CS 840 Assignment 1

Due October 8, 2020, via Dropbox on LEARN

Instructor: I. Munro

1. Consider the idea of using a hash function in the van Emde Boas “priority queue” to reduce the space requirements. Assume that hashing a key to a location takes O(1) time and space for the hash table is proportional to the size of the data entries and keys,. Take the scheme for hashing as a “black box”. How can you use such hashing to implement the van Emde Boas method efficiently?

   a. Outline your scheme, perhaps by showing how it differs from the standard version.

   b. Assuming the hashing works in constant time for an insert, delete or search, how much time is taken for each of the operations: insert, delete and successor.

   c. What is the space requirement of your method? Assume you have a universe of u elements and a word size of lg u bits. n elements are currently stored in the data structure.

   Refs:

   Peter van Emde Boas, R. Kaas, E. Zijlstra: Design and Implementation of an Efficient Priority Queue. Math. Syst. Theory 10: 99-127 (1977)

   Or

   Peter van Emde Boas: Preserving Order in a Forest in less than Logarithmic Time. FOCS 1975: 75-84

2. Read the Frigo et al paper and Erik Demaine’s survey of cache oblivious data structures. (Available through course website via my home page.) Pay particular attention to the Funnelsort algorithm or Brodal and Fagerberg’s “simplified” version. Describe, in your own words, one of these methods and comment of the difficulty of a clean implementation. (Especially in comparison with a more conventional method such multiway Mergesort)

   Refs:

   Gerth Stølting Brodal and Rolf Fagerberg. Funnelheap: a cache oblivious priority queue. In Proceedings of the 13thAnnual International Symposiumon Algorithms and Computation, volume 2518 of Lecture Notes in ComputerScience, pages 219-228

   Matteo Frigo, Charles E. Leiserson, Harald Prokop, and SridharRamachandran.Cache-obliviousalgorithms.In Proceedings of the 40thAnnual Symposium on Foundations of ComputerScience, pages285-297,NewYork,October 1999.

   Or

   Matteo Frigo, Charles E. Leiserson, Harald Prokop, Sridhar Ramachandran: Cache-Oblivious Algorithms. ACM Trans. Algorithms 8(1): 4:1-4:22 (2012)

   You should be able to access these papers through your access to a U Waterloo account.