

Automated Database Benchmarking Tool

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

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Module	DB Seminar
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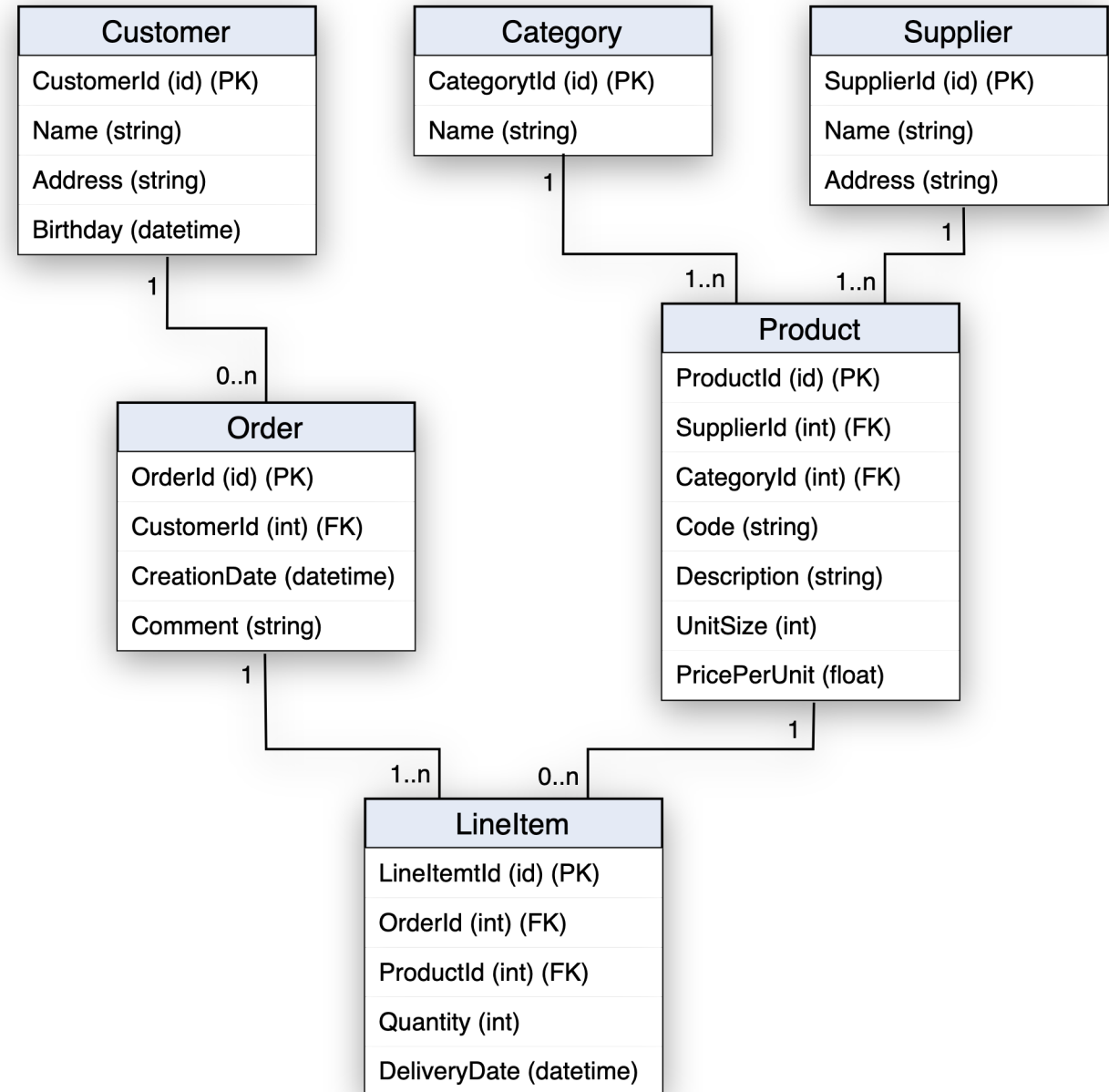


Content

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- Tool `godbbench`
- Synthetic Script & Substitution
- Custom Scripts (`merchant` , `employees`)
- Automation
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- Conclusion & Future Work

