



Assignment Project Exam Help

Database Security – Part 2

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Access Control

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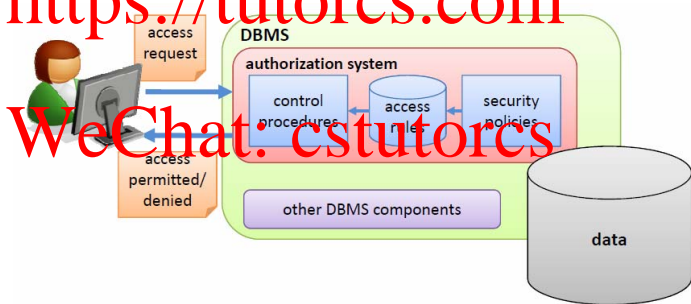
Access Control

● Access Control refers to any means of controlling access to resources in a database.

- Can be seen as **the combination of authentication and authorization** plus **additional measures**, such as IP-based restrictions.

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Authentication vs. Authorization

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- **Authentication** is the process by which a system can identify users.

- Who are the users?
- Are the users really whom they represent themselves to be?

– Identified by username/password, a smart card, a PIN number, a secret code sent in a letter, a fingerprint scan, and so on.

- **Authorization** is the process by which a system determines what level of access a user (who **is already authenticated**) has to secured resources.

- Is a user authorized to access or modify a table?
- ...

Main Approaches to Access Control

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1 Discretionary access control (DAC)

- Based on the concept of **access privileges** for giving users such privileges.
- SQL support DAC; most commercial DBMSs also support DAC.

2 Mandatory access control (MAC)

- Based on **system-wide policies** that cannot be changed by individual users.
- SQL doesn't support MAC but some DBMSs support MAC.

3 Role-based access control (RBAC)

- Based on **roles** (can be used with DAC and MAC).
- SQL support privileges on roles; many DBMSs support RBAC.



Discretionary Access Control (DAC)

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- Called **discretionary** because it allows a subject to grant other subjects privileges to access objects of the subject at its own discretion.

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- DAC governs the access of subjects (e.g. accounts, etc.) to objects (relations, views, etc.) **on the basis of subjects' privileges.**

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- SQL supports DAC through the **GRANT** and **REVOKE** commands.
 - **GRANT** gives privileges to users;
 - **REVOKE** takes away privileges from users.



Specifying Privileges - Grant

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- The syntax of the **GRANT** command:

GRANT privileges **ON** object **TO** users [**WITH GRANT OPTION**]

Examples: Consider the relation schemas

SUPPLIER(id, sname, city, rating)

RATINGSTANDARD(no, description)

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- GRANT SELECT ON SUPPLIER TO Jerry;**
- GRANT INSERT, DELETE ON SUPPLIER TO Tom;**
- GRANT UPDATE (rating) ON SUPPLIER TO Tom;**
- GRANT REFERENCES (no) ON RATINGSTANDARD TO Bob;**

Specifying Privileges - Views

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- Views provide an important mechanism for discretionary authorization.
- The **syntax** of **creating a view**:

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```
CREATE VIEW view_name AS  
  SELECT attribute_list  
    FROM table_list  
   [WHERE condition]  
   [GROUP BY attribute_list [HAVING group-condition]]  
   [ORDER BY attribute_list];
```

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- Creating a view requires SELECT privilege on all relations involved in the view definition.

Specifying Privileges - Views

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- **Example:** Consider the relation schema

SUPPLIER(id, sname, city, rating)

How to give Bob read access to SUPPLIER for suppliers in Paris (only), but

not to supplier ratings?

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Specifying Privileges - Views

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• Example: Consider the relation schema:

SUPPLIER(id, sname, city, rating)

How to give Bob read access to SUPPLIER for suppliers in Paris (only), but not to supplier ratings?

Step 1: CREATE VIEW SUPPLIER-PARIS AS

```
SELECT id, sname, city  
FROM SUPPLIER  
WHERE city='Paris';
```

Step 2: GRANT SELECT ON SUPPLIER-PARIS TO Bob

Users of this view only see part of SUPPLIER (**horizontal subset** by applying city='Paris' and **vertical subset** by excluding rating).



Revoking Privileges - Revoke

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- The syntax of the **REVOKE** command:

```
REVOKE [GRANT OPTION FOR] privileges ON object FROM users
```

Example: Still consider the relation schema

SUPPLIER(id, sname, city, rating)

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1. `REVOKE INSERT, DELETE ON SUPPLIER FROM Peter;`

2. `GRANT SELECT ON SUPPLIER TO Bob;`

Bob is working on the task ... and done!

