DAT151 – Oblig5

Optimalisering og implementasjon av større database.

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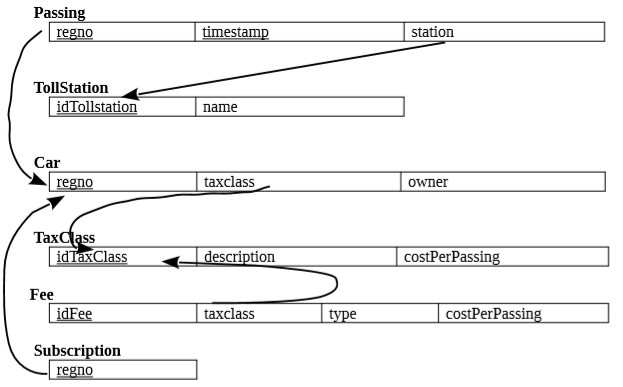
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# Oppgave 1: Normal form



## Er skjemaet 1NF?

Et skjema er 1NF hvis og bare hvis alle underliggende domener har atomiske verdier.

All data er atomære om vi antar «timestamp» er det.

## Er det 2NF?

Et skjema er 2NF hvis og bare hvis det er 1NF og alle ikke nøkkel attributter er knyttet til en kandidat nøkkel eller en annen ikke nøkkel attributt.

Her kan man diskutere at Passing ikke følger denne regelen. Ettersom tollstasjon ikke er avhengig av hverken «regno» eller «timestamp».

## er den 3nf

Om man mener station er knyttet til timestamp og regno er den det. Ellers er den ikke det siden den ikke fyller 2nf.

# Oppgave 2: Implementasjon av fysisk skjema og test miljø.

Jeg bruker skjemaet fra forrige oppgave uten endringer.

SQL filer kan finnes på <https://github.com/H571531/DAT151/tree/master/Oblig5>

**>** Source **/**home**/**admo**/**git**/**DAT151**/**Oblig5**/SQL/**CreateTable**.sql**

**CREATE** **TABLE** **IF** **NOT** **EXISTS** ImportTable **(**

regno **VARCHAR(**45**)** **NULL,**

tid **DATETIME** **NULL,**

idTollstation **VARCHAR(**45**)** **NULL,**

tollname **VARCHAR(**45**)** **NULL,**

OwnerName **VARCHAR(**45**)** **NULL,**

taxId **varchar(**3**),**

taxDesc **VARCHAR(**45**)** **NULL,**

Subscription **VARCHAR(**10**),**

TollSFee **INT(**11**)** **NULL,**

SubFee **INT(**11**)** **NULL**

**)**

ENGINE **=** MyISAM**;**

**CREATE** **TABLE** **IF** **NOT** **EXISTS** Tollstation **(**

idTollstation **SMALLINT** UNSIGNED **NOT** **NULL,**

name **VARCHAR(**85**)** **NULL,**

**PRIMARY** **KEY** **(** idTollstation **))**

ENGINE **=** InnoDB**;**

**CREATE** **TABLE** **IF** **NOT** **EXISTS** TaxClass **(**

idTaxClass **SMALLINT** UNSIGNED **NOT** **NULL,**

description TEXT **NULL,**

**PRIMARY** **KEY** **(** idTaxClass **)**

**)**

ENGINE **=** InnoDB**;**

**CREATE** **TABLE** **IF** **NOT** **EXISTS** Fee **(**

idFee **SMALLINT** **NOT** **NULL** AUTO\_INCREMENT**,**

taxclass **SMALLINT** UNSIGNED **NOT** **NULL,**

**type** ENUM**(**'regular'**,** 'withsubscription'**)** **NOT** **NULL,**

costPerPassing **DECIMAL(**5**,**2**)** **NOT** **NULL,**

**PRIMARY** **KEY** **(** idFee **),**

**CONSTRAINT** TeacherFK **FOREIGN** **KEY** **(**taxclass**)** **REFERENCES** TaxClass**(**idTaxClass**)**

**)**

ENGINE **=** InnoDB**;**

**CREATE** **TABLE** **IF** **NOT** **EXISTS** Car **(**

regno **CHAR(**7**)** **NOT** **NULL,**

owner **VARCHAR(**85**)** **NULL,**

taxclass **SMALLINT** UNSIGNED **NOT** **NULL,**

**PRIMARY** **KEY** **(** regno **),**

**CONSTRAINT** fk\_Car\_TaxClass1

**FOREIGN** **KEY** **(** taxclass **)**

**REFERENCES** TaxClass **(**idTaxClass**)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**)**

ENGINE **=** InnoDB**;**

**CREATE** **TABLE** **IF** **NOT** **EXISTS** Passing **(**

regno **CHAR(**7**)** **NOT** **NULL,**

**timestamp** **TIMESTAMP** **NOT** **NULL,**

tollstation **SMALLINT** UNSIGNED **NOT** **NULL,**

**PRIMARY** **KEY** **(** regno **,** **timestamp** **),**

**CONSTRAINT** fk\_Passing\_1

**FOREIGN** **KEY** **(** tollstation **)**

**REFERENCES** Tollstation **(** idTollstation **)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**,**

**CONSTRAINT** fk\_Passing\_Subscription1

**FOREIGN** **KEY** **(** regno **)**

**REFERENCES** Car **(**regno**)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**)**

ENGINE **=** InnoDB**;**

**CREATE** **TABLE** **IF** **NOT** **EXISTS** Subscription **(**

regno **CHAR(**7**)** **NOT** **NULL,**

**PRIMARY** **KEY** **(** regno **),**

**CONSTRAINT** fk\_Subscription\_Car1

**FOREIGN** **KEY** **(**regno**)**

**REFERENCES** Car **(**regno**)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**)**

ENGINE **=** InnoDB**;**

## Get data

#!/bin/bash

**wget** https://eple.hib.no/fag/dat151/v2020/carpassingdb.txt

(reason for making a script is due to Github limitations (Can’t push files over 100MB) )

**>** LOAD **DATA** **LOCAL** INFILE '/home/admo/git/DAT151/Oblig5/SQL/carpassingdb.txt' **INTO** **TABLE** ImportTable FIELDS TERMINATED **BY** ';'**;**

## Move data to tables

-- Tollstation

**INSERT** **INTO** Tollstation

**SELECT** **DISTINCT** idTollstation**,**tollname

**FROM** ImportTable**;**

-- TaxClass

**INSERT** **INTO** TaxClass

**SELECT** **DISTINCT** taxId**,**taxDesc

**FROM** ImportTable**;**

-- Car

**INSERT** **INTO** Car

**SELECT** **DISTINCT** regno**,**OwnerName**,**taxId

**FROM** ImportTable**;**

-- Subscription

**INSERT** **INTO** Subscription

**SELECT** **DISTINCT** regno

**FROM** ImportTable

**WHERE** Subscription**=**'yes'**;**

-- Passing

**INSERT** **INTO** Passing

**SELECT** **DISTINCT** regno**,**tid**,**idTollstation

**FROM** ImportTable**;**

-- Fee

**INSERT** **INTO** Fee **(**taxclass**,type,**costPerPassing**)**

**SELECT** **DISTINCT** taxId**,**'regular'**,**TollSFee

**FROM** ImportTable

**WHERE** Subscription**=**'no'**;**

**INSERT** **INTO** Fee **(**taxclass**,type,**costPerPassing**)**

**SELECT** **DISTINCT** taxId**,**'withsubscription'**,**SubFee

**FROM** ImportTable

**WHERE** Subscription**=**'yes'**;**

# Oppgave 3: Optimalisering av database

## Query 1

Finner navnet og tiden til noen som har kjørt igjennom en bomstasjon en spesifikk dag.

