17 Things Developers should know about Databases

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OpenSource 101 Home
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Lets start with some Humor

The Great Split

Developers

Technical Operations

Operations

Focused on Database (DBA etc)

Generalist (Sysadmin, SRE, etc)

Devs vs Ops

DevOps suppose to have solved it but tension is still common between Devs and Ops

Especially with Databases which are often special snowflake

Especially with larger organizations

Large Organizations

Ops vs Ops have conflict too

Devs vs Ops Conflict

Devs

- Why is this stupid database always the problem.
- Why can’t it just work and work fast

Ops

- Why do not learn schema design
- Why do not you write optimized queries
- Why do not you think about capacity planning

Database Responsibility

Shared Responsibility for Ultimate Success

Top Recommendations for Developers

Learn Database Basics

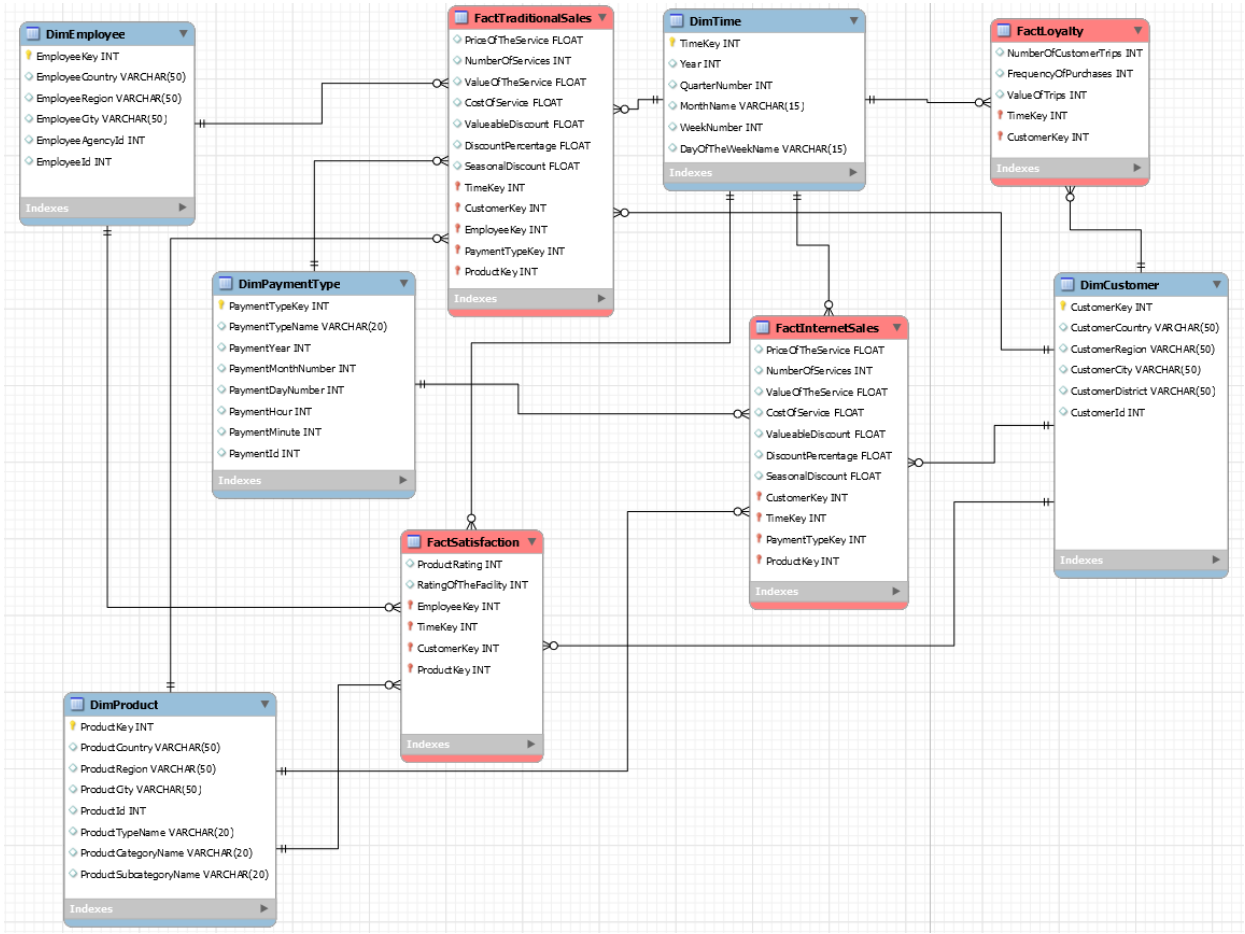
You can’t build great database powered applications if you do not understand how databases work

