OST
Eastern Switzerland
University of Applied Sciences

Automated Database Benchmarking Tool

Performance Analysis of MySQL, Neo4j, and PostgreSQL using Different Data Scenarios

Institute: Eastern Switzerland University of Applied Science

Program: MSc Computer Science

Course: DB Seminar

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Stage: *interim*

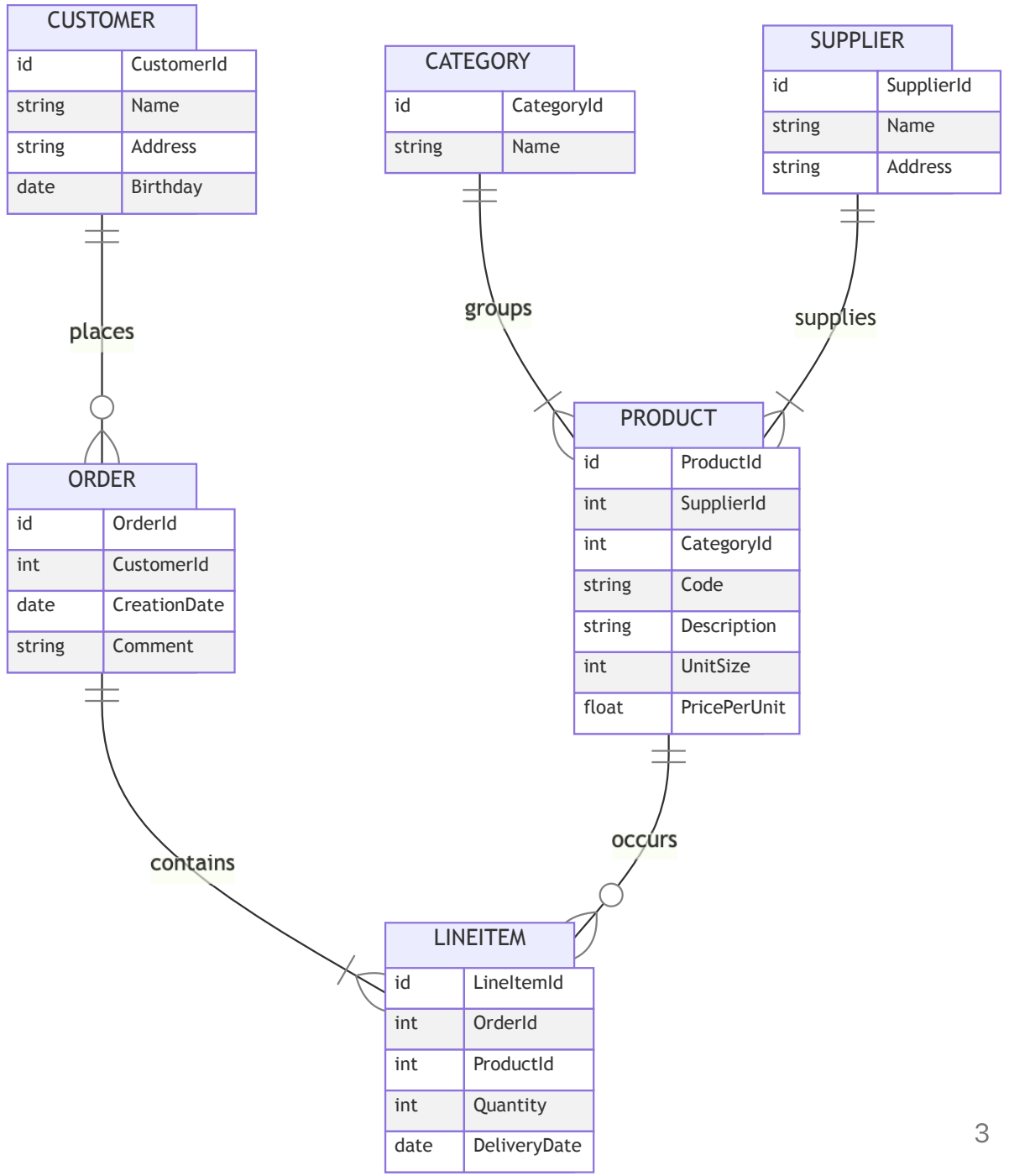
Date: 14. April 2023

Content

- Relational DBMS vs. Graph-Based DBMS
- Tool `gobench`
- Synthetic Script & Substitution
- Custom Scripts (`merchant`, `employees`, `friends`)
- Automation
- Result Analysis
- Open Work