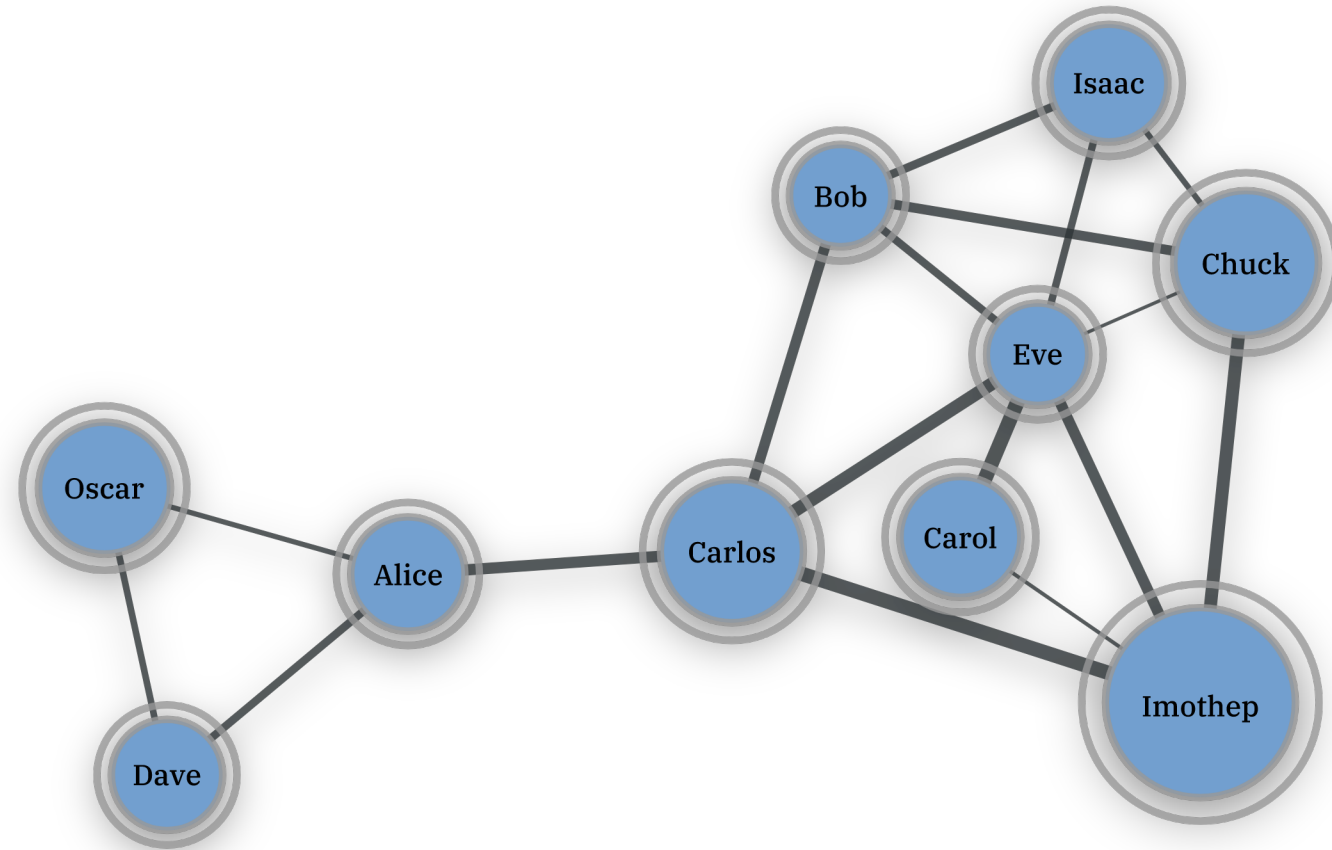
Relational DBMS

- Tables are entities
- Relationships using keys
- Homogenous data through schema
- Ideal for **predefinable & rigid** data use cases



Graph-Based DBMS

- Attributed nodes and edges
- Relationships are first-class citizen
- Heterogenous data (schema-less)
- Ideal for **alternating** & **highly connected** data use cases



