Problem 1. Consider the AVL-tree below:

```
  30
 /  \
15   40
 /  \\ /
10 20 35 73
 /  \
3 32 36 60
 \   
 35
```

Show the AVL-tree after inserting 37.

Problem 2. Show the AVL-tree after inserting 1 to the tree in Problem 1.

Problem 3. Show the AVL-tree after deleting 60 from the tree in Problem 1.

Problem 4. Show the AVL-tree after deleting 15 from the tree in Problem 1.

Problem 5. Recall that in the dictionary search problem, we want to preprocess a set $S$ of $n$ integers into a data structure to answer the following queries efficiently: given an integer $q$, determine whether $q \in S$. Describe a data structure that satisfies all the following requirements:

- It consumes $O(n)$ space.
- It answers each query in $O(1)$ expected time, and simultaneously, $O(\log n)$ worst-case time.

Problem 6. Let $S$ be a dynamic set of integers. Let $n = |S|$. Describe a data structure on $S$ to support the following operations on $S$ with the required performance guarantees:

- Insert a new element to $S$ in $O(\log n)$ time.
- Delete an element from $S$ in $O(\log n)$ time.
- Report the $k$ smallest elements of $S$ in $O(k)$ time, for any $k$ satisfying $1 \leq k \leq n$.

Your structure must consume $O(n)$ space at all times.