CS & IT ENGINEERING

Database Management System

DBMS

Lecture No. 2

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Recap of Previous Lecture

Topic

Introduction

Topics to be Covered

- **Topic** Integrity Constraints & ER Model (2 Marks)
- **Topic** Normalization (2-4 Marks)
- **Topic** Queries (Relational Algebra, SQL, Tuple Relational Calculus) (4 Marks)
- **Topic** File Organization & Indexing(2-4 Marks)
- **Topic** Transactions & Concurrency Control (2- 4 Marks)

FOREIGN KEY (Referential key)

Foreign Key:

- Used to relate tables.
- Usually defined over two relations.
  - → Referenced and Referencing Relation.

FOREIGN KEY (Referential key)

- **Definition:** Set of one or more attributes referencing to a primary key or alternative key of the same relation or other relation.

- X & Y can be from same relation or from two different relations.

FOREIGN KEY (Referential key)

Example 1: Relation 1: Stud (Sid, Sname, DOB)

Relation 2: ENROLL (Sid, Cid, Fee)

Referenced

Fk

Referencing

Stud

Sid	Sname	DOB
S1	A	1990
S2	A	1992
S3	B	1990

ENROLL

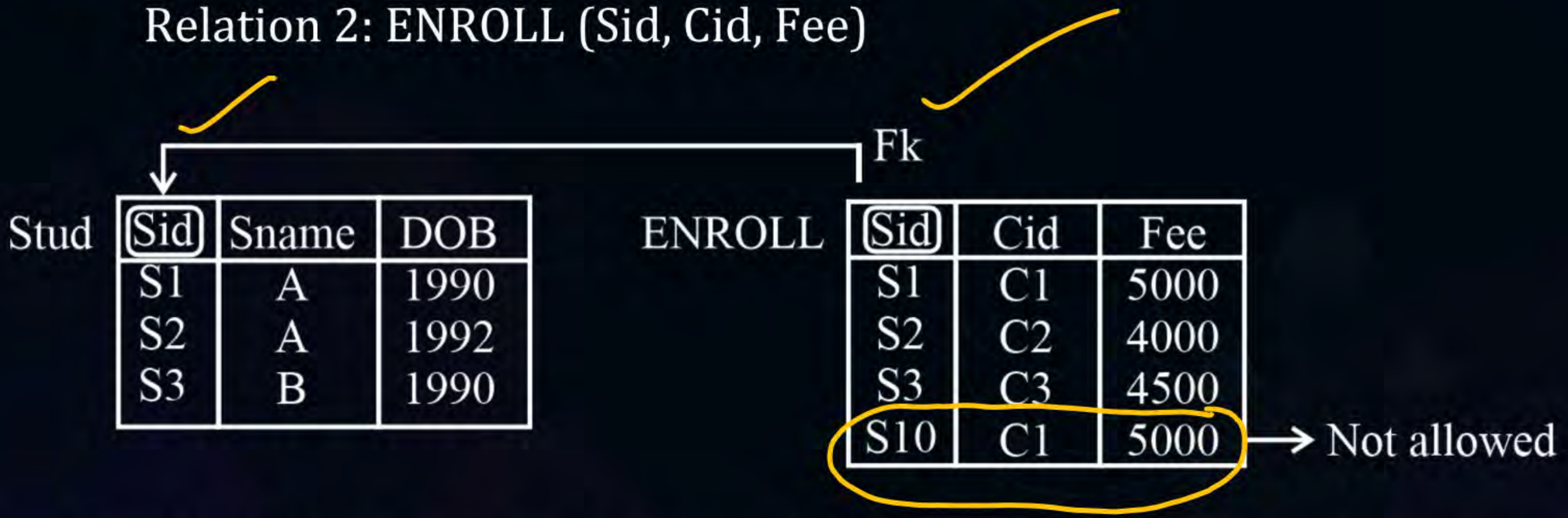
Sid	Cid	Fee
S1	C1	5000
S2	C2	4000
S3	C3	4500
S10	C1	5000

→ Not allowed

FOREIGN KEY (Referential key)

Example 1: Relation 1: Stud (Sid, Sname, DOB)

Relation 2: ENROLL (Sid, Cid, Fee)



