final

Chapter-6

19-12-2024

E-R Diagram/Model

Entity → Relationship

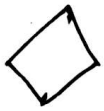
(i) We can't design a model with redundancy.
(ii) " " " incompleteness.

(i) Entity set → আলাদা table, আলাদা entity set

(ii) Relationship set → 2 টা table এর মধ্যে relation থাকলে তার জন্য আলাদা table বানাতে হয়।

(iii) Attributes →

(i) Entity set → Rectangle 

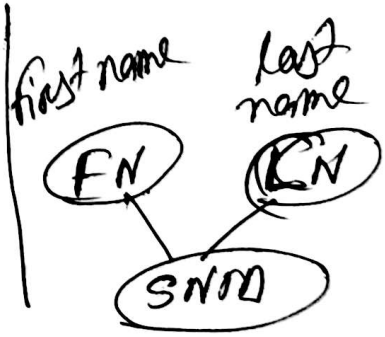
(ii) Relationship set → Diamond 

(iii) Attribute → Ellipse 

Types of attributes:

(i) Simple vs composite attribute.
→ আলাদা attribute যেগুলো ভাঙা যায়।

Ex: Name, Address.



② Single vs Multivalued : Double ellipse

Ex : Phone , address

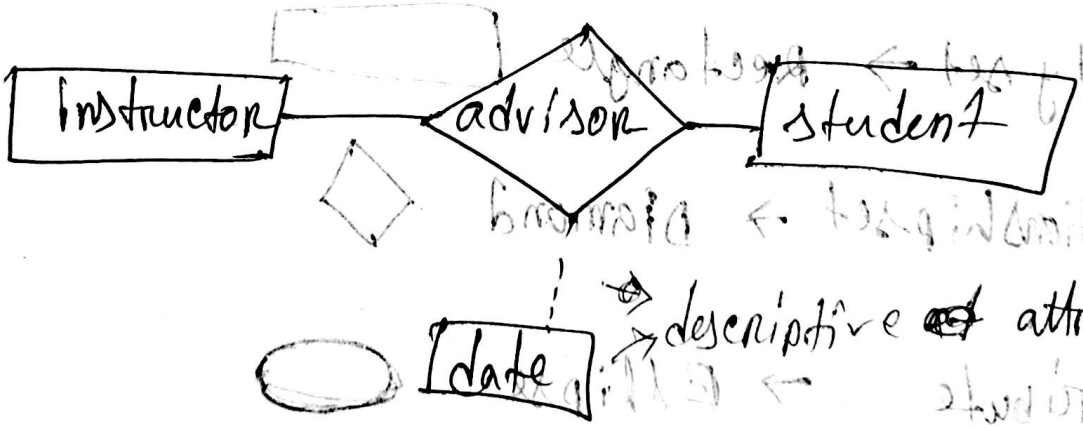
③ Derived attribute : Dotted ellipse

Ex : 'age'

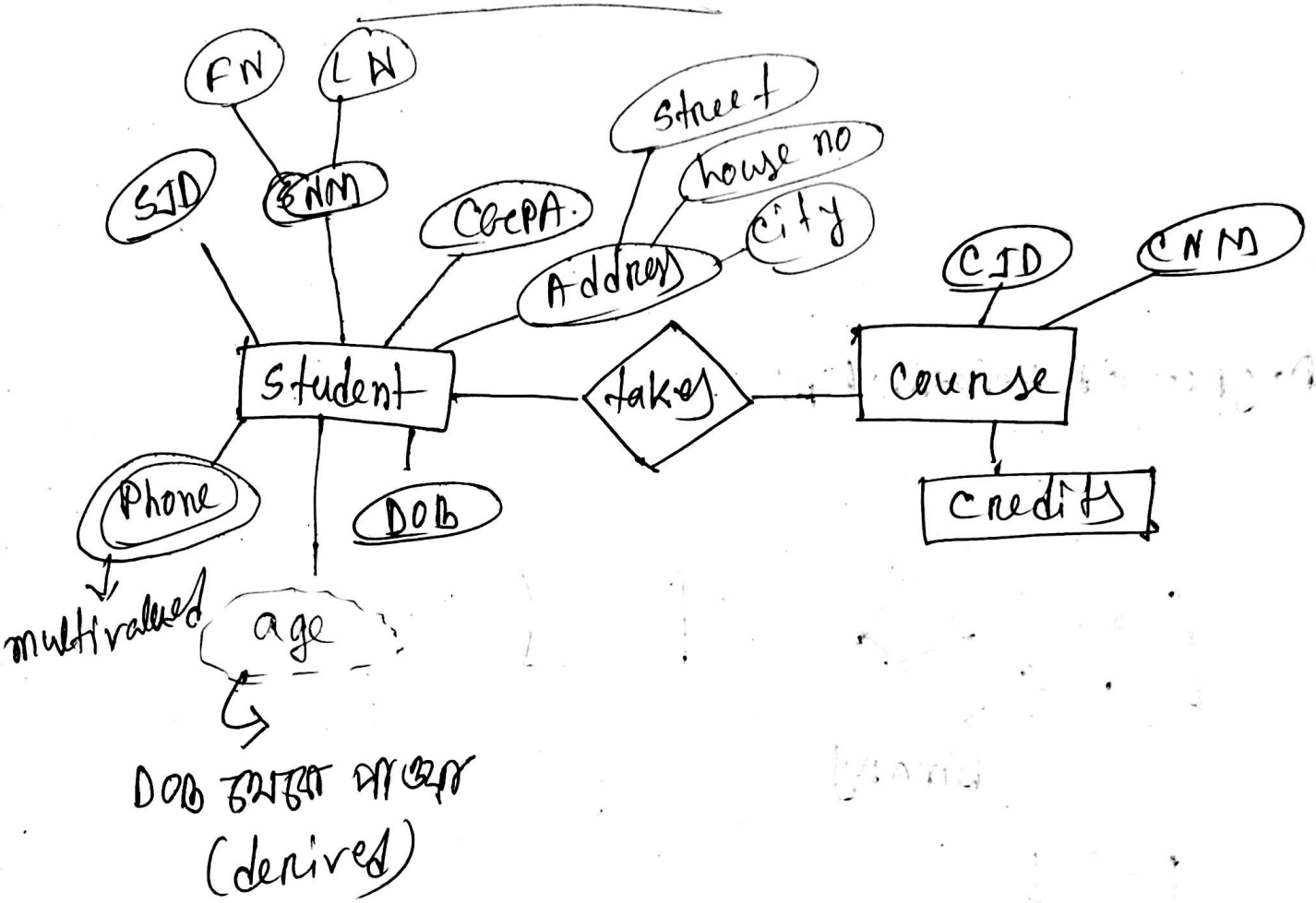
④ Complex attribute : (composite + multivalued)

Ex : address

⑤ Descriptive attribute :



E-R model



DOB থেকে বয়স বের করা যায়
(derived)

* Schema:

Student (SID, FN, LN, CGPA, DOB, age)

Course (CID, CNM, Credits)

SID
↳ course এ SID add করলে takes (relationship) বলে বুঝবে।

☆ Roles:

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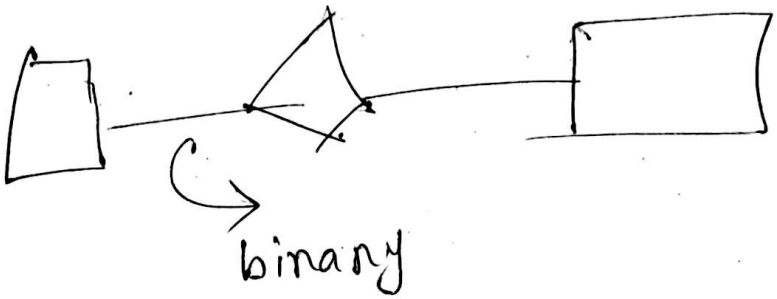
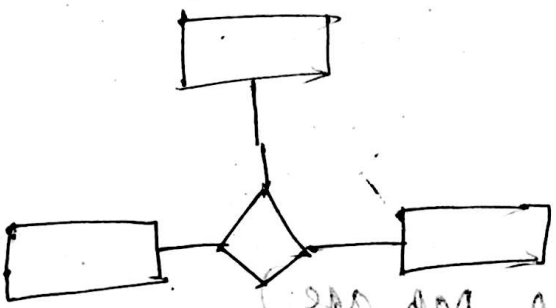
☆ Degree of Relationship:

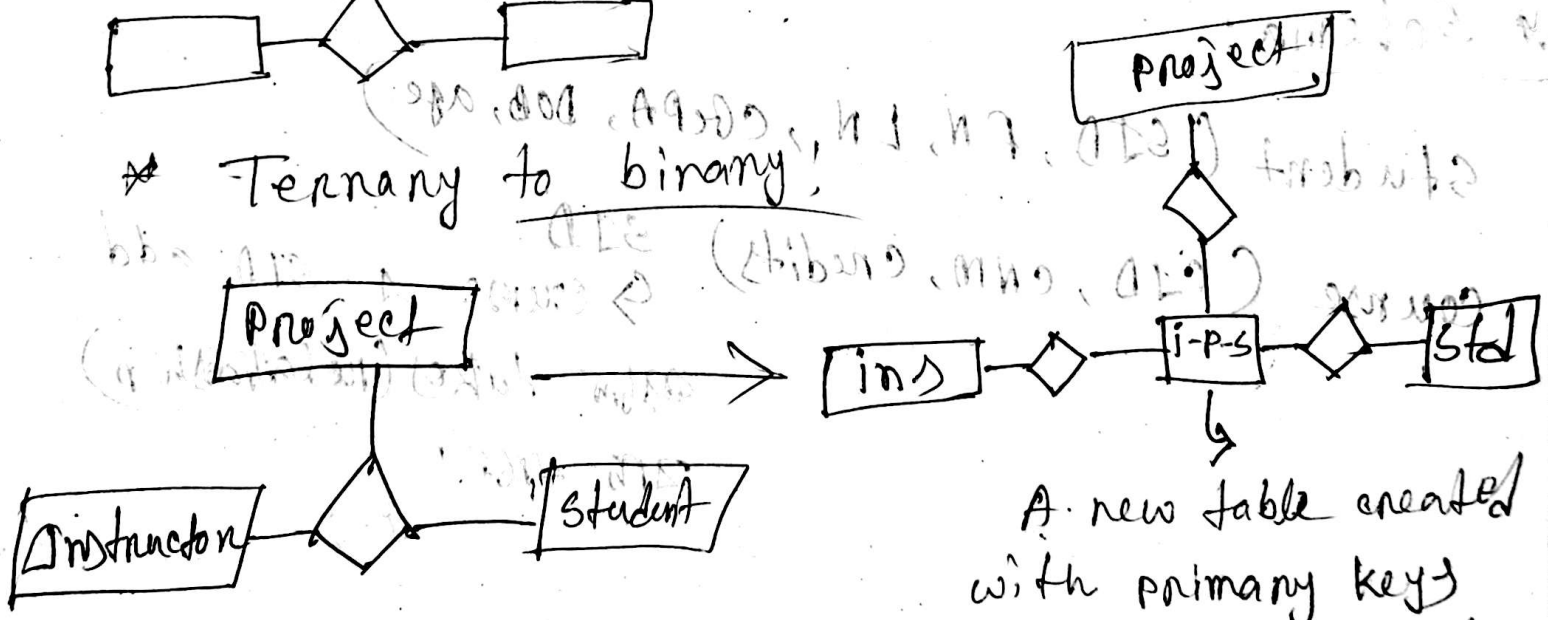


binary



→ ternary

☆ Ternary to binary:



A new table created with primary keys of project, std and ins.

☆ Mapping cardinality: for binary relationship;

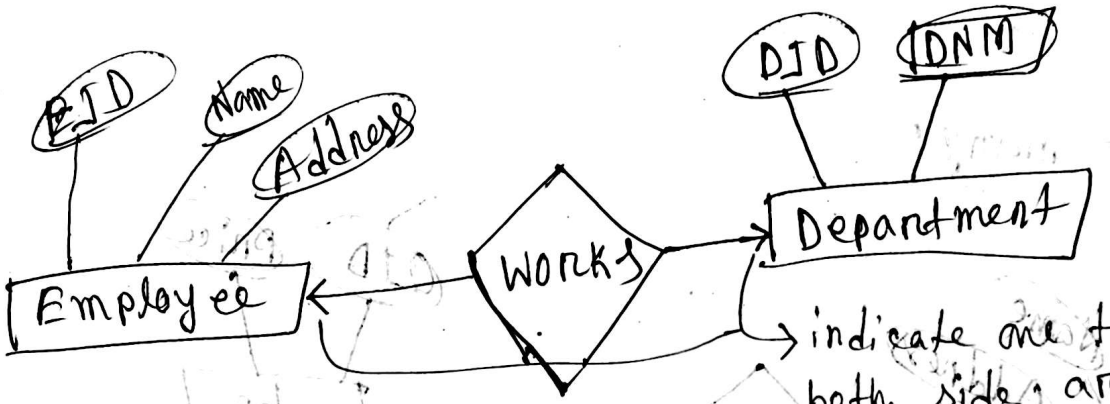
→ One to one

→ One to many

→ many to one

→ many to many.

☆ One to one:



Employee

EID PK	Name	Address
1	x	A
2	y	B
3	z	C

WORKS

EID (FK)	DID (FK)
1	D2
2	D3
3	D1

Department

DID PK	DNM
D1	CSE
D2	MBA
D3	CE

Questions:

① What is the PK of this relationship?

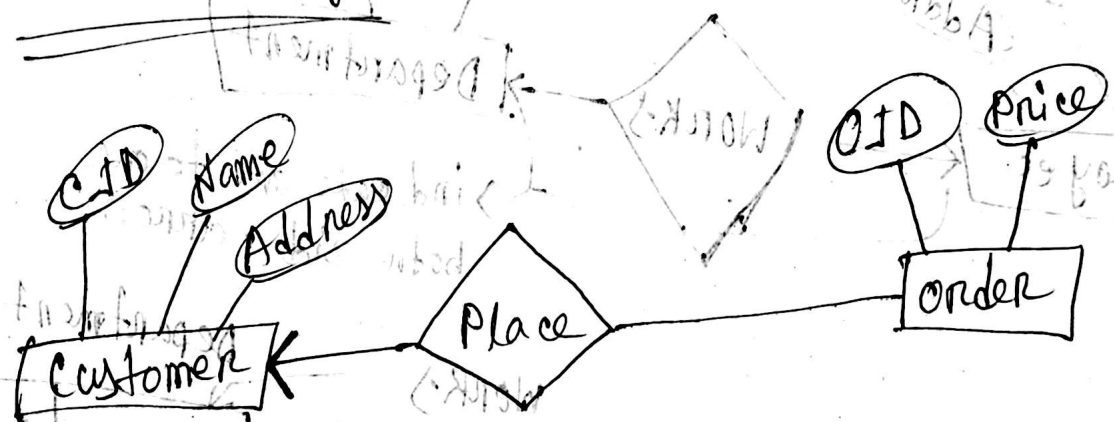
→ EID/DID

② Can we ~~redat~~ reduce relation?

→ Employee(EID, Name, Address) } have to give schema.

Department(DID, DNM, EID)

* One to many:



↳ arrow in one side

Customer

CID PK	Name	Address
1	x	A
2	y	B
3	z	C

Place

CID FK	OID FK
1	02
1	03
3	01
2	04

Order

OID PK	Price
01	100
02	1000
03	9000
04	550

Questions:

① what is the primary key?

→ OID (PK of many side) → which is unique

② Can we reduce relationship?

→ Customer (CID, name, Address) → Remain same

Order (OID, Price, CID) → one side's PK to many side's Table

* Many to many:

Takes → no arrow

Student

SID PK	Name	Address
1	x	A
2	y	B
3	z	C
4	-	-
5	-	-

Takes

SID PK	CID PK
1	02
1	04
3	02
4	03
3	01
5	02

Course

CID PK	CNM
01	DB
02	SP
03	OOP
04	AB

Question:

① What is the primary key?

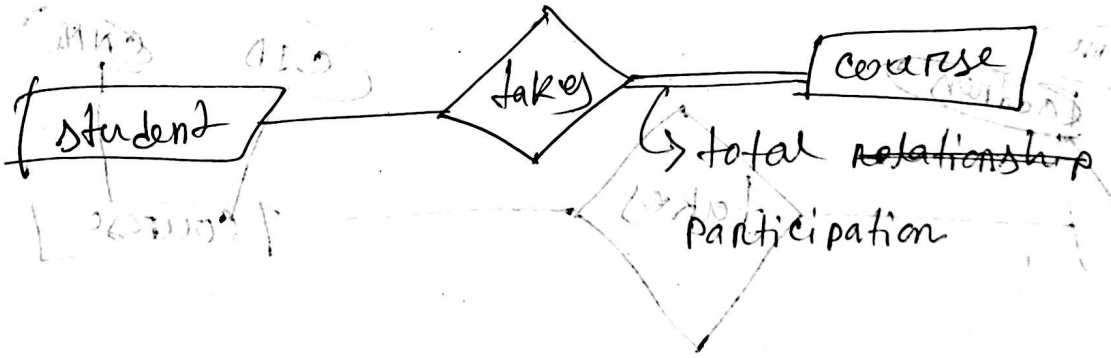
→ (STD, CID),

composite key

② Can we reduce relationship?

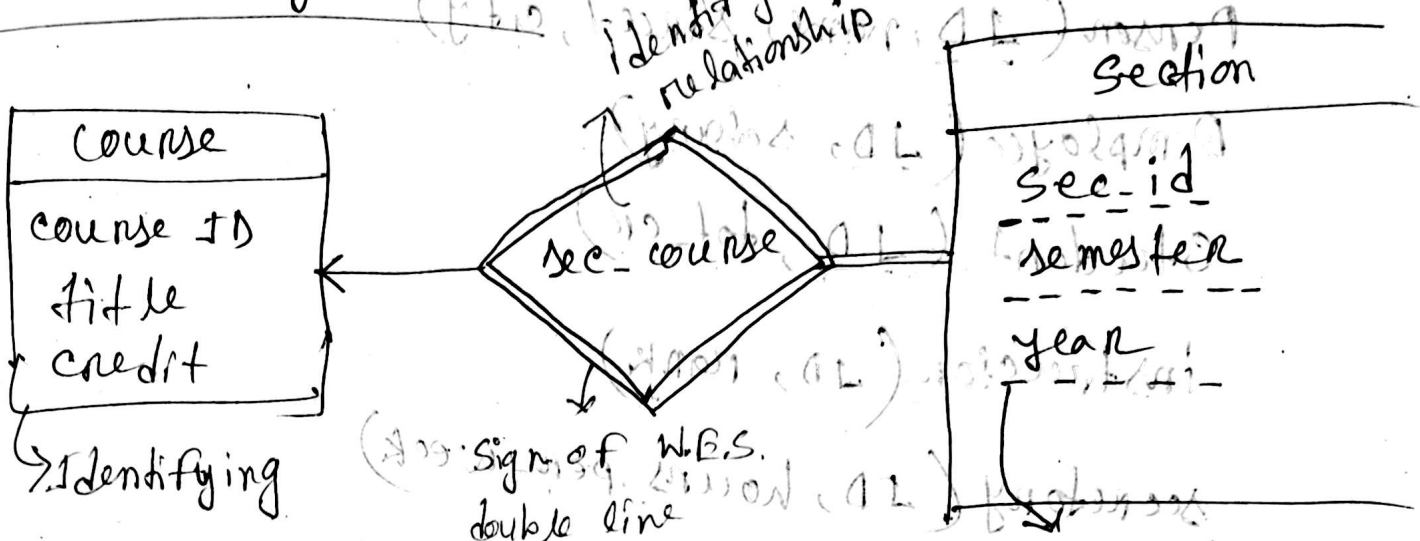
→ NO.

✱ Partial and total participation:



02-01-2024

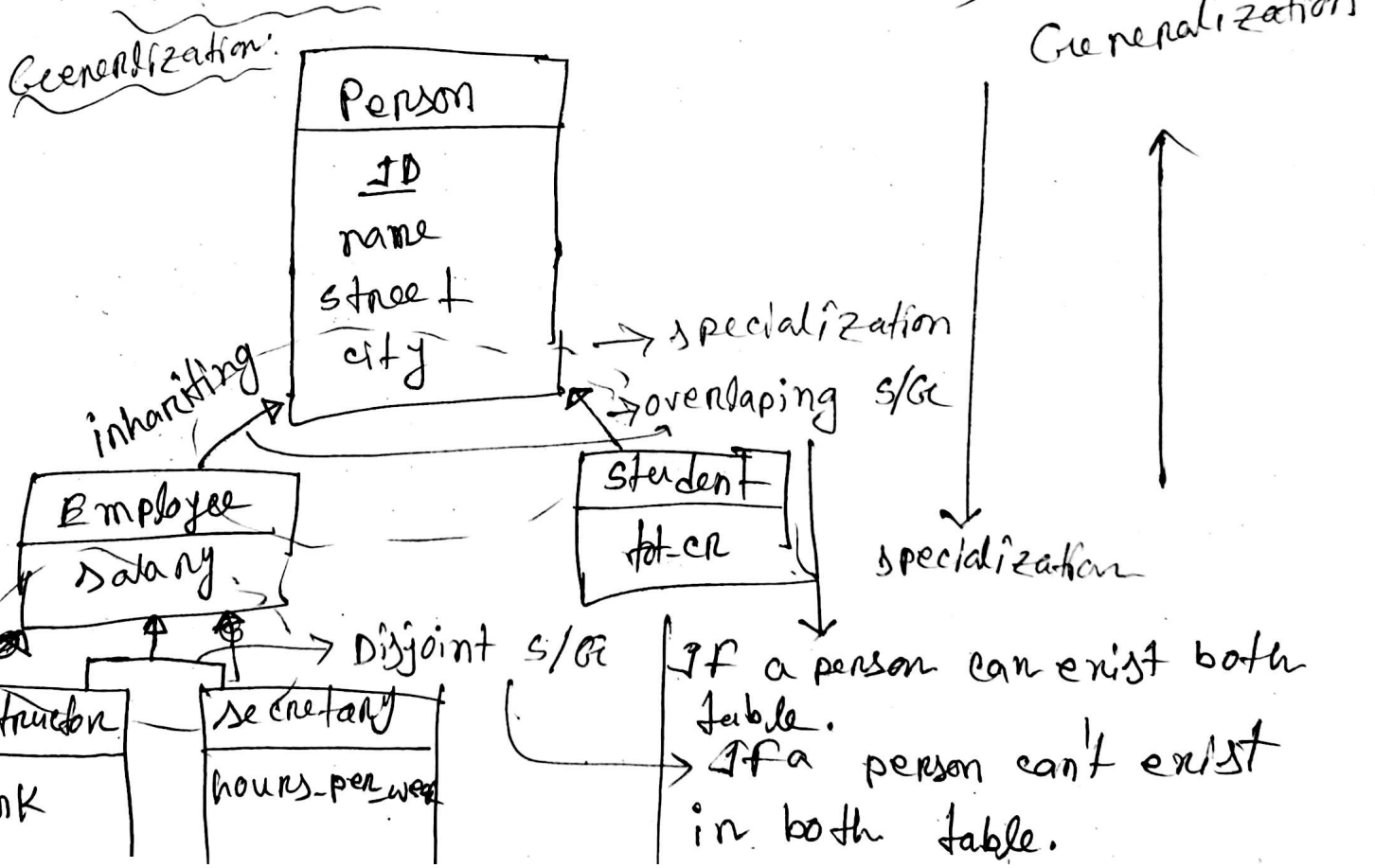
☆ Weak Entity sets:



যার primary key হিসেবে act করতে পারছে না.

☆☆ Extended E-R Features:

* Specialization: 295 Page (ISA Relationship)



Implementation:

give up [X]

Die [O]

Person (ID, name, street, city)

Employee (ID, salary)

Student (ID, tot_cr)

instructor (ID, rank)

secretary (ID, hours_per_week)

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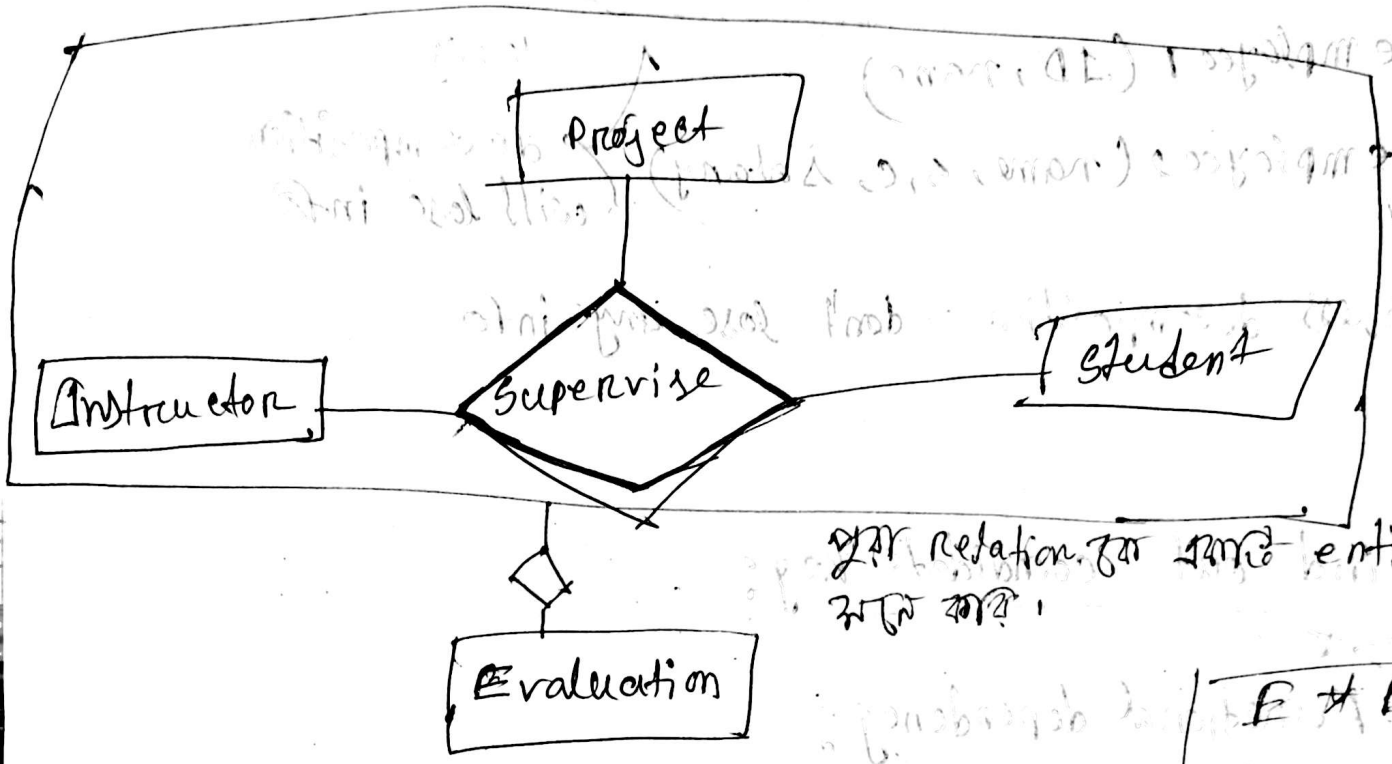
05-01-2025

Again

☆ Aggregation:



দুইটা relation কে একটা entity হিসেবে ধরা।

E * E ✗

R * R ✗

Chapter 7

Normalization

Normalization
- → to reduce redundancy
- → to maintain data integrity.

employee (ID, name, S, C, salary)

↓

employee1 (ID, name)

employee2 (name, S, C, salary)

lossy decomposition will lose info

lossless decomposition → don't lose any info

★ Find out candidate key:

★★★★

① Functional dependency:

SID → Sname give exactly one answer.

IID → Iname → SID থেকে Sname বের করা যায়

SID → dept

IID → dept

SID → Sname, dept

Closure:

$F = \{ SID \rightarrow sname, cgpa, dept$

$\quad\quad FID \rightarrow fname, salary \}$

$\rightarrow F+$

* $R(A, B, C, D)$

$F = \{ A \rightarrow B$

$\quad\quad B \rightarrow C$

$\quad\quad C \rightarrow D \}$

$\rightarrow$ closer of A

$A^+ \rightarrow A$

$\rightarrow AB$

$\rightarrow ABC$

$\rightarrow ABCD$

$B^+ \rightarrow B$

$\rightarrow BC$

$\rightarrow BCD$

$C^+ \rightarrow C$

$\rightarrow CD$

$D^+ \rightarrow D$

$\therefore$ 'A' is candidate key

can be one or more

$\therefore$ candidate key = $\{A\}$

Therefore primary key = A

*

F = { A → B
B → C
C → D
D → A }

$A^+ \rightarrow A$
$\rightarrow AB$
$\rightarrow ABC$
$\rightarrow ABCD$

$B^+ \rightarrow B$
$\rightarrow BC$
$\rightarrow BCD$
$\rightarrow BCDA$

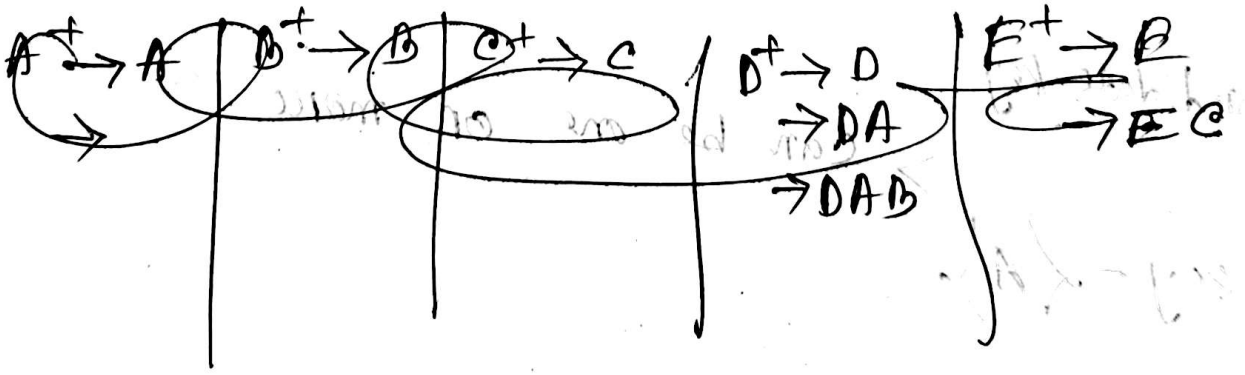
$C^+ \rightarrow C$
$\rightarrow CD$
$\rightarrow CDA$
$\rightarrow CDAB$

$D^+ \rightarrow D$
$\rightarrow DA$
$\rightarrow DAB$
$\rightarrow DABC$

∴ candidate key = { A, B, C, D }

* R : (A, B, C, D, E)

F = {
A → B
BC → D
E → C
D → A
}



$E^+ \rightarrow E$
$\rightarrow EC$

$(AE)^+ \rightarrow AE$
$\rightarrow AEB$
$\rightarrow AEBC$
$\rightarrow AEBCD$

$(BE)^+ \rightarrow BE$
$\rightarrow BEC$
$\rightarrow BECD$
$\rightarrow BECDA$

$(CE)^+ \rightarrow CE$

candidate key = (AE, BE, DE)

→ primary key is any of them or all.

$DE^+ \rightarrow DE$
$\rightarrow DEA$
$\rightarrow DEAB$
$\rightarrow DEABC$

09-01-2025

(9) a) given sample question:

$(ABE)^+ \rightarrow ABE$

$\Rightarrow ABCE$

$\rightarrow ABCDE$

★ Trivial Dependency:

$\alpha \rightarrow B$ is trivial if $B \subseteq \alpha$

ID, name $\rightarrow$ ID

α $\quad$ B

then $B \subseteq \alpha$

ID, name $\rightarrow$ ID, salary $\rightarrow$ not trivial

α $\quad$ B

↳ left side a 'salary' missing.

* $R = (A, B, C)$

$F = \{A \rightarrow B, B \rightarrow C\}$

$R_1 = (A, B)$, $R_2 = (B, C)$

Now $R_1 \cap R_2 = B$, which is present in Both R_1, R_2. so lossless.

↳ [illegible] table a 'B' [illegible]

যদি common attribute এবং table গুলো না থাকে
→ lossy.

☆ Dependency preservation:

dept_advisor(S_ID, I_ID, Dept_name)

↳ R1(S_ID, Dept_name)

R2(I_ID, Dept_name)

can retrieve info from single sub table

∴ I_ID → Dept_name → Preserve dependency
(α) (β)

∴ S_ID, Dept_name → I_ID → doesn't "

↘ can't retrieve info from single subtable.

☆ BCNF, 3 NF : (normal form)

↳ check decomposed tables are in good form or not.

Condition:

(1) α − β trivial

(11) α is a superkey for R

→ will have to fulfil atleast 1 condition

Ex°. $A \to BCD$

$BC \to DE$

$B \to D$

$D \to A$

① $A \to BCD$ which is not trivial

$A^+ \to X$

② A is not a superkey (~~can't~~

So, R is not in BCNF. (Doesn't fulfil any condition).

* formula to decompose in BCNF :-

① $(\alpha \cup \beta) = R_1$

② $R - (\beta - \alpha) = R_2$

will have to take any one of BCNF violating dependency and make it BCNF & decomposed

$A \to BCD$

$\alpha \quad \beta$

$\therefore R_1 = A \cup (BCD) = ABCD$

$\therefore R_2 = (A, B, C, D, E, Ge) - (BCD - A)$

$= AE Ge$

* $R_1 \cap R_2 = A$

Now $A^+ \rightarrow A$

$\rightarrow ABCD$

$\rightarrow ABCDE$

So, A is not a candidate key of R_2, but a candidate key of R_1.

So, this is lossless.

* The whole decomposition is not preserving.

$BC \rightarrow DE$. for this dependency, all elements can't find from R_1.

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\# advisor(SID, IID, Dept_name)

IID → Dept name

SID, Dept_name → IID

⇒ $\underset{\alpha}{IID} \rightarrow \underset{\beta}{Dept\_name}$ is not in BCNF

Now decompositing to BCNF

$R_1 : \alpha \cup \beta$, $R_2 : R - (\beta - \alpha)$

$\therefore R_1 = R_1(IID, Dept\_name)$

$\therefore R_2 = R_2(SID, IID)$

But still not dependency preserving.

3 NF:

Condition to become 3 NF:

(i) $\alpha \rightarrow B$ trivial

(ii) α is a superkey of R

(iii) $B - \alpha$ is contained in a candidate for R

$AB \rightarrow C$
$DE \rightarrow C$
$B \rightarrow D$

Question 4

(a) $\underbrace{AB}_{\alpha} \rightarrow \underbrace{C}_{\beta}$

i) this is not trivial

(ii) $(AB)^+ \rightarrow AB$
$\rightarrow ABC$
$\rightarrow ABCD$

So AB is not a superkey

iii) $(ABE)^+ \rightarrow ABE$
$\rightarrow ABCE$
$\rightarrow ABCDE$

So candidate key = $\{ABE\}$

Now $B - \alpha = C - AB$
$= C$, which is not present in candidate key set.

$\therefore$ R is not in 3NF

⭐⭐⭐ Difference betⁿ BCNF & 3NF:

BCNF	3NF
→ loseless	→ loseless
→ May/may be dependency preserving	→ Always dependency preserving

→ to reduce checking time

⭐ Canonical(minimum) cover → Reduced FD set:

(5)

$$F = \{ P \to QR,\ Q \to R,\ P \to Q,\ PQ \to R \}$$

step 1

step 1 : Merge FDs

Left side এ same value থাকলে merge হবে single value হবে থাকবে। right side এর value ও merge হবে

$$F = \{ P \to QR,\ Q \to R,\ PQ \to R \}$$

Step 2: Check extraneous attribute on

left side:

if P is extraneous attribute in $PQ \to R$

then,

$$F = \begin{cases} P \to QR \\ Q \to R \end{cases}$$

$$Q^+ \to Q$$
$$\to QR$$

So P is extraneous

Step 3: check extraneous in Right side

if Q is extraneous attribute in $P \to QR$

$$F = \begin{cases} P \to R \\ Q \to R \end{cases}$$

$$(P)^+ \to P$$
$$\to PR$$

So Q is not extraneous. because we can not get Q from P

if R is extraneous attribute in $P \to QR$ then

$$F = \{ P \to Q,\ Q \to R \}$$

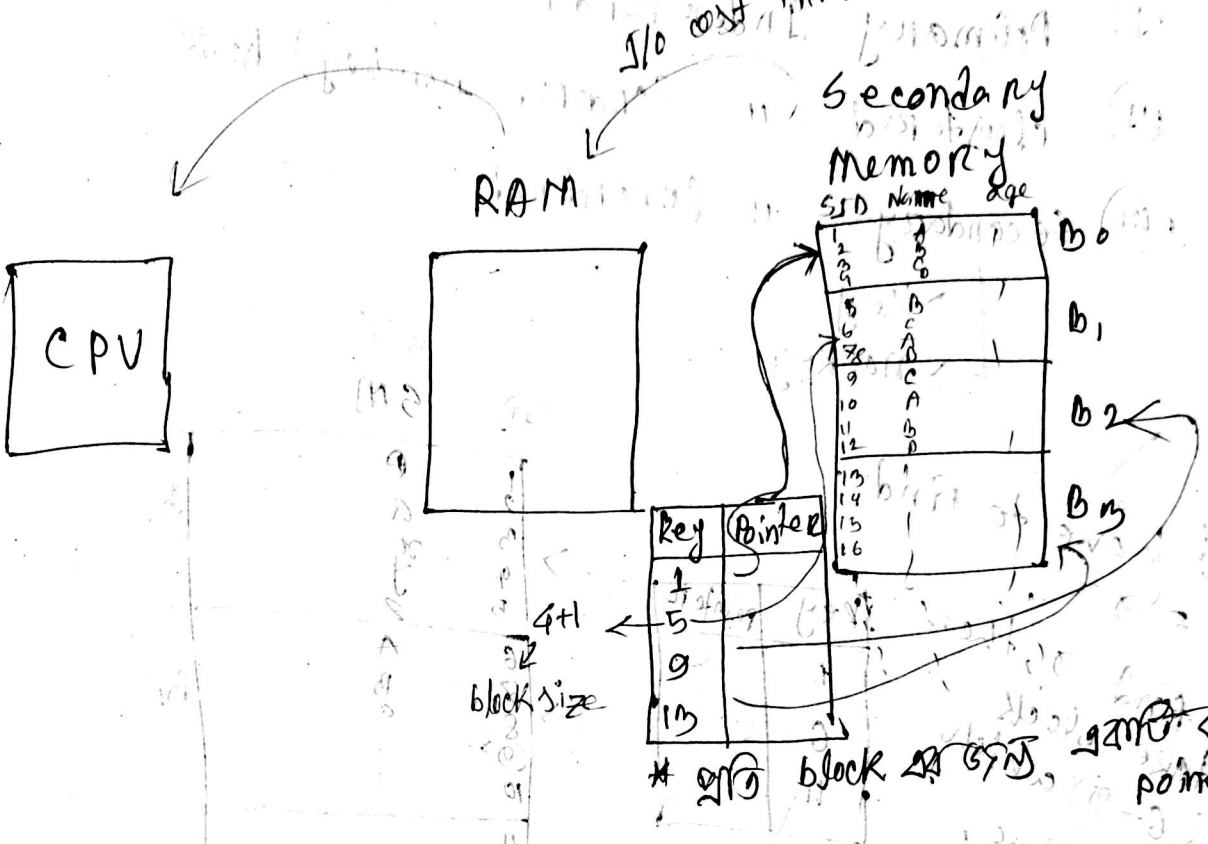
$P^+ \to P$
$\to PQ$
$\to PQR$

We get R from P^+ after removing R from $P \to QR$.

So R is extraneous

☆ Chapter-14 → Indexing:

→ to reduce runtime



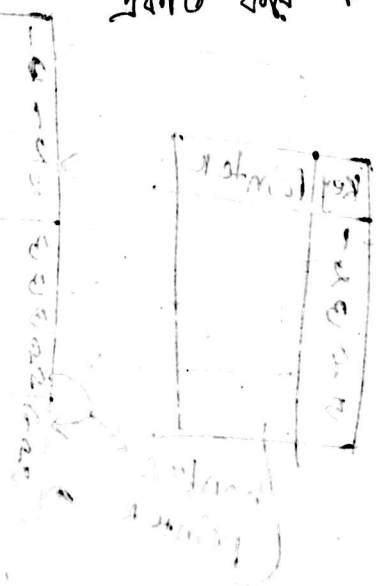
* প্রতি block এর শেষে একটা pointer.

☆ Index File:

↳ Dense

↳ connect a pointer with every pk attribute

* প্রতিটা individual value এর শেষে একটা pointer.



☆ Types of indexing:

(i) Primary Index (ordered key) (block)

(ii) Clustered " (ordered, non key) Dense

(iii) Secondary " (unordered)

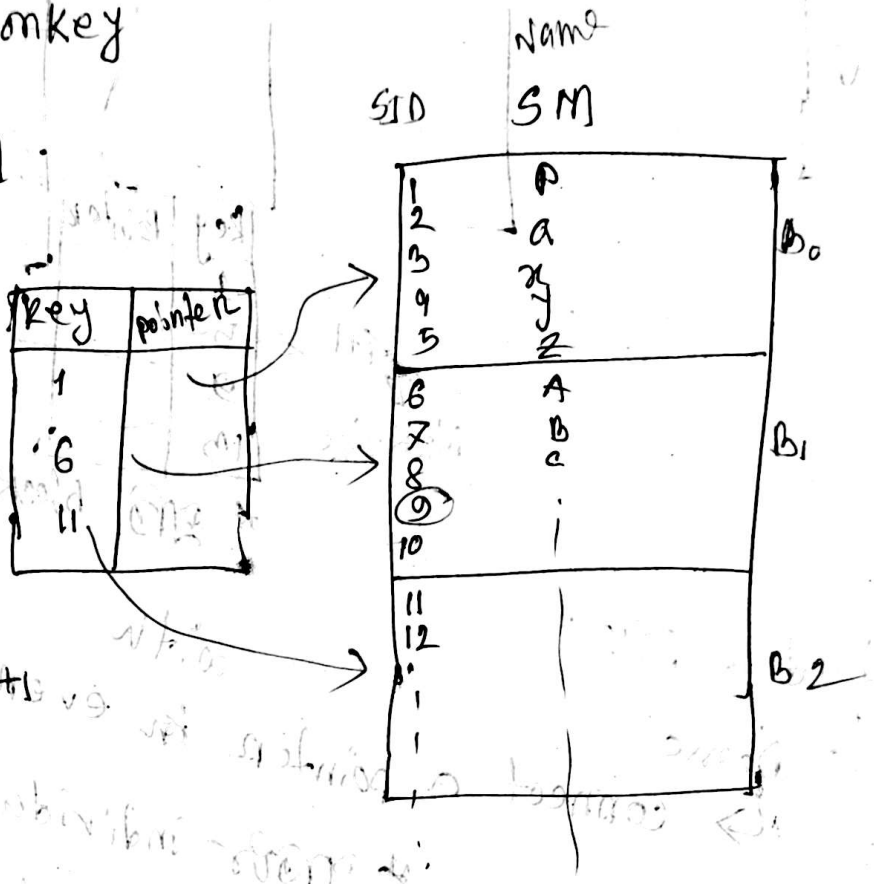
- key
- nonkey

(i)

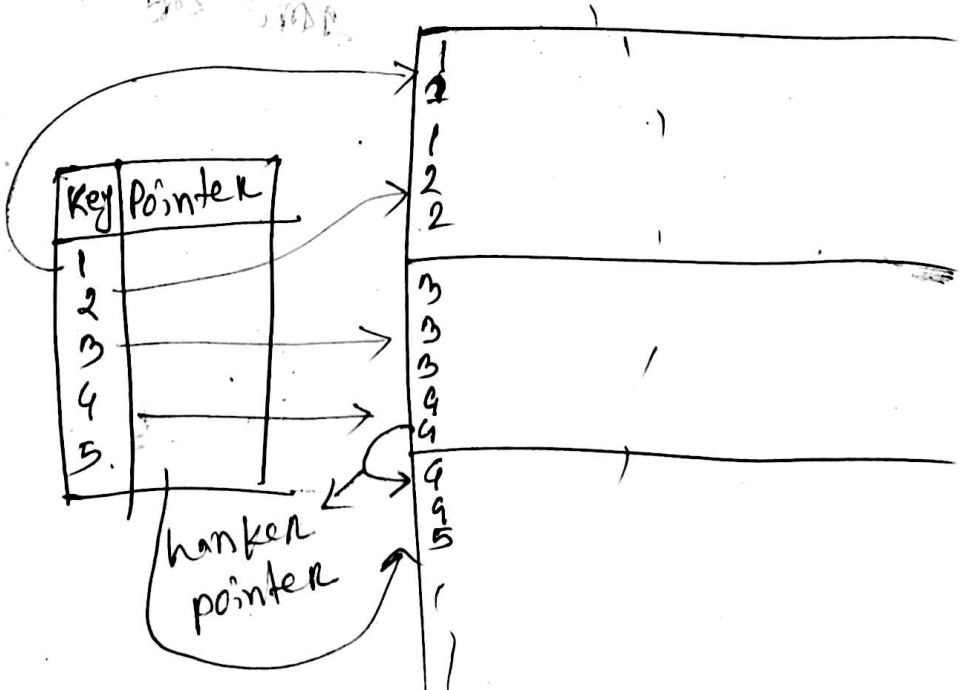
will have to find SID = '9'

→ will find 9, then will take block from (6-9) which cost 'logN time.

