



# Chapter 4: Intermediate SQL

**Edited by Radhika Sukapuram**

**Database System Concepts, 6<sup>th</sup> Ed.**

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# Large-Object Types

- Large objects (photos, videos, CAD files, etc.) are stored as a *large object*.
  - **blob**: binary large object -- uninterpreted binary data
  - **clob**: character large object -- a large collection of character data
- When a query returns a large object, a pointer is returned rather than the large object itself.



# User-Defined Types

- **distinct types** in SQL
- **create type** construct in SQL creates user-defined type

```
create type Rupees as numeric (12,2) final;  
create type Dollars as numeric (12,2) final;
```

- Example:

```
create table department  
  (dept_name varchar (20),  
   building varchar (15),  
   budget Dollars);
```



# User-Defined Types contd.

- Strong type checking
- A value of type *Rupees* assigned to a value of type *Dollars* results in compile-time error
- What about (*department.budget* + 20 ) ?
  - **cast** (*department.budget* to numeric(12,2))
  - How to save the result back into *Rupees* ?



# Domains

- **create domain** construct in SQL-92 creates user-defined domain types

```
create domain person_name char(20) not null
```

- Example for a constraint:

```
create domain degree_level varchar(10)  
constraint degree_level_test  
check (value in ('Bachelors', 'Masters', 'Doctorate'));
```



# Domains contd.

- Types and domains - differences
  - Domains can have constraints, such as **not null**
  - Domains can have **default** values for variables



# Authorization

- ❑ We may assign a user several forms of authorizations on parts of the database (related to data).
  - ❑ **Read** - allows reading, but not modification of data.
  - ❑ **Insert** - allows insertion of new data, but not modification of existing data.
  - ❑ **Update** - allows modification, but not deletion of data.
  - ❑ **Delete** - allows deletion of data.
- ❑ Each of these types of authorizations is called a **privilege**.
- ❑ We may authorize the user
  - ❑ all, none, or a combination of these types of privileges
  - ❑ on specified parts of a database, such as a relation or a view.



# Authorization (Cont.)

- Forms of authorization to modify the database schema
  - **Index** - allows creation and deletion of indices.
  - **Resources** - allows creation of new relations.
  - **Alteration** - allows addition or deletion of attributes in a relation.
  - **Drop** - allows deletion of relations.





# Authorization Specification in SQL - data

- The **grant** statement is used to confer authorization  
**grant** <privilege list> **on** <relation or view > **to** <user list>
- <user list> is:
  - a user-id
  - **public**, which allows all valid users the privilege granted
  - A role (more on this later)
- Example:
  - **grant select on** *department* **to** Amit, Satoshi
- Granting a privilege on a view does not imply granting any privileges on the underlying relations.
- The grantor of the privilege must already hold the privilege on the specified item (or be the database administrator).

