Granting Privileges

- The owner has all priv. on the objects he/she creates.
- Owner can pass privileges to others

GRANT <list privileges> ON <object>
TO <userlist> [WITH GRANT OPTION];

Grant option

A user has grant option on a given priv. if he/she is the owner of the object or has received grant option on the given privilege.

Subprivileges

A user can pass more restricted priv. to other users (including with grant option)

Ex: User A has SELECT on R(a,b) with grant option.

User A can pass SELECT on R(a) to user B

A executes: GRANT SELECT(a) ON R TO B;

Example 2:

User A created table R(a,b)

A executes:

GRANT SELECT, UPDATE(a) ON R
TO B WITH GRANT OPTION;

B executes

GRANT SELECT(a), UPDATE(a) ON R
TO PUBLIC;

Special authentication ID
⇒ it means every user

Revoking privileges

REVOKE <list privileges> ON <object>
FROM <userlist> { CASCADE
RESTRICT

When a user revokes privileges from a user the DBMS must verify if other users depend on that grant.

Ex: See example 2 above.

A granted to B SELECT
B granted to PUBLIC SELECT(a)
if A revokes SELECT from B, should PUBLIC lose it?

CASCADE: Removes privilege from user and any other users that depend on it

RESTRICT: If other users depend on the grant being removed, the revoke fails.

User A runs:

REVOKE SELECT ON R FROM B CASCADE;

Both B & PUBLIC lose privilege.

REVOKE SELECT ON R FROM B RESTRICT;

Revoke fails because PUBLIC priv. on R depends on B.

But what if PUBLIC also got the privilege from another user?

- it becomes complicated.

Grant Diagrams

Formalism to model grants and revokes and to determine, at runtime if a user has a given privilege.

Each node is a tuple:

⟨user, priv, grant option?, is owner?⟩

Edges (directed)

⟨X, Y⟩

⇒ implies that grant described in Y was granted by X

If successful a GRANT statement creates an edge (if it does not already exist).

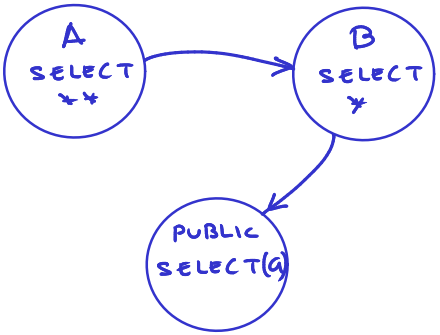
If successful a REVOKE removes one or more edges.

For the sake of simplicity we only draw nodes involved in a sequence of grants.

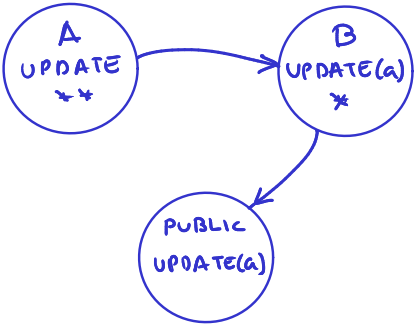
- A node with ** means is owner (implies GRANT option)
- A node with * means GRANT option.

SELECT

- One graph per super-privilege
- includes its subprivileges e.g. SELECT(a)



UPDATE



Fundamental Rule:

User C has privilege Q as long as there exists a path from XP** to either CQ, CQ*, or CQ** and P is a super-privilege of Q.

Example:

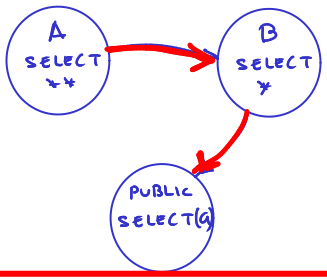
Does PUBLIC have SELECT on R?

Node (PUBLIC SELECT) (not shown) above is unreachable from (A SELECT **)

⇒ No, PUBLIC does not have SELECT.

Does PUBLIC have SELECT(a) R?

Yes, there is a path from A/select/** to PUBLIC/select.



Important: Cycles are not allowed in SQL grants.
e.g. A grants to B, B grants to A

Building the graph.

Nodes:

- Every user has a node for each combination of
  - Relation.
  - Privilege on that relation
    - It might be a subprivilege
  - With and without grant option

Ex. R(a,b) User A

... etc.

Grant option separate from non-grant option.

Subprivileges are separate from privilege.

Subprivileges in grant diag. not part of exam

- Owner only uses nodes with grant option and owner:

- No need for subprivileges (Implicit)
- No need for non-grant option.

Creating the Graph.

When user A runs

- GRANT P ON R TO B

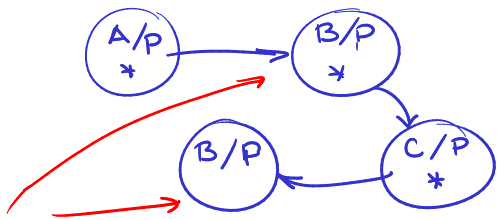
This creates an edge from A/P* to B/P

Edge is created from grantor to grantee A → B

- If A uses WITH GRANT OPTION edge goes from A/P* to B/P*

Edges <u>always</u> start in grant op. nodes.

- Grants cannot create cycles!!
  ⇒ directed acyclic graph.
- But it is possible to return back a privilege without grant:



B has both P with and without grant.

- If A grants P to B with grant op and B already has P from A
  A/P → B/P is deleted
  and A/P* → B/P* created.

Revoking Privileges

if A revokes P from B

Either $A/P* \rightarrow B/P$ or $A/P* \rightarrow B/P*$ exists.

- If $A/P* \rightarrow B/P$ (B has no grant option) revoke succeeds. Delete $A/P* \rightarrow B/P$
- If $A/P* \rightarrow B/P*$ (B has grant option)

RESTRICT:

If there is any edge that starts at $B/P*$ then REVOKE fails.

Otherwise $A/P* \rightarrow B/P*$ is removed.

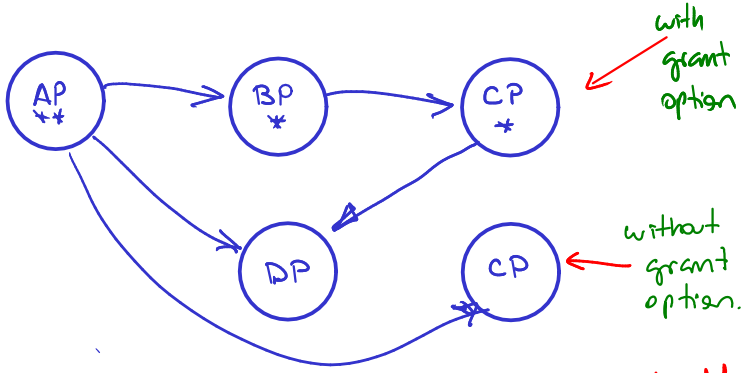
CASCADE:

- Remove $A/P* \rightarrow B/P*$
- For any edges from $B/P*$, remove them.

Recursively:

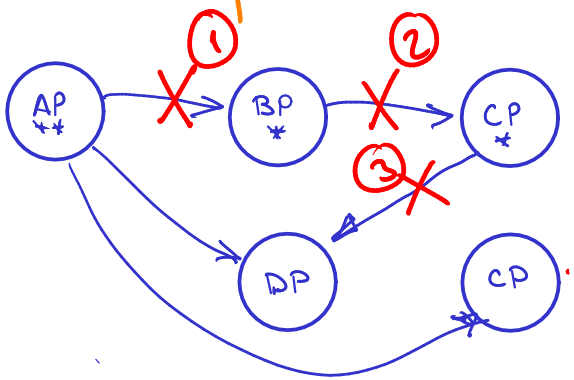
- For every node $X/P*$ (user X has grant option on P) that has outgoing edges:
  - Verify that $X/P*$ is reachable from owner
    - if not remove outgoing edges from $X/P*$

Ex:

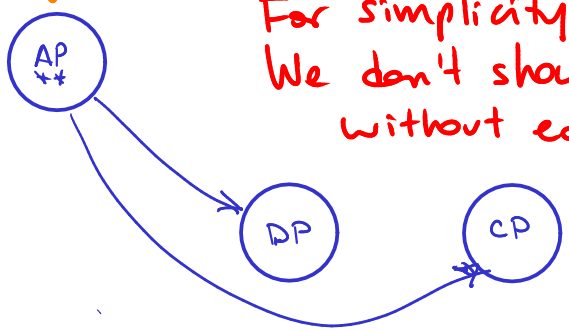


Order of grants does not matter!!

Now A revokes P from B with CASCADE.



Resulting graph:



For simplicity
We don't show nodes
without edges

Users D an C keep P without grant.

Revoking only grant option

REVOKE GRANT OPTION FOR <priv>
FROM <user> { CASCADE / RESTRICT

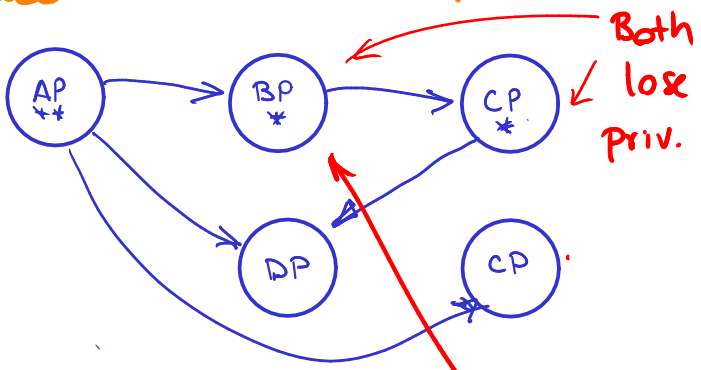
If user has privilege with grant option it is equivalent to:

REVOKE privilege
GRANT privilege without grant.

Example:

Now A revokes grant option from B with cascade:

Before:



After: