CSIT115 Data Management and Security

CSIT882 Data Management Systems

Views

Subject Coordinators: Dr Chen Chen, Dr Thanh Le

School of Computing and Information Technology -
University of Wollongong

Views

Outline

Inline views

An inline view is `SELECT` statement enclosed within `(` and `)` brackets and followed by an optional inline view name

A view name is a name of a temporary relational table created while `SELECT` statement is processed

A temporary relational table is created only for a period of time when `SELECT` statement, that contains inline view is processed

A name of inline view can be used within `SELECT` statement in any place where a name of a relational table can be used

Inline views

Sample database

CREATE TABLKE statement

```
CREATE TABLE DEPARTMENT(
 name                VARCHAR(50)        NOT NULL,
 code                CHAR(5)            NOT NULL,
 total_staff_number DECIMAL(2)          NOT NULL,
 chair               VARCHAR(50)            NULL,
 budget              DECIMAL(9,1)       NOT NULL,
  CONSTRAINT dept_pkey PRIMARY KEY(name),
  CONSTRAINT dept_ckey1 UNIQUE(code),
  CONSTRAINT dept_ckey2 UNIQUE(chair),
  CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

CREATE TABLE statement

```
CREATE TABLE COURSE(
 cnum                CHAR(7)            NOT NULL,
 title               VARCHAR(200)       NOT NULL,
 credits             DECIMAL(2)         NOT NULL,
 offered_by          VARCHAR(50)            NULL,
  CONSTRAINT course_pkey PRIMARY KEY(cnum),
  CONSTRAINT course_check1 CHECK (credits IN (6, 12)),
  CONSTRAINT course_fkey1 FOREIGN KEY(offered_by)
                        REFERENCES DEPARTMENT(name) ON DELETE CASCADE );
```

In HTML view press 'p' to see the lecture notes

Inline views

A query find the chair people of departments, that offer more than one course can be decomposed into the following queries

Find the total number of courses offered by a department

```
                                Inline view that contains the total number of courses offered by a department
( SELECT count(*)
  FROM COURSE
  WHERE COURSE.offered_by = ... )
```

Find the chair people of departments, such that the total number of courses offered by a department is greater than one

```
                                                Chair people of departments that offer more than one course
SELECT DEPARTMENT.chair
FROM DEPARTMENT
WHERE ( SELECT count(*)
        FROM COURSE
        WHERE COURSE.offered_by = DEPARTMENT.name )  > 1;
```

Inline views

A query find the chair people of departments, that offer more than one course and the total number of courses offered by each department can be decomposed into the following queries

Find the names of departments, that offer more than one course and the total number of courses offered by each department

```
                                    Inline view with the names of departments that offer more than one course
                                    and the total number of courses offered by a department

( SELECT offered_by, count(*) total
  FROM COURSE
  GROUP BY offered_by
  HAVING count(*) > 1 ) MORETHAN1
```

Find the chair people of departments, that offer more than one course and the total number of courses offered by each department

```
                          Chair people of departments that offer more than one course and the total number of courses
SELECT DEPARTMENT.chair, MORETHAN1.total
FROM DEPARTMENT JOIN ( SELECT offered_by, count(*) total
                       FROM COURSE
                       GROUP BY offered_by
                       HAVING count(*) > 1 ) MORETHAN1
                ON DEPARTMENT.name = MORETHAN1.offered_by;
```

In HTML view press 'p' to see the lecture notes

Inline views

A query find the chair people of departments, that offer more than one course and the total number of courses offered by each department can be decomposed into the following queries

Find the total number of courses offered by a department

```
                                  Inline view with the total number of courses offered by a department
( SELECT count(*)
  FROM COURSE
  WHERE COURSE.offered_by = ... ) TOTALC
```

Find the chair people of departments and the total number of courses offered by each department

```
      Inline view with the chair people of departments and the total number of courses per department
( SELECT chair, ( SELECT count(*)
                  FROM COURSE
                  WHERE COURSE.offered_by = DEPARTMENT.name ) TOTALC
  FROM DEPARTMENT ) CHAIRTOTAL
```

Inline views

Find the chair people of departments, that offer more than one course and the total number of courses offered by each department