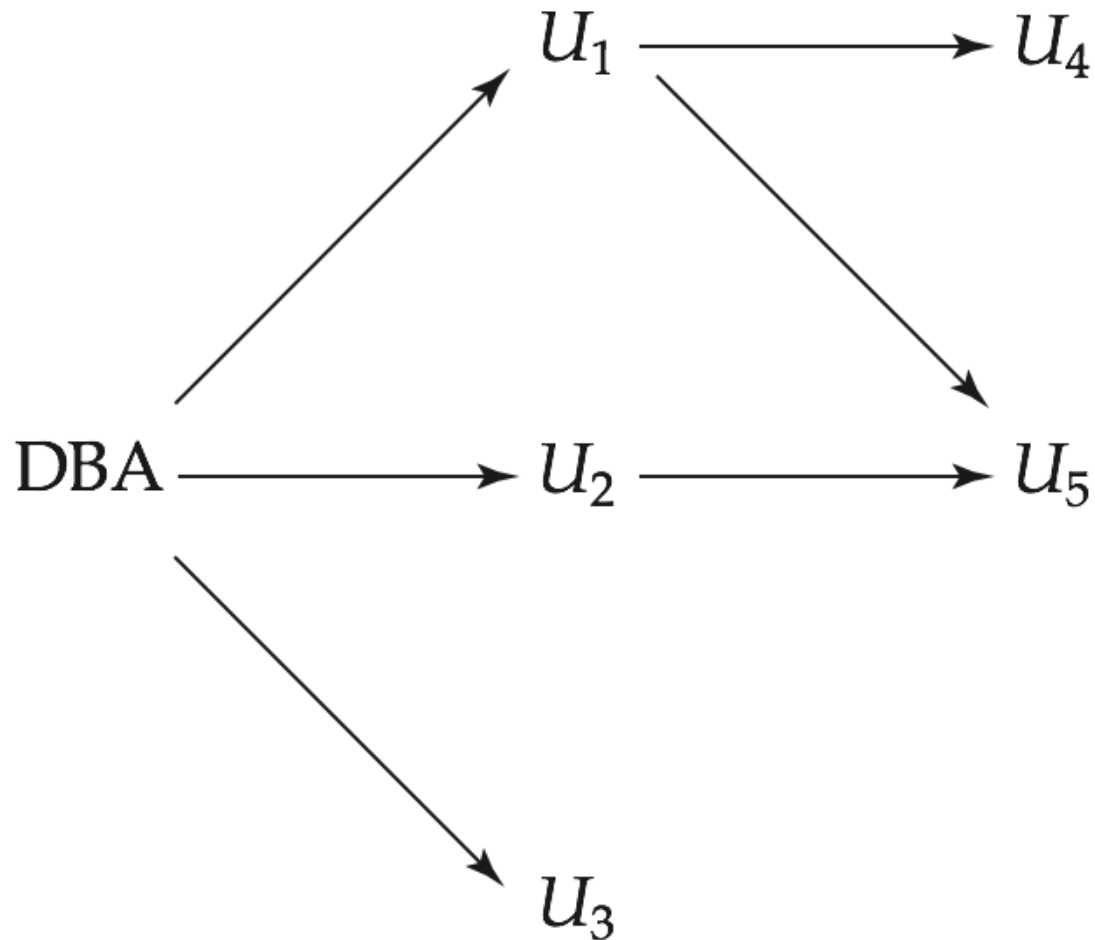


# Privileges in SQL - data

- **select**: allows read access to relation, or the ability to query using the view
  - Example: grant users  $U_1$ ,  $U_2$ , and  $U_3$  **select** authorization on the *instructor* relation:  
**grant select on *instructor* to  $U_1$ ,  $U_2$ ,  $U_3$**
- **insert**: the ability to insert all or some attributes of tuples
- **update**: the ability to update all or some attributes
- **delete**: the ability to delete tuples.
- **all privileges**: used as a short form for all the allowable privileges



# Authorization-Grant Graph



Transfer of privileges:  
**grant select on *department* to  $U_1$  with grant option;**



# Revoking Authorization in SQL

- The **revoke** statement is used to revoke authorization.  
**revoke** <privilege list> **on** <relation or view> **from** <user list>
- Example:  
**revoke select on student from  $U_1, U_2, U_3$**
- <privilege-list> may be **all** to revoke all privileges the revokee may hold.
- If <revokee-list> includes **public**, all users lose the privilege except those granted it explicitly.
- If the same privilege was granted twice to the same user by different grantees, the user may retain the privilege after the revocation.
- All privileges that depend on the privilege being revoked are also revoked – view and underlying relations



# Roles

- A **role** is a way to distinguish among various users
  - denotes what these users can access/update in the database.
  - No need to give individual authorizations
- To create a role we use:  
**create role** <name>
- Example:
  - **create role** instructor
- Once a role is created we can assign “users” to the role using:
  - **grant** <role> **to** <users>



# Roles Example

- ❑ **create role** instructor;
- ❑ **grant** *instructor* **to** Amit;
- ❑ Privileges can be granted to roles:
  - ❑ **grant select on** *takes* **to** *instructor*;
- ❑ Roles can be granted to users, as well as to other roles
  - ❑ **create role** *teaching\_assistant*
  - ❑ **grant** *teaching\_assistant* **to** *instructor*;
    - ▶ *instructor* inherits all privileges of *teaching\_assistant*
- ❑ Chain of roles
  - ❑ **create role** *dean*;
  - ❑ **grant** *instructor* **to** *dean*;
  - ❑ **grant** *dean* **to** Satoshi;



# Authorization on Views

- ❑ **create view** *geo\_instructor* **as**  
(**select** \*  
**from** *instructor*  
**where** *dept\_name* = 'Geology');
- ❑ **grant select on** *geo\_instructor* **to** *geo\_staff* --*geo\_staff* is a role
- ❑ Suppose that a *geo\_staff* member issues
  - ❑ **select** \*  
**from** *geo\_instructor*;
- ❑ What if
  - ❑ *geo\_staff* does not have permissions on *instructor*?
  - ❑ creator of view did not have some permissions on *instructor*?



# Other Authorization Features

- transfer of privileges
  - **grant select on *department* to Amit with grant option;**
  - **revoke select on *department* from Amit, Satoshi cascade;**
    - ▶ Revocation will cascade (default behavior)
  - **revoke select on *department* from Amit, Satoshi restrict;**
    - ▶ An error if there are cascading revocations
  - And more!





