Федеральное государственное бюджетное
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«НОВОСИБИРСКИЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ»

НГТУ НЭТИ | **Факультет прикладной математики и информатики**

Кафедра теоретической и прикладной информатики

Лабораторная работа № 4

по дисциплине «Администрирование информационных систем»

РЕЗЕРВНОЕ КОПИРОВАНИЕ И ВОССТАНОВЛЕНИЕ

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1 Развернуть резервный кластер

Для этого, под пользователем postgres создадим каталог данных

sudo -Hiu postgres mkdir /var/lib/pgpro/std-14-sec

sudo -Hiu postgres initdb -D /var/lib/pgpro/std-14-sec/data

```
[dba@centos-7 ~]$ sudo -Hiu postgres mkdir /var/lib/pgpro/std-14-sec
[sudo] password for dba:
[dba@centos-7 ~]$ sudo -Hiu postgres initdb -D /var/lib/pgpro/std-14-sec/data
The files belonging to this database system will be owned by user "postgres".
This user must also own the server process.

The database cluster will be initialized with locale "en_US.UTF-8".
The default collation provider is "icu".
The default database encoding has accordingly been set to "UTF8".
The default text search configuration will be set to "english".

Data page checksums are enabled.

creating directory /var/lib/pgpro/std-14-sec/data ... ok
creating subdirectories ... ok
selecting dynamic shared memory implementation ... posix
selecting default max_connections ... 100
selecting default shared_buffers ... 128MB
selecting default time zone ... Asia/Novosibirsk
creating configuration files ... ok
running bootstrap script ... ok
performing post-bootstrap initialization ... ok
syncing data to disk ... ok

initdb: warning: enabling "trust" authentication for local connections
You can change this by editing pg_hba.conf or using the option -A, or
--auth-local and --auth-host, the next time you run initdb.

Success. You can now start the database server using:

    /opt/pgpro/std-14/bin/pg_ctl -D /var/lib/pgpro/std-14-sec/data -l logfile st
art
```

Изменить конфигурационный параметр порта прослушивания в файле postgres.conf

sudo vi /var/lib/pgpro/std-14-sec/data/postgresql.conf

```
#------------------------------------------------------------------------------
# CONNECTIONS AND AUTHENTICATION
#------------------------------------------------------------------------------

# - Connection Settings -

#listen_addresses = 'localhost'          # what IP address(es) to listen on;
                                         # comma-separated list of addresses;
                                         # defaults to 'localhost'; use '*' for all
                                         # (change requires restart)
port = 5433                              # (change requires restart)
max_connections = 100                    # (change requires restart)
#superuser_reserved_connections = 3      # (change requires restart)
#unix_socket_directories = '/tmp'        # comma-separated list of directories
                                         # (change requires restart)
#unix_socket_group = ''                  # (change requires restart)
#unix_socket_permissions = 0777          # begin with 0 to use octal notation
                                         # (change requires restart)
#bonjour = off                           # advertise server via Bonjour
                                         # (change requires restart)
```

sudo -Hiu postgres /opt/pgpro/std-11/bin/pg_ctl -D /var/lib/pgpro/std-11-sec/data -l logfile start

```
[dba@centos-7 ~]$ sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_ctl -D /var/lib/pgpro/std-14-sec/data -l logfile start
waiting for server to start.... done
server started
```

Создать суперпользователя:

sudo -Hiu postgres createuser -sP dba -p 5433

```
[dba@centos-7 ~]$ sudo -Hiu postgres createuser -sP dba -p 5433
Enter password for new role:
Enter it again:
```

Подключиться к этой службе из pgAdmin

2 Логическое копирование и восстановление

Уничтожить ранее созданную в отдельном табличном пространстве таблицу.

DROP TABLE shema_1.bookings_2;

Уничтожить табличное пространство, созданное в ЛР №2

DROP TABLESPACE tablespace_1;

```
demo=# DROP TABLE shema_1.bookings_2;
DROP TABLE
demo=# DROP TABLESPACE tablespace_1;
DROP TABLESPACE
```

Сделать с помощью pg_dump копию б.д. demo.

