

CS 353 Spring 2020
Homework 5
Due: 22 April, Wednesday till midnight

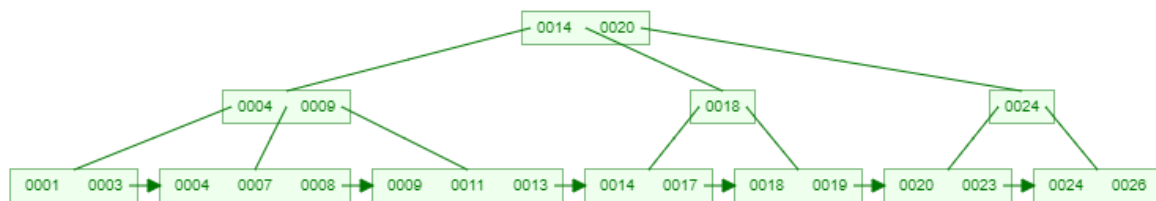
Q.1 [18 pts, 6 pts each]

Consider a B+ tree with $n = 3$. Construct the tree for each of the following parts, using the “insertion algorithm provided in the textbook”.

- (a) Draw the tree after inserting the following keys in the given order.
10, 9, 3, 7, 4, 21, 16, 1, 14, 20.
- (b) Draw the tree after inserting the following keys in the given order.
13, 10, 1, 2, 5, 3, 9, 16, 12, 7.
- (c) Draw the tree after inserting the following keys in the given order.
3, 10, 12, 4, 13, 15, 14, 16, 18, 17, 19, 20.

Q.2 [32 pts, 8 pts each]

Consider the following B+ tree with $n = 4$. For the following operations, use the insertion / deletion algorithms provided in the textbook.



- (a) Draw the tree after insertion of an entry with search key value $k = 5$.
- (b) Draw the tree after insertion of an entry with search key value $k = 12$ to the resulting tree in (a).
- (c) Draw the tree after deletion of the entry with search key value $k = 18$ from the resulting tree in (b).
- (d) Draw the tree after deletion of the entry with search key value $k = 19$ from the resulting tree in (c)

Q.3 [50 pts, 25 pts each]

Consider an extendable hash structure where buckets can hold 3 search-key values. Suppose that the global-depth is Y . Then the hash function returns Y Least Significant Bits (i.e., use the least significant bits of the hash value, **not** the most significant bits as shown in the textbook). Assume that global-depth and local-depths of the extendable hash table are initially 1. Show the contents of the hash table and the bucket address table after all the search-key values are inserted / deleted. Indicate which insertions lead to bucket splits.

- (a) Insert 15, 22, 10, 20, 9, 4, 12, 8, 16, 18 and 14.
- (b) Delete 18, 14, 22, 20, 12, 4 and 10 from the resulting structure in (a).