CSCE 222-200 Discrete Structures for Computing

Fall 2024

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Assignment # 4

(Due October 24)

1. Give a recursive algorithm for finding the maximum value in an array $A[1..n]$, making use of the fact that the maximum in $A[1..n]$ is the larger of $A[n]$ and the maximum in $A[1..n-1]$. What is the time complexity of your algorithm in terms of big-O notation?

2. Consider the following two recursive algorithms for computing the function $H(n)$ for Hanoi Tower, where n is a positive integer and the function $H(n)$ is defined as $H(1) = 1$, and $H(n) = 2H(n-1) + 1$ for $n > 1$. What is the time complexity of each of these algorithms in terms of big-O notation?

Function $H_1(n)$
1. **if** $(n == 1)$ **then** return(1);
2. $h = H_1(n-1) + H_1(n-1) + 1$;
3. return(h).

Function $H_2(n)$
1. **if** $(n == 1)$ **then** return(1);
2. $h = 2 \cdot H_2(n-1) + 1$;
3. return(h).

3. In the following, $n \geq 2$ is an integer.
(a) How many different binary strings are there of length n?
(b) How many different binary strings are there of length not larger than n?
(c) How many different binary strings are there of length n that start with 1?

4. Give a formal proof for the following statement: for 145 people of different heights standing in a line, it is always possible to find 13 people (not necessarily consecutively) in the order they are standing in the line with heights that are either increasing or decreasing.

5. A *circular permutation* of n people is a seating of the n people around a circular table, where seatings are considered to be the same if they can be obtained from each other by rotating the table. How many different circular permutations are there for n people? Give an explanation on your answer.