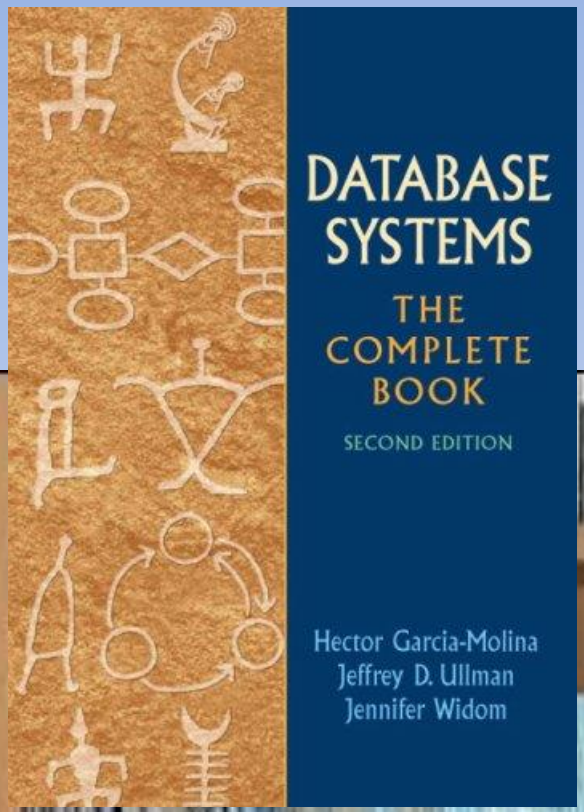
Chapter 10: Advanced Topics in Relational Databases



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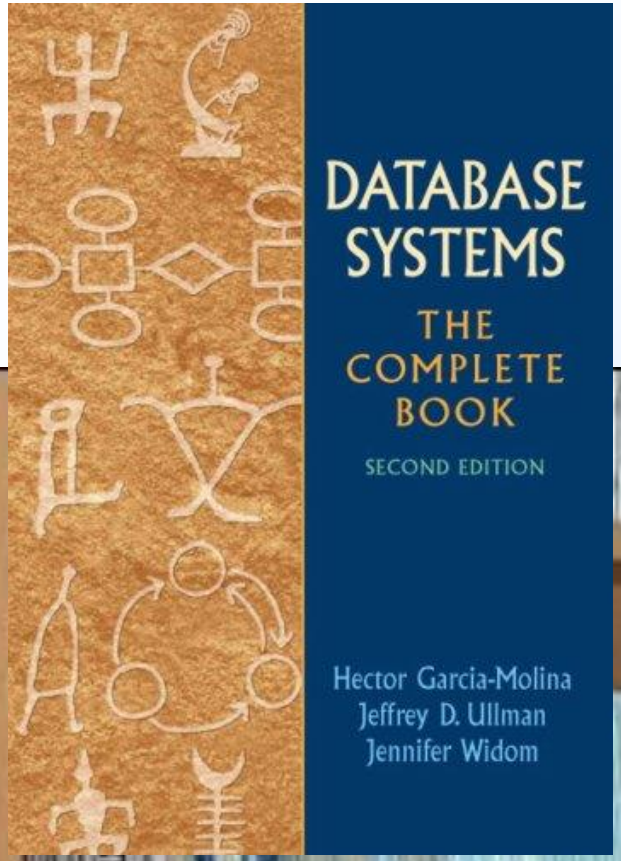

