

Database Keys

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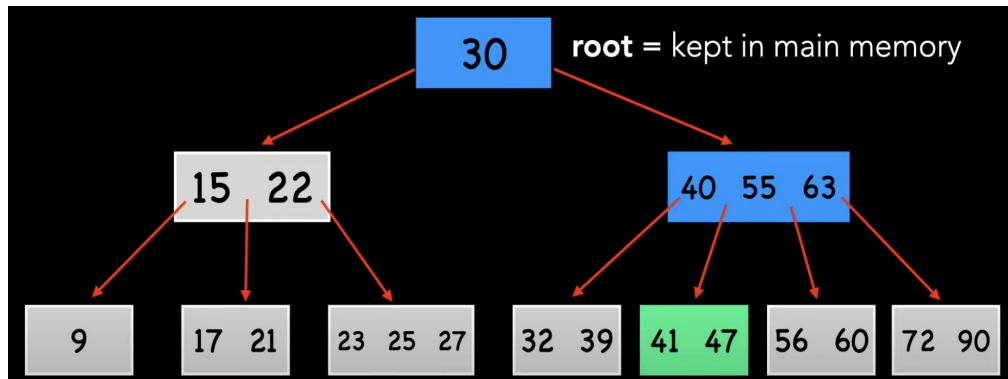


Practical Uses of Database Keys

Accelerating Query Time

What does adding a primary key actually do behind the hood?

- Uniqueness and Not Null Constraints
- B-tree Index Creation



B-tree Diagram

B-tree indexes speed up certain queries compared to having no index. Especially range searches, equality searches, and deletions.

Search, insert, and delete operations have an average time complexity of $O(\log(n))$



Practical Uses of Database Keys

Accelerating Query Time

Incident Table

	id integer 🔒	incident_datetime timestamp without time zone 🔒	report_datetime timestamp without time zone 🔒	longitude real 🔒	latitude real 🔒	report_type_code character varying (2) 🔒	incident_code integer 🔒	
1	1308653	2023-08-17 18:00:00	2023-08-17 23:01:00	-122.45338	37.71777	VI	7021	
2	1308649	2023-08-14 19:45:00	2023-08-17 22:44:00	-122.44111	37.774567	IS	75000	
3	1308644	2023-08-17 22:01:00	2023-08-17 22:01:00	-122.419014	37.752205	VS	71012	
4	1308641	2023-08-17 20:00:00	2023-08-17 22:51:00	-122.42056	37.806656	II	6243	
5	1308640	2023-08-17 19:00:00	2023-08-17 22:38:00	-122.41726	37.80707	II	71000	
6	1308638	2023-08-15 07:00:00	2023-08-17 22:32:00	-122.42197	37.732433	II	9029	
7	1308637	2023-08-17 19:45:00	2023-08-17 20:01:00	-122.41905	37.758633	II	64085	
8	1308636	2023-08-17 21:00:00	2023-08-17 22:11:00	-122.418785	37.80624	II	6244	
9	1308634	2023-07-17 14:00:00	2023-08-17 22:00:00	-122.40471	37.730316	IS	4011	
10	1308632	2023-08-16 23:30:00	2023-08-17 22:14:00	-122.39991	37.735287	VI	7021	
11	1308630	2023-08-17 16:27:00	2023-08-17 19:21:00	-122.406334	37.753002	II	6362	
Total rows: 1000 of 637442 Query complete 00:00:00.850								Ln 13, Col 28

Query	Query History
1	ALTER TABLE incident
2	DROP CONSTRAINT incident_pkey;
3	
4	SELECT *
5	FROM incident
6	WHERE id BETWEEN 621000 AND 622000
7	OR id BETWEEN 610100 AND 61300; -- 133ms
8	
9	ALTER TABLE incident
10	ADD CONSTRAINT incident_pkey PRIMARY KEY (id);
11	
12	SELECT *
13	FROM incident
14	WHERE id BETWEEN 621000 AND 622000
15	AND id BETWEEN 610100 AND 61300; -- 57ms



Practical Uses of Database Keys

Accelerating Query Time

```
SELECT *  
FROM incident  
JOIN incident_type ON incident.incident_code = incident_type.incident_code; -- 1.22s
```

