



Relational Database Concepts

Examples Of Integrity Rules

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Objectives

- Understand the integrity rules by using examples.

EXAMPLE 1

- The primary key of the STUDENT table is StdNo.

STDNO	STDFIRSTNAME	STDLASTNAME	STDCITY	ST	STDZIP	STDMAJ	ST	STDGPA
123-45-6789	HOMER	WELLS	SEATTLE	WA	98121-1111	IS	FR	3
124-56-7890	BOB	NORBERT	BOTHELL	WA	98011-2121	FIN	JR	2.7
234-56-7890	CANDY	KENDALL	TACOMA	WA	99042-3321	ACCT	JR	3.5
345-67-8901	WALLY	KENDALL	SEATTLE	WA	98123-1141	IS	SR	2.8
456-78-9012	JOE	ESTRADA	SEATTLE	WA	98121-2333	FIN	SR	3.2
567-89-0123	MARIAH	DODGE	SEATTLE	WA	98114-0021	IS	JR	3.6
678-90-1234	TESS	DODGE	REDMOND	WA	98116-2344	ACCT	SO	3.3
789-01-2345	ROBERTO	MORALES	SEATTLE	WA	98121-2212	FIN	JR	2.5
876-54-3210	CRISTOPHER	COLAN	SEATTLE	WA	98114-1332	IS	SR	4
890-12-3456	LUKE	BRAZZI	SEATTLE	WA	98116-0021	IS	SR	2.2
901-23-4567	WILLIAM	PILGRIM	BOTHELL	WA	98113-1885	IS	SO	3.8



EXAMPLE 1

- You define the primary key when you create the table by entering the CONSTRAINT clause for the PRIMARY KEY.
- The constraint name (PKStudent) following the CONSTRAINT keyword facilitates identification of the constraint if a violation occurs when a row is inserted or updated.

```
CREATE TABLE Student
(stdNo          char(11) not null,
stdFirstName    varchar2(30) not null,
stdLastName     varchar2(30) not null,
stdCity         varchar2(30) not null,
stdState        char(2) not null,
stdZip          char(10) not null,
stdMajor        char(6),
StdClass        char(2),
stdGPA          decimal(3,2),
CONSTRAINT PKStudent PRIMARY KEY (StdSSN) );
```



EXAMPLE 1

- Primary keys are usually assigned by organizations EXCEPT for SSN numbers which are assigned by entities (federal government) outside of the organization.
- Examples of primary keys could be order numbers, course numbers, house numbers, model numbers, customer numbers, product numbers, and employee numbers.
- These are usually assigned by the organization controlling the underlying database and automatic generation of unique values is required

EXAMPLE 2

Entity Integrity Variations

- Candidate keys that are not primary keys are declared with the UNIQUE keyword.
- The Course table contains two candidate keys: CourseNo (primary key) and CrsDesc (course description).

```
CREATE TABLE Course
( CourseNo    CHAR(6),
  CrsDesc     VARCHAR2(50),
  CrsUnits    INTEGER,
  CONSTRAINT PKCourse PRIMARY KEY(CourseNo),
  CONSTRAINT Unique CrsDesc UNIQUE (CrsDesc) );
```

EXAMPLE 2

COURSE	CRSDESC	CRSUNITS
FIN300	FUNDAMENTALS OF FINANCE	4
FIN450	PRINCIPLES OF INVESTMENTS	4
FIN480	CORPORATE FINANCE	4
IS320	FUNDAMENTALS OF BUSINESS PROGRAMMING	4
IS460	SYSTEMS ANALYSIS	4
IS470	BUSINESS DATA COMMUNICATIONS	4
IS480	FUNDAMENTALS OF DATABASE MANAGEMENT	4



EXAMPLE 3

- Some tables need more than one column in the primary key.
- In the Enrollment table, the combination of StdNo and OfferNo is the only candidate key. Both columns are needed to identify a row.

OFFERNO	STDNO	ENRGRADE
1234	123-45-6789	3.3
1234	234-56-7890	3.5
1234	345-67-8901	3.2
1234	456-78-9012	3.1
1234	567-89-0123	3.8
1234	678-90-1234	3.4
4321	123-45-6789	3.5
4321	234-56-7890	3.2



EXAMPLE 3

- A primary key consisting of more than one column is known as a composite or a combined primary key.

```
CREATE TABLE Enrollment  
(OfferNo INTEGER,  
StdNo CHAR(11),  
EnrGrade DECIMAL(3,2),  
CONSTRAINT PKEnrollment PRIMARY KEY(OfferNo, StdNo) );
```

- Non minimal superkeys are not important because they are common and contain columns that do not contribute to the uniqueness property.
- For example, the combination of StdNo and StdLastName in the student table is unique. If StdLastName is removed, StdNo is still unique.

EXAMPLE 4

Referential Integrity

- For referential integrity, the columns StdNo and OfferNo are foreign keys in the Enrollment table.
- The StdNo column refers to the Student table and the OfferNo column refers to the Offering table.

STUDENT TABLE

STDNO	STDFIRSTNAME	STDLASTNAME	STDCITY	ST	STDZIP	STDMAJ	ST	STDGPA
123-45-6789	HOMER	WELLS	SEATTLE	WA	98121-1111	IS	FR	3
124-56-7890	BOB	NORBERT	BOTHELL	WA	98011-2121	FIN	JR	2.7
234-56-7890	CANDY	KENDALL	TACOMA	WA	99042-3321	ACCT	JR	3.5
345-67-8901	WALLY	KENDALL	SEATTLE	WA	98123-1141	IS	SR	2.8
456-78-9012	JOE	ESTRADA	SEATTLE	WA	98121-2333	FIN	SR	3.2
567-89-0123	MARIAH	DODGE	SEATTLE	WA	98114-0021	IS	JR	3.6
578-90-1234	TESS	DODGE	REDMOND	WA	98116-2344	ACCT	SO	3.3
789-01-2345	ROBERTO	MORALES	SEATTLE	WA	98121-2212	FIN	JR	2.5
876-54-3210	CRISTOPHER	COLAN	SEATTLE	WA	98114-1332	IS	SR	4
890-12-3456	LUKE	BRAZZI	SEATTLE	WA	98116-0021	IS	SR	2.2
901-23-4567	WILLIAM	PILGRIM	BOTHELL	WA	98113-1885	IS	SO	3.8

EXAMPLE 4

- Referential integrity constraints can be defined similarly to the way of defining primary keys.

ENROLLMENT TABLE

OFFERNO	STDNO	ENRGRADE
1234	123-45-6789	3.3
1234	234-56-7890	3.5
1234	345-67-8901	3.2
1234	456-78-9012	3.1
1234	567-89-0123	3.8
1234	678-90-1234	3.4

EXAMPLE 4

For example, to define the foreign keys in Enrollment, you should use CONSTRAINT clauses for foreign keys at the end of the CREATE TABLE statement as shown in the CREATE TABLE statement for the Enrollment table.

```
CREATE TABLE Enrollment
(OfferNo      INTEGER not null,
StdNo        char(11) not null,
EnrGrade     decimal(3,2),
CONSTRAINT Enrollment PK PRIMARY KEY (OfferNo, StdNo),
CONSTRAINT Offering FK FOREIGN KEY (OfferNo) REFERENCES Offering ON
DELETE CASCADE,
CONSTRAINT Student FK FOREIGN KEY (StdNo) REFERENCES Student ON
DELETE CASCADE );
```



EXAMPLE 4

- Although referential integrity permits foreign keys to have null values, it is not common for foreign keys to have null values.
- When a foreign key is part of a primary key, null values are not permitted because of the entity integrity rule.
- For example, null values are not permitted for either Enrollment. StdNo or Enrollment. OfferNo because each column is part of the primary key.
- When a foreign key is not part of a primary key, usage dictates whether null values should be permitted.
- Another example of referential integrity is seen in the relationship between the Course and Offering Tables through the CourseNo column.

EXAMPLE 4

- The CourseNo is a foreign key in the Offering table.
- The CourseNo column in the Offering table refers to the Parent table Course.
- In most universities, a course cannot be offered before it is approved. Thus, an offering should not be inserted without a related course.

Course Table

COURSE	CRSDESC	CRSUNITS
FIN300	FUNDAMENTALS OF FINANCE	4
FIN450	PRINCIPLES OF INVESTMENTS	4
FIN480	CORPORATE FINANCE	4
IS320	FUNDAMENTALS OF BUSINESS PROGRAMMING	4
IS460	SYSTEMS ANALYSIS	4
IS470	BUSINESS DATA COMMUNICATIONS	4
IS480	FUNDAMENTALS OF DATABASE MANAGEMENT	4

EXAMPLE 4

- An Offering row represents a course given in an academic period (summer, winter, etc.), year, time, location, and days of the week.
- The primary key of Offering is OfferNo.
- A course such as IS460 will have different offer numbers each time it is offered.

Offering Table

OFFERNO	COURSE	OFFTER	OFFYEAR	OFFLOCATION	OFFTIME	FACNO	OFFD
1111	IS320	SUMMER	2013	BLM302	10:30:00		MW
1234	IS320	FALL	2012	BLM302	10:30:00	098-76-5432	MW
2222	IS460	SUMMER	2012	BLM412	13:30:00		TTH
3333	IS320	SPRING	2013	BLM214	08:30:00	098-76-5432	MW
4321	IS320	FALL	2012	BLM214	15:30:00	098-76-5432	TTH
4444	IS320	WINTER	2013	BLM302	15:30:00	543-21-0987	TTH
5555	FIN300	WINTER	2012	BLM207	08:30:00	765-43-2109	MW
5678	IS480	WINTER	2013	BLM302	10:30:00	987-65-4321	MW
5679	IS480	SPRING	2013	BLM412	15:30:00	876-54-3210	TTH
6666	FIN450	WINTER	2013	BLM212	10:30:00	987-65-4321	TTH
7777	FIN480	SPRING	2013	BLM305	13:30:00	765-43-2109	MW

EXAMPLE 5

- The NOT NULL keywords indicate that a column cannot have null values as shown in the CREATE TABLE statement for the Offering table.
- The NOT NULL constraints are inline constraints associated with a specific column while primary and foreign key constraints in the CREATE TABLE statement for the Offering table are table constraints in which the associated columns must be specified in the constraint.
- Constraint names should be used with both table and inline constraints to facilitate identification when a violation occurs.

```
CREATE TABLE Offering
(OfferNo      INTEGER not null,
CourseNo     char(6) not null,
OffTerm      char(6) not null,
OffYear      INTEGER not null,
OffLocation  varchar2(30),
OffTime      varchar2(10),
FacNo        char(11),
OffDays      char(4),
CONSTRAINT OfferingPK PRIMARY KEY (OfferNo),
CONSTRAINT CourseFK FOREIGN KEY (CourseNo) REFERENCES Course,
CONSTRAINT FacultyFK FOREIGN KEY (FacNo) REFERENCES Faculty );
```

EXAMPLE 5

```
CREATE TABLE Offering
(OfferNo      INTEGER not null,
CourseNo      char(6) not null,
OffTerm       char(6) not null,
OffYear       INTEGER not null,
OffLocation   varchar2(30),
OffTime       varchar2(10), char(11),
OffDays       char(4),
CONSTRAINT Offering PK PRIMARY KEY (OfferNo),
CONSTRAINT CourseFK FOREIGN KEY (CourseNo) REFERENCES Course,
CONSTRAINT FacultyFK FOREIGN KEY (FacNo) REFERENCES Faculty );
```

EXAMPLE 5

The Offering.FacNo column referring to the faculty member teaching the offering may be null.

