Need for Speed: Indexierung unter MySQL

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Oli Sennhauser

Senior MySQL Berater bei FromDual GmbH

oli.sennhauser@fromdual.com

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MySQL und Indexierung

- **MySQL Dokumentation:**

  The best way to improve the performance of `SELECT` operations is to create indexes on one or more of the columns that are tested in the query.

- **Grossartig! Aber:**

  Unnecessary indexes waste space and waste time to determine which indexes to use. You must find the right balance to achieve fast queries using the optimal set of indexes.

- **... hmmm, somit müssen wir wohl ein bisschen denken... :-(**

Was ist ein Index?

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- **Adams, Douglas: *The Hitchhiker's Guide to the Galaxy*?**

- **Sennhauser, Oli, Uster?**

52 WAG-WEE ◎ DIALLING CODES :—FOR FULL PARTICULARS SEE PAGES 7 and 8

Waghorne A. R,
Hohnerwch Sandford Mill rd.....Cheltenham 4517
Waghorne Bros,Btchrs,346 High st.....Cheltenham 2956
Waghorne D. E,12 Pittville villas.....Cheltenham 3594
Waghorne Frank,Btchr,4 Tivoli bldgs...Cheltenham 3419
Waghorne & Evans,Motr Engrs,
Shurdington rd.....Cheltenham 3211
Waghorne Mrs. M. A,
1 Oxford villas London rd.....Cheltenham 2411
Waghorne Wallace,
Beulah ho 82 Prestbury rd.....Cheltenham 3596
Wagner Mrs. O. H,Spencer cottage
Cirencester rd Minchinhampton....Brimscombe 170
Wagon & Horses Hotel,Hucclecote....Gloucester 614211
Wagon Repairs Ltd,India rd.....★Gloucester 2225
Lydney.....Lydney 73
Waine W. O,Tramgr,Fountain st.....Nailsworth 83
Waite Mrs. A. E,Church hig Highnam...Gloucester 3819
Waite A. F,29 Derby rd.....★Gloucester 3301
Waite Eric,Dntl Srgn,9 Imperial sq....Cheltenham 2988
Waite & Son,Jwlrs,349 High st.....Cheltenham 2891
Waite T. Wilfred,Engelberg.....◎Cleeve Hill 72
Wake Mrs,H,10 Imperial sq.....Cheltenham 5140
Wake H. B, L,Newick ho Sandford rd...Cheltenham 4162
Wakefield H. E,13 Park pl.....Cheltenham 4583
Wakefield Mrs. L,10 Church st.....Cheltenham 4532
Wakefield Miss M. C,
Camperdown St Stephens rd.....Cheltenham 3407
Wakefield Mrs. M. E,Spring Hill ch....Nailsworth 105
Wakefield & Son,Frts,Market pl.....Cirencester 119
Wakefield Thomas,Church farm.....Northleach 49
Wakeford E. E,Plmbr, Hot-Water Fittr,
Sidney parade.....Gloucester 2952
Walden F,Bchr,26 Dyer st.....Cirencester 191
Wales Sydney,
Hyde Tyeing Minchinhampton....Brimscombe 130
Wales Sydney,Queens Minchinhampton..Brimscombe 201
Walford Miss K. M,
Royal Well villa Chapel walk.....Cheltenham 3958
Walford S. T,Upbill 189 Leckhampton rd.Cheltenham 2839
Walker Mrs. A,Sub Postmistress PO.....Cutkerton 1
Walker A. A,Church ho Naunton.....Guiting Power 29
Walker A. J,Bkr,Confctnr,17 Long st...Wotton-u-E 123
Walker A. W,Btchr,Kemerton nr Tewkesbury Bredon 6
Walker Mrs. C. F,The Mount.....Amberley 43
Walker Col. C. W. G,Manor ho.....South Cerney 10
Walker C. Co's Strs Ltd,Grcrs,George st....Stroud 125
Walker & Co.'s Strs,Castle st.....Cirencester 84
Walker E. W, Berry Wormington.....Toddington 2
Walker Mrs. Gavin,7 Queens parade....Cheltenham 4967
Walker George N,Norton ct Glouste.....Twigworth 64
Walker G. S,Hardwicke ho.....Bredon 7
Walker Harry,High st garMinchinhmptn Brimscombe 73
Walker H. C,Greentrees Hatherley rd...Cheltenham 4962
Walker H. J,St Briavels Stores.....St. Briavels 29
Walker Lt-Col. H. S,Greenfields..Bourton-on-the-W 21
Walker J,Genl Strs,
Cheltenham rd Gloucester.....◎Churchdown 357
Walker James,
Honeyacre Uhlswood Cheltenham..Shurdington 71
Walker James (Goldsmith & Silversmith) Ltd,
48 Promenade.....Cheltenham 3427
Walker Miles,F.R.S,Dunkirk ho.....Amberley 131
Walker R. W,
The Hawthorns Church rd.....Cheltenham 5090
Walker Thos. H,Underhill.....Dursley 159
Walker T. Lawson,Frnr,
Pool fm Acton Beauchamp Worcs.Fromes Hill 17
Walker W. C. & Son,Bkrs,Grcrs,
Chedworth.....Fossebridge 18
Walker W. J,Buscot Wick.....Lechlade 63
Wallis Mrs. M,Avonside.....Tewkesbury 20
Wallis Miss M. J. E,
Sunnyside Bussage Stroud.....Brimscombe 150
Walpamur Co. Ltd. The,Commercial rd..Gloucester 3411
Walters Rev. F. E,
Minsterworth vicarage Gloucester..Minsterworth 32
Walters J. T. & Co,Drprs,5 High st.....Ledbury 141
Walters & Son,Bkrs, Cndtrs,
Cotswold cafe.....Dursley 35
Waltham C,Btchr,5 Suffolk par.....Cheltenham 2151
Wallis G. Allan,
Waltham Watch Depot,14 King sq....Gloucester 3753
Walton E. L,The Northend Northgate st.Gloucester 356011
Walton J. Ltd,Fruit Mchts,
G.W.R. Goods yard.....Longhope 65
Walton Mrs. M,The Moorend Much Cowarne,
Bronyard.....Stirtn Grandison 14
Walton S. A,Frir,19 Russell st.....Stroud 382
Walwin,Glmst,47 Southgate st.....Gloucester 2844
Waiwin Mrs,Sunnymede Upton lane....Gloucester 6143
Wankiyn Mrs. W. L,
The Little Manor Charlton Kings...Cheltenham 3910
Wanswell Call Office,PO.....Sharpness 013
Warburton Mrs. E. M. T,