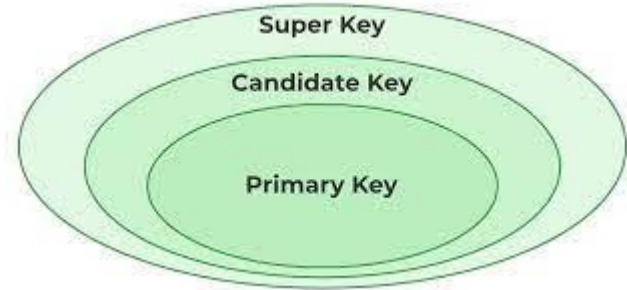
```
CREATE INDEX idx_incident_code ON incident(incident_code);
```

```
SELECT *  
FROM incident  
JOIN incident_type ON incident.incident_code = incident_type.incident_code; -- 0.833s
```



Keys to Uniqueness:

A Culinary Perspective on Super Keys, Candidate Keys, and Alternate Keys





Super Key:

The Recipe for Uniqueness

- Imagine a super key as a recipe that combines various ingredients to create a unique dish.
- Each ingredient in the recipe corresponds to an attribute in the super key. Some ingredients may be essential for uniqueness, while others may add flavor or nuance.
- Just like a recipe can have variations, a super key may contain extra attributes that contribute to uniqueness but are not strictly necessary.
- The recipe can be used to recreate the same dish, just as the super key can be used to uniquely identify rows in a database table.



Candidate Key:

The Signature Dish

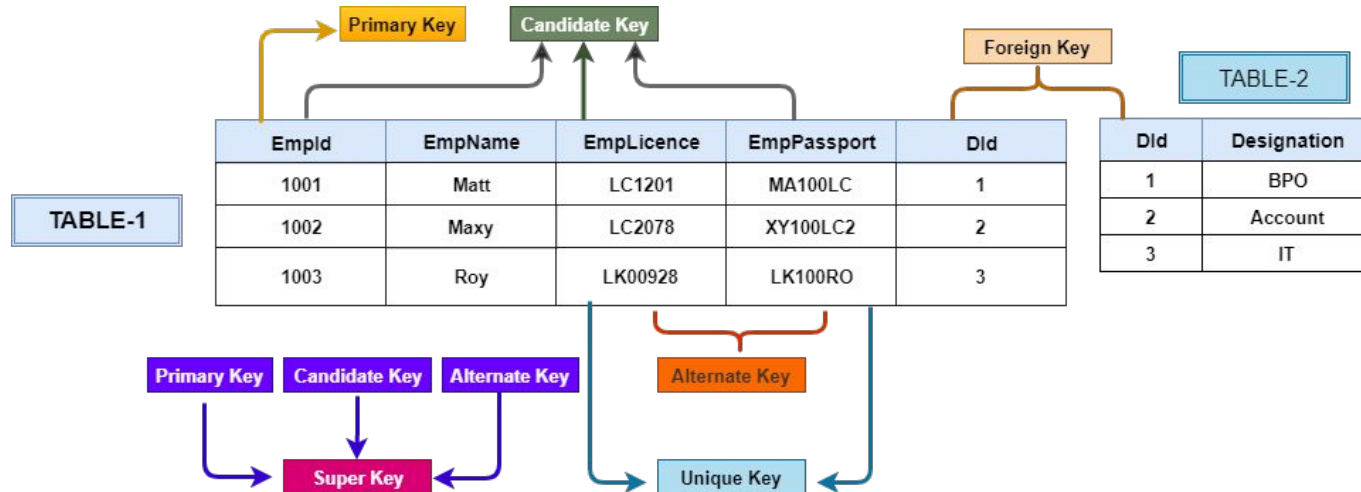
- A candidate key is like the signature dish of a renowned chef, known for its uniqueness and excellence.
- Just as a chef carefully selects the ingredients and preparation method for a signature dish, a candidate key is meticulously chosen to uniquely identify rows in a database table.
- While other dishes (attributes or keys) may also be exceptional, the signature dish (candidate key) stands out as the primary choice for identification.



