

1. Delete:

a) i. Delete the book where Genre is NULL:

Violation of referential integrity constraint: NOT NULL constraint on Genre.

Solution: Only delete books where Genre is not NULL. Use SET DEFAULT or SET NULL for cascading constraint.

BookID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Plath	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1984	George Orwell	Thriller	14.99
4	The Prophet	Kahlil Gibran	Poetry	NULL

OrderID	BookID	CustomerID	Quantity	OrderDate	OrderStatus
120	1	12	2	2024-02-01	Processing
121	2	16	3	2024-02-01	Completed
122	3	18	4	2024-02-02	Shipped
123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02-02	Cancelled

ii. Delete the book where Price is less than \$10.00.

violated Referential integrity constraint: Price constraint.

Solution: Only delete books where Price is greater than or equal to \$10.00. Use SET DEFAULT or SET NULL for cascading constraint.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
3	1984	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	1	12	2	2024-02-1	Processing
121	2	16	3	2024-02-1	Completed
122	3	18	4	2024-02-2	Shipped
123	NULL	19	1	2024-02-02	Processing

iii. Delete the order where Book ID is 1.

Successful operation. No integrity constraints violated.

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
121	2	16	3	2024-02-1	Completed
122	3	18	4	2024-02-2	Shipped
123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02002	Canceled
125	5	21	3	2024-02-3	NULL

iv. Delete the book where Book ID is 4.

Successful operation.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1984	George Orwell	Thriller	14.99
5	Gulistan	Saadi Shirazi	NULL	8.99

b) SET NULL OPTION

i. Delete the book where Genre is Autobiography.

This will delete the rows with book_id 1 in the books and set book_id from 1 to null in the orders table.

Book ID	Title	Author	Genre	Price
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1984	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	NULL	12	2	2024-02-1	Processing
121	2	16	3	2024-02-1	Completed
122	3	18	4	2024-02-2	Shipped

123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02002	Canceled
125	5	21	3	2024-02-3	NULL

ii. Delete the order where Book ID is NULL.

It will delete the row with order_id 123 in the orders table.

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	1	12	2	2024-02-1	Processing
121	2	16	3	2024-02-1	Completed
122	3	18	4	2024-02-2	Shipped
124	2	20	6	2024-02002	Canceled
125	5	21	3	2024-02-3	NULL

iii. Delete the book where Author is 'George Orwell'

This will delete the row with book_id 3 in the books and change book_id from 3 to null in orders table.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	1	12	2	2024-02-1	Processing
121	2	16	3	2024-02-1	Completed
122	NULL	18	4	2024-02-2	Shipped
123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02002	Canceled
125	5	21	3	2024-02-3	NULL

iv. Delete all books.

This will delete all books and set all book_id in orders in the order table to null.

Book ID	Title	Author	Genre	Price
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Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	NULL	12	2	2024-02-1	Processing
121	NULL	16	3	2024-02-1	Completed
122	NULL	18	4	2024-02-2	Shipped
123	NULL	19	1	2024-02-02	Processing
124	NULL	20	6	2024-02002	Canceled
125	NULL	21	3	2024-02-3	NULL

c) NO ACTION

i. Delete the book where Price is NULL.

This will delete row with book_id 4 in books table.

No changes in orders table

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
5	Gulistan	Saadi Shirazi	NULL	8.99

ii. Delete the book where Book ID is 4.

This will delete row with book_id 4 in books table.

No changes in orders table.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
5	Gulistan	Saadi Shirazi	NULL	8.99

iii. Delete the book where Book ID is 2.

This will delete row with book_id 2 in books table.

No changes in orders table.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99

2. Insert:

a) i. Insert <6, "Broken Wings", "Kahlil Gibran", "Poetry", NULL > into Books.

Successful operation.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99
6	Broken Wings	Khalil Gibran	Poetry	NULL

ii. Insert <5, "A Tale of Two Cities", "Charles Dickens", "Historical Novel", \$9.99 > into Books.

Successful operation.

iii. Insert <NULL, "Animal Farm", "George Orwell", "Satire", \$10.99 > into Books.

- Integrity constraint violated: NOT NULL constraint on Book ID.

Solution: Provide a valid Book ID.

iv. Insert <126, 5, 21, 4," 2024-02-3","Processing"> into Orders.

Successful operation.

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	1	12	2	2024-02-1	Processing

121	2	16	3	2024-02-1	Completed
122	3	18	4	2024-02-2	Shipped
123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02002	Canceled
125	5	21	3	2024-02-3	NULL
126	5	21	4	2024-02-3	Processing

b)

Here are the updated tables after the insert operations:

Table: Books

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Plath	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1984	George Orwell	Thriller	14.99
4	The Prophet	Kahlil Gibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99
7	The Zahir	Paulo Coelho	Novel	9.99
NULL	A Tale of Two Cities	Charles Dickens	Historical Novel	9.99
8	Pride and Prejudice	Jane Austen	Novel	NULL

Table: Orders

Order ID	Book ID	Customer ID	Quantity	Order Date	Order Status
120	1	12	2	2024-02-01	Processing
121	2	16	3	2024-02-01	Completed
122	3	18	4	2024-02-02	Shipped
123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02-02	Cancelled
125	NULL	21	4	2024-02-03	Cancelled
126	6	21	2	2024-02-03	Processing

- i. For Book ID 7, "The Zahir" by Paulo Coelho is inserted into the Books table.
- ii. In Orders table, Order ID 125 is inserted with Book ID set to NULL since Book ID 5 doesn't exist in the Books table.
- iii. Book ID is set to NULL in Orders table for Order ID 125 because of the foreign key constraint with the Set NULL option.
- iv. Insert <126, 6, 21, 2," 2024-02-3","Processing"> into Orders

This insert operation will set the Book ID of Order 126 to NULL since the Book ID 6 doesn't exist in the Books table. The Orders table will look like this

Order ID	Book ID	Customer ID	Quantity	Order Date	Order Status
126	NULL	21	2	2024-02-03	Processing

c) Foreign key with No Action:

i. Insert <8, "Pride and Prejudice", "Jane Austen", "Novel" > into Books.

This insert operation will add a new book to the Books table:

Book ID	Title	Author	Genre	Price
8	Pride and Prejudice	Jane Austen	Novel	NULL

ii. Insert <125, 7, 23, 1," 2024-02-3","Shipped"> into Orders

This insert operation will not be allowed because Book ID 7 doesn't exist in the Books table and the foreign key constraint is set to No Action. It would violate the foreign key constraint, and the insertion would fail.

d)

i. Insert <8, "Pride and Prejudice", "Jane Austen", "Novel" > into Books.

It will add aforementioned entry into books and set price to null

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99
8	Pride and Prejudice	Jane Austen	Novel	NULL

ii. Insert <125, 7, 23, 1," 2024-02-3","Shipped"> into Orders

Primary key violation uniqueness, order_id 125 already exists in orders table

Foreign key constraint violation there is no book with book_id 7 in books table.

3. Update:

a) i. For Book ID=5 change it to 2 in book table.

Successful operation.

Book ID	Title	Author	Genre	Price
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1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	1	12	2	2024-02-1	Processing
121	2	16	3	2024-02-1	Completed
122	3	18	4	2024-02-2	Shipped
123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02002	Canceled
125	2	21	3	2024-02-3	NULL

ii. For Book ID=5 change it to 6 in book table.

Successful operation.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	1	12	2	2024-02-1	Processing
121	2	16	3	2024-02-1	Completed
122	3	18	4	2024-02-2	Shipped
123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02002	Canceled

125	6	21	3	2024-02-3	NULL
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iii. For Book ID=2 change the price \$6.99.

Successful operation.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	6.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99

iv. For Order ID = 121 change Book ID = 12.

Integrity constraint violated: Foreign key constraint.

Solution: Either provide a valid Book ID or remove the foreign key constraint.

b) SET NULL

i. For Book ID=5 change it to 7 in book table

book_id 5 will be updated to 7 in book table and in order table it will be set to null

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
7	Gulistan	Saadi Shirazi	NULL	8.99

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	1	12	2	2024-02-1	Processing
121	2	16	3	2024-02-1	Completed
122	3	18	4	2024-02-2	Shipped
123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02002	Canceled

125	NULL	21	3	2024-02-3	NULL
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ii. For Book ID=4 change the Author to 'KG'.

Author of book_id = 4 will be changed to KG in books table. No changes in the orders table.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	KG	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99

iii. For Orders having NULL Order Status change Book ID = 2.

Book id of order having book_id 5 previously will be changed to 2.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99

Order ID	Book ID	Customer ID	Quantity	Order Data	Order Status
120	1	12	2	2024-02-1	Processing
121	2	16	3	2024-02-1	Completed
122	3	18	4	2024-02-2	Shipped
123	NULL	19	1	2024-02-02	Processing
124	2	20	6	2024-02002	Canceled
125	2	21	3	2024-02-3	NULL

c. NO ACTION

i. For Book having book ID=2 change it to 6 in book table.

Book_id 2 will be updated to 6 in the books table but there will be no change in the orders table.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
6	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	NULL
5	Gulistan	Saadi Shirazi	NULL	8.99

ii. For Book having Book ID=4 change price to \$10.99.

The price of book with book_id=4 will be updated to 10.99. No changes in the orders table.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Path	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	9.99
3	1983	George Orwell	Thriller	14.99
4	The prophet	Khalil Jibran	Poetry	10.99
5	Gulistan	Saadi Shirazi	NULL	8.99

iii. For Orders having NULL Order Status change Book ID = 8.

Foreign key violation. There is no book with book_id= 8 in the parent table books.

Book ID	Title	Author	Genre	Price
1	The Bell Jar	Sylvia Plath	Autobiography	12.99
2	Crime and Punishment	Fyodor Dostoevsky	Mystery	6.99
3	1984	George Orwell	Thriller	14.99
4	The Prophet	KG	Poetry	10.99
5	Gulistan	Saadi Shirazi	NULL	NULL
6	The Prophet	Kahlil Gibran	Poetry	NULL
7	The Zahir	Paulo Coelho	Novel	8.99
8	Pride and Prejudice	Jane Austen	Novel	NULL

Order ID	Book ID	Customer ID	Quantity	Order Date	Order Status
120	1	12	2	2024-02-01	Processing
121	NULL	16	3	2024-02-01	Completed
122	3	18	4	2024-02-02	Shipped
123	2	19	1	2024-02-02	Processing
124	2	20	6	2024-02-02	Cancelled

Order ID	Book ID	Customer ID	Quantity	Order Date	Order Status
125	7	21	4	2024-02-03	Cancelled
126	NULL	21	2	2024-02-03	Processing

Q2. Database schema is designed as:

a) Primary keys of all relations:

Relation	Primary Key
Flight	FlightId
Pilot	PilotId
Customer	CusId
Booking	BookingId

b) **Secondary keys:** Not necessary but if we want to make than secondary keys are as follows:

Relation	Secondary Key
Pilot	LisenceNo
Customer	PassportNo

c) Foreign keys are:

Relation	Foreign Key	References
Flight	PilotId	Pilot (PilotId)
Booking	CusId and FlightId	Customer(CusId) and Flight(FlightId)

d) Example of insertion in Flight relation that violates referential integrity constraint:

The referential integrity requirement would be broken if we attempted to enter a record with a PilotId into the Flight database that does not exist in the Pilot table. The referential integrity requirement is broken if we insert 652 PilotId into the table since there isn't a pilot with PilotId 652 in the Pilot relation. For example:

Let's say we have the following data in the Pilot table:

Pilot:

PilotId	PilotName	LicenseNo	PhoneNo
101	Fawwaz	35413	03224855632
102	khalil	24612	03224855635

And let's say we attempt to insert a flight record into the Flight table with a PilotId that does not exist, violating the referential integrity constraint:

Flight:

FlightId	DepartureDate	ArrivalDate	PilotId
201	2023-02-23	2023-02-27	103

In this case, PilotId 103 does not exist in the Pilot table. Therefore, this insertion violates the referential integrity constraint.

e) Example of insertion in Flight relation that violates entity integrity constraint:

The entity integrity constraint would be broken if we attempted to insert a record with a NULL value in FlightId because FlightId is a main key and cannot be NULL or An entity integrity constraint is broken if we enter a duplicate value for flightId. For example:

Flight:

FlightId	DepartureDate	ArrivalDate	PilotId
301	NULL	2022-02-24	101

In this example, the DepartureDate attribute is NULL, violating the entity integrity constraint because DepartureDate is supposed to be a mandatory attribute and cannot be NULL.

