Database Technology

Topic 2: Relational Databases

Olaf Hartig olaf.hartig@liu.se



Relations



Relational Model Concepts

- Relational database: represent data as a collection of *relations*
- Example relation:

Name	Ssn	Home_phone	Address	Office_phone	Age	Gpa
Benjamin Bayer	305-61-2435	<mark>(817)373-1616</mark>	2918 Bluebonnet Lane	NULL	19	3.21
Chung-cha Kim	381-62-1245	(817)375-4409	125 Kirby Road	NULL	18	2.89
Dick Davidson	422-11-2320	NULL	3452 Elgin Road	(817)749-1253	25	3.53
Rohan Panchal	489-22-1100	(817)376-9821	265 Lark Lane	(817)749-6492	28	3.93
Barbara Benson	533-69-1238	<mark>(817)839-8461</mark>	7384 Fontana Lane	NULL	19	3.25
	Name Benjamin Bayer Chung-cha Kim Dick Davidson Rohan Panchal Barbara Benson	Name Ssn Benjamin Bayer 305-61-2435 Chung-cha Kim 381-62-1245 Dick Davidson 422-11-2320 Rohan Panchal 489-22-1100 Barbara Benson 533-69-1238	Name Ssn Home_phone Benjamin Bayer 305-61-2435 (817)373-1616 Chung-cha Kim 381-62-1245 (817)375-4409 Dick Davidson 422-11-2320 NULL Rohan Panchal 489-22-1100 (817)376-9821 Barbara Benson 533-69-1238 (817)839-8461	Name Ssn Home_phone Address Benjamin Bayer 305-61-2435 (817)373-1616 2918 Bluebonnet Lane Chung-cha Kim 381-62-1245 (817)375-4409 125 Kirby Road Dick Davidson 422-11-2320 NULL 3452 Elgin Road Rohan Panchal 489-22-1100 (817)376-9821 265 Lark Lane Barbara Benson 533-69-1238 (817)839-8461 7384 Fontana Lane	Name Ssn Home_phone Address Office_phone Benjamin Bayer 305-61-2435 (817)373-1616 2918 Bluebonnet Lane NULL Chung-cha Kim 381-62-1245 (817)375-4409 125 Kirby Road NULL Dick Davidson 422-11-2320 NULL 3452 Elgin Road (817)749-1253 Rohan Panchal 489-22-1100 (817)376-9821 265 Lark Lane (817)749-6492 Barbara Benson 533-69-1238 (817)839-8461 7384 Fontana Lane NULL	NameSsnHome_phoneAddressOffice_phoneAgeBenjamin Bayer305-61-2435(817)373-16162918 Bluebonnet LaneNULL19Chung-cha Kim381-62-1245(817)375-4409125 Kirby RoadNULL18Dick Davidson422-11-2320NULL3452 Elgin Road(817)749-125325Rohan Panchal489-22-1100(817)376-9821265 Lark Lane(817)749-649228Barbara Benson533-69-1238(817)839-84617384 Fontana LaneNULL19

STUDENT

• **Quiz:** each of these things is called a ...

A) record / B) tuple / C) row

... in the relation data model.



Quiz (NULL Values)

 Notice the value NULL that the Barbara Benson tuple has for the Office_phone attribute

	STODENT			_			
	Name	Ssn	Home_phone	Address	Office_phone	Age	Gpa
Tuples	Benjamin Bayer	305-61-2435	(817)373-1616	2918 Bluebonnet Lane	NULL	19	3.21
	Chung-cha Kim	381-62-1245	(817)375-4409	125 Kirby Road	NULL	18	2.89
	Dick Davidson	422-11-2320	NULL	3452 Elgin Road	(817)749-1253	25	3.53
	Rohan Panchal	489-22-1100	(817)376-9821	265 Lark Lane	(817)749-6492	28	3.93
	Barbara Benson	533-69-1238	(817)839-8461	7384 Fontana Lane	NULL	19	3.25

- What can this value mean?
 - A) Barbara Benson doesn't have an office phone.
 - B) Barbara Benson has an office phone but we don't know the number (perhaps withheld).
 - C) Any of the previous two.

CTUDENT



• A *relation schema* consists of:

A) relation name, attribute names and domains, and tuples;

or

B) relation name, attribute names and domains, and restrictions;

or

C) relation name, tuples, and NULL values.



A relation schema consists of:

A) relation name, attribute names and domains, and tuples;

or

B) relation name, attribute names and domains, and restrictions; integrity constraints

or

C) relation name, tuples, and NULL values.