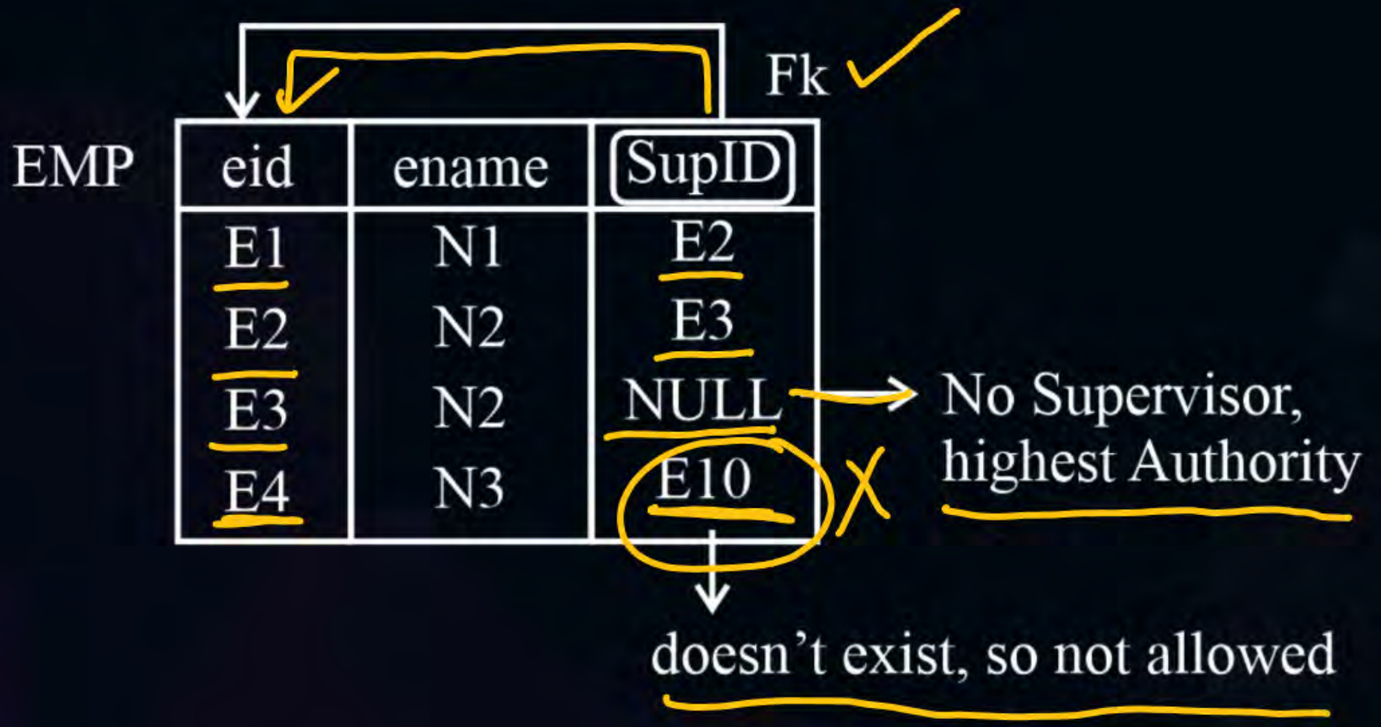
Here, Stud Relation is called Referenced Relation and ENROLL Relation is called Referencing Relation.

FOREIGN KEY (Referential key)

Example 2: Self Referencing

FOREIGN KEY (Referential key)

Example 2: Self Referencing



Inspiring Stories : Malati Mem

Background: **From tea-garden community in Assam.**

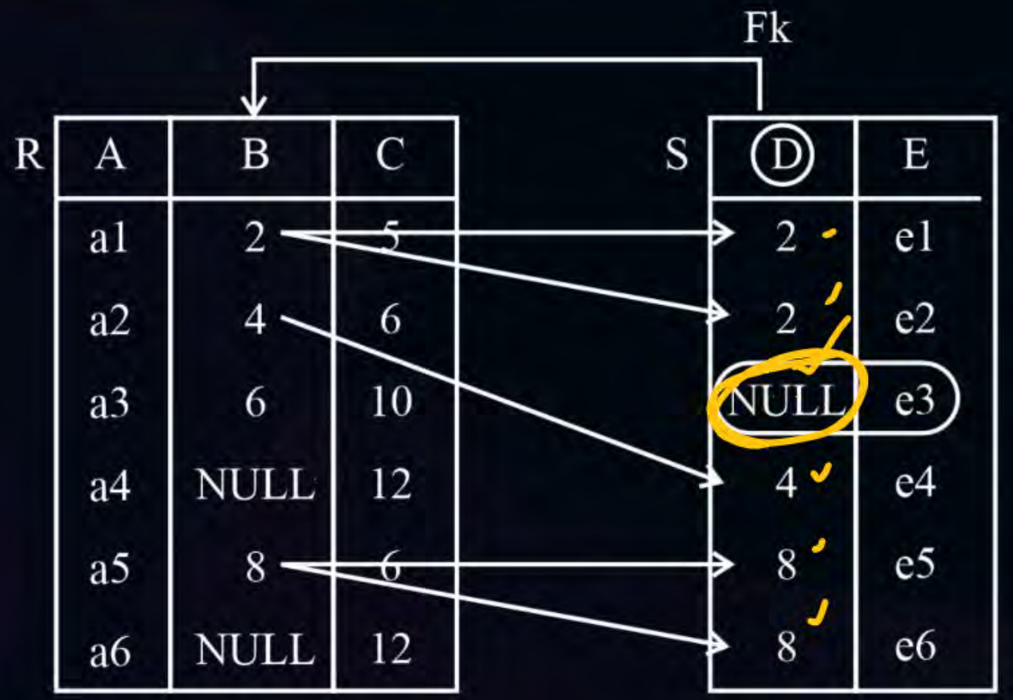
Struggles: **British pushed opium addiction to control labor.**