```
                                    Inline view with the total number of courses offered by a department
SELECT chair, TOTALC
FROM ( SELECT chair, ( SELECT count(*)
                       FROM COURSE
                       WHERE COURSE.offered_by = DEPARTMENT.name ) TOTALC
       FROM DEPARTMENT ) CHAIRTOTAL
WHERE CHAIRTOTAL.TOTALC > 1;
```

It is quite important to indent the clauses of the respective `SELECT` statements in a way, that shows which `SELECT`, `FROM` and `WHERE` clauses belong to the same `SELECT` statement

Views

Outline

- Inline views
- Queries with WITH clause
- Relational views

In HTML view press 'p' to see the lecture notes

Queries with `WITH` clause

Consider a query, that finds the names of all departments together with the total number of courses offered by each department, include the departments that offer no courses

The query can be decomposed into the following two queries:

- find the names of departments and the numbers of courses offered by each department, and a query ...
- aggregate the results from the first query over the names of departments and count the total number of courses offered by each department

The first query can be implemented as a query definition `DEPT_COURSE` within `WITH` clause

```
WITH DEPT_COURSE AS                                    WITH clause with a query definition
                  ( SELECT name, cnum
                    FROM DEPARTMENT LEFT OUTER JOIN COURSE
                                    ON DEPARTMENT.name = COURSE.offered_by ),
```

A query definition is an inline view, with a name preceeding `SELECT` statement

Queries with `WITH` clause

The second query can be implemented as a query definition `DC_COUNT`, that references a query definition `DEPT_COURSE` within `WITH` clause

WITH clause with two query definitions

```
WITH DEPT_COURSE AS
                  ( SELECT name, cnum
                    FROM DEPARTMENT LEFT OUTER JOIN COURSE
                                    ON DEPARTMENT.name = COURSE.offered_by ),
     DC_COUNT AS
                  ( SELECT name, COUNT(cnum) total_courses
                    FROM DEPT_COURSE
                    GROUP BY name )
```

Note, that a comma (`,`) separates the query definitions included in `WITH` clause

The last query definion included in `WITH` clause does not have a comma following it

A keyword `AS` following a name of query definition separates a name of query definition from an inline view

In HTML view press 'p' to see the lecture notes

Queries with `WITH` clause

The final query is implemented as `SELECT` statement appended to a query definition `DC_COUNT` within `WITH` clause

WITH clause with two query definitions and SELECT statement

```
WITH DEPT_COURSE AS
                    ( SELECT name, cnum
                      FROM DEPARTMENT LEFT OUTER JOIN COURSE
                                      ON DEPARTMENT.name = COURSE.offered_by ),
     DC_COUNT AS
                    ( SELECT name, COUNT(cnum) total_courses
                      FROM DEPT_COURSE
                      GROUP BY name )
    SELECT name
    FROM DC_COUNT;
```

Note, that there is no comma after the last query definition `DC_COUNT`

Queries with `WITH` clause

In another example, `WITH` clause is used to reduce the complexity of implementation of a query, that finds the chair people of departments, that offer both 6 and 12 credit point courses

The query is decomposed into the following subqueries:

- Find the names of departments, that offer 6 credit point courses
- Find the names of departments, that offer 12 credit point courses
- Find the names of departments included in both results from the subqueries above
- Find the chair people of departments included in the previous subquery

The first subquery is implemented as a query definition `COURSE6CR` within `WITH` clause

WITH clause with a query definition

```
WITH COURSE6CR AS
                ( SELECT offered_by
                  FROM COURSE
                  WHERE credits = 6 ),
```

Queries with `WITH` clause

A subquery, that finds the names of departments, that offer 12 credit point courses is implemented as a query definition `COURSE12CR` and it is appended to `WITH` clause

WITH clause with two query definitions