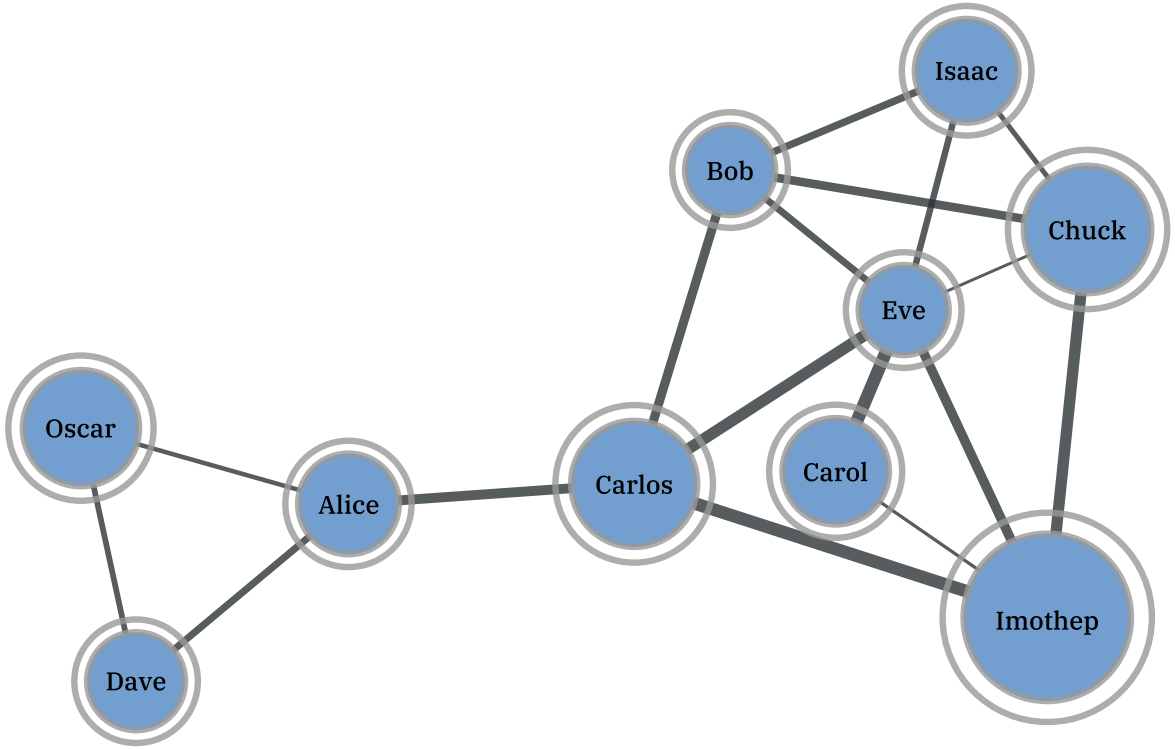
Relational DBMS

- Tables are entities
- Relationships using keys
- Homogenous data through schema



Graph-Based DBMS

- Attributed nodes and edges
- Relationships are first class elements
- Heterogenous data (schema-less)



Query Languages

Query adult customers

```
-- SQL
SELECT * FROM Customer c WHERE c.Age >= 18

-- Cyper
MATCH (c:Customer) WHERE c.Age > 18 RETURN c;
```