Schema Design

Power of the Database Language

How Database Executes the Query

Example of Relational Database Schema



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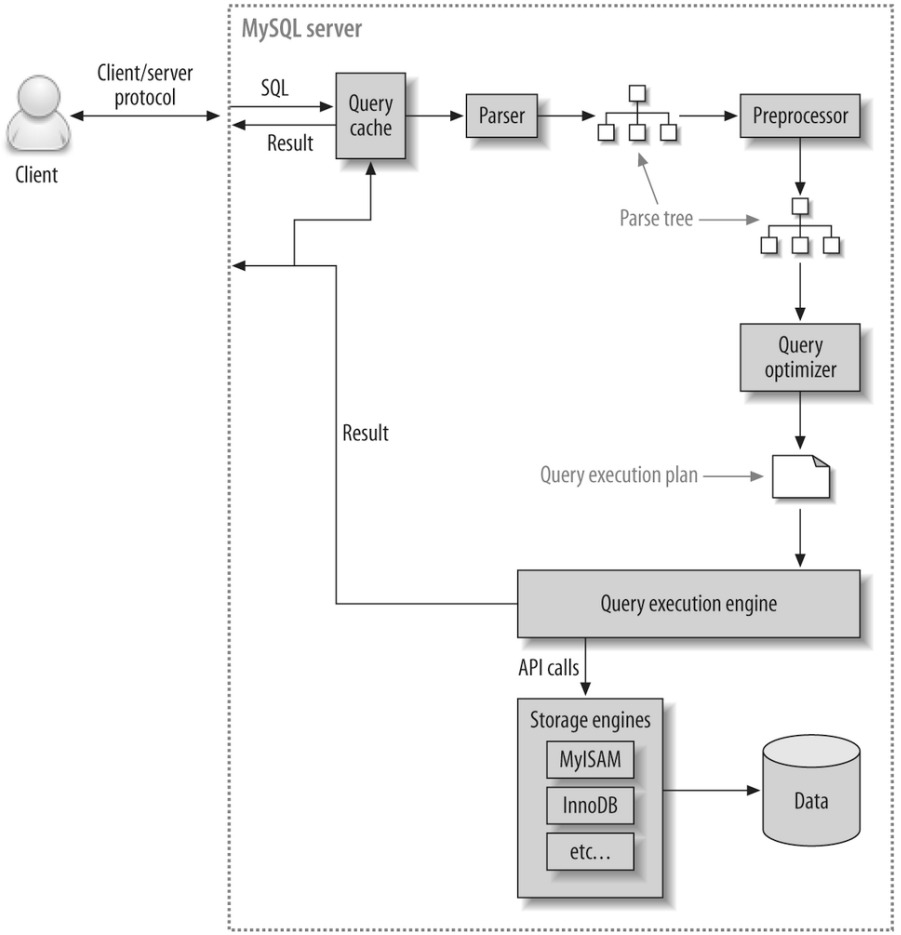
Query Execution Diagram



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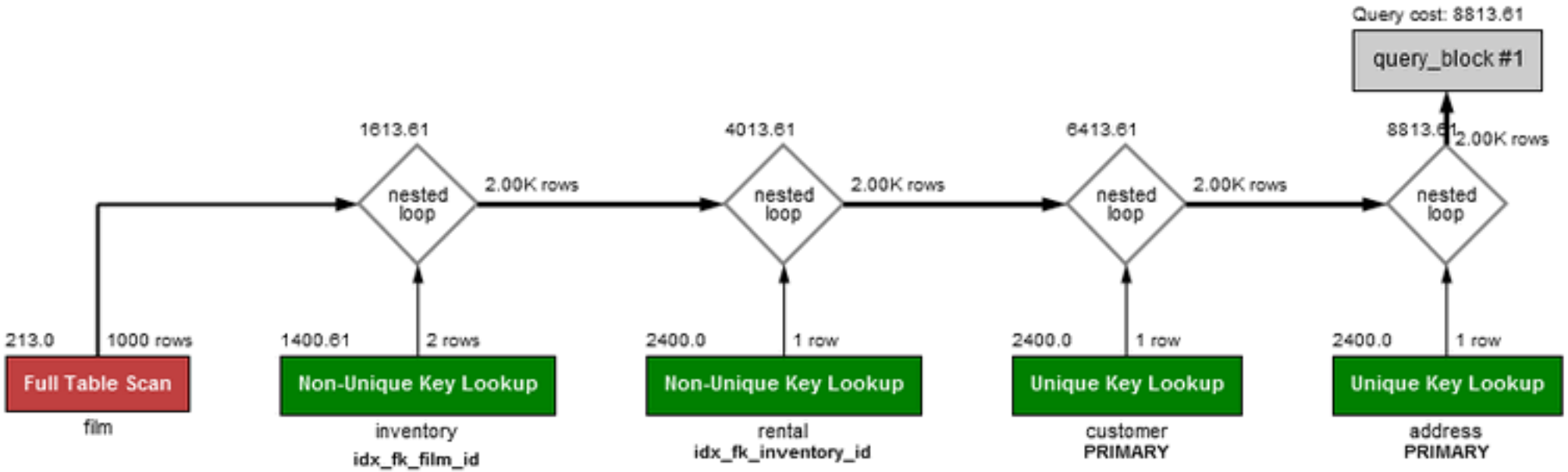
EXPLAIN