Achievements: **Fought against it, taught villages about its danger—but got shot by police.**

Impact: **Showed how everyday people can stand up for health and freedom.**

FOREIGN KEY (Referential key)

- FK attributes allows NULL values.
- Referencing Related Records whose Foreign Key value is NULL, is not related to any referenced related record.

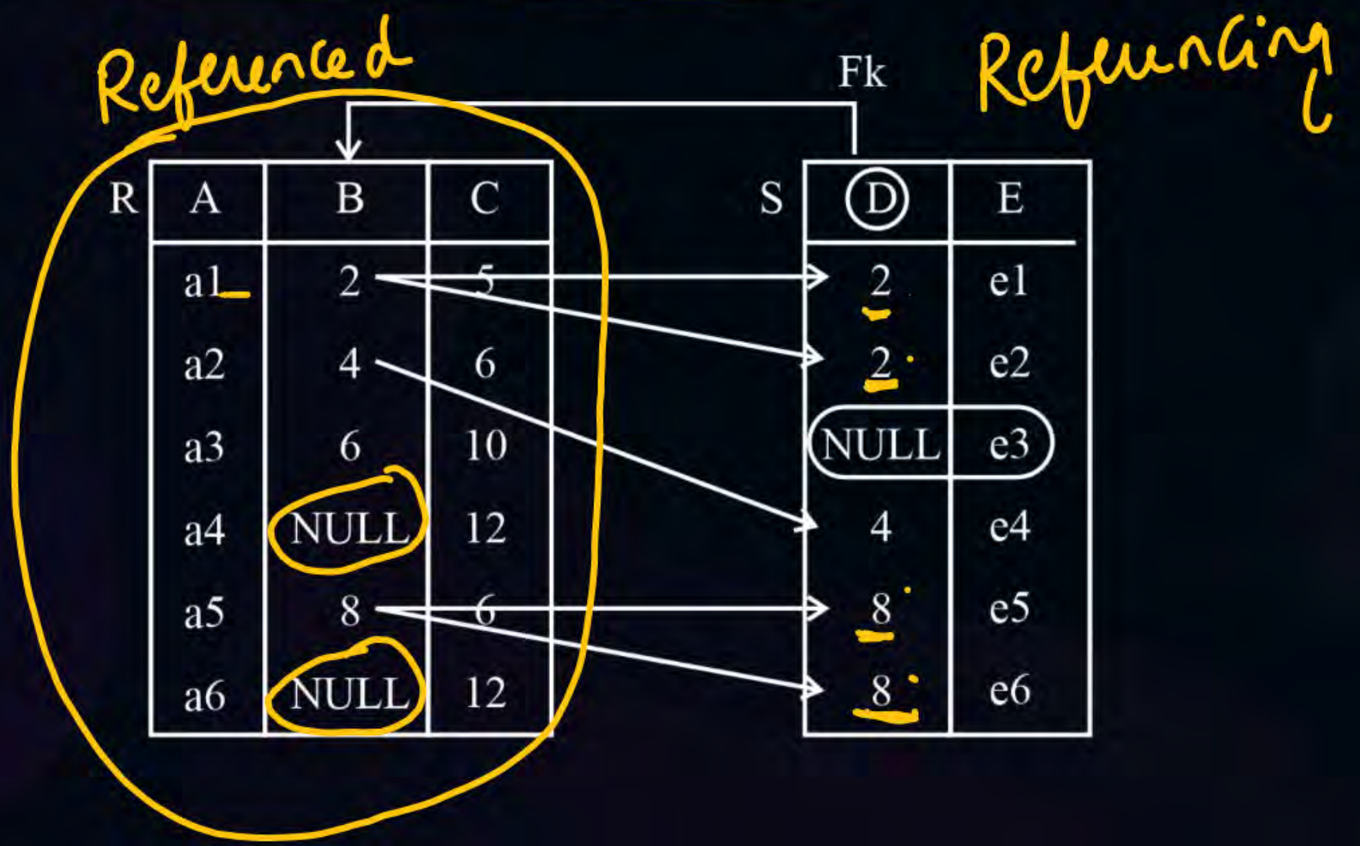


FOREIGN KEY (Referential key)

- Referenced and Referencing relation have 1 : Many Relationship.

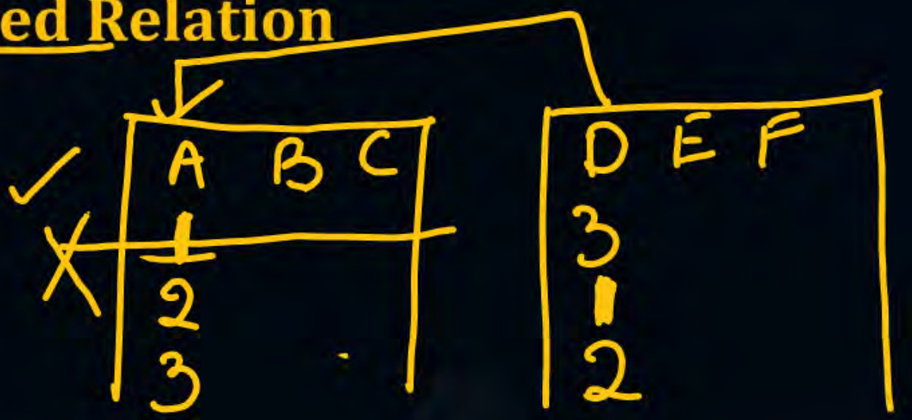
  Referenced → Referencing (Many)

  Referencing → Referenced (At Most one)



Referential Integrity Constraints

Foreign key Integrity Constraints with Referenced Relation



(a) Insertion:

No violation so No action is needed.

(b) Deletion:

May cause violation, these are handled in 3 ways.

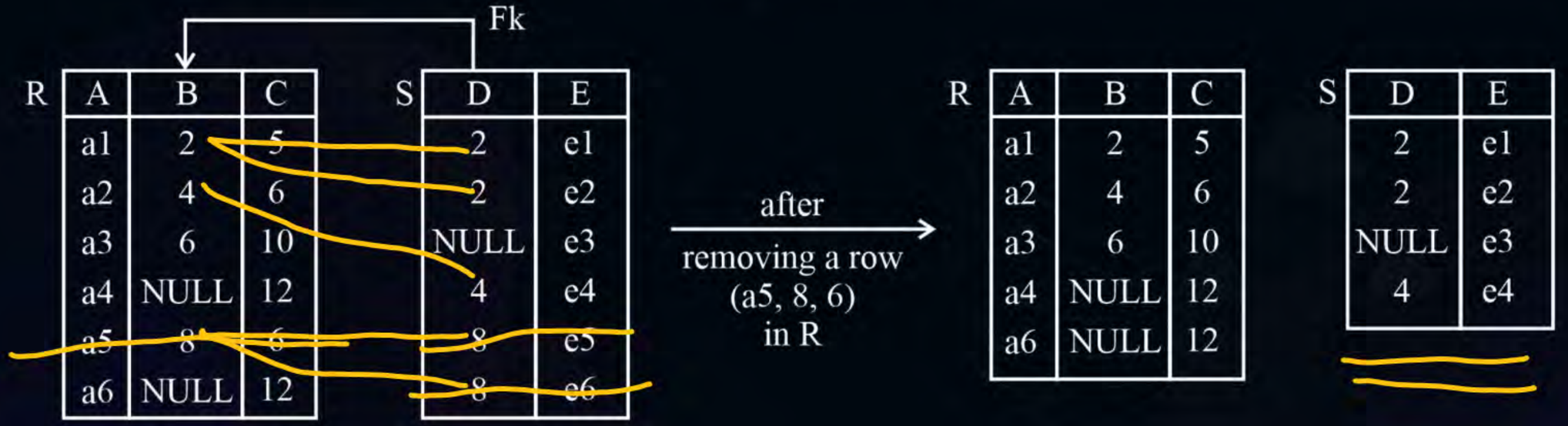
(i) ON DELETE NO ACTION (default)

- Deletion restricted if Foreign Key violation occurs.

Referential Integrity Constraints

(ii) ON DELETE CASCADE

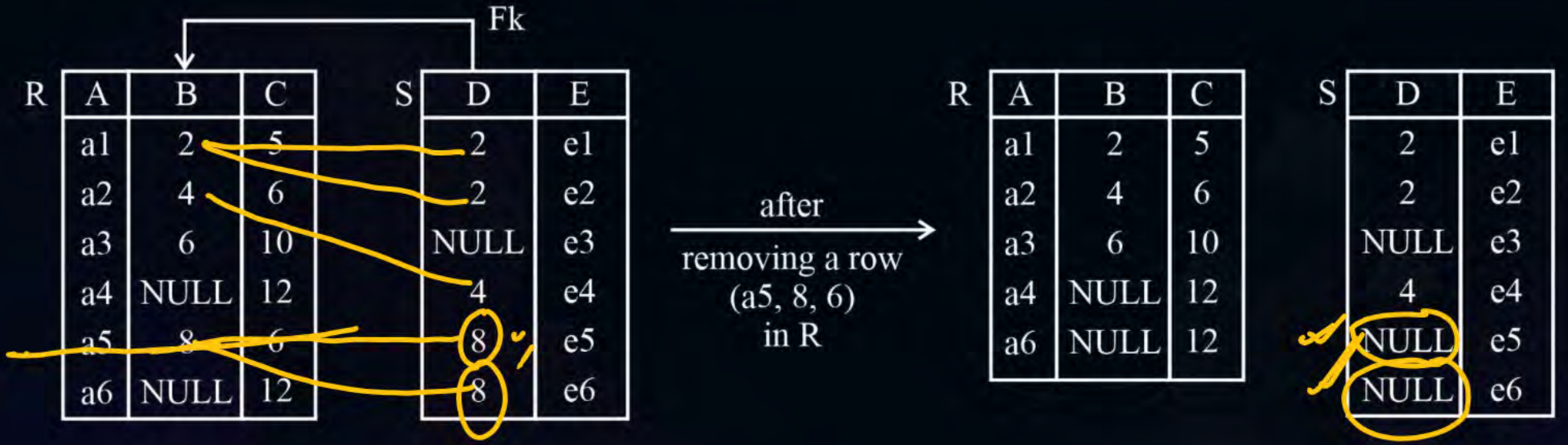
- Forced to delete related referencing records.



Referential Integrity Constraints

(iii) ON DELETE SET NULL

- Set Null in the rows that are deleted



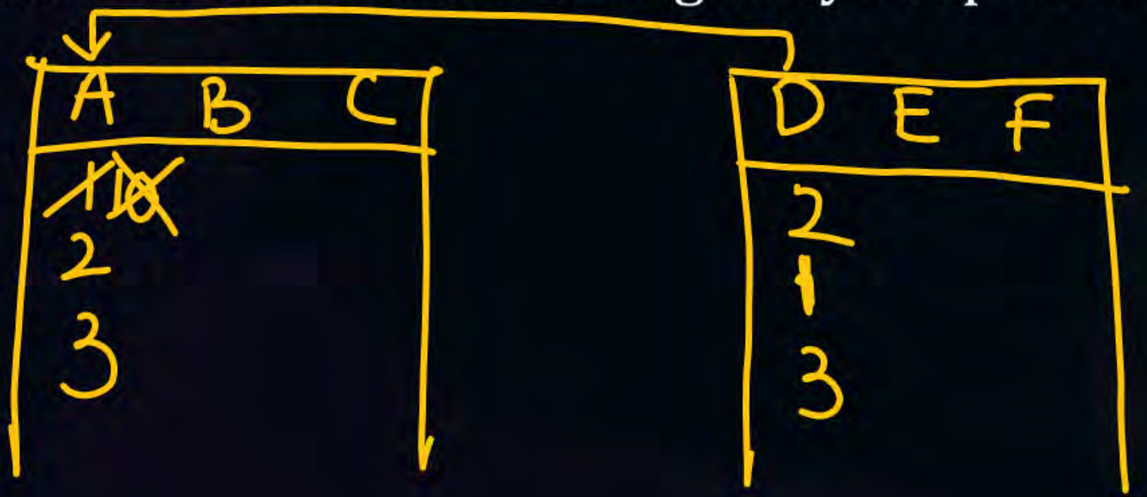
Referential Integrity Constraints

(c) Updation:

- May cause violation, this is also handled in ways.