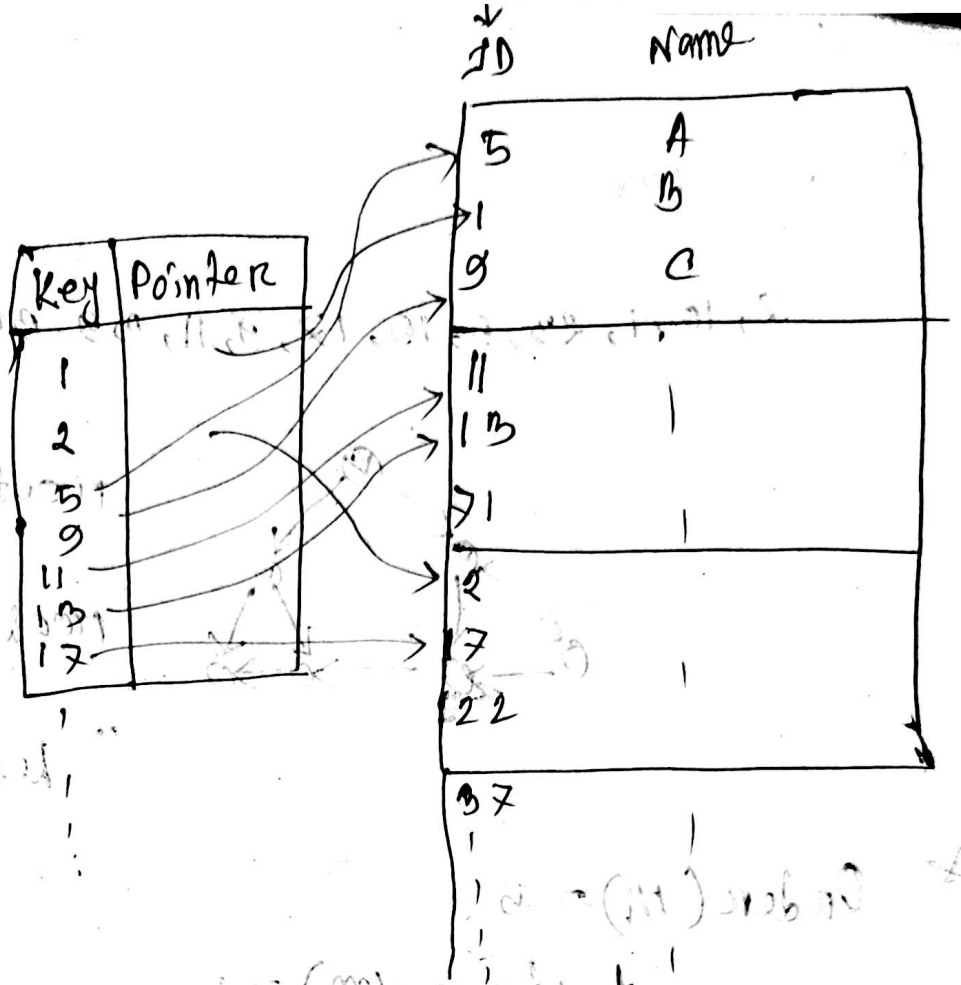
total time = logN+1



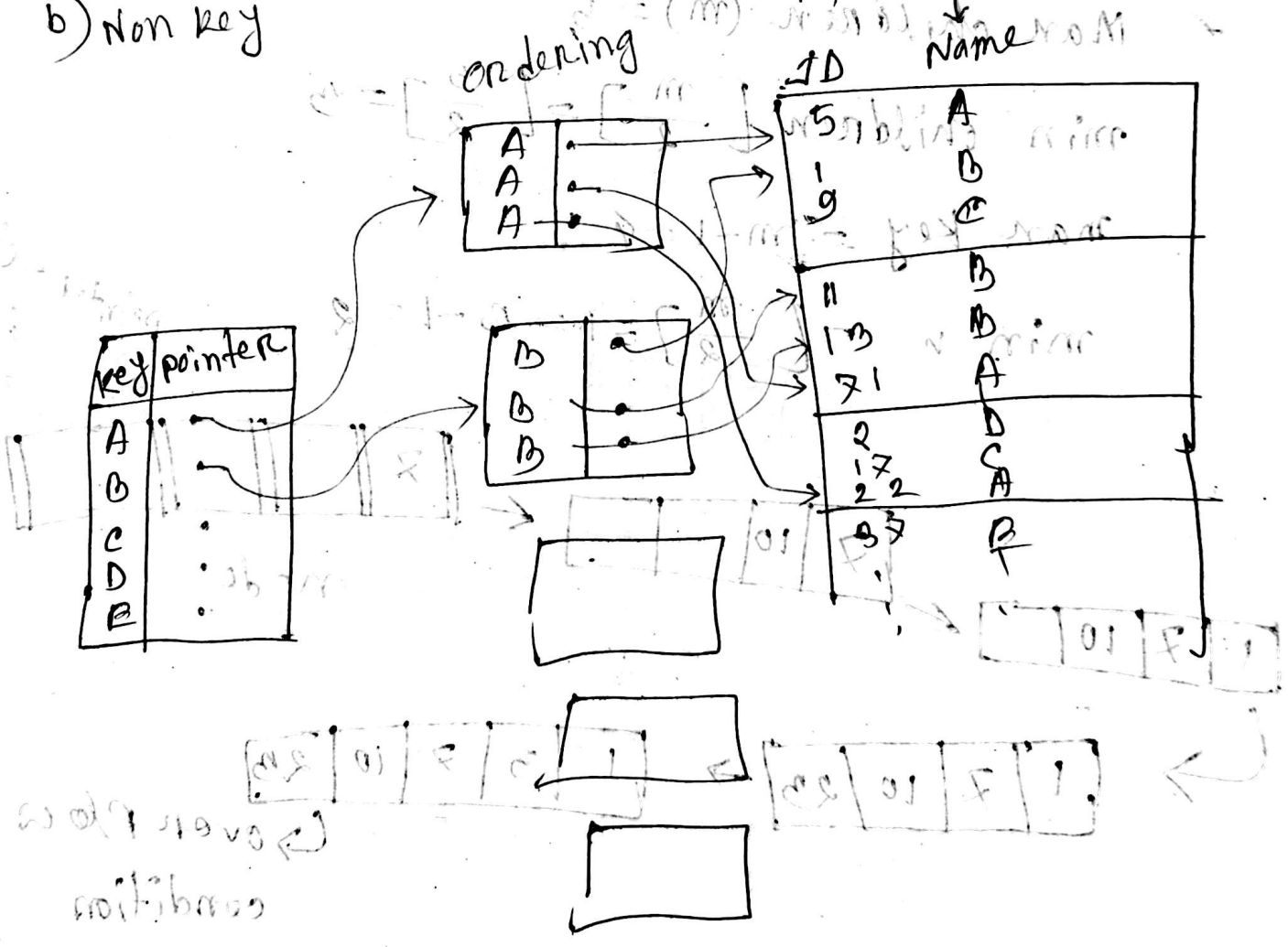
(ii)



(III) a) key



b) Non key



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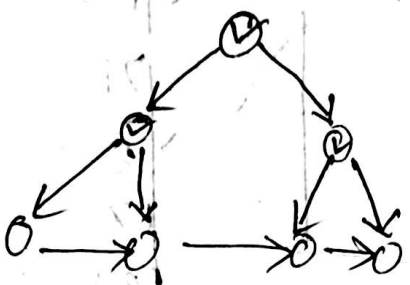
B+ Tree