https://dev.mysql.com/doc/refman/8.0/en/execution-plan-information.html

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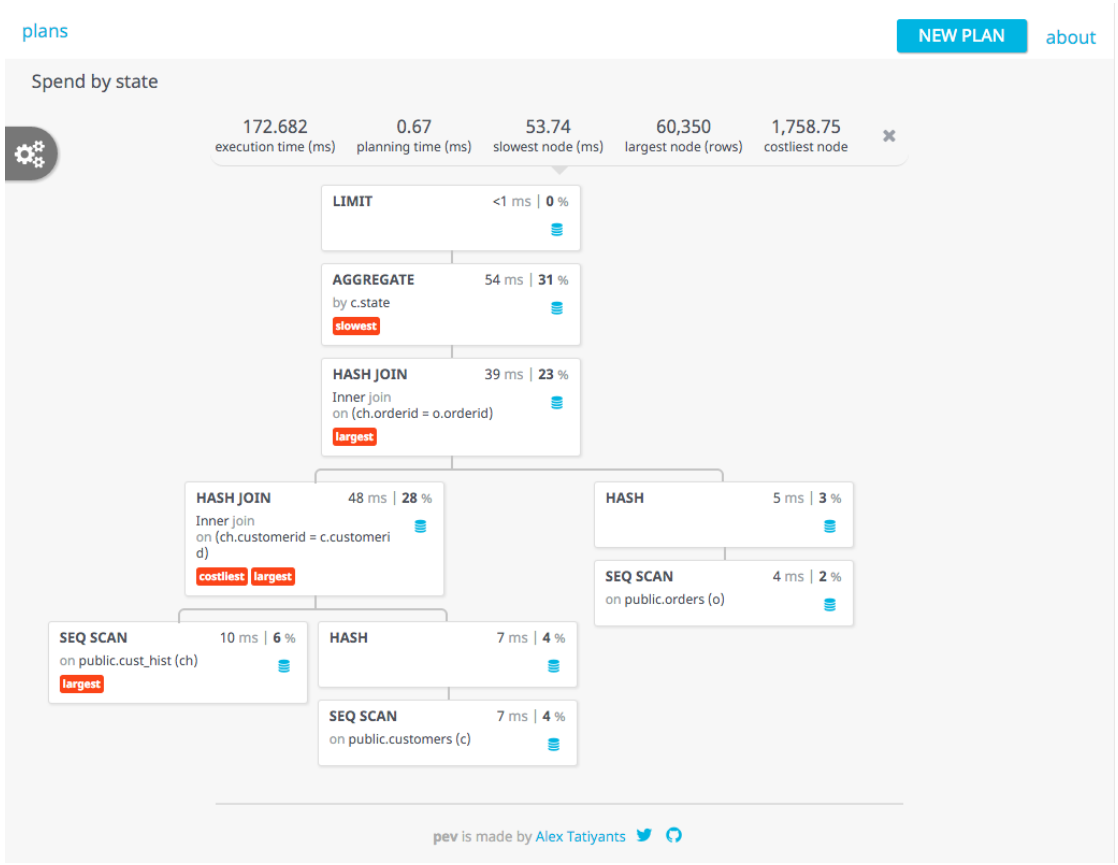
Visualizing PostgreSQL Plan with PEV



http://tatiyants.com/postgres-query-plan-visualization/

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Which Queries are Causing the Load

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Why Are they Causing this Load