(i) ON UPDATE NO ACTION (default)

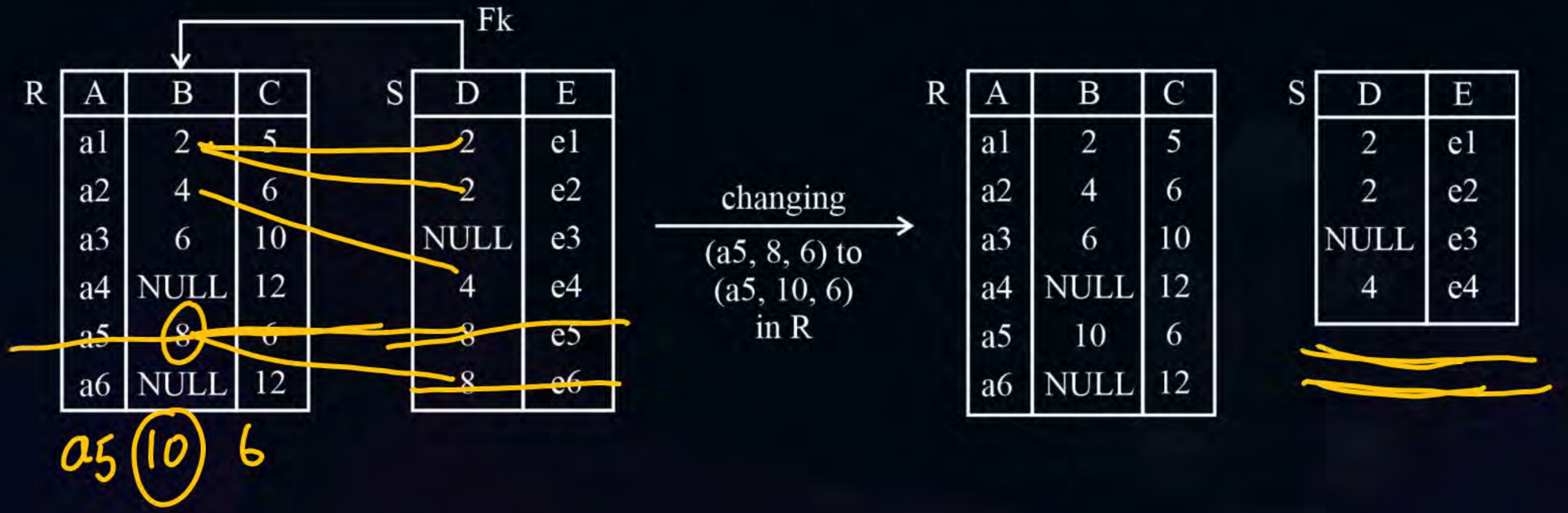
Updation is restricted if there are foreign keys dependent on the row deleted.



Referential Integrity Constraints

(ii) ON UPDATE CASCADE

Forced to delete the records referencing the row delete updated.



R

A	B	C
a1	2	5
a2	4	6
a3	6	10
a4	NULL	12
a5	10	6
a6	NULL	12

S

D	E
2	e1
2	e2
NULL	e3
4	e4

Referential Integrity Constraints

(iii) ON UPDATE SET NULL

Sets NULL in the rows that are referenced to the updated value.

Fk

R

A	B	C
a1	2	5
a2	4	6
a3	6	10
a4	NULL	12
a5	8	6
a6	NULL	12

S

D	E
2	e1
2	e2
NULL	e3
4	e4
8	e5
8	e6

a5 10 6

changing (a5, 8, 6) to (a5, 10, 6) in R

R

A	B	C
a1	2	5
a2	4	6
a3	6	10
a4	NULL	12
a5	10	6
a6	NULL	12

S

D	E
2	e1
2	e2
NULL	e3
4	e4
NULL	e5
NULL	e6

Referential Integrity Constraints

Foreign key Integrity Constraints with Referencing Relation

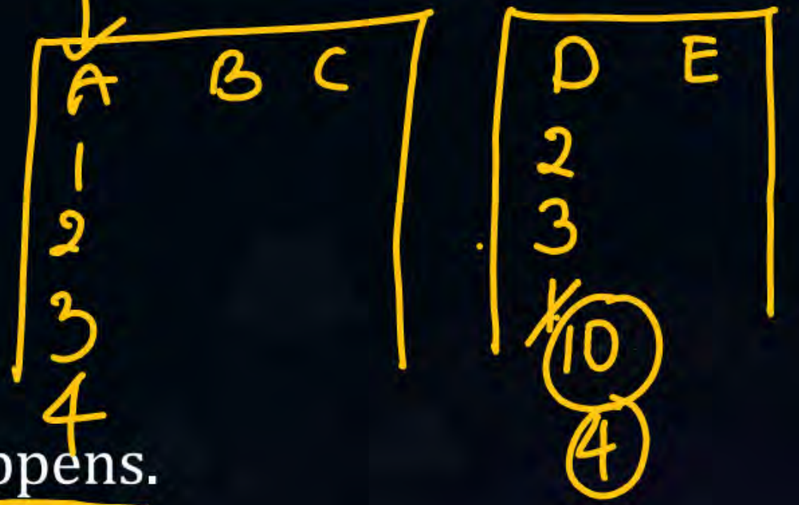
(a) Insertion: May cause foreign key violation

Sol: Restricted the Insertion if violation occurs.