MariaDB **[**Oblig5**]>** **SELECT** SQL\_NO\_CACHE C**.**owner**,** P**.timestamp**

**->** **FROM** Car C **JOIN** Passing P **USING(**regno**)**

**->** **WHERE** **YEAR(**P**.timestamp)=**2018 **AND** **MONTH(**P**.timestamp)=**3

**->** **AND** DAYOFWEEK**(**P**.timestamp)=**1**;**

**+**--------------------+---------------------+

**|** owner **|** **timestamp** **|**

**+**--------------------+---------------------+

**|** Urfan SandÃ¸y **|** 2018**-**03**-**04 04**:**30**:**00 **|**

**|** Urfan SandÃ¸y **|** 2018**-**03**-**04 05**:**42**:**00 **|**

**|** Birte Fossum **|** 2018**-**03**-**04 02**:**18**:**00 **|**

**|** Birte Fossum **|** 2018**-**03**-**04 23**:**31**:**00 **|**

**|** Stanley Ingvaldsen **|** 2018**-**03**-**04 02**:**18**:**00 **|**

**|** Stanley Ingvaldsen **|** 2018**-**03**-**04 23**:**31**:**00 **|**

**|** Amar Wiig **|** 2018**-**03**-**04 05**:**53**:**00 **|**

**|** Minda Larssen **|** 2018**-**03**-**04 14**:**24**:**00 **|**

**|** Storm Nordstrand **|** 2018**-**03**-**04 03**:**09**:**00 **|**

**|** Marcus Hafstad **|** 2018**-**03**-**04 14**:**24**:**00 **|**

**|** Mathilde Lillevik **|** 2018**-**03**-**04 04**:**30**:**00 **|**

**|** Mathilde Lillevik **|** 2018**-**03**-**04 05**:**42**:**00 **|**

**|** Zilan Solbakken **|** 2018**-**03**-**04 05**:**53**:**00 **|**

**|** Kurt Aslaksen **|** 2018**-**03**-**04 19**:**02**:**00 **|**

**|** Dilara Skar **|** 2018**-**03**-**04 03**:**09**:**00 **|**

**|** Annette Sara **|** 2018**-**03**-**04 19**:**02**:**00 **|**

**+**--------------------+---------------------+

16 **rows** **in** **set** **(**3.085 sec**)**

### Profiling before optimization:

Ran the query 10 times before profiling start.

MariaDB **[**Oblig5**]>** SHOW PROFILES**;**

**+**----------+------------+--------------------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|**

**+**----------+------------+--------------------------------------------------------+

**|** 1 **|** 3.08046248 **|** **SELECT** SQL\_NO\_CACHE C**.**owner**,** P**.timestamp** **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **WHERE** **YEAR(**P**.timestamp)=**2018 **AND** **MONTH(**P**.timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**|** 2 **|** 3.14813736 **|** **SELECT** SQL\_NO\_CACHE C**.**owner**,** P**.timestamp** **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **WHERE** **YEAR(**P**.timestamp)=**2018 **AND** **MONTH(**P**.timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**|** 3 **|** 3.15549203 **|** **SELECT** SQL\_NO\_CACHE C**.**owner**,** P**.timestamp** **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **WHERE** **YEAR(**P**.timestamp)=**2018 **AND** **MONTH(**P**.timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**|** 4 **|** 3.16799906 **|** **SELECT** SQL\_NO\_CACHE C**.**owner**,** P**.timestamp** **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **WHERE** **YEAR(**P**.timestamp)=**2018 **AND** **MONTH(**P**.timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**|** 5 **|** 3.16238553 **|** **SELECT** SQL\_NO\_CACHE C**.**owner**,** P**.timestamp** **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **WHERE** **YEAR(**P**.timestamp)=**2018 **AND** **MONTH(**P**.timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**+**----------+------------+--------------------------------------------------------+

Picking Query 3 for furter info:

MariaDB **[**Oblig5**]>** SHOW PROFILE **for** QUERY 3**;**

**+**------------------------+----------+

**|** Status **|** Duration **|**

**+**------------------------+----------+

**|** Starting **|** 0.000083 **|**

**|** Checking permissions **|** 0.000004 **|**

**|** Opening tables **|** 0.000032 **|**

**|** **After** opening tables **|** 0.000006 **|**

**|** System **lock** **|** 0.000002 **|**

**|** **Table** **lock** **|** 0.000005 **|**

**|** Init **|** 0.000029 **|**

**|** Optimizing **|** 0.000018 **|**

**|** Statistics **|** 0.000021 **|**

**|** Preparing **|** 0.000018 **|**

**|** Executing **|** 0.000002 **|**

**|** Sending **data** **|** 3.155202 **|**

**|** **End** **of** **update** **loop** **|** 0.000017 **|**

**|** Query **end** **|** 0.000003 **|**

**|** **Commit** **|** 0.000004 **|**

**|** Closing tables **|** 0.000003 **|**

**|** Unlocking tables **|** 0.000001 **|**

**|** Closing tables **|** 0.000010 **|**

**|** Starting cleanup **|** 0.000002 **|**

**|** Freeing items **|** 0.000008 **|**

**|** Updating status **|** 0.000021 **|**

**|** Reset **for** **next** command **|** 0.000003 **|**

**+**------------------------+----------+

Most of the time in this query is spent between Executing and Sending data. (The Duration label is abit misleading…) Each time means the time elapsed between the previous event and the new event.