Alternate Key:

The Seasonal Special

- Think of alternate keys as seasonal or occasional specials on a restaurant's menu.
- These specials are unique and can be used as an alternative to the signature dish (candidate key) but are not always available or the primary choice.
- Customers (database users) may occasionally order these specials (alternate keys) for specific purposes, but they are not the mainstay of the menu (primary key).





Evolution of Database Key Creation

Challenges with Manual Keys

1. Manual primary key assignment could lead to conflicts, data duplication, and human errors.
Examples from last code demo.
2. Scaling databases and ensuring data consistency became more challenging as applications grew in complexity.



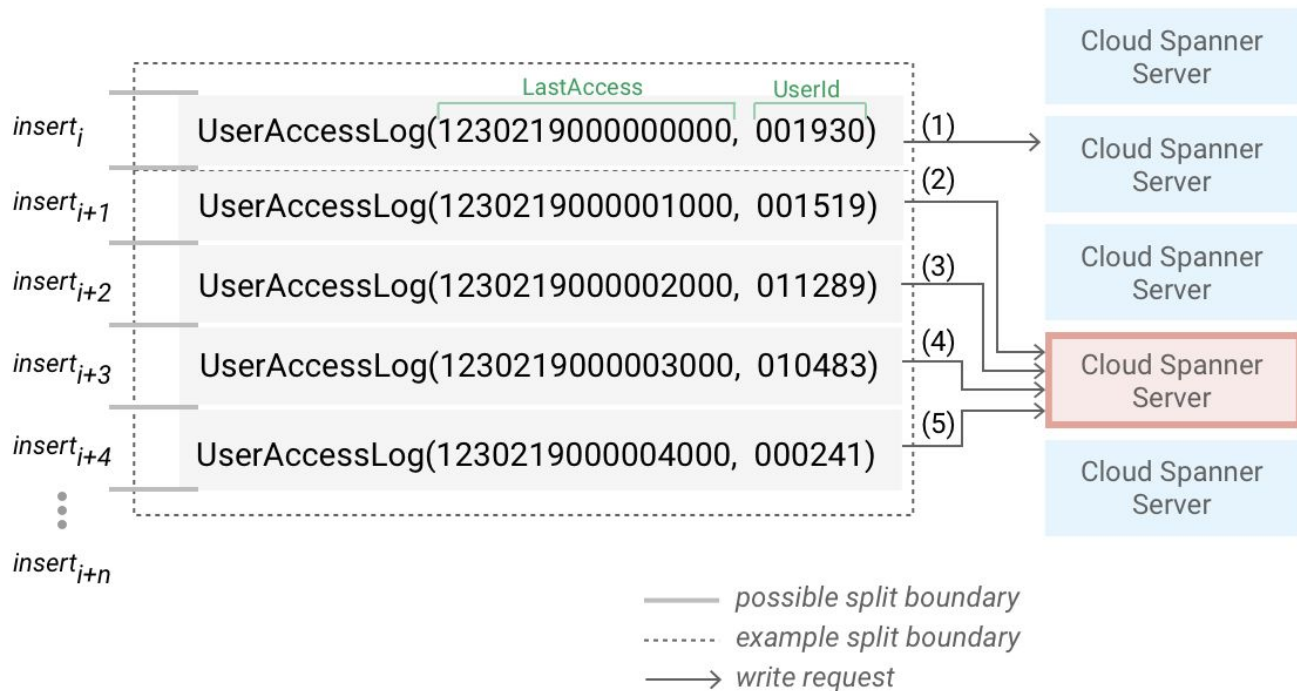
Autonomous Key Generation

Definition: automatic creation of primary keys by the database system or the application itself.