121 Cheltenham rd.....Cirencester 491
WAR DEPARTMENT—
Recruiting Office,353 High st.....Cheltenham 4193
Recruiting Office,The Barracks....Gloucester 2993
Ward A. D,Bank Agnt,etc,
Bank chambers High st.....Northleach 45
Ward Mrs. Addleton,Beechworth lawn..Cheltenham 2637
Ward Mrs. A. G,
Treelands 130 Leckhampton rd.....Cheltenham 2273
Ward R. L, Ltd,Drprs, Frnshrs,High st★Cheltenham 5165
Ward E. L,2 Hatherley Court rd.....Cheltenham 4215
Ward R. T. & Son,Coal Mchts,G.W.R. wharf.Stroud 199
Ward Capt. F. C,
Hillfrois Barnwood rd.....Gloucester 3885
Ward Miss F. M,Southcote Kemerton....Overbury 28
Ward Geo. W,Bldr,
Buckstone Oakland av.....Cheltenham 3543
Ward H. Waltman,Srgn,
Chipping manor.....Wotton-u-E 14
Ward J. E, L,Gambles End.....◎Cleeve Hill 105
Ward & Woodman,Chmnys,Eastgate st...Gloucester 2825
Warden Mrs. Ellary,Swan cottage.....Much Marcle 15
Warden Capt. St. L. S,
Midland House Flat,1 Montpelier Ter.Cheltenham 3479
Wardon Mrs. M,Fosse Wold.....Stow-on-the-Wold 102
Wardle-Smith J. H,
Winstone Cove Cirencester.....Miserden 28
Ware E. P,Frnr,Sudgrove farm Stroud...Miserden 24
Ware Maj.-Gen. Sir Fabian,Dhsl cottage..Amberley 63
Ware G. S,Hide Market Northgate st....Gloucester 2531
Wares Private Hotel,Suffolk sq.....Cheltenham 2663
Wargent H,Parkhold cottage.....Trumpet 78
Wargent H. H,Garage Ashperto.....Trumpet 45
Wargent & Sons,Engrs,CanonFrome Stirtn Grandison 2
Warman Mrs. W,Woodlands.....Stroud 8
Warman W. & Son,Soltrs,1 Rowcroft.....Stroud 17
Warn J,The Rivers.....Dursley 65
Warner A,Frnr,Highfield farm.....Tetbury 7291
Warner A. E. F,Btchr,Frnr,Lawn Longfrd Gloucester 2694
Warner Bros,Motr Engrs,Twyning green....Bredon 23
Warner Maj. C. A. S,
Little Rissington manor....Bourton-on-the-W 49
Warner C. T,Garage,113 High st.....Tewkesbury 8
Warner F. The Cottage.....◎Churchdown 253
Warner E,Haulier,Snow farm Ashcch..Tewkesbury 27
Warner R. F,Southwick.....Tewkesbury 206
Watkin W. R,Stroud rd.....Gloucester 3850
Watkins Mrs. A,Frogmore Little dean..Cinderford 2127
Watkins C. W,Fairoaks Hollybush,....Bromesberrow 42
Watkins E. L,Manor farm Longdon...Birtsmorton 28
Watkins Fred (Iron Ore Mines),Coleford....Coleford 200
Watkins H. B,Comm Agnt,
Mountaigne Woodside.....Broam 13
Watkins L. G,Baker,
The Bakery Ashperton Ledbury.....Trumpet 46
Watkins Maurice S,Bldr, Undtkr,
Wintles hill.....Westbury-on-S 36
Watkins R. J,Yazleton farm.....Longhope 66
Watkins T. J,Hitchfield.....Longhope 56
Watkins W. A,Haulage & Coal,
Frampton-on-Severn.....Saul 79
Watkins W. H,Grcr,7 High st.....Cheltenham 4161
Watney Lady Margaret,
Wilmstrp park Fairford Glos. Coin St. Aldwyns 40
Watson A. H,6 Cirencester rd.....Cheltenham 3155
Watson Rev. C. E,Churchfields lo Rodboro....Stroud 157
Watson Col. C. H,Del Rey ho.....Cheltenham 3734
Watson Mrs. Edgar,5 Suffolk mans.....Cheltenham 3869
Watson G. E,8 Gadshill rd Charlton Kings Cheltenham 3193
Watson Mrs. G. R,Wyneide.....St. Briavels 39
Watson M. T,Chmst,Roweroft Pharmacy..Stroud 49
Watson R. E,Comm Agnt,
Commercial st.....Cinderford 3100
Watson R. S,High Elms Prestbury.....Cheltenham 7154
Watson W. E,Foothill Salperton.....Guiting Power 70
Watson W. G,146 Old Bath rd.....Cheltenham 3340
Watson W. S. J,Pen Moel Park rd.....Stroud 519
Watson's,Soft Furnishings,3 Clarence st. Cheltenham 3898
Watt-Smyth Mrs,
Orchard cottage Woodmancote.....◎Cleeve Hill 41
Watts Mrs. B. A,Moor fm MorefonValmor....Saul 14
Watts Charles,Outfitter,148A High st....Cheltenham 4624
Watts Major R. M,
The Bungalow Middle Lypiatt.....Stroud 629
Watts (Factors) Ltd,Genl Fctrs,High st....★Lydney 92
Watts F. E,Frnr,Elts farm Ilmore.....Hardwicke 1344
Watts H. F,Elstcrd Engr,Park rd.....Nailsworth 238
Watts John H,The Rocklands.....Lydney 134
Watts J. S. & Son,Irnmgrs,Broam.....Broam 15
Watts L. J,Bldr,Kings hill.....Dursley 164
Watts W. D,Rosemount.....Lydney 129
Watts W. & Son,Haulgrs,
Montpellier walk.....Cheltenham 3348
Waugh Evelyn,Piers et Stonebcombe....Dursley 250
Waylen C. W,Kenelcroe 356 Old Bath rd.Cheltenham 3451
Wayte W. J,Gayton Greenhills rd.....Cheltenham 3644
Wear L. R,34 Vicarage rd.....Gloucester 3762
Weare E. R,4 Oxford st.....Lydney 159
Wearne Rev. E. C,Barnsley, Circencester.....Bibury 40
Weaver Mrs. A. M. M,
Spring cottage Llandogo.....St. Briavels 82
Weaver George & Sons,Fruit, Corn,
Castlemorton.....Bromesberrow 26
Weaver H.PO Berrow.....Bromesberrow 20
Weaver Mrs. J. Y,
The Plough Upper Oddington.Stow-on-the-W 134
Weaver Nurse,2 Berkeley vls Pittville..Cheltenham 2829
Weavers Stores,Grcrs,
Church st Charlton Kings.....Cheltenham 3446
Webb Mrs. A. E,21 Alexander rd.....Gloucester 3247
Webb Bros,Domestic Engrs,Belmont rd....Stroud 290
Webb Bros. Ltd, Brick, Tile Mfrs,
Battledown works.....★Cheltenham 3001
Coal Mchts,14 Promenade.....★Cheltenham 3001
Colliery Agnts,Battledown works.★Cheltenham 3001
Webb S. S,Station gar Charlton Kings..Cheltenham 3747

