RELATIONAL DATABASES

OBJECTIVES

- DEFINE A PRIMARY KEY
- DEFINE A FOREIGN KEY
- DEFINE A COLUMN-INTEGRITY RULE
- IDENTIFY ROW, COLUMN, PRIMARY KEY, UNIQUE KEY, AND FOREIGN KEY ELEMENTS GIVEN A DIAGRAM OF A TABLE CONTAINING THESE ELEMENTS
- IDENTIFY VIOLATIONS OF DATA INTEGRITY RULES

PURPOSE

- CONCEPTUAL MODEL IS TRANSFORMED INTO A RELATIONAL DATABASE DESIGN
- THE ENTITIES, ATTRIBUTES, RELATIONSHIPS, AND UNIQUE IDENTIFIERS WILL BE TRANSLATED INTO OBJECTS IN A RELATIONAL DATABASE
- DATABASE DESIGNER MUST KNOW HOW TO IMPLEMENT THE DESIGNS AND UNDERSTAND THE STRUCTURE OF THE RELATIONAL DATABASE OBJECTS
- TRANSFORM ONE SET OF OBJECTS (ER) INTO ANOTHER (PHYSICAL CONSTRUCTS)

RELATIONAL DATABASE ILLUSTRATED

- A RELATIONAL DATABASE: COLLECTION OF OBJECTS OR RELATIONS, SET OF OPERATORS TO ACT ON THOSE RELATIONS AND DATA INTEGRITY FOR ACCURACY AND CONSISTENCY.
- A RELATIONAL DATABASE FOR A USER HAS A COLLECTION OF TWO DIMENSIONAL TABLES, EACH CONTAINING ROWS AND COLUMNS

EMPLOYEES (table name)

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	DEPARTMENT_ID
100	Steven	King	90
101	Neena	Kochhar	90
102	Lex	De Haan	90
200	Jennifer	Whalen	10
205	Shelley	Higgins	110

- EACH ROW OF DATA DESCRIBES AN EMPLOYEE. EACH COLUMN IS AN ATTRIBUTE OF THAT EMPLOYEE.

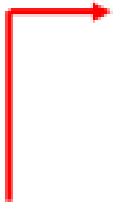
LANGUAGE TO ACCESS DATA

- STRUCTURED QUERY LANGUAGE (SQL) ALLOWS US TO ACCESS DATA IN RELATIONAL DATABASES IN AN EFFICIENT WAY
- INSTEAD OF MANUALLY SEARCHING THROUGH EACH ROW TO FIND THE RECORD FOR EMPLOYEE 200 WE USE SQL:

```
SELECT LAST_NAME, DEPARTMENT_ID
FROM EMPLOYEES
WHERE EMPLOYEE_ID=200;
```

EMPLOYEES (table name)

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	DEPARTMENT_ID
100	Steven	King	90
101	Neena	Kochhar	90
102	Lex	De Haan	90
200	Jennifer	Whalen	10
205	Shelley	Higgins	110



```
SELECT last_name, department_id
FROM employees
WHERE employee_id = 200;
```

LAST_NAME	DEPARTMENT_ID
Whalen	10

SPECIFIC SQL QUERY

- TO FIND ALL THE EMPLOYEES IN DEPARTMENT NUMBER 90, WE WRITE A DIFFERENT SQL STATEMENT:

```
SELECT *
FROM EMPLOYEES
WHERE DEPARTMENT_ID = 90;
```

- THE * AFTER SELECT MEANS WE WANT TO SEE ALL OF THE COLUMNS IN THE TABLE.
- SQL ALLOWS US TO ACCESS THE WHOLE TABLE OR PARTS OF IT DEPENDING ON WHAT COMES AFTER SELECT AND WHAT IS SPECIFIED IN THE WHERE CLAUSE

EMPLOYEES (table name)

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	...	DEPARTMENT_ID
100	Steven	King	...	90
101	Neena	Kochhar	...	90
102	Lex	De Haan	...	90
200	Jennifer	Whalen	...	10
205	Shelley	Higgins	...	110

```
SELECT  *
FROM employees
WHERE department_id = 90;
```

EMPLOYEES (table name)

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	...	DEPARTMENT_ID
100	Steven	King	...	90
101	Neena	Kochhar		90
102	Lex	De Haan	... ...	90

PRIMARY KEY

- A PRIMARY KEY (PK) IS A COLUMN OR SET OF COLUMNS THAT UNIQUELY IDENTIFIES EACH ROW IN A TABLE.
- IT IS ALSO A CONSTRAINT WHICH ENSURES THAT THE COLUMN CONTAINS A VALUE AND THAT THE VALUE IS UNIQUE TO THE TABLE.

