# Database Systems (Theory)

# Digital Assignment

# Faculty Name: Prof. Bimal Kumar Ray

# SLOT:G1+TG1

**Question**

Consider a disk with block size B = 4096 bytes. A block pointer is P = 6 bytes long, and a record pointer is

PR = 7 bytes long. A file has r = 50,000 Customer records of fixed length. Each record has the following

fields: Name (30 bytes), Mobile_no (13 bytes), Profession (12 bytes), Address (40 bytes),

Birth_date (8 bytes), Gender (1 byte).

(a) Calculate the record size R in bytes.

(b) Calculate the blocking factor bfr and the number of file blocks b, assuming an unspanned

organization.

(c) Suppose that the file is ordered by the key field Mobile_no and we want to construct a primary index

on Mobile_no. Calculate (i) the index blocking factor bfri (which is also the index fan-out fo); (ii) the

number of first-level index entries and the number of first-level index blocks; (iii) the number of levels

needed if we make it into a multilevel index; (iv) the total number of blocks required by the multilevel

index; and (v) the number of block accesses needed to search for and retrieve a record from the file—

given its Mobile_no value – using the primary index.

**Screenshots of Answer:**

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① Block size, $B = 4096$ bytes

Block pointer, $P = 6$ bytes

Record pointer, $P_R = 7$ bytes

$r = 50000$

Name (30 bytes)

Mobile_no (13 bytes)

Profession (12 bytes)

Address (40 bytes)

Birth_date (8 bytes)

~~Gender~~

Gender (1 byte)

(a) $R = 30 + 13 + 12 + 40 + 8 + 1 = 104$ bytes

(b) Blocking factor

$$bf_r = \left\lfloor \frac{B}{R} \right\rfloor = \left\lfloor \frac{4096}{104} \right\rfloor = \lfloor 39.38\overline{4} \rfloor = 39$$

no. of file blocks

$$b = \left\lceil \frac{r}{bf_r} \right\rceil = \left\lceil \frac{50000}{39} \right\rceil = 1283 \text{ blocks}$$

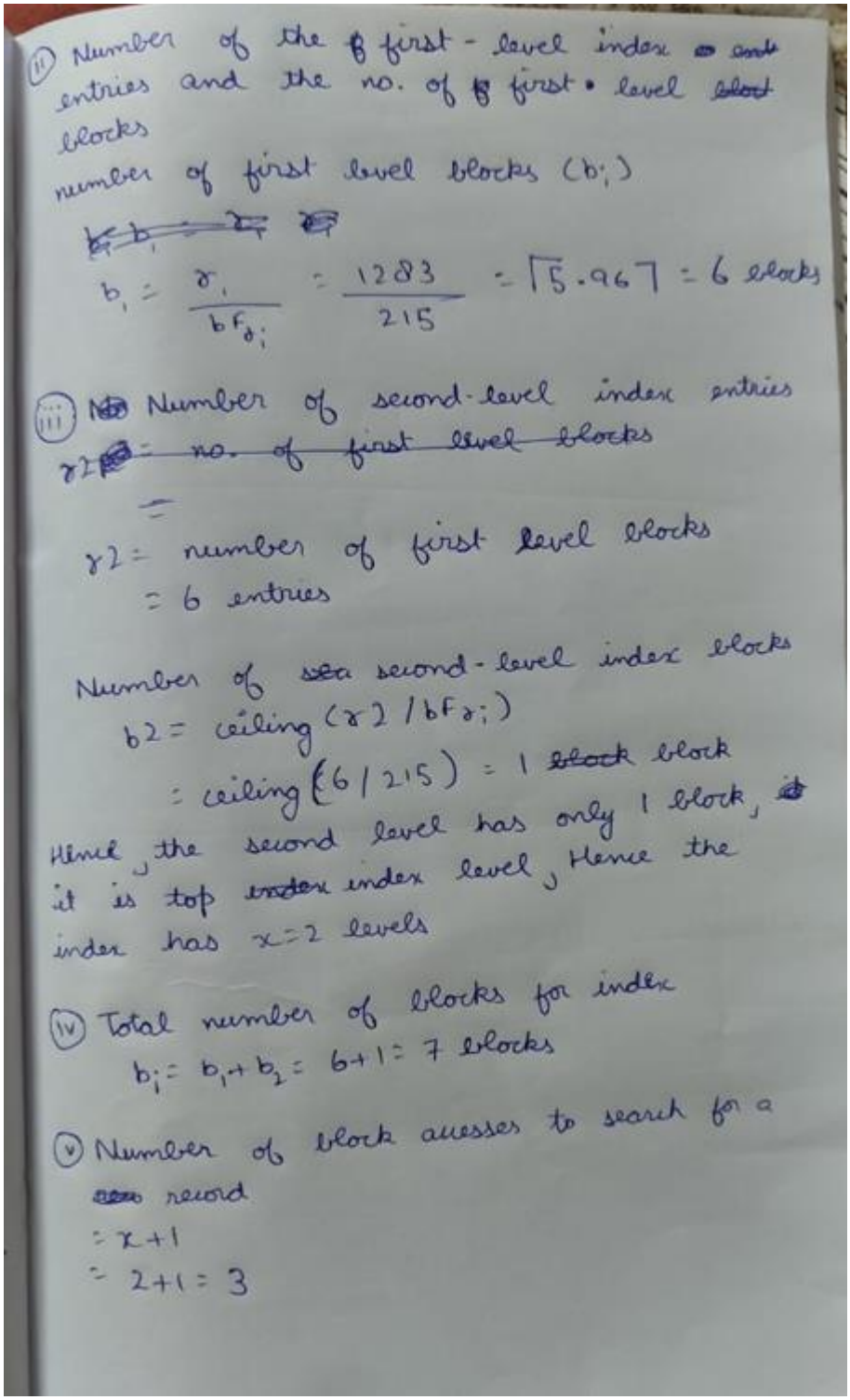
(c)

(i) Index record size, $R_i$ = Mobile_no + P

$= 13 + 6 = 19$ bytes

Index blocking factor $= bf_{r_i} = F_o = \frac{B}{R_i} = \frac{4096}{19}$

$= 215$



(ii) Number of the first-level index entries and the no. of first-level blocks

number of first level blocks ($b_1$)

$$b_1 = \frac{r_1}{bf_{r_1}} = \frac{1283}{215} = \lceil 5.967 \rceil = 6 \text{ blocks}$$

(iii) Number of second-level index entries

$r_2$ = number of first level blocks

= 6 entries

Number of second-level index blocks

$b_2$ = ceiling ($r_2 / bf_{r_1}$)

= ceiling (6/215) = 1 block

Hence, the second level has only 1 block, it is top index level, Hence the index has $x = 2$ levels

(iv) Total number of blocks for index

$b_i = b_1 + b_2 = 6 + 1 = 7$ blocks

(v) Number of block accesses to search for a record

$= x + 1$

$= 2 + 1 = 3$