Index technisch gesehen

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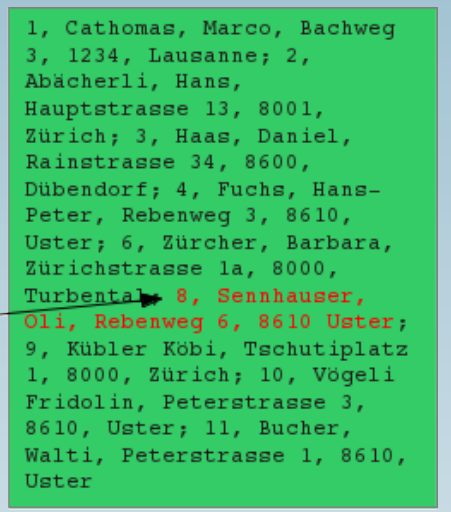
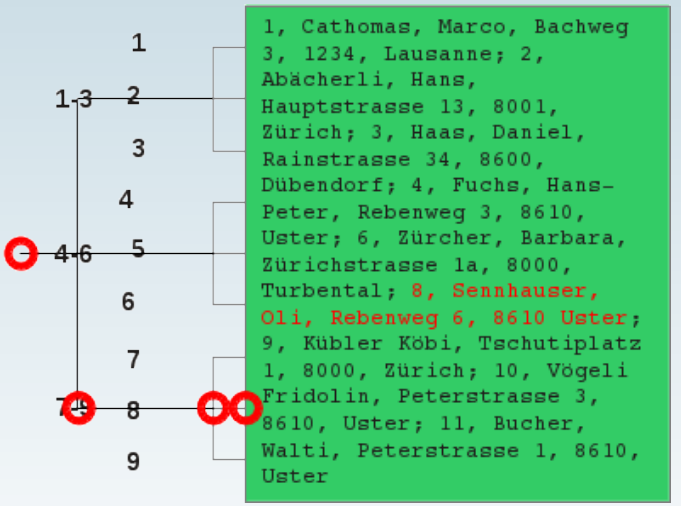


MyISAM



InnoDB

MySQL nutzt Indizes:

- Um Eindeutigkeit zu erzwingen (`PRIMARY KEY`, `UNIQUE KEY`)
- Um schnell auf Zeilen zuzugreifen und diese zu filtern (`WHERE`)
- Um Joins schnell auszuführen (`JOIN`)
- Um `MIN()` und `MAX()` Werte schnell zu finden
- Für Sortier- und Gruppier-Operationen (`ORDER BY`, `GROUP BY`)
- Um Joins mittels eines Covering Index zu vermeiden
- Um `FOREIGN KEY` Constraints (`FOREIGN KEY`) zu erzwingen

