CS 5300 Advanced Algorithms

HW # 1

1. Suppose computer A is running a sorting algorithm and it is supposed to sort an array of ten million numbers. Suppose that computer A executes a billion instructions per second, and suppose computer A requires $\mathbf{100}\boldsymbol{nlgn}$ instructions to sort n numbers. Find the time it takes computer A to sort the ten million numbers?
2. Suppose we are comparing implementations of insertion sort and merge sort on the same machine. For inputs of size n, insertion sort runs in $2n^2$ steps, while merge sort runs in $10nlgn$ steps. For which values of n does insertion sort beat merge sort?
3. Using the example we went over in the class as a model, illustrate the operations of insertion- sort on the array $A = < 3, 7, 5, 1, 8, 2, >$
4. Rewrite the INSERTION-SORT procedure to sort into non-increasing instead of non-decreasing order.
5. Use the top-down approach to illustrate the operations of merge-sort on the array $A = < 3{,}1, 15, 11{,}2, 7{,}15 >$. Use the notes discussed in class as a guide
6. Use the bottom-up approach to illustrate the operations of merge-sort on the array $A = < 3{,}1, 15, 11{,}2, 7{,}15 >$. Use the notes discussed in class as a guide
7. Illustrate the operations of merge on the array $A = < 3{,}7{,}11{,}2{,}5{,}16 >$. Use the notes discussed in class as a guide
8. Rewrite the MERGE procedure so that it does to use sentinels, instead stopping once either array L or R has had all its elements copied back to A and then copying the reminder of the other array back into A.
9. Express the function $\frac{n^3}{1000} - 100n^2 - 100n + 3$ in terms of Θ-notation.