WEEK 2

CONSTRAINTS IN RELATIONAL DATABASE MODELS

STUDENT OBJECTIVES

- Upon completion of this video, you should be able to:
  - List key constraints in a table
  - Identify referential integrity constraints that are violated by insert, delete and modify actions on given tables
  - Identify semantic integrity constraints that are violated, given an existing table and an update operation on a table such as modify, insert or delete

TYPES OF CONSTRAINTS IN RELATIONAL DATABASES

- There are 3 main types of constraints:
  - Key constraints
  - Referential integrity constraints
  - Semantic integrity constraints

KEY CONSTRAINTS

- PRIMARY KEY - Allows you to state which attribute(s) will be the primary key (the attribute(s) that ensures that no 2 tuples are identical).
  - A table can only have ONE primary key but the primary key can be made up of several attributes
  - The primary key MUST be unique
- NOT NULL – Forces the user to never leave a key attribute null (empty) for a particular tuple.

REFERENTIAL INTEGRITY

Referential Integrity: a tuple in one relation (table) that refers to another relation (table) must refer to an existing tuple in the relation.

foreign key must exist in the table they are referred to.

Formally:

Assume we have R1 and R2 with a referential integrity between the two of them. R1 has a set of attributes FK (foreign key) that references the attributes PK (primary key) R2, it must satisfy the following rules:

•FK attributes must have the same domain as PK

•a value of FK in a tuple t of the current state r1(R1) either occurs as a value of PK for some tuple t2 in the current state or r2(R2) is null.

UPDATE OPERATIONS ON RELATIONS MAINTAINING INTEGRITY RULES

Department

DeptID	DeptName	*MgrEmpID	MgrStartDate
G8H	Head Office	4	12/12/99
S7G	Safety Department	3	11/11/98
Y5J	Research Department	6	12/24/98

it would crash
=7 we add a row
with value 7.

Employee

EmpID	LastName	FirstName	*DeptID	Sex
1	Simpson	Bart	S7G	M
2	Smithers	Waylan	G8H	M
4	Burns	Monty	G8H	M
6	Simpson	Lisa	Y5J	F
3	Beuvieau	Patty	S7G	M
12	Simpson	Homer	S7G	M

QUESTION: Determine the problems (if any exist) with the following operations to the above tables?

Insert Operation

IS THIS VALID?

Insert <13, 'Gumble', 'Barney', 'S7G', 'M'> into EMPLOYEE [✓ Yes] No

duplicate Insert <3, 'Simpson', 'Granpa', 'Y5J', 'M'> into EMPLOYEE Yes [✓ No]

NULL Insert <NULL, 'Flanders', 'Ned', 'Y5J', 'M'> into EMPLOYEE Yes [✓ No]

does not exist Insert <18, 'Flanders', 'Todd', 'P68', 'M'> into EMPLOYEE Yes [✓ No]

Department

DeptID	DeptName	*MgrEmpID	MgrStartDate
G8H	Head Office	4	12/12/99
S7G	Safety Department	3	11/11/98
Y5J	Research Department	6	12/24/98

Employee

EmpID	LastName	FirstName	*DeptID	Gender
1	Simpson	Bart	S7G	M
2	Smithers	Waylan	G8H	M
4	Burns	Monty	G8H	M
6	Simpson	Lisa	Y5J	F
3	Beuvieau	Patty	S7G	M
12	Simpson	Homer	S7G	M

Delete Operation

IS THIS VALID?

Delete employee where EmpID = 4 — Yes [✓ No]

Delete department where DeptID = 'S7G' — Yes [✓ No]

these records could not be delete since they are used in other tables. If these records are deleted, the tables crashed.

Department

DeptID	DeptName	*MgrEmpID	MgrStartDate
G8H	Head Office	4	12/12/99
S7G	Safety Department	3	11/11/98
Y5J	Research Department	6	12/24/98

Employee

EmpID	LastName	FirstName	*DeptID	Gender
1	Simpson	Bart	S7G	M
2	Smithers	Waylan	G8H	M
4	Burns	Monty	G8H	M
6	Simpson	Lisa	Y5J	F
3	Beuvieau	Patty	S7G	M
12	Simpson	Homer	S7G	M

be very carefully about it!