Формат копирования: D

sudo -Hiu postgres pg_dump -Fd demo -f demodump

sudo -Hiu postgres ls -lh demodump

```
[dba@centos-7 ~]$ sudo -Hiu postgres pg_dump -Fd demo -f demodump
[sudo] password for dba:
[dba@centos-7 ~]$ ls -lh demodump
ls: cannot access demodump: No such file or directory
[dba@centos-7 ~]$ ^C
[dba@centos-7 ~]$ sudo -Hiu postgres ls -lh demodump
total 22M
-rw-r--r--. 1 postgres postgres  174 Mar 22 09:58 4140.dat.gz
-rw-r--r--. 1 postgres postgres 3.1K Mar 22 09:58 4141.dat.gz
-rw-r--r--. 1 postgres postgres 3.9M Mar 22 09:58 4142.dat.gz
-rw-r--r--. 1 postgres postgres 2.4M Mar 22 09:58 4143.dat.gz
-rw-r--r--. 1 postgres postgres 439K Mar 22 09:58 4144.dat.gz
-rw-r--r--. 1 postgres postgres 3.0K Mar 22 09:58 4147.dat.gz
-rw-r--r--. 1 postgres postgres 3.7M Mar 22 09:58 4148.dat.gz
-rw-r--r--. 1 postgres postgres  11M Mar 22 09:58 4149.dat.gz
-rw-r--r--. 1 postgres postgres  38K Mar 22 09:58 toc.dat
```

Создадим базу demo на резервном кластере:

createdb -h localhost -p 5433 -U postgres demo_restore

Восстановить с помощью pg_restore на резервном кластере.

sudo -Hiu postgres pg_restore -p 5433 -d demo_restore demodump
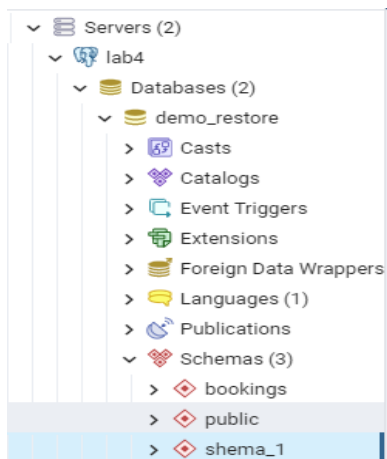
3 Настройка архивации журналов и резервное копирование.

Включить архивацию журналов. Архивы сегментов размещать в подкаталоге домашнего каталога. Убедиться, что у пользователя postgres будут права записи в него.

Создадим директорию segments, в которую будут помещаться архивы.

sudo mkdir segments

sudo chown postgres:postgres segments

sudo chmod ugo+rwx segments

```
[dba@centos-7 home]$ ls -la
total 0
drwxr-xr-x.  4 root      root       33 Mar 22 10:57 .
dr-xr-xr-x. 17 root      root      224 Oct 20  2020 ..
drwxrwxrwx.  6 dba       dba       257 Mar 22 10:56 dba
drwxrwxrwx.  2 postgres postgres    6 Mar 22 10:57 segments
```

Чтобы включить архивирование WAL, установим в параметре конфигурации wal_level уровень replica, в archive_mode — значение on, и зададимим желаемую команду оболочки в параметре archive_command.

ALTER SYSTEM SET wal_level = replica;

ALTER SYSTEM SET archive_mode=on;

```
demo=# ALTER SYSTEM SET wal_level = replica;
ALTER SYSTEM
demo=# ALTER SYSTEM SET archive_mode=on;
ALTER SYSTEM
```

ALTER SYSTEM SET archive_command = 'test ! -f /home/dba/segments/%f && cp %p /home/dba/segments/%f';

```
demo=# ALTER SYSTEM SET archive_command = 'test ! -f /home/dba/segments/%f && cp %p /home/dba/segments/%f';
ALTER SYSTEM
```

systemctl restart postgrespro-std-14

```
[dba@centos-7 ~]$ systemctl restart postgrespro-std-14
==== AUTHENTICATING FOR org.freedesktop.systemd1.manage-units ===
Authentication is required to manage system services or units.
Authenticating as: dba
Password:
==== AUTHENTICATION COMPLETE ===
[dba@centos-7 ~]$ psql demo
psql (14.1)
Type "help" for help.

demo=# show wal_level;
 wal_level
-----------
 replica
(1 row)

demo=# show archive_mode;
 archive_mode
--------------
 on
(1 row)

demo=# show archive_command;
                        archive_command
-----------------------------------------------------------------
 test ! -f /home/dba/segments/%f && cp %p /home/dba/segments/%f
(1 row)
```

Выполнить сценарии модификации таблиц, аналогичные ЛР №3

```python
import psycopg2
from time import sleep
conn = psycopg2.connect("dbname='demo_restore' user='dba' host='127.0.0.1' port='5433'
password='sladkiyKot'")
cur = conn.cursor()
cur.execute("""select a.*
        from bookings.tickets a
        order by a.ticket_no
        limit 10""")
rows = cur.fetchall()
for i in rows:
 cur.execute("""update bookings.tickets
        set passenger_name = 'PYTHON SCRIPT'
        where ticket_no = %s""", (i[0],))
 sleep(4)
 conn.commit()
```

for i in {1..5}; do echo -n "Python program $i start";python3 lab3.py & done

```
[dba@centos-7 ~]$ for i in {1..5}; do echo -n "Python program $i start";python3 lab3.py & done
Python program 1 start[1] 26408
Python program 2 start[2] 26409
Python program 3 start[3] 26410
Python program 4 start[4] 26411
Python program 5 start[5] 26412
[dba@centos-7 ~]$ ps
  PID TTY          TIME CMD
22797 pts/0    00:00:00 bash
26408 pts/0    00:00:00 python3
26409 pts/0    00:00:00 python3
26410 pts/0    00:00:00 python3
26411 pts/0    00:00:00 python3
26412 pts/0    00:00:00 python3
26426 pts/0    00:00:00 ps
[dba@centos-7 ~]$ ps
  PID TTY          TIME CMD
22797 pts/0    00:00:00 bash
26496 pts/0    00:00:00 ps
[1]   Done                    python3 lab3.py
[2]   Done                    python3 lab3.py
[3]   Done                    python3 lab3.py
[4]-  Done                    python3 lab3.py
[5]+  Done                    python3 lab3.py
```

После этого проверить наличие архивных сегментов в созданном каталоге.

```
[dba@centos-7 segments]$ ls -la
total 32768
drwxrwxrwx. 2 postgres postgres       70 Mar 22 11:03 .
drwxrwxrwx. 6 dba      dba           257 Mar 22 10:56 ..
-rw-------. 1 postgres postgres 16777216 Mar 22 11:00 000000010000000000000012
-rw-------. 1 postgres postgres 16777216 Mar 22 11:03 000000010000000000000013
```

Выполнить горячую резервную копию используя pg_basebackup.

pg_basebackup -h localhost -p 5433 -D backup

Сравнить объем полученной резервной копии с объемом каталога данных кластера.

du -sh backup

sudo du -sh /var/lib/pgpro/std-14/data

```
[dba@centos-7 ~]$ du -sh backup
324M    backup
[dba@centos-7 ~]$ du -sh /var/lib/pgpro/std-14/data
du: cannot access '/var/lib/pgpro/std-14/data': Permission denied
[dba@centos-7 ~]$ sudo du -sh /var/lib/pgpro/std-14/data
533M    /var/lib/pgpro/std-14/data
```

4 Резервное копирование и восстановление с использованием pg_probackup

Установить pg_probackup

sudo yum install postgrespro-std-14-pgprobackup.x86_64

sudo yum install pg-probackup-std-14

sudo /opt/pgpro/std-14/bin/pg_probackup version

```
[dba@centos-7 ~]$ sudo /opt/pgpro/std-14/bin/pg_probackup version
pg_probackup 2.5.5 (Postgres Pro 14.2.1 standard)
```

Создать пользователя в postgres для работы в pg_probackup.

CREATE ROLE backup WITH LOGIN;

GRANT USAGE ON SCHEMA pg_catalog TO backup;

GRANT EXECUTE ON FUNCTION current_setting(text) TO backup;

GRANT EXECUTE ON FUNCTION pg_is_in_recovery() TO backup;

GRANT EXECUTE ON FUNCTION pg_start_backup(text, boolean, boolean) TO backup;

GRANT EXECUTE ON FUNCTION pg_stop_backup() TO backup;

GRANT EXECUTE ON FUNCTION pg_stop_backup(boolean, boolean) TO backup;

GRANT EXECUTE ON FUNCTION pg_create_restore_point(text) TO backup;

GRANT EXECUTE ON FUNCTION pg_switch_wal() TO backup;

GRANT EXECUTE ON FUNCTION txid_current() TO backup;

GRANT EXECUTE ON FUNCTION txid_current_snapshot() TO backup;

GRANT EXECUTE ON FUNCTION txid_snapshot_xmax(txid_snapshot) TO backup;

ALTER ROLE backup WITH REPLICATION;

```
demo=# CREATE ROLE backup WITH LOGIN;
CREATE ROLE
demo=# GRANT USAGE ON SCHEMA pg_catalog TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION current_setting(text) TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION pg_is_in_recovery() TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION pg_start_backup(text, boolean, boolean) TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION pg_stop_backup() TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION pg_stop_backup(boolean, boolean) TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION pg_create_restore_point(text) TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION pg_switch_wal() TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION txid_current() TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION txid_current_snapshot() TO backup;
GRANT
demo=# GRANT EXECUTE ON FUNCTION txid_snapshot_xmax(txid_snapshot) TO backup;
GRANT
demo=# ALTER ROLE backup WITH REPLICATION;
ALTER ROLE
```

Создать каталог копий.

mkdir backup_lab4

sudo chown postgres:postgres backup_lab4

Выполнить полную резервную копию. Получить ее размер, сравнить с размером резервной копии полученной pg_basebackup.

sudo /opt/pgpro/std-14/bin/pg_probackup init -B /home/backup_lab4

mkdir backups

mkdir wal

sudo chown postgres:postgres backups

sudo chown postgres:postgres wal

sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_probackup add-instance -B /home/dba/backup_lab4 -D /var/lib/pgpro/std-14/data --instance backup

sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_probackup backup -B /home/dba/backup_lab4 --instance backup -b full –stream

```
[dba@centos-7 backup_lab4]$ sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_probackup backup -B /home/dba/backup_lab4 --instance backup -b full --stream
INFO: Backup start, pg_probackup version: 2.5.5, instance: backup, backup ID: R94RGE, backup mode: FULL, wal mode: STREAM, remote: false, compress-algorithm: none, comp
ress-level: 1
WARNING: Current PostgreSQL role is superuser. It is not recommended to run pg_probackup under superuser.
INFO: wait for pg_start_backup()
INFO: Wait for WAL segment /home/dba/backup_lab4/backups/backup/R94RGE/database/pg_wal/000000010000000000000015 to be streamed
INFO: PGDATA size: 307MB
INFO: Start transferring data files
INFO: Data files are transferred, time elapsed: 7s
INFO: wait for pg_stop_backup()
INFO: pg_stop backup() successfully executed
INFO: Syncing backup files to disk
INFO: Backup files are synced, time elapsed: 0
INFO: Validating backup R94RGE
INFO: Backup R94RGE data files are valid
INFO: Backup R94RGE resident size: 324MB
INFO: Backup R94RGE completed
```

Pg_basebackup = 324 Mb

Pg_probacku = 324 Mb

Произвести изменения в данных, аналогичные п.3.

```
[dba@centos-7 ~]$ for i in {1..5}; do echo -n "Python program $i start";python3 lab3.py & done
Python program 1 start[1] 29560
Python program 2 start[2] 29561
Python program 3 start[3] 29562
Python program 4 start[4] 29563
Python program 5 start[5] 29564
[dba@centos-7 ~]$ ps
  PID TTY          TIME CMD
22797 pts/0    00:00:00 bash
26870 pts/0    00:00:01 bash
29560 pts/0    00:00:00 python3
29561 pts/0    00:00:00 python3
29562 pts/0    00:00:00 python3
29563 pts/0    00:00:00 python3
29564 pts/0    00:00:00 python3
29572 pts/0    00:00:00 ps
[dba@centos-7 ~]$ ps
  PID TTY          TIME CMD
22797 pts/0    00:00:00 bash
26870 pts/0    00:00:01 bash
29576 pts/0    00:00:00 ps
[1]   Done                    python3 lab3.py
[2]   Done                    python3 lab3.py
[3]   Done                    python3 lab3.py
[4]-  Done                    python3 lab3.py
[5]+  Done                    python3 lab3.py
```

