Relational Data Model – Part 2

Integrity Constraints over Relations

- Constraints are **conditions** that must hold on *all* relations in a database st
- T

1. **Domain constraints**;
2. **Key constraints**;
3. **Entity integrity constraints**;
4. **Referential integrity constraints**.

(1) Domain Constraints

- E
  - https://eduassistpro.github.i
  - DATE
  - SMALLINT
  - NOT NULL

(2) Key Constraints - Observation

- We observe that: **data does not occur independently from one another within individual relations.**
- N

459	Fran	11/09/1987	frankk@gmail.com
...	...	...	

- No two enrolments have the same student ID the s
the same semester:

ENROL				
StudentID	CourseNo	Semester	Status	EnrolDate
456	COMP2400	2016 S2	active	25/05/2016
458	COMP1130	2016 S1	active	20/02/2016
459	COMP2400	2016 S2	active	11/06/2016
...	...	...	...	...

(2) Key Constraints - Definitions

- Let $R(A_1, \ldots, A_n)$ be a relation schema.
- A
  su $_1, \ldots, A_n\}$,
  - k.
- A superkey SK of R is **minimal** if there is no K held on R. A minimal superkey is also known as a
- A **primary key** PK of R is a minimal superkey of R, (i.e., a primary key is one of the candidate keys). If a relation has only one candidate key then that would be the primary key.

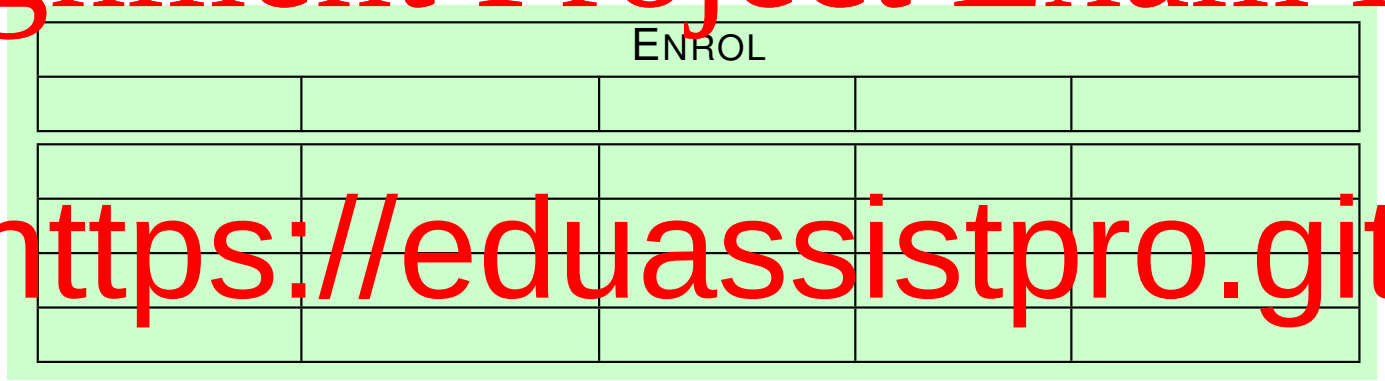
(2) Key Constraints - Example

STUDENT

StudentID	Name	DoB	Email

- Is {DoB} a superkey of STUDENT? **No!**
- Is {StudentID, DoB} a superkey of STUD
- Is {StudentID, DoB} a candidate key of S
- Is {StudentID} a candidate key of STUDENT? **Yes!**
- Can {StudentID} be chosen as a primary key of STUDENT? **Yes!**
- Can {DoB} be chosen as a primary key of STUDENT? **No!**

(2) Key Constraints - Example



- Is {CourseNo, Semester} a superkey of E
- Is {StudentID, CourseNo, Semester} a candidate key of ENROL? **Yes!**
- Can {StudentID, CourseNo} be chosen as a primary key of ENROL? **No!**

(3) Entity Integrity Constraints

- Specifying a primary key also invokes the entity integrity constraint.

