

第 10 章 索引的构建与使用

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```

--dms@ecu54e-rcpman-comple/openGauss server-U03
railway=# CREATE OR REPLACE FUNCTION gen_hanzi(INT) RETURNS TEXT AS $$
railway=# DECLARE
railway# res TEXT;
railway# BEGIN
IF $1 >= 1 THEN
SELECT string_agg(chr((9940+(random()*20901)::int)), '') INTO res
FROM generate_series(1,$1);
RETURN res;
END IF;railway# railway# railway# railway# railway#
railway# 25
RETURN NULL; END; $$ LANGUAGE plpgsql STRICT;railway#
ERROR: syntax error at or near "25"
LINE 10: 25

```

```

railway=# CREATE OR REPLACE FUNCTION gen_hanzi(INT) RETURNS TEXT AS $$
railway=# DECLARE
railway# res TEXT;
railway# BEGIN
IF $1 >= 1 THEN
SELECT string_agg(chr((9940+(random()*20901)::int)), '') INTO res
FROM generate_series(1,$1);
RETURN res;
END IF;railway# railway# railway# railway# railway#
railway# RETURN NULL;
railway# END;
railway# $$ LANGUAGE plpgsql STRICT;
CREATE FUNCTION
railway=# SELECT setseed(0);
--seeded
--
(1 row)

```

```

railway=# INSERT INTO users VALUES ('to_char(generate_series(100, 199)), to_char(random() * 100000000, '99999999'), gen_hanzi(3), to_char(1000000000 + random() * 1000000000, '999999999999'), CURRENT_DATE + floor(random() * 15)::int);
INSERT 0 100
railway=# SELECT * FROM users;

```

	u_id	u_passwd	u_name	u_idnum	u_regtime
100	17082020	警匪狙击	15773035064	2024-05-24 00:00:00	
101	6321245	李成茂	14405081961	2024-05-18 00:00:00	
102	73215163	陳延龍	14460301371	2024-05-21 00:00:00	
103	7383593	李國強	1458228023	2024-05-18 00:00:00	
104	56859542	鄭國文	12750509747	2024-05-16 00:00:00	
105	82659474	陳永強	10820304854	2024-05-27 00:00:00	
106	62857483	陳國強	15203334578	2024-05-24 00:00:00	
107	43064144	章秋松	11073508229	2024-05-24 00:00:00	
108	70536564	李成茂	14482826224	2024-05-26 00:00:00	
109	50281837	潘國強	15765506332	2024-05-22 00:00:00	
110	42542562	陳永強	11437760011	2024-05-19 00:00:00	
111	32486484	陳秋松	11012315419	2024-05-27 00:00:00	
112	48484868	李國強	14009180430	2024-05-23 00:00:00	
113	64586085	陳國強	18051645177	2024-05-21 00:00:00	
114	28235572	鄭秋松	13754361742	2024-05-26 00:00:00	
115	62859328	李國強	14213881383	2024-05-23 00:00:00	
116	74676273	陳國強	17035034804	2024-05-14 00:00:00	
117	63043603	李成茂	13284460687	2024-05-15 00:00:00	
118	15459219	鄭秋松	13171403090	2024-05-20 00:00:00	
119	43221146	李成茂	13582049493	2024-05-27 00:00:00	
120	93858757	李國強	14599933606	2024-05-25 00:00:00	
121	83214856	李國強	15794745151	2024-05-14 00:00:00	
122	38677474	陳國強	14884505440	2024-05-23 00:00:00	
123	56651080	鄭秋松	18802015724	2024-05-21 00:00:00	
124	22323211	陳國強	7703222025	2024-05-27 00:00:00	

[illegible]

[illegible]

执行 `SELECT a.* FROM pg_class c, pg_attribute a WHERE c.relname='usersidx' and c.oid = a.attrelid;`出现

```

railway=# \x
Expanded display is on.
railway=# SELECT a.* FROM pg_class c, pg_attribute a WHERE c.relname='usersidx' and c.oid = a.attrelid;
INFO:  ExecNestLoop: getting info from node
INFO:  ExecNestLoop: entering main loop
INFO:  ExecNestLoop: getting new outer tuple
INFO:  ExecNestLoop: saving new outer tuple information
INFO:  ExecNestLoop: rescanning inner plan
INFO:  ExecNestLoop: getting new inner tuple
INFO:  ExecNestLoop: testing qualification
The connection to the server was lost. Attempting reset: Failed.

```

对上次实验添加的代码进行注释后重新编译后解决

[illegible]


