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образования  
**«НАЦИОНАЛЬНЫЙ ИССЛЕДОВАТЕЛЬСКИЙ УНИВЕРСИТЕТ ИТМО»**

## **ОТЧЕТ**

по практической работе  
**«HA Postgres Cluster»**

по дисциплине **«Администрирование компьютерных сетей»**

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Санкт-Петербург 2025г.

## Установил docker на виртуальную машину:

```
Preparing to unpack .../4-docker-ce_5%3a27.5.1-1~ubuntu.24.04~noble_amd64.deb ...
Unpacking docker-ce (5:27.5.1-1~ubuntu.24.04~noble) ...
Selecting previously unselected package docker-ce-rootless-extras.
Preparing to unpack .../5-docker-ce-rootless-extras_5%3a27.5.1-1~ubuntu.24.04~noble_amd64.deb ...
Unpacking docker-ce-rootless-extras (5:27.5.1-1~ubuntu.24.04~noble) ...
Selecting previously unselected package docker-compose-plugin.
Preparing to unpack .../6-docker-compose-plugin_2.32.4-1~ubuntu.24.04~noble_amd64.deb ...
Unpacking docker-compose-plugin (2.32.4-1~ubuntu.24.04~noble) ...
Selecting previously unselected package libltdl7:amd64.
Preparing to unpack .../7-libltdl7_2.4.7-7build1_amd64.deb ...
Unpacking libltdl7:amd64 (2.4.7-7build1) ...
Selecting previously unselected package libslirp0:amd64.
Preparing to unpack .../8-libslirp0_4.7.0-1ubuntu3_amd64.deb ...
Unpacking libslirp0:amd64 (4.7.0-1ubuntu3) ...
Selecting previously unselected package slirp4netns.
Preparing to unpack .../9-slirp4netns_1.2.1-1build2_amd64.deb ...
Unpacking slirp4netns (1.2.1-1build2) ...
Setting up docker-buildx-plugin (0.20.0-1~ubuntu.24.04~noble) ...
Setting up containerd.io (1.7.25-1) ...
Created symlink /etc/systemd/system/multi-user.target.wants/containerd.service → /usr/lib/systemd/system/containerd.service.
Setting up docker-compose-plugin (2.32.4-1~ubuntu.24.04~noble) ...
Setting up libltdl7:amd64 (2.4.7-7build1) ...
Setting up docker-ce-cli (5:27.5.1-1~ubuntu.24.04~noble) ...
Setting up libslirp0:amd64 (4.7.0-1ubuntu3) ...
Setting up pigz (2.8-1) ...
Setting up docker-ce-rootless-extras (5:27.5.1-1~ubuntu.24.04~noble) ...
Setting up slirp4netns (1.2.1-1build2) ...
Setting up docker-ce (5:27.5.1-1~ubuntu.24.04~noble) ...
Created symlink /etc/systemd/system/multi-user.target.wants/docker.service → /usr/lib/systemd/system/docker.service.
Created symlink /etc/systemd/system/sockets.target.wants/docker.socket → /usr/lib/systemd/system/docker.socket.
Processing triggers for man-db (2.12.0-4build2) ...
Processing triggers for libc-bin (2.39-0ubuntu8.3) ...
Scanning processes...
Scanning linux images...

Running kernel seems to be up-to-date.

No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
root@lab-3:~# sudo docker run hello-world
Unable to find image 'hello-world:latest' locally
latest: Pulling from library/hello-world
e6590344b1a5: Pull complete
Digest: sha256:d715f14f9eca81473d9112df50457893aa4d099adeb4729f679006bf5ea12407
Status: Downloaded newer image for hello-world:latest

Hello from Docker!
This message shows that your installation appears to be working correctly.

To generate this message, Docker took the following steps:
 1. The Docker client contacted the Docker daemon.
 2. The Docker daemon pulled the "hello-world" image from the Docker Hub.
    (amd64)
 3. The Docker daemon created a new container from that image which runs the
    executable that produces the output you are currently reading.
 4. The Docker daemon streamed that output to the Docker client, which sent it
    to your terminal.

To try something more ambitious, you can run an Ubuntu container with:
$ docker run -it ubuntu bash

Share images, automate workflows, and more with a free Docker ID:
https://hub.docker.com/

For more examples and ideas, visit:
https://docs.docker.com/get-started/
```

