



#ASLI ENGINEERING

How indexes make a database read faster?

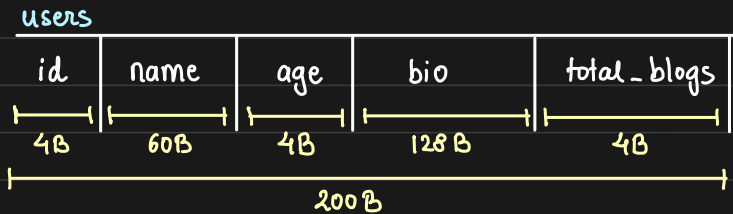


BY

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How indexing makes your DB faster

Database is a collection of records.



Users table has 5 columns and each record of the table will be 200B long.

Say the users table has 100 rows
total size = $200 \times 100 = 20000B$

users

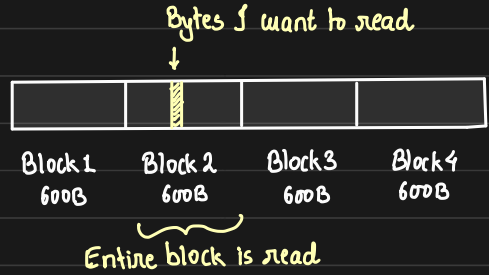
id	name	age	bio	total_blogs
1	A	23	_____	7
2	B	21	_____	10
3	C	22	_____	8
4	D	23	_____	2
5	E	22	_____	1
6	F	24	_____	15
⋮	⋮	⋮	⋮	⋮

How reads from disk happen?

↳ One disk read = one block read

600B

Even if we read one byte, it will read the entire block that contains the byte



Users table in blocks

Each record is 200B

Block size is 600B

id	name	age	bio	total_blogs
1	A	23	=====	7
2	B	21	=====	10
3	C	22	=====	8
4	D	23	=====	2
5	E	22	=====	1
6	F	24	=====	15
⋮	⋮	⋮	⋮	⋮

Each block can hold 3 records =



The entire 'users' having 100 rows can fit in $\frac{100}{3} = 33.3 \sim 34$ Blocks

So, reading the entire table will require the database engine to read 34 Blocks from the disk.

If hypothetically Read 1 Block takes 1 sec
time to read entire table = 34 sec.

Query: Find all users with age == 23

id	name	age	bio	total_blogs
1	A	23	_____	7
2	B	21	_____	10
3	C	22	_____	8
4	D	23	_____	2
5	E	22	_____	1
6	F	24	_____	15
⋮	⋮	⋮	⋮	⋮

Flow:

- ↳ iterate table row by row
 - ↳ block by block
- ↳ read the block in memory
- ↳ check age == 23 on each record
- ↳ if yes, add the record to an output buffer
- ↳ if no, discard
- ↳ return the output buffer

Time taken to answer this query is same as time taken to read the blocks

34 blocks = 34 sec

Let's see how indexes make this fast...

Indexes

↳ Indexes are smaller referential tables that holds row references against the indexed value

On a very high level

Eg: Say we create an index on 'age'
it would look something like this

users_age_idx

Ordered
by the
indexed
value

age	id
21	2
22	3
22	5
23	1
23	4
24	6
⋮	⋮

Each entry in index is
 $4B + 4B = 8B$ big
↓ ↓
age id

There will be 100 entries in the
index, so total size of index
will be $8 \times 100 = 800B$

One disk block = 600B

So, index will require only 2 blocks
on the disk.

Query: Find all users with age == 23 with index

Flow:

↳ iterate index (worst case complex index)

↳ block by block

↳ check age == 23 in entries

↳ if yes, add the 'id' in a buffer

↳ if no, discard

↳ for all the relevant id in the buffer

↳ read the records from the disk

↳ add to an output buffer

↳ return the output buffer

Read the index and
note the relevant ids
matching criteria

For the relevant ids
fetch the actual records
from the disk

Let's walk through on our data & example

	age	id
	21	2
	22	3
	22	5
Ordered by the indexed value	23	1 *
	23	4 *
	24	6
	⋮	⋮

To find the relevant ids,

we read the index
and filter out relevant ids

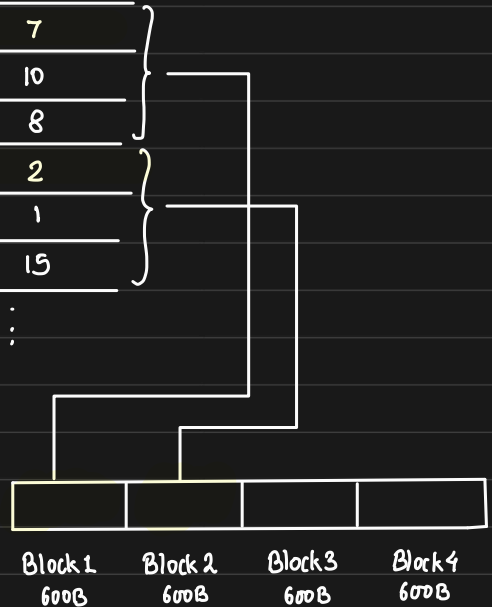
Blocks read = 2

↑
worst case

Relevant IDs with age == 23 are [1, 4]

Users table in blocks

id	name	age	bio	total_blogs
1	A	23	_____	7
2	B	21	_____	10
3	C	22	_____	8
4	D	23	_____	2
5	E	22	_____	1
6	F	24	_____	15
⋮	⋮	⋮	⋮	⋮



We need row ids 1 and 4
which are present in Block 1 &
Block 2, so, we read the
two blocks from the disk,
extract the records and return

Blocks read = 2

Total Blocks read = 2 + 2 → 4 block ~ 4sec
(Index) (record)

Time take without index = 32 sec } 8x
with index = 4 sec }