CS 206: 2021 FALL QUIZ

Worth 200 points

- **The total score in this exam paper is 80 points.**
- **80 points will be converted to 200 points by multiplying your earned score by 2.5.**

0. INFORMATION (WORTH 2 POINT)

Write your name and KAIST ID number at the top of **EACH** page on your answer sheet.

1. (WORTH 8 POINTS)

1) What is the worst-case running time of deleting a node with the minimum key from a

왼쪽이 오른쪽보다 작음 binary search tree containing N nodes? Use the Big-Oh notation. (worth 1 point)

2) Explain why it takes that running time in your answer to 1). (worth 7 points)

2. (WORTH 16 POINTS)

A. Statement: Every node in any full binary tree is balanced.

0 아님 2인가..?

1) Is the statement above true or false? **(Note: Your answer should be either true or false. Otherwise, it is not possible to grade. You will get 0 points.)** (worth 1 point)

2) If the statement is true, justify why. If the statement is false, show the counterexample[1]. (worth 7 points)

B. Statement: Every node in any complete binary tree is balanced.

0 또는 -1만 ㄱㄴ 왼쪽부터 채움

1) Is the statement above true or false? **(Note: Your answer should be either true or false. Otherwise, it is not possible to grade. You will get 0 points).** (worth 1 point)

2) If the statement is true, justify why. If the statement is false, show the counterexample. (worth 7 points)

3. (WORTH 12 POINTS) 범위 아님

Consider that keys 33, 10, 9, 13, 12, 45 are inserted into a hash table of size 12 in that order, using the hash function $h(x) = x \bmod 12$. Collisions are handled by double hashing. The secondary hash function is $h'(x) = 7 - (x \bmod 7)$. We do not resize the hash table.
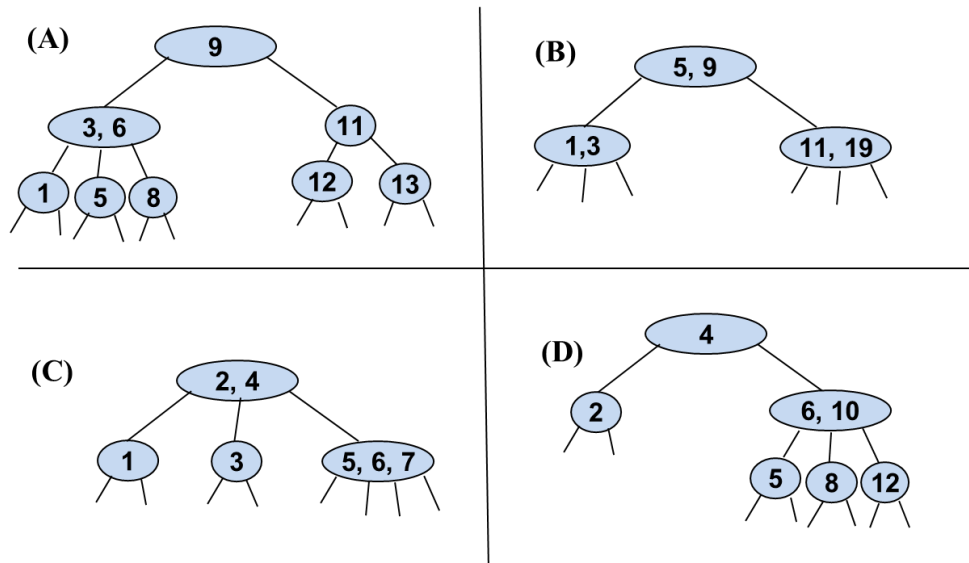
Draw the resulting hash table.

⌘ **Notes:**
1) You are not required to include intermediate steps in your final answer.
2) Do not make any typos—no partial credit.

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[1] A counterexample is a specific case which shows that a given statement is false.

Consider the following trees (A), (B), (C), and (D):

(A)

```
        9
   3, 6      11
 1  5  8   12  13
```

(B)

```
      5, 9
 1,3       11, 19
```

(C)

```
          2, 4
   1       3      5, 6, 7
```

(D)

```
          4
   2          6, 10
           5  8  12
```

1) Select all valid 2-3 trees. If there are no valid 2-3 trees, write "None" in your answer. **(Note: Do not make any typos—no partial credit.) (worth 2 points)**

2) For **EACH** of the given trees above (A) ~ (D), explain why it is a valid 2-3 tree or not. (4 points @ each)

5. (WORTH 24 POINTS)

For **EACH** of the following situations (A ~ C) in a valid LLRB tree,

1) (Worth 1 point) Specify whether the color of the node is

   ① Red

   ② Black

   ③ Either red or black.

⌘ **Notes:**
   - **Recall that a node's color is the same as the color of the node's link connected to its parent.**
   - **Do not make any typos—no partial credit.**

2) (Worth 7 points) Explain why the node has that color you selected in 1).

범위 아님

A. A node whose parent is red in a valid LLRB tree.

B. A node whose children are the same color in a valid LLRB tree.

C. A node with the maximum key in a valid LLRB tree containing more than one node.