Benefits

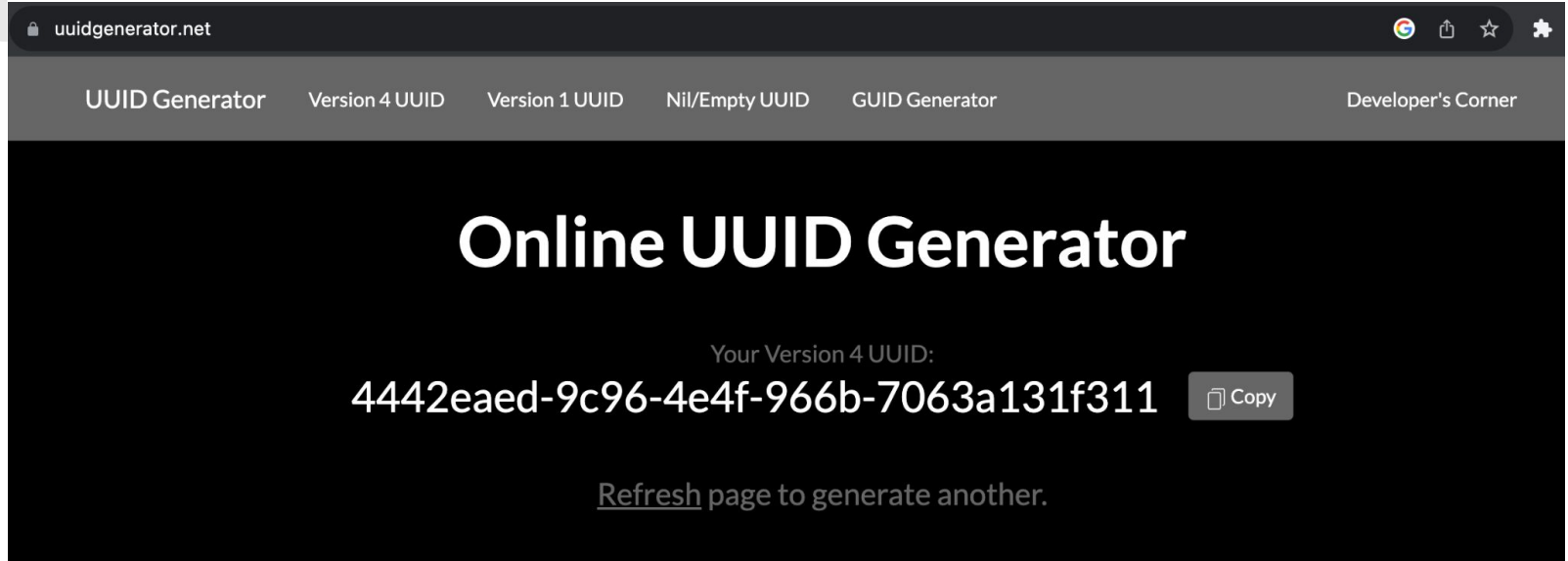
1. **Data Integrity:** ensures the uniqueness and integrity of primary keys, reducing the risk of data errors.
2. **Scalability:** As applications scale, autonomous key generation systems can handle the creation of millions of keys efficiently.
3. **Simplicity:** Developers can focus on application logic rather than managing key generation.

Choosing a Primary Key to prevent Hotspots



Be careful when choosing a primary key in the schema design to not accidentally create hotspots in your database. One cause of hotspots is having a column whose value monotonically changes as the first key part, because this results in all inserts occurring at the end of your key space. This pattern is undesirable because Spanner uses key ranges to divide data among servers, which means all your inserts are directed at a single server that ends up doing all the work.

Solution



The screenshot shows a web browser window with the address bar displaying 'uuidgenerator.net'. The page has a dark theme with a grey navigation bar at the top containing links: 'UUID Generator', 'Version 4 UUID', 'Version 1 UUID', 'Nil/Empty UUID', 'GUID Generator', and 'Developer's Corner'. The main content area is black and features the title 'Online UUID Generator' in large white text. Below the title, it says 'Your Version 4 UUID:' followed by the generated UUID '4442eaed-9c96-4e4f-966b-7063a131f311'. To the right of the UUID is a 'Copy' button with a document icon. At the bottom, there is a link that says 'Refresh page to generate another.'

uuidgenerator.net

UUID Generator Version 4 UUID Version 1 UUID Nil/Empty UUID GUID Generator Developer's Corner

Online UUID Generator

Your Version 4 UUID:

4442eaed-9c96-4e4f-966b-7063a131f311 [Copy](#)

[Refresh](#) page to generate another.

Version 1 UUID Generator

Version 4 UUID Generator

A Universally Unique Identifier (UUID) is a label used to uniquely identify a resource among all other resources of that type.