Class participation Quiz 2

3 questions. 1 point each.

Q1. Given an array A which stores 0 and 1, such that each entry containing 0 appears before all those entries containing 1. In other words, it is like {0, 0, 0, ..., 0, 0, 1, 1, ..., 111}. Design an algorithm to find out the small index i in the array A such that A[i] = 1 using c log n instructions in the worst case for some positive constant c.

Q2. Theorem All horses are the same color

Proof by induction

Base Case: n = 1, then there is only one horse in the set, and it must consequently have the same color as itself.

Inductive Step: Let us assume for n ≥ 1 that all horses in a set of size n have the same color.

Conclusion: suppose we have a set of n + 1 horses: { h_1, h_2, ..., h_n, h_{n+1}}. We could break this up into to two sets, { h_1, h_2, ..., h_n} and { h_2, ..., h_n, h_{n+1}}. Each of these is a set of size n and thus all horses in each set, by assumption, are the same color. As there is an overlap between the two sets, it follows that all the horses in both sets must be the same color, and thus, all the horses in {h_1, h_2, ..., h_n, h_{n+1}} have the same color.

Hence Proved.

Choose the correct option:

A) This is plainly wrong. It can't be proved why. Everyone knows that all horses are not of the same color. But the math in the given proof is correct.

B) Induction is only useful for numbers.

C) This solution is wrong because induction is not an axiom

D) The proof given is wrong and the reasons described above are wrong. Now, the mistake in the proof is:

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Q3) a binary tree is a data structure that facilitates searching and inserting into a data set. A common problem that programmers encounter is to poorly balance a binary tree as shown in Fig 5.1. To fully understand the importance of balancing a binary tree, answer the following questions:

a) What is the worst case performance of finding an element in a balanced binary tree and of an extremely unbalanced binary tree* ? (in big-o-notation)

b) What data structure does an extremely unbalanced binary tree* resemble?

*extremely unbalanced tree means that all data points are always inserted into either the left or right of the data point before

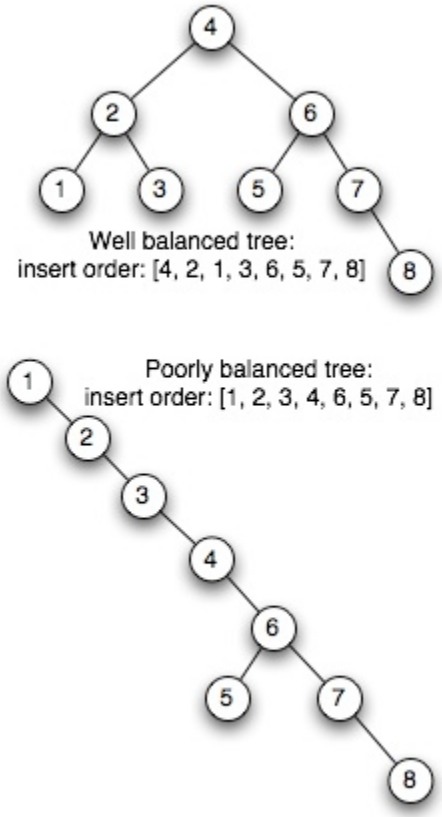

Fig 5.1: balanced vs unbalanced binary trees