```

chao@ecs-54ts-1open-gauss-compute:open-gauss-server-3.0.0
railway=#
railway=#
railway=# EXPLAIN ANALYZE SELECT * FROM users WHERE u_name = '桃瓷嶺';
               QUERY PLAN
-----
Seq Scan on users  (cost=0.00..14.09 rows=2 width=220) (actual time=0.087..0.043 rows=1 loops=1)
  Filter: ((u_name)::text = '桃瓷嶺'::text)
  Rows Removed by Filter: 999
  Total runtime: 0.163 ms
(1 row)

railway=# CREATE INDEX usersidx ON users (u_name);
CREATE INDEX
railway=# EXPLAIN ANALYZE SELECT * FROM users WHERE u_name = '桃瓷嶺';
               QUERY PLAN
-----
Bitmap Heap Scan on users  (cost=4.29..12.76 rows=2 width=220) (actual time=0.191..0.192 rows=1 loops=1)
  Recheck Cond: ((u_name)::text = '桃瓷嶺'::text)
  Heap Blocks: exact=1
    => Bitmap Index Scan on usersidx  (cost=0.00..4.29 rows=2 width=0) (actual time=0.166..0.166 rows=1 loops=1)
      Index Cond: ((u_name)::text = '桃瓷嶺'::text)
  Total runtime: 0.405 ms
(1 row)

railway=# DROP TABLE users;
DROP TABLE
railway=# CREATE TABLE users
railway=# (
railway=# u_id varchar(20),u_passwd varchar(20),u_name varchar(10),u_idnum varchar(20),u_regtime timestamp);
CREATE TABLE
railway=# SELECT setseed(0);
setseed
-----
(1 row)

railway=# INSERT INTO users VALUES ( to_char(generate_series(100000, 199999)), to_char(random() * 100000000, '09999999'), gen_hanzi(3), to_char(10000000000 + random() * 10000000000, '099999999999'), CURRENT_DATE + floor(random() * 15)::int);
INSERT 0 100000
railway=# EXPLAIN ANALYZE SELECT * FROM users WHERE u_name = '桃瓷嶺';
               QUERY PLAN
-----
Seq Scan on users  (cost=0.00..1316.85 rows=153 width=220) (actual time=0.119..0.640 rows=1 loops=1)
  Filter: ((u_name)::text = '桃瓷嶺'::text)
  Rows Removed by Filter: 99999
  Total runtime: 0.638 ms
(1 row)

railway=# CREATE INDEX usersidx ON users (u_name);
CREATE INDEX
railway=# EXPLAIN ANALYZE SELECT * FROM users WHERE u_name = '桃瓷嶺';
               QUERY PLAN
-----
Bitmap Heap Scan on users  (cost=0.12..822.16 rows=500 width=220) (actual time=0.170..0.171 rows=1 loops=1)
  Recheck Cond: ((u_name)::text = '桃瓷嶺'::text)
  Heap Blocks: exact=1
    => Bitmap Index Scan on usersidx  (cost=0.00..12.00 rows=500 width=0) (actual time=0.158..0.158 rows=1 loops=1)
      Index Cond: ((u_name)::text = '桃瓷嶺'::text)
  Total runtime: 0.350 ms
(1 row)

railway=#

```

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                Index Cond: ((u_name)::text = '桃瓷嶺'::text)
Total runtime: 0.392 ms
(6 rows)

railway=# SELECT pg_size_pretty(pg_relation_size('usersidx')) AS size;
      size
-----
 3104 kB
(1 row)

railway=# SELECT pg_size_pretty(pg_relation_size('users')) AS size;
      size
-----
 7480 kB
(1 row)

railway=# DROP TABLE users;
DROP TABLE
railway=#