SELECT sbtest

737F39F04B198EF6

Metrics

Query first seen: Aug 3, 2017 1:55 PM ••• Last seen: Today at 9:46 AM

Metrics	Rate/Sec	Sum	Per Query Stats
Query Count	104.05 (per sec)	374.58 k 4.27% of total	
Query Time	19.00 load	18:59:56 29.73% of total	183.66 ms avg
Lock Time	0.11 (avg load)	0:06:42 1.35% of total 0.61% of query time	1.13 ms avg
Innodb IO Read Wait	0.61 (avg load)	0:36:44 9.10% of total 3.38% of query time	6.20 ms avg
Innodb Read Ops	52.35 (per sec)	188.45 k 7.62% of total	0.00 avg
Innodb Read Bytes	857.64 KB (per sec)	3.09 GB 7.62% of total 16.38 KB avg io size	8.22 KB avg
Innodb Distinct Pages	-	-	4.69 avg
Rows Sent	10.41 k (per sec)	37.46 m 30.52% of total	100.00 avg
Bytes Sent	1.30 MB (per sec)	4.67 GB 30.78% of total 124.71 Bytes bytes/row	12.47 KB avg
Rows Examined	1.14 m (per sec)	4.11 b 39.17% of total 109.79 per row sent	10.47 k avg
External Sorts (Filesort)	104.05 (per sec)	374.58 k 49.93% of total 100.00% of queries	-
Full Table Scans	0.01 (per sec)	40.00 0.17% of total 0.01% of queries	-
Queries Requiring Tmp Table In Memory	104.05 (per sec)	374.58 k 95.17% of total 100.00% of queries	-

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How to Improve their Performance

Example

```
SELECT DISTINCT c
FROM sbtest1
WHERE id
    BETWEEN 5559
        AND 5658
ORDER BY  c
```

CREATE

```
CREATE TABLE `sbtest1` (
  `id` int(10) unsigned NOT NULL AUTO_INCREMENT,
  `k` int(10) unsigned NOT NULL DEFAULT '0',
  `c` char(120) NOT NULL DEFAULT '',
  `pad` char(60) NOT NULL DEFAULT '',
  PRIMARY KEY (`id`),
  KEY `k_1` (`k`)
) ENGINE=InnoDB AUTO_INCREMENT=100000001 DEFAULT
```

JSON

Expand All

```
-{
   "query_block": -{
      "select_id": 1,
      "cost_info": +{...},
      "ordering_operation": -{
         "using_filesort": false,
         "duplicates_removal": -{
            "using_temporary_table": true,
            "using_filesort": true,
            "cost_info": +{...},
            "table": +{...}
```


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Check out Percona Monitoring and Management

http://pmmdemo.percona.com

PMM v 2.6 is fresh off the press

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How are Queries Executed ?

Single Threaded

Single Node

Distributed

Indexes

Indexes are Must

Indexes are Expensive

Capacity Planning

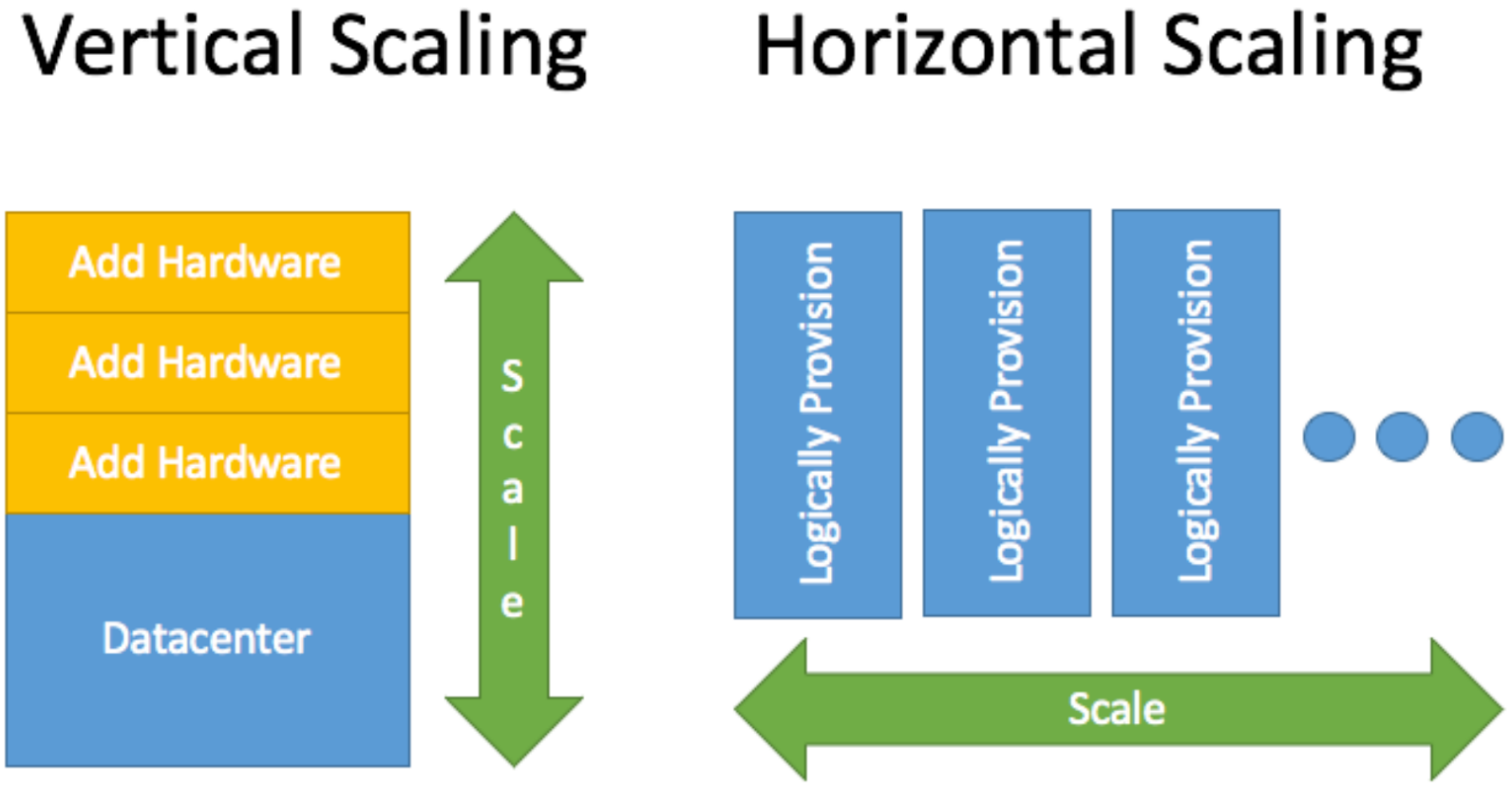
No Database can handle “unlimited scale”