ACCOUNTS

BANK_NO	ACCT_NO	BALANCE	DATE_OPENED
104	75760	12,0050.00	21-OCT-89
104	77956	100.10	
105	89570	55,775.00	15-JAN-85
103	55890	15,001.85	10-MAR-91
105	75760	5.00	22-SEP-03

Multiple Column Primary Key

EMPLOYEES

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	...	DEPARTMENT_ID
100	Steven	King	...	90
101	Neena	Kochhar	...	90
102	Lex	De Haan	...	90
200	Jennifer	Whalen	...	10
205	Shelley	Higgins	...	110

Single Column Primary Key

PRIMARY KEY

- EACH TABLE SHOULD HAVE A PRIMARY KEY
- NO PART OF THE PRIMARY KEY CAN BE EMPTY
- THERE CAN BE SEVERAL CANDIDATE KEYS IN A TABLE, ONLY ONE PRIMARY KEY, THE OTHERS BECOME ALTERNATE KEYS (OR UNIQUE KEYS)
- A UNIQUE KEY IS AN INTEGRITY CONSTRAINT THAT REQUIRES EVERY VALUE IN A COLUMN OR SET OF COLUMNS BE UNIQUE
- A UNIQUE KEY IS ANOTHER WAY TO LOCATE A RECORD

MEMBERS

MEMBER_ID	LAST_NAME	FIRST_NAME	PAYROLL_ID
100	SMITH	DANA	21215
310	ADAMS	TYLER	59877
210	CHEN	LAWRENCE	1101
405	GOMEZ	CARLOS	52
378	LOUNGANI	NEIL	90386

