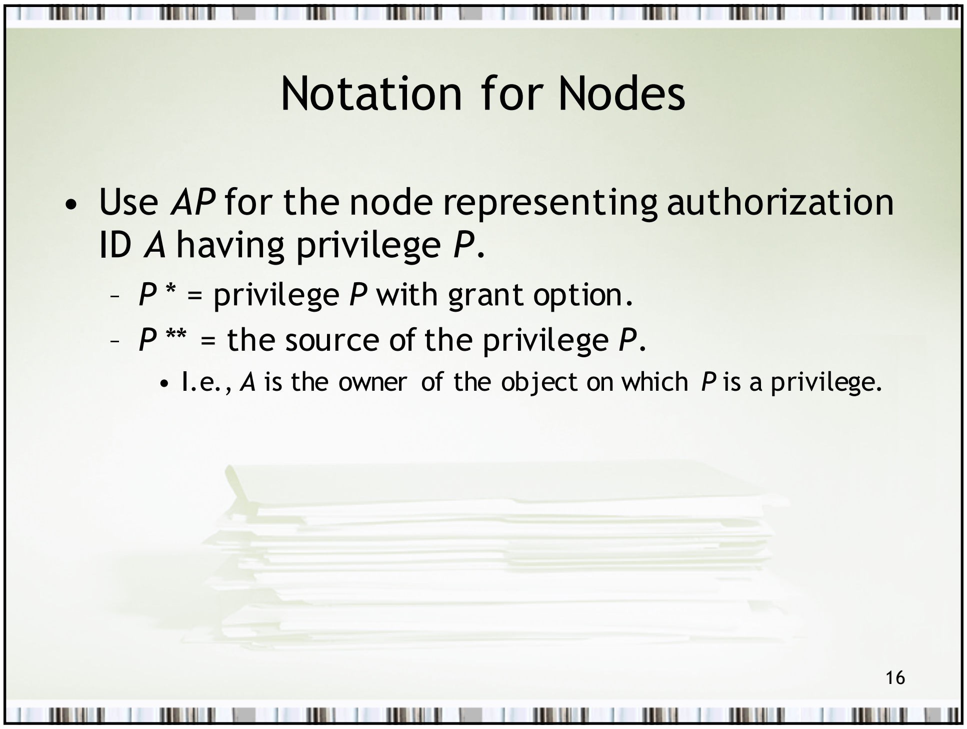
REVOKE Options

- 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.”



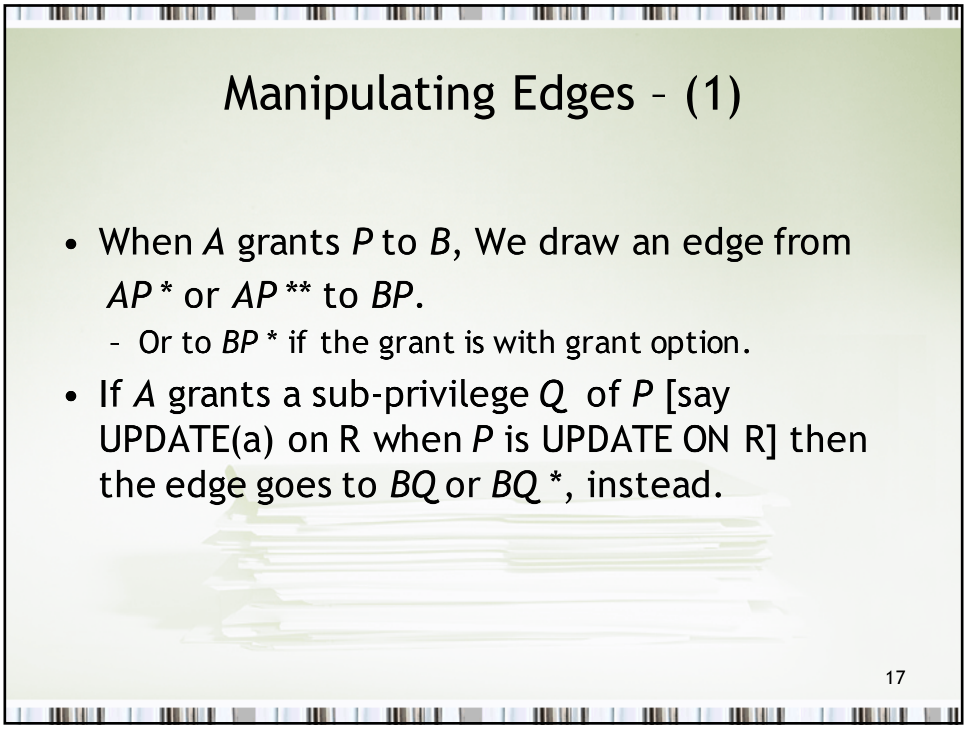
Grant Diagrams

- Node = user/privilege/grant option
  - 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* grants *Y*.