7, 10, 1, 23, 5, 15, 17, 9, 11, 39, 35, 8, 40, 25



~~root + internal search~~

root + internal node → search

left → data

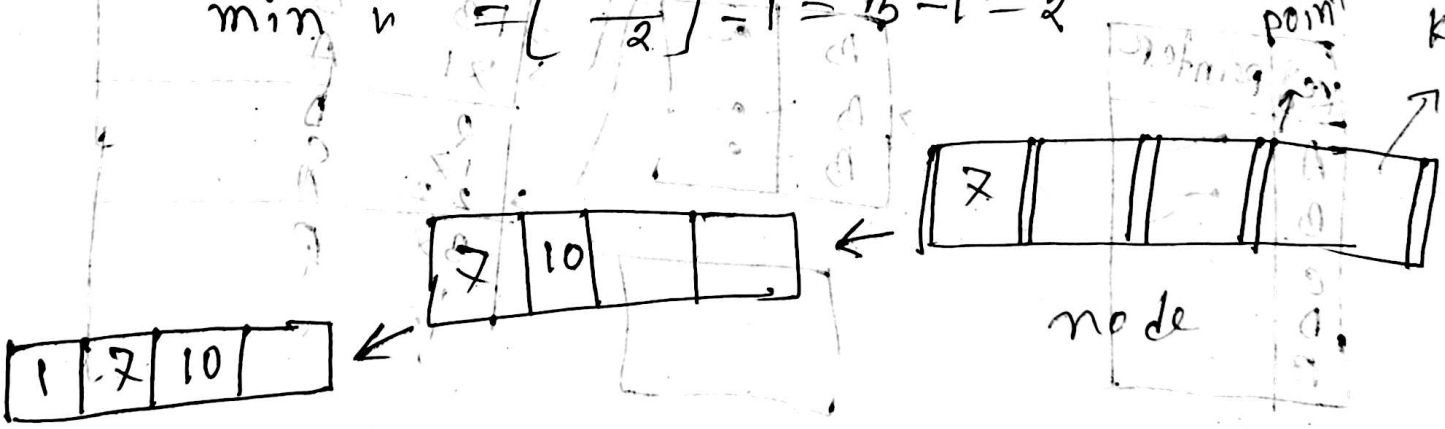
☆ Order (M) = 5

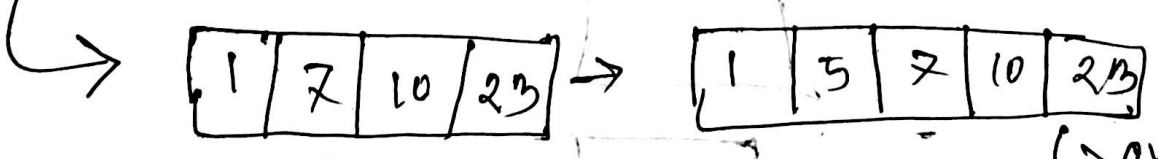
☆ Max children (m) = 5

min children $\left[\frac{m}{2}\right] = \left[\frac{5}{2}\right] = 3$

max key = m − 1 = 4

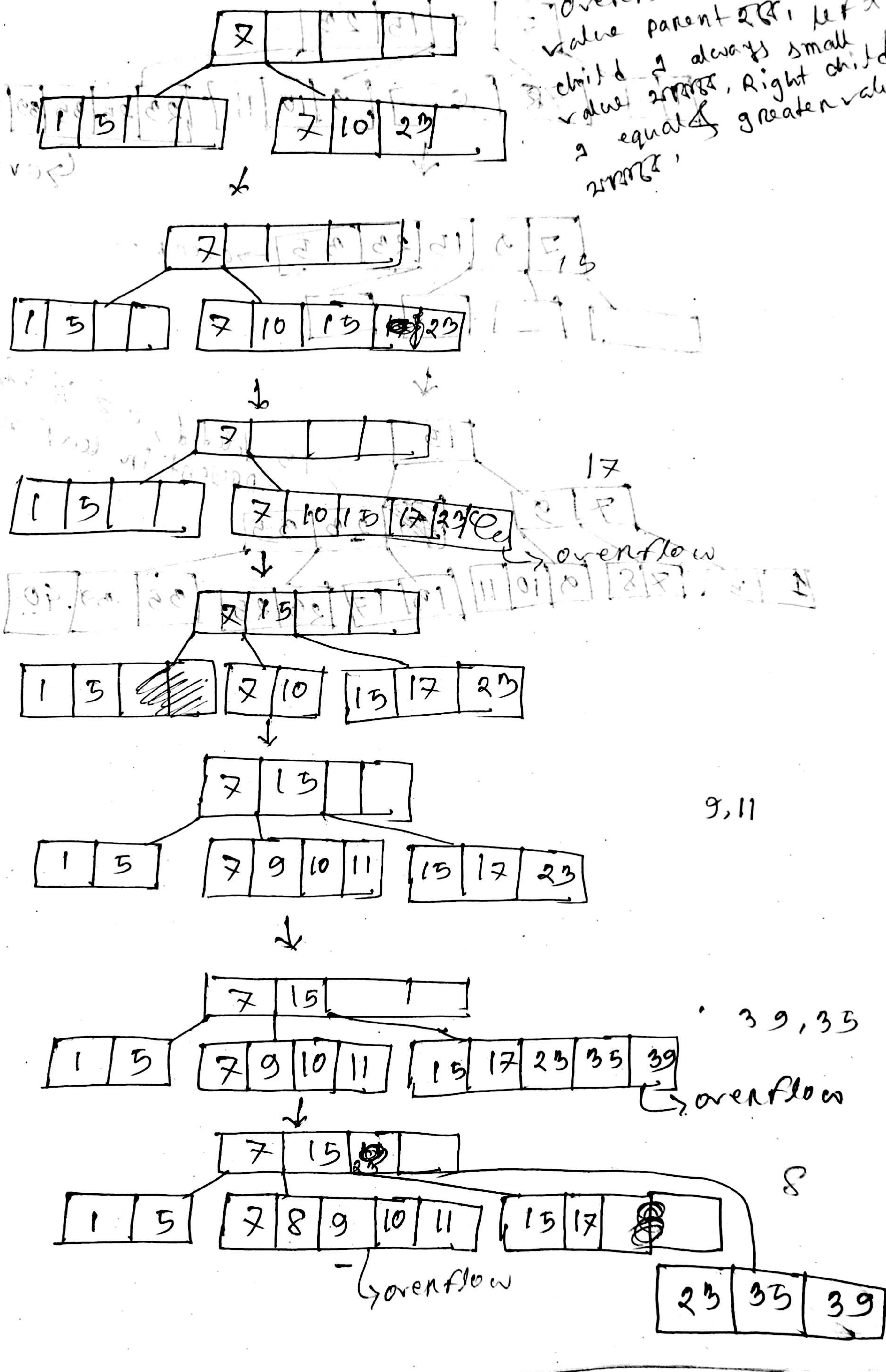
min v = $\left[\frac{m}{2}\right] - 1 = 3 - 1 = 2$

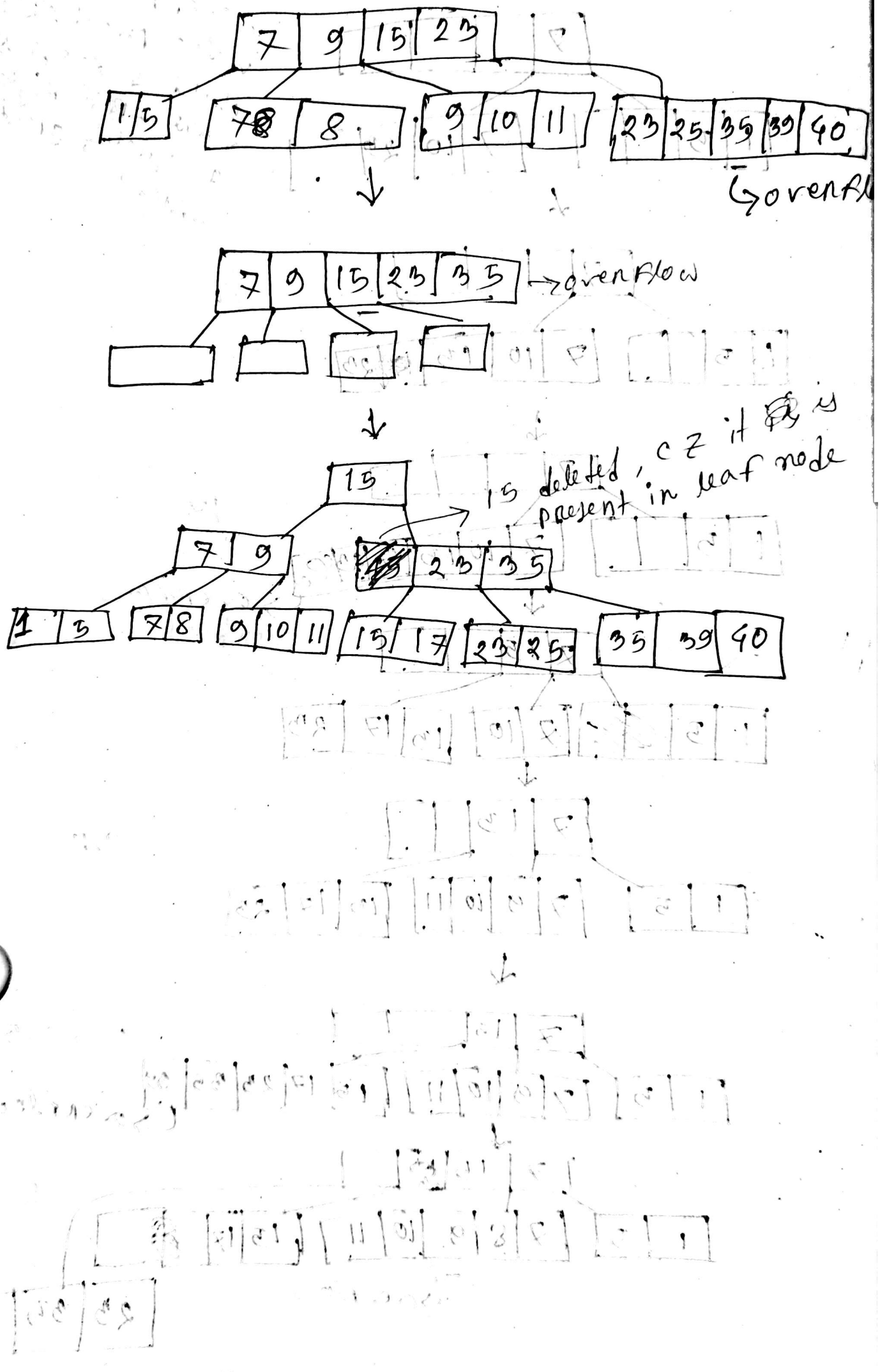




↳ overflow condition

Overflow হলে mid value parent হবে, left child এ always small value থাকবে, Right child এ equal ও greater value থাকবে।




7 9 15 23
1 5
7 8
9 10 11
23 25 35 39 40
overflow
7 9 15 23 35
overflow
15
15 deleted, cz it is present in leaf node
7 9
23 35
1 5
7 8
9 10 11
15 17
23 25
35 39 40

Chapter - 7

BCNF, 2NF, Dependency preservation, lossy - lossless, candidate key, closer, BCNF Decomposition

Chapter - 6

Reduction (ER/OR, Aggregation, weak entity)