Scalability is very application dependent

Trust Measurements more than Promises

Can be done or can be done Efficiently ?

Vertical and Horizontal Scaling



Scalable != Efficient

The Systems which promote a scalable can be less efficient

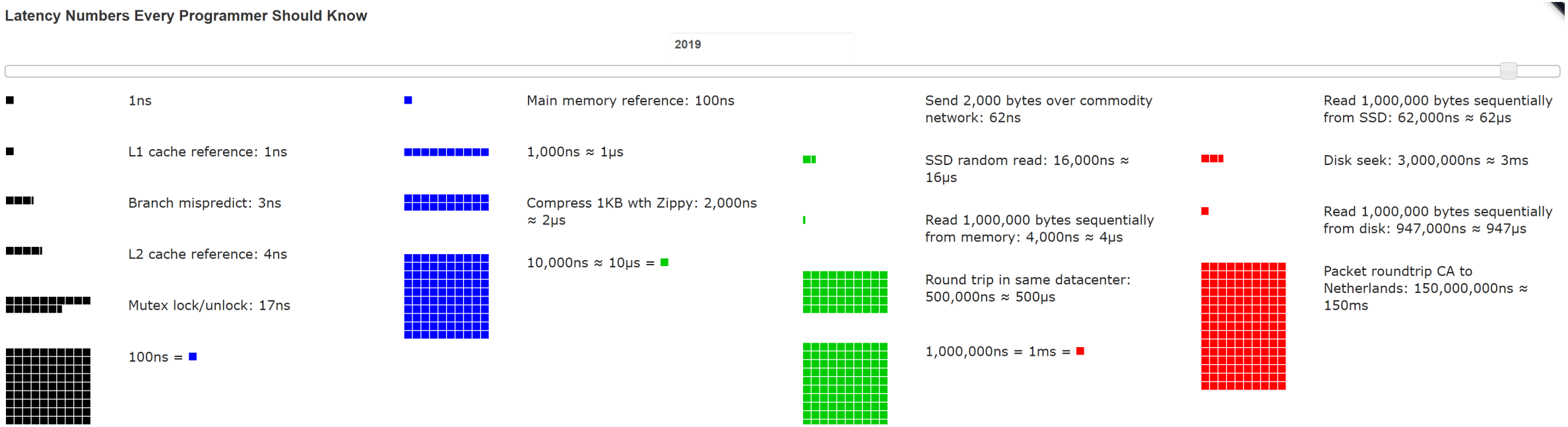
Hadoop, Cassandra, TiDB are great examples

By only the wrong thing you can get in trouble

Throughput != Latency

If I tell you system can do 100.000 queries/sec would you say it is fast ?

Latency Numbers to Know



Very cool Interactive Diagram

https://colin-scott.github.io/personal_website/research/interactive_latency.html

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Speed of Light Limitations

High Availability Design Choices

You want instant durable replication over wide geography or Performance ?