Candidate Key

Candidate Key

- EITHER COULD BE THE PRIMARY KEY, BOTH ARE UNIQUE AND HAVE VALUES IN ALL

MEMBERS

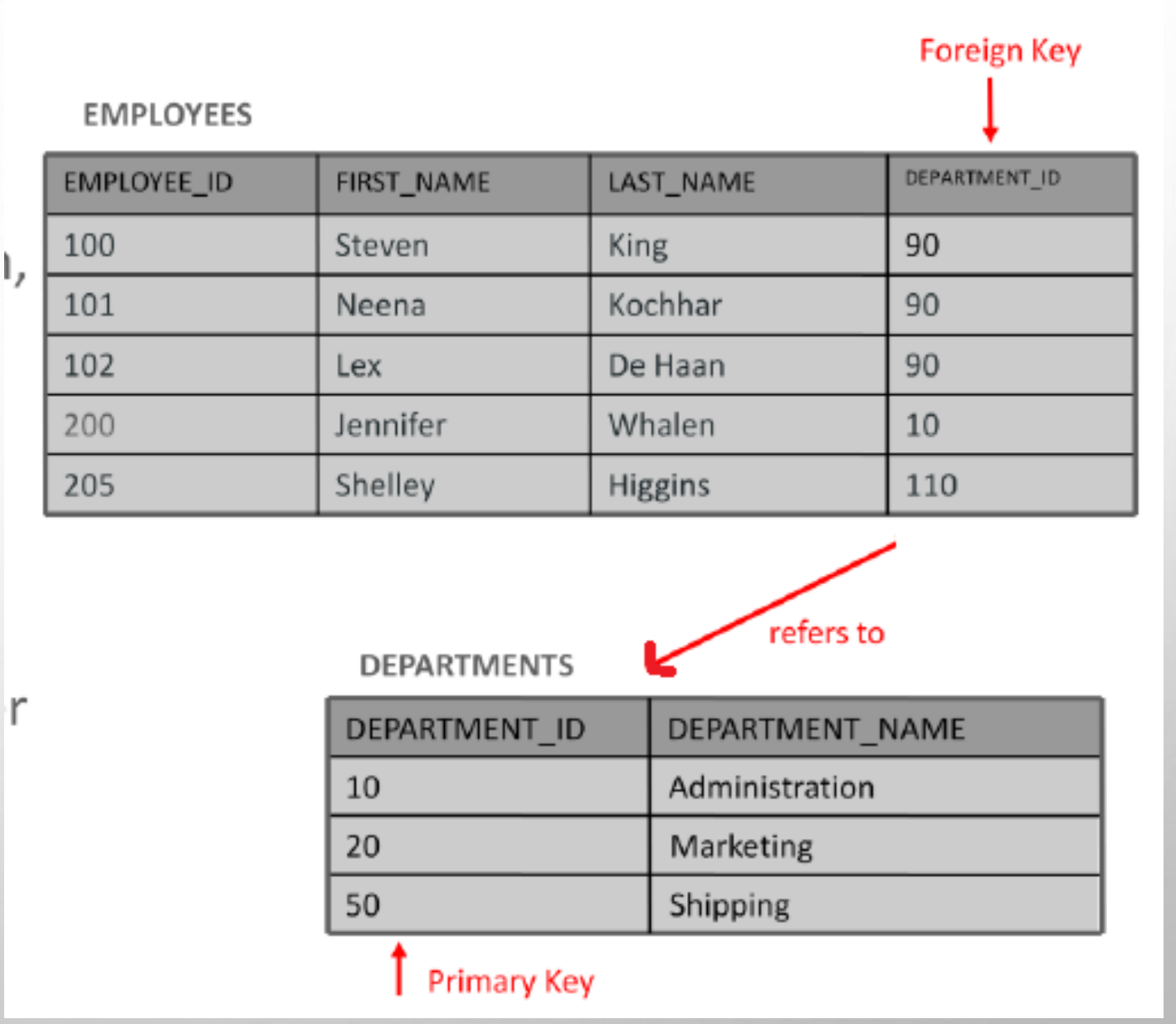
MEMBER_ID	LAST_NAME	FIRST_NAME	PAYROLL_ID
100	SMITH	DANA	21215
310	ADAMS	TYLER	59877
210	CHEN	LAWRENCE	1101
405	GOMEZ	CARLOS	52
378	LOUNGANI	NEIL	90386

Primary Key

Alternate or Unique Key (UK)