WHERE Klausel 1


```
SELECT *
  FROM customers
 WHERE name = 'Fro
```

```
SHOW CREATE TABLE customers\G

CREATE TABLE `customers` (
  `customer_id` smallint(5) unsigned
, `name` varchar(64) DEFAULT NULL
, PRIMARY KEY (`customer_id`)
```

```
EXPLAIN
SELECT *
  FROM customers
 WHERE name = 'FromDual';

+----------+------+---------------+------+-------+-------------+
| table    | type | possible_keys | key  | rows  | Extra       |
+----------+------+---------------+------+-------+-------------+
| customers | ALL  | NULL          | NULL | 31978 | Using where |
+----------+------+---------------+------+-------+-------------+
```

Wie legt man Indices an?


```
ALTER TABLE …
```

- `ADD PRIMARY KEY (id);`
- `ADD UNIQUE KEY (uuid);`
- `ADD FOREIGN KEY (customer_id) REFERENCES customers (customer_id);`
- `ADD INDEX (last_name, first_name);`
- `ADD INDEX pre_ind (hash(8));`
- `ADD FULLTEXT INDEX (last_name, first_name);`

WHERE Klausel 2


```
ALTER TABLE customers
  ADD INDEX (name);
```

```
                                    ) unsigned
                                    LT NULL
                                    d`)
, KEY `name` (`name`)
)
```

Verbesserung: 20 ms → 5 ms

```
+----------+-----+---------------+------+---------+-------+------+
| table    | type | possible_keys | key  | key_len | ref   | rows |
+----------+-----+---------------+------+---------+-------+------+
| customers | ref  | name          | name | 67      | const |    1 |
+----------+-----+---------------+------+---------+-------+------+
```

JOIN Klausel


```
EXPLAIN SELECT *
  FROM customers AS c
  JOIN orders AS o ON c.customer_id = o.customer_id
 WHERE c.name = 'FromDual';
+-------+------+--------------+------+---------+-------+---------+
| table | typ                                                  rows    |
+-------+----                                                -------+
| c     | ref                                                      1 |
| o     | ALL                                                1045105 |
+-------+----                                                -------+
```

Verbesserung: 450 ms → 6 ms

```
ALTER TABLE orders
  ADD INDEX (customer_id);
```

```
+-------+------+---------------+-------------+---------+---------------+------+
| table | type | possible_keys | key         | key_len | ref           | rows |
+-------+------+---------------+-------------+---------+---------------+------+
| c     | ref  | PRIMARY,name  | name        | 67      | const         |    1 |
| o     | ref  | customer_id   | customer_id | 3       | c.customer_id |    8 |
+-------+------+---------------+-------------+---------+---------------+------+
```

Tabellen sortieren oder gruppieren

ORDER BY, GROUP BY

```
EXPLAIN SELECT *
  FROM contacts AS c
 WHERE last_name = 'Sennhauser'
 ORDER BY last_name, first_name;
+-------+------+---------------+
| table | type |               |
+-------+------+---------------+
| c     | ref  | Using filesort |
+-------+------+---------------+
```

Verbesserung : 20 ms → 7 ms

```
ALTER TABLE contacts
  ADD INDEX (last_name, first_name);
```

```
+-------+------+-------------+------+-------------------------+
| table | type | key         | rows | Extra                   |
+-------+------+-------------+------+-------------------------+
| c     | ref  | last_name_2 | 1561 | Using where; Using index |
+-------+------+-------------+------+-------------------------+
```

Covering Indices


```
EXPLAIN
SELECT customer_id, amount
  FROM orders AS o
 WHERE customer_id = 59349;
+-------+------+-------------+------+-------+
| table | type
+-------+-----
| o     | ref
+-------+-----
```

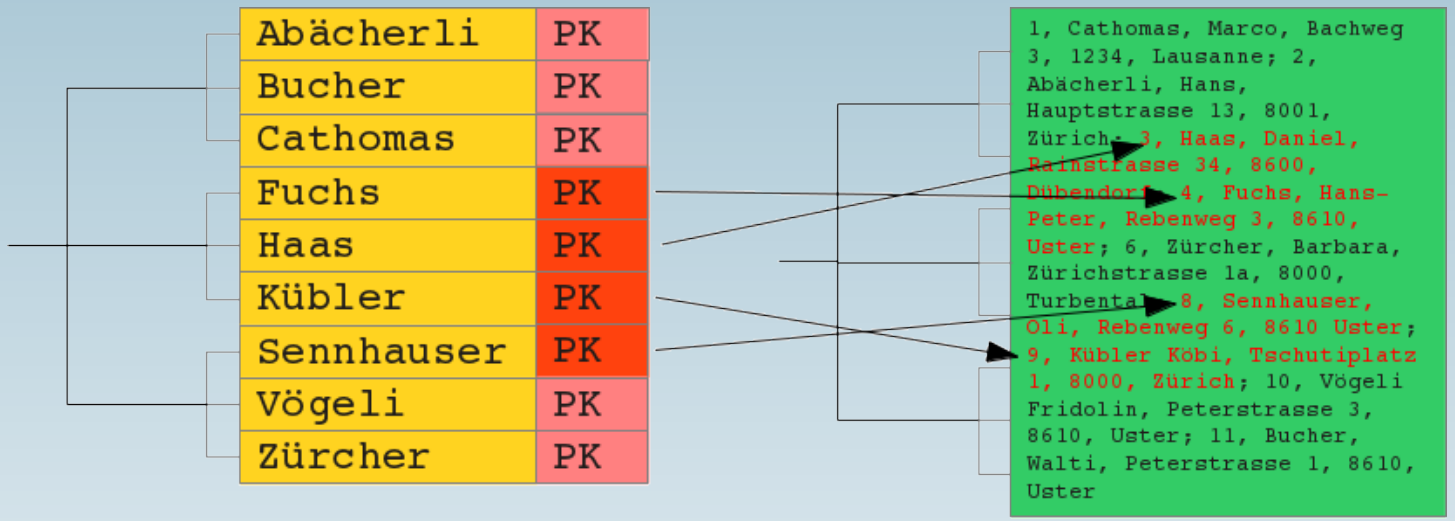
Und jetzt?

```
ALTER TABLE orders
  ADD INDEX (customer_id, amount);
```

```
+-------+------+--------------+------+-------------+
| table | type | key          | rows | Extra       |
+-------+------+--------------+------+-------------+
| o     | ref  | customer_id_2 |   15 | Using index |
+-------+------+--------------+------+-------------+
```