Query Languages

Query adult customers

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

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

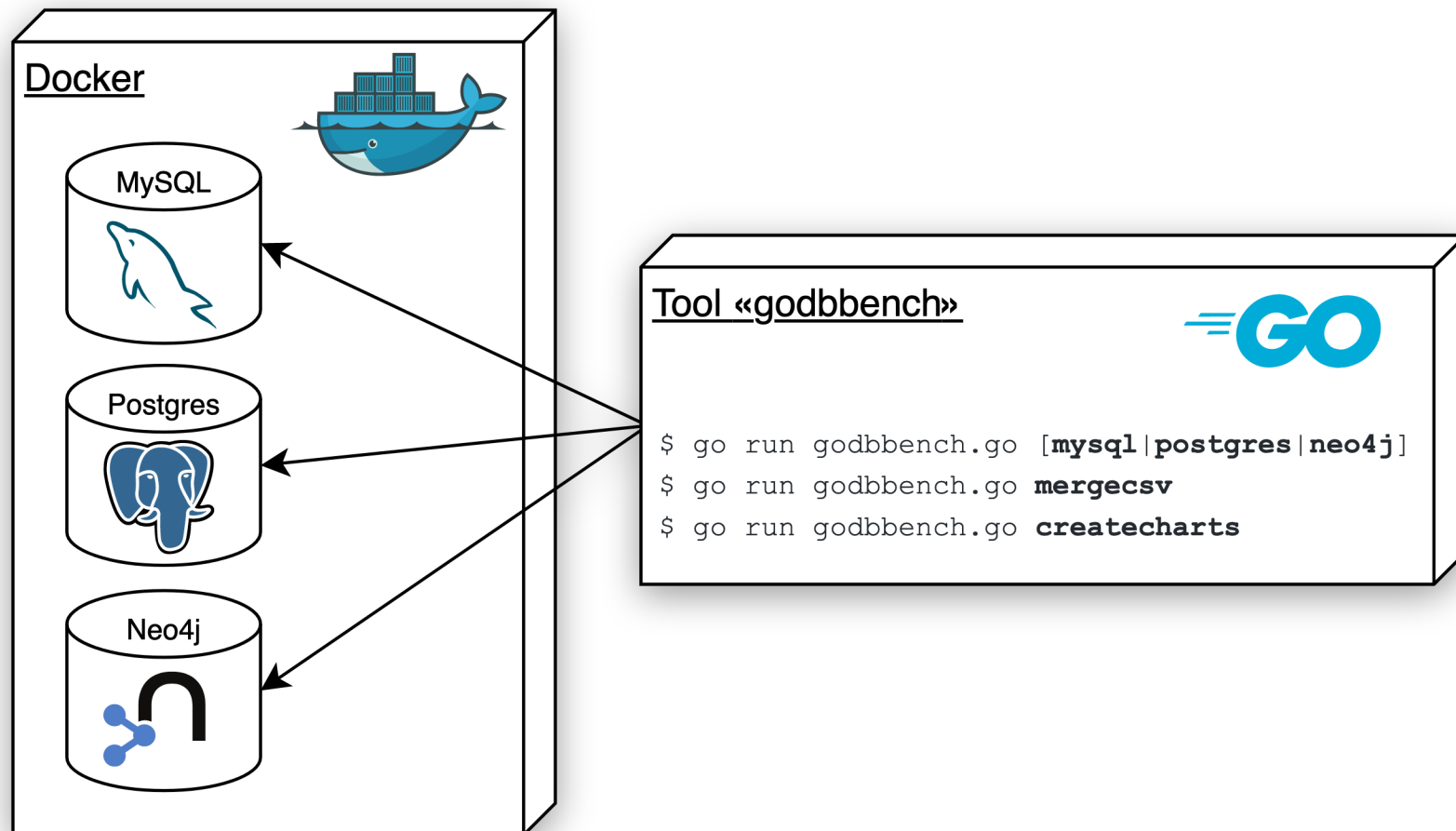
Show top clients based on revenue

```
-- 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

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

System Setup

- Requirements:
 - Docker
 - Go
 - godbbench



Command Line Interface (CLI)

- Open terminal and navigate to the location of `godbbench.go`
`$ cd ~/path/to/godbbench/cmd`
- Interact with `go run godbbench.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 goddbench.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 goddbench.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 goddbench.go mergecsv \  
    --rootDir "~/path/with/csv-files/to-be-merged"  
    --targetFile "~/anypath/allresults.csv"
```

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


Statement Substitutions

Allows for dynamic creation of queries without specifying thousands of structurally identical DBMS statements.