Understanding Difference between High Availability and Disaster Recovery protocols

Network Bandwidth is not the same as Latency

Wide Area Networks

Tend not to be as stable as Local Area Networks (LAN)

Expect increased Jitter

Expect Short term unavailability

Also Understand

Connections to the database are expensive

Especially if doing TLS Handshake

Query Latency Tends to Add Up

Especially on real network and not your laptop

ORM (Object-Relational-Mapping)

Allows Developers to query the database without need to understand SQL

Can create SQL which is very inefficient

Learn SQL Generation “Hints”, Learn JPQL/HQL advanced features

Be ready to manually write SQL if there is no other choice

Do not Leave Transactions Open

Open Connection is rather inexpensive

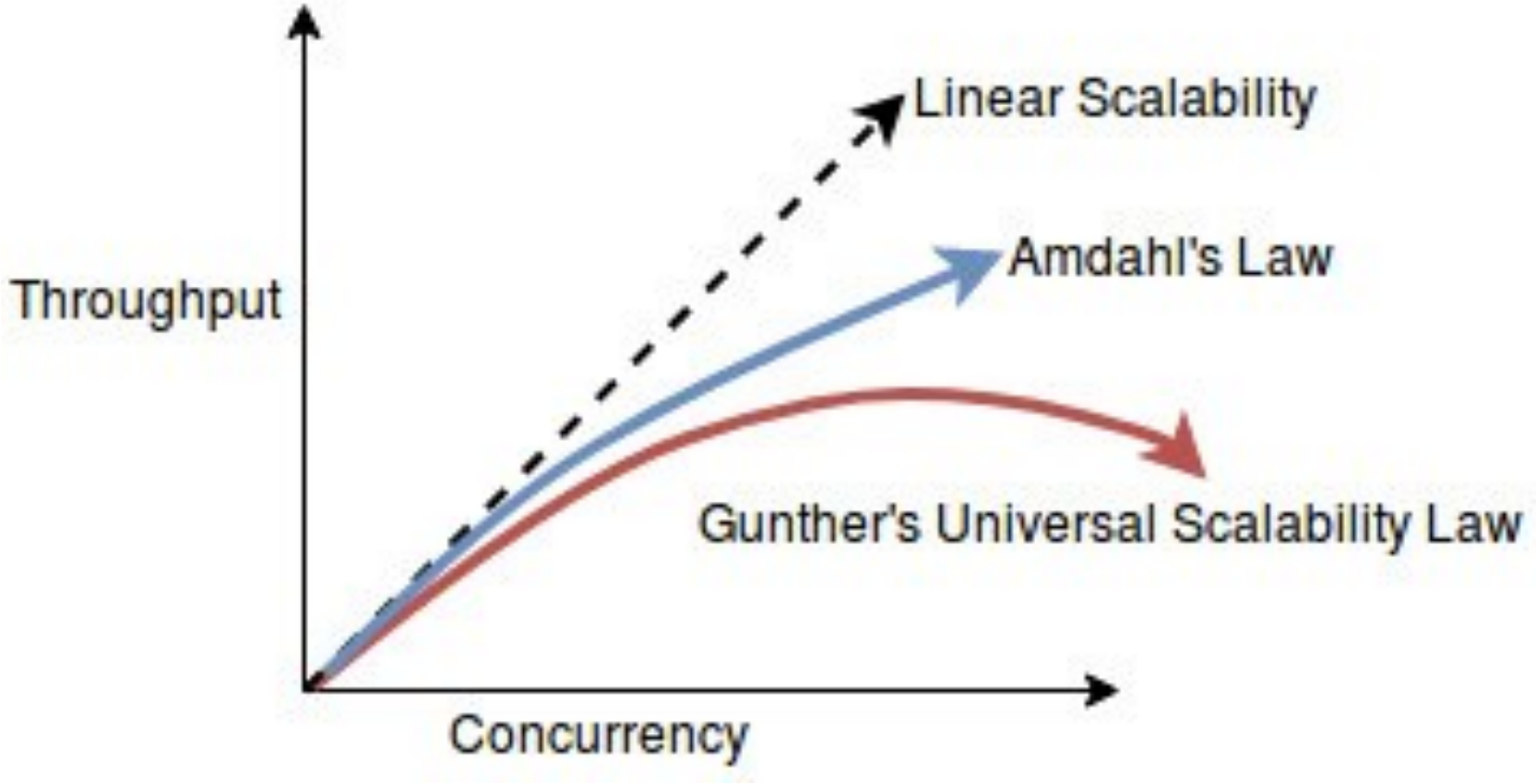
Transaction open for Long Time can get very expensive (even if it performed no writes)