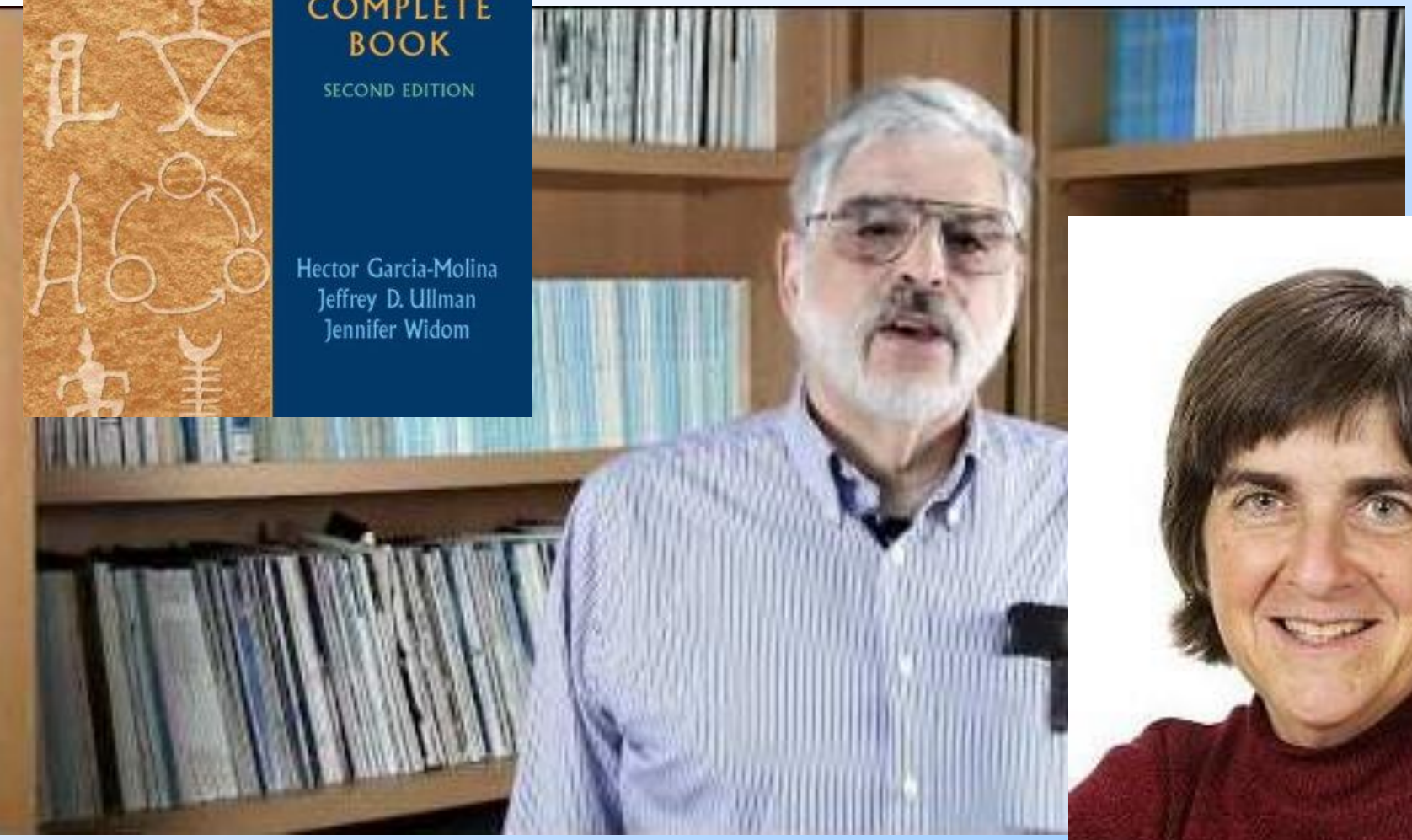

SQL Authorization

Privileges

Grant and Revoke

Grant Diagrams

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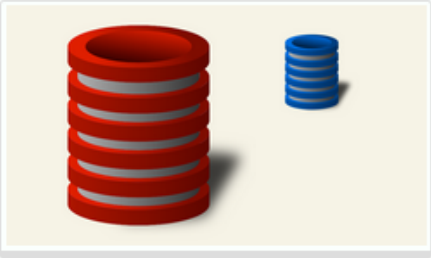

Databases

Course Started - Jun 09, 2014 at 15:00 UTC

DB12 Views and Authorization

Your final grade: **90%**.

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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 Ships(sname, class)
  SELECT class, class FROM Classes C
  WHERE NOT EXISTS
      (SELECT * FROM Ships
       WHERE sname = C.class);
```

Classes that do not appear in Ships. We add them to Ships with a NULL launch.

- We require privileges SELECT on Classes and Ships, and INSERT on Ships or Ships.sname.

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."

Users w/ MySQL

- First, lets create a new user

CREATE USER *user*
IDENTIFIED BY '*password*'

Users w/ MySQL

- First, lets create a new user

CREATE USER *user*
IDENTIFIED BY '*password*'

CREATE user anonymous@'%'
IDENTIFIED BY 'test';

Users w/ MySQL

- Let’s create a user
- But first, let’s list current users:

```
SELECT User,Host FROM mysql.user;
```

Users w/ MySQL

```
424  #user stuff
425  select User,Host from mysql.user;
```

Result Set Filter: Edit: Export/Import:

User	Host
cs126	%
root	127.0.0.1
root	::1
root	localhost
NULL	NULL

Users w/ MySQL

- Now, lets create a new user

CREATE USER *user*
IDENTIFIED BY '*password*'

CREATE user test@localhost
IDENTIFIED BY 'test';

Users w/ MySQL

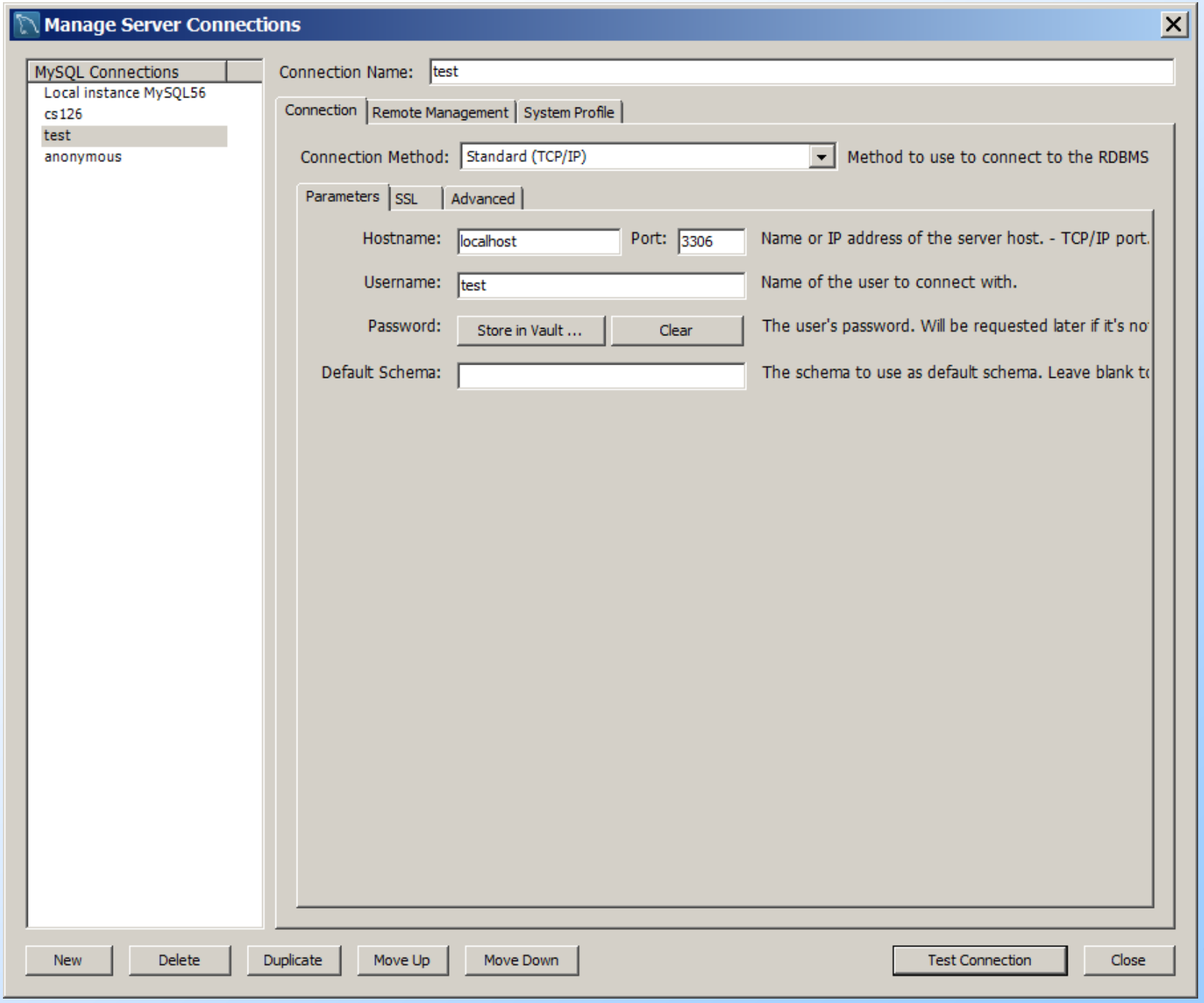
```
#user stuff
select User,Host from mysql.user;
```

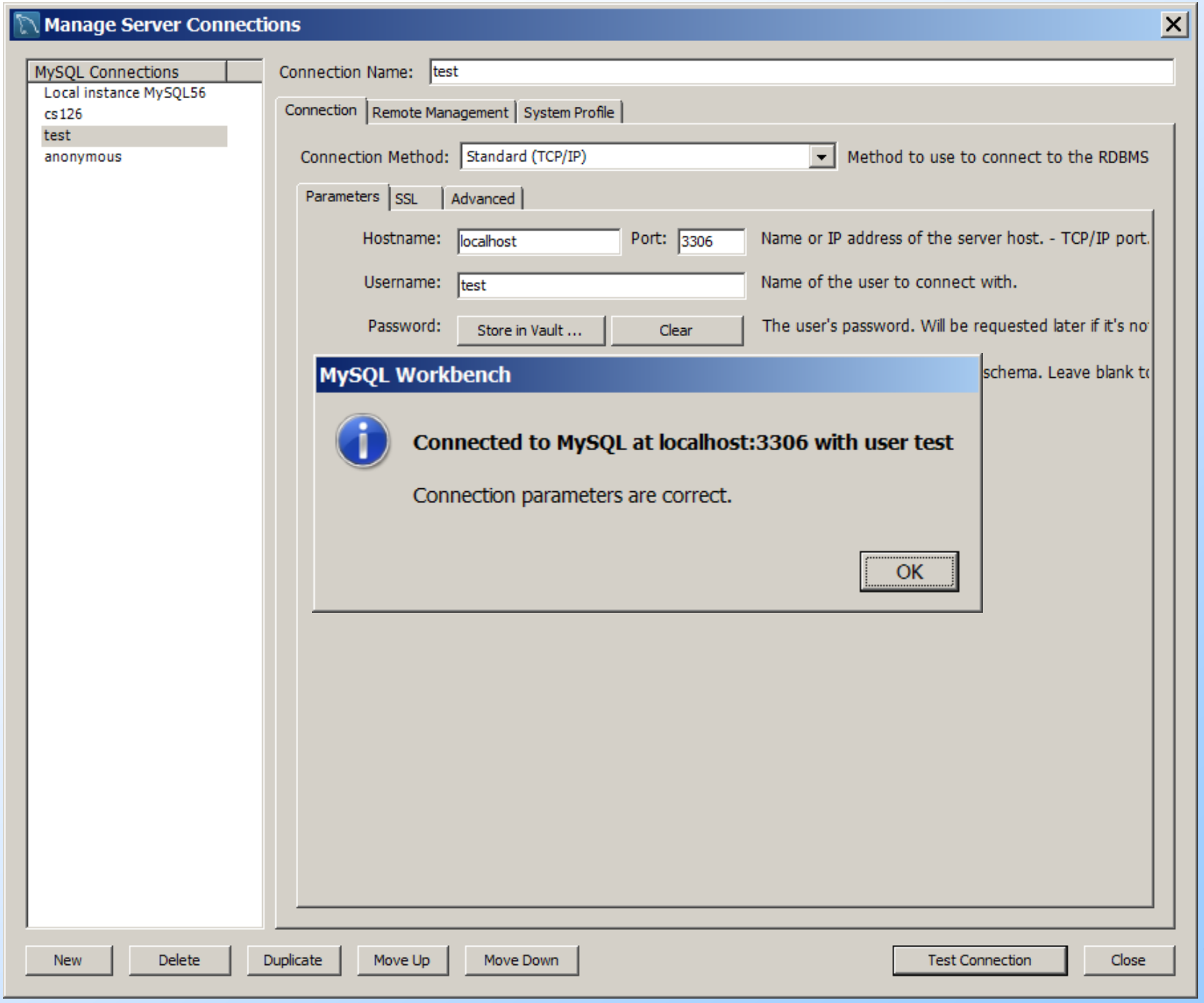
Result Set Filter: Edit: Export/Im

User	Host
cs126	%
root	127.0.0.1
root	::1
root	localhost
test	localhost
NULL	NULL

Connecting as User

- To login to database as our new user:
  - Connection established using new user.


Manage Server Connections
MySQL Connections
Local instance MySQL56
cs126
test
anonymous
Connection Name:
test
Connection
Remote Management
System Profile
Connection Method:
Standard (TCP/IP)
Method to use to connect to the RDBMS
Parameters
SSL
Advanced
Hostname:
localhost
Port:
3306
Name or IP address of the server host. - TCP/IP port.
Username:
test
Name of the user to connect with.
Password:
Store in Vault ...
Clear
The user's password. Will be requested later if it's no
Default Schema:
The schema to use as default schema. Leave blank t
New
Delete
Duplicate
Move Up
Move Down
Test Connection
Close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Name of the user to connect with.
Password:
Store in Vault ...
Clear
The user's password. Will be requested later if it's no
schema. Leave blank t
MySQL Workbench
Connected to MySQL at localhost:3306 with user test
Connection parameters are correct.
OK
New
Delete
Duplicate
Move Up
Move Down
Test Connection
Close

User Test

- Lets access computers as ‘test’

User Test

- Lets access computers as ‘test’
- Test needs Privileges