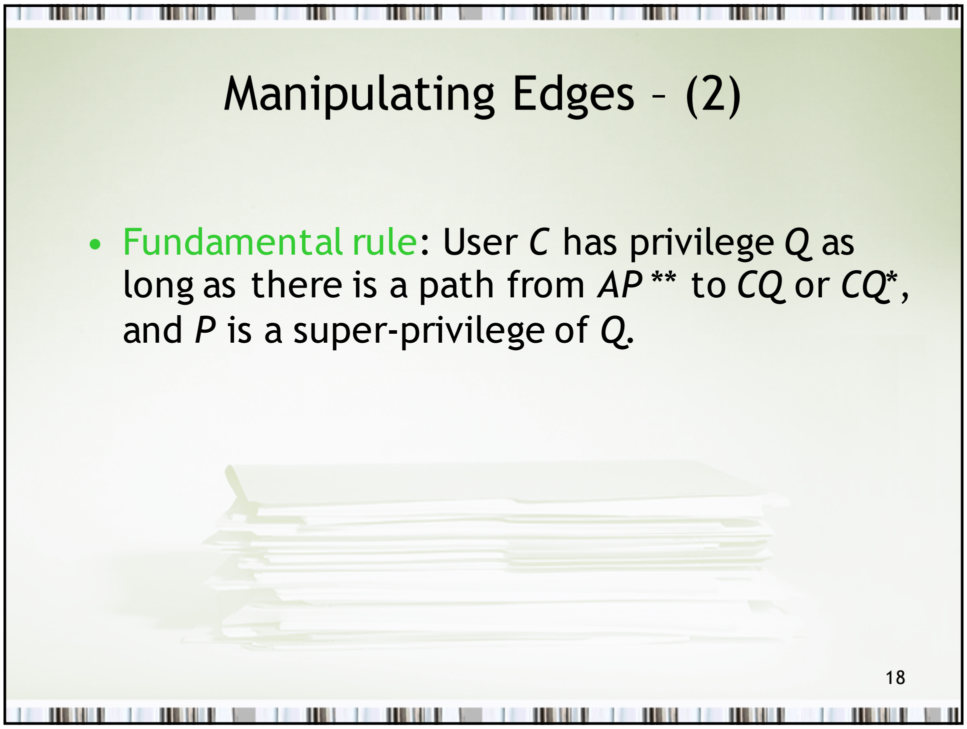
Notation for Nodes

- 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.



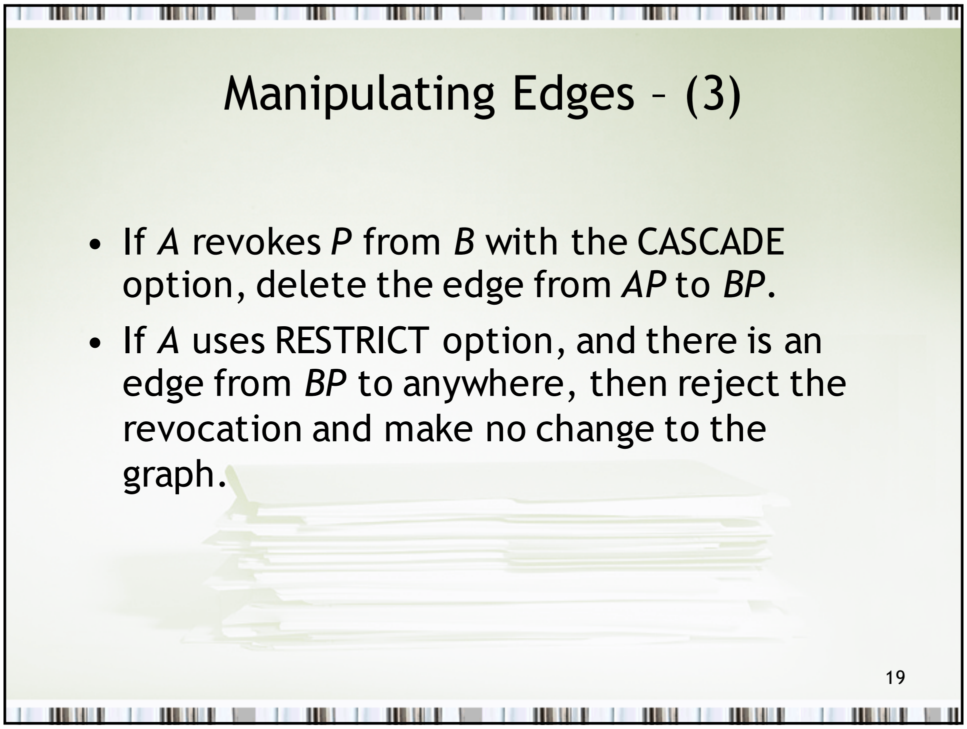
Manipulating Edges – (1)

