Data Structures and Algorithms in Python

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Study Guide: Hints to Exercises

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Chapter 3 Algorithm Analysis

Hints

Reinforcement

R-3.1) Use powers of two as your values for n.

R-3.2) Set the running times equal, use algebra to simplify the equation, and then various powers of two to home in on the right answer.

R-3.3) Set both sides equal to each other to determine this.

R-3.4) Any growing function will have a "flatter" curve on a log-log scale than it has on a standard scale.

R-3.5) Think of another way to write $\log n^c$.

R-3.6) Characterize this in terms of the sum of all integers from 1 to n.

R-3.7) Use the fact that if $a < b$ and $b < c$, then $a < c$.

R-3.8) Simplify the expressions, and then use the ordering of the seven important algorithm-analysis functions to order this set.

R-3.9) Review the definition of big-Oh and use the constant from this definition.

R-3.10) Start with the product and then apply the definition of the big-oh for $d(n)$ and then $e(n)$.

R-3.11) Use the definition of the big-oh and add the constants (but be sure to use the right n_0).

R-3.12) You need to give a counterexample. Try the case when $d(n)$ and $e(n)$ are both $O(n)$ and be specific.

R-3.13) Use the definition of the big-oh first to $d(n)$ and then to $f(n)$ (but be sure to use the right n_0).

R-3.14) First show that the max is always less than the sum.

R-3.15) Simply review the definitions of big-oh and big-omega. This one is easy.

R-3.16) Recall that $\log n^k = k \log n$.

R-3.17) Notice that $(n+1) \leq 2n$ for $n \geq 1$.

R-3.18) $2^{n+1} = 2 \cdot 2^n$.

R-3.19) Make sure you don't get caught by the fact that $\log 1 = 0$.

R-3.20) Use the definition of big-omega, but don't get caught by the fact that $\log 1 = 0$.

R-3.21) Use the definition of big-omega, but don't get caught by the fact that $\log 1 = 0$.

R-3.22) If $f(n)$ is a positive nondecreasing function that is always greater than 1, then $\lceil f(n) \rceil \leq f(n) + 1$.

R-3.23) Consider the number of times the loop is executed and how many primitive operations occur in each iteration.

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R-3.25) Consider the number of times the inner loop is executed and how many primitive operations occur in each iteration, and then do the same for the outer loop.

R-3.26) Consider the number of times the inner loop is executed and how many primitive operations occur in each iteration, and then do the same for the outer loop.

R-3.27) Consider the number of times the inner loop is executed and how many primitive operations occur in each iteration, and then do the same for the two outer loops.

R-3.28) You can do all rows except for $n \log n$ just by setting the function equal to the value and solving for n. For the $n \log n$ function, the easiest technique is unfortunately to simply use trial-and-error on a calculator.

R-3.29) The $O(\log n)$ calculation is performed n times.

R-3.30) The $O(n)$ calculation is performed $\log n$ times.

R-3.31) Consider the cases when all entries of S are even or odd.

R-3.32) First characterize the running time of Algorithm D using a summation.

R-3.33) Discuss how the definition of the big-oh fits into Al's claim.

R-3.34) Recall the definition of the Harmonic number, H_n.

Creativity

C-3.35) Use sorting as a subroutine.

C-3.36) Note that 10 is a constant!

C-3.37) Think of a function that grows and shrinks at the same time without bound.

C-3.38) Use induction, a visual proof, or bound the sum by an integral.

C-3.39) 1

C-3.40) Use the log identity that translates $\log bx$ to a logarithm in base 2.

C-3.41) 1

C-3.42) Consider the sum of the maximum number of visits each friend can make without visiting his/her maximum number of times.

C-3.43) You need to line up the columns a little differently.

C-3.44) Characterize the number of bits needed first.

C-3.45) Consider computing a function of the integers in S that will immediately identify which one is missing.

C-3.46) Consider the first induction step.

C-3.47) Consider the contribution made by one line.

C-3.48) Look carefully at the definition of big-Oh and rewrite the induction hypothesis in terms of this definition.

C-3.49) Use the definition of big-omega, and make $n = 1$ and $n = 2$ your base cases.

C-3.49) Use the definition of big-Omega, and make $n = 1$ and $n = 2$ your base cases.

C-3.50) Consider writing a pseudo-code description of this algorithm and note its loop structure.

C-3.51) Try to bound from above each term in this summation.

C-3.52) Try to bound a significant number of the terms from below.

C-3.53) Number each bottle and think about the binary expansion of each bottle's number.

C-3.54) Use an auxiliary array that keeps counts for each value.

Projects

P-3.55) Choose representative values of the input size n, and run at least 5 tests for each size value n.

P-3.56) Try to reuse your code as much as possible.

P-3.57) You should try several runs over many different problem sizes.

P-3.58) Do a type of "binary search" to determine the maximum effective value of n for each algorithm.