Integrity Constraints

Uniqueness, Keys, and Superkeys



 Consider the following relation and assume a uniqueness constraint has been defined for the attribute set {Code, Year}

C	Course			
	Code	Title	Year	Leader
	TDDD12	Database Technology	2020	49
	TDDD12	Database Technology	2021	49
	TDDE49	Databases and Information Security	2021	49
	TDDD43	Advanced Databases and Data Models	2020	31
	753A01	Sports Analytics	2021	31

Suppose we want to insert the following tuple
TDDD43
Advanced Databases

2021 31

Would this be a violation of the uniqueness constraint?

A) yes B) no C) it depends



 Consider the following relation and assume a uniqueness constraint has been defined for the attribute set {Code, Year}

С	ourse			
	Code	Title	Year	Leader
	TDDD12	Database Technology	2020	49
	TDDD12	Database Technology	2021	49
	TDDE49	Databases and Information Security	2021	49
	TDDD43	Advanced Databases and Data Models	2020	31
	753A01	Sports Analytics	2021	31

Specify a superkey for this relation that is not a key



 Consider the following relation and assume a uniqueness constraint has been defined for the attribute set {Code, Year}

ourse			
Code	Title	Year	Leader
TDDD12	Database Technology	2020	49
TDDD12	Database Technology	2021	49
TDDE49	Databases and Information Security	2021	49
TDDD43	Advanced Databases and Data Models	2020	31
753A01	Sports Analytics	2021	31
	Code TDDD12 TDDD12 TDDD12 TDDE49 TDDD43 753A01	CodeTitleTDDD12Database TechnologyTDDD12Database TechnologyTDDE49Databases and Information SecurityTDDD43Advanced Databases and Data Models753A01Sports Analytics	CodeTitleYearTDDD12Database Technology2020TDDD12Database Technology2021TDDE49Databases and Information Security2021TDDD43Advanced Databases and Data Models2020753A01Sports Analytics2021

- Specify a superkey for this relation that is not a key
- Each of the following sets of attributes is a possible answer
 - { Code, Year, Title }
 - { Code, Year, Leader }
 - { Code, Year, Title, Leader }



Which set of attributes could be a key for the following relation?

Engine_serial_number	Make	Model	Year		
A69352	Ford	Mustang	02		
B43696	Oldsmobile	Cutlass	05		
X83554	Oldsmobile	Delta	01		
C43742	Mercedes	190-D	99		
Y82935	Toyota	Camry	04		
U028365	Jaguar	XJS	04		
	Engine_serial_number A69352 B43696 X83554 C43742 Y82935 U028365	Engine_serial_numberMakeA69352FordB43696OldsmobileX83554OldsmobileC43742MercedesY82935ToyotaU028365Jaguar	Engine_serial_numberMakeModelA69352FordMustangB43696OldsmobileCutlassX83554OldsmobileDeltaC43742Mercedes190-DY82935ToyotaCamryU028365JaguarXJS		

CAR



• Which set of attributes could be a key for the following relation?

License_number	Engine_serial_number	Make	Model	Year		
Texas ABC-739	A69352	Ford	Mustang	02		
Florida TVP-347	B43696	Oldsmobile	Cutlass	05		
New York MPO-22	X83554	Oldsmobile	Delta	01		
California 432-TFY	C43742	Mercedes	190-D	99		
California RSK-629	Y82935	Toyota	Camry	04		
Texas RSK-629	U028365	Jaguar	XJS	04		

- The following two keys are possible
 - { License_number }

CAP

- { Engine_serial_number }
- Remember that we call each of them a candidate key, and we have to select one of them to be the primary key



Integrity Constraints

Referential Integrity Constraints (Foreign Keys)



Consider the following two relation schemas



- Let's make sure that, for every course leader mentioned in the Course relation, data about that course leader is present in CourseLeader
- What do we have to do?
- A) Define the attribute PN to be a foreign key that refers to the attribute Leader.
- B) Define the attribute Leader to be a foreign key that refers to the attribute PN.
- C) Define that the attributes Leader and PN form a foreign key.



Consider the following two relation schemas



- Let's make sure that, for every course leader mentioned in the Course relation, data about that course leader is present in CourseLeader
- What do we have to do?
- -A) -Define the attribute-PN to be a foreign key that refers to the attribute Leader.
 - B) Define the attribute Leader to be a foreign key that refers to the attribute PN.
- --C)-Define-that-the-attributes Leader-and PN-form-a-foreign key:-



Another Example

Consider the following two relation schemas





Question

Consider the following two relation schemas



- Assume we want to record for every course leader the course that is her/his favorite course, which we may do by adding a foreign key from the CourseLeader relation to the Course relation.
- To do so, we might have to attributes to the CourseLeader relation. How many attributes?

A) 2 B) 1 C) 0 (i.e., the existing attributes can be used)



Feedback

How difficult/easy did find the quizzes and exercise today in general?

A) quite difficult (most of them)

B) just right (most of them)

C) too easy (most of them)



www.liu.se