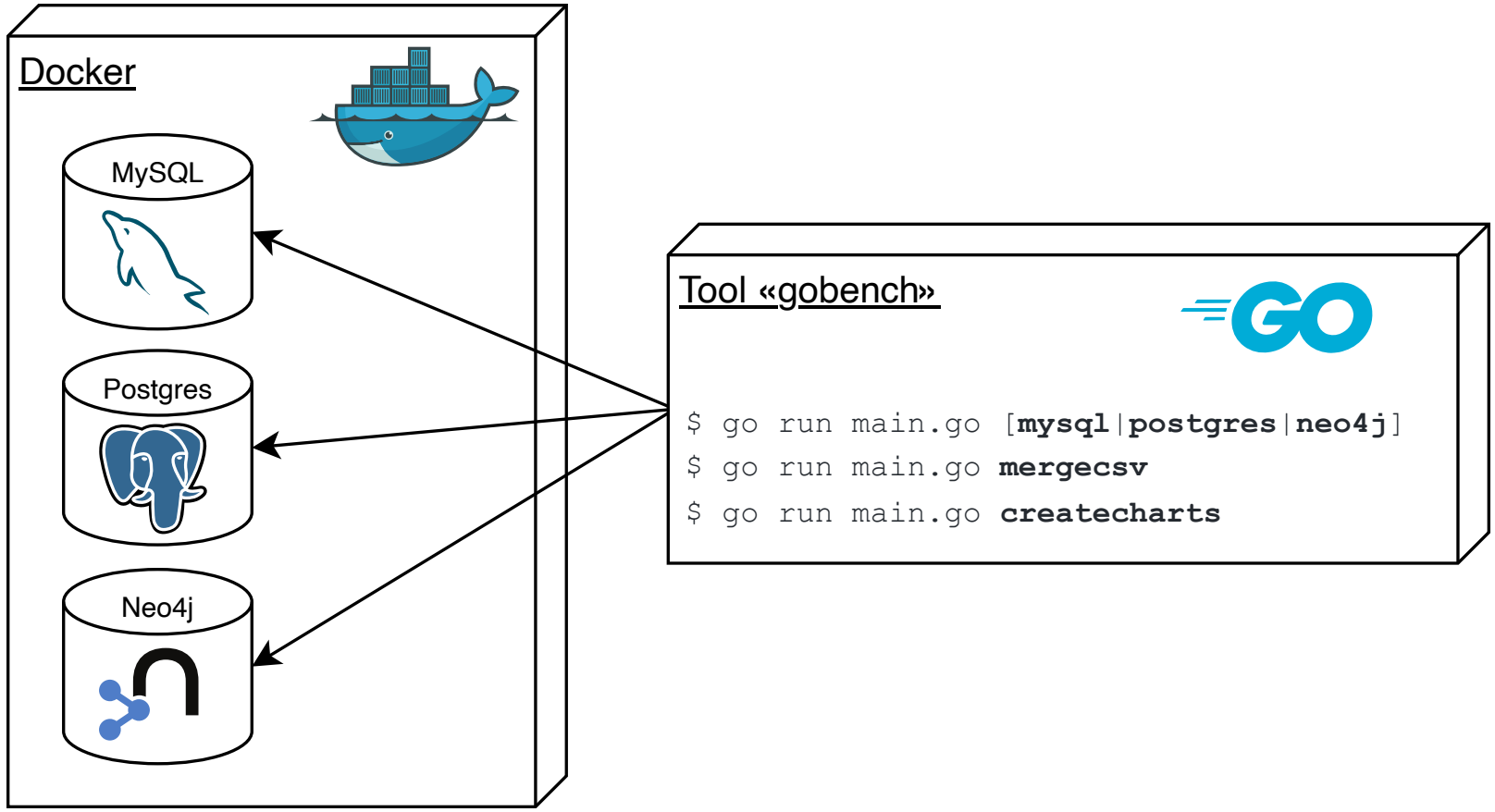
Show top clients based on revenue

```
-- SQL
SELECT c.CustomerId, c.Name, SUM(p.Total) FROM Customer c
INNER JOIN Purchase p on c.CustomerId = p.CustomerId
GROUP BY c.CustomerId, c.Name ORDER BY SUM(p.Total) DESC

-- Cyper
MATCH (c:Customer)-[:MAKES]->(p:Purchase)
RETURN c.Name, SUM(p.Total) AS TotalOrderValue ORDER BY TotalOrderValue DESC
```

System Setup

- Requirements:
  - Docker
  - Go
  - gobench



Command Line Interface (CLI)

- Open terminal and navigate to the location of `main.go`
  `$ cd ~/path/to/gobench/cmd`
- Interact with `go run main.go` to see flags

```
▶ go run main.go -h
Available subcommands:
        mysql | postgres | neo4j | mergecsv | createcharts
        Use 'subcommand --help' for all flags of the specified command.
pflag: help requested
exit status 2
```

Possilbe CLI Commands

```
# run synthetic INSERT and SELECT statements against MySQL, each 100x
$ go run main.go mysql --host 127.0.0.1 --port 3306 --user "root" \
        --pass "password" --iter 100 --run "inserts selects"
```

```
# run statemets of custom script against Postgres, save results in file
$ go run main.go postgres --host 127.0.0.1 --port 5432 --user "postgres" \
        --pass "password" --iter 100 --script "./path/to/mysql.sql" \
        --writecsv "./path/to/results/mysql.csv"
```

```
# merge serveral result files
$ go run main.go mergecsv \
        --rootDir "~/path/with/csv-files/to-be-merged"
        --targetFile "~/anypath/allresults.csv"
```

```
# visualize the benchmarking results
$ go run main.go createcharts \
        --dataFile "~/anypath/allresults.csv" --charttype "line"
```