```
#testing
use computers;
```

Output

Action Output

	Time	Action	Message
1	10:10:02	use computers	Error Code: 1044. Access denied for user 'test'@'localhost' to database 'computers'

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

- Lets give Test SELECT privilege on Computers.Product to test

```
GRANT select
ON computers.product
TO test@localhost;
```

Now Test has the right to issue any query on Product

```
23 • select * from product;
24 • select model, color from printer;
25
26 • select * from pc where speed >= 3.00;
```

Result Set Filter: Export: Wrap Cell Content:

maker	model	ctype
A	1001	pc
A	1002	pc
A	1003	pc
B	1004	pc
B	1005	pc
B	1006	pc
C	1007	pc
D	1008	pc
D	1009	pc

product 1

Output

Action Output

	Time	Action	Message
1	10:10:02	use computers	Error Code: 1044. Access denied for user 'test'@'localhost' to database 'computers'
2	10:17:49	grant select on computers.product to test...	Error Code: 1142. SELECT, GRANT command denied to user 'test'@'localhost' for table 'product'
3	10:18:54	use computers	0 row(s) affected
4	10:21:13	select * from product LIMIT 0, 1000	31 row(s) returned

Example: GRANT

- Lets give Test SELECT privilege on Computers.Product to test

```
GRANT select
ON computers.product
TO test@localhost;
```

Now Test has the right to issue any query on Product

But not PC table!

Example: GRANT

- Lets give Test SELECT privilege on