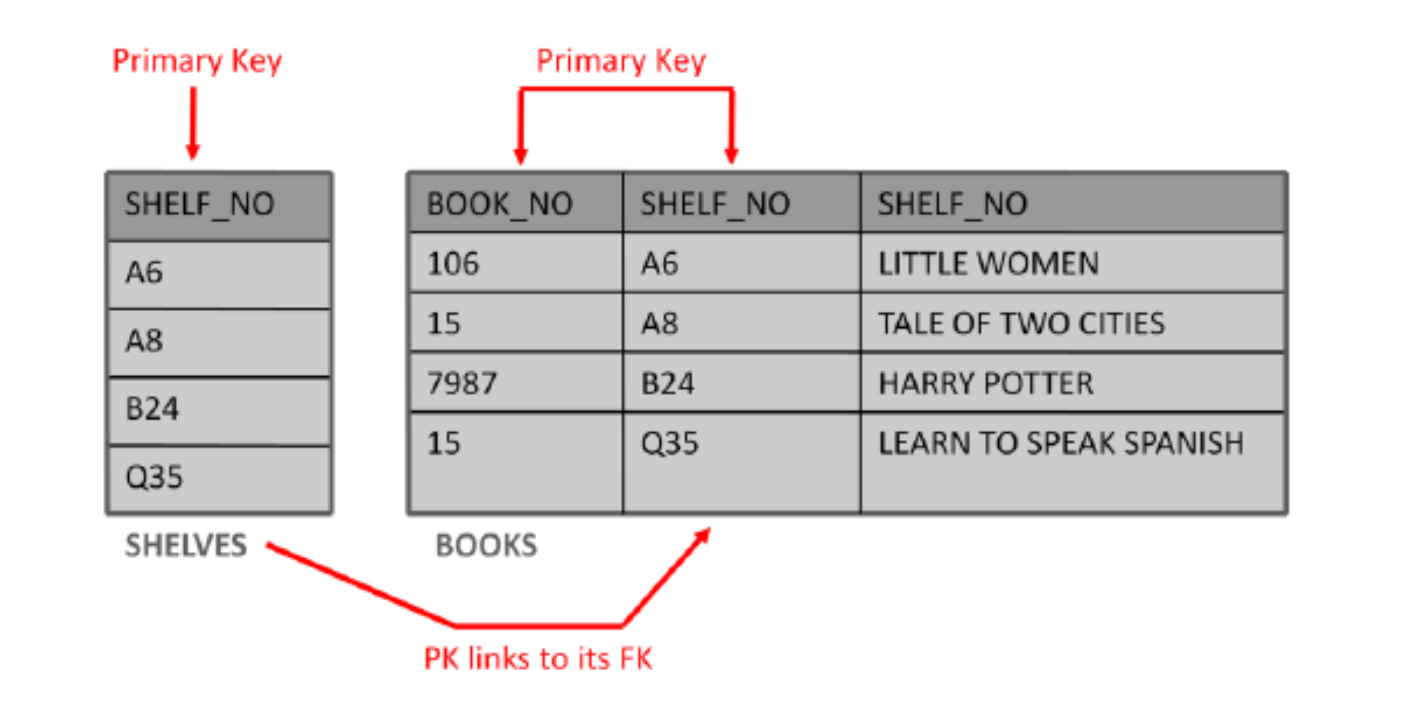
FOREIGN KEY

- A FOREIGN KEY (FK) IS A COLUMN, OR COMBINATION OF COLUMNS, IN ONE TABLE THAT CONTAINS VALUES THAT MATCH THE PRIMARY KEY VALUE IN ANOTHER TABLE.



FOREIGN KEY RULES

- IF A PRIMARY KEY IS COMPOSED OF ONE OR MORE FOREIGN KEYS, THE FOREIGN KEY VALUE CANNOT BE EMPTY, IT MUST BE A MANDATORY COLUMN.



DATA INTEGRITY

- A COLUMN MUST CONTAIN ONLY VALUES THAT ARE CONSISTENT WITH THE DEFINED DATA FORMAT OF THE COLUMN
- A COLUMN IS AN IMPLEMENTATION OF AN ATTRIBUTE OR RELATIONSHIP IN A TABLE.
- A ROW IS AN ENTRY IN A TABLE, CONSISTING OF VALUES FOR EACH APPROPRIATE COLUMN.

ACCOUNTS

BANK_NO	ACCT_NO	BALANCE	DATE_OPENED
104	75760	12,0050.00	21-OCT-1989
104	77956	100.10	
105	89570	55,775.00	15-JAN-1985
103	55890	15,001.85	10-MAR-1991
105	75760	5.00	22-SEP-2003

ACCOUNTS Table Definition

Column Name	Data Type	Optionality
BANK_NO	Number (5)	Not null
ACCT_NO	Number (8)	Not null
BALANCE	Number (12,2)	Not null
DATE_OPENED	Date	

DATA INTEGRITY RULES

- DATA INTEGRITY RULES DEFINE THE RELATIONALLY CORRECT STATE FOR A DATABASE
- DATA INTEGRITY RULES ENSURE THAT USERS CAN PERFORM ONLY THOSE OPERATIONS THAT LEAVE THE DATABASE IN A CORRECT, CONSISTENT STATE.

Constraint Type	Explanation	Example
Entity Integrity	A primary key must be unique, and no part of the primary key can be null	The column emp_no in the EMPLOYEES table cannot be null
Referential Integrity	A foreign key must match an existing primary key value (or else be null if nulls are allowed)	The value in the dept_no column of the EMPLOYEES table must match a value in the dept_no column in the DEPARTMENTS table
Column Integrity	A column must contain only values consistent with the defined data format of the column	The value in the balance column of the ACCOUNTS table must be numeric
User-Defined Integrity	The data stored in a database must comply with the rules of the business	If the value in the balance column of the ACCOUNTS table is below 1.00, we must send a letter to the account owner (this will need additional programming to enforce)