Data Structures and Algorithms in Python

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Study Guide: Hints to Exercises

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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 $(n+1) \le 2n$ for $n \ge 1$.

- **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 $\lceil f(n) \rceil \le f(n) + 1$.
- **R-3.23**) Consider the number of times the loop is executed and how many primitive operations occur in each iteration.
- **R-3.24**) Consider the number of times the loop is executed and how many primitive operations occur in each iteration.
- **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.