### EXPLAIN before Optimization

MariaDB **[**Oblig5**]>** EXPLAIN **SELECT** SQL\_NO\_CACHE C**.**owner**,** P**.timestamp** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **WHERE** **YEAR** **(**P**.timestamp)=**2018 **AND** **MONTH** **(**P**.timestamp)=**3 **AND** DAYOFWEEK**(**P**.timestamp)=**1**;**

**+**------+-------------+-------+------+---------------+---------+---------+----------------+--------+-------------+

**|** id **|** select\_type **|** **table** **|** **type** **|** possible\_keys **|** **key** **|** key\_len **|** **ref** **|** **rows** **|** Extra **|**

**+**------+-------------+-------+------+---------------+---------+---------+----------------+--------+-------------+

**|** 1 **|** SIMPLE **|** C **|** **ALL** **|** **PRIMARY** **|** **NULL** **|** **NULL** **|** **NULL** **|** 203998 **|** **|**

**|** 1 **|** SIMPLE **|** P **|** **ref** **|** **PRIMARY** **|** **PRIMARY** **|** 7 **|** Oblig5**.**C**.**regno **|** 1 **|** **Using** **where** **|**

**+**------+-------------+-------+------+---------------+---------+---------+----------------+--------+-------------+

2 **rows** **in** **set** **(**0.000 sec**)**

### Optimization of query and table.

By breaking normalization I might get a better result.

The easiest change I can see right now is remove the need to join the car table with Passing.

The only thing we need from the Car table is the name. Therefore I add name to the Passing.

**CREATE** **TABLE** **IF** **NOT** **EXISTS** Passing2 **(**

regno **CHAR(**7**)** **NOT** **NULL,**

**timestamp** **TIMESTAMP** **NOT** **NULL,**

tollstation **SMALLINT** UNSIGNED **NOT** **NULL,**

owner **VARCHAR(**85**),**

**PRIMARY** **KEY** **(** regno **,** **timestamp** **),**

**CONSTRAINT** fk\_Passing\_2

**FOREIGN** **KEY** **(** tollstation **)**

**REFERENCES** Tollstation **(** idTollstation **)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**,**

**CONSTRAINT** fk\_Passing\_Subscription2

**FOREIGN** **KEY** **(** regno **)**

**REFERENCES** Car **(**regno**)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**)**

ENGINE **=** InnoDB**;**

-- Passing2

**INSERT** **INTO** Passing2

**SELECT** **DISTINCT** regno**,**tid**,**idTollstation**,**OwnerName

**FROM** ImportTable**;**

-- Query

**SELECT** SQL\_NO\_CACHE owner**,timestamp**

**FROM** Passing2 **WHERE** **YEAR(timestamp)=**2018 **AND** **MONTH(timestamp)=**3

**AND** DAYOFWEEK**(timestamp)=**1**;**

**+**--------------------+---------------------+

**|** owner **|** **timestamp** **|**

**+**--------------------+---------------------+

**|** Urfan SandÃ¸y **|** 2018**-**03**-**04 04**:**30**:**00 **|**

**|** Urfan SandÃ¸y **|** 2018**-**03**-**04 05**:**42**:**00 **|**

**|** Birte Fossum **|** 2018**-**03**-**04 02**:**18**:**00 **|**

**|** Birte Fossum **|** 2018**-**03**-**04 23**:**31**:**00 **|**

**|** Stanley Ingvaldsen **|** 2018**-**03**-**04 02**:**18**:**00 **|**

**|** Stanley Ingvaldsen **|** 2018**-**03**-**04 23**:**31**:**00 **|**

**|** Amar Wiig **|** 2018**-**03**-**04 05**:**53**:**00 **|**

**|** Minda Larssen **|** 2018**-**03**-**04 14**:**24**:**00 **|**

**|** Storm Nordstrand **|** 2018**-**03**-**04 03**:**09**:**00 **|**

**|** Marcus Hafstad **|** 2018**-**03**-**04 14**:**24**:**00 **|**

**|** Mathilde Lillevik **|** 2018**-**03**-**04 04**:**30**:**00 **|**

**|** Mathilde Lillevik **|** 2018**-**03**-**04 05**:**42**:**00 **|**

**|** Zilan Solbakken **|** 2018**-**03**-**04 05**:**53**:**00 **|**

**|** Kurt Aslaksen **|** 2018**-**03**-**04 19**:**02**:**00 **|**

**|** Dilara Skar **|** 2018**-**03**-**04 03**:**09**:**00 **|**

**|** Annette Sara **|** 2018**-**03**-**04 19**:**02**:**00 **|**

**+**--------------------+---------------------+

16 **rows** **in** **set** **(**2.555 sec**)**

Can already see some time saved.

### Profiling after optimization

Query has been ran 10 times before profiling was turned on.

MariaDB **[**Oblig5**]>** show profiles**;**

**+**----------+------------+------------------------------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|**

**+**----------+------------+------------------------------------------------------------------+

**|** 1 **|** 2.46529822 **|** **SELECT** SQL\_NO\_CACHE owner**,timestamp** **|**

**|** **|** **|** **FROM** Passing2 **WHERE** **YEAR(timestamp)=**2018 **AND** **MONTH(timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** 2 **|** 2.51719002 **|** **SELECT** SQL\_NO\_CACHE owner**,timestamp** **|**

**|** **|** **|** **FROM** Passing2 **WHERE** **YEAR(timestamp)=**2018 **AND** **MONTH(timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** 3 **|** 2.52976462 **|** **SELECT** SQL\_NO\_CACHE owner**,timestamp** **|**

**|** **|** **|** **FROM** Passing2 **WHERE** **YEAR(timestamp)=**2018 **AND** **MONTH(timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** 4 **|** 2.51797654 **|** **SELECT** SQL\_NO\_CACHE owner**,timestamp** **|**

**|** **|** **|** **FROM** Passing2 **WHERE** **YEAR(timestamp)=**2018 **AND** **MONTH(timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** 5 **|** 2.47903186 **|** **SELECT** SQL\_NO\_CACHE owner**,timestamp** **|**

**|** **|** **|** **FROM** Passing2 **WHERE** **YEAR(timestamp)=**2018 **AND** **MONTH(timestamp)=**3 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**+**----------+------------+------------------------------------------------------------------+

5 **rows** **in** **set** **(**0.000 sec**)**

Showing for query 3

MariaDB **[**Oblig5**]>** show profile **for** query 3**;**

**+**------------------------+----------+

**|** Status **|** Duration **|**

**+**------------------------+----------+

**|** Starting **|** 0.000077 **|**

**|** Checking permissions **|** 0.000005 **|**

**|** Opening tables **|** 0.000019 **|**

**|** **After** opening tables **|** 0.000004 **|**

**|** System **lock** **|** 0.000003 **|**

**|** **Table** **lock** **|** 0.000006 **|**

**|** Init **|** 0.000025 **|**

**|** Optimizing **|** 0.000014 **|**

**|** Statistics **|** 0.000014 **|**

**|** Preparing **|** 0.000019 **|**

**|** Executing **|** 0.000002 **|**

**|** Sending **data** **|** 2.529506 **|**

**|** **End** **of** **update** **loop** **|** 0.000018 **|**

**|** Query **end** **|** 0.000002 **|**

**|** **Commit** **|** 0.000005 **|**

**|** Closing tables **|** 0.000003 **|**

**|** Unlocking tables **|** 0.000001 **|**

**|** Closing tables **|** 0.000009 **|**

**|** Starting cleanup **|** 0.000002 **|**

**|** Freeing items **|** 0.000006 **|**

**|** Updating status **|** 0.000021 **|**

**|** Reset **for** **next** command **|** 0.000003 **|**

**+**------------------------+----------+

22 **rows** **in** **set** **(**0.000 sec**)**

### Explain optimized query

MariaDB **[**Oblig5**]>** EXPLAIN **SELECT** SQL\_NO\_CACHE owner**,timestamp**

**->** **FROM** Passing2 **WHERE** **YEAR(timestamp)=**2018 **AND** **MONTH(timestamp)=**3

**->** **AND** DAYOFWEEK**(timestamp)=**1**;**

**+**------+-------------+----------+------+---------------+------+---------+------+---------+-------------+

**|** id **|** select\_type **|** **table** **|** **type** **|** possible\_keys **|** **key** **|** key\_len **|** **ref** **|** **rows** **|** Extra **|**

