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PolarDB
PostgreSQL

PostgreSQL 数据库结构

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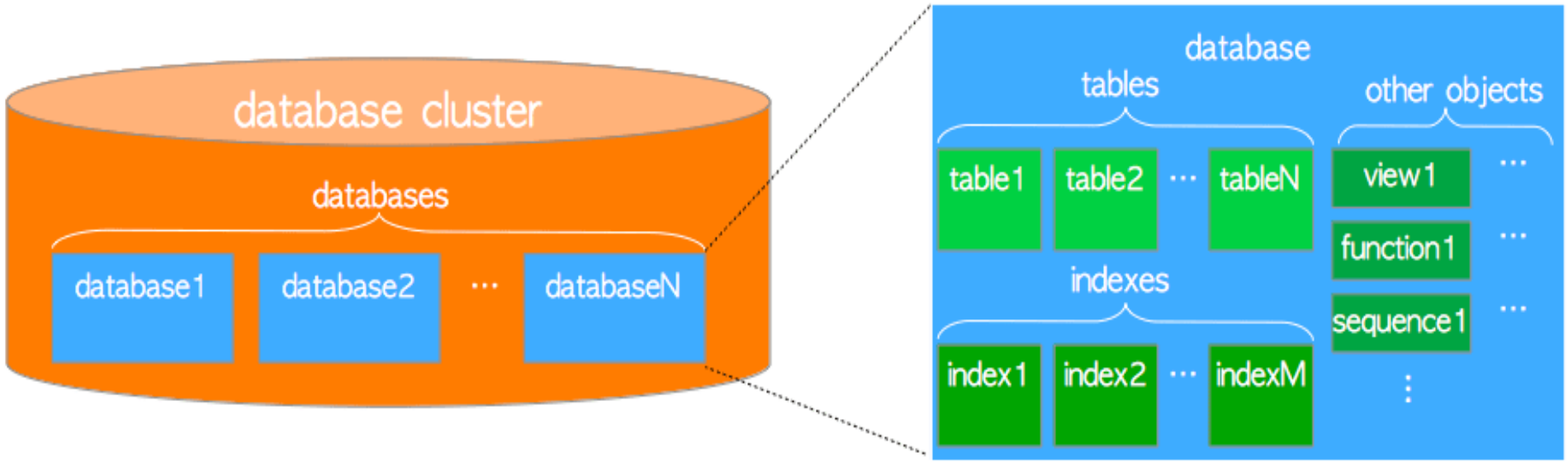
Objectives

- PostgreSQL数据库逻辑结构
- PostgreSQL数据库物理结构
- PostgreSQL表空间结构

数据库集簇逻辑结构

- 数据库集簇逻辑结构



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对象标识符

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PostgreSQL中的所有数据库对象都由各自的对象标识符（oid）在内部管理。

- 这些对象标识符是无符号的4字节整数。数据库对象和相应的oid之间的关系存储在适当的系统目录中，具体取决于对象的类型。
- 数据库的oid存储在pg_database中。
- 数据库的oid与对应的数据库目录名是一致的

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数据库集簇物理结构

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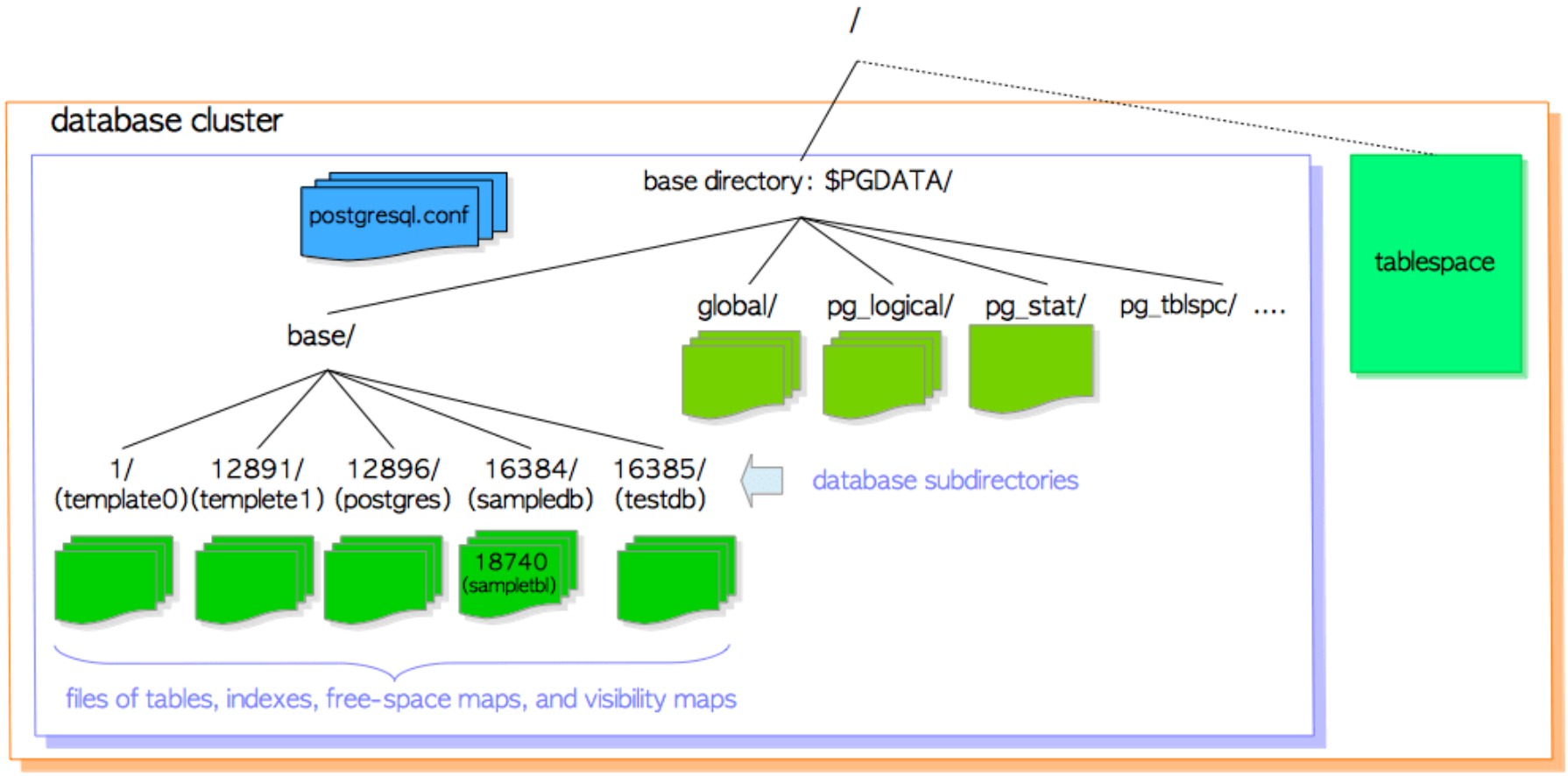