# Authorizations on schema

- Primitive: Only the owner can carry out any modification to the schema
- **references** privilege to declare foreign keys while creating a relation
  - **grant reference** (*dept\_name*) **on** *department* **to** Mariano;
  - Now Mariano can create a foreign key in *r* referencing *department*
  - why is this a privileged operation ?



# End of Chapter 4

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## Figure 4.01

<i>ID</i>	<i>name</i>	<i>dept_name</i>	<i>tot_cred</i>
00128	Zhang	Comp. Sci.	102
12345	Shankar	Comp. Sci.	32
19991	Brandt	History	80
23121	Chavez	Finance	110
44553	Peltier	Physics	56
45678	Levy	Physics	46
54321	Williams	Comp. Sci.	54
55739	Sanchez	Music	38
70557	Snow	Physics	0
76543	Brown	Comp. Sci.	58
76653	Aoi	Elec. Eng.	60
98765	Bourikas	Elec. Eng.	98
98988	Tanaka	Biology	120



## Figure 4.02

<i>ID</i>	<i>course_id</i>	<i>sec_id</i>	<i>semester</i>	<i>year</i>	<i>grade</i>
00128	CS-101	1	Fall	2009	A
00128	CS-347	1	Fall	2009	A-
12345	CS-101	1	Fall	2009	C
12345	CS-190	2	Spring	2009	A
12345	CS-315	1	Spring	2010	A
12345	CS-347	1	Fall	2009	A
19991	HIS-351	1	Spring	2010	B
23121	FIN-201	1	Spring	2010	C+
44553	PHY-101	1	Fall	2009	B-
45678	CS-101	1	Fall	2009	F
45678	CS-101	1	Spring	2010	B+
45678	CS-319	1	Spring	2010	B
54321	CS-101	1	Fall	2009	A-
54321	CS-190	2	Spring	2009	B+
55739	MU-199	1	Spring	2010	A-
76543	CS-101	1	Fall	2009	A
76543	CS-319	2	Spring	2010	A
76653	EE-181	1	Spring	2009	C
98765	CS-101	1	Fall	2009	C-
98765	CS-315	1	Spring	2010	B
98988	BIO-101	1	Summer	2009	A
98988	BIO-301	1	Summer	2010	<i>null</i>



# Figure 4.03

<i>ID</i>	<i>name</i>	<i>dept_name</i>	<i>tot_cred</i>	<i>course_id</i>	<i>sec_id</i>	<i>semester</i>	<i>year</i>	<i>grade</i>
00128	Zhang	Comp. Sci.	102	CS-101	1	Fall	2009	A
00128	Zhang	Comp. Sci.	102	CS-347	1	Fall	2009	A-
12345	Shankar	Comp. Sci.	32	CS-101	1	Fall	2009	C
12345	Shankar	Comp. Sci.	32	CS-190	2	Spring	2009	A
12345	Shankar	History	32	CS-315	1	Spring	2010	A
12345	Shankar	Finance	32	CS-347	1	Fall	2009	A
19991	Brandt	Music	80	HIS-351	1	Spring	2010	B
23121	Chavez	Physics	110	FIN-201	1	Spring	2010	C+
44553	Peltier	Physics	56	PHY-101	1	Fall	2009	B-
45678	Levy	Physics	46	CS-101	1	Fall	2009	F
45678	Levy	Physics	46	CS-101	1	Spring	2010	B+
45678	Levy	Physics	46	CS-319	1	Spring	2010	B
54321	Williams	Comp. Sci.	54	CS-101	1	Fall	2009	A-
54321	Williams	Comp. Sci.	54	CS-190	2	Spring	2009	B+
55739	Sanchez	Music	38	MU-199	1	Spring	2010	A-
76543	Brown	Comp. Sci.	58	CS-101	1	Fall	2009	A
76543	Brown	Comp. Sci.	58	CS-319	2	Spring	2010	A
76653	Aoi	Elec. Eng.	60	EE-181	1	Spring	2009	C
98765	Bourikas	Elec. Eng.	98	CS-101	1	Fall	2009	C-
98765	Bourikas	Elec. Eng.	98	CS-315	1	Spring	2010	B
98988	Tanaka	Biology	120	BIO-101	1	Summer	2009	A
98988	Tanaka	Biology	120	BIO-301	1	Summer	2010	<i>null</i>



