

## INTEGRITY RULES

Relational database integrity rules are very important to good database design. Many RDBMS enforce integrity rules automatically. Those rules are:

### 1- ENTITY INTEGRITY

All primary key entries are unique, and no part of primary key may be null. Each row will have a unique identity, and foreign key values can properly reference primary key values, for example... No invoice can have a duplicate number, nor can it be null. In short, all invoices are uniquely identified by their invoice number.

### 2- REFERENTIAL INTEGRITY

A foreign key may have either a null entry, as long as it is not a part of its table's primary key, or an entry that matches the primary key value in a table to which it is related.(every non –null foreign key value must reference an existing primary key value).It is possible for an attribute not to have corresponding value, but it will be impossible to have an invalid entry. for example, A Customer might not yet have an assigned sales representative(number),but it will be impossible to have an invalid sales representative(number).as in figure below:

Table name: CUSTOMER										Database name: Ch03_InsureCo	
Primary key: CUS_CODE											
Foreign key: AGENT_CODE											
CUS_CODE	CUS_LNAME	CUS_FNAME	CUS_INITIAL	CUS_AREACODE	CUS_PHONE	CUS_INSURE_TYPE	CUS_INSURE_AMT	CUS_RENEW_DATE	AGENT_CODE		
10010	Ramas	Alfred	A	615	844-2573	T1	100.00	09-Apr-2008	502		
10011	Dunne	Leona	K	713	894-1238	T1	250.00	15-Jun-2008	501		
10012	Smith	Kathy	W	615	894-2285	S2	150.00	29-Jan-2009	502		
10013	Olowu	Paul	F	615	894-2180	S1	300.00	14-Oct-2008	502		
10014	Orlando	Myron		615	222-1672	T1	100.00	28-Dec-2008	501		
10015	O'Brian	Amy	B	713	442-3361	T2	850.00	22-Sep-2008	503		
10016	Brown	James	G	615	297-1228	S1	120.00	25-Mar-2009	502		
10017	Williams	George		615	290-2556	S1	250.00	17-Jul-2008	503		
10018	Farriss	Anne	G	713	382-7185	T2	100.00	03-Dec-2008	501		
10019	Smith	Olette	K	615	297-3609	S2	500.00	14-Mar-2009	503		

Table name: AGENT				
Primary key: AGENT_CODE				
Foreign key: none				
AGENT_CODE	AGENT_AREACODE	AGENT_PHONE	AGENT_LNAME	AGENT_YTD_SLS
501	713	226-1249	Alby	132735.75
502	615	882-1244	Hahn	138967.35
503	615	123-5589	Okon	127093.45

To avoid nulls, some designers use special codes, known as flags, to indicate the absence of some value.

AGENT_CODE	AGENT_AREACODE	AGENT_PHONE	AGENT_LNAME	AGENT_YTD_SALES
-99	000	000-0000	None	\$0.00

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### THE DATA DICTIONARY AND THE SYSTEM CATALOG

**Data dictionary** provides a detailed description of all tables found within the user/designer-created database. It contains the attribute names and characteristics for each table in the system. In short it contains metadata As in table below

TABLE NAME	ATTRIBUTE NAME	CONTENTS	TYPE	FORMAT	RANGE	REQUIRED	PK OR FK	FK REFERENCED TABLE
CUSTOMER	CUS_CODE	Customer account code	CHAR(5)	99999	10000—99999	Y	PK	
	CUS_LNAME	Customer last name	VARCHAR(20)	Xxxxxxxx		Y		
	CUS_FNAME	Customer first name	VARCHAR(20)	Xxxxxxxx		Y		
	CUS_INITIAL	Customer initial	CHAR(1)	X				
	CUS_RENEW_DATE	Customer insurance renewal date	DATE	dd-mm-yyyy				
	AGENT_CODE	Agent code	CHAR(3)	999			FK	AGENT_CODE
AGENT	AGENT_CODE	Agent code	CHAR(3)	999		Y	PK	
	AGENT_AREACODE	Agent area code	CHAR(3)	999		Y		
	AGENT_PHONE	Agent telephone number	CHAR(10)	999-9999		Y		
	AGENT_LNAME	Agent last name	VARCHAR(20)	Xxxxxxxx		Y		
	AGENT_YTD_SLS	Agent year-to-date sales	NUMBER(9,2)	9,999,999.99		Y		

