

Indexing and Query optimization

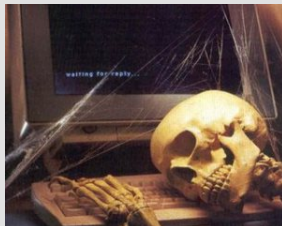
Hogeschool Rotterdam
Rotterdam, Netherlands

Lecture topics

- Query optimization.
- Examples of slow query operations.
- Hashing.
- Trees.

Reasons

- Query needs to be fast.
- Sometimes they are not.
- You do not want to see your nephew born before retrieving the book you are looking for from Amazon.



Causes

- Too much data (Big data analysis).
 - Data clustering.
 - Better hardware. (arrays of disks, caching, ...)
- Too complex queries (DBMS optimization)
 - Refactor query. (Access planner)
 - Refactor data. (Indexing)

Indexes

- Query refactoring not always possible.
- Build additional data to speed up the data retrieval.

Indexes

- Take your text book and look for the paragraph titled “Key constraints” without using the index. How many pages have you looked?

Indexes

- Take your text book and look for the paragraph titled “Key constraints” without using the index. How many pages have you looked?
- **Answer:** 29 (from page 3 to 32).

Indexes

- Take your text book and look for the paragraph titled “Key constraints” without using the index. How many pages have you looked?
- **Answer:** 29 (from page 3 to 32).
- Do the same using the index. How many pages have you looked?

Indexes

- Take your text book and look for the paragraph titled “Key constraints” without using the index. How many pages have you looked?
- **Answer:** 29 (from page 3 to 32).
- Do the same using the index. How many pages have you looked? **Answer:** 2 (1 in the index, 1 in the text).

```
SELECT name
FROM ships
WHERE firepower >= 500
```

ships				
name	type	firepower	speed	position
Red 1	X-Wing	10	300	(1,3,1)
Red 2	X-Wing	10	300	(1,2,1)
Red 3	X-Wing	10	300	(0,2,5,1)
Red 4	X-Wing	10	300	(2,2,5,1)
Red 5	X-Wing	10	300	(2,2,5,0)
Red 6	X-Wing	10	300	(2,2,5,0)
Tantine IV	Corellian Corvette	60	300	(4,2,5,0)
Tyranny	Imperial Star Destroyer	1500	100	(12,0,0)
Accuser	Imperial Star Destroyer	1500	100	(-12,0,0)
Bombard	Victory Star Destroyer	500	175	(-6,1,0)

```
SELECT name
FROM ships
WHERE firepower >= 500
```

ships				
name	type	firepower	speed	position
Red 1	X-Wing	10	300	(1,3,1)
Red 2	X-Wing	10	300	(1,2,1)
Red 3	X-Wing	10	300	(0,2,5,1)
Red 4	X-Wing	10	300	(2,2,5,1)
Red 5	X-Wing	10	300	(2,2,5,0)
Red 6	X-Wing	10	300	(2,2,5,0)
Tantine IV	Corellian Corvette	60	300	(4,2,5,0)
Tyranny	Imperial Star Destroyer	1500	100	(12,0,0)
Accuser	Imperial Star Destroyer	1500	100	(-12,0,0)
Bombard	Victory Star Destroyer	500	175	(-6,1,0)

Number of comparisons: 10

Indexes

- How many comparisons we do at most in a table with R records?

Indexes

- How many comparisons we do at most in a table with R records?
- **R comparisons**

Indexes

- How many comparisons we do at most in a table with R records?
- **R comparisons**
- How many comparisons we do at least in a table with R records?

Indexes

- How many comparisons we do at most in a table with R records?
- **R comparisons**
- How many comparisons we do at least in a table with R records?
- **R comparisons**

- Sorting and grouping requires to sort the column values.
- The best sorting algorithm requires about $R \log R$ operations, where R is the number of records.
- Running the query below requires about $10 * \log 10 \simeq 23$ operations.

```
SELECT type
FROM ships
WHERE firepower >= 500
ORDER BY firepower DESC
```


- Generate pairs with one element from the first table and the second from the other followed by a selection.
- Same problem of the selection.
- Consider the following query applied to ship and the table below.

```
SELECT s.name,p.damage  
FROM ships s,projectiles p  
WHERE s.position = p.position AND  
       s.name = p.target
```

Projectiles		
target	position	damage
Tantine IV	(0,1,0)	30
Tantine IV	(3,1,-2)	50
Tantine IV	(4,2.5,0)	100