Custom Script (`merchant`)

```
-- INIT
\benchmark once \name initialize
DROP SCHEMA IF EXISTS gobench CASCADE;
CREATE SCHEMA gobench;
CREATE TABLE gobench.Customer (CustomerId INT PRIMARY KEY, Name VARCHAR(10), ... );
CREATE TABLE gobench.order (OrderId INT PRIMARY KEY, CustomerId INT NOT NULL, ... );

-- INSERTS
\benchmark loop 1.0 \name inserts
INSERT INTO gobench.Customer (CustomerId, Name, Birthday)
VALUES ( {{.Iter}}, '{{call .RandString 3 10 }}', '{{call .RandDate }}');

INSERT INTO gobench.Order (OrderId, CustomerId, CreationDate, Comment)
VALUES( {{.Iter}}, (SELECT CustomerId FROM gobench.Customer ORDER BY RANDOM() LIMIT 1),
        '{{call .RandDate }}', '{{call .RandString 0 50 }}');

-- SELECTS
\benchmark loop 1.0 \name select_simple
SELECT * FROM gobench.Customer WHERE CustomerId = {{.Iter}}

-- CLEAN
\benchmark once \name clean
DROP SCHEMA IF EXISTS gobench CASCADE;
```

Statement Substitutions

Sequences of the following patterns will be substituted before the statement is executed:

`{{.Iter}}` --> The iteration counter. Will return 1 when `\benchmark once`.
`{{call .RandIntBetween 1 100}}` --> Random integer between `1` and `100`.
`{{call .RandFloatBetween 0 1}}` --> Random float between `0` and `1`.
`{{call .RandString 3 15}}` --> Random string with length between `3` and `15`.
`{{call .RandDate}}` --> Random date.

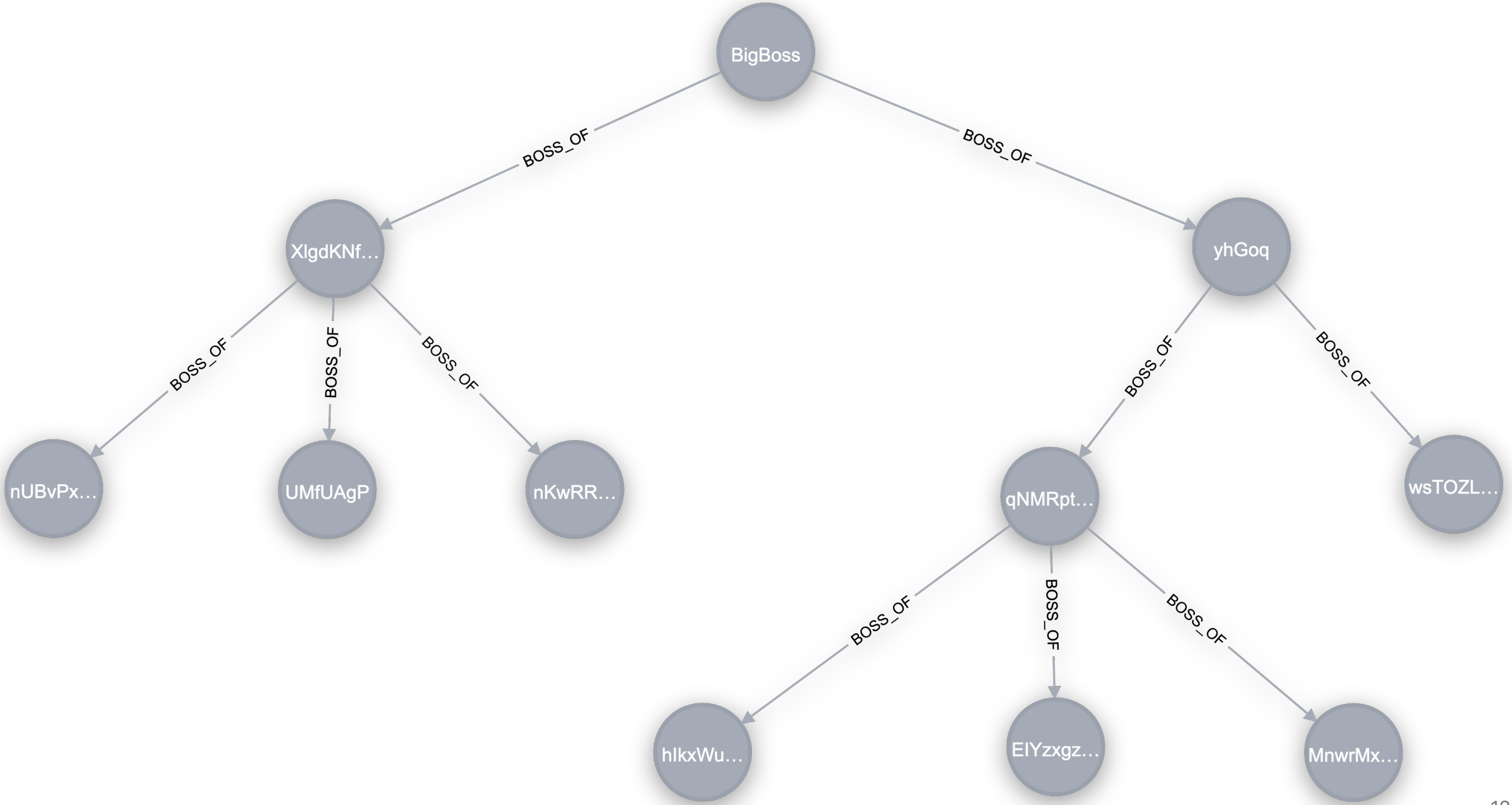
Custom Script (`employees`)