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数据库集簇物理结构

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每个数据库是base子目录下的子目录；数据库目录名与相应的oid相同。

例如，当数据库sampledb的OID为16384时，其子目录名为16384。

```
$ cd $PGDATA
$ ls -ld base/16384
drwx------ 213 postgres postgres 7242 8 26 16:33 16384
```

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其它目录结构

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数据库集群的布局的主要文件和子目录如下所示：

files	description
PG_VERSION	A file containing the major version number of PostgreSQL
pg_hba.conf	A file to control PosgreSQL's client authentication
pg_ident.conf	A file to control PostgreSQL's user name mapping
postgresql.conf	A file to set configuration parameters
postgresql.auto.conf	A file used for storing configuration parameters that are set in ALTER SYSTEM (version 9.4 or later)
postmaster.opts	A file recording the command line options the server was last started with

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其它目录结构

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subdirectories	description
base/	Subdirectory containing per-database subdirectories.
global/	Subdirectory containing cluster-wide tables, such as pg_database and pg_control.
pg_commit_ts/	Subdirectory containing transaction commit timestamp data. Version 9.5 or later.
pg_clog/ (Version 9.6 or earlier)	Subdirectory containing transaction commit state data. It is renamed to pg_xact in Version 10.
pg_dynshmem/	Subdirectory containing files used by the dynamic shared memory subsystem. Version 9.4 or later.
pg_logical/	Subdirectory containing status data for logical decoding. Version 9.4 or later.
pg_multixact/	Subdirectory containing multitransaction status data (used for shared row locks)
pg_notify/	Subdirectory containing LISTEN/NOTIFY status data
pg_repslot/	Subdirectory containing replication slot data. Version 9.4 or later.
pg_serial/	Subdirectory containing information about committed serializable transactions (version 9.1 or later)
pg_snapshots/	Subdirectory containing exported snapshots (version 9.2 or later). The PostgreSQL's function pg_export_snapshot creates a snapshot information file in this subdirectory.

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其它目录结构

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subdirectories	description
pg_stat/	Subdirectory containing permanent files for the statistics subsystem.
pg_stat_tmp/	Subdirectory containing temporary files for the statistics subsystem.
pg_subtrans/	Subdirectory containing subtransaction status data
pg_tblspc/	Subdirectory containing symbolic links to tablespaces
pg_twophase/	Subdirectory containing state files for prepared transactions
pg_wal/ (Version 10 or later)	Subdirectory containing WAL (Write Ahead Logging) segment files. It is renamed from pg_xlog in Version 10.
pg_xact/ (Version 10 or later)	Subdirectory containing transaction commit state data. It is renamed from pg_clog in Version 10.
pg_xlog/ (Version 9.6 or earlier)	Subdirectory containing WAL (Write Ahead Logging) segment files. It is renamed to pg_wal in Version 10