Isolation Mode Matters

SET AUTOCOMMIT=0 - Any SELECT query will Open Transaction

COMMIT/ROLLBACK closes transaction

Understanding Optimal Concurrency



Embrace Queueing

Request Queueing is Normal

With requests coming at “Random Arrivals” some queueing will happen with any system scale

Should not happen to often or for very long

Queueing is “Cheaper” Close to the User

Benefits of Connection Pooling

Avoiding Connection Overhead, especially TLS/SSL

Avoiding using Excessive Number of Database Connections

Multiplexing/Load Management

Law of Gravity

Shitty Application at scale will bring down any Database

Scale Matters

Developing and Testing with Toy Database is risky

Queries Do not slow down linearly

The slowest query may slow down most rapidly

Memory or Disk

Data Accessed in memory is much faster than on disk

It is true even with modern SSDs

SSD accesses data in large blocks, memory does not

Fitting data in Working Set

Newer is not Always Faster

Upgrading to the new Software/ Hardware is not always faster

Test it out

Defaults Change are often to blame

Upgrades are needed but not seamless

Major Database Upgrades often require application changes

Having Conversation on Application Lifecycle is a key

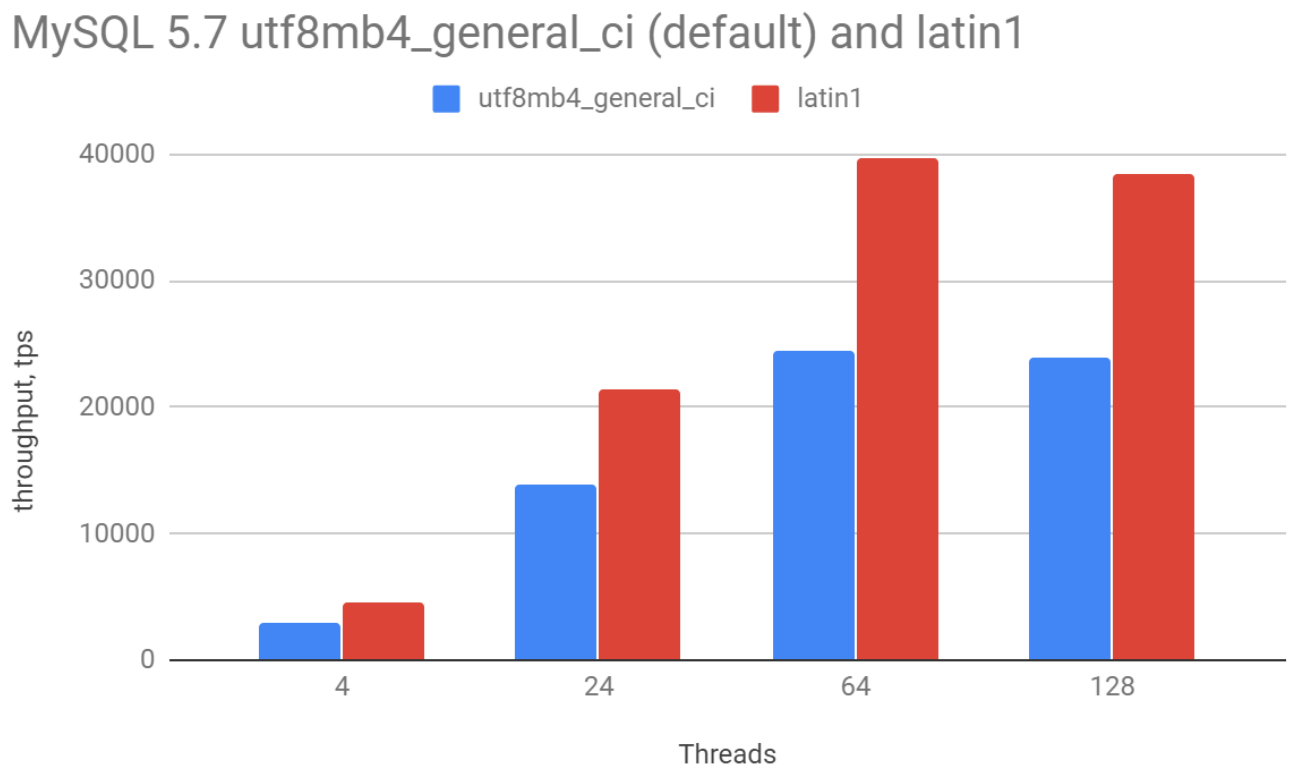