Настраиваю конфиг для postgres. Избавляюсь от master и slave и заменяю на номера, чтобы не путаться.

```
scope: my_cluster # Имя нашего кластера
name: postgresql0 # Имя первой ноды

restapi: # Адреса первой ноды
  listen: pg-0:8008
  connect_address: pg-0:8008

zookeeper:
  hosts:
    - zoo:2181 # Адрес Zookeeper

bootstrap:
  dcs:
    ttl: 30
    loop_wait: 10
    retry_timeout: 10
    maximum_lag_on_failover: 10485760
    master_start_timeout: 300
    synchronous_mode: true
  postgresql:
    use_pg_rewind: true
    use_slots: true
    parameters:
      wal_level: replica
      hot_standby: "on"
      wal_keep_segments: 8
      max_wal_senders: 10
      max_replication_slots: 10
      wal_log_hints: "on"
      archive_mode: "always"
      archive_timeout: 1800s
      archive_command: mkdir -p /tmp/wal_archive && test ! -f /tmp/wal_archive/%f && cp %p /tmp/wal_archive/%f

  pg_hba:
    - host replication replicator 0.0.0.0/0 md5
    - host all all 0.0.0.0/0 md5

postgresql:
  listen: 0.0.0.0:5432
  connect_address: pg-0:5432 # Адрес первой ноды
  data_dir: /var/lib/postgresql/data/postgresql0 # Место хранения данных первой ноды
  bin_dir: /usr/lib/postgresql/15/bin
  pgpass: /tmp/pgpass0
  authentication:
    replication: # логонасс для репликации, при желании можно поменять
      username: replicator
      password: rep-pass
    superuser: # админский логонасс, при желании можно поменять (в том числе в файле compose)
      username: postgres
      password: postgres
  parameters:
    unix_socket_directories: '.'

watchdog:
  mode: off

tags:
  nofailover: false
  noloadbalance: false
  clonefrom: false
  nosync: false
```

```
scope: my_cluster # Имя нашего кластера
name: postgresql1 # Имя первой ноды

restapi: # Адреса первой ноды
  listen: pg-1:8008
  connect_address: pg-1:8008

zookeeper:
  hosts:
    - zoo:2181 # Адрес Zookeeper

bootstrap:
  dcs:
    ttl: 30
    loop_wait: 10
    retry_timeout: 10
    maximum_lag_on_failover: 10485760
    master_start_timeout: 300
    synchronous_mode: true
    postgresql:
      use_pg_rewind: true
      use_slots: true
      parameters:
        wal_level: replica
        hot_standby: "on"
        wal_keep_segments: 8
        max_wal_senders: 10
        max_replication_slots: 10
        wal_log_hints: "on"
        archive_mode: "always"
        archive_timeout: 1800s
        archive_command: mkdir -p /tmp/wal_archive && test ! -f /tmp/wal_archive/%f && cp %p /tmp/wal_archive/%f

  pg_hba:
    - host replication replicator 0.0.0.0/0 md5
    - host all all 0.0.0.0/0 md5

postgresql:
  listen: 0.0.0.0:5432
  connect_address: pg-1:5432 # Адрес первой ноды
  data_dir: /var/lib/postgresql/data/postgresql1 # Место хранения данных первой ноды
  bin_dir: /usr/lib/postgresql/15/bin
  pgpass: /tmp/pgpass0
  authentication:
    replication: # логин для репликации, при желании можно поменять
      username: replicator
      password: rep-pass
    superuser: # админский логин, при желании можно поменять (в том числе в файле compose)
      username: postgres
      password: postgres
  parameters:
    unix_socket_directories: '.'

watchdog:
  mode: off

tags:
  nofailover: false
  noloadbalance: false
  clonefrom: false
  nosync: false
```

В docker-compose.yml так же избавляюсь от master и slave.

```
services:
  pg-0:
    build: .
    image: localhost/postres:patroni # имя для кастомного образа из Dockerfile, можно задать любое
    container_name: pg-0 # Будущий адрес первой ноды
    restart: always
    hostname: pg-0
    environment:
      POSTGRES_USER: postgres
      POSTGRES_PASSWORD: postgres
      PGDATA: '/var/lib/postgresql/data/pgdata'
    expose:
      - 8008
    ports:
      - 5433:5432
    volumes:
      - pg-0:/var/lib/postgresql/data
    command: patroni /postgres0.yml

  pg-1:
    build: .
    image: localhost/postres:patroni # имя для кастомного образа из Dockerfile, можно задать любое
    container_name: pg-1 # Будущий адрес второй ноды
    restart: always
    hostname: pg-1
    expose:
      - 8008
    ports:
      - 5434:5432
    volumes:
      - pg-1:/var/lib/postgresql/data
    environment:
      POSTGRES_USER: postgres
      POSTGRES_PASSWORD: postgres
      PGDATA: '/var/lib/postgresql/data/pgdata'
    command: patroni /postgres1.yml

  zoo:
    image: confluentinc/cp-zookeeper:7.7.1
    container_name: zoo # Будущий адрес зукенера
    restart: always
    hostname: zoo
    ports:
      - 2181:2181
    environment:
      ZOOKEEPER_CLIENT_PORT: 2181
      ZOOKEEPER_TICK_TIME: 2000

volumes:
  pg-0:
  pg-1:
```

Запускаю compose и проверяю что ноды postgres договорились о том, кто главный.

```
[+] Building 70.7s (16/18)
=> [pg-0 internal] load build definition from Dockerfile
=> => transferring dockerfile: 889B
=> [pg-1 internal] load build definition from Dockerfile
=> => transferring dockerfile: 889B
=> [pg-0 internal] load metadata for docker.io/library/postgres:15
=> [pg-1 internal] load .dockerignore
=> => transferring context: 2B
=> [pg-0 internal] load .dockerignore
=> => transferring context: 2B
=> [pg-0 1/5] FROM docker.io/library/postgres:15@sha256:68bb947ec37e6cfd5486c51ecdd122babc3ddaebd490ac913130a7e325d36c5
=> => resolve docker.io/library/postgres:15@sha256:68bb947ec37e6cfd5486c51ecdd122babc3ddaebd490ac913130a7e325d36c5
=> => sha256:8f53978cb655fd83b1ff6ee97e4215d0cea9ee38fe9c81f7edd83624246aadda 4.53MB / 4.53MB
=> => sha256:5ea2c273de9795486ee448aba32375a5ae6fdcccf3394ae69095f8401b1bdc 9.92KB / 9.92KB
=> => sha256:4dc18197e359fa063a278cbe29f12f0e9a9976f7262b1b657c8feee64dd3d4 1.27KB / 1.17KB
=> => sha256:68bb947ec37e6cfd5486c51ecdd122babc3ddaebd490ac913130a7e325d36c5 10.27KB / 10.27KB
=> => sha256:af302e5c37e9dc1db2eadc8f509d82a9140e6b541b0d1a6daa91d0cc55057d 28.21MB / 28.21MB
=> => sha256:03689b9e81c79ee6f29db9fe2691b0c65da21baac5ce2a678207298a15493a6e8 3.63KB / 3.63KB
=> => sha256:be79eb752db7fe8cfb5f8f8881d2da4304106467ee1cae228c234ea5a7ba266 1.45MB / 1.45MB
=> => extracting sha256:af302e5c37e9dc1db2eadc8f509d82a9140e6b541b0d1a6daa91d0cc55057d 107.05MB / 107.05MB
=> => sha256:d276fdcf9d077c2d988cce89cfacdad5277ff8d98b575839e2b2ccf0518ce 1.20MB / 1.20MB
=> => sha256:2c58bbcb81a2068ebcfcbf1318a95b042ff08031ae75619d2b3c90d12c2409 8.07MB / 8.07MB
=> => sha256:6e800049036731b7334c22fa1763765226b6faddd8e386453478b3b8f5f3e4 116B / 116B
=> => sha256:208bc8546178137d0b36334c18f2ff2e849716a279b506f38c305e3ae05f4de3c9 3.14KB / 3.14KB
=> => sha256:5b731ac21676abcbca01232cc0825379f65cded159f130c8963d97efc3eb7d851 107.05MB / 107.05MB
=> => sha256:28a0d4d767d7f869d468139c245d99b3f69eb76a479c3d080575823c23739c1 9.78KB / 9.78KB
=> => sha256:4db0bf51897c8b1a29ab0f7f9f452c54a3b980b2b2cf9d8a236388291c841924 127B / 127B
=> => sha256:fla20c73f96939c920080cc3eb3f7ed74019f71a048211e05585b41fa277401 167B / 167B
=> => sha256:b41b07a1ff21c50c95a8c858cd66580f617c17c038dd57cdd28046d7532d16 5.42KB / 5.42KB
=> => sha256:d17da90a169f5cc15a7db8fdb8a8d33c7a421713ca7b84cbce020ee83b4de62 185B / 185B
=> => extracting sha256:4dc18197e359fa063a278cbe29f12f0e9a9976f7262b1b657c8feee64dd3d4
=> => extracting sha256:8f53978cb655fd83b1ff6ee97e4215d0cea9ee38fe9c81f7edd83624246aadda
=> => extracting sha256:be79eb752db7fe8cfb5f8f8881d2da4304106467ee1cae228c234ea5a7ba266
=> => extracting sha256:2c58bbcb81a2068ebcfcbf1318a95b042ff08031ae75619d2b3c90d12c2409
=> => extracting sha256:d276fdcf9d077c2d988cce89cfacdad5277ff8d98b575839e2b2ccf0518ce
=> => extracting sha256:208bc8546178137d0b36334c18f2ff2e849716a279b506f38c305e3ae05f4de3c9
=> => extracting sha256:5b731ac21676abcbca01232cc0825379f65cded159f130c8963d97efc3eb7d851
=> => extracting sha256:28a0d4d767d7f869d468139c245d99b3f69eb76a479c3d080575823c23739c1
=> => extracting sha256:4db0bf51897c8b1a29ab0f7f9f452c54a3b980b2b2cf9d8a236388291c841924
=> => extracting sha256:fla20c73f96939c920080cc3eb3f7ed74019f71a048211e05585b41fa277401
=> => extracting sha256:b41b07a1ff21c50c95a8c858cd66580f617c17c038dd57cdd28046d7532d16
=> => extracting sha256:d17da90a169f5cc15a7db8fdb8a8d33c7a421713ca7b84cbce020ee83b4de62
=> [pg-0 internal] load build context
=> => transferring context: 3.62KB
=> [pg-1 internal] load build context
=> => transferring context: 3.62KB
=> [pg-1 2/5] RUN apt-get update -y && apt-get install -y netcat-openbsd python3-pip curl python3-psycpg2 python3-venv iputils-ping
=> [pg-1 3/5] RUN python3 -m venv /opt/patroni-venv && /opt/patroni-venv/bin/pip install --upgrade pip && /opt/patroni-venv/bin/pip install patroni[zookeeper] psycpg2-binary
=> [pg-1 4/5] COPY postgres0.yml /postgres0.yml
=> [pg-0 5/5] COPY postgres1.yml /postgres1.yml
=> [pg-1] exporting to image
=> => exporting layers
=> => writing image sha256:5e0e256342380ae106c388c35fd102ece59e37be88a9e8c3dae762eff8fb61
=> => naming to localhost/postres:patroni
=> [pg-0] exporting to image
=> => exporting layers
=> => writing image sha256:dec952cfff73124b037cfa985984cb09406ccda6c5ee50c23f670dd86bbc56d1
=> => naming to localhost/postres:patroni
=> [pg-0] resolving provenance for metadata file
=> [pg-1] resolving provenance for metadata file
[+] Running 8/8
  pg-0 Built
  pg-1 Built
  Network root_default Created
  Volume "root_pg-0" Created
  Volume "root_pg-1" Created
  Container zoo Started
  Container pg-0 Started
  Container pg-1 Started
```

```
2025-01-23 13:28:44.023 UTC [32] LOG: starting PostgreSQL 15.10 (Debian 15.10-1.pgdg120+1) on x86_64-pc-linux-gnu, compiled by gcc (Debian 12.2.0-14) 12.2.0, 64-bit
2025-01-23 13:28:44.023 UTC [32] LOG: listening on IPv4 address "0.0.0.0", port 5432
2025-01-23 13:28:44.026 UTC [32] LOG: listening on Unix socket "./.s.PGSQL.5432"
2025-01-23 13:28:44.029 INFO: postmaster pid=32
2025-01-23 13:28:44.035 UTC [36] LOG: database system was shut down at 2025-01-23 13:28:43 UTC
