

Keys

Credit: Database System Concepts and Dr. Bruns

Problem: identify a row in a table

instructor

ID	name	dept_name	salary
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000
33456	Gold	Physics	87000
45565	Katz	Comp. Sci.	75000
58583	Califieri	History	62000
76543	Singh	Finance	80000
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

We select data from a table by using attribute values.

So if we want a certain row, it must have unique attribute values.

Question: how do we identify objects in a programming language?

Solution

instructor

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To ensure every row can be selected, a DB designer will specify:

“No two rows in this table can have the same ID value”

This is a kind of **constraint**, and the database system will enforce it.

question: how?

Example

Last name	First name	Sex	Date of Birth	Ward No.
Smith	John	M	14.08.78	6
Jones	Peter	M	07.12.85	8
Brown	Brenda	F	17.06.61	3
Jenkins	Alan	M	29.01.72	7
Brown	Chris	M	25.02.95	6

The database designer has specified that no two rows of this table should have the same value for “Last name”.

Is there an error in the table?

superkey!

course

course_id	title	dept_name	credits
BIO-101	Intro. to Biology	Biology	4
BIO-301	Genetics	Biology	4
BIO-399	Computational Biology	Biology	3
CS-101	Intro. to Computer Science	Comp. Sci.	4
CS-190	Game Design	Comp. Sci.	4
CS-347	Database System Concepts	Comp. Sci.	3
EE-181	Intro. to Digital Systems	Elec. Eng.	3
FIN-201	Investment Banking	Finance	3
HIS-351	World History	History	3
PHY-101	Physical Principals	Physics	4



- ☐ **superkey**: a set of attributes is a superkey for a table if no two rows of a table **should ever** have the same values of those attributes
- ☐ is {title} a superkey?
- ☐ is {dept_name, credits} a superkey?
- ☐ is {course_id} a superkey?
- ☐ is {course_id, dept_name} a superkey?

superkey!

course

course_id	title	dept_name	credits
BIO-101	Intro. to Biology	Biology	4
BIO-301	Genetics	Biology	4
BIO-399	Computational Biology	Biology	3
CS-101	Intro. to Computer Science	Comp. Sci.	4
CS-190	Game Design	Comp. Sci.	4
CS-347	Database System Concepts	Comp. Sci.	3
EE-181	Intro. to Digital Systems	Elec. Eng.	3
FIN-201	Investment Banking	Finance	3
HIS-351	World History	History	3
PHY-101	Physical Principals	Physics	4



- ☐ **superkey**: a set of attributes is a superkey for a table if no two rows of a table **should ever** have the same values of those attributes
- ☐ is {title} a superkey? No
- ☐ is {dept_name, credits} a superkey? No
- ☐ is {course_id} a superkey? Yes
- ☐ is {course_id, dept_name} a superkey? Yes

Questions

course

course_id	title	dept_name	credits
BIO-101	Intro. to Biology	Biology	4
BIO-301	Genetics	Biology	4
BIO-399	Computational Biology	Biology	3
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HIS-351	World History	History	3
PHY-101	Physical Principals	Physics	4

Let A,B be attributes of some table.

If $\{A\}$ is a superkey, then is $\{A,B\}$ a superkey? Yes

If $\{A,B\}$ is a superkey, then is $\{A\}$ a superkey? No

Questions

course

course_id	title	dept_name	credits
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FIN-201	Investment Banking	Finance	3
HIS-351	World History	History	3
PHY-101	Physical Principals	Physics	4

Let A,B be attributes of some table.

If $\{A\}$ is a superkey, then is $\{A,B\}$ a superkey?

If $\{A,B\}$ is a superkey, then is $\{A\}$ a superkey?

candidate key

course_id	title	dept_name	credits
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BIO-301	Genetics	Biology	4
BIO-399	Computational Biology	Biology	3
CS-101	Intro. to Computer Science	Comp. Sci.	4
CS-190	Game Design	Comp. Sci.	4
CS-347	Database System Concepts	Comp. Sci.	3
EE-181	Intro. to Digital Systems	Elec. Eng.	3
FIN-201	Investment Banking	Finance	3
HIS-351	World History	History	3
PHY-101	Physical Principals	Physics	4

- ☐ **candidate key**: a superkey that wouldn't be a superkey if one of the attributes were removed
- ☐ Is {title, dept_name} a superkey?
- ☐ Is {title, dept_name} a candidate key?
- ☐ Is {title} a candidate key?
- ☐ Is {course_id} a candidate key?

