ASL Exercise 5

Measuring a baseline
System under test

- MonetDB
  - Main-memory database (reads data off disk, keeps it in memory)
  - Best for analytical queries (no updates, etc.)

- Our clients
  - Simple scripts that run three types of queries from TPC-H
  - Log the output and runtime of each query
Testing methodology

• Experiment length
  – 4 minutes (without warmup and cooldown)
  – 3 repetitions

• Number of clients
  – Between 1 and 20

• MonetDB
  – Different multi-threading setups

• Machines
  – Two physical machines
  – 16 cores each
Testing setup

Load generator (clients)

MonetDB (server)

1) Send query
2) Process
3) Send response

while (time not up)
  Query 1 and wait
  Query 2 and wait
  Query 3 and wait
end

$T_{\text{network}} << T_{\text{processing}}$
Collecting results

- $mtX/$ – $X$ threads in MonetDB
  - $pY/$ – $Y$ parallel clients
  - $cZ/$ – Data output by client number $Z$
  - $rW/$ – Repetition number $W$
- $dump.dat$

<table>
<thead>
<tr>
<th>supp_nation</th>
<th>cust_nation</th>
<th>l_year</th>
<th>revenue</th>
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<tbody>
<tr>
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<tr>
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<td>1996</td>
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4 tuples (639.316ms)
Script to transform results

• Response times
  – Collect all response times per repetition
  – Collect response times per query type per repetition
  – Compute average and standard deviation

• Throughput
  – Count returned queries from all clients / 4 minutes
  – Compute average and standard deviation
Results are stored in one large file

- Print one line per each experiment
- Many columns (average, stdev, etc.)
- Filter this file as needed to plot

<table>
<thead>
<tr>
<th>mt</th>
<th>p</th>
<th>q</th>
<th>avg-r1</th>
<th>stdev-r1</th>
<th>avg-r2</th>
<th>stdev-r2</th>
<th>avg-r3</th>
<th>stdev-r3</th>
<th>avg-all</th>
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<tbody>
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<td>1</td>
<td>qall</td>
<td>0.77802</td>
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</tbody>
</table>
How many threads in MonetDB?
And now?
Maybe if we look at the TPUT graph?
Maximum throughput?

Query: qall

Throughput (ops/s)

Number of clients

Average of 3 rep.
Interactive law

Maximum throughput?

But RT seems to change here...
A word on standard deviation

All nice and clean... or is it?
A word on standard deviation (II)

Let’s see AVG and STDEV inside a repetition...

![Graph showing response time vs number of clients with AVG and STDEV error bars for repetition 1.](image.png)
What happened to our STDEV?

• What could be the reason?
What happened to our STDEV?

• What could be the reason?
• Recall: Each client sends three types of queries...
• What if their response times are different?
RT by Query type

If we average over three classes of queries, the standard deviation is going to be high.
Interactive law

$TPUT = \frac{1}{(RT+Z)} \times \#Clients$
Interactive law (II)

\[ TPUT = \frac{1}{RT+Z} \times \#Clients \]

- But we don’t only run Q2!
- If we would run Q2 alone we would get the blue line. The green line is 1/3 the global throughput!
Interactive law (III)

Response time ~ 0.4s at 16 clients

Actual throughput ~ 5 at 16 clients

Because system throughput (Q1+Q2+Q3) ~ 14 at 16 clients

Response time ~ 2.75s at 16 clients

Actual throughput ~ 5 at 16 clients
Plotting Best Practices

• Start axis at zero, try and keep same range for related graphs
• Label both axis, state units clearly
  – Use Ops/s not Ops/minute, and other “exotic” units
  – Instead of 12000000 use 1.2 million
• Caution with logarithmic scales on axis
• Include error bars!
• Make sure system configuration is easily found