FK

= Foreign key

PK

= Primary key

CHAR

= Fixed character length data (1–255 characters)

VARCHAR

= Variable character length data (1–2,000 characters)

NUMBER

= Numeric data (NUMBER(9,2)) is used to specify numbers with two decimal places and up to nine digits, including the decimal places. Some RDBMSs permit the use of a MONEY or CURRENCY data type.

Note: Telephone area codes are always composed of digits 0–9. Because area codes are not used arithmetically, they are most efficiently stored as character data. Also, the area codes are always composed of three digits. Therefore, the area code data type is defined as CHAR(3). On the other hand, names do not conform to some standard length. Therefore, the customer first names are defined as VARCHAR(20), thus indicating that up to 20 characters may be used to store the names. Character data are shown as left-justified.

**System catalog** contains metadata .the system catalog can be described as detailed system data dictionary that describes all objects within the database, including data about table name, the table's creator and creation date, the number of columns in each table, the data type corresponding to each column, index filenames, index creators, authorized users, and access privileges. Current relational database software generally provides only a system catalog, from which the designer's data dictionary information may be derived.

In effect, the system catalog automatically produces database documentation. As new tables are added to the database, that documentation also allows the RDBMS to check for and eliminate homonyms and synonyms.

**Homonyms indicate** the use of the same attribute name to label different attributes. For example, you might use C-NAME to label a customer name

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attribute in a CUSTOMER table and also use C-NAME to label a consultant name attribute in a CONSULTANT table.

**Synonym** is the opposite of homonym and indicates the use of different names to describe the same attribute.

## RELATIONSHIPS WITHIN THE RELATIONAL DATABASE

### 1- THE 1:M RELATIONSHIP

It is the relational database norm

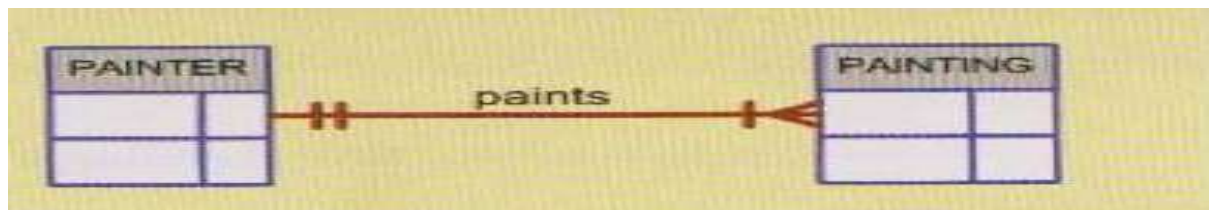


Table name: PAINTER  
Primary key: PAINTER\_NUM  
Foreign key: none

Database name: Ch03\_Museum

PAINTER_NUM	PAINTER_LNAME	PAINTER_FNAME	PAINTER_INITIAL
123	Ross	Georgette	P
126	Itero	Julio	O

Table name: PAINTING  
Primary key: PAINTING\_NUM  
Foreign key: PAINTER\_NUM

PAINTING_NUM	PAINTING_TITLE	PAINTER_NUM
1338	Dawn Thunder	123
1339	Vanilla Roses To Nowhere	123
1340	Tired Flounders	126
1341	Hasty Exit	123
1342	Plastic Paradise	126





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Table name: COURSE  
Primary key: CRS\_CODE  
Foreign key: none

Database name: Ch03\_TinyCollege

CRS_CODE	DEPT_CODE	CRS_DESCRIPTION	CRS_CREDIT
ACCT-211	ACCT	Accounting I	3
ACCT-212	ACCT	Accounting II	3
CIS-220	CIS	Intro. to Microcomputing	3
CIS-420	CIS	Database Design and Implementation	4
QM-261	CIS	Intro. to Statistics	3
QM-362	CIS	Statistical Applications	4