Show all subordinates of an employee (tree queries)

```
-- use WITH RECURISON notation in Postgres (similar in MySQL)
WITH RECURSIVE hierarchy AS (
    SELECT employeeId, firstname, boss_id, 0 AS level
    FROM gobench.employee
    WHERE employeeId = {{.Iter}}
  UNION ALL
    SELECT e.employeeId, e.firstname, e.boss_id, hierarchy.level + 1 AS level
    FROM gobench.employee e JOIN hierarchy ON e.boss_id = hierarchy.employeeId
)
SELECT * FROM hierarchy;

-- simpler query using Cypher
MATCH (boss)-[:BOSS_OF*1..]->(sub) WHERE boss.employeeId={{.Iter}} RETURN sub;
```

> see example graph on next slide ...


BigBoss
BOSS_OF
BOSS_OF
XlgdKNf…
yhGoq
BOSS_OF
BOSS_OF
BOSS_OF
BOSS_OF
BOSS_OF
nUBvPx…
UMfUAgP
nKwRR…
qNMRpt…
wsTOZL…
BOSS_OF
BOSS_OF
BOSS_OF
hIkxWu…
EIYzxgz…
MnwrMx…

Custom Script (`friends`)

Show the shortest acquaintance path of two people (cyclic graph queries)

```
**************************************************************************
************************** `WORK IN PROGRESS` **************************
**************************************************************************
```

