

COP 3502 Recitation Sheet: Algorithm Analysis Problems

Directions: Each of these questions is from either a past Foundation Exam or one of my past exams. Since these are essentially mathematics problems, they are meant to just be solved on paper.

1) Querying a user in our data base of 10^4 users take 10 milliseconds. The runtime of the query is logarithmic with respect to the number of users. Namely, if there are n users, a query takes $O(\lg n)$ time. How many users can we support while taking no more than 20 milliseconds per query?

2) An algorithm to find a particular value among n total values takes $O(\log(n))$. On a data set with $n = 2^{30}$, it took 1.2 seconds to find the desired value. How many milliseconds will it take to find a value in a data set with $n = 2^{20}$? (Note: For ease of computation, you may use a logarithm with base 2.)

3) For a certain known data structure, a look up takes $O(\sqrt{n})$ time, where n is the number of stored items. For a data set of 8,000,000 items, the run time for a look up was approximately 10 ms. On a different data set, the look up took 40 ms. About how many **items** were stored in the second data set?

4) A sorting algorithm takes $O(n\sqrt{n})$ time to sort n values. The algorithm took .2 milliseconds to sort an array of 1000 values. How many **seconds** would it take to sort an array of size 900,000?

5) A backtracking solution took $O(n(k^n))$ time where n is the number of decisions, and k is the number of options for each decision. With $n=20$ and $k=1$, the time it took was 10 seconds. What is the expected time, in **seconds**, the solution will take to run on an input with 10 decisions ($n=10$), where each decision has 2 options ($k=2$)?

6) An algorithm to process input data about n cities takes $O(n!)$ time. For $n = 10$, the algorithm runs in 10 ms. How many **seconds** should the algorithm take to run for an input size of $n = 12$?

7) A program processing an array of size 100 took 50 ms to finish and on an array of size 1000 it took 75 ms to finish. What Big Oh runtime would be most reasonable for the program? (Hint: make a couple guesses to the function and see if those guesses are consistent with the run-times listed.)