Types of Keys in Relational Model (Candidate, Super, Primary, Alternate and Foreign)

Pre-Requisite: DBMS | Relational Model Introduction and Codd Rules

Keys are one of the basic requirements of a relational database model. It is widely used to identify the tuples(rows) uniquely in the table. We also use keys to set up relations amongst various columns and tables of a relational database.

Different Types of Keys in the Relational Model

1. Candidate Key
2. Primary Key
3. Super Key
4. Alternate Key
5. Foreign Key

1. Candidate Key: The minimal set of attributes that can uniquely identify a tuple is known as a candidate key. For Example, STUD_NO in STUDENT relation.

- It is a minimal super key.
- It is a super key with no repeated data is called a candidate key.
- The minimal set of attributes that can uniquely identify a record.
- It must contain unique values.
- It can contain NULL values.
- Every table must have at least a single candidate key.
- A table can have multiple candidate keys but only one primary key (the primary key cannot have a NULL value, so the candidate key with a NULL value can't be the primary key).
- The value of the Candidate Key is unique and may be null for a tuple.
- There can be more than one candidate key in a relationship.

Example:

```
STUD_NO is the candidate key for relation STUDENT.
```

Table STUDENT

STUD_NO	SNAME	ADDRESS	PHONE
1	Shyam	Delhi	123456789
2	Rakesh	Kolkata	223365796
3	Suraj	Delhi	175468965

- The candidate key can be simple (having only one attribute) or composite as well.

Example:

```
{STUD_NO, COURSE_NO} is a composite
candidate key for relation STUDENT_COURSE.
```

Table STUDENT_COURSE

STUD_NO	TEACHER_NO	COURSE_NO
1	001	C001
2	056	C005

Note: In SQL Server a unique constraint that has a nullable column, **allows** the value '**null**' in that column **only once**. That's why the STUD_PHONE attribute is a candidate here, but can not be a 'null' value in the primary key attribute.

2. Primary Key: There can be more than one candidate key in relation out of which one can be chosen as the primary key. For Example, STUD_NO, as well as STUD_PHONE, are candidate

keys for relation STUDENT but STUD_NO can be chosen as the primary key (only one out of many candidate keys).

- It is a unique key.
- It can identify only one tuple (a record) at a time.
- It has no duplicate values, it has unique values.
- It cannot be NULL.
- Primary keys are not necessarily to be a single column; more than one column can also be a primary key for a table.

Example:

```
STUDENT table -> Student(STUD_NO, SNAME,
ADDRESS, PHONE) , STUD_NO is a primary key
```

Table STUDENT

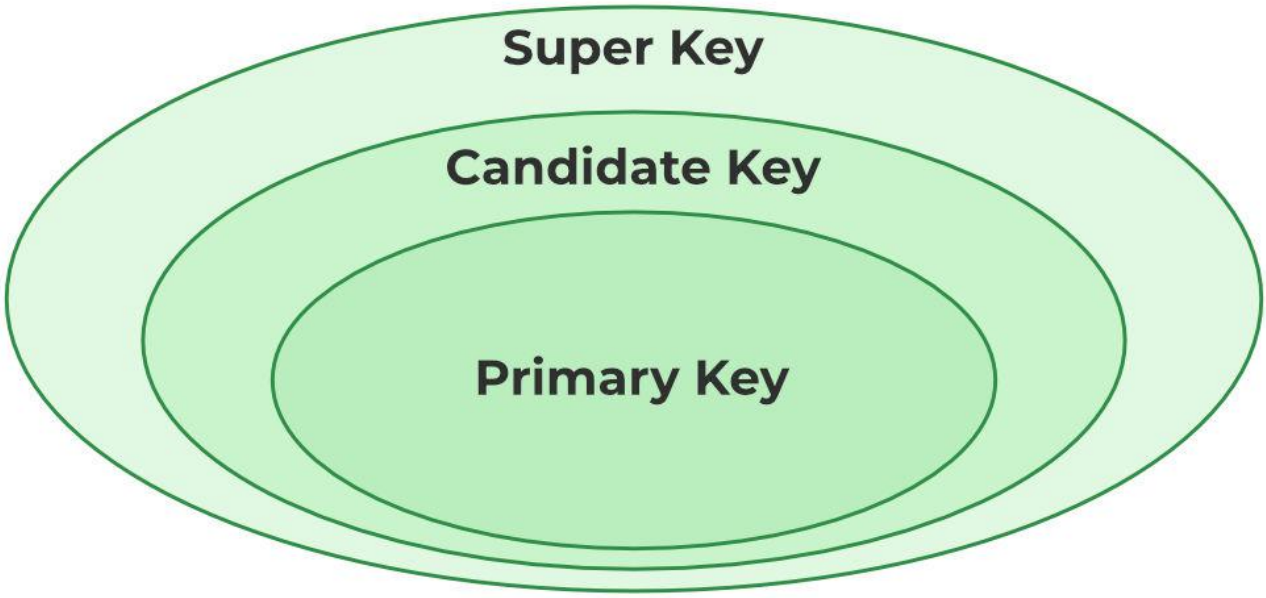
STUD_NO	SNAME	ADDRESS	PHONE
1	Shyam	Delhi	123456789
2	Rakesh	Kolkata	223365796
3	Suraj	Delhi	175468965

3. Super Key: The set of attributes that can uniquely identify a tuple is known as Super Key. For Example, STUD_NO, (STUD_NO, STUD_NAME), etc. A super key is a group of single or multiple keys that identifies rows in a table. It supports NULL values.

