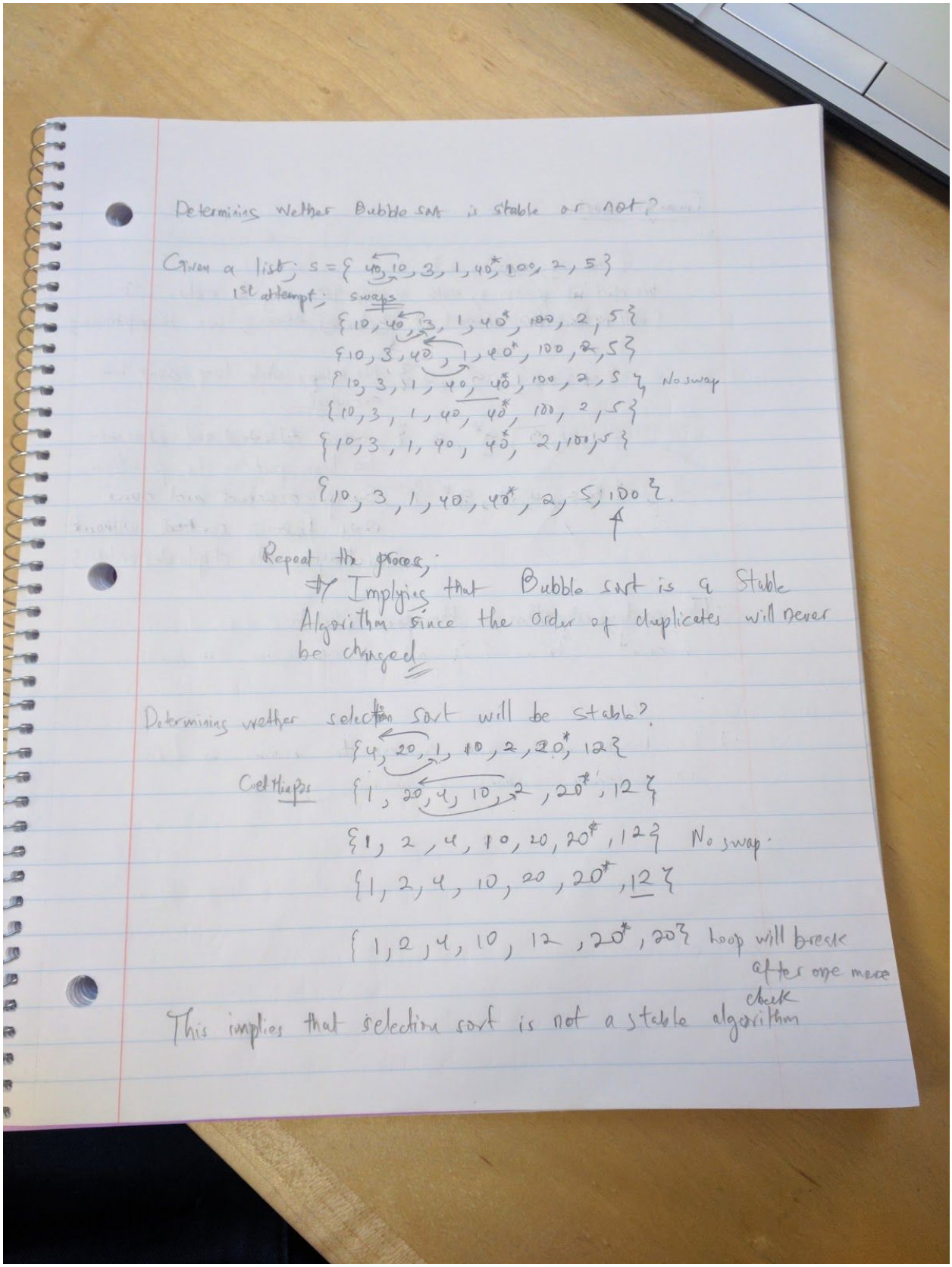
Problem1


Determining Wether Bubble sort is stable or not?
Given a list; S = { 40, 10, 3, 1, 40*, 100, 2, 5 }
1st attempt; swaps
{ 10, 40, 3, 1, 40*, 100, 2, 5 }
{ 10, 3, 40, 1, 40*, 100, 2, 5 }
{ 10, 3, 1, 40, 40*, 100, 2, 5 } No swap
{ 10, 3, 1, 40, 40*, 100, 2, 5 }
{ 10, 3, 1, 40, 40*, 2, 100, 5 }
{ 10, 3, 1, 40, 40*, 2, 5, 100 }
Repeat the process;
Implying that Bubble sort is a Stable Algorithm since the order of duplicates will never be changed
Determining wether selection sort will be stable?
{ 4, 20, 1, 10, 2, 20*, 12 }
Get Hints { 1, 20, 4, 10, 2, 20*, 12 }
{ 1, 2, 4, 10, 20, 20*, 12 } No swap.
{ 1, 2, 4, 10, 20, 20*, 12 }
{ 1, 2, 4, 10, 12, 20*, 20 } loop will break after one more check
This implies that selection sort is not a stable algorithm

Insertion sort

{ 4, 9, 1, 9*, 2 }

We start at position 1, make a comparison only to realise it's smaller than the element at position 0; meaning we keep traversing.