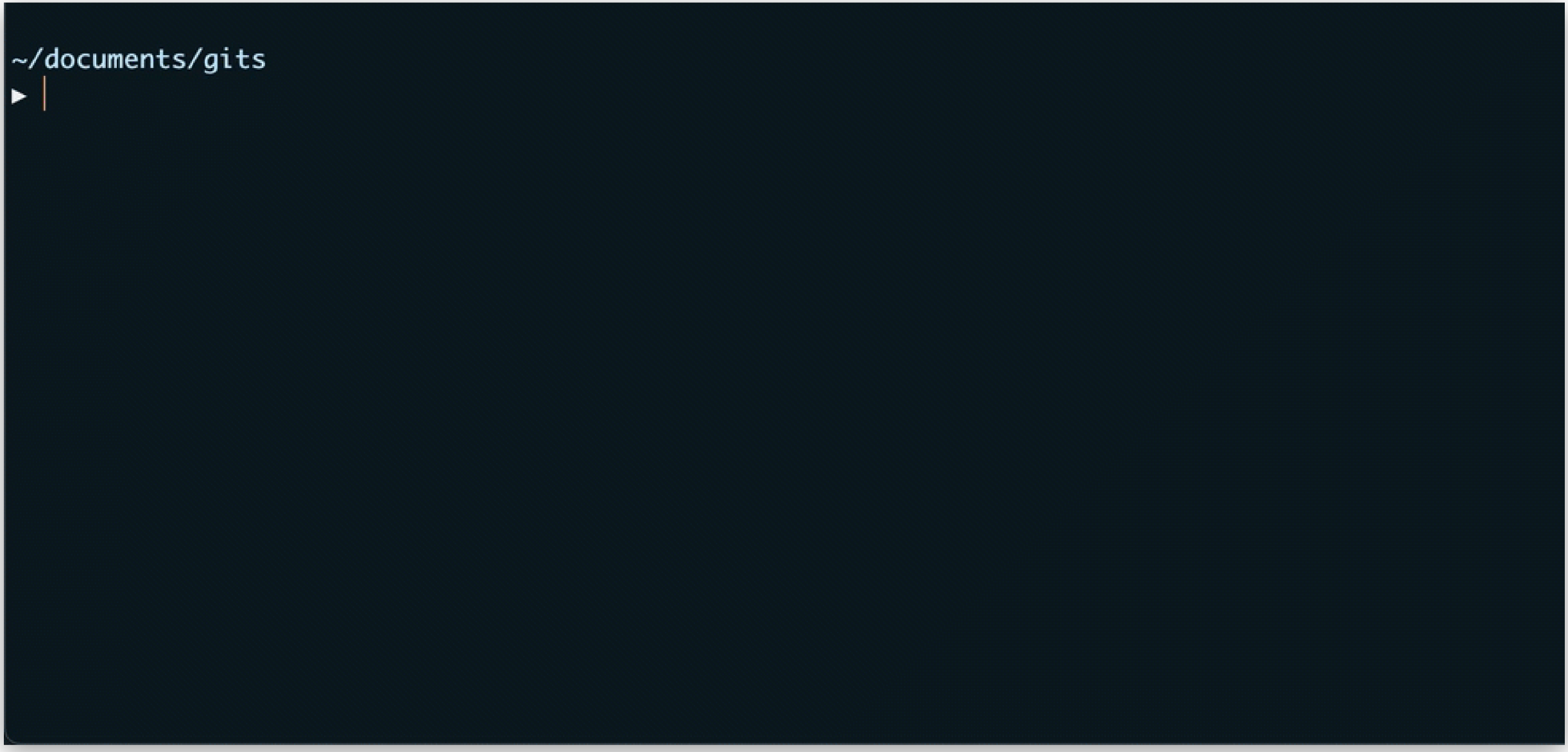
Automation

```
$ bash bashscript.sh
```

```
start_time=`date +%s`
echo -e "\nSTART BENCHMARKING...\n"
for MULT in "${MULTIPLICITIES[@]}"; do
    echo $(for i in $(seq 1 50); do printf "_"; done)
    echo -e "\nITERATIONS: ${MULT}"

    echo -e "\nTEST MYSQL"
    go run $gobench_main_path mysql \
        --host $db_host \
        --port $mysql_port \
        --user $mysql_user \
        --pass $mysql_pass \
        --iter $MULT \
        --threads $threads \
        --script "${script_base_path}/${script_set}/mysql.sql" \
        --writecsv "${result_base_path}/${script_set}/mysql_${MULT}.csv"
```

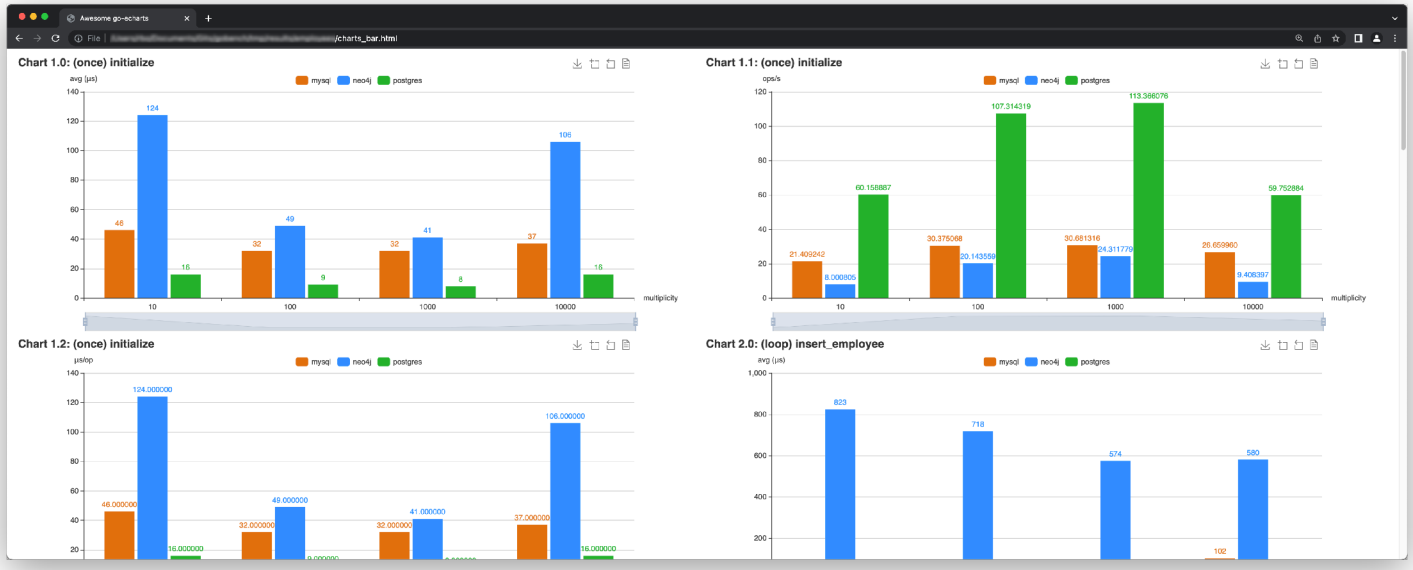
> see demo on next slide...