```
WITH COURSE6CR AS
                ( SELECT offered_by
                  FROM COURSE
                  WHERE credits = 6 ),
     COURSE12CR AS
                ( SELECT offered_by
                  FROM COURSE
                  WHERE credits = 12 ),
```

Queries with `WITH` clause

A subquery, that finds the names of departments that offer both 6 and 12 credit point courses is implemented as a query definition `COURSE6_12CR` and it is appended to `WITH` clause

WITH clause with three query definitions

```
WITH COURSE6CR AS
                ( SELECT offered_by
                  FROM COURSE
                  WHERE credits = 6 ),
     COURSE12CR AS
                ( SELECT offered_by
                  FROM COURSE
                  WHERE credits = 12 ),
     COURSE6_12CR AS
                ( SELECT COURSE6CR.offered_by
                  FROM COURSE6CR JOIN COURSE12CR
                                 ON COURSE6CR.offered_by = COURSE12CR.offered_by ),
```

Queries with `WITH` clause

A subquery, that finds the chair people of departments that offer both 6 and 12 credit point courses is implemented as a query definition `CHAIR` and it is appended to `WITH` clause

WITH clause with four query definitions

```
WITH COURSE6CR AS
                ( SELECT offered_by
                  FROM COURSE
                  WHERE credits = 6 ),
     COURSE12CR AS
                ( SELECT offered_by
                  FROM COURSE
                  WHERE credits = 12 ),
     COURSE6_12CR AS
                ( SELECT COURSE6CR.offered_by
                  FROM COURSE6CR JOIN COURSE12CR
                                 ON COURSE6CR.offered_by = COURSE12CR.offered_by ),
     CHAIR AS
                ( SELECT DEPARTMENT.chair
                  FROM COURSE6_12CR JOIN DEPARTMENT
                                    ON COURSE6_12CR.offered_by = DEPARTMENT.name )
```

In HTML view press 'p' to see the lecture notes

Queries with `WITH` clause

Finally a query, that finds the chair people of departments that offer both 6 and 12 credit point courses is implemented as `SELECT` statement and it is appended to `WITH` clause