```

```
dblab@ecs-541a:~/opengauss-compile/opengauss-server-v3.0.0
make install_mysql_fdw
make[1]: Entering directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0'
make[1]: Nothing to be done for 'install_mysql_fdw'.
make[1]: Leaving directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0'
make install_oracle_fdw
make[1]: Entering directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0'
make[1]: Nothing to be done for 'install_oracle_fdw'.
make[1]: Leaving directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0'
make install_pldebugger
make[1]: Entering directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0'
make[1]: Nothing to be done for 'install_pldebugger'.
make[1]: Leaving directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0'
make -C contrib/postgres_fdw install
make[1]: Entering directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/contrib/postgres_fdw'
flock ../../src/common/interfaces/libpq/libpq.lock make -C ../../src/common/interfaces/libpq all
make[2]: Entering directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/src/common/interfaces/libpq'
make fe-wchar.cpp -C frontend_parser
make[3]: Entering directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/src/common/interfaces/libpq/frontend_parser'
make[3]: 'fe-wchar.cpp' is up to date.
make[3]: Leaving directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/src/common/interfaces/libpq/frontend_parser'
make all-lib
make[3]: Entering directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/src/common/interfaces/libpq'
make[3]: Nothing to be done for 'all-lib'.
make[3]: Leaving directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/src/common/interfaces/libpq'
make[2]: Leaving directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/src/common/interfaces/libpq'
/usr/bin/mkdir -p '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/lib/postgresql'
/usr/bin/mkdir -p '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/share/postgresql/extension'
/usr/bin/mkdir -p '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/share/postgresql/extension'
/bin/sh ../../config/install-sh -c -m 755 postgres_fdw.so '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/lib/postgresql/postgres_fdw.so'
/bin/sh ../../config/install-sh -c -m 644 ./postgres_fdw.control '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/share/postgresql/extension/'
/bin/sh ../../config/install-sh -c -m 644 ./postgres_fdw--1.0.sql '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/share/postgresql/extension/'
make[1]: Leaving directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/contrib/postgres_fdw'
make -C contrib/hstore install
make[1]: Entering directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/contrib/hstore'
/usr/bin/mkdir -p '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/lib/postgresql'
/usr/bin/mkdir -p '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/share/postgresql/extension'
/usr/bin/mkdir -p '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/share/postgresql/extension'
/bin/sh ../../config/install-sh -c -m 755 hstore.so '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/lib/postgresql/hstore.so'
/bin/sh ../../config/install-sh -c -m 644 ./hstore.control '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/share/postgresql/extension/'
/bin/sh ../../config/install-sh -c -m 644 ./hstore--1.1.sql ./hstore--1.0--1.1.sql ./hstore--unpacked-1.0.sql '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/dest/share/postgresql/extension/'
make[1]: Leaving directory '/home/dblab/opengauss-compile/opengauss-server-v3.0.0/contrib/hstore'
opengauss installation complete.
[dblab@ecs-541a opengauss-server-v3.0.0]$
```

```
dblab@ecs-541a:~/opengauss-compile/openGauss-server-v3.0.0
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 58 | [index] key = 螭距螭, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 45 | [index] key = 猓郅痧, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 93 | [index] key = 訕駢獎, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 23 | [index] key = 謁賴曜, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 1 | [index] key = 誓噤銀, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 57 | [index] key = 译男衡, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 21 | [index] key = 舒榭伺, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 51 | [index] key = 猓莞寶, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 16 | [index] key = 玢褊繼, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 79 | [index] key = 貶愬志, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 35 | [index] key = 鑊峒衰, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 99 | [index] key = 迷衰鏰, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 38 | [index] key = 酌筦欄, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 98 | [index] key = 鑢突鵬, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 87 | [index] key = 閑撿壞, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 86 | [index] key = 靈磨噴, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 54 | [index] key = 靈葦有, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 50 | [index] key = 荳蒴駝, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 85 | [index] key = 騾林歎, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 63 | [index] key = 骸丿槌, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 12 | [index] key = 鋪款潰, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 14 | [index] key = 鯨鰭路, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 89 | [index] key = 鮒皖輶, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 5 | [index] key = 鯨郢丿, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 15 | [index] key = 銅結燧, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 64 | [index] key = 驚倥楨, level = 0, blocknum
=
INFO: _bt_buildadd: [rel] blocknum = 0, offsetnum = 25 | [index] key = 麗蟪蛋, level = 0, blocknum
=
INFO: _bt_leafbuild: [# pages allocated] = 2[# pages written out] = 2
INFO: btbuild: [# of tuples seen in the relation] = 100 [# of tuples inserted into index] = 100
CREATE INDEX
railway=# ^C
railway=# █
```

1. **[rel] blocknum** 和 **offsetnum** 分别表示关系表的块号和该块内的偏移量。
2. **[index] key** 显示了索引的键值，这些键值是在索引构建过程中添加的。
3. **level** 显示了 btree 索引的层级，这里的 0 层可能表示这是叶节点。
4. **blocknum** 显示了索引条目所在的索引块号。

[illegible]