1. [25 points] You are a robot facing an infinitely long wall and your task is to find a door in the wall. You are only allowed to walk along the wall to your left or to your right and at any time you may turn and walk in the opposite direction. Assume that the door is an (unknown, but finite) integer number of steps away.

As a function of the (possibly unknown) distance to the door, what is the minimum number of steps you have to walk to find the door in the following situations. (Note that ”minimum number of steps” means the minimum number in the worst case, that is, using the best algorithm that you can think of. For each situation, you should describe the procedure that the robot should follow, and analyze its cost.)

(a) You know that the door is to your left.
(b) You don’t know where the door is but you know that it is $n$ steps away.
(c) You don’t know where the door is but you know that it is within $n$ steps away.
(d) You neither know where the door is nor how far away.

2. [25 points] Find a way to add one additional pointer to each node of a singly-linked list so that access to the $i$th element in a list of $n$ elements requires $O(\log n)$ time.