Vorteil von Covering Indices

- **Warum sind Covering Indices vorteilhaft?**



ohne

mit

Finden von fehlenden Indices

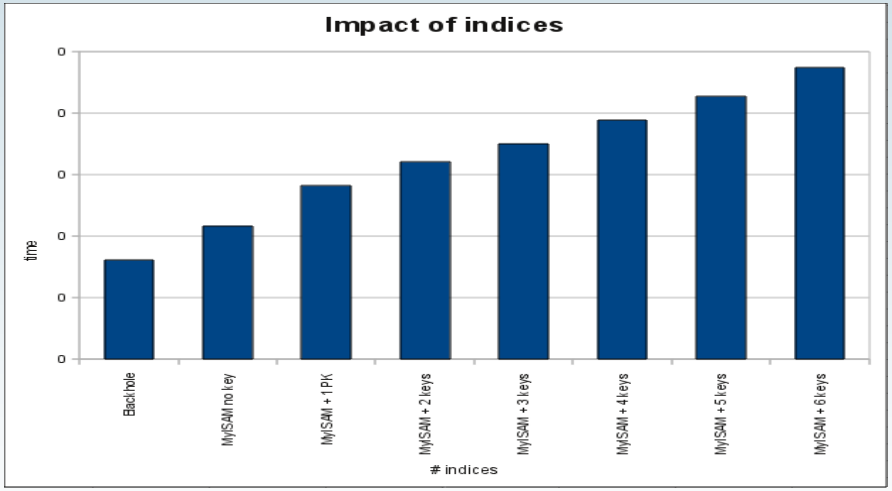
- ER Diagramm? :-(
  - Hängt hauptsächlich von der Business Logik ab...
- Wie FINDET man sie? --> Slow Query Log
- MySQL Variablen:
- Seit v5.1 on-line!

```
+-------------------------------+----------+
| Variable_name                 | Value    |
+-------------------------------+----------+
| log_queries_not_using_indexes | ON       |
| long_query_time               | 0.250000 |
| min_examined_row_limit        | 100      |
| slow_query_log                | ON       |
| slow_query_log_file           | slow.log |
+-------------------------------+----------+
```

Indices sind nicht nur gut!

- Indices brauchen Platz (Platte, heisse Daten im RAM!)
- Indices brauchen Zeit für Wartung (CPU, RAM, I/O)
- Optimizer braucht Zeit um herauszufinden, welchen Index er nehmen soll.
- Manchmal ist der Optimizer völlig verwirrt und trifft eine falsche Entscheidung wenn zu viele (ähnliche) Indices vorhanden sind.

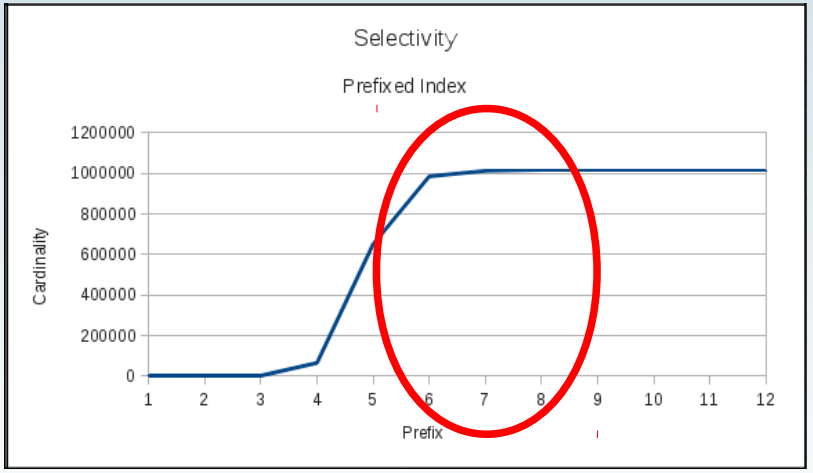
→ *Es gilt die richtige Balance für schnelle Abfragen und optimalen Indices zu finden.*



Kleiner Index – schnelle Abfrage

- Passt besser in RAM (weniger I/O)
- Höhere Datendichte (Rows/Block)
- Weniger CPU Zyklen
- Prefixed Index:

```
ADD INDEX pre_ind (hash(8));
```



Indices vermeiden

- Vermeide redundante (daher unnötige) Indices
- Wie kann so was passieren?
  - Entwickler 1: Kreiert einen Foreign Key Constraint → erledigt
  - Entwickler 2: Ouu! Abfrage ist langsam → Oli hat gesagt: Index anlegen → erledigt
  - Entwickler 3: Ouu! Anfrage ist langsam → Entwickler 2 ist ein Idiot! → Index anlegen → erledigt
- Frameworks vs. Entwickler
- Upgrade Prozess vs. DevOps

- Vermeide Indexes welche nicht benutz/benötigt werden!