2025-01-23 13:28:44.045 UTC [32] LOG: database system is ready to accept connections
localhost:5432 - accepting connections
localhost:5432 - accepting connections
2025-01-23 13:28:44.099 INFO: establishing a new patroni heartbeat connection to postgres
2025-01-23 13:28:44.116 INFO: running post_bootstrap
2025-01-23 13:28:44.184 INFO: Reaped pid=46, exit status=0
2025-01-23 13:28:44.187 INFO: Reaped pid=47, exit status=0
2025-01-23 13:28:44.217 INFO: initialized a new cluster
2025-01-23 13:28:52.214 UTC [34] LOG: checkpoint starting: force wait
2025-01-23 13:28:52.674 UTC [34] LOG: checkpoint complete: wrote 7 buffers (0.0%); 0 WAL file(s) added, 0 removed, 0 recycled; write=0.408 s, sync=0.004 s, total=0.460
2025-01-23 13:28:52.674 UTC [48] WARNING: skipping special file "./.s.PGSQL.5432"
2025-01-23 13:28:52.688 UTC [48] WARNING: skipping special file "./.s.PGSQL.5432"
2025-01-23 13:28:53.709 UTC [59] ERROR: replication slot "postgresql1" does not exist
2025-01-23 13:28:53.709 UTC [59] STATEMENT: START REPLICATION SLOT "postgresql1" 0/3000000 TIMELINE 1
2025-01-23 13:28:53.733 UTC [60] ERROR: replication slot "postgresql1" does not exist
2025-01-23 13:28:53.733 UTC [60] STATEMENT: START REPLICATION SLOT "postgresql1" 0/3000000 TIMELINE 1
2025-01-23 13:28:54.188 INFO: Lock owner: postgresql0; I am postgresql0
2025-01-23 13:28:54.204 INFO: Enabled synchronous replication
2025-01-23 13:28:54.221 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-23 13:29:04.182 INFO: Lock owner: postgresql0; I am postgresql0
2025-01-23 13:29:04.189 INFO: Assigning synchronous standby with status to ['postgresql1']
2025-01-23 13:29:04.194 UTC [32] LOG: received SIGHUP, reloading configuration files
server signaled
2025-01-23 13:29:04.196 UTC [32] LOG: parameter "synchronous_standby_names" changed to "postgresql1"
2025-01-23 13:29:04.402 UTC [61] LOG: standby "postgresql1" is now a synchronous standby with priority 1
2025-01-23 13:29:04.402 UTC [61] STATEMENT: START REPLICATION SLOT "postgresql1" 0/3000000 TIMELINE 1
```

```

2025-01-23 13:28:42,168 INFO: Failed to acquire initialize lock
2025-01-23 13:28:52,131 INFO: Lock owner: postgresql0; I am postgresql1
2025-01-23 13:28:52,132 INFO: trying to bootstrap from leader 'postgresql0'
WARNING: skipping special file "/.s.PGSQL.5432"
WARNING: skipping special file "/.s.PGSQL.5432"
2025-01-23 13:28:53,019 INFO: replica has been created using basebackup
2025-01-23 13:28:53,021 INFO: bootstrapped from leader 'postgresql0'
2025-01-23 13:28:53,531 INFO: postmaster pid=21
2025-01-23 13:28:53,542 UTC [21] LOG: starting PostgreSQL 15.10 (Debian 15.10-1.pgdg120+1) on x86_64-pc-linux-gnu, compiled by gcc (Debian 12.2.0-14) 12.2.0, 64-bit
2025-01-23 13:28:53,542 UTC [21] LOG: listening on IPv4 address "0.0.0.0", port 5432
2025-01-23 13:28:53,544 UTC [21] LOG: listening on Unix socket "/.s.PGSQL.5432"
localhost:5432 - rejecting connections
2025-01-23 13:28:53,549 UTC [25] LOG: database system was interrupted; last known up at 2025-01-23 13:28:52 UTC
2025-01-23 13:28:53,550 UTC [26] FATAL: the database system is starting up
2025-01-23 13:28:53,562 UTC [28] FATAL: the database system is starting up
localhost:5432 - rejecting connections
2025-01-23 13:28:53,678 UTC [25] LOG: entering standby mode
2025-01-23 13:28:53,678 UTC [25] LOG: starting backup recovery with redo LSN 0/2000028, checkpoint LSN 0/2000060, on timeline ID 1
2025-01-23 13:28:53,683 UTC [25] LOG: redo starts at 0/2000028
2025-01-23 13:28:53,685 UTC [25] LOG: completed backup recovery with redo LSN 0/2000028 and end LSN 0/2000100
2025-01-23 13:28:53,685 UTC [25] LOG: consistent recovery state reached at 0/2000100
2025-01-23 13:28:53,685 UTC [21] LOG: database system is ready to accept read-only connections
2025-01-23 13:28:53,710 UTC [30] FATAL: could not start WAL streaming: ERROR: replication slot "postgresql1" does not exist
2025-01-23 13:28:53,733 UTC [31] FATAL: could not start WAL streaming: ERROR: replication slot "postgresql1" does not exist
2025-01-23 13:28:53,733 UTC [25] LOG: waiting for WAL to become available at 0/3000018
localhost:5432 - accepting connections
2025-01-23 13:28:54,617 INFO: Reaped pid=34, exit status=0
2025-01-23 13:28:54,618 INFO: Lock owner: postgresql0; I am postgresql1
2025-01-23 13:28:54,618 INFO: establishing a new patroni heartbeat connection to postgres
2025-01-23 13:28:54,664 INFO: no action. I am (postgresql1), a secondary, and following a leader (postgresql0)
2025-01-23 13:28:58,739 UTC [38] LOG: started streaming WAL from primary at 0/3000000 on timeline 1
2025-01-23 13:29:04,625 INFO: no action. I am (postgresql1), a secondary, and following a leader (postgresql0)
2025-01-23 13:29:14,621 INFO: no action. I am (postgresql1), a secondary, and following a leader (postgresql0)
2025-01-23 13:29:24,608 INFO: no action. I am (postgresql1), a secondary, and following a leader (postgresql0)
2025-01-23 13:29:34,609 INFO: no action. I am (postgresql1), a secondary, and following a leader (postgresql0)
2025-01-23 13:29:44,616 INFO: no action. I am (postgresql1), a secondary, and following a leader (postgresql0)

```

*Порты 8008 и 5432 вынесены в разные директивы, expose и ports. По сути, если записать 8008 в ports, то он тоже станет exposed. В чем разница?*

Expose даёт доступ к обращениям к порту другим контейнерам, но не хосту. ports сопоставляет порт хоста и порт контейнера так, чтобы при обращении к порту хоста можно было бы подключиться к определённому порту контейнера. При этом в ports можно еще и указать интерфейс, по которому порт будет доступен на хосте.

*При обычном перезапуске композ-проекта, будет ли сбилден заново образ? А если предварительно отредактировать файлы postgresX.yml? А если содержимое самого Dockerfile? Почему?*

При обычной перезагрузке не будет. Если предварительно отредактировать конфиг файл тоже. Если поменяется содержимое Dockerfile, то новое изображение **не** будет создано. Потому что докер не проверяет изменение содержания никаких файлов.

Получаю доступ к портам баз данных из локальной машины:

	Listen interface	Port	Destination host	Port	Comment
<input checked="" type="checkbox"/>	127.0.0.1	8080	localhost	8080	
<input checked="" type="checkbox"/>	127.0.0.1	8082	localhost	8082	
<input checked="" type="checkbox"/>	127.0.0.1	3000	localhost	3000	
<input checked="" type="checkbox"/>	127.0.0.1	5433	localhost	5433	
<input checked="" type="checkbox"/>	127.0.0.1	5434	localhost	5434	

Добавляю подключение к нодам postgres:

Register - Server

×

General

Connection

Parameters

SSH Tunnel

Advanced

Host name/address

localhost

Port

5433

Maintenance database

postgres

Username

postgres

Kerberos authentication?

☐

Password

.....

Save password?

☐

Role

Service

i

?

×

 Close

↺

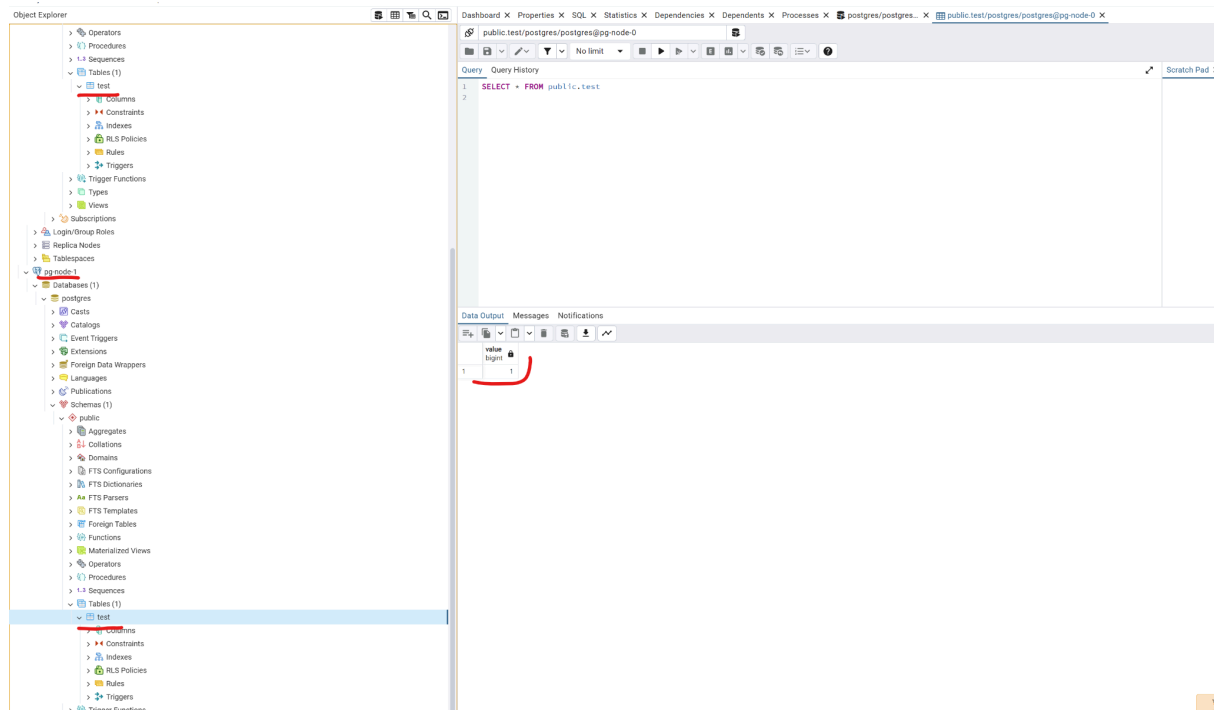
 Reset

💾

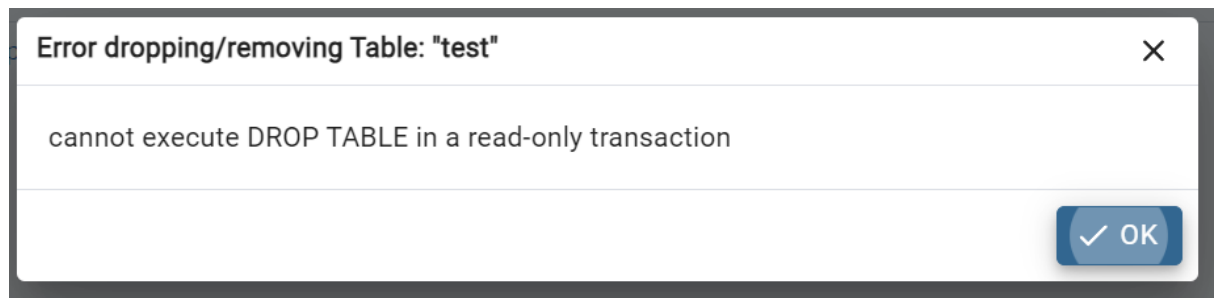
 Save



Создал таблицу в мастере, добавил туда значение, таблица автоматически создавалась в slave.



Удалить таблицу из slave не получилось.



Добавляю haproxy в docker-compose:

```
services:
  pg-0:
    build: .
    image: localhost/postres:patroni # имя для кастомного образа из Dockerfile, можно задать любое
    container_name: pg-0 # Будущий адрес первой ноды
    restart: always
    hostname: pg-0
    environment:
      POSTGRES_USER: postgres
      POSTGRES_PASSWORD: postgres
      PGDATA: '/var/lib/postgresql/data/pgdata'
    expose:
      - 8008
    ports:
      - 5433:5432
    volumes:
      - pg-0:/var/lib/postgresql/data
    command: patroni /postgres0.yml

  pg-1:
    build: .
    image: localhost/postres:patroni # имя для кастомного образа из Dockerfile, можно задать любое
    container_name: pg-1 # Будущий адрес второй ноды
    restart: always
    hostname: pg-1
    expose:
      - 8008
    ports:
      - 5434:5432
    volumes:
      - pg-1:/var/lib/postgresql/data
    environment:
      POSTGRES_USER: postgres
      POSTGRES_PASSWORD: postgres
      PGDATA: '/var/lib/postgresql/data/pgdata'
    command: patroni /postgres1.yml

  zoo:
    image: confluentinc/cp-zookeeper:7.7.1
    container_name: zoo # Будущий адрес зукипера
    restart: always
    hostname: zoo
    ports:
      - 2181:2181
    environment:
      ZOOKEEPER_CLIENT_PORT: 2181
      ZOOKEEPER_TICK_TIME: 2000

  haproxy:
    image: haproxy:3.0
    container_name: postgres_entrypoint # Это будет адрес подключения к БД, можно выбрать любой
    ports:
      - 5432:5432 # Это будет порт подключения к БД, можно выбрать любой
      - 7000:7000
    depends_on: # Не забываем убедиться, что сначала все корректно поднялось
      - pg-0
      - pg-1
      - zoo
    volumes:
      - ./haproxy.cfg:/usr/local/etc/haproxy/haproxy.cfg

volumes:
  pg-0:
  pg-1:
```