**+**------+-------------+----------+------+---------------+------+---------+------+---------+-------------+

**|** 1 **|** SIMPLE **|** Passing2 **|** **ALL** **|** **NULL** **|** **NULL** **|** **NULL** **|** **NULL** **|** 5035359 **|** **Using** **where** **|**

**+**------+-------------+----------+------+---------------+------+---------+------+---------+-------------+

1 **row** **in** **set** **(**0.001 sec**)**

### Indexes

Now attempting to add a index on the timestamp collumn to perhaps make the query abit faster.

**CREATE** **INDEX** **Timestamp** **ON** Passing2**(timestamp);**

This adds very little to making the query any faster.

This also counts for Passing (the original table) the optimizer does not even want to use the index.

My thoughts aret hat this is because there is no need for it.

Note:

It is worth noting that on pre cache queries The un optimized query used 7s and the optimized query used 4s.

## Query 2

Finner de som har abonnement med total kostnad over 4000

**CREATE** **INDEX** **Timestamp** **ON** Passing**(timestamp);**

-- b

MariaDB **[**Oblig5**]>** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee

**->** **FROM** Car C **JOIN** Passing P **USING(**regno**)**

**->** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass

**->** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass

**->** **JOIN** Subscription S **USING(**regno**)**

**->** **WHERE** F**.type=**'withsubscription'

**->** **GROUP** **BY** C**.**owner **HAVING** totalfee **>** 4000**;**

**+**----------------+----------+

**|** carowner **|** totalfee **|**

**+**----------------+----------+

**|** Ansgar Oftedal **|** 4210.00 **|**

**|** Rina Kvalheim **|** 4605.00 **|**

**+**----------------+----------+

2 **rows** **in** **set** **(**2.475 sec**)**

MariaDB **[**Oblig5**]>** EXPLAIN **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee

**->** **FROM** Car C **JOIN** Passing P **USING(**regno**)**

**->** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass

**->** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass

**->** **JOIN** Subscription S **USING(**regno**)**

**->** **WHERE** F**.type=**'withsubscription'

**->** **GROUP** **BY** C**.**owner **HAVING** totalfee **>** 4000**;**

**+**------+-------------+-------+--------+--------------------------+------------------+---------+---------------------+------+----------------------------------------------+

**|** id **|** select\_type **|** **table** **|** **type** **|** possible\_keys **|** **key** **|** key\_len **|** **ref** **|** **rows** **|** Extra **|**

**+**------+-------------+-------+--------+--------------------------+------------------+---------+---------------------+------+----------------------------------------------+

**|** 1 **|** SIMPLE **|** T **|** **index** **|** **PRIMARY** **|** **PRIMARY** **|** 2 **|** **NULL** **|** 10 **|** **Using** **index;** **Using** **temporary;** **Using** filesort **|**

**|** 1 **|** SIMPLE **|** F **|** **ref** **|** TeacherFK **|** TeacherFK **|** 2 **|** Oblig5**.**T**.**idTaxClass **|** 1 **|** **Using** **where** **|**

**|** 1 **|** SIMPLE **|** C **|** **ref** **|** **PRIMARY,**fk\_Car\_TaxClass1 **|** fk\_Car\_TaxClass1 **|** 2 **|** Oblig5**.**T**.**idTaxClass **|** 1 **|** **|**

**|** 1 **|** SIMPLE **|** S **|** eq\_ref **|** **PRIMARY** **|** **PRIMARY** **|** 7 **|** Oblig5**.**C**.**regno **|** 1 **|** **Using** **index** **|**

**|** 1 **|** SIMPLE **|** P **|** **ref** **|** **PRIMARY,**reg **|** **PRIMARY** **|** 7 **|** Oblig5**.**C**.**regno **|** 13 **|** **|**

**+**------+-------------+-------+--------+--------------------------+------------------+---------+---------------------+------+----------------------------------------------+

5 **rows** **in** **set** **(**0.001 sec**)**

The optimizer already uses indexes and I cant see a better way to do the indexes. However I want to attempt denormalization to see if it can get better by denormalization.

I see that Taxclass is joined with the cars taxclass. Only to get fee. Now if we get the fee into passing we wont have to do those two joins. And if we also add owner to the table we might just have to find the cars with subscription. Adding who has subscription aswell might be faster. Butt his will increase the collumn count with 3 so the negative effects of this could be negative to the outcome.

Trying this either way.

### Optimizing

Sql: Table

**CREATE** **TABLE** **IF** **NOT** **EXISTS** Passing3 **(**

regno **CHAR(**7**)** **NOT** **NULL,**

**timestamp** **TIMESTAMP** **NOT** **NULL,**

tollstation **SMALLINT** UNSIGNED **NOT** **NULL,**

owner **VARCHAR(**85**),**

**type** ENUM**(**'regular'**,** 'withsubscription'**)** **NOT** **NULL,**

costPerPassing **DECIMAL(**5**,**2**)** **NOT** **NULL,**

**PRIMARY** **KEY** **(** regno **,** **timestamp** **),**

**CONSTRAINT** fk\_Passing\_3

**FOREIGN** **KEY** **(** tollstation **)**

**REFERENCES** Tollstation **(** idTollstation **)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**,**

**CONSTRAINT** fk\_Passing\_Subscription3

**FOREIGN** **KEY** **(** regno **)**

**REFERENCES** Car **(**regno**)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**)**

ENGINE **=** InnoDB**;**

Adding data:

-- Passing3

**INSERT** **INTO** Passing3

**SELECT** **DISTINCT** regno**,**tid**,**idTollstation**,**OwnerName**,**'withsubscription'**,**SubFee

**FROM** ImportTable

**WHERE** Subscription**=**'yes'**;**

**INSERT** **INTO** Passing3

**SELECT** **DISTINCT** regno**,**tid**,**idTollstation**,**OwnerName**,**'regular'**,**TollSFee

**FROM** ImportTable

**WHERE** Subscription**=**'no'**;**

Query:

**SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee

**from** Passing3

**WHERE** **type=**'withsubscription'

**GROUP** **BY** owner **HAVING** totalfee **>** 4000**;**

We can see the Query being alot shorter with no joins and maybe arguably easier to read.