Q3: Database Design for SOFTEC System

a) Main Relations are may be as follows:

1. **Competition:** Stores information about individual competitions
2. **Student:** Stores information about participating students.
3. **Faculty:** Stores information about FAST-NU faculty
4. **Evaluation:** Stores evaluation details for participants by Faculty judges.

b) Attributes for relations are :

Competition:

- Competition ID (int, Primary Key)

- Name (varchar)
- Faculty ID (int, Foreign Key references Faculty(FacultyID))
- Description (text)

Student:

- Student ID (int, Primary Key)
- Name (varchar)
- University (varchar)
- Email (varchar)
- Phone No. (varchar)

Faculty:

- Faculty ID (int, Primary Key)
- Name (varchar)
- Department (varchar)
- Email (varchar)
- Phone No. (varchar)

Evaluation:

- Evaluation ID (int, Primary Key)
- Competition ID (int, Foreign Key references Competition ID)
- Student ID (int, Foreign Key references Student ID)
- Score (int)
- Feedback (text)

c) Keys:

- **Primary Keys:** Each table has a unique identifier as its primary key (Competition_ID, Student_ID, Faculty_ID, Evaluation_ID).
- **Secondary Keys:**
 1. Student: Email
 2. Faculty: Email
- **Foreign Keys:**
 1. Competition: HeadFaculty_ID references Faculty(Faculty_ID)
 2. Evaluation: StudentID references Student(StudentID)

d)1. Competition:

CompetitionId	Name	Date	Venue	FacultyId
1	Software Competition	2022-03-21	Auditorium	10
2	Programming Competition	2023-03-24	Lecture room	12

CompetitionId	Name	Date	Venue	FacultyId
3	AI	2025-03-15	Seminar Room	103
4	Tech	2028-03-20	Auditorium Hall	141
5	Robo rumble	2034-03-2	Auditorium	20

2. Student:

StudentId	Name	University	ContactNo	Email
1	Fawwaz	FAST University	03254027546	Lhrnu1@gmail.com
2	Talha	FAST Institute	03254027546	Lhrnu2@gmail.com
3	Ibrahim	GCU College	03254027546	Lhrnu3@gmail.com
4	Arbaz	GIKI University	03254027546	Lhrnu4@gmail.com
5	Awais	NUST Institute	03254027546	Lhrnu5@gmail.com

3. Faculty:

FacultyId	Name	Department	Email	PhoneNo
101	Prof. ISHAQ	Computer Science	asd@fast.nu.edu.pk	03251023232
102	Dr. Sarah	Electrical Eng.	dsaf@fast.nu.edu.pk	03251023232
103	Prof. Aleena	Mechanical Eng.	thgr@fast.nu.edu.pk	03251023232
104	Dr. Yasir	Computer Science	jyghn@fast.nu.edu.pk	03251023232
105	Prof. Yousaf	Chemical Eng.	dhrtr@fast.nu.edu.pk	03251023232

5. Evaluation:

EvaluationId	CompetitionId	StudentId	Score	Remarks
1	1	1	90	Very good
2	1	1	95	Very good
3	2	2	75	good
4	2	3	60	Very good
5	3	4	58	Well done

e) A straightforward centralised DBMS would work well in this situation. A centralised database would be simpler to administer, scale, and maintain because the system is for a single organisation (FAST-NU) and a relatively small amount of data is anticipated. Furthermore, a distributed database would be more difficult to set up and maintain and offer little advantages in this situation as opposed to a centralised database, which would offer superior consistency, dependability, and security.

Scalability: A distributed database management system (DBMS) facilitates smooth extension to accommodate growing demand without compromising performance, even with anticipated increases in contests and players.

Performance: Softec's multiple locations are made possible via a distributed database management system (DBMS), which lowers latency by storing data closer to users and improves system responsiveness.

Data Distribution and Usage: Distributed data storage lowers latency and network overhead for users using the system from different places, which helps Softec's broad participant base.