```
26 • select * from pc where speed >= 3.00;
27 • select model from pc where speed >= 3.00;
```

Output

Action Output

	Time	Action	Message
1	10:10:02	use computers	Error Code: 1044. Access denied for user 'test'@'localhost' to database 'computers'
2	10:17:49	grant select on computers.product to test...	Error Code: 1142. SELECT, GRANT command denied to user 'test'@'localhost' for table 'product'
3	10:18:54	use computers	0 row(s) affected
4	10:21:13	select * from product LIMIT 0, 1000	31 row(s) returned
5	10:22:47	select * from pc where speed >= 3.00 LIM...	Error Code: 1142. SELECT command denied to user 'test'@'localhost' for table 'pc'

Now Test has the right to issue any query on Product

But not PC table!

Changing Password

- Set Password can be used to change passord for a user:

SET PASSWORD [FOR *user*] = PASSWORD('*cleartext password*')

Changing Password

- Set Password can be used to change passord for a user:

SET PASSWORD [FOR *user*] = PASSWORD(‘*cleartext password*’)

- For Example:

set password = password('test99');

Changing Password

- Set Password can be used to change passord for a user:

SET PASSWORD [FOR *user*] = PASSWORD(‘*cleartext password*’)

- For Example:

SET password

FOR test@localhost = password('test99');

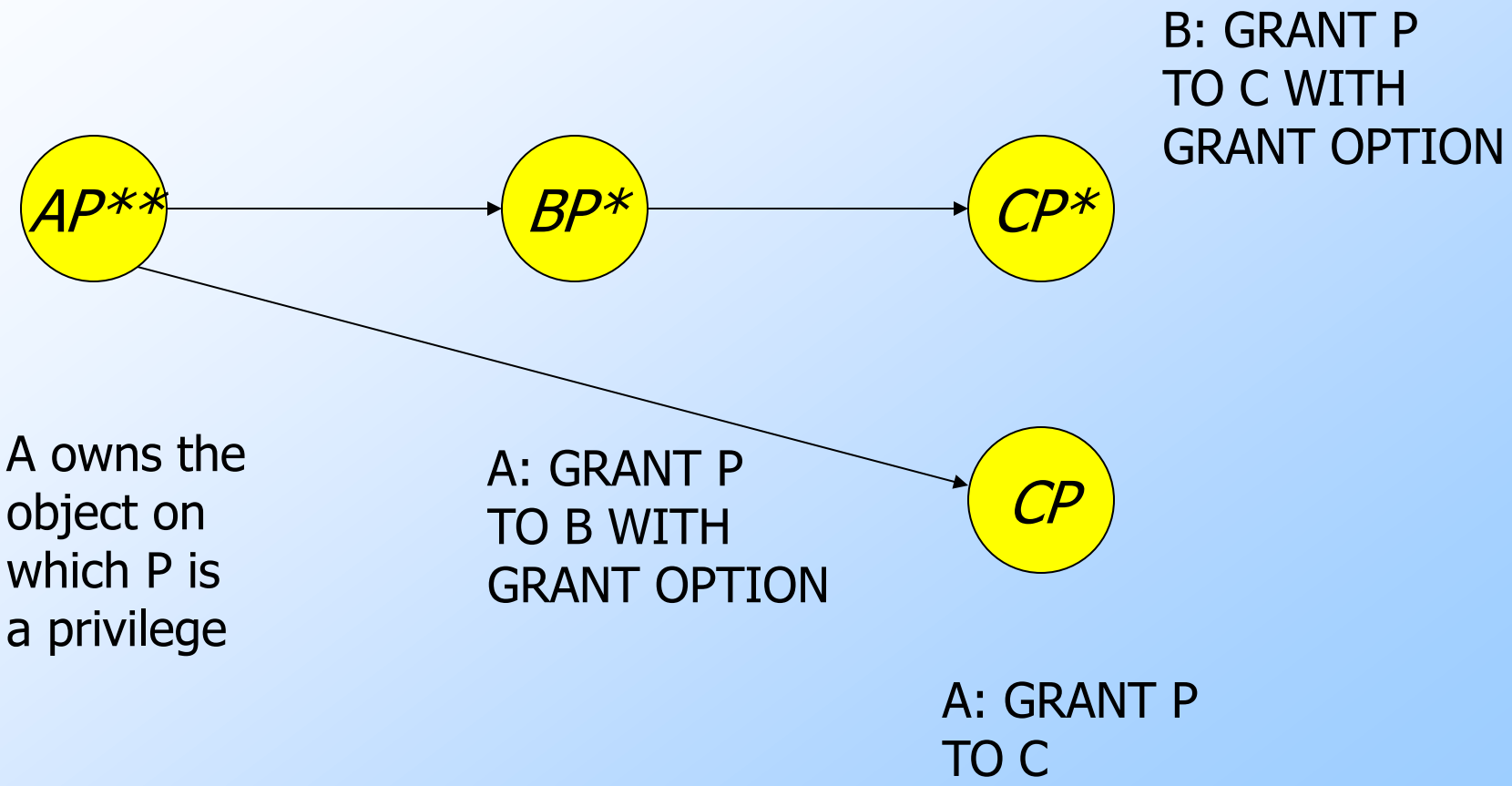
Remember Privileges

- 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.

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*.

Example: Grant Diagram



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*.

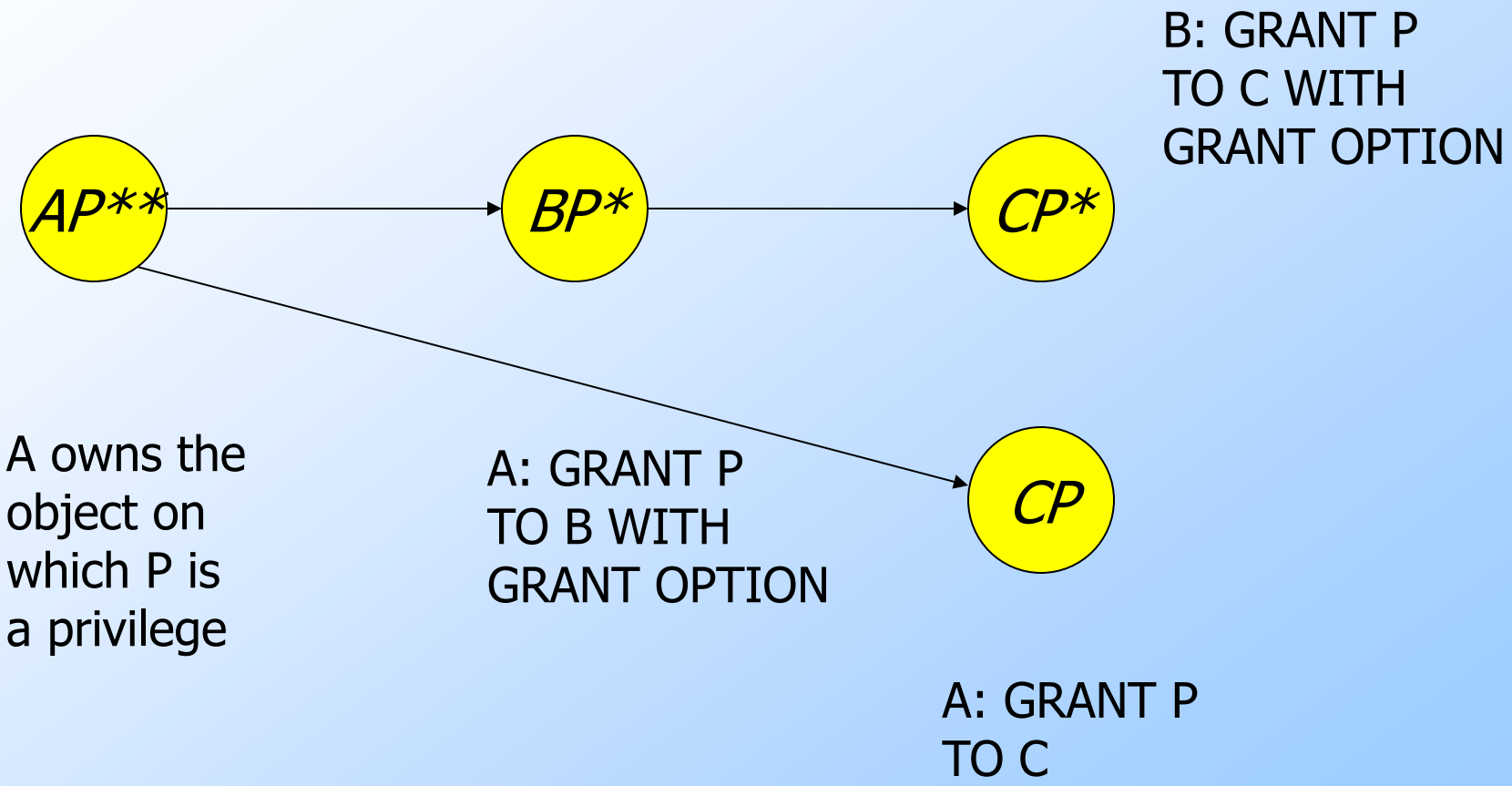
Manipulating Edges – (3)

- 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)

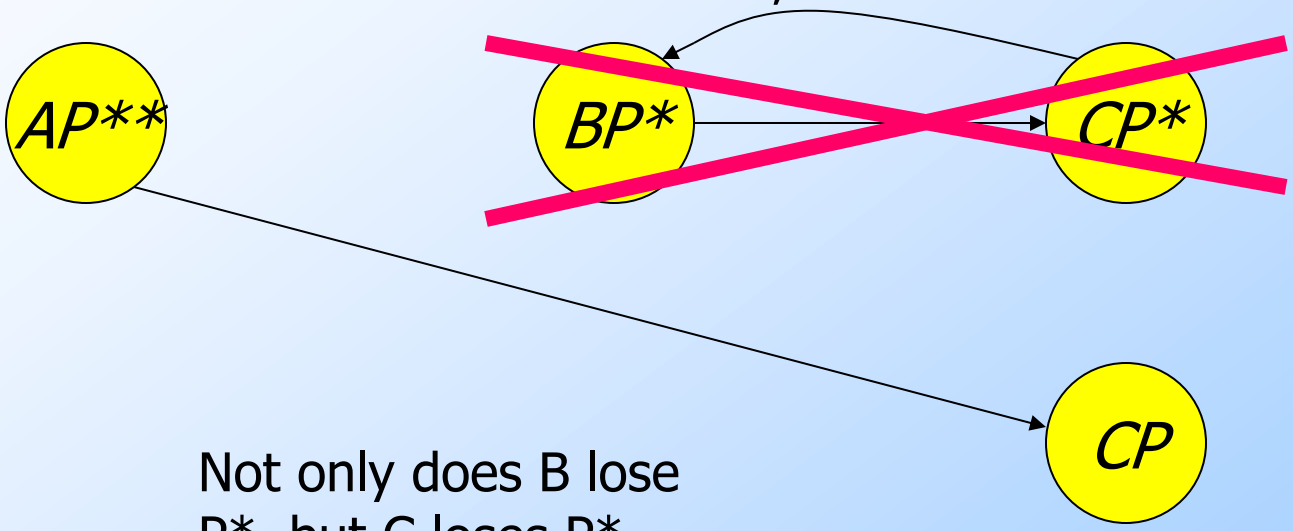
- Having revised the edges, we must check that each node has a path from some ** node, representing ownership.
- Any node with no such path represents a revoked privilege and is deleted from the diagram.

Example: Grant Diagram



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.

Example: GRANT

- Lets give Test SELECT privilege on Computers.Product WITH GRANT OPTION

