Homework 7 sample solution

Due 09/21/16

September 15, 2016

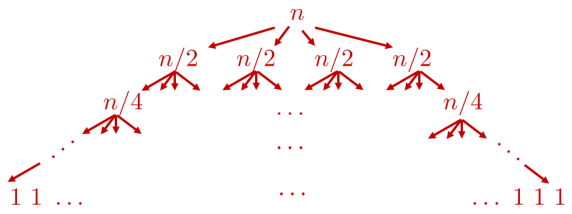
1. Find a recurrence $T(n)$ that describes the runtime of the RecursionMystery algorithm below:

```
   Input: data: array of integers
   Input: n: size of data
 1 Algorithm: RecursionMystery
 2 if n > 1 then
 3 |  min = max = 1
 4 |  for i = 2 to n do
 5 |  |  if data[i] < data[min] then
 6 |  |  |  min = i
 7 |  |  end
 8 |  |  if data[i] > data[max] then
 9 |  |  |  max = i
10 |  |  end
11 |  end
12 |  Swap data[1] and data[min]
13 |  if max > 1 then
14 |  |  Swap data[n] and data[max]
15 |  else
16 |  |  Swap data[min] and data[max]
17 |  end
18 |  if n > 2 then
19 |  |  Call RecursionMystery on data[2..n − 1]
20 |  end
21 end
22 return data
```

Answer: $T(n) = T(n-2) + \Theta(n)$

All lines other than the for loop and the recursive call on line 19 take $\Theta(1)$ time. The body of the for loop takes $\Theta(1)$ time, and it iterates $n = \Theta(n)$ times, for a total of $n\Theta(1) = \Theta(n)$ time. The recursive call is called on an array of size $n-2$, so it takes $T(n-2)$ time to return. In total, it takes $T(n-2) + \Theta(n)$ time to evaluate RecursionMystery on an input of size n.

2. Draw the recurrence tree that corresponds to the recurrence $T(n) = 4T(n/2) + \Theta(1)$.



Answer: 1 1 1 ... ... 1 1 1