- 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 sub-privilege _Q_ of _P_ [say UPDATE(a) on R when _P_ is UPDATE ON R] then the edge goes to _BQ_ or _BQ_ *, instead.



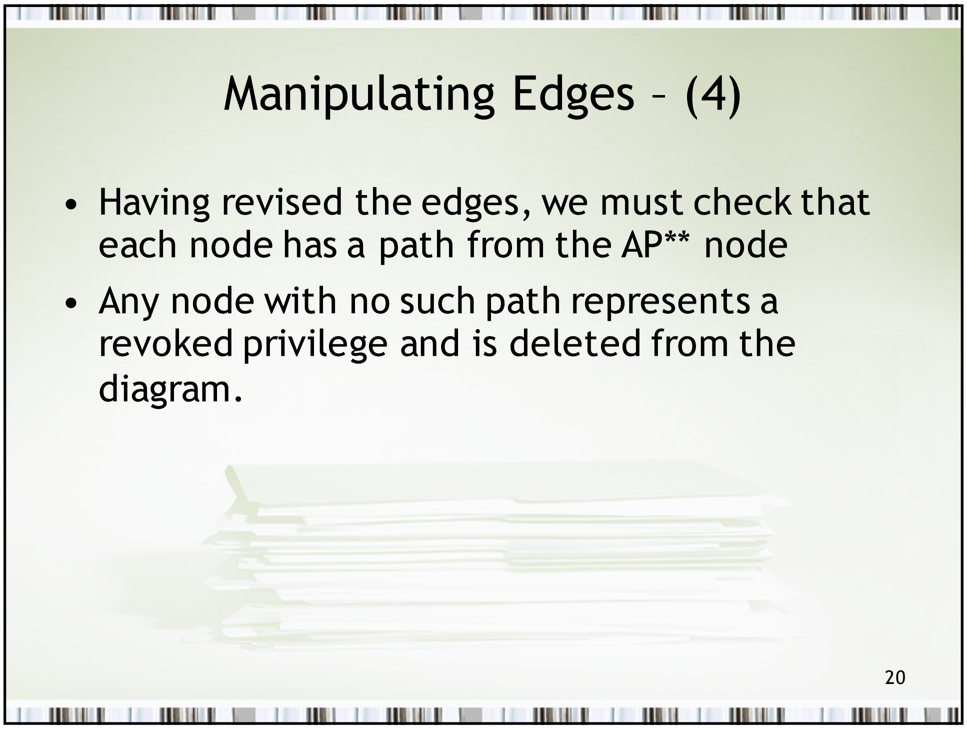
Manipulating Edges – (2)

- Fundamental rule: User _C_ has privilege _Q_ as long as there is a path from _AP_ ** to _CQ_ or _CQ_*, and _P_ is a super-privilege of _Q_.



