CSCI 3333 Homework: Heaps

**Problem 1.** *(Based on Book Exercise 6.2)* Show the min heap that results from inserting the following sequence of elements: 10, 12, 1, 14, 6, 5, 8, 15, 3, 9, 7, 4. Show the heap as both a tree and an array.

**Problem 2.** *(Based on Book Exercise 6.3)* Show the step-by-step result of calling `pop()` three times from the min heap resulting from Problem 1. Show the heap as both a tree and an array.

**Problem 3.** Suppose we wanted to implement a heap via a ternary approach (each node has up to three children).

- For a node at index $p$ in the array, what indices should contain $p$’s children?
- For a node at index $c$ in the array, what index should contain $c$’s parent?

**Problem 4.** *(Based on Book Exercise 6.1)* Consider implementing a min priority queue (not necessarily using a heap). Ignoring any time spent to allocate memory, is it possible to implement a min priority queue that has the following worst-case running times:

- $O(1)$ for `push()`, `front()`, and `pop()`?
- $O(1)$ for `pop()` and `front()`?
- $O(1)$ for `push()` and `front()`?
- $O(1)$ for `push()` and `pop()`?

For each answer, either describe why not or give a rough idea for an implementation.