```
REVOKE SELECT ON SUPPLIER FROM Bob;
```



Delegating Privileges

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- Can we pass on privileges to others?

- We are the object owner;
- We have received the privilege with GRANT OPTION.

Example: Tom, the owner of SUPPLIER, wants to give Bob the right to grant his SELECT privilege on SUPPLIER to other users for one month.

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```
GRANT SELECT ON SUPPLIER TO Bob WITH GRANT OPTION;
```

One month later ...

```
REVOKE GRANT OPTION FOR SELECT ON SUPPLIER FROM Bob;
```



Delegating Privileges - Recursive Revocation

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- The privileges of an object can be given to a user *with or without* the **GRANT OPTION**

```
GRANT SELECT ON SUPPLIER TO Bob;
```

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```
GRANT SELECT ON SUPPLIER TO Bob WITH GRANT OPTION;
```

- A user can only revoke privileges that he or she has granted earlier, with two optional keywords in **REVOKE** command:

- CASCADE**: revoking the privilege from a specified user also revokes the privileges from all users who received the privilege from that user.
- RESTRICT**: revoking the privilege only from a specified user.



Delegating Privileges - Recursive Revocation

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- If a user receives a certain privilege from multiple sources, and the user would lose the privilege only after all sources revoke this privilege.

- **Example:**

1. GRANT SELECT ON SUPPLIER TO Bob WITH GRANT OPTION; (by Tom)

2. GRANT SELECT ON SUPPLIER TO Jerry; (by Tom)

3. GRANT SELECT ON SUPPLIER TO Jerry WITH GRANT OPTION; (by Bob)

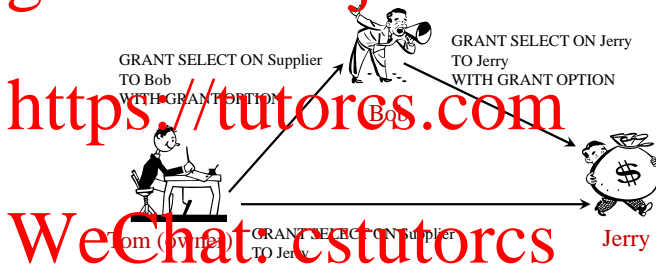
4. REVOKE SELECT ON SUPPLIER FROM Bob CASCADE; (by Tom)

- **Questions:**

- 1 Will Bob lose the SELECT privilege on SUPPLIER?
- 2 Will Jerry lose the SELECT privilege on SUPPLIER?

Delegating Privileges - Recursive Revocation

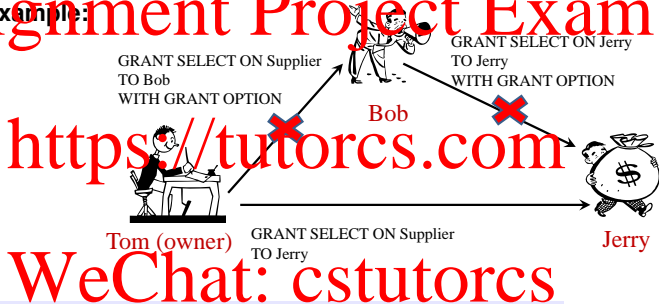
Example:



1. GRANT SELECT ON SUPPLIER TO Bob WITH GRANT OPTION; (by Tom)
2. GRANT SELECT ON SUPPLIER TO Jerry; (by Tom)
3. GRANT SELECT ON SUPPLIER TO Jerry WITH GRANT OPTION; (by Bob)

Delegating Privileges - Recursive Revocation

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4.REVOKE SELECT ON SUPPLIER FROM Bob CASCADE; (by Tom)

- 1 Bob will lose the privilege.
- 2 Jerry won't lose the privilege.

Delegating Privileges - Propagation

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- There are techniques to limit the propagation of privileges. But not implemented in most DBMSs and not part of SQL.

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- Limiting **horizontal propagation**: limits that an account given the GRANT OPTION can grant the privilege to at most n other accounts;

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- Limiting **vertical propagation**: limits the depth of the granting privileges.



Mandatory Access Control (MAC)

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- Restrict access to objects based on the sensitivity of the information contained in the objects and the formal authorization of subjects to access information of such sensitivity.

- Sensitivity of the information (e.g., security classes)
top secret (TS), secret (S), confidential (C), unclassified (U).

$$TS \geq S \geq C \geq U$$

- Authorization (e.g., clearances)

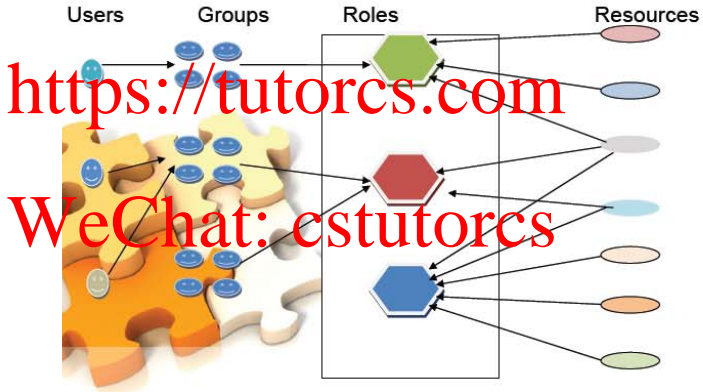
Example:

| id | name | city | rating | security class |
|----|------|----------|--------|------------------|
| 1 | S1 | Paris | 4 | secret (S) |
| 2 | S2 | Canberra | 5 | confidential (C) |

- Bob with C clearance can only access the second tuple.
- Peter with S clearance can access both tuples.

Role-Based Access Control (RBAC)¹

- Access rights are grouped by **roles**, and the use of resources is restricted to individuals assigned to specific roles.



¹Comprehensive Approach to Database Security, Ajoy S. Kumar, 2008