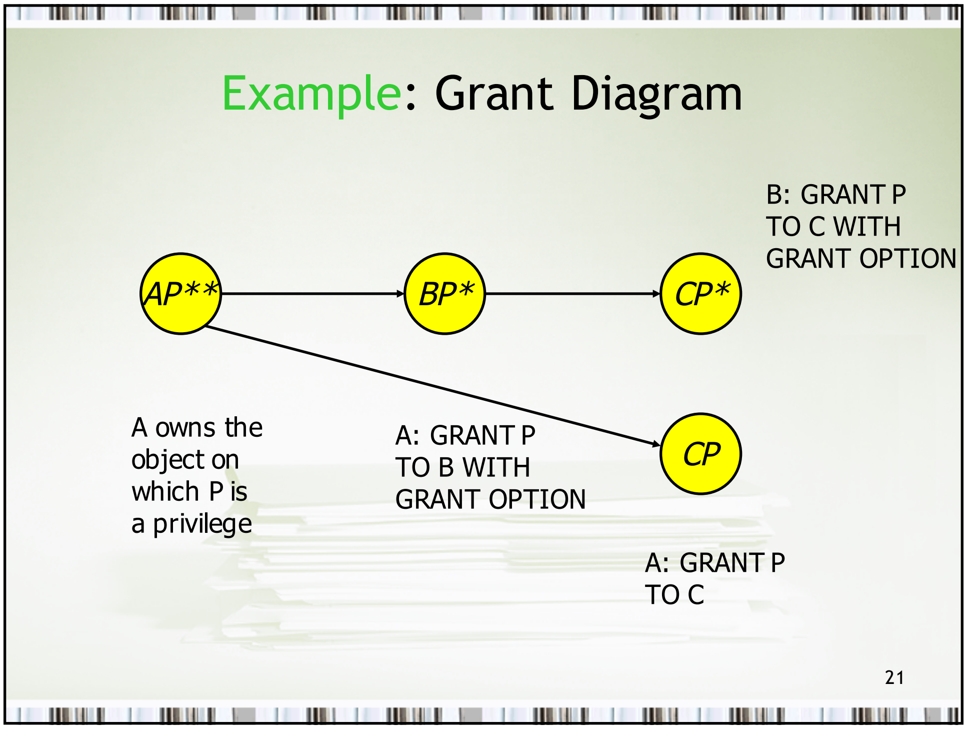
Manipulating Edges – (3)

- If *A* revokes *P* from *B* with the CASCADE option, delete the edge from *AP* to *BP*.
- If *A* uses RESTRICT option, 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 the AP** node
- Any node with no such path represents a revoked privilege and is deleted from the diagram.



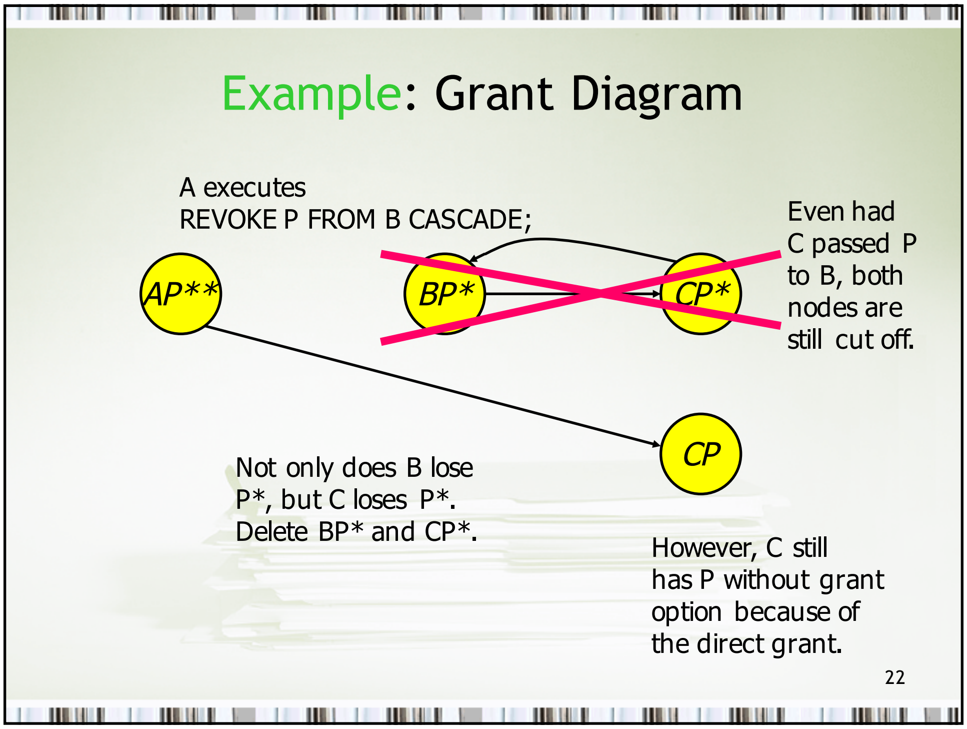
Example: Grant Diagram

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.