5. The Security and Integrity Constraints (2/2)

Triggers

- Trigger: procedure that starts automatically if specified changes occur to the DBMS
- Three parts:
  - **E**vent (activates the trigger)
  - **C**ondition (tests whether the triggers should run)
  - **A**ction (what happens if the trigger runs)
- Active database rules (ECA rules)

Triggers: Example

```
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
```

Execution of Rules

- Immediate execution √
- Deferred execution
- Decoupled or detached mode
- Cascading trigger
  - Control nested execution of rules
  - Prevent nontermination
    - Triggering graph
    - Specify the upper limit of cascading times
  - So triggers should be used reasonably

Implementation of ECA

- Loosely coupling
- Tightly coupling (DB2, Oracle, etc.)
- Nested method

  The rules are nested into transaction and executed by DBMS as a part of the transaction.
  - Grafting method
  - Query modification method

6. Database Design (1/2)

6.1 Data Dependency and Normalization of Relational Schema

- Some dependent relations exist between attributes.
- Function dependency (FD): the most basic kind of data dependencies. The value of one or a group attributes can decide the value of other attributes.

  FD is the most important in general database design.
- Multi-valued Dependency (MVD): the value of some attribute can decide a group of values of some other attributes.
- Join Dependency (JD): the constraint of lossless join decomposition.

1NF

every attribute of a relation must be atomic.

name	dept	address		
		prov	city	street

Non 1NF

name	dept	prov	city	street

1NF

2NF

- R∈1NF and no partially function dependency exists between attributes.

S(S#, SNAME, AGE, ADDR, C#, GRADE)

--- non 2NF

Problems of non 2NF:

- Insert abnormity: can not insert the students' information who have not selected course.
- Delete abnormity: if a student unselect all courses, his basic information is also lost.
- Hard to update: because of redundancy, it is hard to keep consistency when update.

Resolving:

According to the rule of **"one fact in one place"** to decompose the relation into 2 new relations:

S(S#, SNAME, AGE, ADDR)

SC(S#, C#, GRADE)

3NF

- R∈2NF and no transfer function dependency exists between attributes.

  EMP(EMP#, SAL_LEVEL, SALARY)

  --- non 3NF

Problems of non 3NF

- Insert abnormity: before the employees's sal_level are decided, the correspondence between sal_level and salary can not input.
- Delete abnormity: if some sal_level has only one man, the correspondence between sal_level and salary of this level will be lost when the man is deleted.
- Hard to update: because of redundancy, it is hard to keep consistency when update.

Resolving:

According to the rule of **"one fact in one place"** to decompose the relation into 2 new relations:

EMP(EMP#,SAL_LEVEL)

SAL(SAL_LEVEL,SALARY)

Material Card

How to define relations to express the information on this card?

Equipment name: Type: Code:							
Unit price: Store place: room rack layer position							
date	voucher No.	coming/going place	take in	take out	balance	sum	remark

5.2 ER Model and ER Diagram

- Concept model: entity—relation, be independent of practical DBMS.
- Legend: