

Министерство науки и высшего образования Российской Федерации
ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ АВТОНОМНОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ОБРАЗОВАНИЯ
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Отчет по дисциплине: «Администрирование компьютерных сетей»
Практическая работа «ЛР 3. НА Postgres Cluster»

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Ход работы

Часть 1. Поднимаем постгрес

Создаем файлы Dockerfile и docker-compose.yml по гайду.

Вопрос: 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?

Ответ: expose используется для внутреннего взаимодействия между контейнерами, когда как ports делает порт контейнера доступным с хоста.

Запускаем через docker-compose up, затем смотрим логи

```
pg-slave | 2024-12-21 14:38:55.875 UTC [24] LOG: consistent recovery state reached at 0/2000100
pg-slave | 2024-12-21 14:38:55.876 UTC [21] LOG: database system is ready to accept read-only connections
pg-slave | 2024-12-21 14:38:55.909 UTC [30] LOG: started streaming WAL from primary at 0/3000000 on timeline 1
pg-slave | localhost:5432 - accepting connections
pg-slave | 2024-12-21 14:38:56.569 INFO: Reaped pid=33, exit status=0
pg-slave | 2024-12-21 14:38:56.570 INFO: Lock owner: postgresql0; I am postgresql1
pg-slave | 2024-12-21 14:38:56.570 INFO: establishing a new patroni heartbeat connection to postgres
pg-slave | 2024-12-21 14:38:56.637 INFO: no action. I am (postgresql1), a secondary, and following a leader (postgresq
l0)
pg-master | 2024-12-21 14:39:05.651 INFO: Lock owner: postgresql0; I am postgresql0
pg-master | 2024-12-21 14:39:05.663 INFO: Assigning synchronous standby status to ['postgresql1']
pg-master | 2024-12-21 14:39:05.669 UTC [31] LOG: received SIGHUP, reloading configuration files
pg-master | server signaled
pg-master | 2024-12-21 14:39:05.670 UTC [31] LOG: parameter "synchronous_standby_names" changed to "postgresql"
pg-master | 2024-12-21 14:39:05.876 UTC [58] LOG: standby "postgresql1" is now a synchronous standby with priority 1
pg-master | 2024-12-21 14:39:05.876 UTC [58] STATEMENT: START_REPLICATION SLOT "postgresql1" 0/3000000 TIMELINE 1
pg-slave | 2024-12-21 14:39:06.584 INFO: no action. I am (postgresql1), a secondary, and following a leader (postgresq
l0)
pg-master | 2024-12-21 14:39:07.784 INFO: Synchronous standby status assigned to ['postgresql1']
```

Лидером является pg-master

Смотрим логи docker logs zoo – с ним всё окей

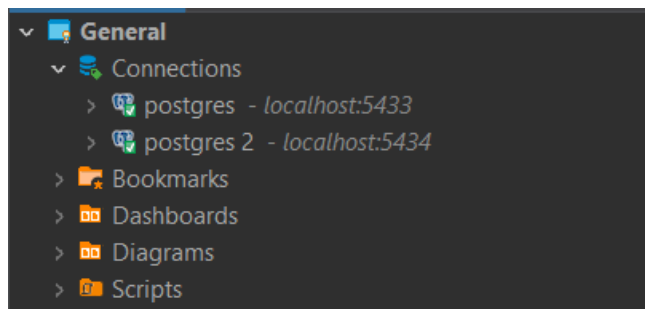
```
nFactory)
[2024-12-21 14:40:43,631] INFO Configuring NIO connection handler with 10s sessionless connection timeout, 2 selector th
read(s), 32 worker threads, and 64 kB direct buffers. (org.apache.zookeeper.server.NIOServerCnxnFactory)
[2024-12-21 14:40:43,633] INFO binding to port 0.0.0.0/0.0.0.0:2181 (org.apache.zookeeper.server.NIOServerCnxnFactory)
[2024-12-21 14:40:43,651] INFO Using org.apache.zookeeper.server.watch.WatchManager as watch manager (org.apache.zookeep
er.server.watch.WatchManagerFactory)
[2024-12-21 14:40:43,651] INFO Using org.apache.zookeeper.server.watch.WatchManager as watch manager (org.apache.zookeep
er.server.watch.WatchManagerFactory)
[2024-12-21 14:40:43,651] INFO Using org.apache.zookeeper.server.watch.WatchManager as watch manager (org.apache.zookeep
er.server.watch.WatchManagerFactory)
```

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

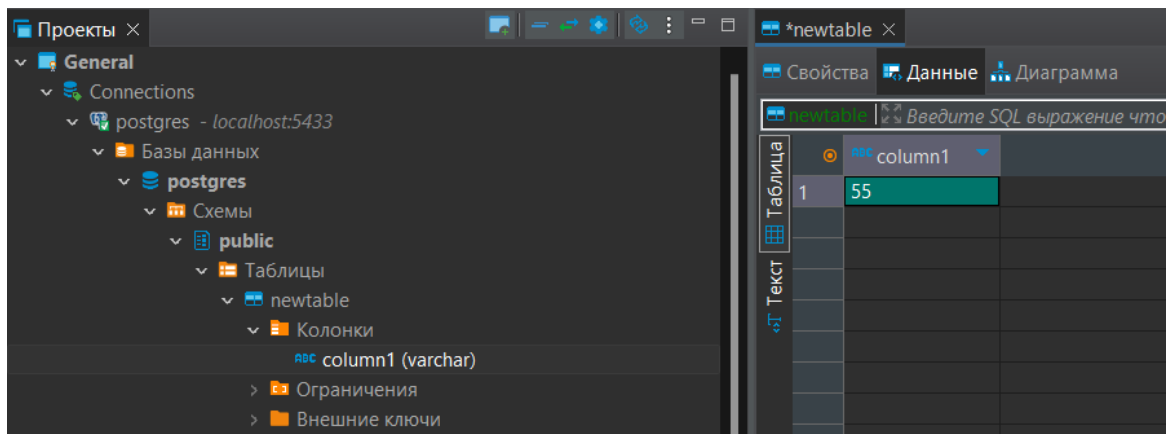
Ответ: при обычном перезапуске докер использует уже существующие образы, чтобы ускорить процесс, поэтому они не пересобираются. Монтируемые файлы, такие как postgresX.yml, применяются сразу, поскольку они подгружаются как тома и доступны в контейнере без пересборки. Если изменить содержимое Dockerfile пересборка не произойдет автоматически. Для этого необходимо явно указать флаг --build при запуске.

Часть 2. Проверяем репликацию

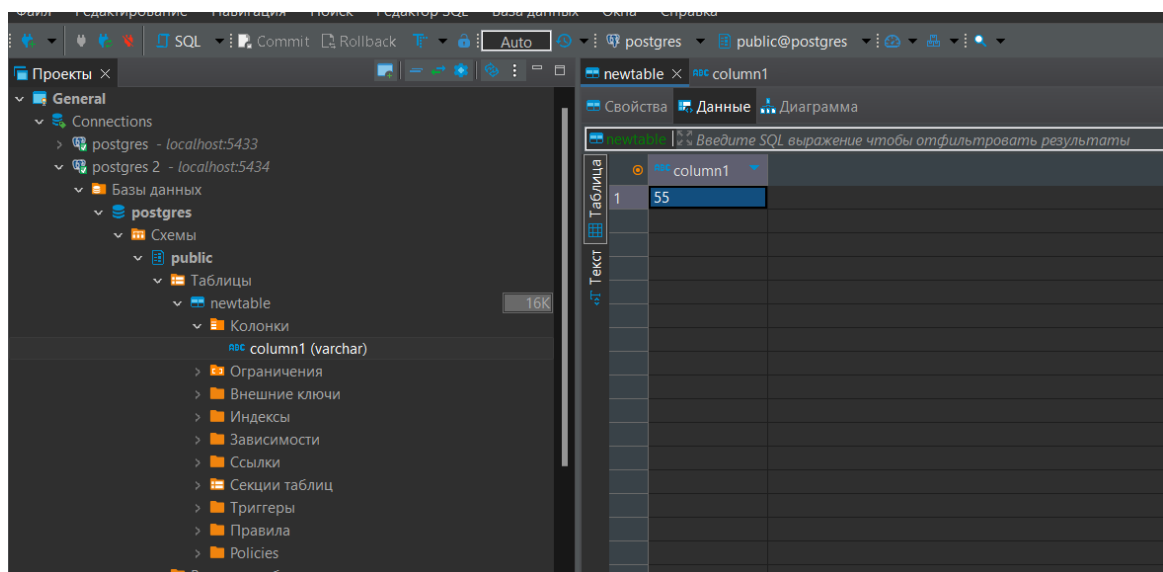
Подключаюсь к нодам через DBBeaver



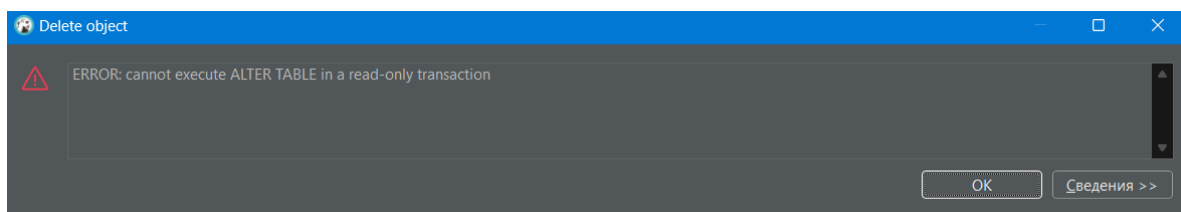
Добавлена таблица и данные



В pg-slave тоже появились эти данные



При попытке удалить колонку column1



Часть 3. Делаем высокую доступность

Добавили haproxy, zookeeper всё ещё работает

```
[2024-12-21 14:53:32,556] INFO Started AdminServer on address 0.0.0.0, port 8080 and command line /commands (org.apache.zookeeper.server.admin.JettyAdminServer)
[2024-12-21 14:53:32,556] INFO Using org.apache.zookeeper.server.NIOServerCnxnFactory as server connection factory (org.apache.zookeeper.server.ServerCnxnFactory)
[2024-12-21 14:53:32,561] WARN maxCnxns is not configured, using default value 0. (org.apache.zookeeper.server.ServerCnxnFactory)
[2024-12-21 14:53:32,571] INFO Configuring NIO connection handler with 10s sessionless connection timeout, 2 selector threads, 32 worker threads, and 64 kB direct buffers. (org.apache.zookeeper.server.NIOServerCnxnFactory)
[2024-12-21 14:53:32,580] INFO binding to port 0.0.0.0/0.0.0.0:2181 (org.apache.zookeeper.server.NIOServerCnxnFactory)
[2024-12-21 14:53:32,648] INFO Using org.apache.zookeeper.server.watch.WatchManager as watch manager (org.apache.zookeeper.server.watch.WatchManagerFactory)
[2024-12-21 14:53:32,649] INFO Using org.apache.zookeeper.server.watch.WatchManager as watch manager (org.apache.zookeeper.server.watch.WatchManagerFactory)
[2024-12-21 14:53:32,649] INFO zookeeper.snapshotSizeFactor = 0.33 (org.apache.zookeeper.server.ZKDatabase)
[2024-12-21 14:53:32,650] INFO zookeeper.commitLogCount=500 (org.apache.zookeeper.server.ZKDatabase)
[2024-12-21 14:53:32,673] WARN Close of session 0x0 (org.apache.zookeeper.server.NIOServerCnxn)
java.io.IOException: ZooKeeperServer not running
```

Pg-slave теперь основная нода

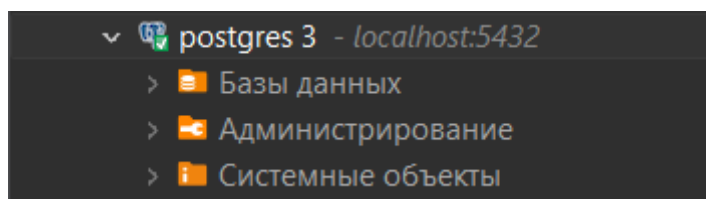
```
2024-12-21 15:48:35.485 UTC [30] LOG: database system is ready to accept connections
2024-12-21 15:48:35.513 UTC [31] LOG: checkpoint complete: wrote 3 buffers (0.0%); 0 WAL file
es=2, longest=0.002 s, average=0.002 s; distance=0 kB, estimate=0 kB
2024-12-21 15:48:36,235 INFO: establishing a new patroni restapi connection to postgres
2024-12-21 15:48:36,452 INFO: Lock owner: postgresql1; I am postgresql1
2024-12-21 15:48:36,463 INFO: Reaped pid=63, exit status=0
2024-12-21 15:48:36,475 INFO: no action. I am (postgresql1), the leader with the lock
```

Проверка haproxy

```
D:\ITMO_UNIVERSITY\5_Semester\Computer_Networks\lab3>docker ps
CONTAINER ID   IMAGE                                COMMAND                                  CREATED        STATUS        PORTS
dc15667c82ac   haproxy:3.0                        "docker-entrypoint.s..."              4 seconds ago   Up 2 seconds   8080->8080
19208dead752   localhost/postgres:patroni         "docker-entrypoint.s..."              5 seconds ago   Up 3 seconds   5432->5432
0771e743fbe7   localhost/postgres:patroni         "docker-entrypoint.s..."              5 seconds ago   Up 3 seconds   5432->5432
b0d852569bb2   confluentinc/cp-zookeeper:7.7.1    "/etc/confluent/dock..."              5 seconds ago   Up 3 seconds   2181->2181

D:\ITMO_UNIVERSITY\5_Semester\Computer_Networks\lab3>docker logs postgres_entrypoint
[NOTICE] (1) : New worker (8) forked
[NOTICE] (1) : Loading success.
[WARNING] (8) : Server postgres/pg_master is DOWN, reason: Layer4 connection problem, info: "Connection re
ns active, 0 queued, 0 remaining in queue.
[WARNING] (8) : Server postgres/pg_slave is DOWN, reason: Layer4 connection problem, info: "Connection re
s active, 0 queued, 0 remaining in queue.
[ALERT] (8) : proxy 'postgres' has no server available!
[WARNING] (8) : Server postgres/pg_slave is UP, reason: Layer7 check passed, code: 200, check duration: 2
queue.
```

Подключение к бд на 5432 (haproxy) проходит успешно



Задание (стандартное)

Этап 1. До отключения мастер-ноды

Мастер-нода спамит логами каждые 10 секунд, оповещая, что она является мастером

```

2025-01-11 03:11:45 pg-master | 2025-01-10 20:11:45,572 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:11:55 pg-master | 2025-01-10 20:11:55,552 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:12:05 pg-master | 2025-01-10 20:12:05,558 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:12:15 pg-master | 2025-01-10 20:12:15,552 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:12:25 pg-master | 2025-01-10 20:12:25,551 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:12:35 pg-master | 2025-01-10 20:12:35,560 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:12:45 pg-master | 2025-01-10 20:12:45,595 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:12:55 pg-master | 2025-01-10 20:12:55,560 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:13:05 pg-master | 2025-01-10 20:13:05,555 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:13:15 pg-master | 2025-01-10 20:13:15,600 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:13:25 pg-master | 2025-01-10 20:13:25,624 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:13:35 pg-master | 2025-01-10 20:13:35,559 INFO: no action. I am (postgresql0), the leader with the lock