Table name: CLASS  
Primary key: CLASS\_CODE  
Foreign key: CRS\_CODE

CLASS_CODE	CRS_CODE	CLASS_SECTION	CLASS_TIME	CLASS_ROOM	PROF_NUM
10012	ACCT-211	1	MWTF 8:00-8:50 a.m.	BUS311	105
10013	ACCT-211	2	MWTF 9:00-9:50 a.m.	BUS200	105
10014	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS262	342
10015	ACCT-212	1	MWTF 10:00-10:50 a.m.	BUS311	301
10016	ACCT-212	2	Th 6:00-8:40 p.m.	BUS262	301
10017	CIS-220	1	MWTF 9:00-9:50 a.m.	KLR209	226
10018	CIS-220	2	MWTF 9:00-9:50 a.m.	KLR211	114
10019	CIS-220	3	MWTF 10:00-10:50 a.m.	KLR209	226
10020	CIS-420	1	W 6:00-8:40 p.m.	KLR209	162
10021	QM-261	1	MWTF 8:00-8:50 a.m.	KLR200	114
10022	QM-261	2	TTh 1:00-2:15 p.m.	KLR200	114
10023	QM-362	1	MWTF 11:00-11:50 a.m.	KLR200	162
10024	QM-362	2	TTh 2:30-3:45 p.m.	KLR200	162

## 2- THE 1:1 RELATIONSHIP

In this relationship, one entity can be related to only one other entity, and vice versa. It should be rare in any relational database design.



Table name: PROFESSOR  
Primary key: EMP\_NUM  
Foreign key: DEPT\_CODE

Database name: Ch03\_TinyCollege

EMP_NUM	DEPT_CODE	PROF_OFFICE	PROF_EXTENSION	PROF_HIGH_DEGREE
103	HIST	DRE 156	6783	Ph.D.
104	ENG	DRE 102	5561	MA
105	ACCT	KLR 229D	8665	Ph.D.
106	MKT/MGT	KLR 126	3899	Ph.D.
110	BIOL	AAK 160	3412	Ph.D.
114	ACCT	KLR 211	4436	Ph.D.
155	MATH	AAK 201	4440	Ph.D.
160	ENG	DRE 102	2248	Ph.D.
162	CIS	KLR 203E	2369	Ph.D.
191	MKT/MGT	KLR 409B	4016	DBA
195	PSYCH	AAK 297	3550	Ph.D.
209	CIS	KLR 333	3421	Ph.D.
226	CIS	KLR 300	3000	Ph.D.
297	MATH	AAK 194	1145	Ph.D.
299	ECON/FIN	KLR 284	2851	Ph.D.
301	ACCT	KLR 244	4883	Ph.D.
335	ENG	DRE 208	2000	Ph.D.
342	SOC	BBG 206	5514	Ph.D.
367	BIOL	AAK 230	8665	Ph.D.
401	HIST	DRE 156	6783	MA
425	ECON/FIN	KLR 284	2851	MBA
435	ART	BBG 185	2278	Ph.D.

↑ The 1:M DEPARTMENT employs PROFESSOR relationship is implemented through the placement of the DEPT\_CODE foreign key in the PROFESSOR table.

↓ The 1:1 PROFESSOR chairs DEPARTMENT relationship is implemented through the placement of the EMP\_NUM foreign key in the DEPARTMENT table.

Table name: DEPARTMENT  
Primary key: DEPT\_CODE  
Foreign key: EMP\_NUM

DEPT_CODE	DEPT_NAME	SCHOOL_CODE	EMP_NUM	DEPT_ADDRESS	DEPT_EXTENSION
ACCT	Accounting	BUS	114	KLR 211, Box 52	3118
ART	Fine Arts	A&SCI	435	BBG 165, Box 128	2278
BIOL	Biology	A&SCI	387	AAK 230, Box 415	4117
CIS	Computer Info. Systems	BUS	209	KLR 333, Box 56	3245
ECON/FIN	Economics/Finance	BUS	299	KLR 284, Box 63	3126
ENG	English	A&SCI	160	DRE 102, Box 223	1004
HIST	History	A&SCI	103	DRE 156, Box 284	1667
MATH	Mathematics	A&SCI	297	AAK 194, Box 422	4234
MKT/MGT	Marketing/Management	BUS	106	KLR 126, Box 55	3342
PSYCH	Psychology	A&SCI	195	AAK 297, Box 438	4110
SOC	Sociology	A&SCI	342	BBG 206, Box 132	2009