However did it increase performance?

### Profiling

#### Pre denormalization

MariaDB **[**Oblig5**]>** show profiles**;**

**+**----------+------------+-----------------------------------------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|** **|**

**+**----------+------------+-----------------------------------------------------------------------------+

**|** 1 **|** 3.51759643 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** 2 **|** 3.53729194 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** 3 **|** 3.51002205 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** 4 **|** 3.47434126 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** 5 **|** 3.39511616 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**+**----------+------------+-----------------------------------------------------------------------------+

5 **rows** **in** **set** **(**0.000 sec**)**

#### Post denormalization

MariaDB **[**Oblig5**]>** show profiles**;**

**+**----------+------------+-------------------------------------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|** **|**

**+**----------+------------+-------------------------------------------------------------------------+

**|** 1 **|** 2.65984540 **|** **SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **from** Passing3 **|**

**|** **|** **|** **WHERE** **type=**'withsubscription' **|**

**|** **|** **|** **GROUP** **BY** owner **HAVING** totalfee **>** 4000 **|**

**|** 2 **|** 2.66344669 **|** **SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **from** Passing3 **|**

**|** **|** **|** **WHERE** **type=**'withsubscription' **|**

**|** **|** **|** **GROUP** **BY** owner **HAVING** totalfee **>** 4000 **|**

**|** 3 **|** 2.66824841 **|** **SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **from** Passing3 **|**

**|** **|** **|** **WHERE** **type=**'withsubscription' **|**

**|** **|** **|** **GROUP** **BY** owner **HAVING** totalfee **>** 4000 **|**

**|** 4 **|** 2.67204567 **|** **SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **from** Passing3 **|**

**|** **|** **|** **WHERE** **type=**'withsubscription' **|**

**|** **|** **|** **GROUP** **BY** owner **HAVING** totalfee **>** 4000 **|**

**|** 5 **|** 2.66805130 **|** **SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **from** Passing3 **|**

**|** **|** **|** **WHERE** **type=**'withsubscription' **|**

**|** **|** **|** **GROUP** **BY** owner **HAVING** totalfee **>** 4000 **|**

**+**----------+------------+-------------------------------------------------------------------------+

5 **rows** **in** **set** **(**0.000 sec**)**

Yes! The performance seem to have been improved. Only with about a second. Both profiles started after the query was ran 10 times.

Having a look at the explain for fun to see how this new query is being optimized by the optimizer.

**+**------+-------------+----------+------+---------------+------+---------+------+---------+----------------------------------------------+

**|** id **|** select\_type **|** **table** **|** **type** **|** possible\_keys **|** **key** **|** key\_len **|** **ref** **|** **rows** **|** Extra **|**

**+**------+-------------+----------+------+---------------+------+---------+------+---------+----------------------------------------------+

**|** 1 **|** SIMPLE **|** Passing3 **|** **ALL** **|** **NULL** **|** **NULL** **|** **NULL** **|** **NULL** **|** 4812140 **|** **Using** **where;** **Using** **temporary;** **Using** filesort **|**

**+**------+-------------+----------+------+---------------+------+---------+------+---------+----------------------------------------------+

1 **row** **in** **set** **(**0.001 sec**)**

From the explain we can see there is no joins, and no other tables to take into concideration. If there was; the lack of keys could mean we would need some sort of indexes. But we only have a select on a single table. And since we’re using where clauses I belive this is sufficiently improved from the original query.

## Query 3

This query does the same as the previous one. This time using joins.

MariaDB **[**Oblig5**]>** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,**

**->** **Sum(**F**.**costPerPassing**)** **AS** totalfee

**->** **FROM** Car C **JOIN** Passing P **USING(**regno**)**

**->** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass

**->** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass

**->** **WHERE** F**.type=**'withsubscription'

**->** **AND** C**.**regno **IN** **(SELECT** regno **FROM** Subscription**)**

**->** **GROUP** **BY** C**.**owner **HAVING** totalfee **>** 4000**;**

**+**----------------+----------+

**|** carowner **|** totalfee **|**

**+**----------------+----------+

**|** Ansgar Oftedal **|** 4210.00 **|**

**|** Rina Kvalheim **|** 4605.00 **|**

**+**----------------+----------+

2 **rows** **in** **set** **(**3.330 sec**)**

### Explain

**+**------+-------------+--------------+--------+--------------------------+------------------+---------+---------------------+------+----------------------------------------------+

**|** id **|** select\_type **|** **table** **|** **type** **|** possible\_keys **|** **key** **|** key\_len **|** **ref** **|** **rows** **|** Extra **|**

**+**------+-------------+--------------+--------+--------------------------+------------------+---------+---------------------+------+----------------------------------------------+

**|** 1 **|** **PRIMARY** **|** T **|** **index** **|** **PRIMARY** **|** **PRIMARY** **|** 2 **|** **NULL** **|** 10 **|** **Using** **index;** **Using** **temporary;** **Using** filesort **|**

**|** 1 **|** **PRIMARY** **|** F **|** **ref** **|** TeacherFK **|** TeacherFK **|** 2 **|** Oblig5**.**T**.**idTaxClass **|** 1 **|** **Using** **where** **|**

**|** 1 **|** **PRIMARY** **|** C **|** **ref** **|** **PRIMARY,**fk\_Car\_TaxClass1 **|** fk\_Car\_TaxClass1 **|** 2 **|** Oblig5**.**T**.**idTaxClass **|** 1 **|** **|**

**|** 1 **|** **PRIMARY** **|** Subscription **|** eq\_ref **|** **PRIMARY** **|** **PRIMARY** **|** 7 **|** Oblig5**.**C**.**regno **|** 1 **|** **Using** **index** **|**

**|** 1 **|** **PRIMARY** **|** P **|** **ref** **|** **PRIMARY,**reg **|** **PRIMARY** **|** 7 **|** Oblig5**.**C**.**regno **|** 13 **|** **|**

**+**------+-------------+--------------+--------+--------------------------+------------------+---------+---------------------+------+----------------------------------------------+

5 **rows** **in** **set** **(**0.001 sec**)**

Here we can see we have available keys on all joins. This is good. The Optimizer will be using indexes some places. The Key length is also fairly small meaning it only needs a few bytes of the key. Therefore I will not be addressing any optimization by indexes.

