Problem set 3

Problem 1:

1.1 block size = 1024 bytes

pointer (offset) size = 4 bytes

block header = 24 bytes

records size = 50 bytes

$\therefore$ No. of records $= \frac{1024-24}{50+4}$

$= \frac{1000}{54} = 18$ Ans

1.2 let suppose maximum block size $= x$

$\therefore \frac{1024-24}{x+4} = 20$

$\Rightarrow \frac{1000}{x+4} = 20$

$\Rightarrow 1000 = 20x + 80$

$\Rightarrow 20x = 920$

$\therefore x = \frac{920}{20} = 46$ Ans

1.3.

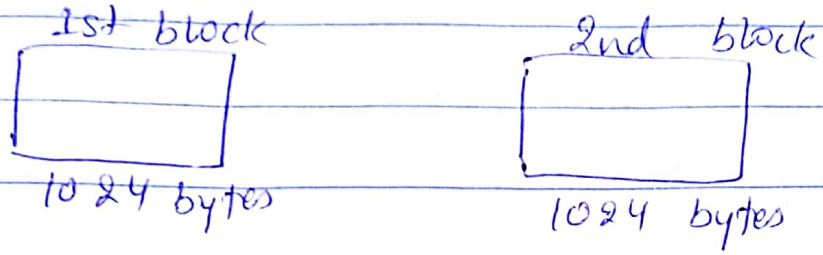
Soln

No. of records = $\frac{1024 - 24}{50}$

= 20 Ans

1.4

Soln



We have 3 records of 600 bytes

Considering 1st record in 1st block:

Bytes available in 1st block after inserting 1st record = 1024 − 24 − 5 − 600 = 395

Now, considering 2nd record in 1st block and 2nd block (Since record size is 600 bytes & 1st block is having only 395 bytes remaining)

∴ Bytes remaining of 2nd record = 600 − 395 − 5

= 210 bytes

210 bytes now will go in 2nd block

= 1024 − 24 − 5 − 210

= 785

Ans: ∴ Bytes remaining in 2nd block = 785 − 5 − 600

= 180 bytes after inserting 3rd record of 600 bytes

Problem 2:

2.1. select distinct r.rating, r.comment from Product p, Reviewer rr, Review r where p.pname = 'ABC' and rr.city = 'Chicago' and p.pid = r.pid and r.rid = rr.rid order by r.rating DESC

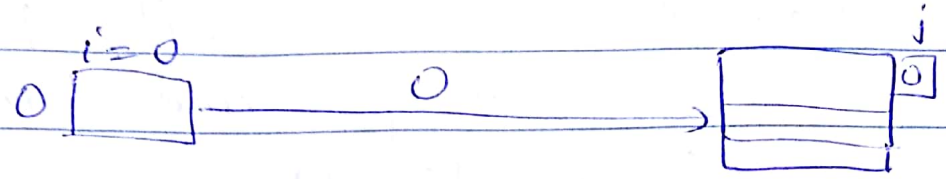
2.2. select rr.city, count(rr.rid) from Reviewer rr group by rr.city order by rr.city

2.3. select rr.rname from ~~rrr~~ Reviewer rr, Review r where rr.rid = r.rid group by r.rid, rr.rid, rr.rname having avg(r.rating) <= 2

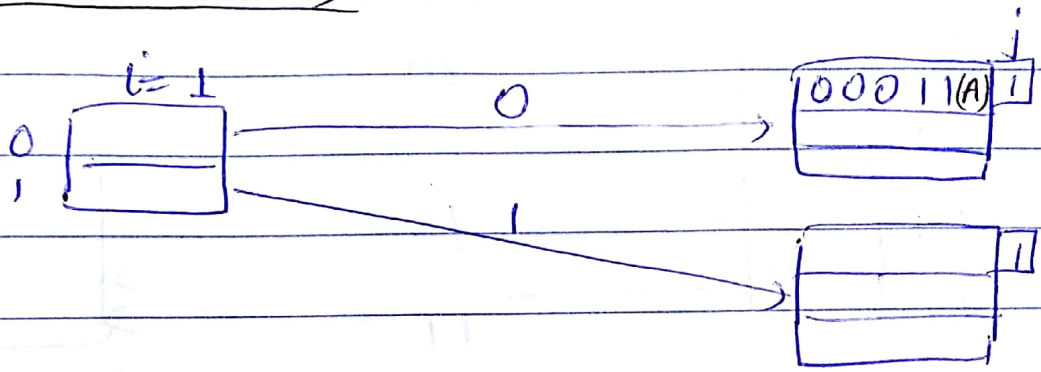
2.4. select p.pname, p.description from Product p, Review r where p.pid = r.pid group by p.pid, p.pname, p.description having min(r.rating) >= 4

Problem 3

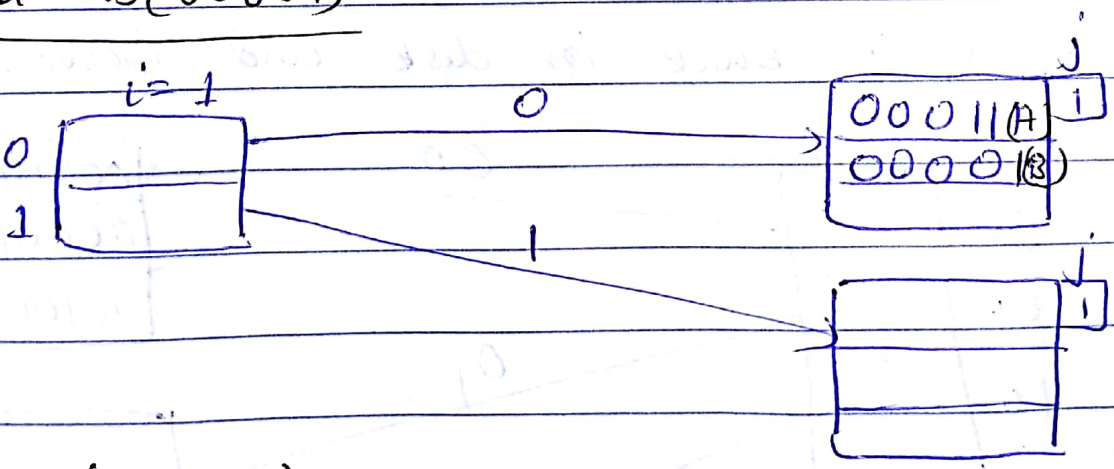
Initial State



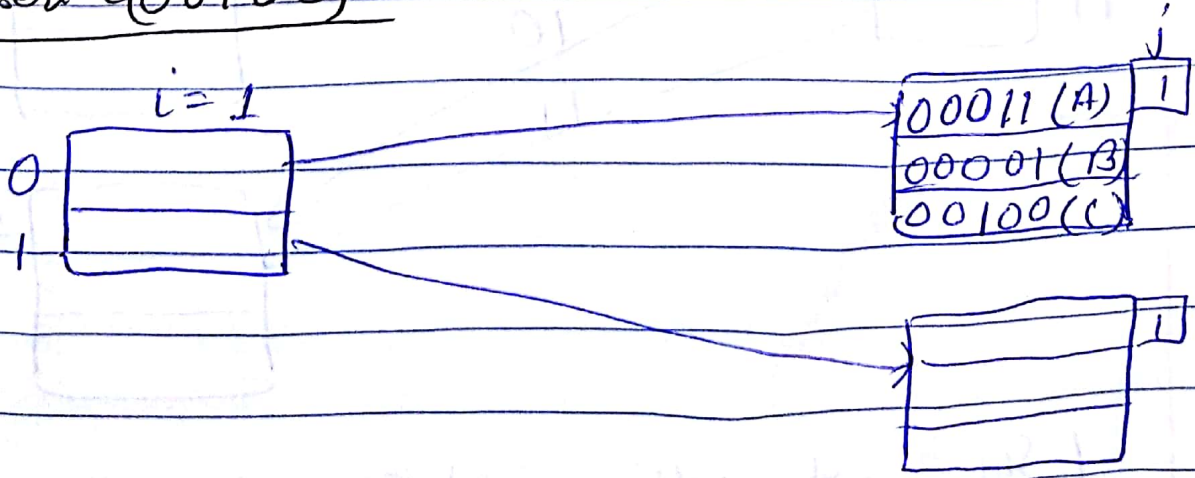
insert A (00011)



insert B (00001)

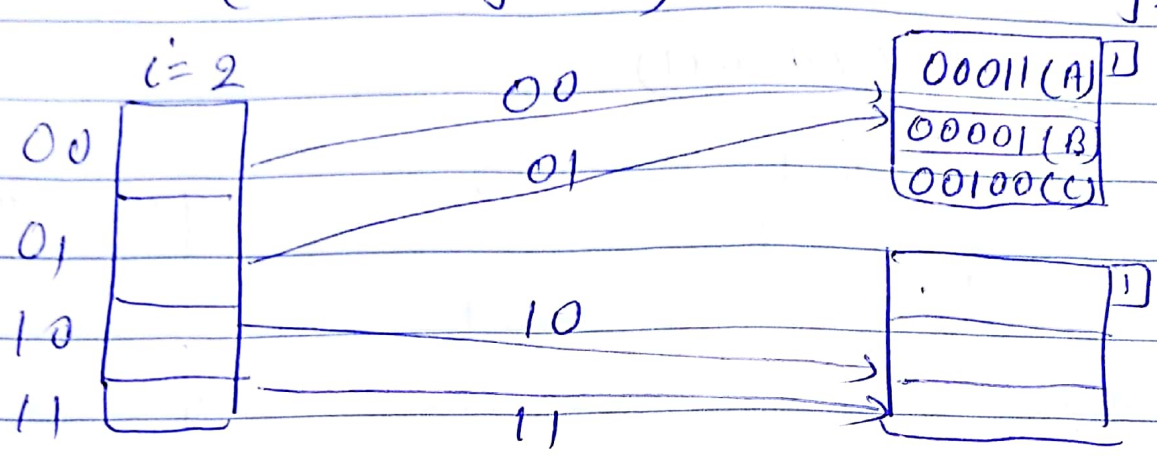


insert C (00100)

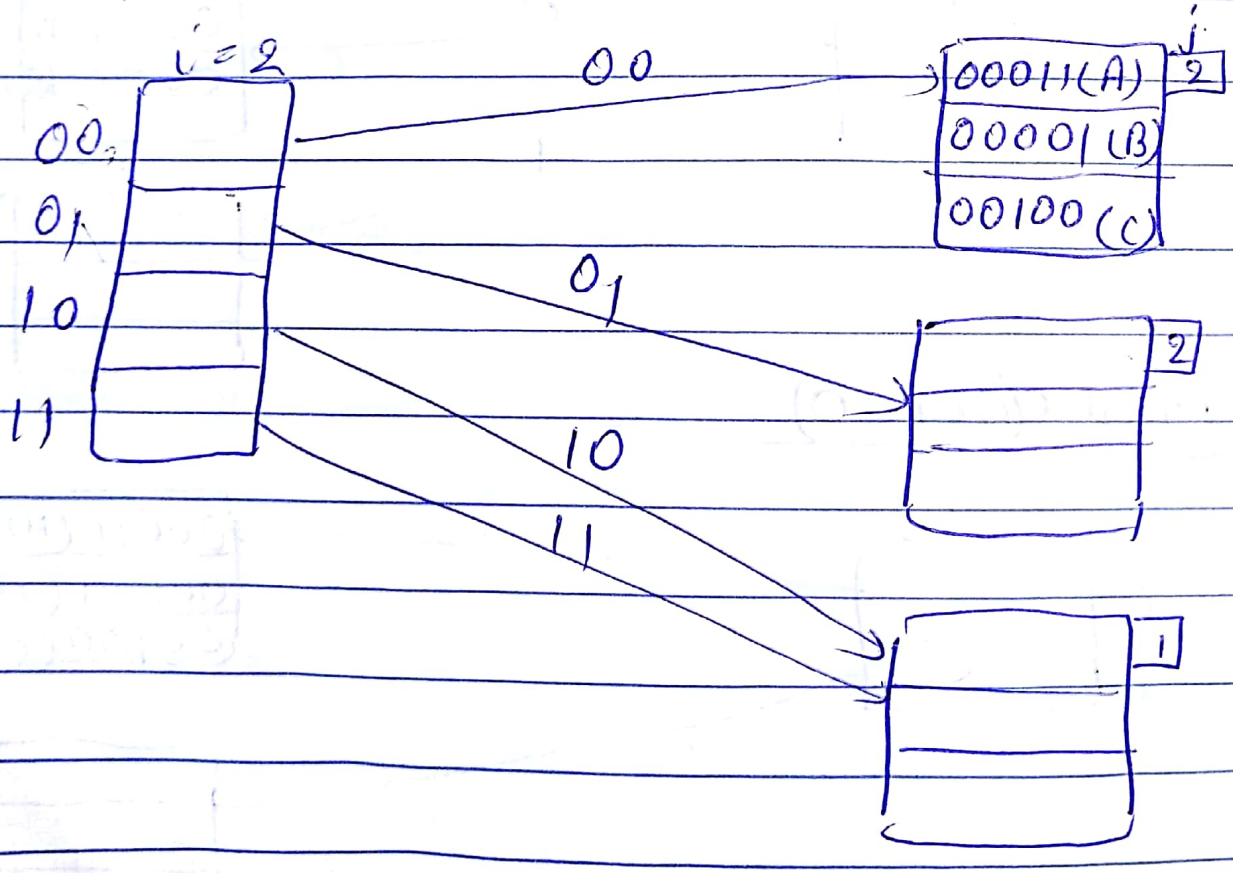


insert D (00000)

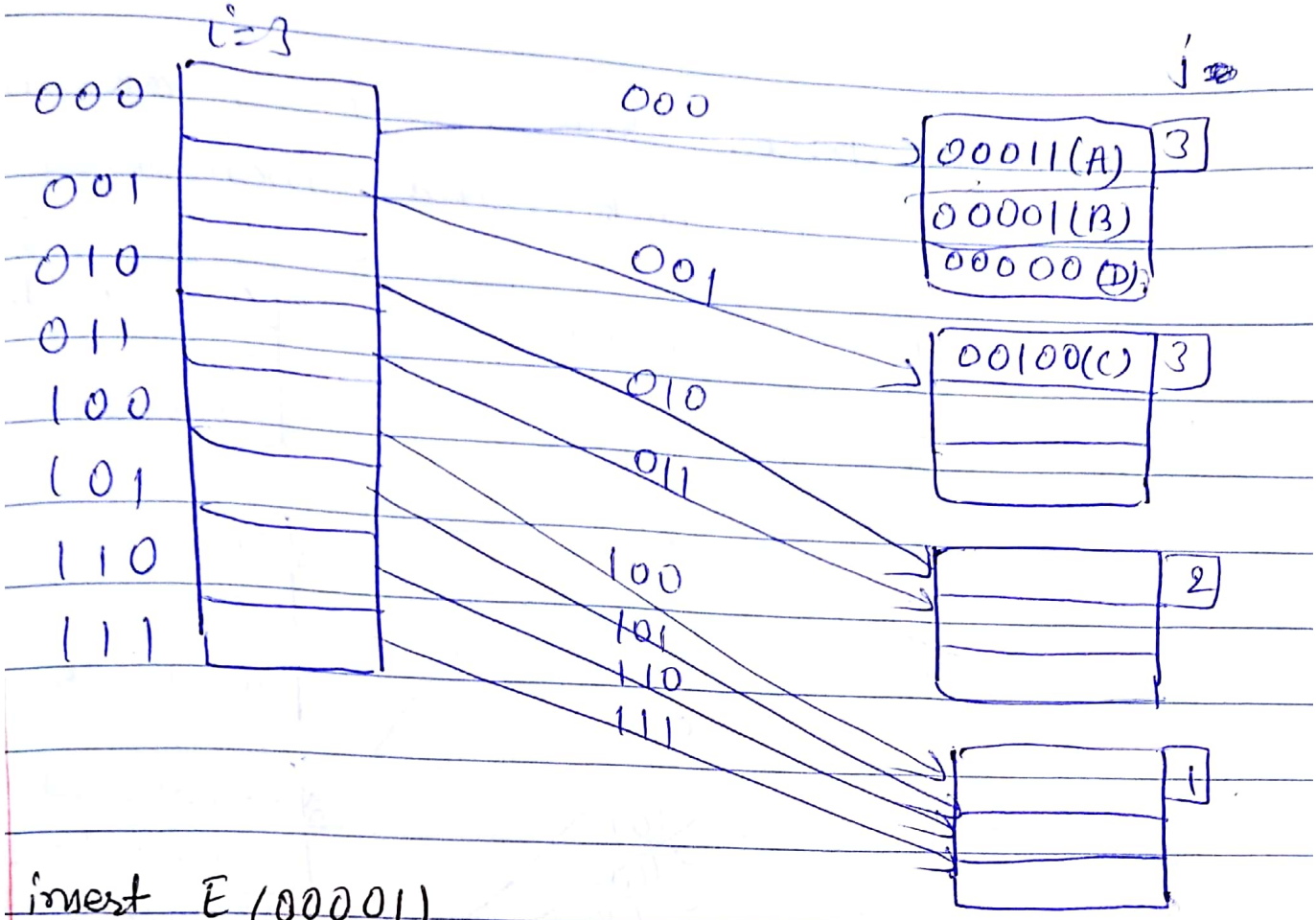
Overflowed, so, we will split the array in memory and increment i by 1 (∵ i = j = 1)



Still no place and (j < i), now we will split block in disk and increase j by 1.



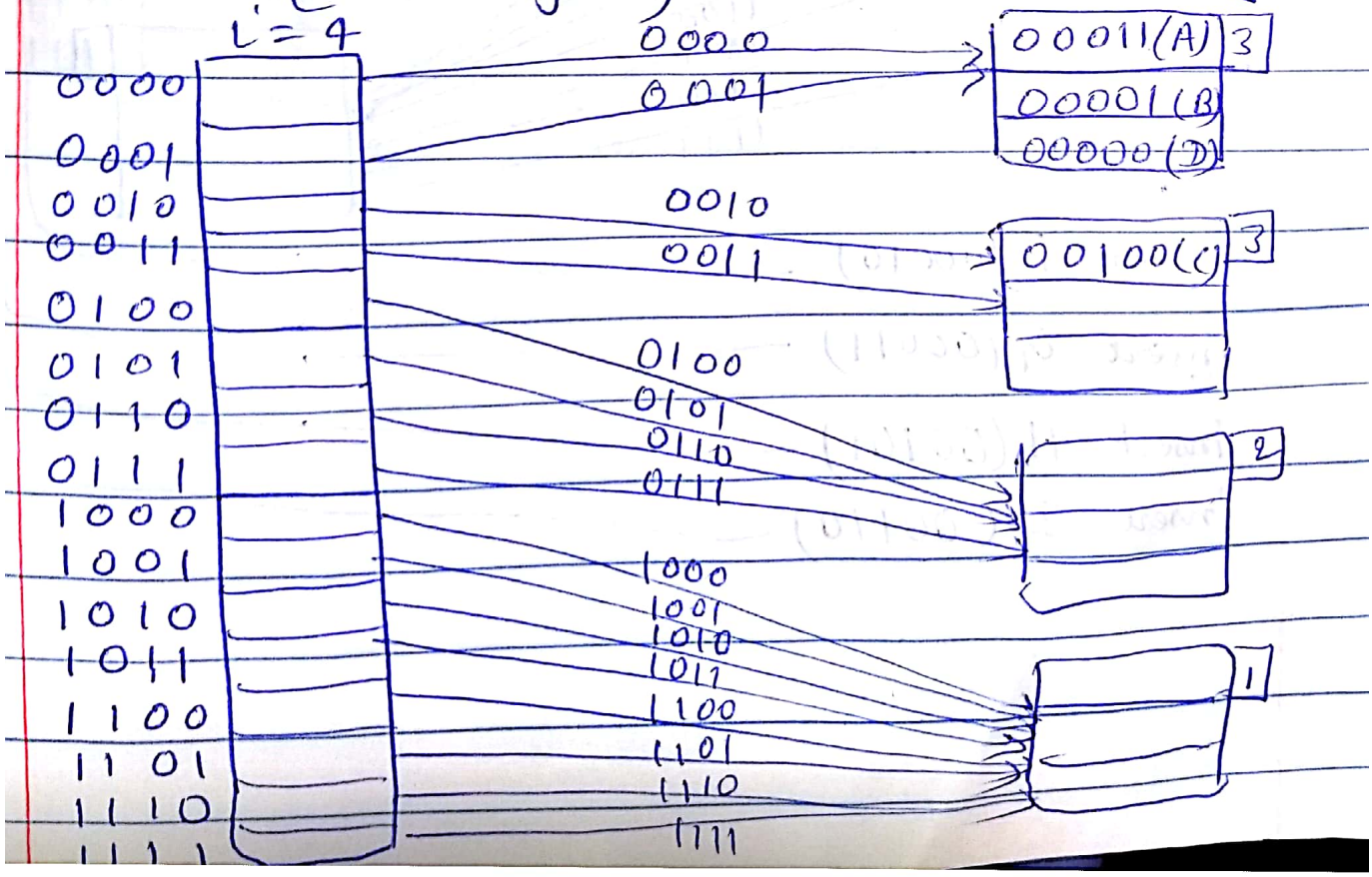
Still not getting place, so we will split again!



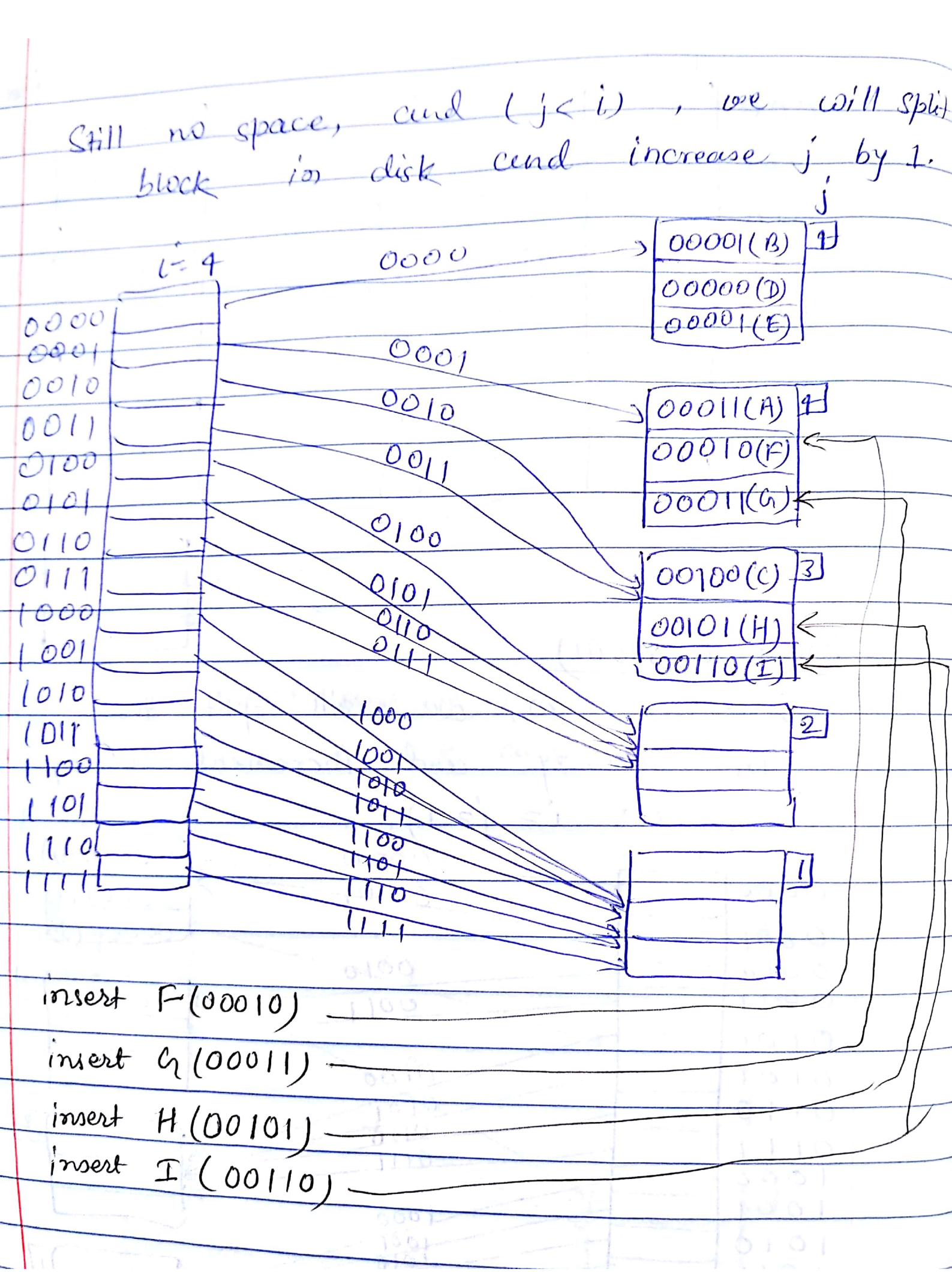
insert E (00001)

Overflowed, so, we will split the array in memory and increment i by 1

(∵ i = j = 1)

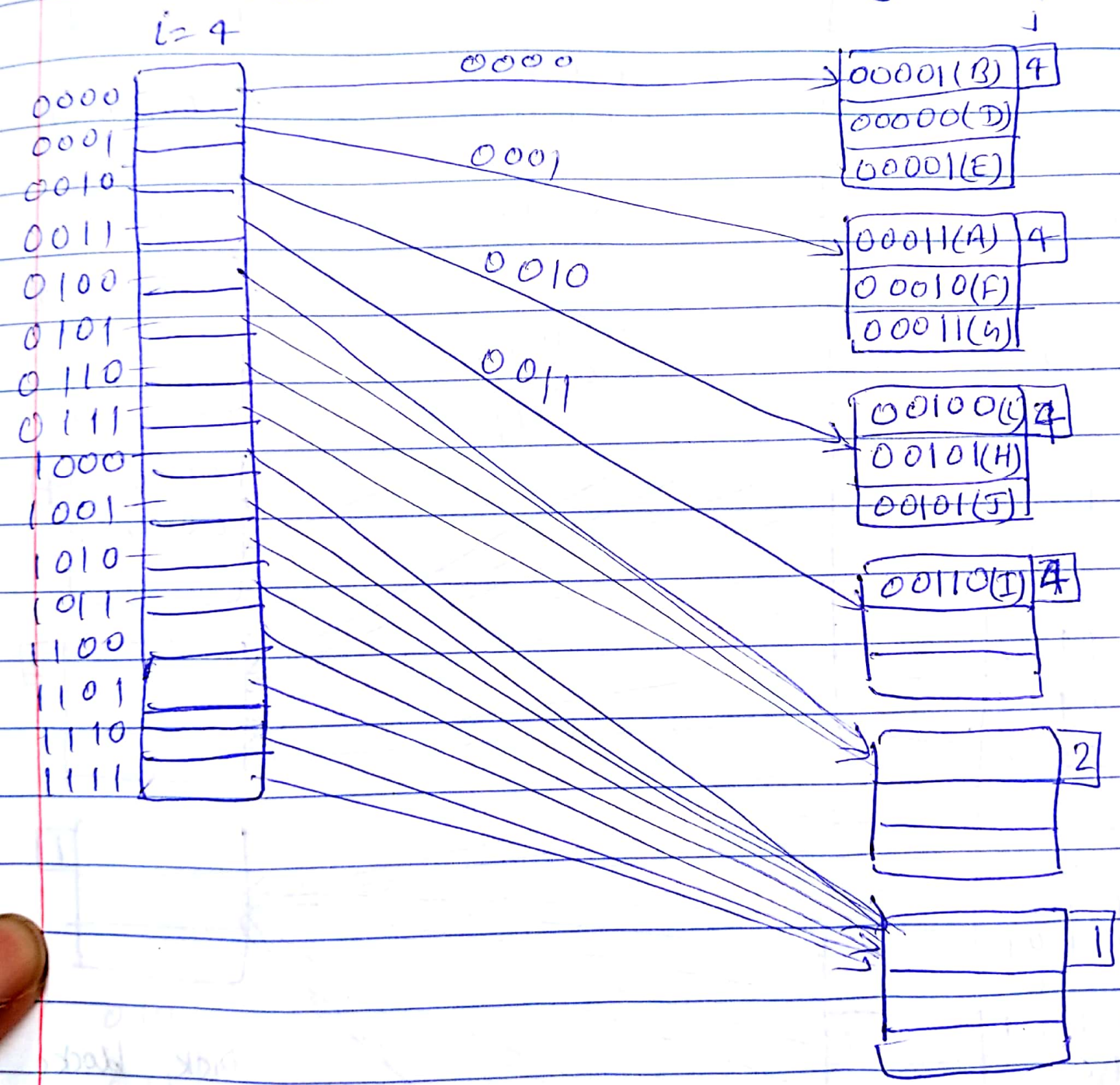


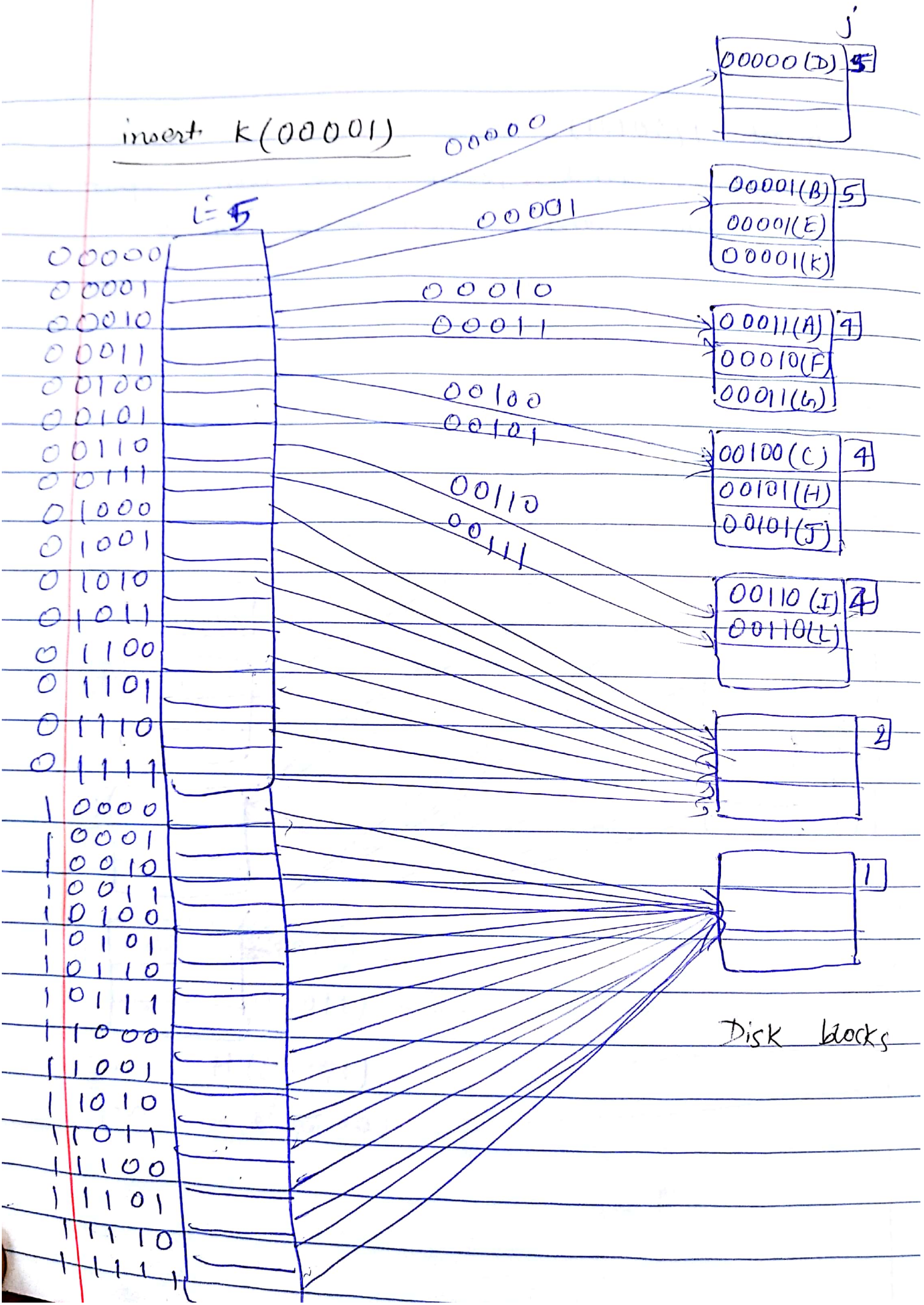
Still no space, and ($j < i$), we will split block in disk and increase j by 1.



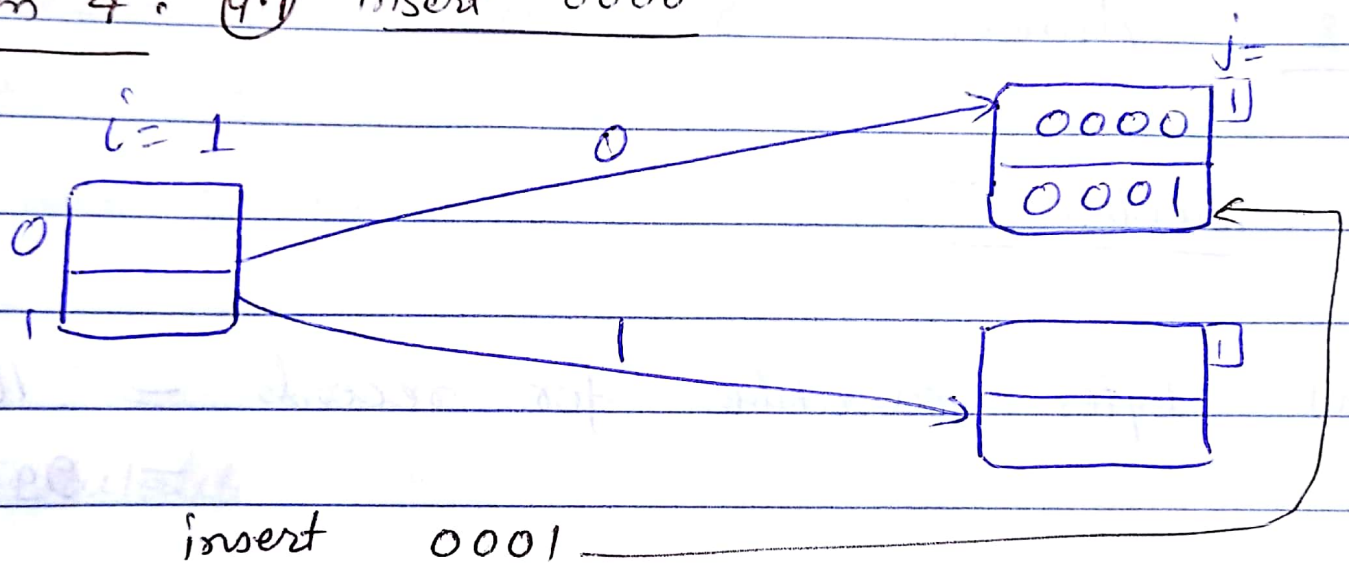
insert J(00101)

overflowed, and (j < i), we will split block in disk and increase j by 1.



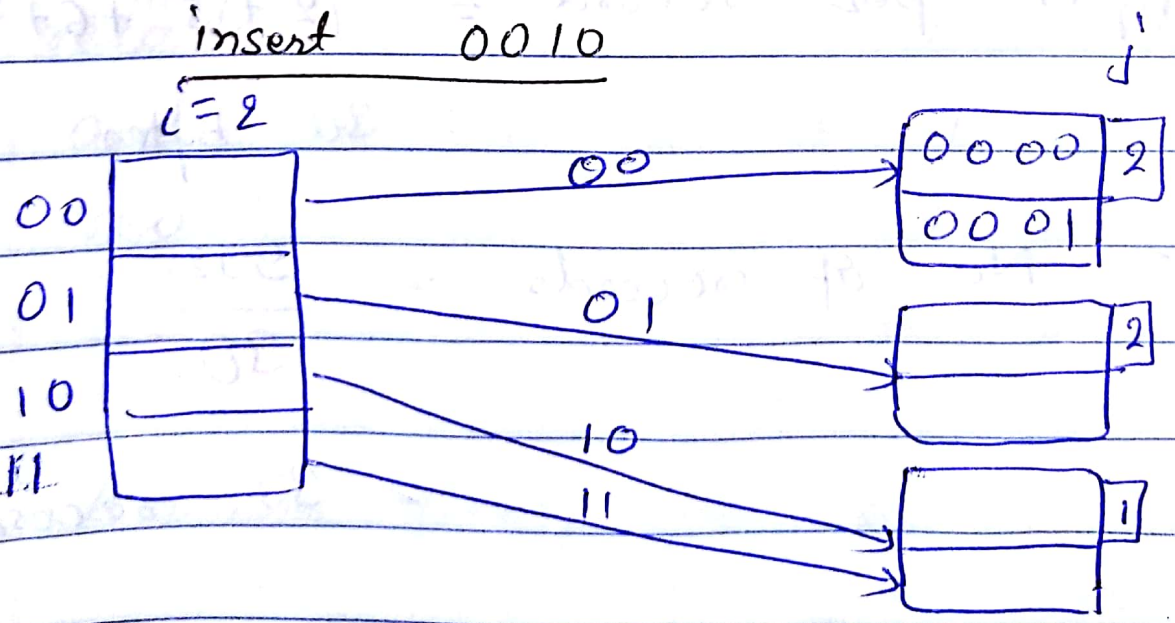


Problem 4. (4.1) insert 0000



insert 0001

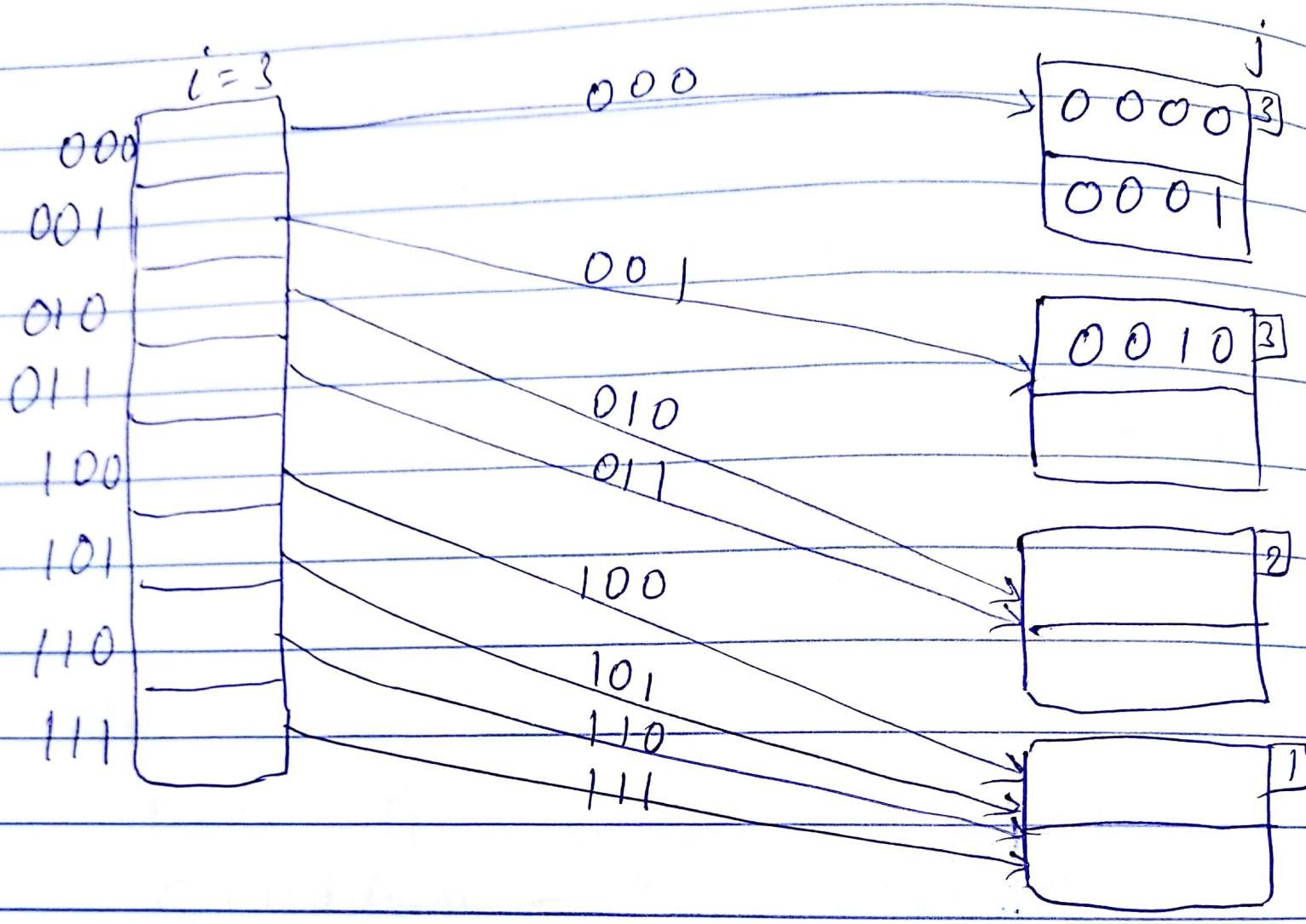
insert 0010



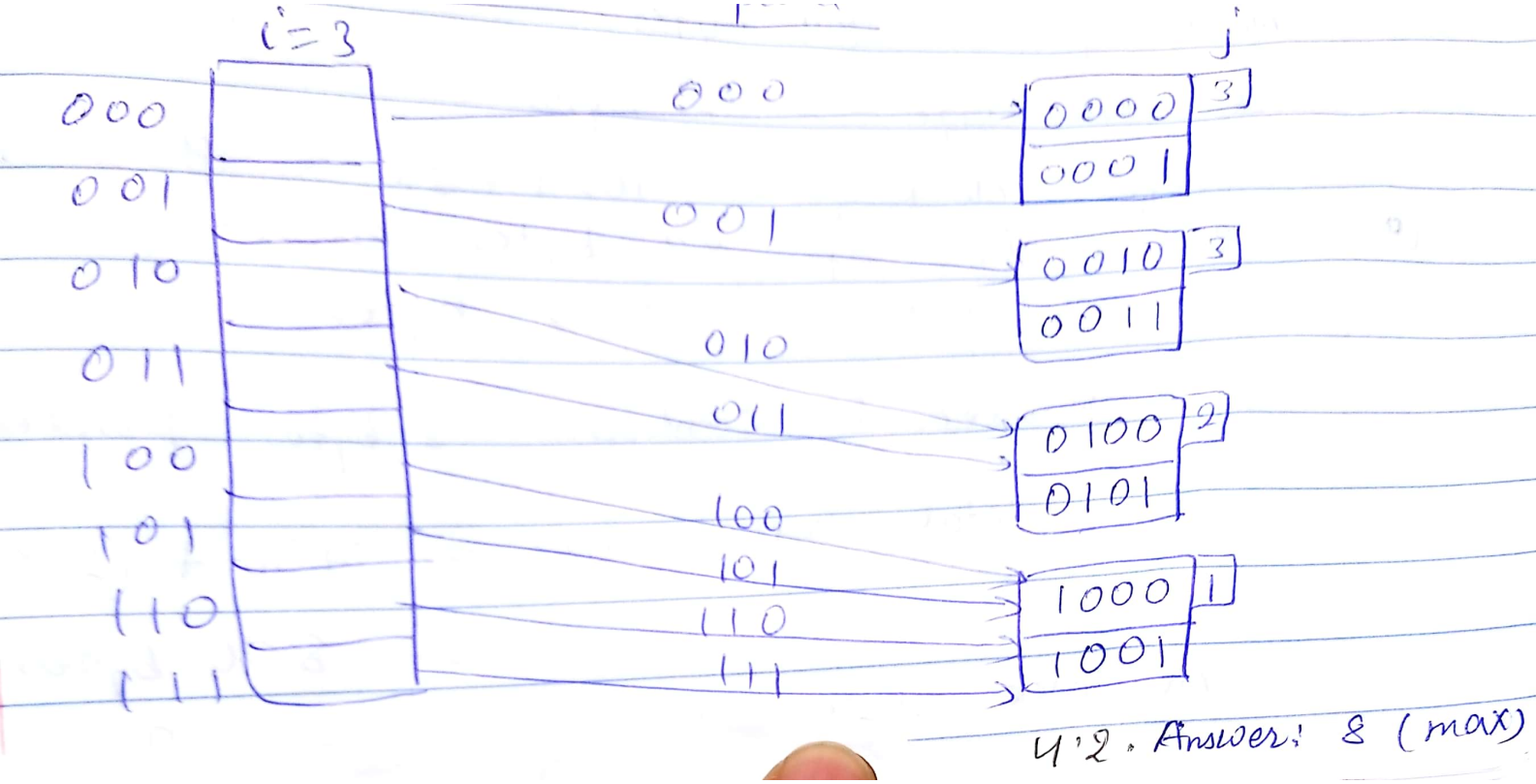
no space, so expand

i = 2

j



Answer = 3 (min)



4'2. Answer: 8 (max)

Problem 5 :

(a) Bytes available for records = 1024 − 32
= 992 bytes

Bytes per record = 12 + 5 + 6 + 7
= 30 bytes

∴ No. of records = $\frac{992}{30}$

= 33 records / block

(b)

block size = 1024 bytes

block header size = 32 bytes

useful block size = 1024 − 32 = 992 bytes

32 records of 23 bytes each.

record size = 32 × 23 bytes

∵ each record contains 2 byte pointers

∴ Total record size = 736 + (2 × 32)

= 800 bytes

Available free bytes = 992 − 800 = 192 bytes

30 records of 20 bytes each and 10 records of 10 bytes each.

Soln record size = (30 x 20) + (10 x 10) + (40 x 2)
= 600 + 100 + 80
= 780 bytes

Available free bytes = 992 - 780
= 212 bytes

5 records of 11 bytes, 10 records of 13 bytes and 20 records of 17 bytes.

Soln: record size = (5 x 11) + (10 x 13) + (20 x 17) + (35 x 2)
= 55 + 130 + 340 + 70
= 595 bytes

Available free bytes = 992 - 595
= 397 bytes

2 records of size 496

Soln: record size = (2 x 496) + 2 x 2
= 996 bytes

It does not fit in single block since block size is of 992 bytes only.

Problem: 6

6.1. Projection cannot be pushed below set union.

let $R(A,B) = \{(1,2)\}$

$S(A,B) = \{(1,4)\}$

$R \cup S = \{(1,2)(1,4)\}$

$\Pi_a(R \cup S) = \{(1),(1)\}$

$\Pi_a R \cup \Pi_a S = \{(1) \cup (1)\} = (1)$

$\Pi_a(R \cup S) \neq \Pi_a R \cup \Pi_a S$ Proved

6.2. Projection can not be pushed below set or bag difference.

Let two relations $R(A,B) = \{(1,2)\}$

$S(A,B) = \{(1,3)\}$

$R - S = (1,2)$

$\therefore \Pi_a(R-S) = (1)$

but $\Pi_a R - \Pi_a S = \phi$

$\therefore \Pi_a(R-S) \neq (\Pi_a R - \Pi_a S)$ Proved

6.3. Duplicate elimination can not be pushed below projection.

let relation $R(A, B) = \{(1,2), (1,4)\}$

$\delta R = \{(1,2), (1,4)\}$

$\Pi_a(\delta R) = \{(1), (1)\}$

Now, $\Pi_a R = \{(1), (1)\}$

$\delta(\Pi_a R) = (1)$

$\Pi_a(\delta R) \neq \delta(\Pi_a R)$ Proved

6.4 Duplicate elimination can not be pushed below bag union or difference

let two relations $R(A, B) = \{(1, 2), (1, 2)\}$

$S(A, B) = \{(1, 2)\}$

$R \cup S = \{(1,2)(1,2), (1,2)\}$

$\delta(R \cup S) = (1, 2)$

Now, $\delta R = (1, 2)$

$\delta S = (1, 2)$

$\delta R \cup \delta S = \{(1, 2), (1, 2)\}$

$\delta(R \cup S) \neq (\delta R \cup \delta S)$ Proved

Problem 7 :

(i) $\Pi_{sname}(\Pi_{sid}((\Pi_{pid}\sigma_{color='red'}\ Parts) \bowtie Catalog) \bowtie Suppliers)$

(ii) $\Pi_{sid}(\Pi_{pid}\sigma_{color='red' \vee color='green'}\ Parts) \bowtie Catalog)$

(iii) $\rho(R1, \Pi_{sid}((\Pi_{pid}\sigma_{color='red'}\ Parts) \bowtie Catalog)$

$\rho(R2, \Pi_{sid}\sigma_{address='10\ West\ 21st\ Street'}\ Suppliers)$

$R1 \cup R2$

(iv) $\rho(R1, \Pi_{sid}((\Pi_{pid}\sigma_{color='red'}\ Parts) \bowtie Catalog))$

$\rho(R2, \Pi_{sid}((\Pi_{pid}\sigma_{color='green'}\ Parts) \bowtie Catalog))$

$R1 \cap R2$

(v) $\rho(R1, catalog)$
$\rho(R2, catalog)$

$\Pi_{R1.sid, R2.sid}(\sigma_{R1.pid = R2.pid \wedge R1.sid \neq R2.sid \wedge R1.cost > R2.cost}(R1 \times R2))$

(vi) ~~$b1 \leftarrow (\Pi_{sid}\ sname$~~
$\rho(R1, catalog)$
$\rho(R2, catalog)$

$\Pi_{R1.pid}\ \sigma_{R1.pid = R2.pid \wedge R1.sid \neq R2.sid}(R1 \times R2)$

(vii) ~~$\rho(R1, \Pi_{sid}\ sname = 'Yosemite\ Sham'\ Suppliers)$~~
~~$\rho(R2, R1 \bowtie Catalog)$~~
~~$\rho(R3, R2)$~~

Sql: Select c.pid from Catalog C, Suppliers S where c.sid = s.sid and s.sname = 'Yosemite Shem' and c.cost = (select max(c.cost) as cost from Catalog C, Suppliers S where C.sid = s.sid and s.sname = 'Yosemite Sham')

(vii)

$\rho(R1, \Pi_{pid, cost}(\sigma_{sname = 'Yosemite\ Sham'}(Suppliers)) \bowtie Catalog)$

$\rho(R2, \rho_{max(cost) \rightarrow Cost}\ \Pi_{max(cost)}(\sigma_{sname = 'Yosemite\ sham'}(Suppliers)) \bowtie Catalog)$

$\Pi_{pid}(R1 \bowtie R2)$

Problem 8

8.1

$$T(q) = \frac{T(Library)}{V(Library, public)} = \frac{100}{2} = 50$$

Ans

8.2. $q = \sigma_{title = Faust \wedge author = Goethe}(book)$

$T(q) = T(book) \times Sel_{title = Faust} \times Sel_{author = Goethe}$

$= T(book) \times \frac{1}{V(book, title)} \times \frac{1}{V(book, author)}$

$= \frac{2}{10000} \times \frac{1}{5000} \times \frac{1}{30000}$

$= \frac{2}{30,000}$

$= 0.00006667$

≈ 0.0001

$T(q) \approx 0$

# of tuples for the query $q = 0$

8.3

$q = \sigma_{edition \geq 2 \wedge edition \leq 4 \wedge title = databases}(book)$

minimal & maximal values in edition attribute are 1 and 15.

$T(q) = T(book) \times Sel_{edition \geq 2} \times Sel_{edition \leq 4}$

$\times Sel_{title = databases}$

$$T(q) = T(book) \times \frac{14}{15} \times \frac{4}{15} \times \frac{1}{V(book, title)}$$

$$= 10\emptyset,\emptyset\emptyset\emptyset \times \frac{14}{15} \times \frac{4}{15} \times \frac{1}{5\emptyset,\emptyset\emptyset\emptyset}$$

$$= \frac{2}{\frac{10 \times 14 \times 4}{15 \times 15 \times 5}}$$

$$= \frac{112}{225} = 0.49777$$

$$\simeq 0.5$$

using ceiling,

$$\boxed{\therefore T(q) \simeq 1}$$

# of tuples for query $q = 1$.

8.4 $q = \sigma_{title = database \vee title = DatabaseSystem}(book) \bowtie_{title = book} Catalog \bowtie_{library = loc} \sigma_{budget \leq 40}(Library)$

minimal & maximal values in the budget attribute are 10 & 70.

Break the query & then combining the results

$$T\left(\sigma_{title=\text{Database Introdu} \vee title=\text{Database Systems}}(book)\right) = T(q_1)$$

$$= Sel_{title=\text{Database Introduction}} \vee Sel_{title=\text{Database Systems}} \times T(book)$$

$$= \neg\left(\neg Sel_{title=\text{database Introdu}} \wedge \neg Sel_{title=\text{Database Systems}}\right) \times T(book)$$

$$= 1 - \neg Sel_{title=\text{Database Introduction}} \wedge \neg Sel_{title=\text{Database Systems}}) \times T(book)$$

$$= \left(1 - \left(1 - \frac{1}{V(book, title)}\right) \times \left(1 - \frac{1}{V(book, title)}\right)\right) \times T(book)$$

$$= \left(1 - \left(1 - \frac{1}{50000}\right) \times \left(1 - \frac{1}{50000}\right)\right) \times 100{,}000$$

$$= (1 - (1 - 0.00002)(1 - 0.00002)) \times 100{,}000$$

$$= (1 - (0.99998 \times 0.99998)) \times 100{,}000$$

$$= (1 - 0.99996) \times 100{,}000$$

$$= 0.00004 \times 100{,}000$$

$$\boxed{T(q_1) = 4}$$

$T(q_1 \bowtie_{title=book} Catalog) = T(q_2)$

$= \frac{T(q_1) \times T(Catalog)}{\max(V(q_1, title), V(Catalog, book))}$

$= \frac{4 \times 20\cancel{0},000}{9\cancel{0}000}$

$= \frac{80}{9} = 8.889$

$\simeq 8.9$

$\boxed{T(q_2) \simeq 9}$

$T(\sigma_{budget \leq 40}(library)) = T(q_3)$

$= T(library) \times \frac{\cancel{70}-40+1}{(70-10+1)}$

$= \frac{100 \times 31}{61} = 50.81$

$\boxed{T(q_3) \simeq 51}$

$T(q_2 \bowtie_{library=loc} q_3) = \frac{T(q_2) \times T(q_3)}{\max(V(q_3, loc), V(q_2, library))}$

$= \frac{9 \times 51}{100} = 4.59 \simeq 5$

$\therefore$ # of tuples for query $2 = 5$ Ans