## 3- THE M:N RELATIONSHIP

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A many-to-many relationship is not supported directly in the relational environment. However, this relationship can be implemented by creating anew entity in 1: M relationships with the original entities.



Table name: STUDENT  
Primary key: STU\_NUM  
Foreign key: none

STU_NUM	STU_LNAME	CLASS_CODE
321452	Bowser	10014
321452	Bowser	10018
321452	Bowser	10021
324257	Smithson	10014
324257	Smithson	10018
324257	Smithson	10021

Database name: Ch03\_Colleg

Table name: CLASS  
Primary key: CLASS\_CODE  
Foreign key: STU\_NUM

CLASS_CODE	STU_NUM	CRS_CODE	CLASS_SECTION	CLASS_TIME	CLASS_ROOM	PROF_NUM
10014	321452	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
10014	324257	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
10018	321452	CIS-220	2	MWTF 9:00-9:50 a.m.	KLR211	114
10018	324257	CIS-220	2	MWTF 9:00-9:50 a.m.	KLR211	114
10021	321452	QM-261	1	MWTF 8:00-8:50 a.m.	KLR200	114
10021	324257	QM-261	1	MWTF 8:00-8:50 a.m.	KLR200	114

- The tables create many redundancies.
  - Given this structure ,the relational operations become very complex.
- This problem can easily be avoided by creating a **composite entity** also referred to as a **bridge entity** or an **associative entity**.

Table name: STUDENT  
Primary key: STU\_NUM  
Foreign key: none

STU_NUM	STU_LNAME
321452	Bowser
324257	Smithson

Database name: Ch03\_CollegeTry2

Table name: ENROLL  
Primary key: CLASS\_CODE + STU\_NUM  
Foreign key: CLASS\_CODE, STU\_NUM

CLASS_CODE	STU_NUM	ENROLL_GRADE
10014	321452	C
10014	324257	B
10018	321452	A
10018	324257	B
10021	321452	C
10021	324257	C