QUESTION: DB2 allows 3 things to happen if you set up referential integrity between keys when you perform a delete, DB2 allows for:

- ***Cascade*** it would delete other rows containing value in other tables.
- ***Restrict*** (default) restrict the operation.
- ***Set Null*** just leave it blank.

What do you think each of these operations do?

Modify Operation:

IS THIS VALID?

Modify the gender of Employee where lastname = ‘Burns' to ‘F’	[✓ Yes]	No
Modify Employee where lastname = 'Smithers' from DeptID = 'G8H' to DeptID = 'Y5J'	[✓ Yes]	No
Modify Employee where lastname = 'Smithers' from DeptID = 'G8H' to DeptID = 'J9J'	Yes	[✓ No]
Modify Employee where lastname = 'Smithers' from EmpID = 2 to EmpID = 12	Yes	[✓ No]

duplicate key value.

does not exist

Department

DeptID	DeptName	*MgrEmpID	MgrStartDate
G8H	Head Office	4	12/12/99
S7G	Safety Department	3	11/11/98
Y5J	Research Department	6	12/24/98

Employee

EmpID	LastName	FirstName	*DeptID	Gender
1	Simpson	Bart	S7G	M
2	Smithers	Waylan	G8H	M
4	Burns	Monty	G8H	M
6	Simpson	Lisa	Y5J	F
3	Beuvieau	Patty	S7G	M
12	Simpson	Homer	S7G	M

if the "Enforce Referential Integrity" checkbox is not selected, then it would not check for these problem, just like deleting the relationship. But it would still keep checking the uniqueness of key attribute.

SEMANTIC INTEGRITY CONSTRAINTS

- ***State Constraints***: state the constraints that a valid state of the database must satisfy

  Example: Hours worked cannot be greater than 50, Quantity Ordered must be greater than 10