# Figure 4.04

ID	name	dept_name	tot_cred	course_id	sec_id	semester	year	grade
00128	Zhang	Comp. Sci.	102	CS-101	1	Fall	2009	A
00128	Zhang	Comp. Sci.	102	CS-347	1	Fall	2009	A-
12345	Shankar	Comp. Sci.	32	CS-101	1	Fall	2009	C
12345	Shankar	Comp. Sci.	32	CS-190	2	Spring	2009	A
12345	Shankar	History	32	CS-315	1	Spring	2010	A
12345	Shankar	Finance	32	CS-347	1	Fall	2009	A
19991	Brandt	Music	80	HIS-351	1	Spring	2010	B
23121	Chavez	Physics	110	FIN-201	1	Spring	2010	C+
44553	Peltier	Physics	56	PHY-101	1	Fall	2009	B-
45678	Levy	Physics	46	CS-101	1	Fall	2009	F
45678	Levy	Physics	46	CS-101	1	Spring	2010	B+
45678	Levy	Physics	46	CS-319	1	Spring	2010	B
54321	Williams	Comp. Sci.	54	CS-101	1	Fall	2009	A-
54321	Williams	Comp. Sci.	54	CS-190	2	Spring	2009	B+
55739	Sanchez	Music	38	MU-199	1	Spring	2010	A-
70557	Snow	Physics	0	<i>null</i>	<i>null</i>	<i>null</i>	<i>null</i>	<i>null</i>
76543	Brown	Comp. Sci.	58	CS-101	1	Fall	2009	A
76543	Brown	Comp. Sci.	58	CS-319	2	Spring	2010	A
76653	Aoi	Elec. Eng.	60	EE-181	1	Spring	2009	C
98765	Bourikas	Elec. Eng.	98	CS-101	1	Fall	2009	C-
98765	Bourikas	Elec. Eng.	98	CS-315	1	Spring	2010	B
98988	Tanaka	Biology	120	BIO-101	1	Summer	2009	A
98988	Tanaka	Biology	120	BIO-301	1	Summer	2010	<i>null</i>





# Figure 4.05

ID	course_id	sec_id	semester	year	grade	name	dept_name	tot_cred
00128	CS-101	1	Fall	2009	A	Zhang	Comp. Sci.	102
00128	CS-347	1	Fall	2009	A-	Zhang	Comp. Sci.	102
12345	CS-101	1	Fall	2009	C	Shankar	Comp. Sci.	32
12345	CS-190	2	Spring	2009	A	Shankar	Comp. Sci.	32
12345	CS-315	1	Spring	2010	A	Shankar	History	32
12345	CS-347	1	Fall	2009	A	Shankar	Finance	32
19991	HIS-351	1	Spring	2010	B	Brandt	Music	80
23121	FIN-201	1	Spring	2010	C+	Chavez	Physics	110
44553	PHY-101	1	Fall	2009	B-	Peltier	Physics	56
45678	CS-101	1	Fall	2009	F	Levy	Physics	46
45678	CS-101	1	Spring	2010	B+	Levy	Physics	46
45678	CS-319	1	Spring	2010	B	Levy	Physics	46
54321	CS-101	1	Fall	2009	A-	Williams	Comp. Sci.	54
54321	CS-190	2	Spring	2009	B+	Williams	Comp. Sci.	54
55739	MU-199	1	Spring	2010	A-	Sanchez	Music	38
70557	<i>null</i>	<i>null</i>	<i>null</i>	<i>null</i>	<i>null</i>	Snow	Physics	0
76543	CS-101	1	Fall	2009	A	Brown	Comp. Sci.	58
76543	CS-319	2	Spring	2010	A	Brown	Comp. Sci.	58
76653	EE-181	1	Spring	2009	C	Aoi	Elec. Eng.	60
98765	CS-101	1	Fall	2009	C-	Bourikas	Elec. Eng.	98
98765	CS-315	1	Spring	2010	B	Bourikas	Elec. Eng.	98
98988	BIO-101	1	Summer	2009	A	Tanaka	Biology	120
98988	BIO-301	1	Summer	2010	<i>null</i>	Tanaka	Biology	120



# Figure 4.07

<i>ID</i>	<i>name</i>	<i>dept_name</i>	<i>salary</i>
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000
33456	Gold	Physics	87000
45565	Katz	Comp. Sci.	75000
58583	Califieri	History	62000
76543	Singh	Finance	80000
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000
69987	White	<i>null</i>	<i>null</i>

*instructor*

<i>dept_name</i>	<i>building</i>	<i>budget</i>
Biology	Watson	90000
Comp. Sci.	Taylor	100000
Elec. Eng.	Taylor	85000
Finance	Painter	120000
History	Painter	50000
Music	Packard	80000
Physics	Watson	70000
<i>null</i>	Taylor	<i>null</i>

*department*