SQL - Indexes

A - All or nothing - Atomicity

C - Same as before - Consistency

I - Multiple transaction should be independent - Isolation

D - After commit, changes are permanent - Durability

- READ ✓
- WRITE ✓
- READ ✓
- WRITE ✗

Isolation level

Level 1 → READ UNCOMITTED

Problem - DIRTY READ

T1 T2

x' = READ(x)

X = READ(X)

1000

X' = READ(X)?

X' += 500

WRITE(X, 1500)

X'' = READ(X)

WRITE(X, 1000)

ROLLBACK

COMMIT(ISO)

Booking

P1

Read

P2

Read S1

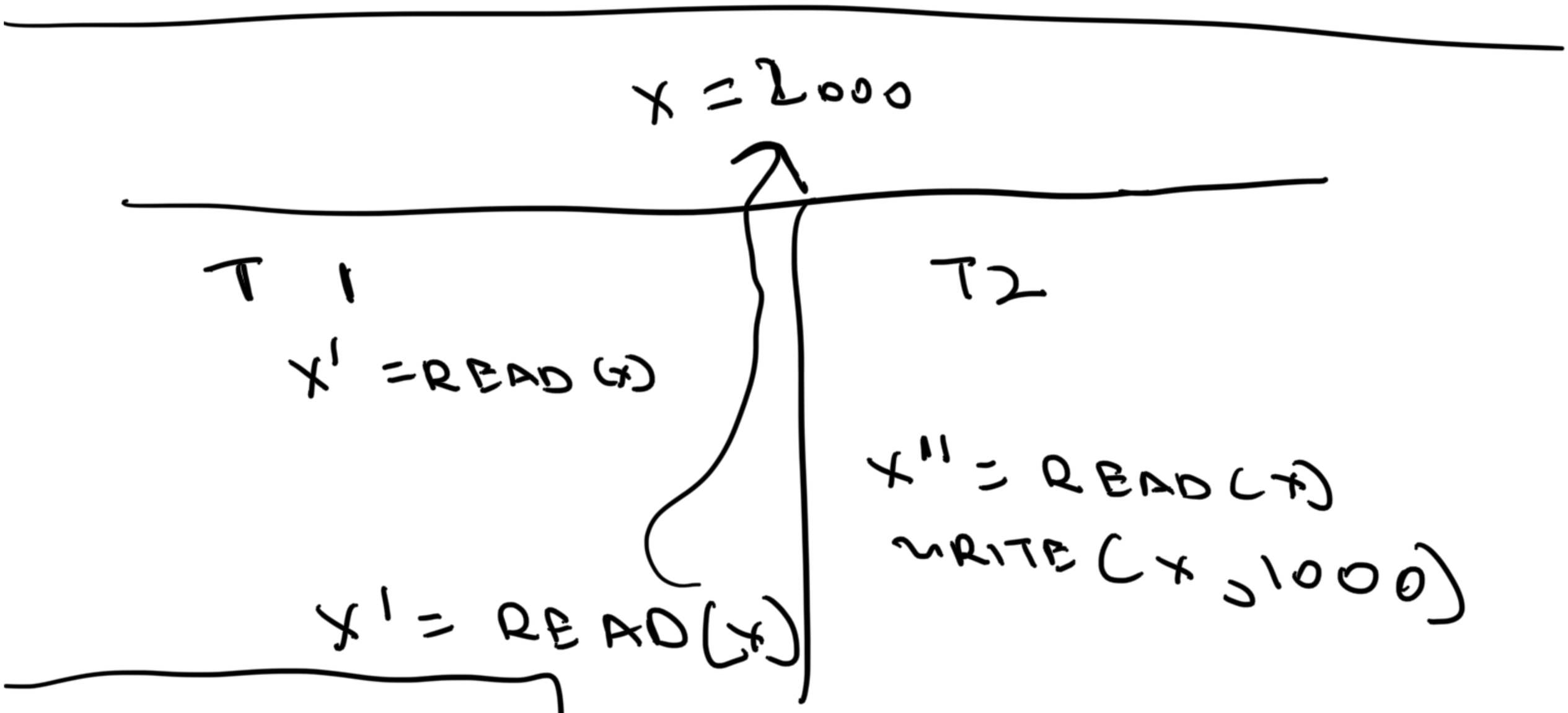
WRITE (S1, BOOKED)

WRITE (S1, Bobbu)