Example

```
INSERT INTO Customer (Id, Name, Birthday)
VALUES ( {{.Iter}}, '{{call .RandString 3 10 }}', '{{call .RandDate }}');
```

will become...

```
INSERT INTO Customer (Id, Name, Birthday) VALUES ( 1, 'd9cfApqFe', '1999-11-25');
```

Substitution Possibilities

Declaration	Substitution
<code>{{.Iter}}</code>	Counter that starts with 1 and ends with the specified multiplicity of the given benchmark.
<code>{{call .RandInt64}}</code>	Returns a random non-negative value of type Int64 .
<code>{{call .RandFloat64}}</code>	Returns a random value within the interval [0.0,1.0) as Float64 .
<code>{{call .RandIntBetween 1 42}}</code>	Returns a random integer between 1 and 42 (Int32).
<code>{{call .RandFloatBetween 0.8 9.9}}</code>	Returns a random float between 0.8 and 9.9 (Float64).
<code>{{call .RandString 1 9}}</code>	Returns a random string with a length between 1 and 9 characters.
<code>{{call .RandDate}}</code>	Returns a random date as string (yyyy-MM-dd) between <code>1970-01-01</code> and <code>2023-01-01</code> .

Custom Script (merchant)

```
-- INIT (illustration purposes)
\benchmark once \name initialize
DROP SCHEMA IF EXISTS goddbench CASCADE; CREATE SCHEMA goddbench;
CREATE TABLE goddbench.order (OrderId INT PRIMARY KEY, CustomerId INT NOT NULL, ... );

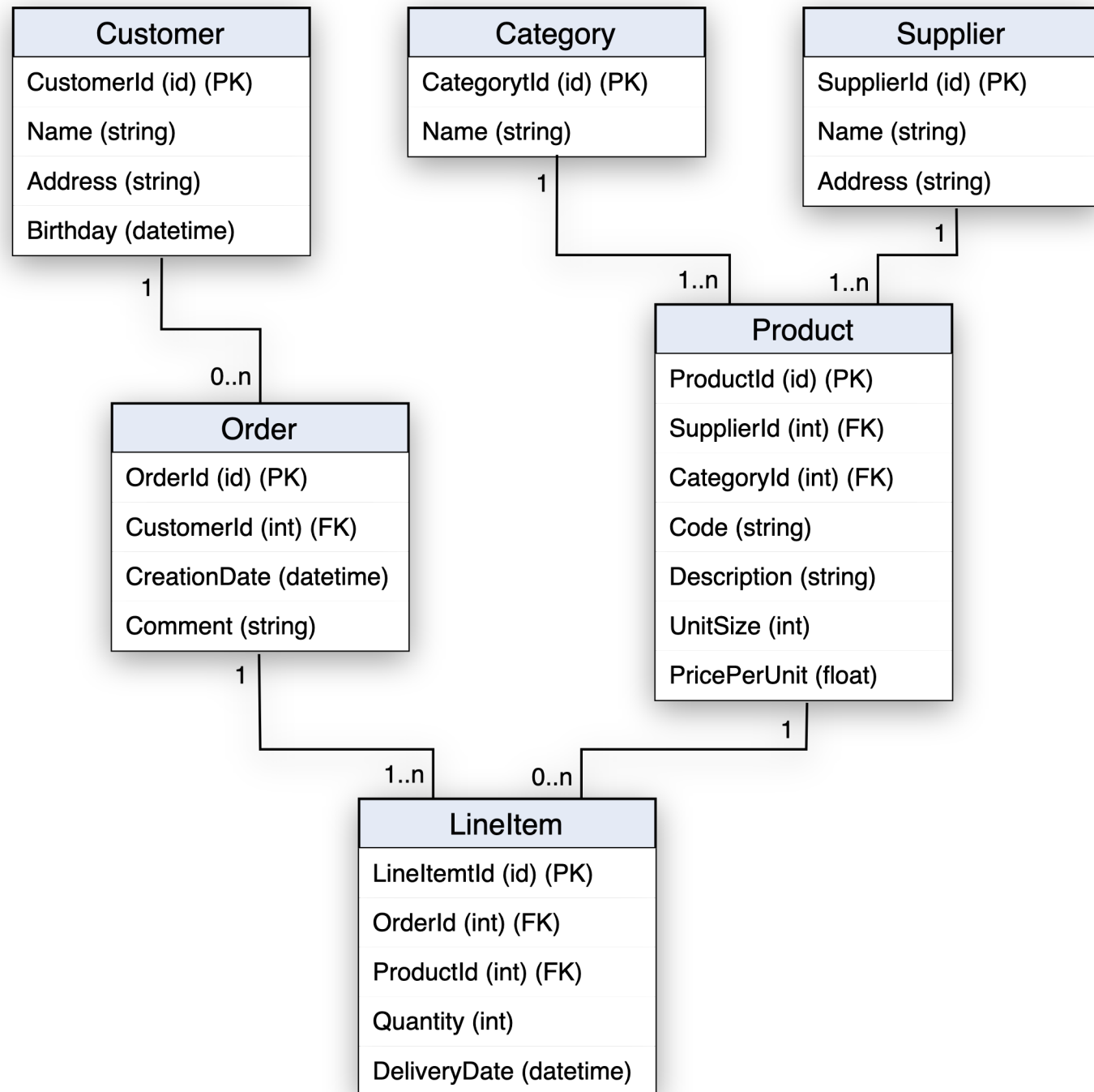
-- INSERTS (illustration purposes)
\benchmark loop 1.0 \name inserts
INSERT INTO goddbench.Order (OrderId, CustomerId, CreationDate, Comment)
VALUES( {{.Iter}}, (SELECT CustomerId FROM goddbench.Customer ORDER BY RANDOM() LIMIT 1),
      '{{call .RandDate }}', '{{call .RandString 0 50 }}');

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

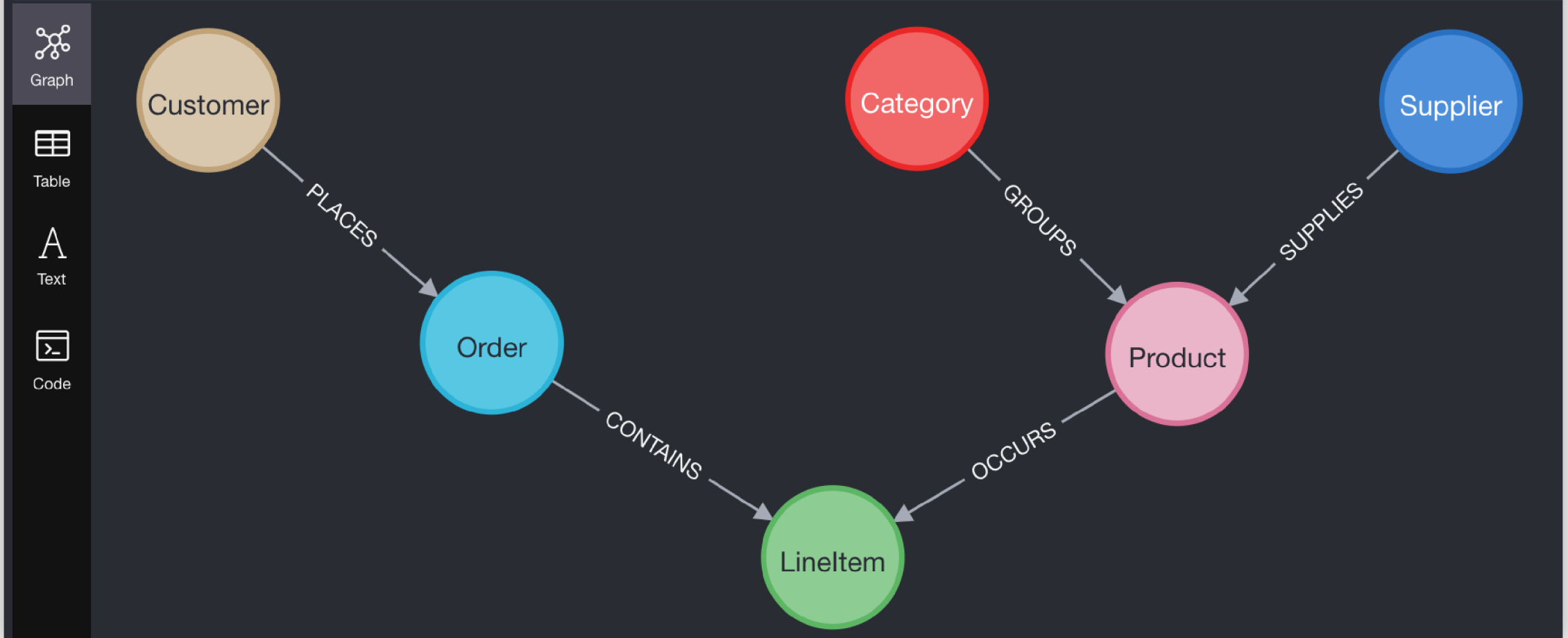
\benchmark loop 1.0 \name select_medium
SELECT * FROM goddbench.Product p JOIN goddbench.Supplier s ON ...

\benchmark loop 1.0 \name select_complex
SELECT c.CustomerId, c.Name, SUM(li.Quantity * p.UnitSize * p.PricePerUnit) as ...

-- CLEAN (illustration purposes)
\benchmark once \name clean
DROP SCHEMA IF EXISTS goddbench CASCADE;
```



```
neo4j$ call db.schema.visualization()
```