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Tablespaces

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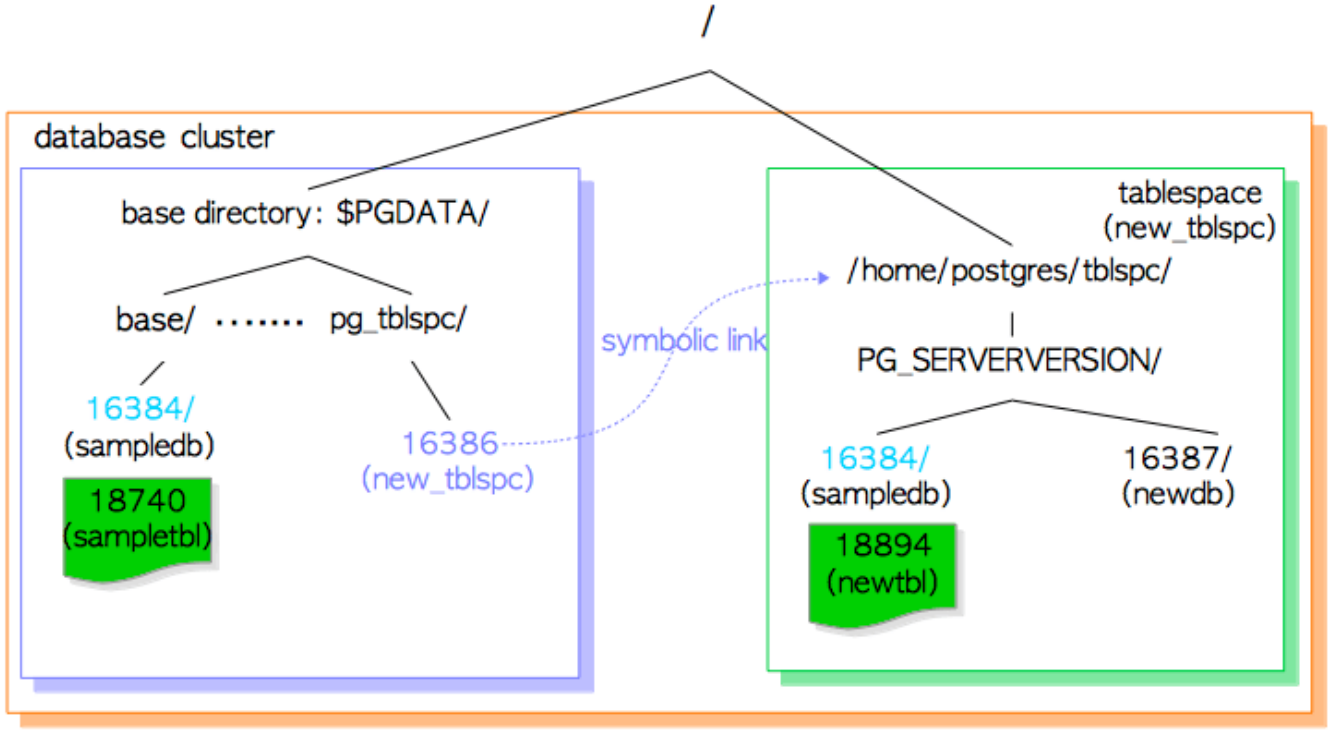
- PostgreSQL中的表空间是基本目录之外的附加数据区域，此功能已在版本8.0中实现。
- 初始化数据库后默认的表空间有pg_default、pg_global。
- pg_global表空间的物理文件位置在数据目录的global目录中，它用来保存系统表。
- pg_default表空间的物理文件位置在数据目录的base子目录中，是template0和template1数据库的默认表空间。
- 创建数据库时，默认从template1数据库进行克隆，因此除非特别指定了新建数据库的表空间，否则默认使用template1使用的表空间，即pg_default表空间。

Tablespaces

PostgreSQL表空间物理文件位置



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Tablespaces

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创建表空间时产生的目录命名规则：

```
PG _ 'Major version' _ 'Catalogue version number'
```

例如：

```
sampledb=# create tablespace new_tblspc location '/home/postgres/tblspc';

$ ls -l /home/postgres/tblspc/
total 4
drwx------ 4 postgres postgres  PG_12_201909212
```

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Tablespaces

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新建表空间的目录由pg_tblspc子目录中的软链接寻址，链接名与表空间的OID值相同。

```
postgres=# select oid,spcname from pg_tablespace;
  oid  |  spcname
-------+------------
  1663 | pg_default
  1664 | pg_global
 90208 | new_tblspc
(3 rows)

$ ls -l $PGDATA/pg_tblspc/
total 0
lrwxrwxrwx. 1 postgres postgres  90208 -> /home/postgres/tblspc
```

Tablespaces

- 创建数据库时指定表空间，那么它的目录将在表空间特定的子目录下创建：

```
testdb=# create database newdb tablespace new_tblspc;
```

- 初建表时指定表空间：

```
testdb=# create table test1 (id int) tablespace new_tblspc;

testdb=# SELECT pg_relation_filepath('test1');
         pg_relation_filepath
----------------------------------------
 pg_tblspc/90208/PG_12_201909212/16385/90210   #在新表空间目录下创建数据库目录
```

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总结

- PostgreSQL数据库逻辑结构
- PostgreSQL数据库物理结构
- PostgreSQL表空间结构

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练习

- 1、创建一个表空间, 创建一个表放到这个表空间, 写入测试数据, 并使用pg_relation_filepath观察这个表的数据文件存放路径, 尝试解读这个路径中的目录结构.

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