CE/CZ 4123 Big Data Management Tutorial 10
Key-Value Stores

Question 1:

Consider a leveling LSM-tree with a size ratio 4. The memory buffer (Level 0) can store 5000 key-value pairs. Initially the LSM-tree is empty. After inserting 70000 key-value pairs with distinct keys continuously, how many levels are formed?

Question 2:

Consider a leveling LSM-tree with a size ratio 4. The LSM-tree has 5 levels (excluding the memory buffer level), and it is incorporated with **both** fence pointers and Bloom Filters. Assume that a key-value pair is always entirely stored within a disk page. Consider the procedure of Get(K) for a key K, which of the followings sequence are possible to be the I/O costs from Level-0 to Level-5? (can select multiple answers)

(a) 1, 1, 1, 1, 1, 1
(b) 0, 1, 1, 1, 1, 1
(c) 0, 0, 1, 0, 0, 1
(d) 0, 0, 0, 0, 0, 1
(e) 1, 0, 0, 0, 0, 0

Question 3:

Consider a leveling LSM-tree with a size ratio 4. The LSM-tree has L levels (excluding the memory buffer level), and it is **only** incorporated with fence pointers (without Bloom Filters). Assume that a key-value pair is always entirely stored within a disk page. Consider the procedure of Get(K) for a key K,

(1) What is the possible I/O cost of accessing Level-i (i is in [1, L])?
(2) If K exists in the LSM-tree, what is the expected I/O cost at Level-i (i is in [1, L])? (hint: divide the cases based on the first-appearing location of the key K)

Question 4:

Consider a leveling LSM-tree with a size ratio 4. The LSM-tree has L levels (excluding the memory buffer level), and it is incorporated with **both** fence pointers and Bloom Filters. Assume that a key-value pair is always entirely stored within a disk page. Consider the procedure of Get(K) for a key K,

(1) What is the possible I/O cost of accessing Level-i (i is in [1, L])?

(2) If K exists in the LSM-tree and the FPR of the Bloom filter at Level-i (i is in [1, L]) is P (P is in [0, 1]), what is the expected I/O cost at Level-i? (hint: divide the cases based on the first-appearing location of the key K)