Выполнить инкрементную копию. Получить ее размер.

sudo   -Hiu   postgres   /opt/pgpro/std-14/bin/pg_probackup   backup   -B

/home/dba/backup_lab4 --instance backup -b delta --stream

```
[dba@centos-7 ~]$ sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_probackup backup -B /home/dba/backup_lab4 --instance backup -b delta --stream
[sudo] password for dba:
INFO: Backup start, pg_probackup version: 2.5.5, instance: backup, backup ID: R94RXB, backup mode: DELTA, wal mode: STREAM, remote: false, compress-algorithm: none, com
press-level: 1
WARNING: Current PostgreSQL role is superuser. It is not recommended to run pg_probackup under superuser.
INFO: wait for pg_start_backup()
INFO: Parent backup: R94RGE
INFO: Wait for WAL segment /home/dba/backup_lab4/backups/backup/R94RXB/database/pg_wal/000000010000000000000017 to be streamed
INFO: PGDATA size: 307MB
INFO: Start transferring data files
INFO: Data files are transferred, time elapsed: 6s
INFO: wait for pg_stop_backup()
INFO: pg_stop backup() successfully executed
INFO: Syncing backup files to disk
INFO: Backup files are synced, time elapsed: 0
INFO: Validating backup R94RXB
INFO: Backup R94RXB data files are valid
INFO: Backup R94RXB resident size: 16MB
INFO: Backup R94RXB completed
```

Размер копии 16 Мб

Повторно произвести изменения данных

```
[dba@centos-7 ~]$ for i in {1..5}; do echo -n "Python program $i start";python3 lab3.py & done
Python program 1 start[1] 29677
Python program 2 start[2] 29678
Python program 3 start[3] 29679
Python program 4 start[4] 29680
Python program 5 start[5] 29681
[dba@centos-7 ~]$ ps
  PID TTY          TIME CMD
22797 pts/0    00:00:00 bash
26870 pts/0    00:00:01 bash
29714 pts/0    00:00:00 ps
[1]   Done                    python3 lab3.py
[2]   Done                    python3 lab3.py
[3]   Done                    python3 lab3.py
[4]-  Done                    python3 lab3.py
[5]+  Done                    python3 lab3.py
```

выполнить инкрементную копию.

```
[dba@centos-7 ~]$ sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_probackup backup -B /home/dba/backup_lab4 --instance backup -b delta --stream
INFO: Backup start, pg_probackup version: 2.5.5, instance: backup, backup ID: R94SDZ, backup mode: DELTA, wal mode: STREAM, remote: false, compress-algorithm: none, com
press-level: 1
WARNING: Current PostgreSQL role is superuser. It is not recommended to run pg_probackup under superuser.
INFO: wait for pg_start_backup()
INFO: Parent backup: R94SDD
INFO: Wait for WAL segment /home/dba/backup_lab4/backups/backup/R94SDZ/database/pg_wal/000000010000000000000024 to be streamed
INFO: PGDATA size: 307MB
INFO: Start transferring data files
INFO: Data files are transferred, time elapsed: 1s
INFO: wait for pg_stop_backup()
INFO: pg_stop backup() successfully executed
INFO: Syncing backup files to disk
INFO: Backup files are synced, time elapsed: 0
INFO: Validating backup R94SDZ
INFO: Backup R94SDZ data files are valid
INFO: Backup R94SDZ resident size: 32MB
INFO: Backup R94SDZ completed
```

32 Мб

Склеить последнюю инкрементную копию с полной.

sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_probackup merge -B /home/dba/backup_lab4 --instance backup -i R94SDZ

```
[dba@centos-7 ~]$ sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_probackup merge -B /home/dba/backup_lab4 --instance backup -i R94SDZ
INFO: Merge started
INFO: Merging backup R94SDZ with parent chain
INFO: Validate parent chain for backup R94SDZ
INFO: Validating backup R94RGE
INFO: Backup R94RGE data files are valid
INFO: Validating backup R94RXB
INFO: Backup R94RXB data files are valid
INFO: Validating backup R94SDD
INFO: Backup R94SDD data files are valid
INFO: Validating backup R94SDZ
INFO: Backup R94SDZ data files are valid
INFO: Start merging backup files
INFO: Backup files are successfully merged, time elapsed: 1s
INFO: Delete: R94RXB 2022-03-22 12:15:18+07
INFO: Delete: R94SDD 2022-03-22 12:24:52+07
INFO: Delete: R94SDZ 2022-03-22 12:25:13+07
INFO: Rename merged full backup R94RGE to R94SDZ
INFO: Validating backup R94SDZ
INFO: Backup R94SDZ data files are valid
INFO: Merge of backup R94SDZ completed
```

Восстановить на втором кластере полученную копию на втором кластере.

Удалим данные второго кластера.

sudo rm -rf /var/lib/pgpro/std-14-sec/data

sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_probackup restore -D /var/lib/pgpro/std-14-sec/data -B /home/dba/backup_lab4 --instance backup
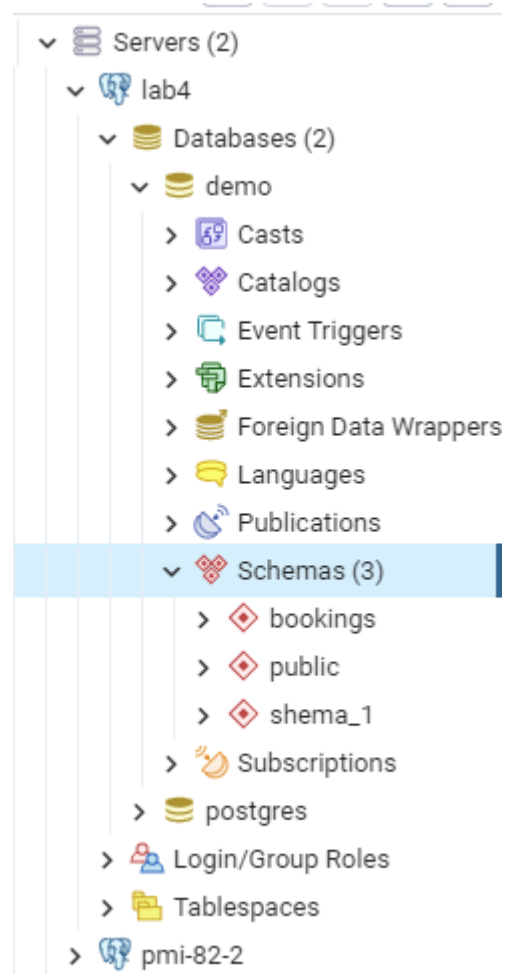
```
[dba@centos-7 ~]$ sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_probackup restore -D /var/lib/pgpro/std-14-sec/data -B /home/dba/backup_lab4 --instance backup
INFO: Validating backup R94SDZ
INFO: Backup R94SDZ data files are valid
INFO: Backup R94SDZ WAL segments are valid
INFO: Backup R94SDZ is valid.
INFO: Restoring the database from backup at 2022-03-22 12:25:11+07
INFO: Start restoring backup files. PGDATA size: 339MB
INFO: Backup files are restored. Transfered bytes: 339MB, time elapsed: 2s
INFO: Restore incremental ratio (less is better): 100% (339MB/339MB)
INFO: Syncing restored files to disk
INFO: Restored backup files are synced, time elapsed: 0
INFO: Restore of backup R94SDZ completed.
```

```
∨ ⊟ Servers (2)
  ∨ ⊟ˣ lab4
    > 🐘 pmi-82-2
```
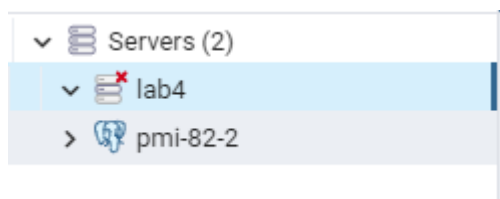
Так как мы восстановили основной кластер, то необходимо поменять порт на 5433.

sudo vi /var/lib/pgpro/std-14-sec/data/postgresql.conf

```
sudo -Hiu postgres /opt/pgpro/std-14/bin/pg_ctl -D /var/lib/pgpro/std-14-sec/data -l logfile start
```


5