Attention:

Relational data schemas should not directly be mapped into a graph-world.

Relationships in graph-based DBs are first-class citizen that can hold information by itself.

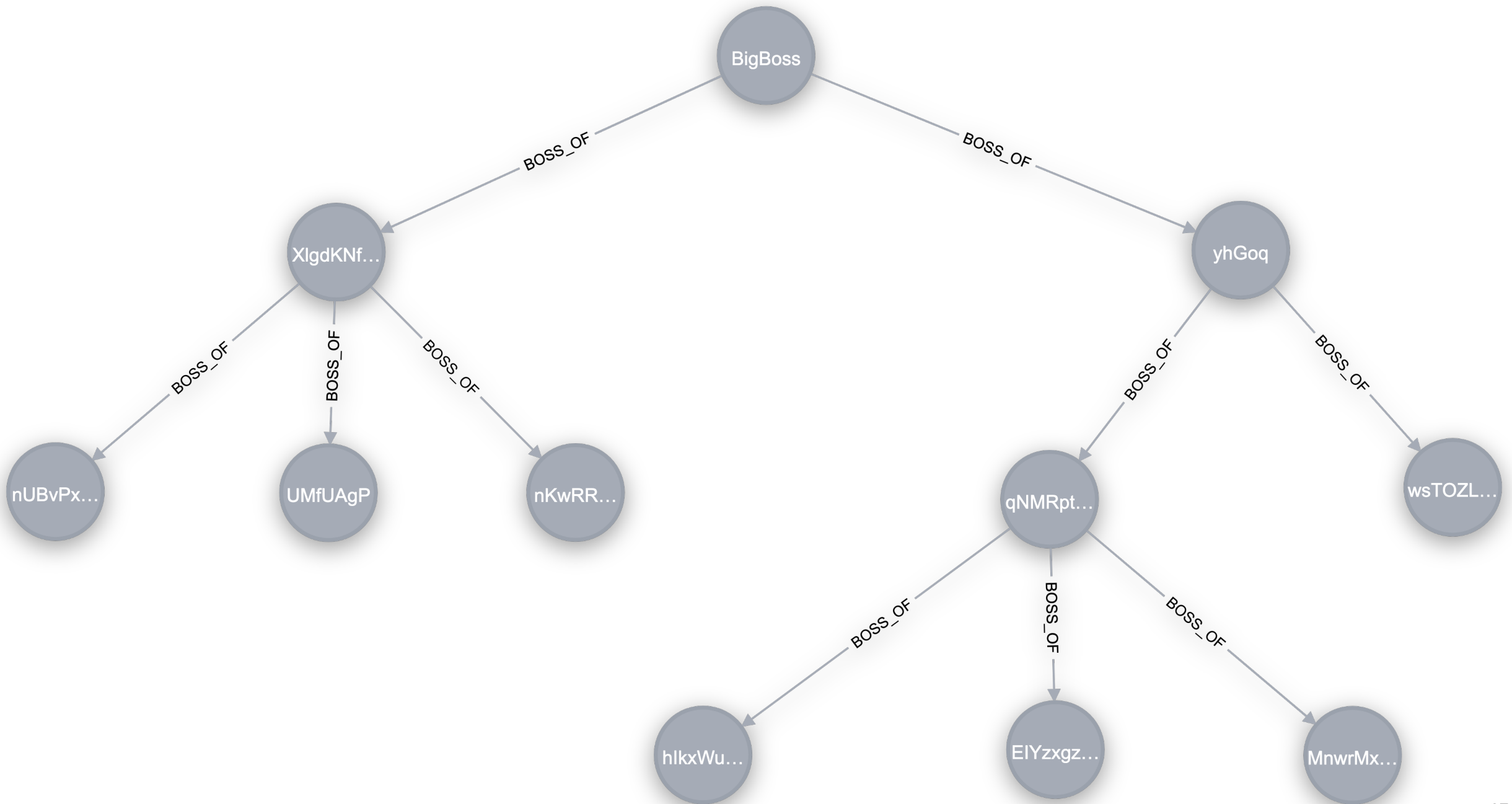
Custom Script (employees)

