



Indexes =

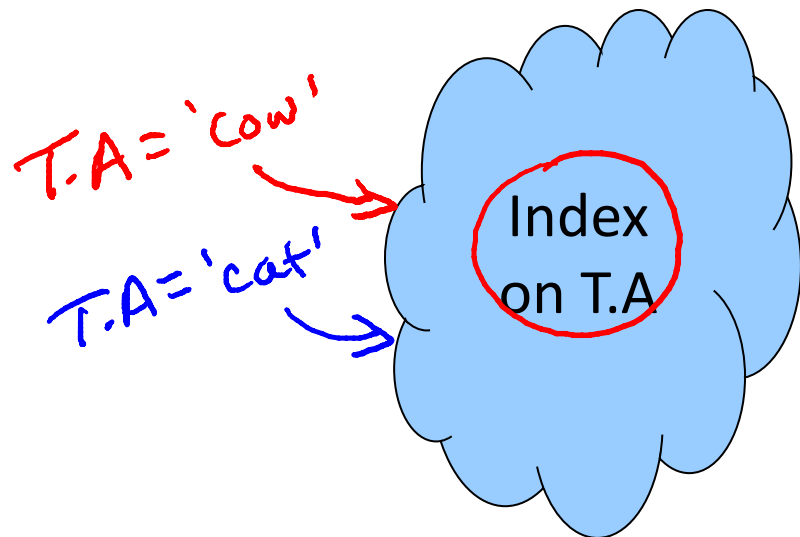
Indices

Indexes

- Primary mechanism to get improved performance on a database
- Persistent data structure, stored in database
- Many interesting implementation issues

But we are focusing on user/application perspective

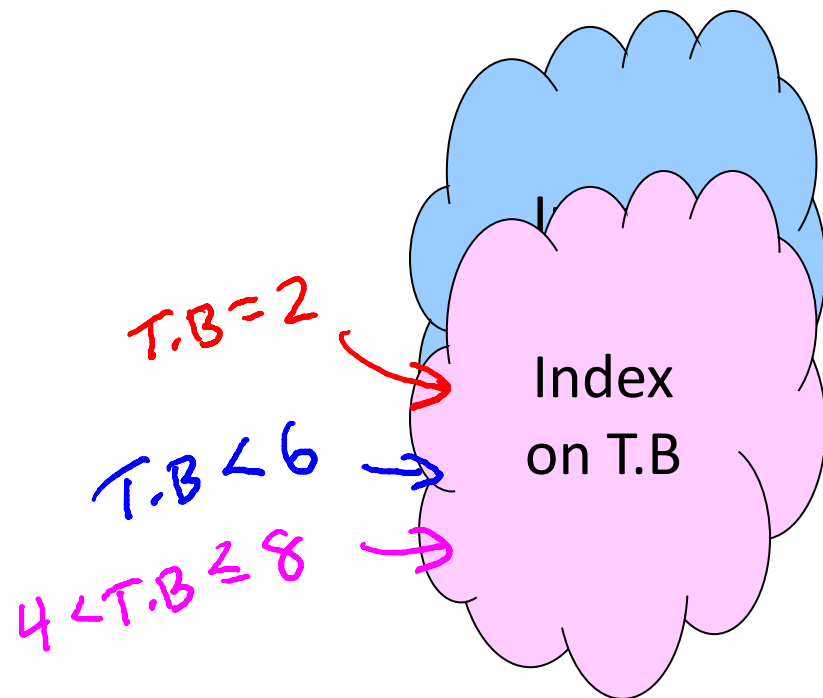
Functionality



T

	A	B	C
1	cat	2	...
2	dog	5	...
3	cow	1	...
4	dog	9	...
5	cat	2	...
6	cat	8	...
7	cow	6	...

Functionality



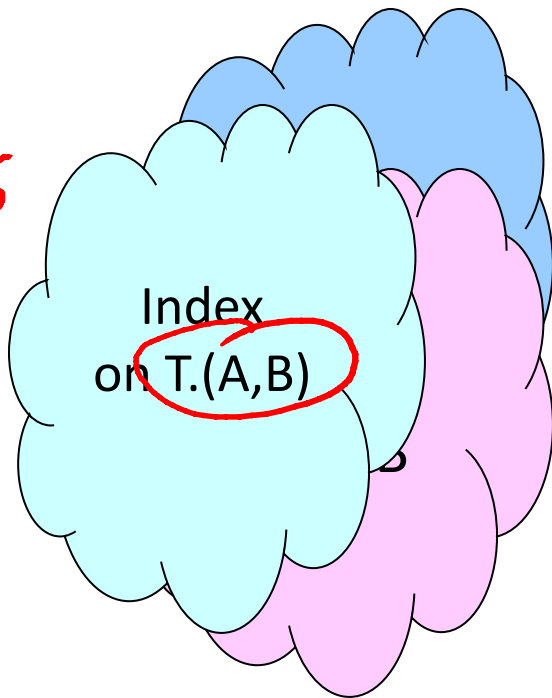
T

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Functionality

$T.A = 'cat'$
and $T.B > 5$

$T.A < 'd'$
and $T.B = 1$

**T**

	A	B	C
1	cat	2	...
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Utility

- Index = difference between full table scans and immediate location of tuples

* Orders of magnitude performance difference

- Underlying data structures

- Balanced trees (B trees, B+ trees)

- Hash tables

$$A = v$$

→ constant ✓

$$A = v \quad v_1 \leq A \leq v_2$$
$$A < v$$

→ logarithmic ✓

```
Select sName  
From Student  
where SID = 18942
```

Index on SID

Many DBMS's build indexes automatically on
PRIMARY KEY (and sometimes **UNIQUE**) attributes

```
Select sID  
From Student  
where sName = 'Mary' And GPA > 3.9
```

Index on sName \leftarrow hash or tree
Index on GPA \leftarrow tree-based
" (sName, GPA)


```
Select sName, cName  
From Student, Apply  
where Student.sID = Apply.sID
```

Index — Index

Query planning & optimization

Downsides of Indexes

- 1) Extra space – marginal
- 2) Index creation – medium
- 3) Index maintenance – can offset benefits

Picking which indexes to create

Benefit of an index depends on:

- Size of table (and possibly layout) ✓
- Data distributions ✓
- Query vs. update load ✓

“Physical design advisors”

Input: database (statistics) and workload

Output: recommended indexes

Benefits outweigh drawbacks

- Database statistics

- Query or update

- Indexes

Query
Optimizer

Best execution plan
with estimated cost

SQL Syntax

Create Index IndexName on T(A)

Create Index IndexName on T(A1,A2,...,An)

Create Unique Index IndexName on T(A)

Drop Index IndexName

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