(b) Deletion: No Violation occurs

(c) Updation: May cause Foreign key violation

Sol: Updation is restricted if Foreign key violation happens.



GATE PYQ on Integrity Constraints

True

Referred Table	Insertion	No Violation
	Deletion	No Action, Cascade or Set NULL
	Updation	No Action, Cascade or Set NULL
Referencing Table	Insertion	May cause violation, Restricted If yes
	Deletion	No Violation
	Updation	May cause violation, Restricted If yes

Inspiring Stories : Helen Lepcha

Background: **From Lepcha tribe in Sikkim.**

Struggles: **British disrespected tribal ways; movement was suppressed.**

Achievements: **Followed Gandhi, helped Subhas Chandra Bose escape, wrote for tribal people.**

Impact: **Kept hope alive in mountains; a tribal heroine.**

GATE PYQ on Integrity Constraints

Q1: ISRO CSE 2016

Let R(a,b,c) and S(d,e,f) be two relations in which d is the foreign key of S that refers to the primary key of R. Consider the following four operations R and S

I. Insert into R
II. Insert into S
III. Delete from R
IV. Delete from S

Which of the following can cause violation of the referential integrity constraint above?

(A) Both I and IV
(B) Both II and III
(C) All of these
(D) None of these

GATE PYQ on Integrity Constraints

Q1: ISRO CSE 2016

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(A) Both I and IV
(B) Both II and III
(C) All of these
(D) None of these

GATE PYQ on Integrity Constraints

Q2: GATE CSE 2017 SET-2

Consider the following tables T1 and T2.

In table T1, P is the primary key and Q is the foreign key referencing R in table T2 with ondelete cascade and on-update cascade. In table T2, R is the primary key and S is the foreign key referencing P in table T1 on-delete set NULL and on-update cascade.

In order to delete record (3,8) from table T1, the number of additional records that need to be deleted from table T1 is _____.

a) 0 b) 1 c) 2 d) 3

T1

P	Q
2	2
3	8
7	3
5	8
6	9
8	5
9	8

T2

R	S
2	2
8	3
3	2
9	7
5	7
7	2

GATE PYQ on Integrity Constraints

Q2: GATE CSE 2017 SET-2

- Since S(FK) refers to P (PK) , removing (3, 8) row in T1, makes (8,3) row in T2 to (8, NULL) due to the ON DELETE SET NULL constraint
- Since Q(FK) refers to R(PK), deletion in a foreign key doesnt affect any table.

So zero entries are removed.

Answer: 0

ON DELETE CASCADE
ON UPDATE CASCADE

T1

P	Q
2	2
3	8
7	3
5	8
6	9
8	5
9	8

T2

R	S
2	2
8	3
3	2
9	7
5	7
7	2

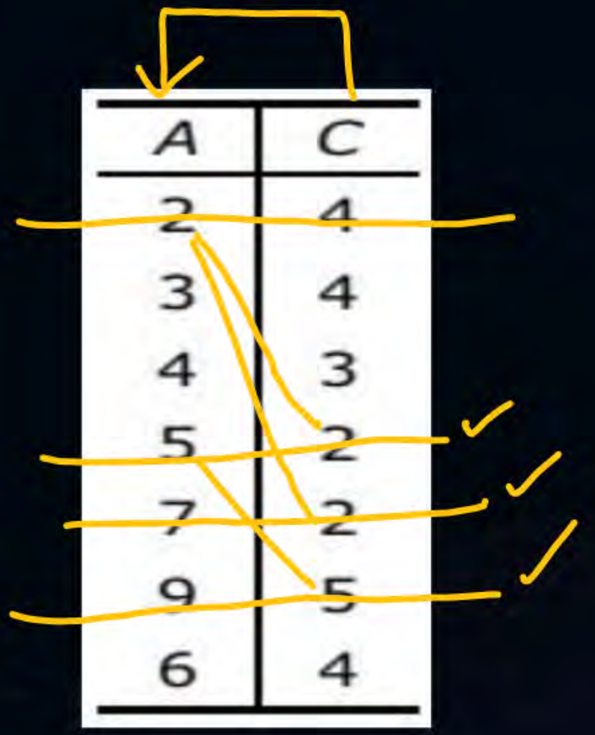
ON DELETE SET NULL
ON UPDATE CASCADE

GATE PYQ on Integrity Constraints

Q3: GATE CSE 2005

The following table has two attributes A and C where A is the primary key and C is the foreign key referencing A with on-delete cascade.