~/documents/gits
▶

Result Analysis

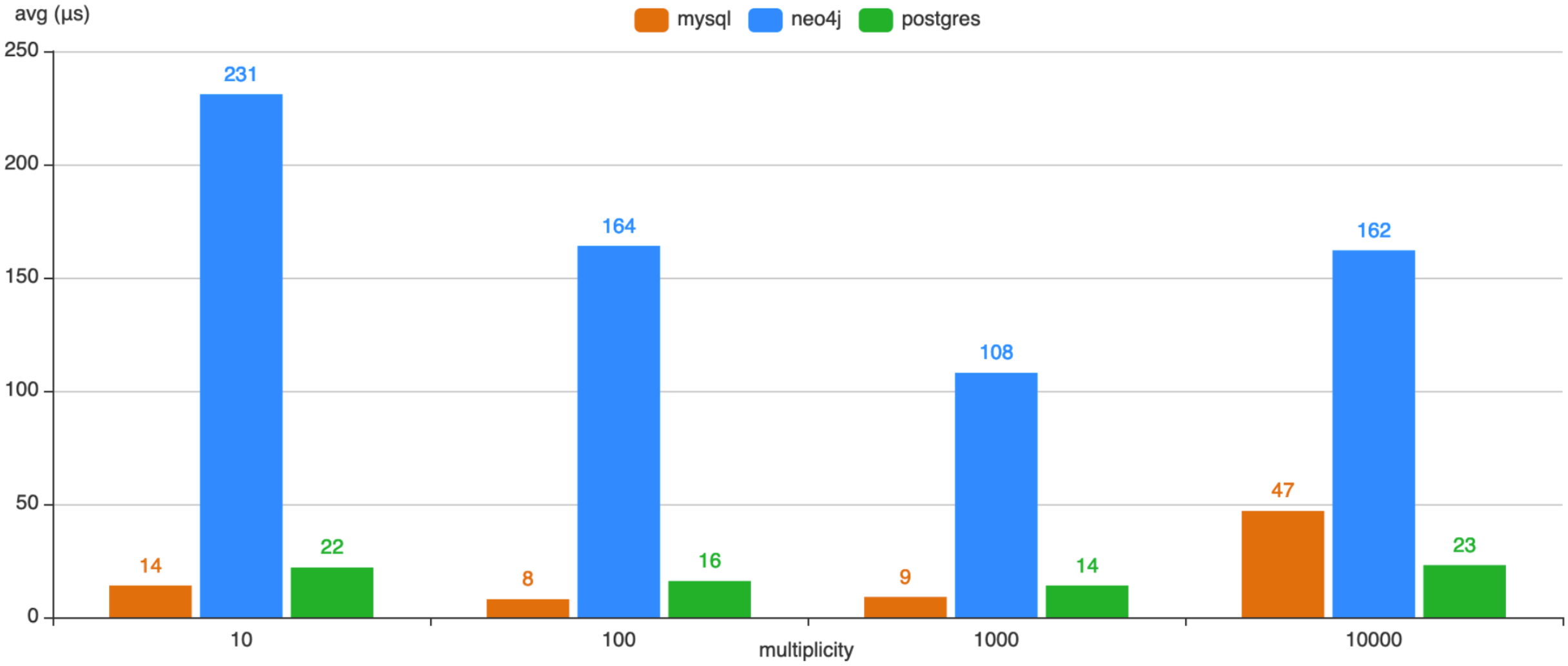
Generating a `chart.html` file to visualize