```

Этап 2. Отключение мастер-ноды приводит к передаче звания другой ноде

```

2025-01-11 03:13:15 pg-master | 2025-01-10 20:13:15,600 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:13:25 pg-master | 2025-01-10 20:13:25,624 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:13:35 pg-master | 2025-01-10 20:13:35,559 INFO: no action. I am (postgresql0), the leader with the lock
2025-01-11 03:15:23 pg-master | 2025-01-10 20:15:23,253 INFO: Connecting to zoo(172.20.0.2):2181, use_ssl: False
2025-01-11 03:15:40 pg-slave | 2025-01-10 20:15:40,049 UTC [264] STATEMENT: START_REPLICATION SLOT "postgresql0" 0/4000000 TIMELINE 1
2025-01-11 03:15:40 pg-slave | 2025-01-10 20:15:40,049 UTC [267] ERROR: requested starting point 0/4000000 on timeline 1 is not in this server's history
2025-01-11 03:15:40 pg-slave | 2025-01-10 20:15:40,049 UTC [267] DETAIL: This server's history forked from timeline 1 at 0/3072538.
2025-01-11 03:15:23 pg-master | 2025-01-10 20:15:23,272 INFO: Zookeeper connection established, state: CONNECTED
2025-01-11 03:15:23 pg-master | 2025-01-10 20:15:23,284 INFO: No PostgreSQL configuration items changed, nothing to reload.
2025-01-11 03:15:23 pg-master | 2025-01-10 20:15:23,287 INFO: Reaped pid=12, exit status=0
2025-01-11 03:15:23 pg-master | 2025-01-10 20:15:23,300 INFO: Reaped pid=15, exit status=0
2025-01-11 03:15:40 pg-slave | 2025-01-10 20:15:40,049 UTC [267] STATEMENT: START_REPLICATION SLOT "postgresql0" 0/4000000 TIMELINE 1
2025-01-11 03:15:43 pg-slave | 2025-01-10 20:15:43,563 INFO: no action. I am (postgresql1), the leader with the lock
2025-01-11 03:15:45 pg-slave | 2025-01-10 20:15:45,065 UTC [270] ERROR: requested starting point 0/4000000 on timeline 1 is not in this server's history

```

При попытке вставки данных через энтрипоинт ошибки не возникает

```

be1ov — psql • runpsql.sh — 80x32
Last login: Sat Jan 11 03:11:21 on ttys006
/dev/fd/12:18: command not found: compdef
/Library/PostgreSQL/16/scripts/runpsql.sh; exit
be1ov@Alexs-MacBook-Air ~ % /Library/PostgreSQL/16/scripts/runpsql.sh; exit
Server [localhost]: localhost
Database [postgres]:
Port [5432]: 5439
Username [postgres]: postgres
Password for user postgres:
psql (16.3, server 15.9 (Debian 15.9-1.pgdg120+1))
Type "help" for help.

postgres=# SELECT * FROM test;
 id | name  | age
----+-----+----
  1 | Alice |  30
  2 | Bob   |  25
  3 | Charlie | 35
(3 rows)

postgres=# INSERT INTO test (name, age) VALUES
postgres-# ('Alice', 30),
postgres-# ('Bob', 25),
postgres-# ('Charlie', 35);
INSERT 0 3
postgres=# INSERT INTO test (name, age) VALUES
('Alice', 30),
('Bob', 25),
('Charlie', 35);
INSERT 0 3
postgres=# bl

```

Этап 3. Восстановление прежней мастер-ноды, попытка вставки данных приводит к ошибке, так как новая мастер-нода забрала исключительное право на запись данных

```
2025-01-11 03:15:55 pg-master | 2025-01-10 20:15:55.081 UTC [47] LOG: new timeline 2 forked off current database system timeline 1 b
2025-01-11 03:15:55 pg-master | 2025-01-10 20:15:55.081 UTC [47] LOG: waiting for WAL to become available at 0/40000B8
2025-01-11 03:15:59 pg-master | 2025-01-10 20:15:59.085 UTC [94] ERROR: cannot execute INSERT in a read-only transaction
2025-01-11 03:15:59 pg-master | 2025-01-10 20:15:59.085 UTC [94] STATEMENT: INSERT INTO test (name, age) VALUES
2025-01-11 03:15:59 pg-master | ('Alice', 30),
2025-01-11 03:15:59 pg-master | ('Bob', 25),
2025-01-11 03:15:59 pg-master | ('Charlie', 35);
2025-01-11 03:16:00 pg-master | 2025-01-10 20:16:00.066 UTC [97] FATAL: could not start WAL streaming: ERROR: requested starting po
```

Таким образом, можно сделать вывод, что при отключении текущей мастер-ноды ZooKeeper инициирует процесс избрания новой ноды, передавая ей статус лидера со всеми преимуществами. После восстановления экс-мастер-ноды, она становится репликантом.