The set of all tuples that must be additionally deleted to preserve referential integrity when the tuple (2,4) is deleted is:



A	C
2	4
3	4
4	3
5	2
7	2
9	5
6	4

GATE PYQ on Integrity Constraints

Q3: GATE CSE 2005

- On removing (2,4), the rows (5,2) and (7,2) are deleted.
- On removing (5,2), (9,5) is also deleted
- Ans: (5,2), (7,2) (9,5) are deleted

A	C
2	4
3	4
4	3
5	2
7	2
9	5
6	4

ON DELETE CASCADE

Topic : NORMALIZATION

1. Introduction to DB Anomalies
2. Functional Dependency
3. Attribute closure & Membership test
4. Finding Candidate Keys ***
5. Lossless join and Dependency Preserving Decomposition **

Topic : NORMALIZATION

6. Normal Forms
   - 1 NF, 2 NF, 3 NF, BCNF → Theory Question
   - Finding highest NF & Relational Schema **
   - Decomposition into higher Normal Form
   - Multivalued Dependency and 4 NF
7. Canonical Cover of FD set (Minimal Cover)

Inspiring Stories : Pasaltha Khuangchera

Background: **Mizo warrior from the hills.**

Struggles: **British troops marched into his land.**

Achievements: **Fought them in 1890 to protect villages; died in battle but did not run.**

Impact: **First known Mizo hero to fall fighting the British; a legend in Mizoram.**

Topic : NORMALIZATION

NORMALIZATION

- Process used to eliminate or reduce redundancy in Database tables.
- When two or more independent relations are stored in a single relation, there is a possibility of Redundancy.

Example:

For a Relation Student lets say the dependency is, Sid → Sname, DOB

For Course Table, Cid → Cname, Instructor

For Enroll Table, Sid, Cid → Fee

Topic : NORMALIZATION

Stud, Course, enroll

Now lets say a table is created on these three relations, then the Relationship formed is:

R

Sid	Sname	DOB	Cid	Cname	Instructor	Fee
S1	A	1990	C1	DB	Korth	—
S2	A	1990	C1	DB	Korth	—
S3	B	1998	C1	DB	Korth	—
S3	B	1998	C2	Algo	Coremon	—
S3	B	1998	C3	OS	Galwin	—

Sid, Cid → Candidate key

- There is redundant data. ✓

Topic : NORMALIZATION

Problems because of Redundancy : [DB Anamolies]

(i) Insertion Anamoly:

- The insertion of student data without a course or viceversa is not possible.

S4 ✓ C4 ✓

R

Sid	Sname	DOB	Cid	Cname	Instructor	Fee
S1	A	1990	C1	DB	Korth	—
S2	A	1990	C1	DB	Korth	—
S3	B	1998	C1	DB	Korth	—
S3	B	1998	C2	Algo	Coremon	—
S3	B	1998	C3	OS	Galwin	—

Topic : NORMALIZATION

Problems because of Redundancy : [DB Anamolies]

(ii) Deletion Anamoly:

- If someone wants to delete S3 data, then it deletes the C1 & C2 course as well.

R

Sid	Sname	DOB	Cid	Cname	Instructor	Fee
S1	A	1990	C1	DB	Korth	—
S2	A	1990	C1	DB	Korth	—
S3	B	1998	C1	DB	Korth	—
S3	B	1998	C2	Algo	Coremon	—
S3	B	1998	C3	OS	Galwin	—

Topic : NORMALIZATION

(iii) Updation Anamoly:

- If the row (S3, B, 1998, C1, DB, Korth)has got updated to (S3, B, 1989, C1, DB, korth), then the data of S3 is inconsistent, like S3 has 2 different DOB's 1988 & 1989.

R

Sid	Sname	DOB	Cid	Cname	Instructor	Fee
S1	A	1990	C1	DB	Korth	—
S2	A	1990	C1	DB	Korth	—
S3	B	1998	C1	DB	Korth	—
S3	B	1998	C2	Algo	Coremon	—
S3	B	1998	C3	OS	Galwin	—

Topic : NORMALIZATION

- These Anamolies indirectly causes Inconsistency.
- The Goal of Normalization is to remove the Redundancy and Inconsistency.
- If there is 0% redundancy in DB table then there are No Database Anamolies present.

Inspiring Stories : Pa Togan

Background: **Young Garo leader.**

Struggles: **British raided the hills and taxed hard.**

Achievements: **Led a bold night attack on a British camp (1872); fell while fighting.**

Impact: **Garo people still honor him every year as a symbol of courage.**

Telegram channel

@RBRSIRPW

THANK - YOU