CPS 130 Homework 9
Heaps, Heapsort

due Thu May 30th

Write and justify your answers in the space provided.[1]

1. (CLRS 6.1-1) What are the minimum and maximum number of elements in a heap of height h?

2. (CLRS 6.1-4) Where in a max-heap might the smallest element reside, assuming that all elements are distinct?

3. (CLRS 6.2-4) What is the effect of calling MAX-HEAPIFY(A, i) for $i > size[A]/2$?

[1]Collaboration is allowed, even encouraged, provided that the names of the collaborators are listed along with the solutions. Students must write up the solutions on their own.

4. (CLRS 6.5-3) Write pseudocode for the procedures HEAP-MINIMUM, HEAP-EXTRACT-MIN, HEAP-DECREASE-KEY and MIN-HEAP-INSERT that implement a min-priority queue with a min-heap.

5. (CLRS 6-2) *Analysis of d-ary heaps*
   A *d-ary heap* is like a binary heap, but instead of 2 children, nodes have d children.

   a. How would you represent a d-ary heap in a array?

   b. What is the height of a d-ary heap of n elements in terms of n and d?

   c. Give an efficient implementation of EXTRACT-MAX. Analyze its running time in terms of d and n.

   d. Give an efficient implementation of INSERT. Analyze its running time in terms of d and n.

   e. Give an efficient implementation of HEAP-INCREASE-KEY(A, i, k), which sets $A[i] \leftarrow \max(A[i], k)$ and updates the heap structure appropriately. Analyze its running time in terms of d and n.