Wie findet man solche Indices?


```
SHOW CREATE TABLE ...\G
```

```
mysqldump --no-data > structure_dump.sql
```

- Seit MySQL 5.6: `PERFORMANCE_SCHEMA`
  - Percona Server / MariaDB: Userstats
  - http://fromdual.com/mysql-performance-schema-hints

```
SELECT object_schema, object_name, index_name
  FROM performance_schema.table_io_waits_summary_by_index_usage
 WHERE index_name IS NOT NULL
   AND count_star = 0
 ORDER BY object_schema, object_name;
```

Vermeide partiell redundante Indices

- `INDEX (city, last_name, first_name)`
- ~~`INDEX (city, last_name)`~~
- ~~`INDEX (city)`~~
- `INDEX (last_name, city)` ???
- `INDEX (first_name, last_name)` !!!

Schlechte Selektivität

- Weg mit Indices mit schlechter Selektivität (~= geringe Kardinalität)
- Kandidaten sind:
  - `status`
  - `gender`
  - `active`
- Wie findet man ob ein Feld eine schlechte Selektivität hat?

  Indices (und Joins) sind teuer!!!
- Break-even zwischen 15% und 66%
- Schauen wir mal ob der MySQL Optimizer davon weiss... :-)

```
SELECT status, COUNT(*)
  FROM orders
 GROUP BY status;

+--------+--------+
| status | cnt    |
+--------+--------+
|      0 | 393216 |
|      1 | 262144 |
|      2 |     12 |
|      3 |     36 |
|      4 |     24 |
|      5 |      4 |
|      6 |      8 |
+--------+--------+
```

Optimizer liegt falsch!

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```
SELECT * FROM orders WHERE status = 2;
+--------+------+---------------+--------+------+
| table  | type | possible_keys | key    | rows |
+--------+------+---------------+--------+------+
| orders | ref  | status        | status |   12 |
+--------+------+---------------+--------+------+
```

```
SELECT * FROM orders WHERE status = 0;
1.43 s
+------
| table
+------
| order
+------
```

5.6.12 (nach `ANALYZE TABLE`)

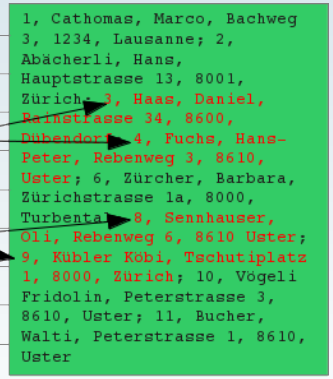
```
---+
   |
---+
69 |
---+
```

```
SELECT status, COUNT(*)
  FROM orders
 GROUP BY status;