- Adding zero or more attributes to the candidate key generates the super key.
- A candidate key is a super key but vice versa is not true.

Example:

```
Consider the table shown above.
STUD_NO+PHONE is a super key.
```



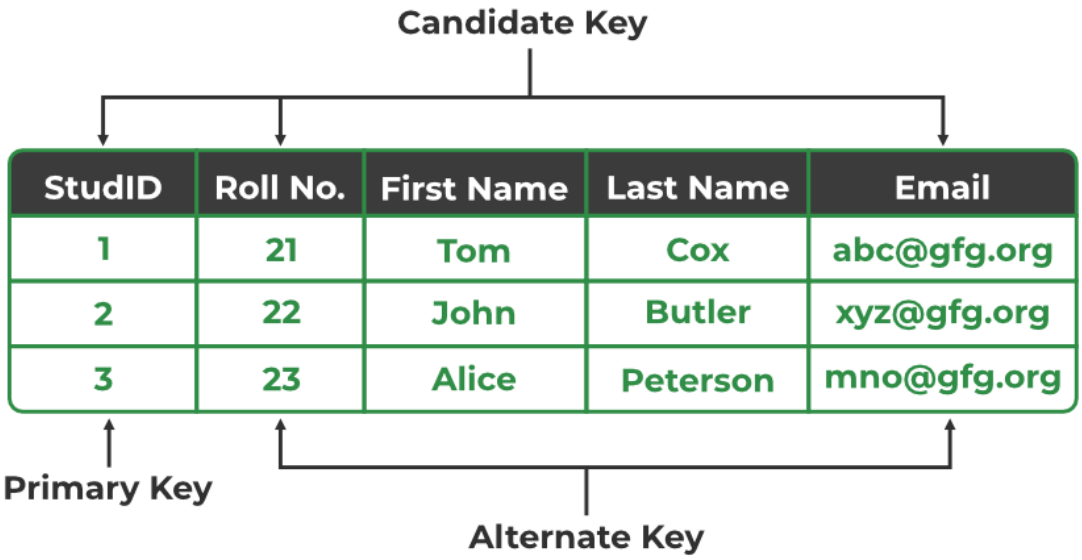
Relation between Primary Key, Candidate Key, and Super Key

4. Alternate Key: The candidate key other than the primary key is called an alternate key.

- All the keys which are not primary keys are called alternate keys.
- It is a secondary key.
- It contains two or more fields to identify two or more records.
- These values are repeated.
- Eg:- SNAME, and ADDRESS is Alternate keys

Example:

```
Consider the table shown above.
STUD_NO, as well as PHONE both,
are candidate keys for relation STUDENT but
PHONE will be an alternate key
(only one out of many candidate keys).
```



Primary Key, Candidate Key, and Alternate Key

5. Foreign Key: If an attribute can only take the values which are present as values of some other attribute, it will be a foreign key to the attribute to which it refers. The relation which is being referenced is called referenced relation and the corresponding attribute is called referenced attribute the relation which refers to the referenced relation is called referencing relation and the corresponding attribute is called referencing attribute. The referenced attribute of the referenced relation should be the primary key to it.

- It is a key it acts as a primary key in one table and it acts as secondary key in another table.
- It combines two or more relations (tables) at a time.
- They act as a cross-reference between the tables.
- For example, DNO is a primary key in the DEPT table and a non-key in EMP

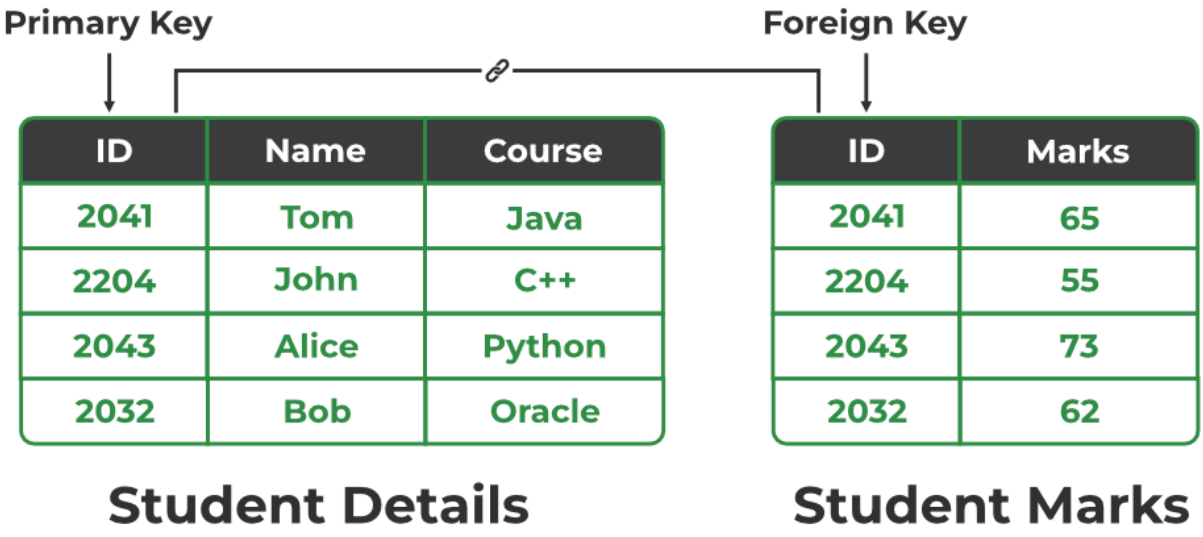
Example:

```
Refer Table STUDENT shown above.
STUD_NO in STUDENT_COURSE is a
foreign key to STUD_NO in STUDENT relation.
```