### Profiling

MariaDB **[**Oblig5**]>** show profiles**;**

**+**----------+------------+--------------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|** **|**

**+**----------+------------+--------------------------------------------------+

**|** 1 **|** 3.00203704 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **|**

**|** **|** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** **|** **|** **AND** C**.**regno **IN** **(SELECT** regno **FROM** Subscription**)** **|**

**|** **|** **|** **GROUP** **BY** C**.**owner HA **|**

**|** 2 **|** 3.05971641 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **|**

**|** **|** **|** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** **|** **|** **AND** C**.**regno **IN** **(SELECT** regno **FROM** Subscription**)** **|**

**|** **|** **|** **GROUP** **BY** C**.**owner HA **|**

**|** 3 **|** 3.00294968 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **|**

**|** **|** **|** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** **|** **|** **AND** C**.**regno **IN** **(SELECT** regno **FROM** Subscription**)** **|**

**|** **|** **|** **GROUP** **BY** C**.**owner HA **|**

**|** 4 **|** 3.11308706 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **|**

**|** **|** **|** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** **|** **|** **AND** C**.**regno **IN** **(SELECT** regno **FROM** Subscription**)** **|**

**|** **|** **|** **GROUP** **BY** C**.**owner HA **|**

**|** 5 **|** 3.08940385 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **|**

**|** **|** **|** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** **|** **|** **AND** C**.**regno **IN** **(SELECT** regno **FROM** Subscription**)** **|**

**|** **|** **|** **GROUP** **BY** C**.**owner HA **|**

**+**----------+------------+--------------------------------------------------+

5 **rows** **in** **set** **(**0.000 sec**)**

In profiling we can see that this Query is performs better than the previous one that used joins instead of subqueries. But still not as good as the denormalized version. Therefore I would suggest using the same sollution as in b)

## Query 4 (same as 2)

This query will be doing the same as in query 2 but for the people without a subscription

MariaDB **[**Oblig5**]>** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee

**->** **FROM** Car C **JOIN** Passing P **USING(**regno**)**

**->** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass

**->** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass

**->** **Left** **JOIN** Subscription S **USING(**regno**)**

**->** **WHERE** F**.type=**'withsubscription'

**->** **AND** S**.**regno **IS** **NULL**

**->** **GROUP** **BY** C**.**owner **HAVING** totalfee **>** 4000**;**

**+**------------------+----------+

**|** carowner **|** totalfee **|**

**+**------------------+----------+

**|** Glen FjÃ¸rtoft **|** 4010.00 **|**

**|** Lasse Nakken **|** 4316.00 **|**

**|** Ulva Hanssen **|** 4130.00 **|**

**|** Yulia Lie **|** 4260.00 **|**

**+**------------------+----------+

4 **rows** **in** **set** **(**3.746 sec**)**

(difference being that we do a Left JOIN on Subscription and look for the regnr not in the subscription table. )

First lets have a look at the performance of this query as is.

MariaDB **[**Oblig5**]>** show profiles**;**

**+**----------+------------+-----------------------------------------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|** **|**

**+**----------+------------+-----------------------------------------------------------------------------+

**|** 1 **|** 3.72908210 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **Left** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** 2 **|** 3.70657548 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **Left** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** 3 **|** 3.62856547 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **Left** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** 4 **|** 3.70396787 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **Left** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**|** 5 **|** 3.71108078 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,** **Sum(**F**.**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **FROM** Car C **JOIN** Passing P **USING(**regno**)** **|**

**|** **|** **|** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass **|**

**|** **|** **|** **Left** **JOIN** Subscription S **USING(**regno**)** **|**

**|** **|** **|** **WHERE** F**.type=**'withsubscription' **|**

**+**----------+------------+-----------------------------------------------------------------------------+

5 **rows** **in** **set** **(**0.000 sec**)**

Now lets have a look at why these queries take almost 4s

**+**------+-------------+-------+--------+--------------------------+------------------+---------+---------------------+------+----------------------------------------------+

**|** id **|** select\_type **|** **table** **|** **type** **|** possible\_keys **|** **key** **|** key\_len **|** **ref** **|** **rows** **|** Extra **|**

**+**------+-------------+-------+--------+--------------------------+------------------+---------+---------------------+------+----------------------------------------------+

**|** 1 **|** SIMPLE **|** T **|** **index** **|** **PRIMARY** **|** **PRIMARY** **|** 2 **|** **NULL** **|** 10 **|** **Using** **index;** **Using** **temporary;** **Using** filesort **|**

**|** 1 **|** SIMPLE **|** F **|** **ref** **|** TeacherFK **|** TeacherFK **|** 2 **|** Oblig5**.**T**.**idTaxClass **|** 1 **|** **Using** **where** **|**

**|** 1 **|** SIMPLE **|** C **|** **ref** **|** **PRIMARY,**fk\_Car\_TaxClass1 **|** fk\_Car\_TaxClass1 **|** 2 **|** Oblig5**.**T**.**idTaxClass **|** 1 **|** **|**

**|** 1 **|** SIMPLE **|** S **|** eq\_ref **|** **PRIMARY** **|** **PRIMARY** **|** 7 **|** Oblig5**.**C**.**regno **|** 1 **|** **Using** **where;** **Using** **index;** **Not** **exists** **|**

**|** 1 **|** SIMPLE **|** P **|** **ref** **|** **PRIMARY,**reg **|** **PRIMARY** **|** 7 **|** Oblig5**.**C**.**regno **|** 13 **|** **|**

**+**------+-------------+-------+--------+--------------------------+------------------+---------+---------------------+------+----------------------------------------------+

Now this explain shows a similar story to the others. I don’t see a Index help for this as it is using indexes and has available keys.

Will be testing the same normalization scheme as in **b)** as this is a very similar operation.

MariaDB **[**Oblig5**]>** show profiles**;**

**+**----------+------------+-------------------------------------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|**

**+**----------+------------+-------------------------------------------------------------------------+

**|** 1 **|** 3.16445208 **|** **SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **from** Passing3 **|**

**|** **|** **|** **WHERE** **type=**'regular' **|**

**|** **|** **|** **GROUP** **BY** owner **HAVING** totalfee **>** 4000 **|**

**|** 2 **|** 3.11762077 **|** **SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **from** Passing3 **|**

**|** **|** **|** **WHERE** **type=**'regular' **|**

**|** **|** **|** **GROUP** **BY** owner **HAVING** totalfee **>** 4000 **|**

**|** 3 **|** 3.12460796 **|** **SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **from** Passing3 **|**

**|** **|** **|** **WHERE** **type=**'regular' **|**

**|** **|** **|** **GROUP** **BY** owner **HAVING** totalfee **>** 4000 **|**

**|** 4 **|** 3.08037990 **|** **SELECT** SQL\_NO\_CACHE owner **AS** carowner**,** **Sum(**costPerPassing**)** **AS** totalfee **|**

**|** **|** **|** **from** Passing3 **|**

**|** **|** **|** **WHERE** **type=**'regular' **|**

**|** **|** **|** **GROUP** **BY** owner **HAVING** totalfee **>** 4000 **|**

**+**----------+------------+-------------------------------------------------------------------------+

4 **rows** **in** **set** **(**0.000 sec**)**

The improvement is there however. 3.08 being the lowest is about .6s from the original query.