A candidate key is a “minimal” superkey

candidate key

course_id	title	dept_name	credits
BIO-101	Intro. to Biology	Biology	4
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CS-101	Intro. to Computer Science	Comp. Sci.	4
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CS-347	Database System Concepts	Comp. Sci.	3
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FIN-201	Investment Banking	Finance	3
HIS-351	World History	History	3
PHY-101	Physical Principals	Physics	4

- ☐ **candidate key:** a superkey that wouldn't be a superkey if one of the attributes were removed
- ☐ Is {title, dept_name} a superkey? Probably yes
- ☐ Is {title, dept_name} a candidate key? Yes
- ☐ Is {title} a candidate key? No
- ☐ Is {course_id} a candidate key? Yes

A candidate key is a "minimal" superkey

primary key

course_id	title	dept_name	credits
BIO-101	Intro. to Biology	Biology	4
BIO-301	Genetics	Biology	4
BIO-399	Computational Biology	Biology	3
CS-101	Intro. to Computer Science	Comp. Sci.	4
CS-190	Game Design	Comp. Sci.	4
CS-347	Database System Concepts	Comp. Sci.	3
EE-181	Intro. to Digital Systems	Elec. Eng.	3
FIN-201	Investment Banking	Finance	3
HIS-351	World History	History	3
PHY-101	Physical Principals	Physics	4

primary key: a candidate key the database designer has chosen to serve as the unique identifier of rows within a table

In this table, course_id was specified as the primary key.

A major point of confusion

- ❑ A set of attributes is not a superkey for a table just because no two rows in the table have the same values for those attribute.
- ❑ A primary key is a kind of **constraint** – it says that the primary key attributes must always uniquely define rows of the table.

foreign key

course

course_id	title	dept_name	credits
BIO-101	Intro. to Biology	Biology	4
BIO-301	Genetics	Biology	4
BIO-399	Computational Biology	Biology	3
CS-101	Intro. to Computer Science	Comp. Sci.	4
CS-190	Game Design	Comp. Sci.	4
CS-347	Database System Concepts	Comp. Sci.	3
EE-181	Intro. to Digital Systems	Elec. Eng.	3
FIN-201	Investment Banking	Finance	3
HIS-351	World History	History	3
PHY-101	Physical Principals	Physics	4

teaches

ID	course_id	sec_id	semester	year
10101	CS-101	1	Fall	2009
10101	CS-315	1	Spring	2010
10101	CS-347	1	Fall	2009
12121	FIN-101	1	Spring	2010
15151	MUS-199	1	Spring	2010
22222	PHY-101	1	Fall	2009
32343	HIS-351	1	Spring	2010
45565	CS-101	1	Spring	2010
45565	CS-319	1	Spring	2010
76766	BIO-101	1	Summer	2009
76766	BIO-301	1	Summer	2010
83821	CS-190	1	Spring	2009
83821	CS-190	2	Spring	2009
83821	CS-319	2	Spring	2010

- ❑ **foreign key:** a set of attributes in one table that are the primary key attributes of another table
- ❑ Is there a foreign key in the 'teaches' table?

Lab

1. Can you think of better name than 'Candidate Key'?
2. Suppose some database has a relation schema $R(a,b,c)$. Can you tell if the attributes a,b form a superkey?
3. Is every candidate key also a superkey?
4. Suppose someone adds a tuple to a table that contained a foreign key. Describe the checks you would need to perform to ensure that adding the tuple did not cause an error in the database. (In other words, did not cause the foreign key constraint to become violated.)

Lab - solutions

1. minimal superkey
2. No. This is super-important. To know if something is a superkey you need real-world knowledge about the subject of the schema
3. Yes!
4. You would need to look in the “other” table to see if some tuple of that other table had primary key attributes equal to the foreign key attributes of the tuple to be added