OFFERING TABLE

OFFERNO	COURSE	OFFTER	OFFYEAR	OFFLOCATION	OFFTIME	FACNO	OFFD
1111	IS320	SUMMER	2013	BLM302	10:30:00		MW
1234	IS320	FALL	2012	BLM302	10:30:00	098-76-5432	MW
2222	IS460	SUMMER	2012	BLM412	13:30:00		TTH
3333	IS320	SPRING	2013	BLM214	08:30:00	098-76-5432	MW
4321	IS320	FALL	2012	BLM214	15:30:00	098-76-5432	TTH
4444	IS320	WINTER	2013	BLM302	15:30:00	543-21-0987	TTH
5555	FIN300	WINTER	2012	BLM207	08:30:00	765-43-2109	MW
5678	IS480	WINTER	2013	BLM302	10:30:00	987-65-4321	MW
5679	IS480	SPRING	2013	BLM412	15:30:00	876-54-3210	TTH
6666	FIN450	WINTER	2013	BLM212	10:30:00	987-65-4321	TTH
7777	FIN480	SPRING	2013	BLM305	13:30:00	765-43-2109	MW



EXAMPLE 5

- The Faculty table stores data about instructors of courses.
- A null value for Offering. FacSSN means that a faculty member is not yet assigned to teach the offering.
- For example, an instructor is not assigned in the first and third rows because offerings must be scheduled perhaps a year in advance, it is likely that instructors for some offerings will not be known until after the offering row is initially stored. Therefore, permitting null values in the Offering table is acceptable

EXAMPLE 5

Referential Integrity for Self-Referencing (Unary) Relationships

- A referential integrity constraint involving a single table is known as a self-referencing relationship.
- Self-referencing relationships are not common, but they are important when they occur.

EXAMPLE 5

Referential Integrity for Self-Referencing (Unary) Relationships

```
CREATE TABLE Faculty
(FacNo          char(11) not null,
FacFirstName    varchar2(30) not null,
FacLastName     varchar2(30) not null,
FacCity         varchar2(30) not null,
FacState        char(2) not null,
FacZipCode      char(10) not null,
FacRank         char(4),
FacHireDate     date,
FacSalary       decimal(10,2),
FacSupervisor   char(11),
FacDept         char(6),CONSTRAINT FacultyPK PRIMARY KEY (FacNo),
CONSTRAINT SupervisorFK FOREIGN KEY (FacSupervisor) REFERENCES Faculty );
```



EXAMPLE 5

- In the university database, a faculty member can supervise other faculty members and be supervised by a faculty member.
- For example, Victoria Emmanuel (first row) supervises Leonard Fibon (third row) as displayed in the data from the Faculty table below.
- The FacSupervisor column shows this relationship: the FacSupervisor value in the third row (543-21-0987) matches the FacNo value in the first row.
- A referential integrity constraint involving the FacSupervisor column represents the self-referencing relationship.
- In the CREATE TABLE statement, the referential integrity constraint for a self-referencing relationship can be written the same way as other referential integrity constraints.

FACNO	FACFIRSTNAME	FACLASTNAME	FACCITY	FA	FACZIPCODE	FACR	FACHIREDA	FACSALARY	FACSUPERVIS	FACDEP
543-21-0987	VICTORIA	EMMANUEL	BOTHELL	WA	98011-2242	PROF	15-APR-01	120000		MS
765-43-2109	NICKI	MACON	BELLEVUE	WA	98015-9945	PROF	11-APR-02	65000		FIN
654-32-1098	LEONARD	FIBON	SEATTLE	WA	98121-0094	ASSC	01-MAY-99	70000	543-21-0987	MS
098-76-5432	LEONARD	VINCE	SEATTLE	WA	98111-9921	ASST	10-APR-00	35000	654-32-1098	MS
876-54-3210	CRISTOPHER	COLAN	SEATTLE	WA	98114-1332	ASST	01-MAR-04	40000	654-32-1098	MS
987-65-4321	JULIA	MILLS	SEATTLE	WA	98114-9954	ASSC	15-MAR-05	75000	765-43-2109	FIN