+--------+--------+
| status | cnt    |
+--------+--------+
|      0 | 393216 |
|      1 | 262144 |
|      2 |     12 |
|      3 |     36 |
|      4 |     24 |
|      5 |      4 |
|      6 |      8 |
+--------+--------+
```

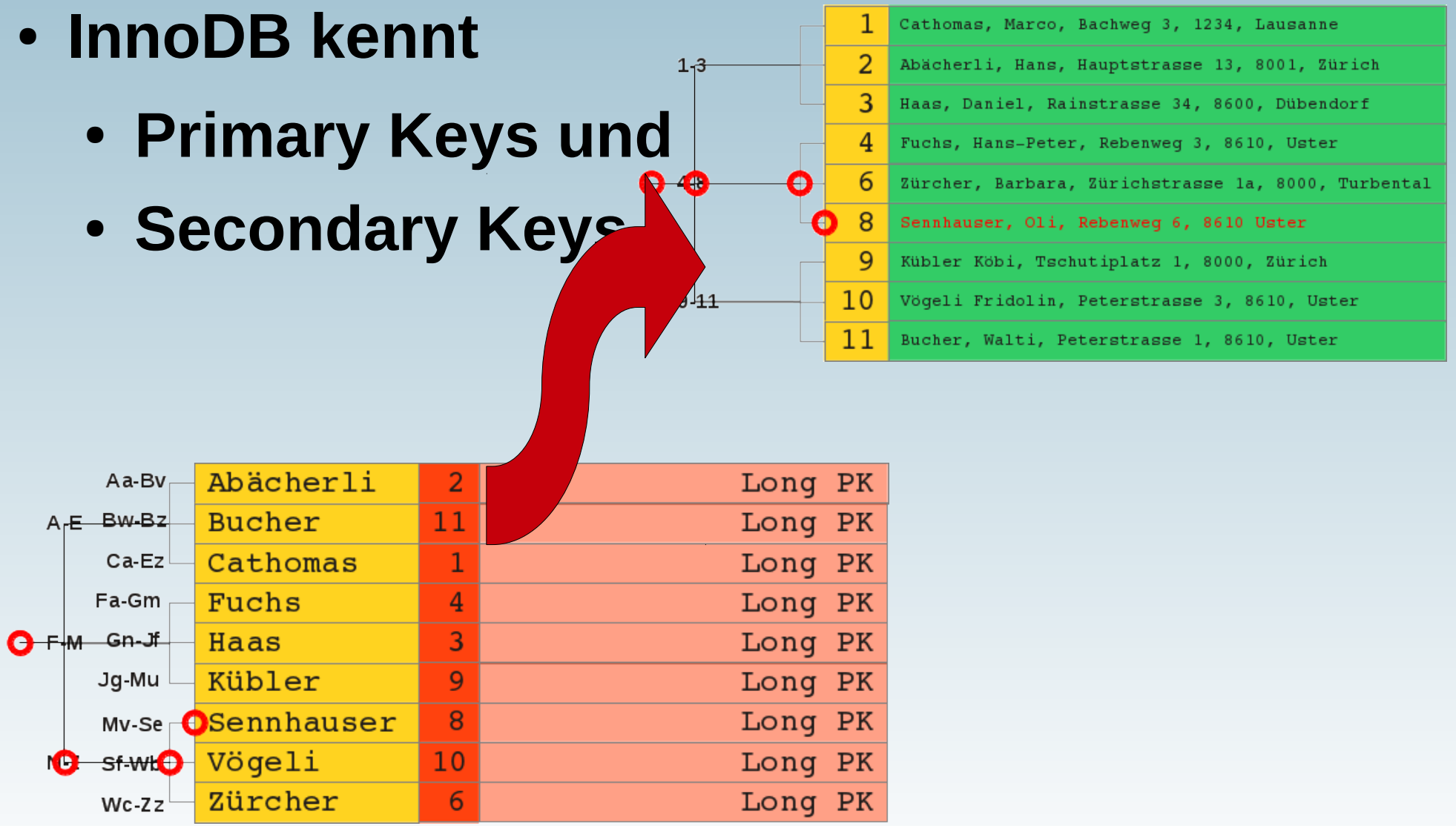
```
SELECT * FROM orders IGNORE INDEX (status) WH
0.44 s
+--------+------+---------------+------+----
| table  | type | possible_keys | key  | rows
+--------+------+---------------+------+----
| orders | ALL  | NULL          | NULL | 6549
+--------+------+---------------+------+----
```

0;



InnoDB PK und SK

- InnoDB kennt
  - Primary Keys und
  - Secondary Keys

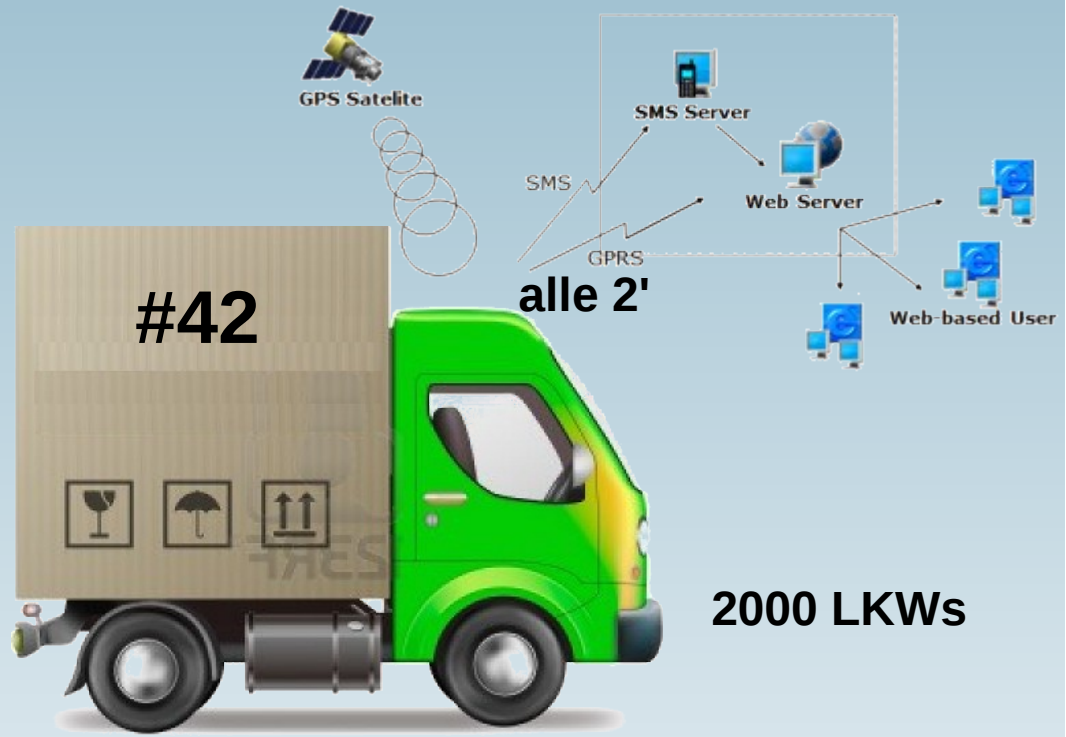


Geclusterter Index

- InnoDB: Daten = Blätter des Primary Keys
  - Heisst auch Index Clustered Table (IOT)
    - → Daten sind sortiert wie PK (Index ist sortiert)!
    - → PK beeinflusst Lokalität der Daten (physische Lage)
- `AUTO_INCREMENT` ~= Sortieren nach Zeit!
- Gut in vielen Fällen
  - Wenn heisse Daten = aktuelle Daten
- Schlecht für Zeitreihen
  - Wenn heisse Daten = Daten pro Objekt

Beispiel: InnoDB

A_I	ts	v_id	xpos	ypos	...
1	17:30	#42	x,	y,	...
2	17:30	#43	x,	y,	...
3	17:30	#44	x,	y,	...
	...				
2001	17:32	#42	x,	y,	...
2002	17:32	#43	x,	y,	...
2003	17:32	#44	x,	y,	...



Q1: Δ in Zeilen? ~ 2000 Zeilen
A1: 1 Zeile ~ 100 byte
Q2: Δ in bytes? ~ 200 kbyte
Q3: Default InnoDB block size? default: 16 kbyte
Q4: Avg. # Zeilen von LKW #42 in 1 InnoDB block? ~ 1
A2: 3 d und 720 pt/d → ~2000 pt ~ 2000 rec ~ 2000 blk
Q5: Wie lange dauert das und warum (32 Mbyte)?
~ 2000 IOPS ~ 10s random read!!!
S: Alles im RAM oder starkes I/O-System oder ...?

die letzten 3 Tage

Geclusterter PK rettet den Tag!

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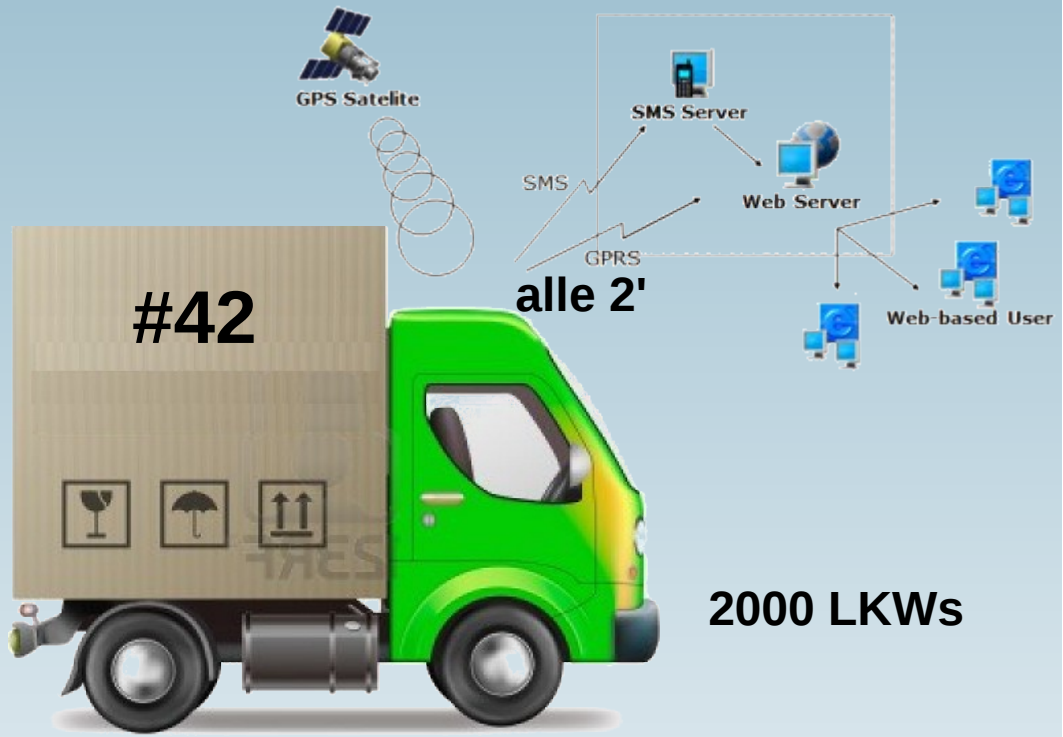
```
ts v_id xpos ypos ...

