Answer the following questions:

a) [10 Points] Debug the UCS function in the program to make it function as described in Figure 3.14 in the book. Indicate the modification/addition to the program in terms of python code. Use the line number in the program as the reference to where you would modify/add code. Explain why each modification/addition was required.

1. Line 122: change frontierCost definition from an array to a dictionary. The key is the hashed node, the value is the shortest distance from initial state to this node.
   All the operation about frontierCost is therefore changed.

2. Line 139: Delete "break" after find the target. For UCS, find the target does not guarantee the optimal solution, therefore we need to keep searching

3. Line 132-142, 145-155, 158-168, 171-181. changed into a function called Expandable, content in the function also changed. My idea is if child is not in frontier and expandable, append the child, calculate the hash value for frontierCost. Add current node as father. Else if the child has explored or is in the frontier, and the new path cost to it is smaller than previous one, change the frontierCost[childHash] to new value and new parent. Append the child in the frontier again in case any other path cost would been affected by this update. (Expandable is from line 161 to line 172 in the new file)

4. Line 128: Add function Reorder, it aims to always find the smallest cost value for frontier to pop. (Reorder is from 176 to 184 in the new file)