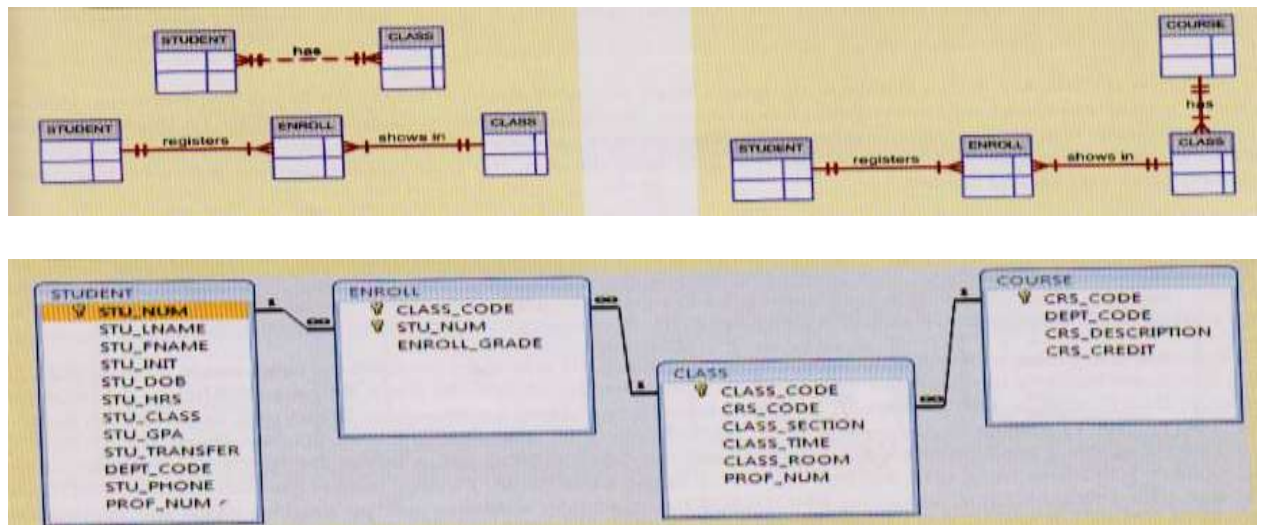
  

Table name: CLASS  
Primary key: CLASS\_CODE  
Foreign key: CRS\_CODE

CLASS_CODE	CRS_CODE	CLASS_SECTION	CLASS_TIME	CLASS_ROOM	PROF_NUM
10014	ACCT-211	3	TTh 2:30-3:45 p.m.	BUS252	342
10018	CIS-220	2	MWTF 9:00-9:50 a.m.	KLR211	114
10021	QM-261	1	MWTF 8:00-8:50 a.m.	KLR200	114



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## DATA REDUNDANCY

**Redundancy** exists when the same data are stored unnecessarily at different places.

Data redundancy leads to data anomalies

- Can destroy the effectiveness of the database

- Foreign keys

- Control data redundancies by using common attributes shared by tables

- Crucial to exercising data redundancy control

- Sometimes, data redundancy is necessary

**Data inconsistency:** different and conflicting versions of same data occur at different places.

**Data anomaly** abnormalities when all of the required changes in the redundant data are not made successfully.

- Update anomalies
- Insertion anomalies
- Deletion anomalies

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Database name: Ch03\_SaleCo

**Table name: CUSTOMER**  
**Primary key: CUS\_CODE**  
**Foreign key: none**

CUS_CODE	CUS_LNAME	CUS_FNAME	CUS_INITIAL	CUS_AREACODE	CUS_PHONE
10010	Ramas	Alfred	A	815	844-2573
10011	Dunne	Leona	K	713	894-1238
10012	Smith	Kathy	W	815	894-2285
10013	Olowski	Paul	F	815	894-2180
10014	Orlando	Myron		815	222-1872
10015	O'Brian	Amy	B	713	442-3381
10016	Brown	James	G	815	297-1229
10017	Williams	George		815	290-2556
10018	Ferris	Anne	O	713	382-7185
10019	Smith	Olette	K	815	297-3809

**Table name: INVOICE**  
**Primary key: INV\_NUMBER**  
**Foreign key: CUS\_CODE**

INV_NUMBER	CUS_CODE	INV_DATE
1001	10014	08-Mar-08
1002	10011	08-Mar-08
1003	10012	08-Mar-08
1004	10011	09-Mar-08

**Table name: LINE**  
**Primary key: INV\_NUMBER + LINE\_NUMBER**  
**Foreign keys: INV\_NUMBER, PROD\_CODE**

INV_NUMBER	LINE_NUMBER	PROD_CODE	LINE_UNITS	LINE_PRICE
1001	1	123-21UUY	1	189.99
1001	2	SRE-657UQ	3	2.99
1002	1	GER-34256	2	18.63
1003	1	ZZX/3245Q	1	6.79
1003	2	SRE-657UQ	1	2.99
1003	3	001278-AB	1	12.95
1004	1	001278-AB	1	12.95
1004	2	SRE-657UQ	2	2.99

**Table name: PRODUCT**  
**Primary key: PROD\_CODE**  
**Foreign key: none**

PROD_CODE	PROD_DESCRIPTION	PROD_PRICE	PROD_ON_HAND	VEND_CODE
001278-AB	Clay hammer	12.95	23	232
123-21UUY	Housetite chain saw, 16-in. bar	189.99	4	235
GER-34256	Sledge hammer, 16-lb. head	18.63	6	231
SRE-657UQ	Rat-tail file	2.99	15	232
ZZX/3245Q	Steel tape, 12-ft. length	6.79	8	235



LINE\_PRICE and PROD\_PRICE are redundant. LINE\_NUMBER in LINE table is redundant .