Rollback

Read committed

↳ Committed



Lost update

S1 = AVBL

P1 (T1)	P2 (T2)
READ (S1)	
	READ (S1)
	WRITE (S1, BookRED)
READ (S1)	
WRITE (Book)	
COMMIT	
	COMMIT

Lost update

P1 | P2

Read uncomitted

READ → AVBL

WRITE → BOOKED

Send email

1. Get all the users — 100

(2) Generate this email — 100

(3) Updates the list — 101

(4) Get all the users — 101

Non-repeatable read

Repeatable Read

x = 2000

READ(X) → 2000

WRITE(X, 1000)

READ(X)

→ RUC → 1000

→ RC → 2000

→ RR → 2000

READ(Y)

→ (1000)

WRITE(Y, 1000)

COMMIT

READ(x)

↳ RUC → 1000

↳ RC → 1000

↳ RR → 2000

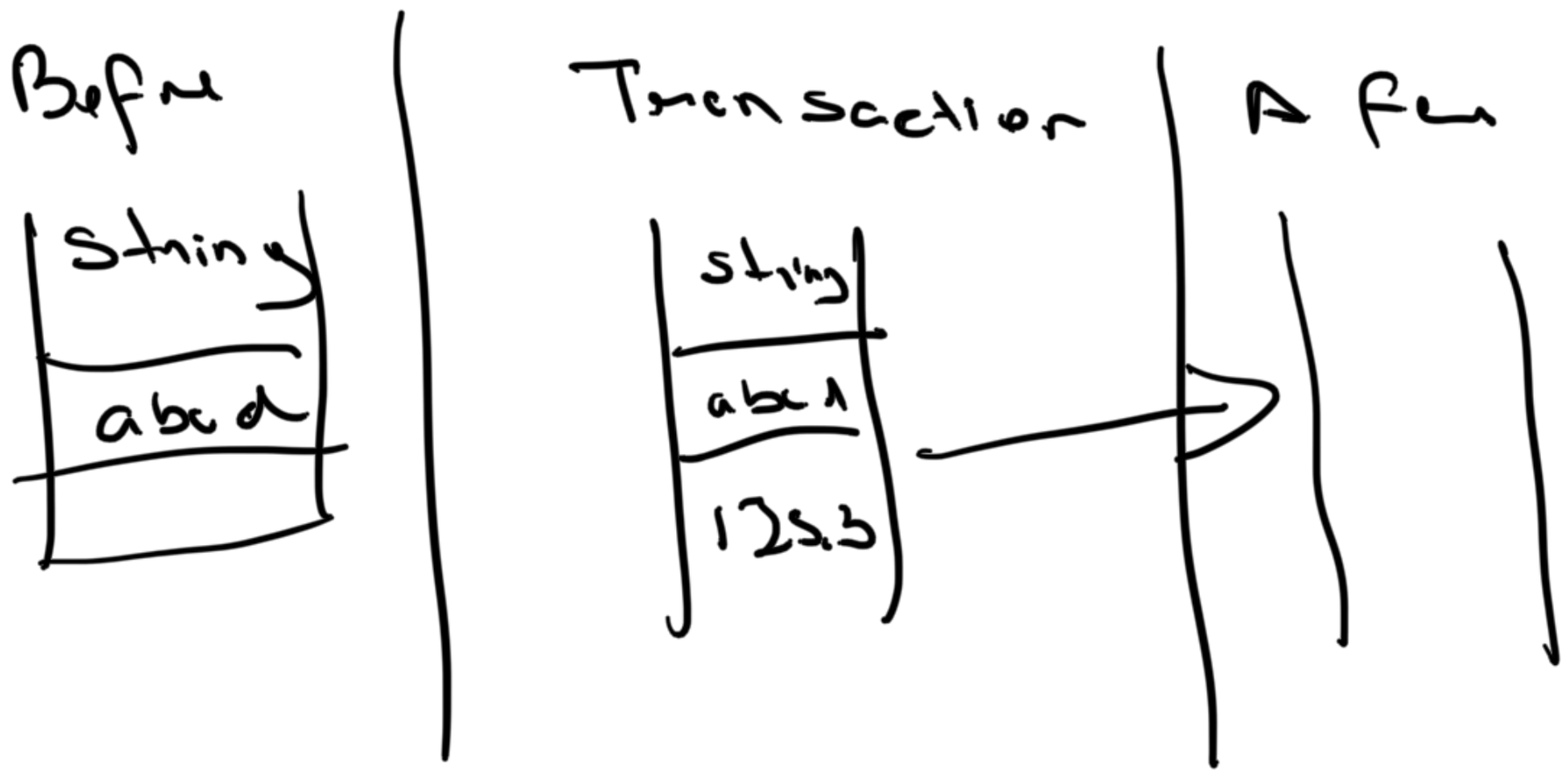
RUC

RC

RR

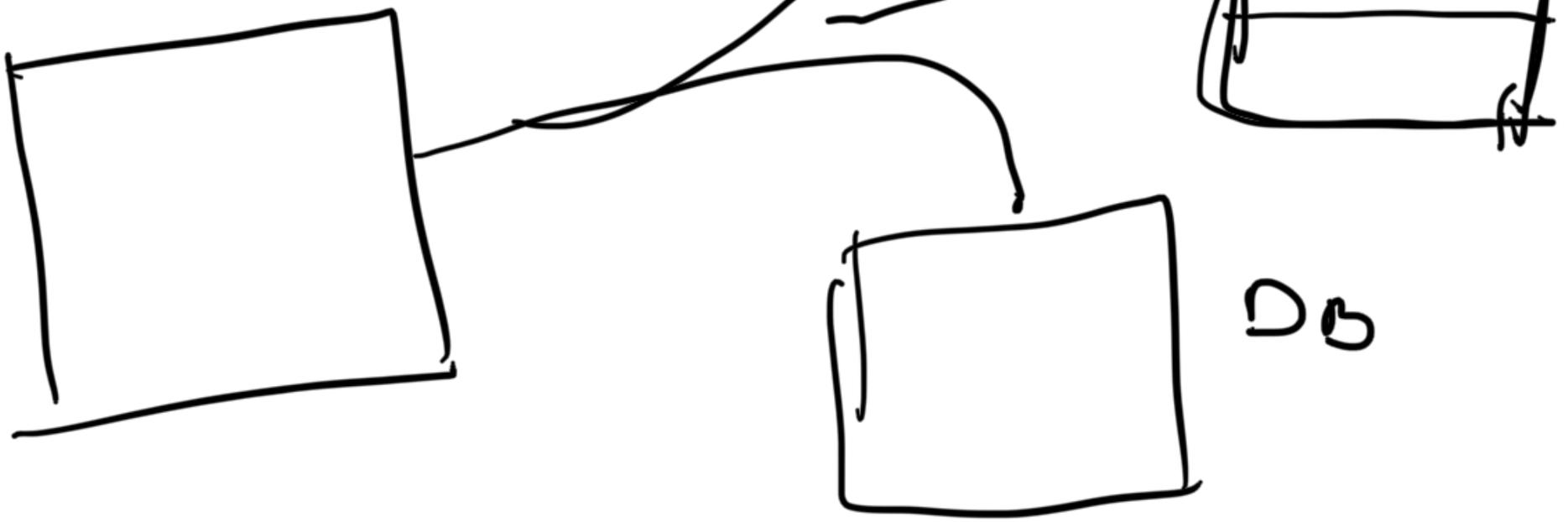
Serial

Performance



WAL (Write ahead logging)

INSERT STUDENTS



6:19 - 6:25

- 10:55 BREAK

Student

Content Type

Storage

Volatile

Persistent

temp.

permanent

RAM

Disk

Cache

Select * students

Mechanical

Slow

RAM

OS

→ Memory

→ OS | CPU can do something else.