## Query 5 (same as 3)

This query will be the same as Query 4 just using subqueries.

MariaDB **[**Oblig5**]>** **SELECT** SQL\_NO\_CACHE C**.**owner **AS** carowner**,**

**->** **Sum(**F**.**costPerPassing**)** **AS** totalfee

**->** **FROM** Car C **JOIN** Passing P **USING(**regno**)**

**->** **JOIN** TaxClass T **ON** C**.**taxclass**=**T**.**idTaxClass

**->** **JOIN** Fee F **ON** F**.**taxclass**=**T**.**idTaxClass

**->** **WHERE** F**.type=**'withsubscription'

**->** **AND** C**.**regno **NOT** **IN** **(SELECT** regno **FROM** Subscription**)**

**->** **GROUP** **BY** C**.**owner **HAVING** totalfee **>** 4000

**->** **;**

**+**------------------+----------+

**|** carowner **|** totalfee **|**

**+**------------------+----------+

**|** Glen FjÃ¸rtoft **|** 4010.00 **|**

**|** Lasse Nakken **|** 4316.00 **|**

**|** Ulva Hanssen **|** 4130.00 **|**

**|** Yulia Lie **|** 4260.00 **|**

**+**------------------+----------+

4 **rows** **in** **set** **(**3.746 sec**)**

(Difference being from «Query 3» being «not in» regno subscription)



This query did about as well as the previous one. And since it is the same operation the denormalization from the previous query can be used.

## Query 6

Denne spørringen finner navnet til de som har gjort en passering på en spesifikk dag og tid.

MariaDB **[**Oblig5**]>** **SELECT** SQL\_NO\_CACHE C**.**owner **FROM** Car C **WHERE** C**.**regno

**->** **IN** **(SELECT** P**.**regno **FROM** Passing P **JOIN** Tollstation T

**->** **ON** P**.**tollstation **=** T**.**idTollstation

**->** **WHERE** T**.**name **LIKE** 'Gravdal'

**->** **AND** **YEAR(**P**.timestamp)=**2018

**->** **AND** **MONTH(**P**.timestamp)=**2

**->** **AND** DAYOFWEEK**(**P**.timestamp)=**1

**->** **AND** **HOUR(**P**.timestamp)** **=** 3**);**

**+**-----------------------+

**|** owner **|**

**+**-----------------------+

**|** Olav HÃ¦tta **|**

**|** Bjarnhild Reistad **|**

**|** Jarle Aarnes **|**

--!!Shortening the output--

**|** Noor Evensen **|**

**|** Danny Straume **|**

**|** Hossein Kolberg **|**

**|** Hassan Haugland **|**

**|** Odin Persson **|**

**|** Enid Nicolaysen **|**

**|** Oddveig Roald **|**

**|** Xhavit HÃ¸iland **|**

**|** VebjÃ¸rn Bauge **|**

**|** Ramona SÃ¸vik **|**

**|** Oda Dammen **|**

**|** Nicholas Heiberg **|**

**+**-----------------------+

177 **rows** **in** **set** **(**3.396 sec**)**

MariaDB **[**Oblig5**]>** EXPLAIN **SELECT** SQL\_NO\_CACHE C**.**owner **FROM** Car C **WHERE** C**.**regno

**->** **IN** **(SELECT** P**.**regno **FROM** Passing P **JOIN** Tollstation T

**->** **ON** P**.**tollstation **=** T**.**idTollstation

**->** **WHERE** T**.**name **LIKE** 'Gravdal'

**->** **AND** **YEAR(**P**.timestamp)=**2018

**->** **AND** **MONTH(**P**.timestamp)=**2

**->** **AND** DAYOFWEEK**(**P**.timestamp)=**1

**->** **AND** **HOUR(**P**.timestamp)** **=** 3**);**

**+**------+-------------+-------+--------+--------------------------+---------+---------+----------------------+--------+----------------------------+

**|** id **|** select\_type **|** **table** **|** **type** **|** possible\_keys **|** **key** **|** key\_len **|** **ref** **|** **rows** **|** Extra **|**

**+**------+-------------+-------+--------+--------------------------+---------+---------+----------------------+--------+----------------------------+

**|** 1 **|** **PRIMARY** **|** C **|** **ALL** **|** **PRIMARY** **|** **NULL** **|** **NULL** **|** **NULL** **|** 203998 **|** **|**

**|** 1 **|** **PRIMARY** **|** P **|** **ref** **|** **PRIMARY,**fk\_Passing\_1**,**reg **|** **PRIMARY** **|** 7 **|** Oblig5**.**C**.**regno **|** 13 **|** **Using** **where** **|**

**|** 1 **|** **PRIMARY** **|** T **|** eq\_ref **|** **PRIMARY** **|** **PRIMARY** **|** 2 **|** Oblig5**.**P**.**tollstation **|** 1 **|** **Using** **where;** FirstMatch**(**C**)** **|**

**+**------+-------------+-------+--------+--------------------------+---------+---------+----------------------+--------+----------------------------+

3 **rows** **in** **set** **(**0.001 sec**)**

Here we see there being a null under key. This is an indication that perhaps we need an index. But since it does have a key to use. And after hinting to use indexes it still didn’t use it.

I don’t belive much to be gained through denormalization but perhaps having Station name and owner in Passing would help.

## Denormalization

### Table:

**CREATE** **TABLE** **IF** **NOT** **EXISTS** Passing4 **(**

regno **CHAR(**7**)** **NOT** **NULL,**

**timestamp** **TIMESTAMP** **NOT** **NULL,**

tollstation **SMALLINT** UNSIGNED **NOT** **NULL,**

owner **VARCHAR(**85**),**

name **VARCHAR(**45**),**

**PRIMARY** **KEY** **(** regno **,** **timestamp** **),**

**CONSTRAINT** fk\_Passing\_4

**FOREIGN** **KEY** **(** tollstation **)**

**REFERENCES** Tollstation **(** idTollstation **)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**,**

**CONSTRAINT** fk\_Passing\_Subscription4

**FOREIGN** **KEY** **(** regno **)**

**REFERENCES** Car **(**regno**)**

**ON** **DELETE** **NO** ACTION

**ON** **UPDATE** **NO** ACTION**)**

ENGINE **=** InnoDB**;**

### Input data:

-- Passing4

**INSERT** **INTO** Passing4

**SELECT** **DISTINCT** regno**,**tid**,**idTollstation**,**OwnerName**,**tollname

**FROM** ImportTable**;**

### New query:

MariaDB **[**Oblig5**]>** **CREATE** **INDEX** RegNr **ON** Passing **(**regno**);**

**SELECT** SQL\_NO\_CACHE owner **FROM** Passing4

**WHERE** name **LIKE** 'Gravdal'

**AND** **YEAR(**P**.timestamp)=**2018

**AND** **MONTH(**P**.timestamp)=**2

**AND** DAYOFWEEK**(**P**.timestamp)=**1

**AND** **HOUR(**P**.timestamp)** **=** 3**);**

Here we can also perhaps speed things up using a index on name.

