

ICS 321 Data Storage & Retrieval Constraints, Triggers, Views & Indexes

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PK and FK Constraints

```
CREATE TABLE Studio (  
    name CHAR(30) NOT NULL PRIMARY KEY,  
    address VARCHAR(255),  
    presC# INT REFERENCES MovieExec(cert#) )
```

```
CREATE TABLE Studio (  
    name CHAR(30) NOT NULL,  
    address VARCHAR(255),  
    presC# INT,  
    PRIMARY KEY(name),  
    FOREIGN KEY(presC#)  
        REFERENCES MovieExec(cert#) )
```

Cert# must be
declared with
PRIMARY KEY or
UNIQUE constraint

Maintaining Referential Integrity

```
CREATE TABLE Studio (  
    name CHAR(30) NOT NULL PRIMARY KEY,  
    address VARCHAR(255),  
    presC# INT REFERENCES MovieExec(cert#) )
```

- INSERT INTO studio VALUES (...)
- UPDATE studio SET presC#=? ...
- DELETE FROM MovieExec
WHERE ...
- UPDATE MovieExec SET
cert#=? ...

If new presC# value
does not exist in
MovieExec, reject!

If deleted cert# values are
used in studio, reject!

If old cert# values are used in
studio, reject!

Other Options for Referential Integrity

```
CREATE TABLE Studio (  
    name CHAR(30) NOT NULL PRIMARY KEY,  
    address VARCHAR(255),  
    presC# INT REFERENCES MovieExec(cert#)  
        ON DELETE SET NULL  
        ON UPDATE CASCADE )
```

- **CASCADE** : changes to referenced attributes are mimicked at FK.
- **SET NULL** : changes to referenced attributes makes affected FK null
- **DEFERABLE** : checking can wait till end of transaction
 - **INITIALLY DEFERRED** : defer checking
 - **INITIALLY IMMEDIATE** : check immediately

Check Constraints

- Attribute, tuple-based, multi-table
- Syntax: **CHECK** *conditional-expression*

```
CREATE TABLE Studio (  
    name CHAR(30) NOT NULL PRIMARY KEY,  
    address VARCHAR(255),  
    presC# INT REFERENCES MovieExec(cert#)  
        CHECK ( presC# >=100000 ) )
```

```
CREATE TABLE MovieStar (  
    name CHAR(30) NOT NULL PRIMARY KEY,  
    address VARCHAR(255),  
    gender CHAR(1), birthdate DATE,  
    CHECK ( gender = 'F' OR name NOT LIKE 'Ms.%' ) )
```

Naming Constraints

```
CREATE TABLE Studio (  
    name CHAR(30) CONSTRAINT nameiskey PRIMARY KEY,  
    address VARCHAR(255),  
    presC# INT REFERENCES MovieExec(cert#)  
    CONSTRAINT sixdigit CHECK ( presC# >=100000 ) )
```

```
ALTER TABLE Studio DROP CONSTRAINT nameiskey;
```

```
ALTER TABLE Studio ADD CONSTRAINT nameiskey  
    PRIMARY KEY(name) ;
```

- Constraints can be named, so that you can refer to them in alter table statements

Constraints over Multiple Tables

- Example: number of boats + number of sailors < 100

```
CREATE TABLE Sailors ( sid INTEGER, sname CHAR(10),  
    rating INTEGER, age REAL, PRIMARY KEY (sid),  
    CHECK (  
        (SELECT COUNT (S.sid) FROM Sailors S)  
        + (SELECT COUNT (B.bid) FROM Boats B) < 100 )
```

- When is the constraint enforced ?
- What happens if the sailors table is empty ?
- Think of a case when the constraint is violated but the system never catches it.

CREATE ASSERTION

- Allows constraints that are not associated with any table.
- Evaluated whenever tables in the condition are updated

```
CREATE ASSERTION smallClub  
CHECK (  
    (SELECT COUNT (S.sid) FROM Sailors S)  
    + (SELECT COUNT (B.bid) FROM Boats B) < 100 )
```


Triggers

- Trigger: procedure that starts automatically if specified changes occur to the DBMS
- Three parts:
 - Event (activates the trigger)
 - Condition (tests whether the triggers should run)
 - Action (what happens if the trigger runs)

Example of a Trigger

```
CREATE TRIGGER youngSailorUpdate  
  AFTER INSERT ON SAILORS  
  REFERENCING NEW TABLE NewSailors  
  FOR EACH STATEMENT  
  INSERT  
    INTO YoungSailors(sid, name, age, rating)  
    SELECT sid, name, age, rating  
    FROM NewSailors N  
    WHERE N.age <= 18
```

- Why is “NewSailors” needed ?
- What is the difference between a constraint and a trigger ?

