CSCE-629 Analysis of Algorithms

Fall 2017

Instructor: Dr. Jianer Chen
Office: HRBB 315C
Phone: 845-4259
Email: chen@cse.tamu.edu
Office Hours: T,Th 2:00pm-3:30pm

Teaching Assistant: Qin Huang
Office: HRBB 315A
Phone: 402-6216
Email: huangqin@email.tamu.edu
Office Hours: T,Th 9:00am-12:00noon

Assignment # 5
(Due November 21, 2017)

1. Let G be a directed graph. The *component graph* G_c of G is a directed simple graph, defined as follows: (1) each vertex in G_c corresponds to a strongly connected component (scc) in G, and (2) there is an edge $[v, w]$ in G_c if and only if there are edges from the scc in G that corresponds to v to the scc in G that corresponds to w. Given an $O(n+m)$-time algorithm that on a directed graph G, constructs the component graph G_c of G.

2. Consider a hash table of size $m = 1009$ and the hash functions $h_1(k) = k \bmod m$ and $h_2(k) = \lfloor m \cdot ((k \cdot A) \bmod 1) \rfloor$, where $A = (\sqrt{5} - 1)/2$. Compute the locations to which the keys 61, 62, 63, 64, and 65 are mapped by each hash function.

3. Suppose that we are storing a set of n keys into a hash table of size m. Show that if the keys are drawn from a universe U with $|U| > nm$, then no matter what hash function h we use, U has a subset of size n consisting of keys that are all hashed by h to the same slot. Note that this shows that in the worst case, searching in a set of n keys by hashing can take time as bad as $\Theta(n)$.