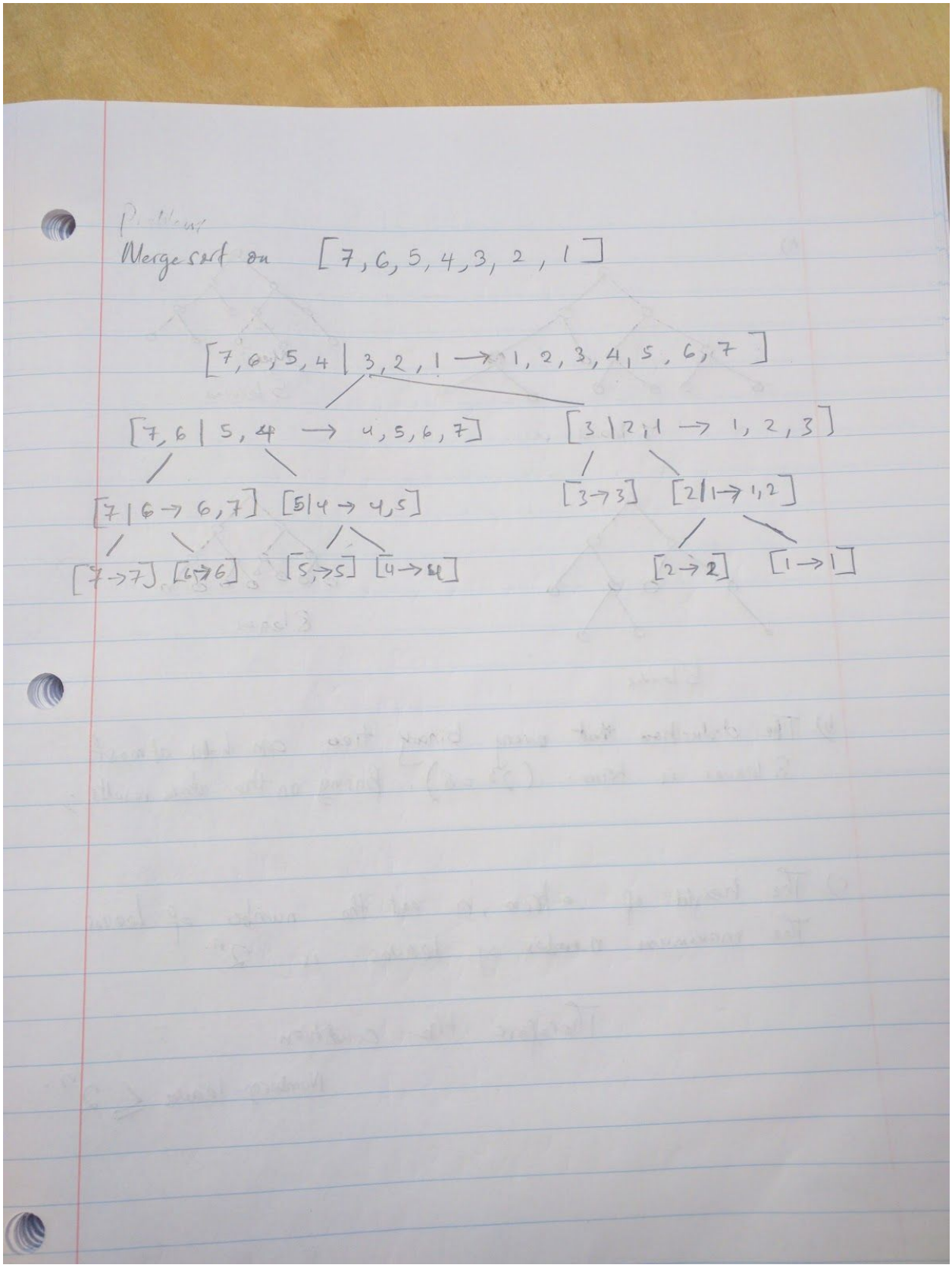
{ 4, 9, 1, 9*, 2 } No swap, while loop won't be executed.

{ 1, 4, 9, 9*, 2 }, Swap detected and element has been put in its position.

{ 1, 2, 4, 9, 9* }, Swap occured and now our list is sorted without interchanging the duplicates orderings.

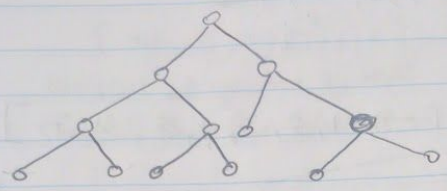
This sorting algorithm is therefore stable

Problem2

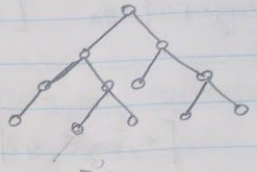

Mergesort on [7, 6, 5, 4, 3, 2, 1]
[7, 6, 5, 4 | 3, 2, 1 → 1, 2, 3, 4, 5, 6, 7]
[7, 6 | 5, 4 → 4, 5, 6, 7]
[3 | 2, 1 → 1, 2, 3]
[7 | 6 → 6, 7]
[5 | 4 → 4, 5]
[3 → 3]
[2 | 1 → 1, 2]
[7 → 7]
[6 → 6]
[5 → 5]
[4 → 4]
[2 → 2]
[1 → 1]

Problem4

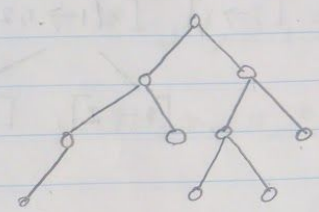
a)



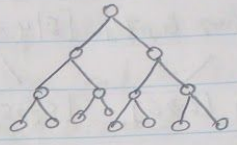
7 leaves



5 leaves



5 leaves



8 leaves

b) The deduction that every binary tree can hold at most 8 leaves is true. ($2^3 = 8$). Basing on the above results;

c) The height of a tree, n and the number of leaves The maximum number of leaves is 2^n.

Therefore the condition

Number of leaves $\leq 2^n$.