17:30 #42 x, y, ...
17:32 #42 x, y, ...
17:34 #42 x, y, ...
          ...
17:30 #43 x, y, ...
17:32 #43 x, y, ...
17:34 #43 x, y, ...

          ...
17:30 #44 x, y, ...
```



Q1: Avg. # Zeilen von LKW #42 in 1 InnoDB block? ~ 120
A1: 3 d und 720 pt/d → ~2000 pt ~ 2000 rec ~ 20 blk
Q2: Wie lange dauert das und warum (320 kbyte)?
~ 1-2 IOPS ~ 10-20 ms sequential read!
S: Wow f=50 schneller! Nachteile?

die letzten 3 Tage

Index Hints

- MySQL Optimizer liegt manchmal falsch!
  - Wir müssen ihm nachhelfen...
- Index Hints (Hinweise) sind:
  - `USE INDEX (ind1, ind2)`
    - Schau nur diese Indices an...
  - `FORCE INDEX (ind3)`
    - Nimm diesen Index ohne weiter nachzudenken
  - `IGNORE INDEX (ind1, ind3)`
    - Schau Dir alle Indices ausser diese an
- Hints nur als allerletzte Rettung verwenden!

MySQL Variablen

- MySQL Variablen welche Indices beeinflussen
  - MyISAM: `key_buffer_size`
  - InnoDB: `innodb_buffer_pool_size`
- InnoDB Change Buffer
  - `innodb_change_buffer_max_size`
  - `innodb_change_buffering`
- Adaptive Hash Index (AHI)
- MySQL 5.6.3 / 5.5.14 Indexlänge 767 → 3072 bytes
  - `innodb_large_prefix`

Wir suchen noch:

- **Datenbank Enthusiast/in für Support / remote-DBA / Beratung**

Q & A

Fragen ?

Diskussion?

Anschliessend ist noch Zeit für ein persönliches Gespräch...

- **FromDual bietet neutral und unabhängig:**
  - **MySQL Beratung**
  - **Remote-DBA**
  - **Support für MySQL, Galera Cluster, MariaDB und Percona Server**
  - **MySQL Schulung**

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