1000 1001 1002

	ID	Name	batch_id	psd
x	1	A	1	20
x	2	B	1	30
	3	C	2	40
x	4	D	1	50

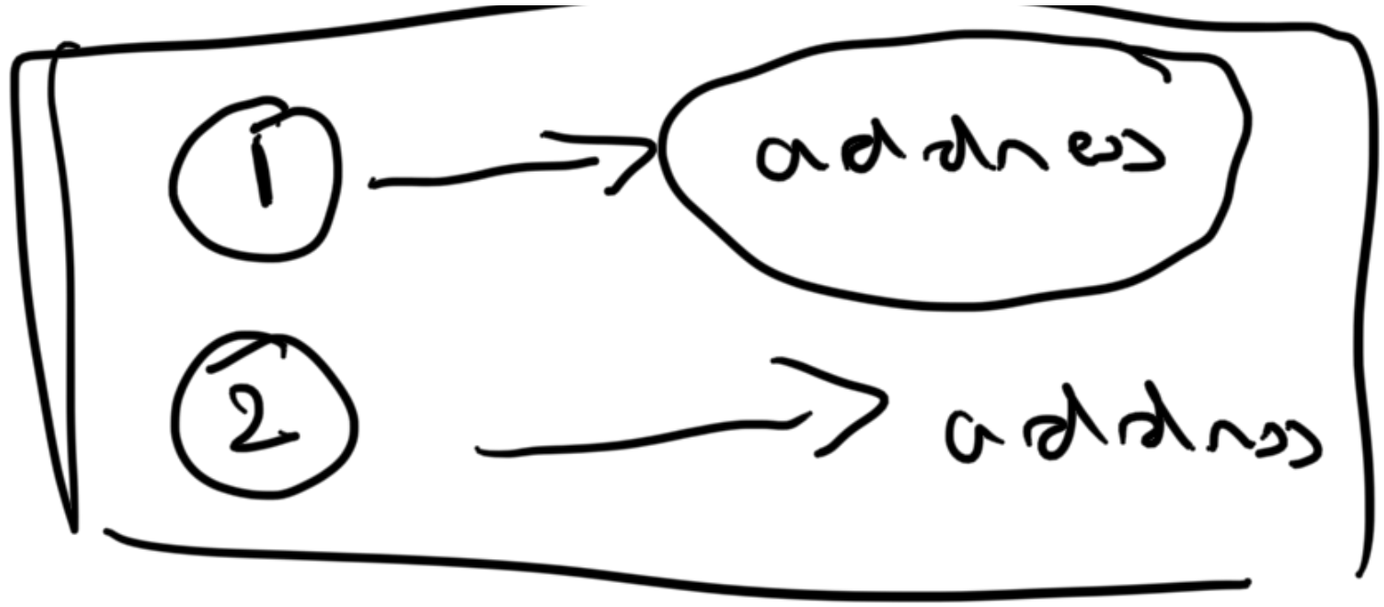
1004

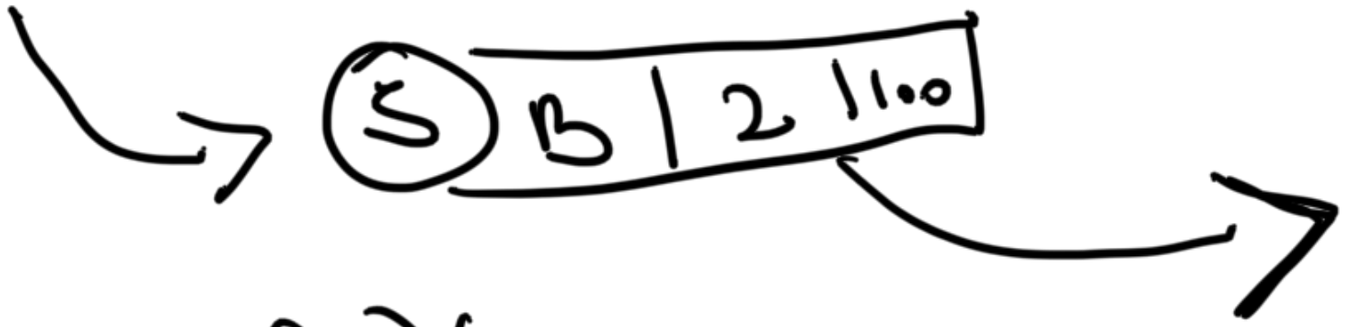
1005

```
Select * from students where batch_id = 2
```

4 row

```
Select * from student where id = 3
```


1
address
2
address


S
B
2
1100


O(n)
ID
ADDR
1
1001
2
1002
4
003
5
Memory
1003

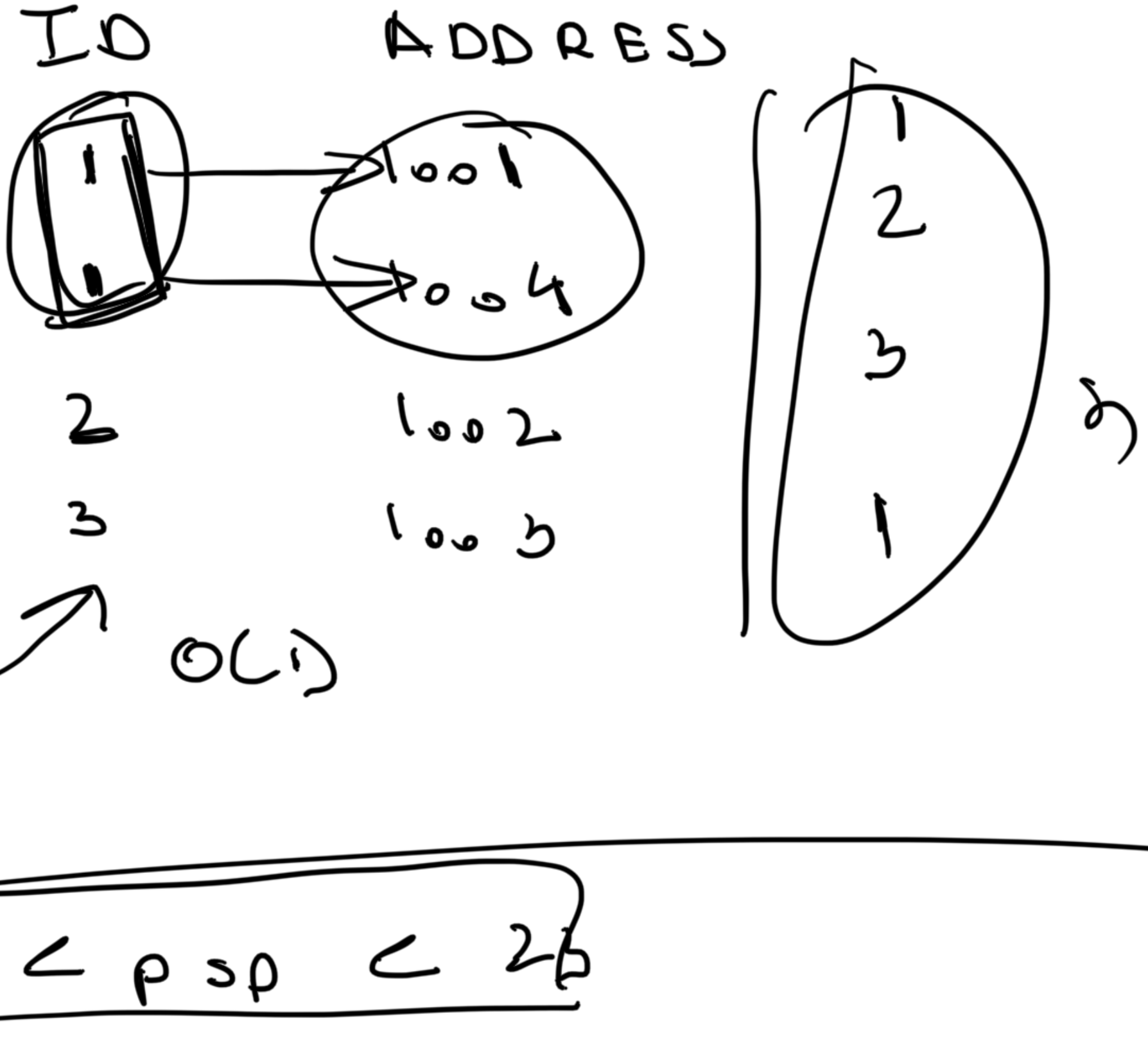
Select * from students where batch_id = 1

batch_id

10001	1	A	1
10002	2	B	2
10003	3	C	3
10004	4	D	1

4 → 2

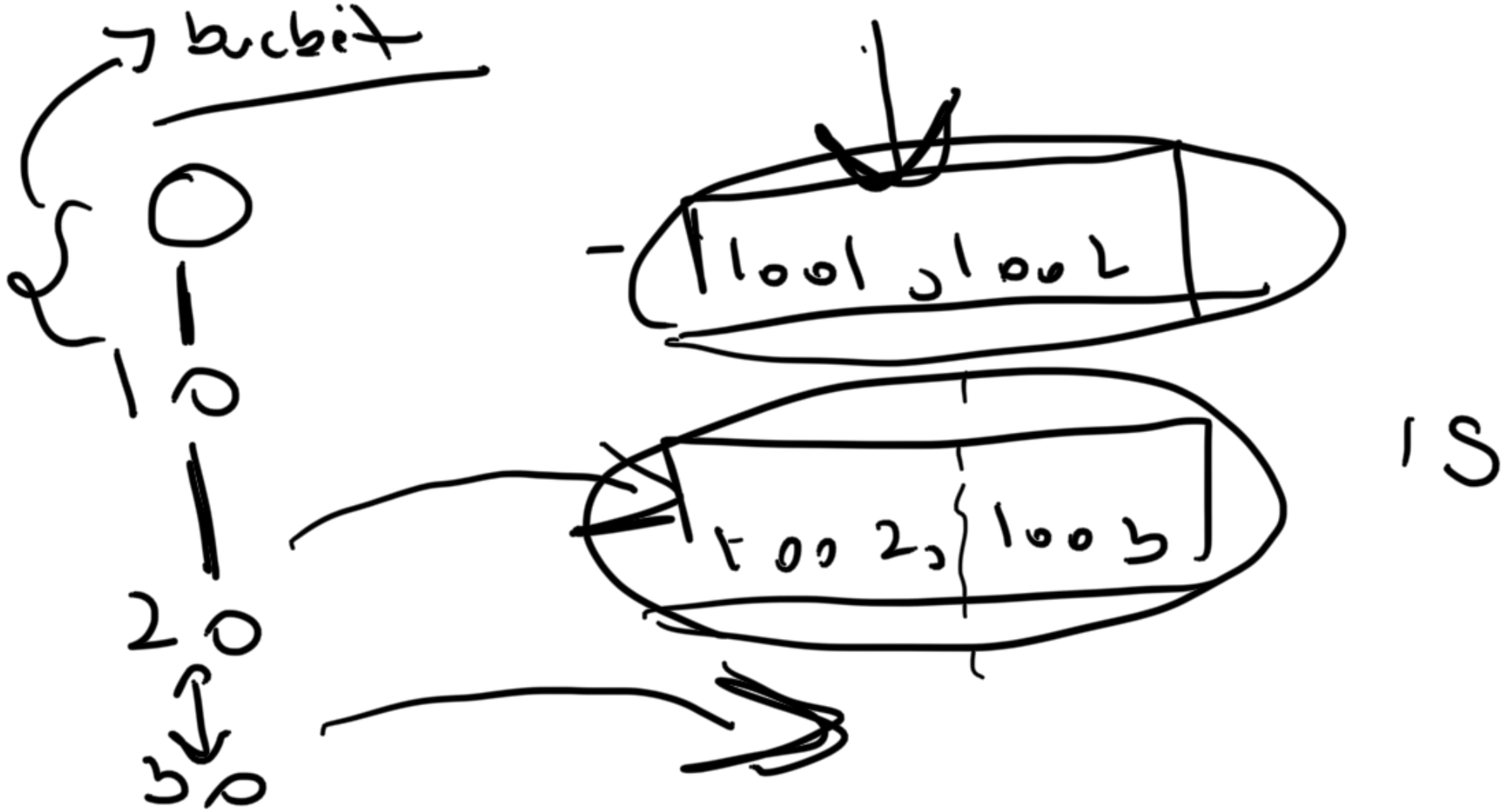
Index



O(1)

$17 < psp < 26$

Range Index



IS

---

① fetching by key → O(1)

→ O(log n)