## Profiling

All queries are ran 10 times before profiling is started.

### Pre Denormalization

MariaDB **[**Oblig5**]>** SHOW profiles**;**

**+**----------+------------+-------------------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|**

**+**----------+------------+-------------------------------------------------------+

**|** 1 **|** 6.77211777 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **FROM** Car C **WHERE** C**.**regno **|**

**|** **|** **|** **IN** **(SELECT** P**.**regno **FROM** Passing P **JOIN** Tollstation T **|**

**|** **|** **|** **ON** P**.**tollstation **=** T**.**idTollstation **|**

**|** **|** **|** **WHERE** T**.**name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(**P**.timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(**P**.timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(**P**.timestamp)** **=** 3**)** **|** **|**

**|** 2 **|** 6.99386417 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **FROM** Car C **WHERE** C**.**regno **|**

**|** **|** **|** **IN** **(SELECT** P**.**regno **FROM** Passing P **JOIN** Tollstation T **|**

**|** **|** **|** **ON** P**.**tollstation **=** T**.**idTollstation **|**

**|** **|** **|** **WHERE** T**.**name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(**P**.timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(**P**.timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(**P**.timestamp)** **=** 3**)** **|**

**|** 3 **|** 7.04556520 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **FROM** Car C **WHERE** C**.**regno **|**

**|** **|** **|** **IN** **(SELECT** P**.**regno **FROM** Passing P **JOIN** Tollstation T **|**

**|** **|** **|** **ON** P**.**tollstation **=** T**.**idTollstation **|**

**|** **|** **|** **WHERE** T**.**name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(**P**.timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(**P**.timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(**P**.timestamp)** **=** 3**)** **|**

**|** 4 **|** 7.02457586 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **FROM** Car C **WHERE** C**.**regno **|**

**|** **|** **|** **IN** **(SELECT** P**.**regno **FROM** Passing P **JOIN** Tollstation T **|**

**|** **|** **|** **ON** P**.**tollstation **=** T**.**idTollstation **|**

**|** **|** **|** **WHERE** T**.**name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(**P**.timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(**P**.timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(**P**.timestamp)** **=** 3**)** **|**

**|** 5 **|** 6.86503810 **|** **SELECT** SQL\_NO\_CACHE C**.**owner **FROM** Car C **WHERE** C**.**regno **|**

**|** **|** **|** **IN** **(SELECT** P**.**regno **FROM** Passing P **JOIN** Tollstation T **|**

**|** **|** **|** **ON** P**.**tollstation **=** T**.**idTollstation **|**

**|** **|** **|** **WHERE** T**.**name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(**P**.timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(**P**.timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(**P**.timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(**P**.timestamp)** **=** 3**)** **|**

**+**----------+------------+-------------------------------------------------------+

5 **rows** **in** **set** **(**0.000 sec**)**

### Post denormalization

MariaDB **[**Oblig5**]>** show profiles**;**

**+**----------+------------+-------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|**

**+**----------+------------+-------------------------------------------+

**|** 1 **|** 2.82387532 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**|** 2 **|** 2.82266015 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**|** 3 **|** 2.91836424 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**|** 4 **|** 2.88128561 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**|** 5 **|** 2.93795634 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**+**----------+------------+-------------------------------------------+

5 **rows** **in** **set** **(**0.000 sec**)**

This did better than the original Query slicing the time spent in half.

Having a look at this new query with explain

MariaDB **[**Oblig5**]>** EXPLAIN **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4

**->** **WHERE** name **LIKE** 'Gravdal'

**->** **AND** **YEAR(timestamp)=**2018

**->** **AND** **MONTH(timestamp)=**2

**->** **AND** DAYOFWEEK**(timestamp)=**1

**->** **AND** **HOUR(timestamp)** **=** 3**;**

**+**------+-------------+----------+------+---------------+------+---------+------+ ---------+-------------+

**|** id **|** select\_type **|** **table** **|** **type** **|** possible\_keys **|** **key** **|** key\_len **|** **ref** **|** **rows** **|** Extra **|**

**+**------+-------------+----------+------+---------------+------+---------+------+ ---------+-------------+

**|** 1 **|** SIMPLE **|** Passing4 **|** **ALL** **|** **NULL** **|** **NULL** **|** **NULL** **|** **NULL** **|** 5054935 **|** **Using** **where** **|**

**+**------+-------------+----------+------+---------------+------+---------+------+ ---------+-------------+

1 **row** **in** **set** **(**0.000 sec**)**

We have no keys to use in this. Trying to create an index for «name»

MariaDB **[**Oblig5**]>** **CREATE** **INDEX** StationName **ON** Passing4**(**name**);**

The optimizer now uses the index created

**+**------+-------------+----------+-------+---------------+-------------+---------+------+--------+-----------------------+

**|** id **|** select\_type **|** **table** **|** **type** **|** possible\_keys **|** **key** **|** key\_len **|** **ref** **|** **rows** **|** Extra **|**

**+**------+-------------+----------+-------+---------------+-------------+---------+------+--------+-----------------------+

**|** 1 **|** SIMPLE **|** Passing4 **|** **range** **|** StationName **|** StationName **|** 48 **|** **NULL** **|** 352184 **|** **Using** **index** condition **|**

**+**------+-------------+----------+-------+---------------+-------------+---------+------+--------+-----------------------+

1 **row** **in** **set** **(**0.042 sec**)**

Checking if this helps for the performance of the query.

MariaDB **[**Oblig5**]>** show profiles**;**

**+**----------+------------+-------------------------------------------+

**|** Query\_ID **|** Duration **|** Query **|**

**+**----------+------------+-------------------------------------------+

**|** 1 **|** 0.17989276 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**|** 2 **|** 0.17888898 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**|** 3 **|** 0.18819179 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**|** 4 **|** 0.17855339 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**|** 5 **|** 0.17951723 **|** **SELECT** SQL\_NO\_CACHE owner **FROM** Passing4 **|**

**|** **|** **|** **WHERE** name **LIKE** 'Gravdal' **|**

**|** **|** **|** **AND** **YEAR(timestamp)=**2018 **|**

**|** **|** **|** **AND** **MONTH(timestamp)=**2 **|**

**|** **|** **|** **AND** DAYOFWEEK**(timestamp)=**1 **|**

**|** **|** **|** **AND** **HOUR(timestamp)** **=** 3 **|**

**+**----------+------------+-------------------------------------------+

5 **rows** **in** **set** **(**0.000 sec**)**

That is quite the improvement from the original query. From 6-7s to ~0.2s