Table STUDENT_COURSE

STUD_NO	TEACHER_NO	COURSE_NO
1	005	C001
2	056	C005

It may be worth noting that, unlike the Primary Key of any given relation, Foreign Key can be NULL as well as may contain duplicate tuples i.e. it need not follow uniqueness constraint. For Example, STUD_NO in the STUDENT_COURSE relation is not unique. It has been repeated for the first and third tuples. However, the STUD_NO in STUDENT relation is a primary key and it needs to be always unique, and it cannot be null.



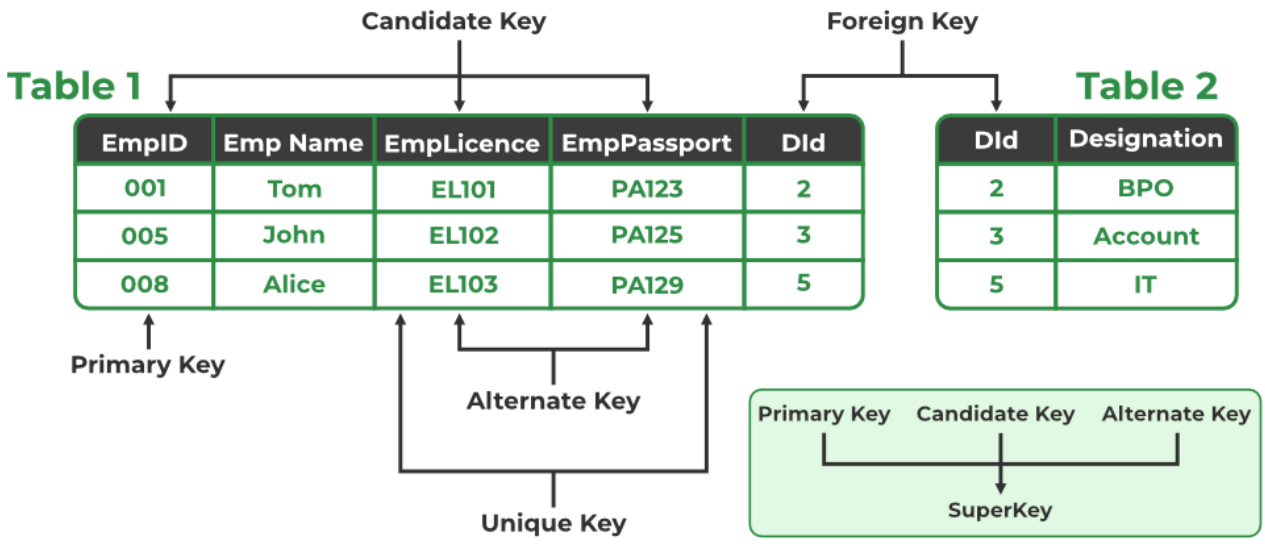
Relation between Primary Key and Foreign Key

6. Composite Key: Sometimes, a table might not have a single column/attribute that uniquely identifies all the records of a table. To uniquely identify rows of a table, a combination of two or more columns/attributes can be used. It still can give duplicate values in rare cases. So, we need to find the optimal set of attributes that can uniquely identify rows in a table.

- It acts as a primary key if there is no primary key in a table
- Two or more attributes are used together to make a composite key.
- Different combinations of attributes may give different accuracy in terms of identifying the rows uniquely.

Example:

```
FULLNAME + DOB can be combined
together to access the details of a student.
```



Different Types of Keys

FAQs

Why keys are necessary for DBMS?

- Keys are one of the important aspects of DBMS. Keys help us to find the tuples(rows) uniquely in the table. It is also used in developing various relations amongst columns or tables of the database.

What is a Unique Key?

- Unique Keys are the keys that define the record uniquely in the table. It is different from Primary Keys, as Unique Key can contain one NULL value but Primary Key does not contain any NULL values.

What is Artificial Key?

- Artificial Keys are the keys that are used when no attributes contain all the properties of the Primary Key or if the Primary key is very large and complex.

Last Updated : 21 Mar, 2023

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