

CS 240 F2007 Final

1. a) False b) False c) False d) True e) False (if insertions/deletions made after construction)
f) True g) True h) False i) False j) False ($n \log n$) k) True l) False m) True

2. a) Since the array is sorted in decreasing order, we would execute line (*) 0 times, since the array is already a max-heap - every parent is already larger than its child.

b) The for loop is executed n times. In each iteration of the for loop, the swap function takes $O(1)$ time. The sink() call takes $O(\log n)$ time. This is a tight bound, since we take the smallest item of the heap so that sink() needs to return it back to the lowest level. Hence the algorithm takes $\Theta(n \log n)$ time.

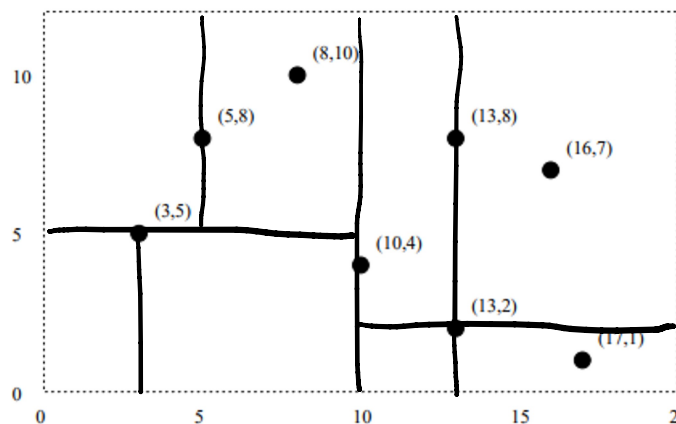
3.

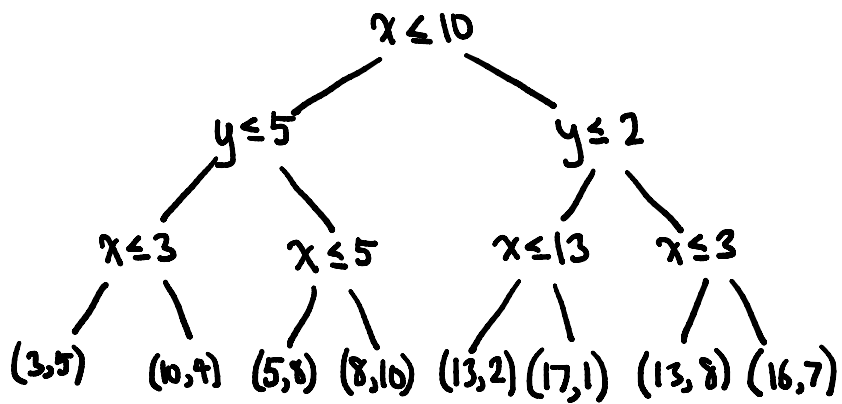
Search	DoNothing	MTF	MTM
Start	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4 5 6 7
4	i=4 1 2 3 4 5 6 7	i=4 4 1 2 3 5 6 7	i=4 1 4 2 3 5 6 7
2	i=2 1 2 3 4 5 6 7	i=3 2 4 1 3 5 6 7	i=3 1 2 4 3 5 6 7
7	i=7 1 2 3 4 5 6 7	i=7 7 2 4 1 3 5 6	i=7 1 2 7 4 3 5 6
7	i=7 1 2 3 4 5 6 7	i=1 7 2 4 1 3 5 6	i=3 1 7 2 4 3 5 6
Total comparisons	20	15	17

4.

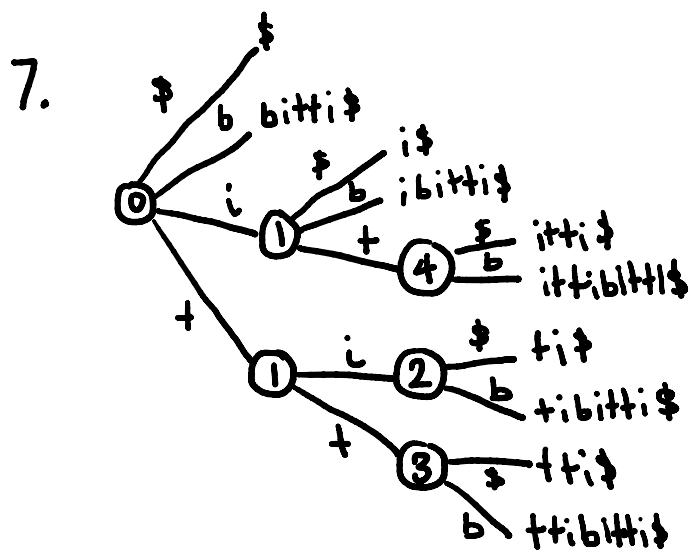
Didn't cover :P

5.





6. Didn't cover :P



b)

Dictionary

s	#(s)
A	65
B	66
C	67
D	68
...	...
AA	128
AB	129
BA	130
ABC	131
CC	132
CCA	133

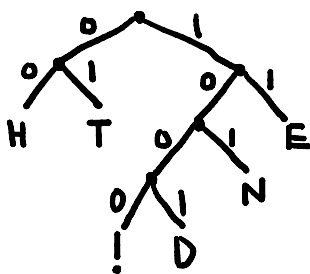
n	s _{new}	c	s _{old} + c	#assigned
65	A	-	-	-
65	A	A	AA	128
66	B	B	AB	129
129	AB	A	BA	130
67	C	C	ABC	131
132	CC	C	CC	132
131	ABC	A	CCA	133

10.

5	A											L	0
6	A											L	1
11	A											D	2
8	B											O	3
9	B											O	4
2	D											A	5
7	D											A	6
10	I											D	7
0	L											B	8
1	L											B	9
3	O											I	10
4	O	B	L	A	D	I	O	B	L	A	D	A	11

$(B, 4) \rightarrow (L, 1) \rightarrow (A, 6) \rightarrow (D, 7) \rightarrow (I, 10) \rightarrow (O, 5) \rightarrow (B, 8) \rightarrow (L, 9) \rightarrow (A, 5) \rightarrow (D, 2)$
 $\uparrow \quad \quad \quad \downarrow$
 $(O, 4) \quad \quad \quad (A, 11)$

11. a)



H: 00
 T: 01
 E: 11
 N: 101
 D: 1001
 !: 1000

$$\text{Total cost} = 6(2) + 5(2) + 9(2) + 4(3) + 2(4) + 1(4) = 64$$

b) 111 101 01 01 000 111 100 1101 0010 0011 101 000 11001

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12. a) P' occurs in T': This does not imply P occurs in T, since pattern matching can split the text at a location that is not the start of a character. Huffman encoding does not ensure the code does not contain invalid substrings.

P' does not occur in T': This implies P does not occur in T, since Huffman encoding is lossless.

b) P' occurs in T': This implies P occurs in T. Since each number encodes a unique sequence of characters, the same sequence of numbers encodes the same sequence of characters.

P' does not occur in T': This does not imply P does not occur in T. A sequence of characters can be contained in multiple code numbers, so LZW is not a one-to-one mapping.