(2) Sorted on key

Map

Ordered Map

TREE MAP

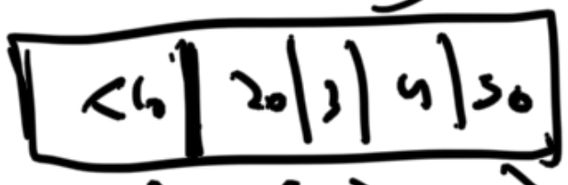
AVL

Red-black tree

flash Map

B+ trees

n-ary tree



InnoDB

↳ Database engine

myISAM

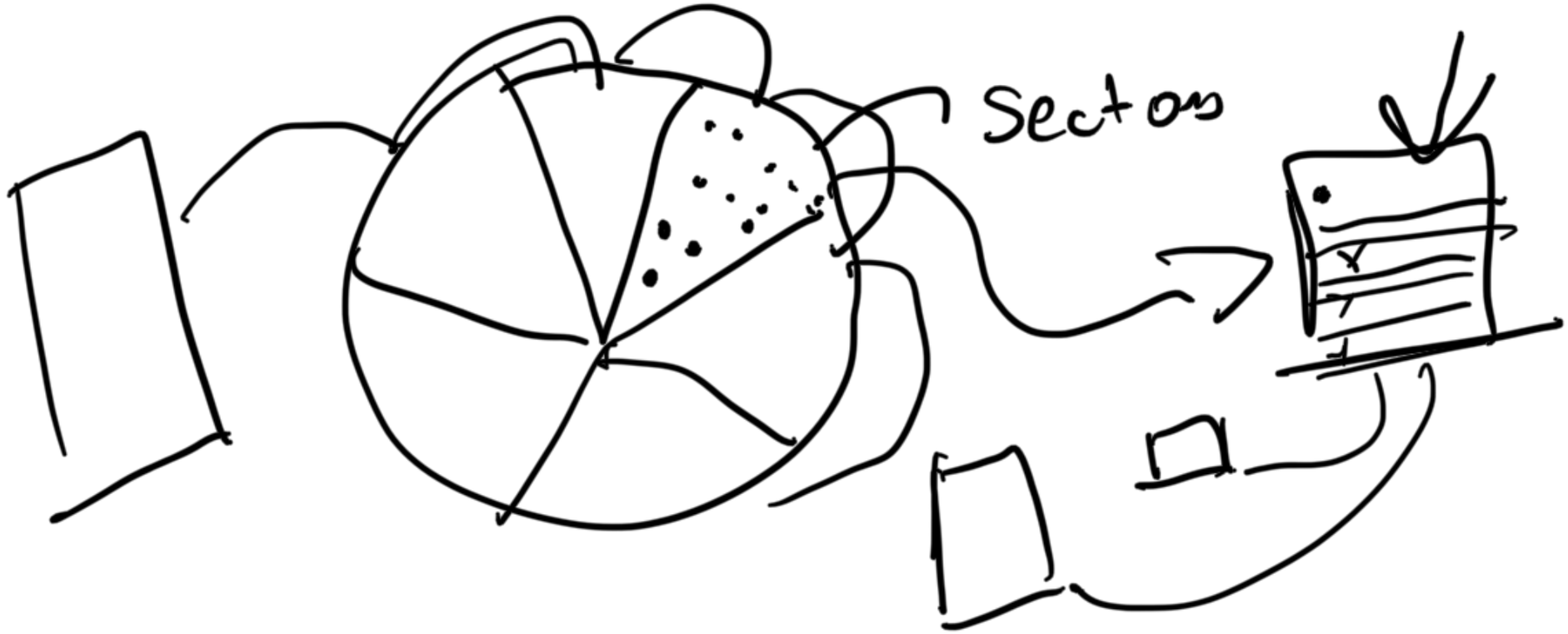
Students

↳ ID

- Bio
- Name
- Email
- Phone

Practical

- Indexes
- Subqueries
- Views



db.execute("select * from ...")

db.select()

