CS3223 Tutorial 1 Sample Solutions

Question 1

a) capacity = 8*2^13*2^8*2^9 = 2^33 = 8 GB

b) to transfer 8 sectors, we need to read 8 sectors + 7 gaps
rotational delay t = 60/3840 = 1/64
read 1 sector + 1 gap, s = t/number of sector = 0.061 ms
read 1 sector w/o gap = 0.9*s = 0.055 ms
transfer time tb = 7*0.061 + 0.055 = 0.482 ms

average time to fetch a block = seek time + rotational delay + transfer time

min transfer occurs when seek time = rotational delay = 0,
min = 0.482

max occurs when head move from innermost to outermost track + full rotational delay
max = 17.4 + 15.6 + 0.48 = 33.5 ms

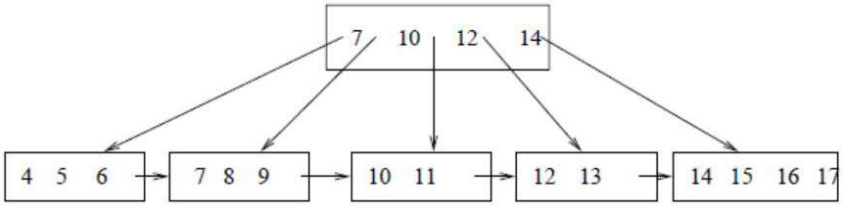
c) the next I/O request could be from any of the cylinders 1, 2, ... 8192 with equal likelihood.

the no. of cylinders travelled in these cases would be 999, 998, ... 7192. Hence the average no. of cylinders travelled would be (999+998+...+1+0+1+...+7192)/8192 = 3218.45

seek time = start time + no. of 500 tracks*1 = 1+3218.5/500 = 7.44 ms
average rotational delay = t/2 = 7.81
transfer time = 0.482 ms

expected block access time = 15.73 ms

Question 2



B+-tree after keys 1, 2 and 3 are deleted.

Question 3

Reference	LRU strategy Least → Most frequently used	Optimal Strategy
5	A B C D E	A B C D E
6	A B C E D	A B C D E
7	B C E D F/A	A B C D F/E
8	B C E F D	A B C D F
9	C E F D G/B	A B C D G/F
10	C E F G D	A B C D G
11	E F G D H/C	A B C D H/G
12	E F G H D	A B C D H
13	F G H D C/E	A B C D H

The LRU is clearly suboptimal because it chooses to replace useful pages like B and C which are needed later. Examine for instance line 13 in the above table: under the LRU, only one (C) out of five buffer pages in memory is useful. Under the ideal situation, we have pages A, B, and C which are much more likely to be referenced in the future.

A more optimal strategy here is to choose pages for replacement based on the corresponding level of the page in the B-tree.

Note that the optimal strategy here is NOT MRU since it would have removed D in Step 7 above.

The key objective of this question is to understand that no single buffer replacement strategies work best. Some systems implement different strategies for different types of data: one replacement strategy for index structures; another for data.