Another Example of a Trigger

- Create a trigger that will cause an error when an update occurs that would result in a salary increase greater than ten percent of the current salary.

```
CREATE TRIGGER RAISE_LIMIT  
    AFTER UPDATE OF SALARY ON EMPLOYEE  
    REFERENCING NEW AS N OLD AS O  
    FOR EACH ROW  
    WHEN (N.SALARY > 1.1 * O.SALARY)  
    SIGNAL SQLSTATE '75000'  
    SET MESSAGE_TEXT='Salary increase>10%'
```

Views

```
CREATE VIEW YoungActiveStudents (name, grade) AS
SELECT S.name, E.grade
FROM Students S, Enrolled E
WHERE S.sid = E.sid and S.age < 21
```

- A view is just a relation, but we store a *definition*, rather than a set of tuples.
- Views can be dropped using the **DROP VIEW** command.
- What if table that the view is dependent on is dropped ?
 - **DROP TABLE** command has options to let the user specify this.

Querying Views

```
CREATE VIEW YoungActiveStudents (name, grade) AS
  SELECT  S.name, E.grade
  FROM    Students S, Enrolled E
  WHERE   S.sid = E.sid and S.age<21
```

```
SELECT  name
FROM    YoungActiveStudents
WHERE   grade = 'A'
```

Query views as with
any table

Conceptually,
you can think of
rewriting using
a subquery

```
SELECT  name
FROM    (SELECT  S.name, E.grade
         FROM    Students S, Enrolled E
         WHERE   S.sid = E.sid and S.age<21)
WHERE   grade = 'A'
```

Updateable Views

- In general views are not updateable. Why?
- A view on R is updateable when
 - WHERE : must not involve R in a subquery
 - FROM : only one occurrence of R and no joins.
 - SELECT : include enough attributes to fill out other attributes in R

```
CREATE VIEW ParamountMovies AS  
SELECT title, year  
FROM movies  
WHERE studioName='Paramount'
```

```
SELECT *  
FROM ParamountMovies
```

```
INSERT INTO ParamountMovies  
VALUES ('Star Trek', 1979)
```



```
INSERT INTO Movies ( title, year )  
VALUES ('Star Trek', 1979)
```

Indexes in SQL

```
SELECT *  
FROM Movies  
WHERE studioName='Disney' AND year=1990
```

Title	Year	Length	Genre	studioName	producerC#
	...				
	1990				

10,000 rows

200 movies are made in 1990

An **index on attribute A** is a data structure that makes it efficient to find those tuples that have a fixed value for attribute A

Creating Indexes

```
CREATE INDEX myidx ON mytable(col1, col3)  
CREATE UNIQUE INDEX myUniqIdx ON mytable(col2, col5)  
CREATE INDEX myidx ON mytable(col1, col3) CLUSTER
```

- **Clustered Index** : an index on an attribute that the tuples are sorted in.
- If a primary key is specified in the CREATE TABLE statement, an (unclustered) index is automatically created for the PK.
- To create a clustered PK index:
 - Create table without PK constraint
 - Create index on PK with cluster option
 - Alter table to add PK constraint
- To get rid of unused indexes: **DROP INDEX** myidx;

Materialized Views

```
CREATE VIEW ParamountMovies AS  
SELECT title, year  
FROM movies  
WHERE studioName='Paramount'
```

```
CREATE TABLE ParamountMovies AS  
(SELECT title, year  
FROM movies  
WHERE studioName='Paramount')
```

- Views can be “materialized” for efficiency
- Updating the materialized view (materialized query table in DB2) : incremental or batch

Queries on base relation
may be able to exploit
materialized views!

```
SELECT title  
FROM movies  
WHERE studioName='Paramount'  
AND year=1990)
```