COMP2009 2022-23 ADE CW TWO Answers and Feedback

QUESTION ONE (4 marks)

Answers

Graph A

Doubling,

Justification:

as the gap between resizes increases over time

OR

it is O(1)

Either answer, or similar, were acceptable.

Graph B

Incremental,

Justification:

as the gap between resizes is constant

OR

it is O(n)

Either answer, or similar, were acceptable.

FEEDBACK

Mean mark: 90%
Median mark 100%

Clearly few people had any trouble with this question
Note that the question was basically the same as the lab that was used for preparation for CW2.

QUESTION TWO 7 marks

Answers

Part a

Log_2 8 = 3 1 mark

COMMON ERROR: computing this incorrectly.
E.g. getting Log_2 8 = 4 - maybe because 8/2 = 4 ?

Case 1, so answer is C

COMMON ERROR: - A even after having said Case 1, which means the scaling is dominated by the recurrence term, which goes as n^3

SUGGESTION: If not totally sure about your log_b a computation, try just working out a few examples for the case when only the recurrence term is present – i.e. ignore the f(n) term.
In this case we can quickly get
T(2) = 8 T(2/2) = 8 = 2^3
T(4) = 8 T(4/2) = 8 T(2) = 8 ^ 2^3 = 4^3
So the recurrence on its own gives a n^3 scaling.

Part b

Case 2, so answer D

The two terms drive the same scaling, n^3, and so though they reinforce each other and we get an extra log.

Part c

Case 3, so answer E

Scaling is dominated entirely by the f(n) term, so can just ignore the recurrence term.

FEEDBACK

Mean	81%
Median	100%

Most people got this correct.
The most common error was miscomputing "log_b a"
MORAL It is worth taking a little extra time to get this correct.

QUESTION THREE (7 marks)

Answers

Part a

Index	0	1	2	3	4	5	6
Key	-	1	**5**	**3**	**7**	-	-

Just read top-to-bottom left to right (as standard in "The west").

Part b

1. Insert 4 as right child of 5
2. 4 < 5, so swap 4 and 5
3. 4 > 1, so no further changes

COMMON ERROR: using methods designed for a BST

Part c

1. Replace 1 with 5
2. 5 > 3 and 4 so swap with min of the children i.e. 3
3. No further changes needed

NOTE: A surprising number of people get the removeMin() incorrect ☹

ERROR: taking "last" to mean "most recent" – but this is not correct! – last means the last node when reading left-to-right top-to-bottom – or the last in the array.

FEEDBACK

Mean 76%
Median 86%

Most people got this correct.

QUESTION FOUR [7 marks]

Answer

Base case

$$T(4^0) = \frac{4^1 - 1}{3} = \frac{3}{3} = 1$$

COMMON ERRORS
not recognising that the base case needs k=0
simply writing the case T(1)=1 – which does not show that the exact formula is correct at n=1 and so is not part of an induction proof

Step case

EITHER: assume valid at k-1 and prove for k

Induction hypothesis $T(4^{k-1}) = \frac{4^k - 1}{3}$

then

$T(4^k) = 4T(4^{k-1}) + 1$ using recurrence and a little simplify

$= 4\left(\frac{4^k - 1}{3}\right) + 1$ using hypothesis

$= \frac{4^{k+1} - 4}{3} + \frac{3}{3}$ simplifying

$= \frac{4^{k+1} - 1}{3}$ as needed at k

OR assume valid at k and prove for k+1

Induction hypothesis $T(4^k) = \frac{4^{k+1} - 1}{3}$ as given on exam paper, so no need to write down

then

$T(4^{k+1}) = 4T\left(\frac{4^{k+1}}{4}\right) + 1$ using recurrence

$T(4^{k+1}) = 4T(4^k) + 1$ using simplify

$= 4\left(\frac{4^{k+1} - 1}{3}\right) + 1$ using induction hypothesis

$= \frac{4^{k+2} - 4}{3} + \frac{3}{3}$ rearranging

$= \frac{4^{(k+1)+1} - 1}{3}$ as needed for the hypotheses at k+1

FEEDBACK
Mean mark: 75%
Median mark 80%

COMMON ERRORS

Trying to work out some cases. This is not induction.

Giving some manipulations but with none of them using the recurrence relation itself. This clearly can never show that the candidate solution is indeed a solution of the recurrence relation.