Show all subordinates of an employee (tree queries)

```
-- use WITH RECURSION notation in PostgreSQL (similar in MySQL)
WITH RECURSIVE hierarchy AS (
    SELECT employee_id, first_name, boss_id, 0 AS level
    FROM employee
    WHERE employeeId = {{.Iter}}
    UNION ALL
    SELECT e.employee_id, e.first_name, e.boss_id, hierarchy.level + 1 AS level
    FROM employee e JOIN hierarchy ON e.boss_id = hierarchy.employee_id
) SELECT * FROM hierarchy;
INSERT INTO employee (first_name, boss_id, salary) VALUES ('BigBoss', null, 999999);

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

see example graph on next slide ...



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

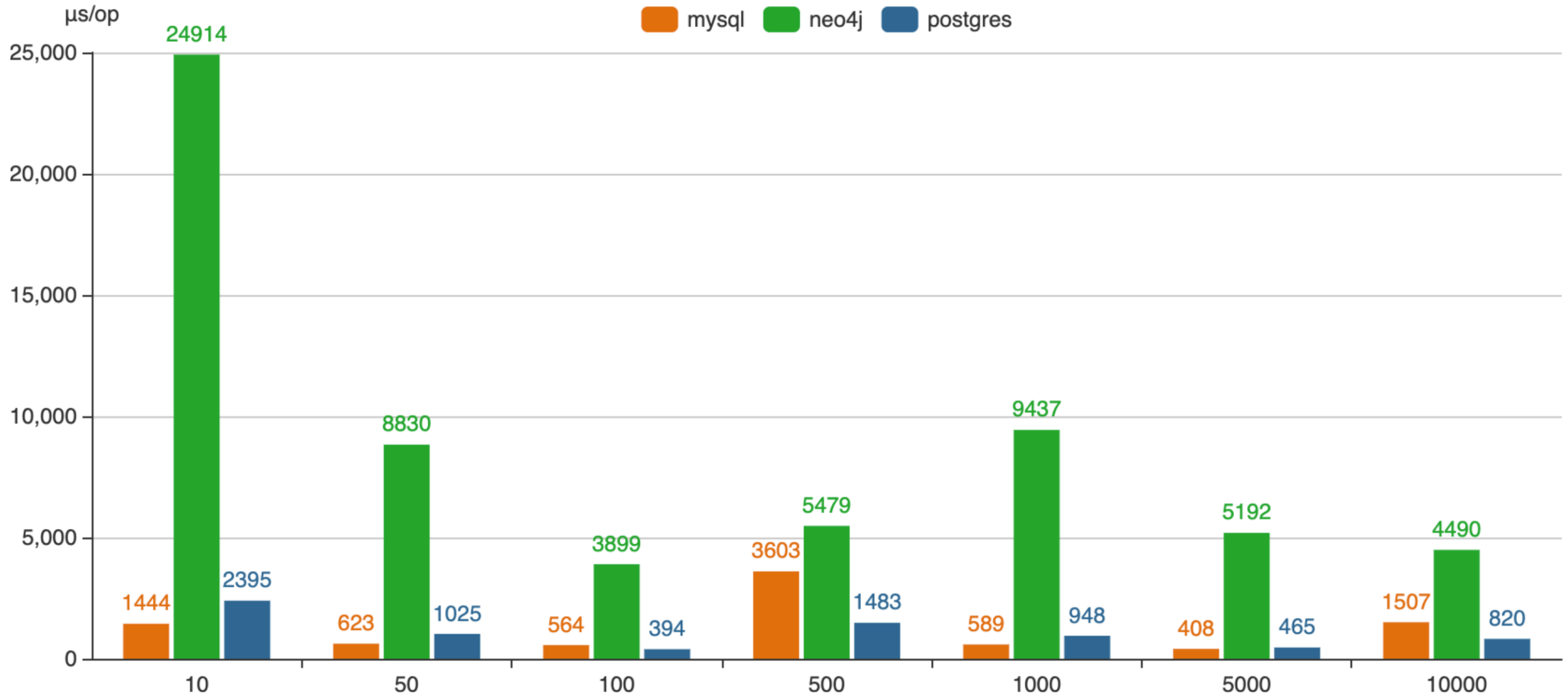
Generating a `chart.html` file to visualize

- 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)



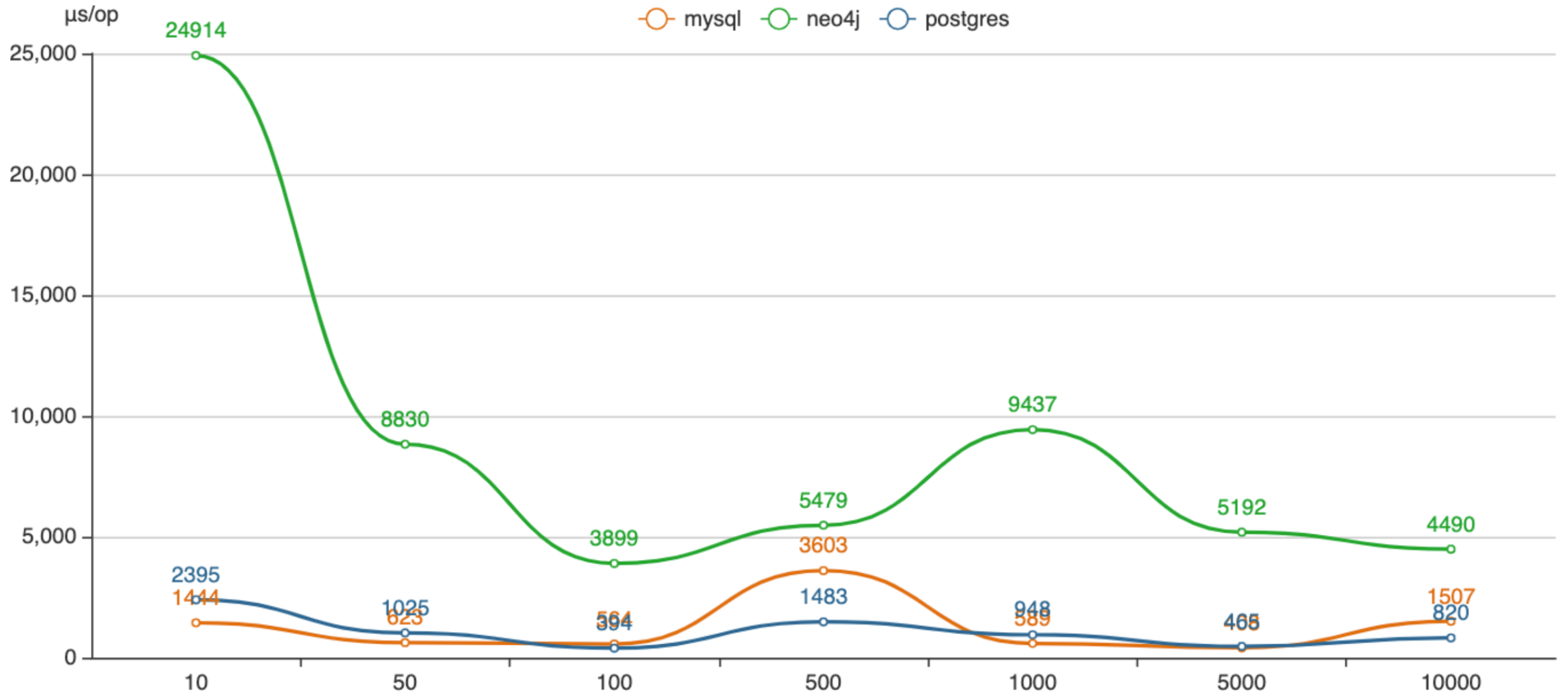
1 second (s) = 1'000'000 microseconds (μs)

Chart 3.3: (loop) select_before_index



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

Chart 3.3: (loop) select_before_index



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

Conclusion & Future Work

- todo

References

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Thanks