```
GRANT select
ON computers.product
TO test@localhost
WITH GRANT OPTION;
```

Now Test has the right to issue any query on Computers.Product

AND give that right to others!

Example: GRANT

- Lets give Test SELECT privilege on

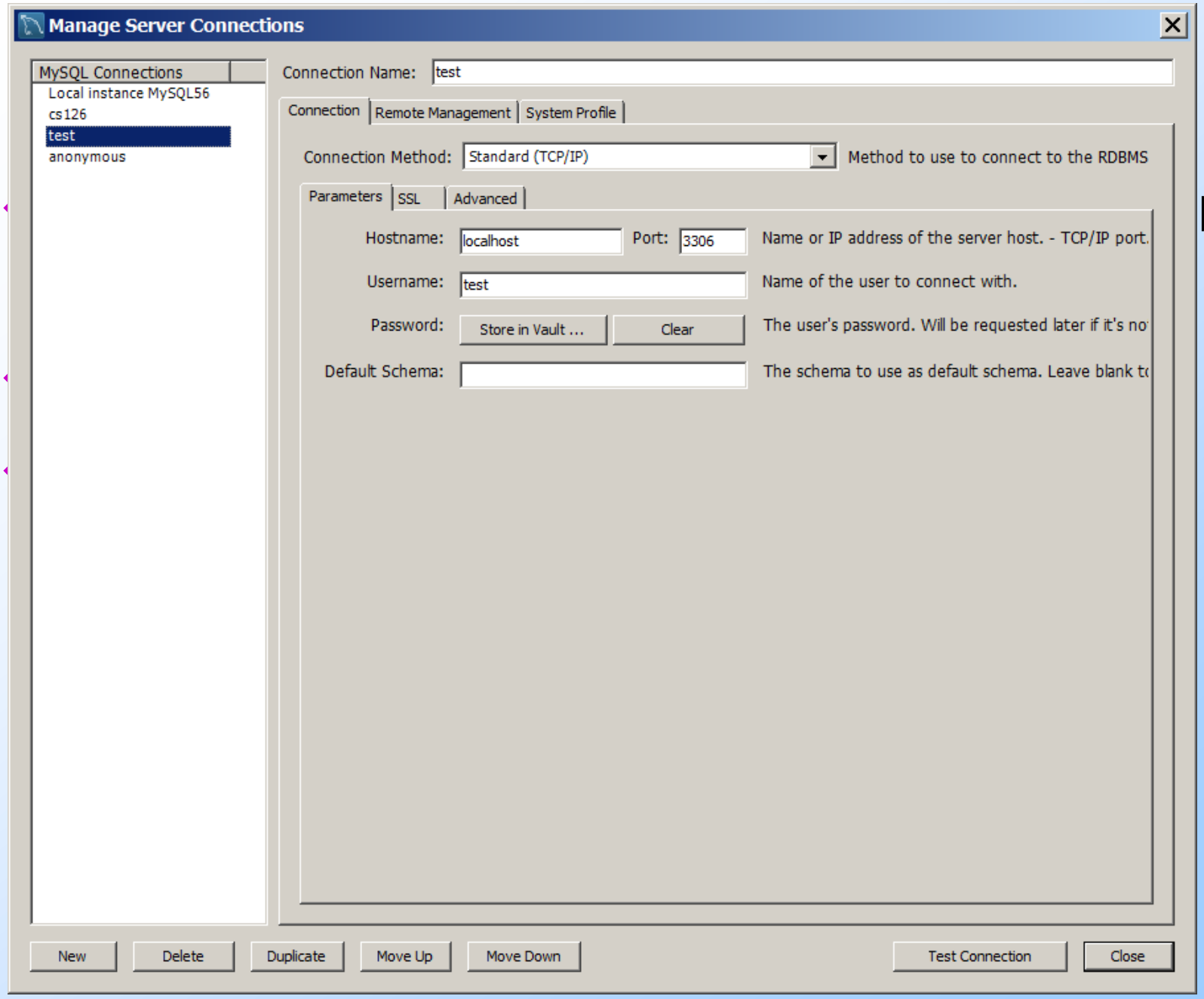
```
show grants for test@localhost;
```

Result Set Filter: Export: Wrap Cell Content:

Grants for test@localhost
GRANT USAGE ON *.* TO 'test'@'localhost' IDENTIFIED BY PASSWORD '*94BDCEBE19083CE2A1F959FD02F964C7AF4CFC29'
GRANT SELECT ON `computers`.`product` TO 'test'@'localhost' WITH GRANT OPTION

Now Test has the right to issue any query on Computers.Product

AND give that right to others!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MySQL Connections
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Method to use to connect to the RDBMS
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Port:
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Name or IP address of the server host. - TCP/IP port.
Username:
test
Name of the user to connect with.
Password:
Store in Vault ...
Clear
The user's password. Will be requested later if it's no
Default Schema:
The schema to use as default schema. Leave blank t
New
Delete
Duplicate
Move Up
Move Down
Test Connection
Close

ry on

Example: GRANT

MySQL Workbench

cs126 × test ×

File Edit View Query Database Server Tools Scripting Help

Navigator

MANAGEMENT
- Server Status
- Client Connections
- Users and Privileges
- Status and System Variables
- Data Export
- Data Import/Restore

INSTANCE
- Startup / Shutdown
- Server Logs
- Options File

SCHEMAS

Filter objects

- computers
- test

SQL File 1 testing ×