- ***Transition Constraints***: define how the state of the database can change

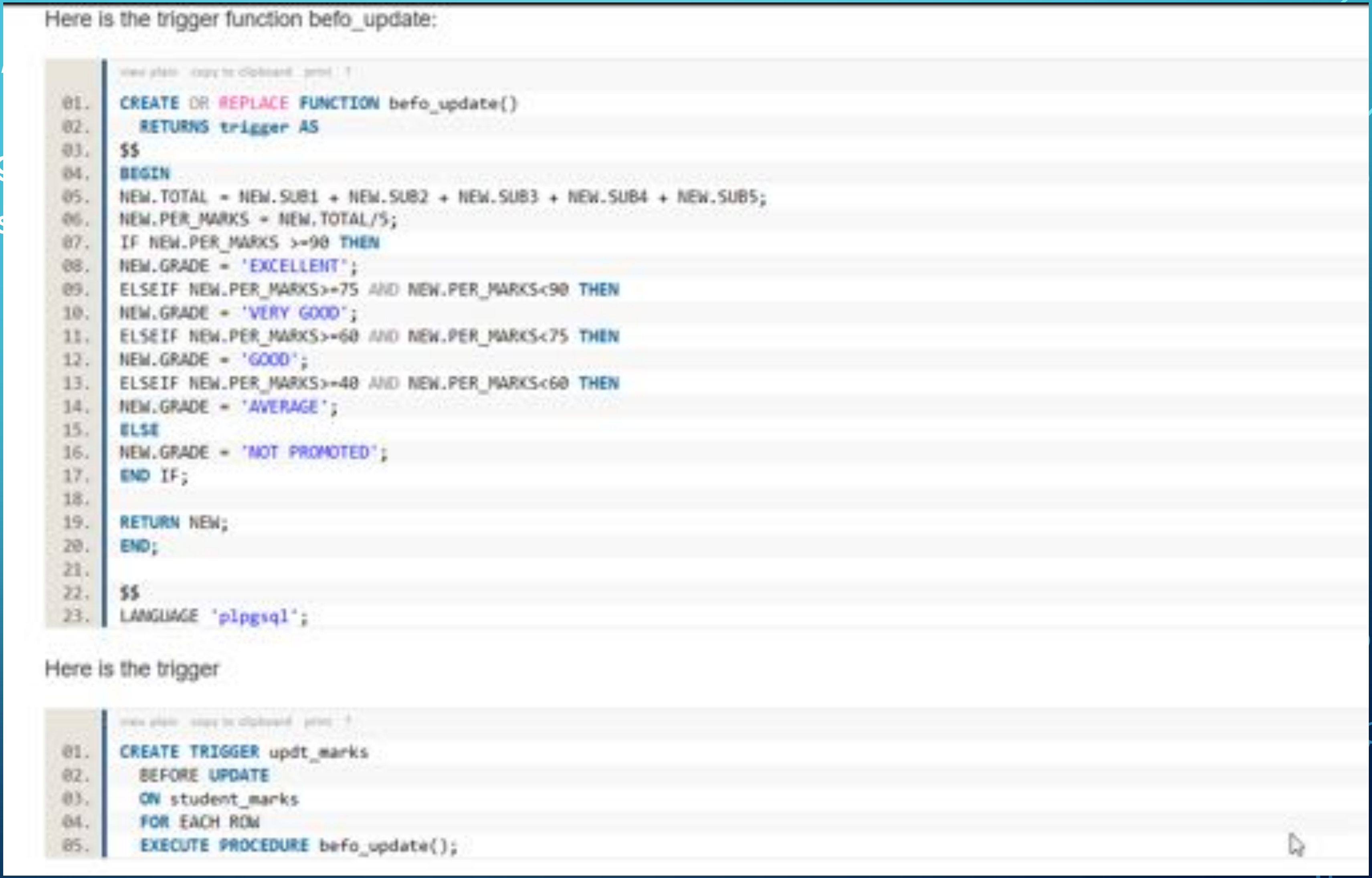
  Example: Salaries can only increase

- Both of the above are enforce in relational databases through *triggers* and *assertions*

EXA

- Trigg

  does



Here is the trigger function befo_update:

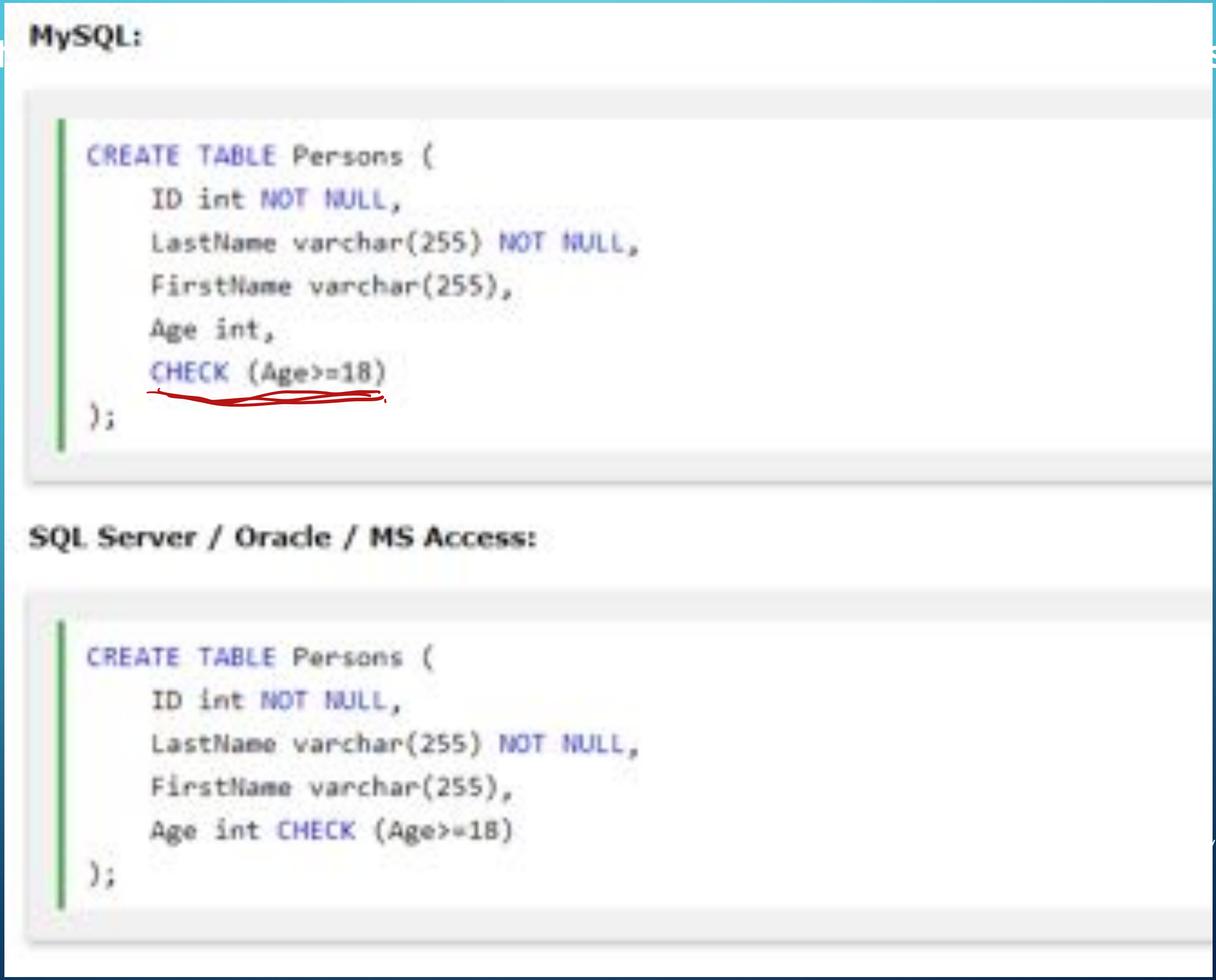
```
CREATE OR REPLACE FUNCTION befo_update()
  RETURNS trigger AS
$$
BEGIN
NEW.TOTAL = NEW.SUB1 + NEW.SUB2 + NEW.SUB3 + NEW.SUB4 + NEW.SUB5;
NEW.PER_MARKS = NEW.TOTAL/5;
IF NEW.PER_MARKS >=90 THEN
NEW.GRADE = 'EXCELLENT';
ELSEIF NEW.PER_MARKS>=75 AND NEW.PER_MARKS<90 THEN
NEW.GRADE = 'VERY GOOD';
ELSEIF NEW.PER_MARKS>=60 AND NEW.PER_MARKS<75 THEN
NEW.GRADE = 'GOOD';
ELSEIF NEW.PER_MARKS>=40 AND NEW.PER_MARKS<60 THEN
NEW.GRADE = 'AVERAGE';
ELSE
NEW.GRADE = 'NOT PROMOTED';
END IF;

RETURN NEW;
END;

$$
LANGUAGE 'plpgsql';
```

Here is the trigger

```
CREATE TRIGGER updt_marks
  BEFORE UPDATE
  ON student_marks
  FOR EACH ROW
  EXECUTE PROCEDURE befo_update();
```

EXAMPLE OF A CONSTRAINT

- Constraint s one does?



MySQL:

```
CREATE TABLE Persons (
    ID int NOT NULL,
    LastName varchar(255) NOT NULL,
    FirstName varchar(255),
    Age int,
    CHECK (Age>=18)
);
```

SQL Server / Oracle / MS Access:

```
CREATE TABLE Persons (
    ID int NOT NULL,
    LastName varchar(255) NOT NULL,
    FirstName varchar(255),
    Age int CHECK (Age>=18)
);
```