```
WITH COURSE6CR AS                    WITH clause with four query definitions and SELECT statement
                ( SELECT offered_by
                  FROM COURSE
                  WHERE credits = 6 ),
     COURSE12CR AS
                ( SELECT offered_by
                  FROM COURSE
                  WHERE credits = 12 ),
     COURSE6_12CR AS
                ( SELECT COURSE6CR.offered_by
                  FROM COURSE6CR JOIN COURSE12CR
                                 ON COURSE6CR.offered_by = COURSE12CR.offered_by ),
     CHAIR AS
                ( SELECT DEPARTMENT.chair
                  FROM COURSE6_12CR JOIN DEPARTMENT
                                    ON COURSE6_12CR.offered_by = DEPARTMENT.name )
SELECT *
FROM CHAIR;
```

In HTML view press 'p' to see the lecture notes

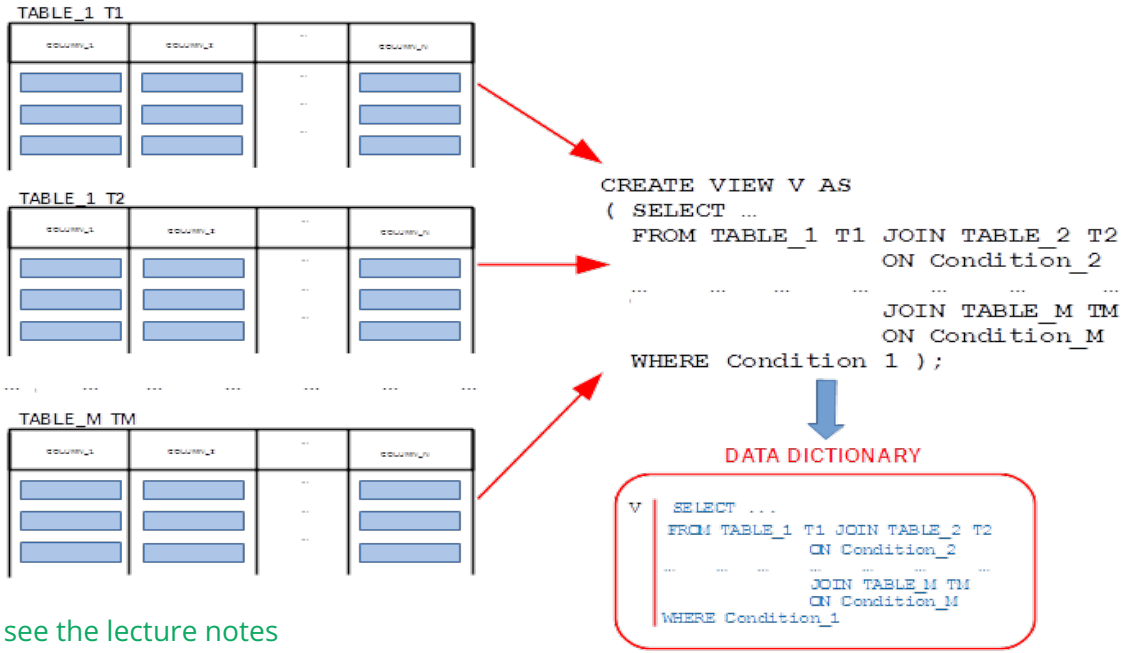
Views

Outline

Relational views

A relational view is a virtual relational table (derived relational table), that occupies no persistent storage and it is computed from very beginning every time it is used in `SELECT` statement

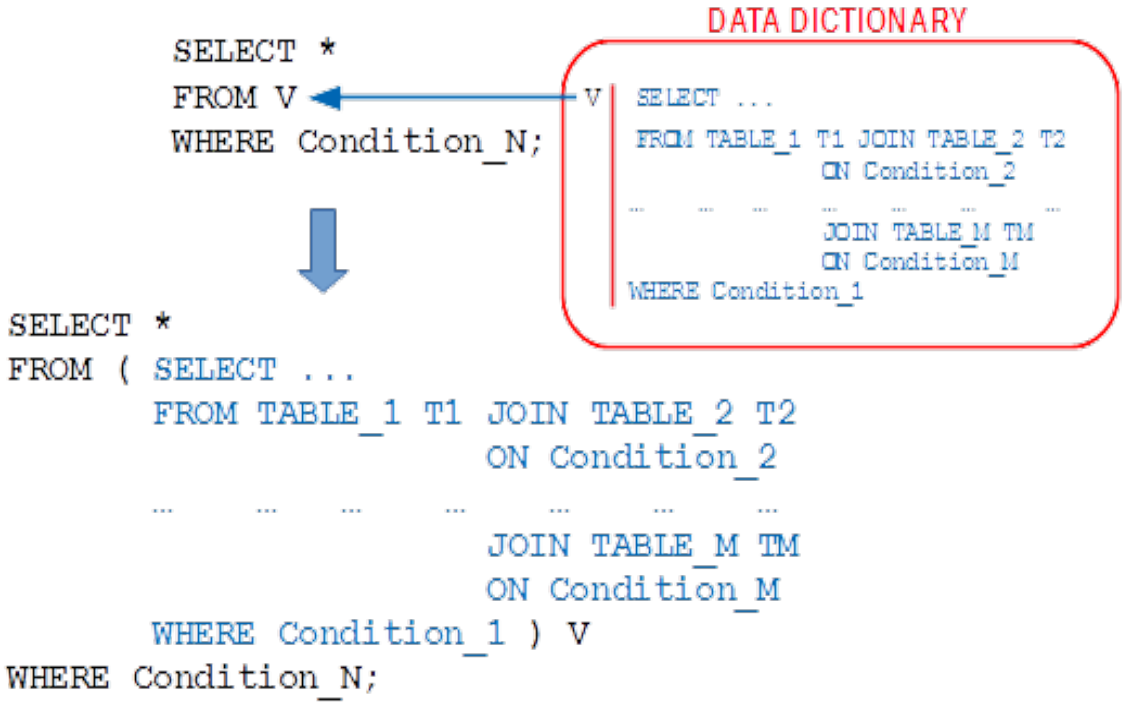
A relational view is stored by a database management system as a pair (name of a view, `SELECT` statement that defines the structure and contents of the view)



In HTML view press 'p' to see the lecture notes

Relational views

Each time a name of a relational view is used in `SELECT` statement, its definition replaces the name of a view and it becomes an inline view



In HTML view press 'p' to see the lecture notes

Relational views

For example, create a relational view, that contains the names of all departments together with the total number of courses offered by each department

CREATE VIEW statement

```
CREATE VIEW VDEPT( name, total_courses ) AS
( SELECT name, count(COURSE.cnum)
  FROM DEPARTMENT LEFT OUTER JOIN COURSE
                  ON DEPARTMENT.name = COURSE.offered_by
  GROUP BY DEPARTMENT.name );
```

Note, that `LEFT OUTER JOIN` operation is used to join the relational tables `DEPARTMENT` and `COURSE` to inlude all names of departments no matter if a department offers a course or not

Also note, that a column `cnum` in a relational table `COURSE` is used for counting the values in each group, do you remember why it is so ?

Relational views

Then, a view `VDEPT` can be used to implement a query, that finds the names of departments that offer more than 1 course

SELECT statement

```
SELECT name
FROM VDEPT
WHERE total_courses > 1;
```

The same query when implemented with `GROUP BY` and `HAVING` is given below

SELECT statement with LEFT OUTER JOIN operation

```
SELECT name, count(cnum)
FROM DEPARTMENT LEFT OUTER JOIN COURSE
                ON DEPARTMENT.name = COURSE.offered_by
GROUP BY name
HAVING count(cnum) > 1;
```

Application of a relational view `VDEPT` splits the complexity of implementation over two simpler `SELECT` statements

Relational views

A relational view can be used to reduce the complexity of `SELECT` statements

For example, a query, that finds the chair people of departments that offer both 6 and 12 credit point courses can be decomposed into the following four queries:

`V6`: Find the names of departments, that offer 6 credit point courses

`V12`: Find the names of departments, that offer 12 credit point courses

`VNAME`: Find the names of departments included in both `V6` and `V12`

`VCHAIR`: Find the chair people of departments included in `VNAME`

Relational views

The views are implemented in the following way

V6: Find the names of departments that offer 6 credit point courses

Creating a view v6

```
CREATE VIEW V6( name ) AS
( SELECT offered_by
  FROM COURSE
  WHERE credits = 6 );
```

V12: Find the names of departments that offer 12 credit point courses

Creating a view V12

```
CREATE VIEW V12( name ) AS
( SELECT offered_by
  FROM COURSE
  WHERE credits = 12 );
```

VNAME: Find the names of departments included in both V6 and V12

Intersection of V6 and V12

```
CREATE VIEW VNAME( name ) AS
( SELECT V6.name
  FROM V6 JOIN V12
       ON V6.name = V12.name );
```

In HTML view press 'p' to see the lecture notes

Relational views

VCHAIR: Find the chairs of departments included in VNAME

Finding chair people in VNAME and DEPARTMENT

```
CREATE VIEW VCHAIR( chair ) AS
( SELECT DEPARTMENT.chair
  FROM VNAME JOIN DEPARTMENT
             ON VNAME.name  = DEPARTMENT.name);
```

The final query is the following

The final query

```
SELECT *
FROM VCHAIR;
```

References

C. Coronel, S. Morris, A. Basta, M. Zgola, Data Management and Security, Chapters 5, 7, Cengage Compose eBook, 2018, eBook: Data Management and Security, 1st Edition

T. Connoly, C. Begg, Database Systems, A Practical Approach to Design, Implementation, and Management, Chapter 7.4.1 Creating a View Pearson Education Ltd, 2015

D. Darmawikarta, SQL for MySQL A Beginner's Tutorial, Chapter 7 Subqueries, Chapter 9 Views, Brainy Software Inc. First Edition: June 2014

How to ... ? Cookbook, How to implement relational views? (Part 2) Recipe 7.3 How to implement relational views ?