- average amount of microseconds (`µs`) per benchmark (the lower the better)
- operations per second (the higher the better)
- microseconds per operation (the lower the better)



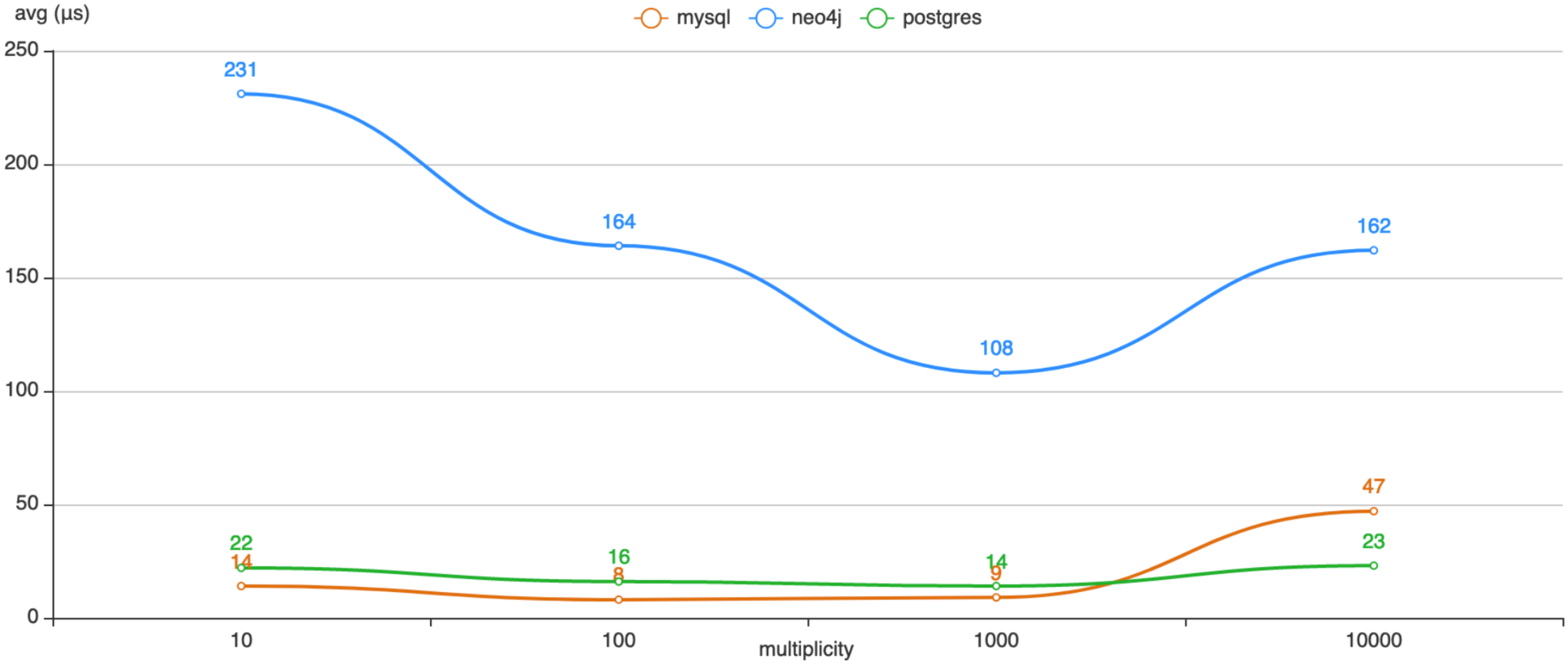
1 second (s) = 1'000'0000 microseconds (µs)

Chart 3.0: (loop) select_before_index



1 second (s) = 1'000'0000 microseconds (µs)

Chart 3.0: (loop) select_before_index



1 second (s) = 1'000'0000 microseconds (µs)

Open Work

CLI Tool	Custom Scripts	Writing
✅ Benchmarking	✅ `merchant`	✅ Abstract
✅ Result consolidation	✅ `employees`	✅ Intro
✅ Chart generation	⭕ `friends`	⭕ System specs & setup
		⭕ Benchmarking approaches
		⭕ Result analysis & conclusion

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Thanks