Добавляю конфиг для haproxy и немного меняю названия нод:

```
global
    maxconn 100

defaults
    log global
    mode tcp
    retries 3
    timeout client 30m
    timeout connect 4s
    timeout server 30m
    timeout check 5s

listen stats
    mode http
    bind *:7000
    stats enable
    stats uri /

listen postgres
    bind *:5432 # Выбранный порт из docker-compose.yml
    option httpchk
    http-check expect status 200 # Описываем нашу проверку доступности (в данном случае обычный HTTP-пинг)
    default-server inter 3s fall 3 rise 2 on-marked-down shutdown-sessions
    server postgresql_pg_0_5432 pg-0:5432 maxconn 100 check port 8008 # Адрес первой ноды постгреса
    server postgresql_pg_1_5432 pg-1:5432 maxconn 100 check port 8008 # Адрес второй ноды постгреса
```

Перезапускаю compose и проверяю, что всё работает:

```
root@lab-3:~# docker compose up -d
[+] Running 7/7
  ✓ haproxy Pulled
  ✓ af302e5c37e9 Already exists
  ✓ 89d67b1065a9 Pull complete
  ✓ 8855209f7173 Pull complete
  ✓ 444fc48b92cc Pull complete
  ✓ 4252e78e7e4a Pull complete
  ✓ 4f4fb700ef54 Pull complete
[+] Running 4/4
  ✓ Container zoo Running
  ✓ Container pg-0 Running
  ✓ Container pg-1 Running
  ✓ Container postgres_entrpoint Started
```

```
2025-01-23 15:44:17,882 INFO: Lock owner: None; I am postgresql0
2025-01-23 15:44:17,896 INFO: Reaped pid=18, exit status=0
2025-01-23 15:44:17,896 INFO: Lock owner: None; I am postgresql0
2025-01-23 15:44:17,897 INFO: starting as a secondary
2025-01-23 15:44:18,492 UTC [24] LOG: starting PostgreSQL 15.10 (Debian 15.10-1.pgdg120+1) on x86_64-pc-linux-gnu, compiled by gcc (Debian 12.
2025-01-23 15:44:18,494 UTC [24] LOG: listening on IPv4 address "0.0.0.0", port 5432
2025-01-23 15:44:18,499 UTC [24] LOG: listening on Unix socket "./.s.PGSQL.5432"
2025-01-23 15:44:18,509 UTC [27] LOG: database system was interrupted while in recovery at log time 2025-01-23 15:44:03 UTC
2025-01-23 15:44:18,509 UTC [27] HINT: If this has occurred more than once some data might be corrupted and you might need to choose an earlie
2025-01-23 15:44:18,544 INFO: postmaster pid=24
2025-01-23 15:44:18,562 UTC [29] FATAL: the database system is starting up
localhost:5432 - rejecting connections
2025-01-23 15:44:18,578 UTC [31] FATAL: the database system is starting up
localhost:5432 - rejecting connections
2025-01-23 15:44:18,665 UTC [27] WARNING: specified neither primary_conninfo nor restore_command
2025-01-23 15:44:18,665 UTC [27] HINT: The database server will regularly poll the pg_wal subdirectory to check for files placed there.
2025-01-23 15:44:18,665 UTC [27] LOG: entering standby mode
2025-01-23 15:44:18,671 UTC [27] LOG: consistent recovery state reached at 0/50000A0
2025-01-23 15:44:18,671 UTC [27] LOG: invalid record length at 0/50000A0: wanted 24, got 0
2025-01-23 15:44:18,671 UTC [27] LOG: waiting for WAL to become available at 0/50000B8
2025-01-23 15:44:18,672 UTC [24] LOG: database system is ready to accept read-only connections
localhost:5432 - accepting connections
2025-01-23 15:44:19,652 INFO: establishing a new patroni heartbeat connection to postgres
2025-01-23 15:44:19,734 INFO: Got response from postgresql1 http://pg-1:8008/patroni: {"state": "starting", "postmaster_start_time": "2025-01-2
d_timestamp": null, "paused": false}, "timeline": 1, "cluster_unlocked": true, "dcs_last_seen": 1737647058, "database_system_identifier": "7463
2025-01-23 15:44:19,793 INFO: promoted self to leader by acquiring session lock
2025-01-23 15:44:19,796 UTC [27] LOG: received promote request
2025-01-23 15:44:19,796 UTC [27] LOG: redo is not required
server promoting
2025-01-23 15:44:19,800 UTC [27] LOG: selected new timeline ID: 2
2025-01-23 15:44:19,842 UTC [27] LOG: archive recovery complete
2025-01-23 15:44:19,850 UTC [25] LOG: checkpoint starting: force
2025-01-23 15:44:19,859 UTC [24] LOG: database system is ready to accept connections
2025-01-23 15:44:19,863 UTC [25] LOG: checkpoint complete: wrote 3 buffers (0.0%); 0 WAL file(s) added, 0 removed, 0 recycled; write=0.003 s,
2025-01-23 15:44:20,837 INFO: establishing a new patroni restapi connection to postgres
2025-01-23 15:44:20,837 INFO: Lock owner: postgresql0; I am postgresql0
2025-01-23 15:44:20,853 INFO: Reaped pid=58, exit status=0
2025-01-23 15:44:20,854 INFO: Assigning synchronous standby status to ['postgresql1']
2025-01-23 15:44:20,858 UTC [24] LOG: received SIGHUP, reloading configuration files
server signaled
2025-01-23 15:44:20,859 UTC [24] LOG: parameter "synchronous_standby_names" changed to "postgresql1"
2025-01-23 15:44:21,066 UTC [54] LOG: standby "postgresql1" is now a synchronous standby with priority 1
2025-01-23 15:44:21,066 UTC [54] STATEMENT: START_REPLICATION SLOT "postgresql1" 0/5000000 TIMELINE 2
2025-01-23 15:44:22,977 INFO: Synchronous standby status assigned to ['postgresql1']
2025-01-23 15:44:22,995 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-23 15:44:30,831 INFO: no action. I am (postgresql0), the leader with the lock
root@lab-3:~#
```

Добавляю порт для подключения через харкоху на локальную машину:

	Listen interface	Port	Destination host	Port	Comment
<input checked="" type="checkbox"/>	127.0.0.1	8080	localhost	8080	
<input checked="" type="checkbox"/>	127.0.0.1	8082	localhost	8082	
<input checked="" type="checkbox"/>	127.0.0.1	3000	localhost	3000	
<input checked="" type="checkbox"/>	127.0.0.1	5433	localhost	5433	
<input checked="" type="checkbox"/>	127.0.0.1	5434	localhost	5434	
<input checked="" type="checkbox"/>	127.0.0.1	5432	localhost	5432	

Добавил подключение через харкоху и убедился, что там отображается ранее созданная таблица:

pg-entry

Databases (1)

postgres

Casts

Catalogs

Event Triggers

Extensions

Foreign Data Wrappers

Languages

Publications

Schemas (1)

public

Aggregates

Collations

Domains

FTS Configurations

FTS Dictionaries

FTS Parsers

FTS Templates

Foreign Tables

Functions

Materialized Views

Operators

Procedures

Sequences

Tables (1)

test

Columns

Constraints

Indexes

RLS Policies

Rules

Triggers

Trigger Functions

Types

Views

Subscriptions

Login/Group Roles

Replica Nodes

Tablespaces

pg-entry

General

Connection

Parameters

SSH Tunnel

Advanced

Host name/address

localhost

Port

5432

Maintenance database

postgres

Username

postgres

Kerberos authentication?

☐

Role

Service

Data

Close

Reset

Save

Если остановить первую ноду, через харкоху внести изменения на вторую ноду, которая стала мастером, а потом поднять первую ноду, то:

1. Нода 1 станет ведомой
2. Она не запустится

```
2025-01-23 16:17:01.255 INFO: Lock owner: postgresql; I am postgresql0
2025-01-23 16:17:01.256 INFO: starting as a secondary
2025-01-23 16:17:01.768 UTC [69] LOG: starting PostgreSQL 15.10 (Debian 15.10-1.pgdg120+1) on x86_64-pc-linux-gnu, compiled by gcc (Debian 12.2.0-14) 12.2.0, 64-bit
2025-01-23 16:17:01.768 UTC [69] LOG: listening on IPv4 address "0.0.0.0", port 5432
2025-01-23 16:17:01.770 UTC [69] LOG: listening on Unix socket "/.s.PGSQL.5432"
2025-01-23 16:17:01.776 INFO: postmaster pid=69
2025-01-23 16:17:01.779 UTC [73] LOG: database system was shut down at 2025-01-23 16:16:40 UTC
2025-01-23 16:17:01.780 UTC [73] LOG: entering standby mode
2025-01-23 16:17:01.780 UTC [73] FATAL: requested timeline 3 is not a child of this server's history
2025-01-23 16:17:01.780 UTC [73] DETAIL: Latest checkpoint is at 0/7000028 on timeline 2, but in the history of the requested timeline, the server forked off from that timeline at 0/50002C8.
2025-01-23 16:17:01.784 UTC [69] LOG: startup process (PID 73) exited with exit code 1
2025-01-23 16:17:01.784 UTC [69] LOG: aborting startup due to startup process failure
2025-01-23 16:17:01.785 UTC [69] LOG: database system is shut down
localhost:5432 - no response
2025-01-23 16:17:02.792 ERROR: postmaster is not running
2025-01-23 16:17:11.242 INFO: Lock owner: postgresql; I am postgresql0
2025-01-23 16:17:11.242 INFO: failed to start postgres
root@lab-3:~# docker ps
CONTAINER ID   IMAGE                                COMMAND                  CREATED        STATUS        PORTS                                NAMES
47ee13ead119   haproxy:3.0                        "docker-entrypoint.s..." 33 minutes ago Up 33 minutes 0.0.0.0:5432->5432/tcp, :::5432->5432/tcp, 0.0.0.0:7000->7000/tcp, :::7000->7000/tcp   postgres_entrypoint
e9e2cd5c67f1   confluentinc/cp-zookeeper:7.7.1   "/etc/confluent/dock..." 33 minutes ago Up 33 minutes 2888/tcp, 0.0.0.0:2181->2181/tcp, :::2181->2181/tcp, 3888/tcp   zoo
146ef294bfaf1  localhost/postgres:patroni        "docker-entrypoint.s..." 33 minutes ago Up 36 seconds 8080/tcp, 0.0.0.0:5433->5432/tcp, [::]:5433->5432/tcp   pg-0
627af4f6fa1f  localhost/postgres:patroni        "docker-entrypoint.s..." 33 minutes ago Up 33 minutes 8080/tcp, 0.0.0.0:5434->5432/tcp, [::]:5434->5432/tcp   pg-1
```

