CS 205: Algorithm design and analysis
Fall Term, 2024

Homework 1

Due: Tuesday 9/17 at 11:59pm

Complete the following. Submit using Google Classroom if at all possible in a format that is easy for the TAs to read such as Google Docs, PDF, Word documents, JPEG (e.g. a picture of a paper solution), or text files. The file(s) should be named based on your name as displayed in Google Classroom. If multiple files are used, please number them. If you are unable to use one of these formats, contact me directly.

1. (10 points) Show the contents of memory used to represent a constant-time initializable array (like those discussed in class) as the following operations are performed:

   - create array of size 7, initialized to 205
   - set the cell at index 0 to hold value 141
   - set the cell at index 4 to hold value 142
   - initialize to 220
   - set the cell at index 1 to hold value 208
   - set the cell at index 0 to hold value 214

   Use a special symbol (squiggle, x, $\emptyset$, ...) to denote memory that has not been initialized. Do not modify any memory address other than those required for the correctness of the algorithm (so some cells may be initialized, but still store "garbage"). Draw the state of the data structure after each operation in this sequence; I want 6 figures.

2. (10 points) Put the following functions into asymptotic order, smallest to largest:

   $$\log_2(n^3), \quad n^2, \quad 10^6, \quad \log_3 205, \quad 3^n, \quad 205n, \quad 4^{\log_2 n}, \quad \log_4 n$$

   Note which are asymptotically equal and which are different. For each pair of neighboring values (in the asymptotic order), include a brief justification for them being either the same or different.

3. (10 points) Let l_h be the number of leaves in the smallest AVL tree of height h. Use induction to prove that $l_h = F_{h+1}$.

4. (1 point) Add a statement of collaboration to the top of your submission. If you worked with other people or used materials other than our book and slides, the statement should identify them and explain the collaboration. If not, just say "I completed this on my own".