- **n**
  b

- The **entity integrity constraint** states that **no primary key value can be NULL**.
  - This is because primary key values are use tuples in a relation.

- **Note:** Other attributes of *R* may be constrained to disallow null values, even though they are not attributes in the primary key.

(3) Entity Integrity Constraints – Example

- If STUDENTID is specified as the primary key of STUDENT, then the fo

NULL	Peter	23/05/1	
459	Fran	11/09/1	

- How about the case when EMAIL is the pri

Answer: **The relation does not violate the entity integrity constraint.**

(4) Referential Integrity Constraints - Observation

- We observe that: **data does not occur independently from one another across relations.**
- E :

459	Fran	11/09/1987	frankk@gmail.com

COURSE		
No	Cna	
COMP1130	Introduction to Advan	
COMP2400	Relational D	

ENROL				
StudentID	CourseNo	Semester	Status	EnrolDate
456	COMP2400	2016 S2	active	25/05/2016
458	COMP1130	2016 S1	active	20/02/2016
459	COMP2400	2016 S2	active	11/06/2016

(4) Referential Integrity Constraints - Definition

- We use $t[A]$ to denote the value of attribute A in tuple t.
  Example: For the tuple t=(459,Fran,11/09/1987,frankk@gmail.com), t[Name]=Fran and t[DoB]=11/09/1987.
- A **two**
  re
- L R_2 has the
  primary key $\{B_1, \ldots, B_n\}$.
- A **foreign key** on R_1 is a statement $[A_1, \ldots,$ icting
  states of S to satisfy the following property:
  - for each tuple $t \in r(R_1)$ there exists a tuple $t' \in r(R_2)$ with $t[A_i] = t'[B_i]$ for $i = 1, \ldots, n$.
- R_1 is called the **referencing relation** and R_2 is called the **referenced relation**.

(4) Referential Integrity Constraints – Example

- What foreign keys can be established in the database StuEnrol?

Student			
_____			

Course		
No	Cname	
COMP1130	Introduction to Advanced C	
COMP2400	Relational Data	

Enrol				
StudentID	CourseNo	Semester	Status	EnrolDate
456	COMP2400	2016 S2	active	25/05/2016
458	COMP1130	2016 S1	active	20/02/2016
459	COMP2400	2016 S2	active	11/06/2016

(4) Referential Integrity Constraints – Example

- In this case, we can establish the following foreign keys on ENROL:
  -
  -

- This database state satisfies the above two foreig
  - for each tuple t_1 in ENROL there is a tup t the CourseNo value in t_1 is the same with th
  - for each tuple t_1' in ENROL, there is a tuple t_2' in STUDENT such that the StudentID value in t_1' is the same with the StudentID value in t_2'.

(4) Referential Integrity Constraints – Question

- If the database StuEnrol is slightly changed as follows, does this database still satisfy the foreign keys in the previous example?

_____			

Course		
No	Cname	
COMP1130	Introduction to Advanced C	
COMP2400	Relational Datab	

Enrol				
StudentID	CourseNo	Semester	Status	EnrolDate
456	COMP2400	2016 S2	active	25/05/2016
458	COMP1130	2016 S1	active	20/02/2016
459	COMP2600	2016 S2	active	11/06/2016

(4) Referential Integrity Constraints – Question

Answer: The following database does not satisfy the foreign key of ENROL: [CourseNo] ⊆ COURSE[No].

_____			

COURSE

No	Cname	
COMP1130	Introduction to Advanced C	
COMP2400	Relational Datab	

ENROL

StudentID	CourseNo	Semester	Status	EnrolDate
456	COMP2400	2016 S2	active	25/05/2016
458	COMP1130	2016 S1	active	20/02/2016
459	COMP2600	2016 S2	active	11/06/2016

Constraint Violations

- There are three basic operations that can change a database state:
  - **Insert**: insert one or more new tuples in a relation;
  -
  -

- W
  a database schema **should not be violated**
- However,
  - Insert may violate ...
  - Delete may violate ...
  - Update may violate ...