1

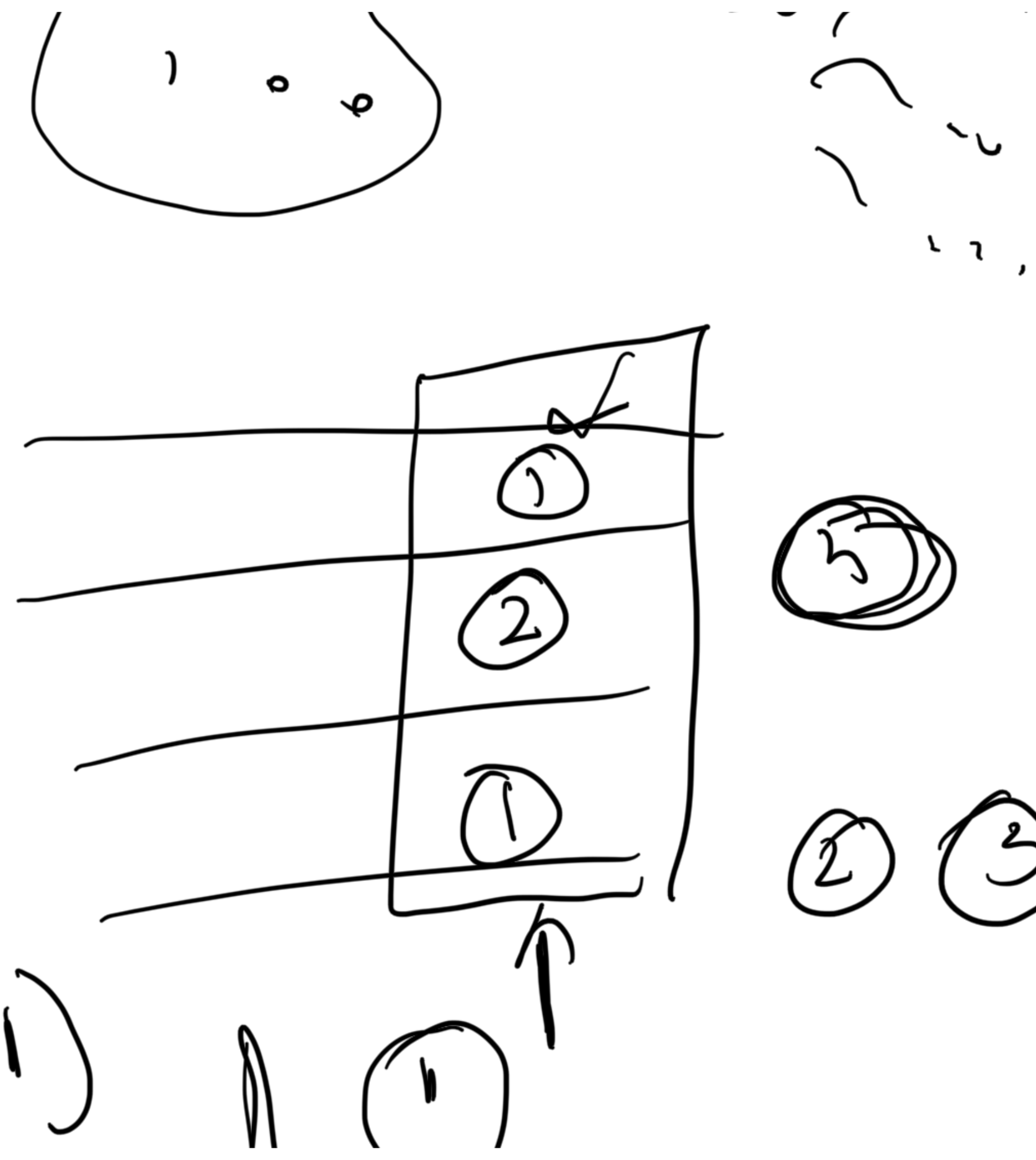
2 — 2001

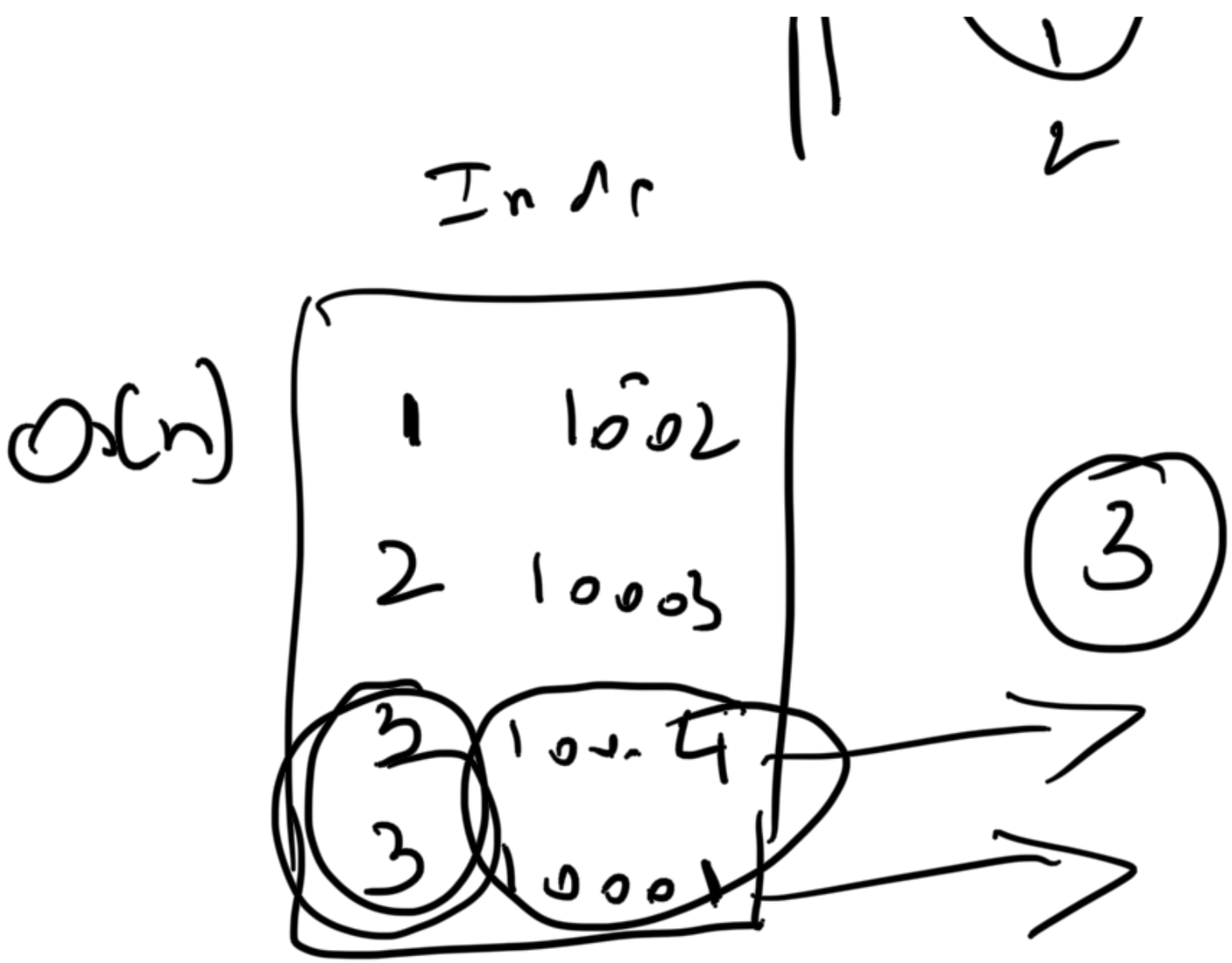
$So \leftarrow psp \leftarrow lop$

- 1 — 1.0
- 2 — 1.01
- 3 — 1.001
- 9
- 5
- 76

0 — 10 — 1001 — 1002 — 1003

90 — 20 — 2001


1
2
1
5
2
3
O(1)


1
2
Insert
O(n)
1 10^02
2 1000
3
3 10^4
3 1000
3