Character Sets

Performance Impact

Pain to Change

Wrong Character Set can cause Data Loss

Character Sets



https://per.co.na/MySQLCharsetImpact

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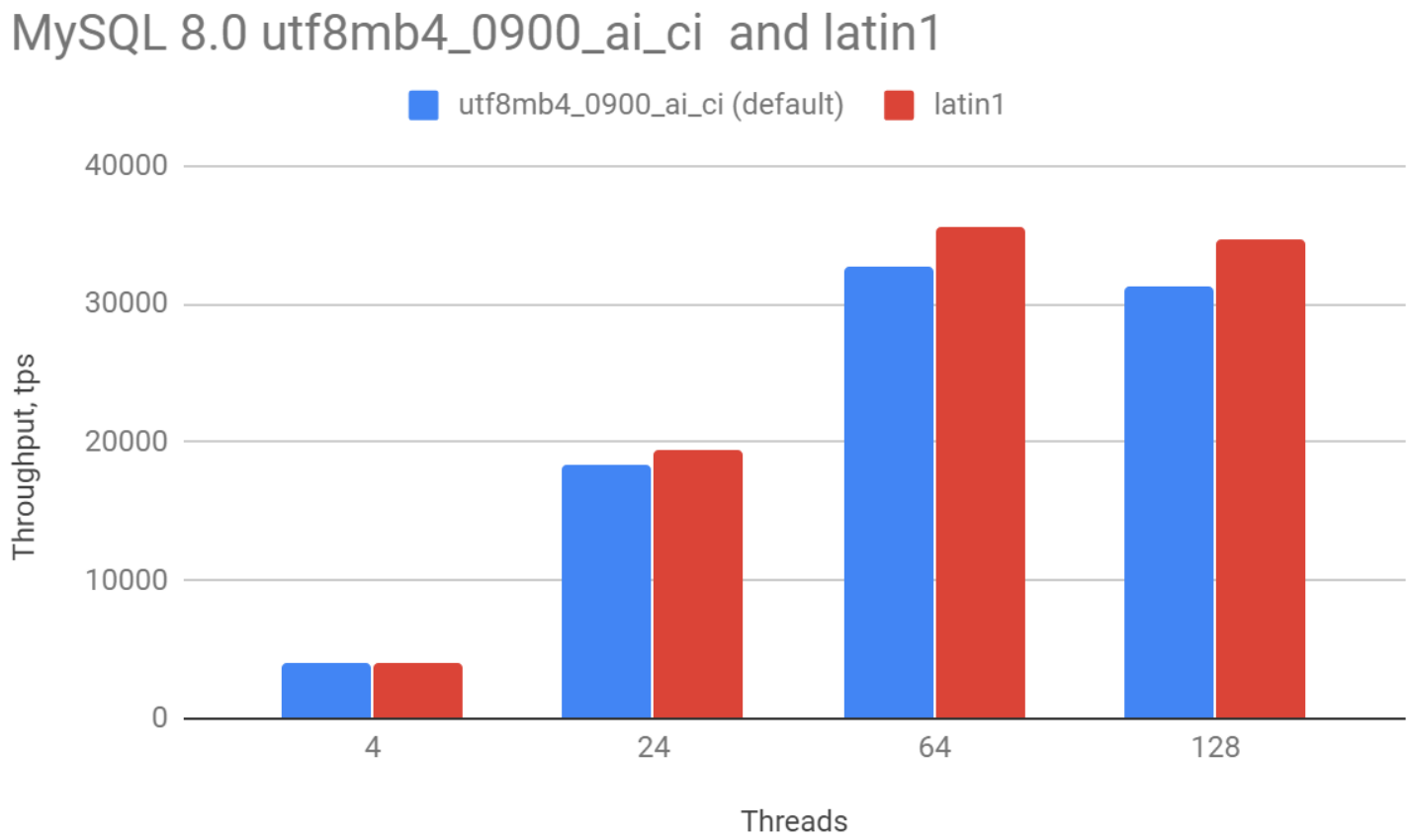
Less impact In MySQL 8



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Operational Overhead

Operations Take Time, Cost Money, Cause Overhead

10TB Database Backup ?

Adding The Index to Large Table ?

Risks of Automation

Automation is Must

Mistakes can destroy database at scale

Security

Database is where the most sensitive data tends to live

Shared Devs and Ops Responsibility

May 19, 10 AM EDT to May 20, 10 AM EDT

THE FIRST 24-HOUR, AROUND-THE-WORLD OPEN SOURCE DATABASE CONFERENCE

PERCONA LIVEONLINE

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SPEAKER COMPANIES

19 -20 May 2020

Open Source Database Survey

http://per.co.na/survey

- Help us to understand your Open Source Database Usage Better
- This will help us to build better Open Source Database technology, so You can benefit
- Results are 100% Anonymous and Open Source (CC BY-SA)
- Do it now - it takes just 5-10 minutes

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Thank You!
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