```
440 • grant insert on searching.activitylog to anonymous@'%';
441 • grant insert on searching.SearchResultsRatings to anonymous@'%';
442
443 • set password = password('test99');
444 • set password for anonymous@'%' = password('test1');
445 • flush privileges;
446
447 • select current_user();
448 • drop user anonymous@'%';
```

Result Set Filter: Export: Wrap Cell Content:

current_user()
test@localhost

Result 1 ×

Output

Action Output

	Time	Action	Message
1	11:16:13	select current_user() LIMIT 0, 1000	1 row(s) returned

Example: GRANT

- Now Test has the right to issue any query on Computers.Product
- AND give that right to others!
- Now we'll Login as Test:
- Give SELECT privilege on computers.product to Anonymous@'%'

Example: GRANT

- Now Test has the right to issue any query on Computers.Product
- AND give that right to others!

```
452 • grant select on computers.product to anonymous@'%';
453
454 • SET password
455   FOR test@localhost = password('test');
456
457
458
```

Output

Action Output

	Time	Action	Message
1	11:16:13	select current_user() LIMIT 0, 1000	1 row(s) returned
2	11:19:50	grant select on computers.product to anonymous@'%'	0 row(s) affected

Example: GRANT

```
454 • show grants for test@localhost;
455 • show grants for anonymous@'%';
456
```

esult Set Filter: Export: Wrap Cell Content:

Grants for anonymous@%
GRANT USAGE ON *.* TO 'anonymous'@'%' IDENTIFIED BY PASSWORD '*94BDCEBE19083CE2A1F959FD02F964C7AF4CFC2
GRANT SELECT ON `computers`.`product` TO 'anonymous'@'%'

Result 2

Output

Action Output

	Time	Action	Message
2	11:11:58	grant select on computers.product to test@localhost with grant option	0 row(s) affected
3	11:12:03	show grants for test@'127.0.0.1'	Error Code: 1141. There is
4	11:12:44	show grants for test@localhost	2 row(s) returned
5	11:15:51	create user anonymous@'%' IDENTIFIED BY 'test'	0 row(s) affected
6	11:22:56	show grants for anonymous@'%'	2 row(s) returned

ry on

duct

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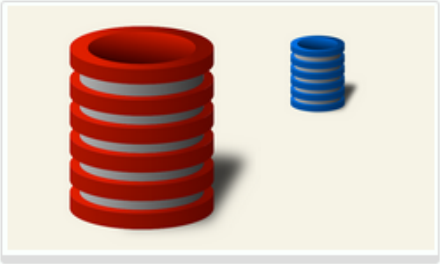

Databases

Course Started - Jun 09, 2014 at 15:00 UTC

DB12 Views and Authorization

Your final grade: **90%**.

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Question

[Q1] The following SQL statement over tables R(a,b), S(b,c), and T(a,c) requires certain privileges to execute:

```
UPDATE R
SET a = 10
WHERE b IN (SELECT c FROM S)
AND NOT EXISTS (SELECT a FROM T WHERE T.a = R.a)
```

Which of the following privileges is **not** useful for execution of this SQL statement?

- SELECT ON T
- SELECT ON R(b)
- SELECT ON S(c)
- INSERT ON R(a)

Question

[Q1] The following SQL statement over tables R(a,b), S(b,c), and T(a,c) requires certain privileges to execute:

```
UPDATE R
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```

Which of the following privileges is **not** useful for execution of this SQL statement?

- ○ SELECT ON T
- ○ SELECT ON R(b)
- ○ SELECT ON S(c)
- ◉ INSERT ON R(a) ✔

Question

[Q2] Consider a set of users A, B, C, D, E. Suppose user A creates a table T and thus is the owner of T. Now suppose the following set of statements is executed in order:

```
1. User A: grant update on T to B,C with grant option
2. User B: grant update on T to D with grant option
3. User C: grant update on T to D with grant option
4. User D: grant update on T to E
5. User A: revoke update on T from C cascade
```

After execution of statement 5, which of the following is true?

> D has privilege UPDATE ON T, but without grant option
>
> D and E do not have privilege UPDATE ON T, but B does
>
> E has privilege UPDATE ON T
>
> D no longer has privilege UPDATE ON T