

Name _____

CSC-477/677: Algorithm Analysis

Fall 2014

Homework #5

Due on: November 6, 2014

Q1 (Needs Programming). There are several versions of cuckoo hashing. The version we learned in class is probably the simplest, where there are two hash functions, and thus only two places where any given item could be stored in the table. Let us consider the set of keys to be printable ASCII strings of length no more than 80.

Let us consider the hash table size to be $tablesize = 17$.

Let us consider two hash functions, f_1 and f_2 . If key is the string representing the key, then let $keysize$ be the size of the string and $key[i]$ be the ASCII code of the $(i+1)^{th}$ character in the string key read from left to right: $key[0]$ is the leftmost character, $key[1]$ is the second leftmost character, etc..

Function f_1 computes first a large number then it brings the result into the proper range using the formulas below:

$$val = \sum_{i=0}^{keysize-1} key[i] \cdot 37^i$$

$$f_1 = val \% tablesize$$

If $f_1 < 0$ then $f_1 = f_1 + tablesize$

Function f_2 computes first a large number then it brings the result into the proper range using the formulas below:

$$val = \sum_{i=0}^{keysize-1} key[keysize - i - 1] \cdot 37^i$$

$$f_2 = val \% tablesize$$

If $f_2 < 0$ then $f_2 = f_2 + tablesize$

- a. Insert the strings: “Analysis of Algorithms”, “University of Nevada”, “Las Vegas”, “Howard R. Hughes”, “College of Engineering”, “Department of Computer Science”, “Dynamic Programming”, “Monge Properties”, “String Matching”, “Matrix Searching”, “Optimal Tree Construction”, “Online algorithms”, “emphasis on”, “Server Problem”, “Some related problem”, “Self-Stabilization”, “Quantum Nature of Universe”, “macroscopic quantum objects”, “Greatest mystery”, “In physics”, “astronomy are known”, “to science”, “Scientists believe”, “natural laws”, “A” into the hash table using f_1 for the first table and f_2 for the second table. Show the result of the insertion in the table below.

Name _____

	Table T1	Table T2
[0]		
[1]		
[2]		
[3]		
[4]		
[5]		
[6]		
[7]		
[8]		
[9]		
[10]		
[11]		
[12]		
[13]		
[14]		
[15]		
[16]		

Hint: consider a two-dimensional table of strings t , where $t[0]$ is T1 and $t[1]$ is T2. Consider a variable `index` that oscillates between 0 and 1 as it would have oscillated between T1 and T2. In C++, the value of `index` could be changed using the tertiary operator: `index = index ? 0 : 1`. Depending on the value of `index`, either apply hash function f_1 (`index == 0`) or f_2 (`index == 1`).

- b. Insert the strings “Analysis of Algorithms”, “University of Nevada”, “Las Vegas”, “Howard R. Hughes”, “College of Engineering”, “Department of Computer Science”, “Dynamic Programming”, “Monge Properties”, “String Matching”, “Matrix Searching”, “Optimal Tree Construction”, “Online algorithms”, “emphasis on”, “Server Problem”, “Some related problem”, “Self-Stabilization”, “Quantum Nature of Universe”, “macroscopic quantum objects”, “Greatest mysteries”, “In physics and”, “astronomy are known”, “to science”, “Scientists believe”, “natural laws” into the hash table using f_2 for the first table and f_1 for the second table. Show the result of the insertion in the table below.

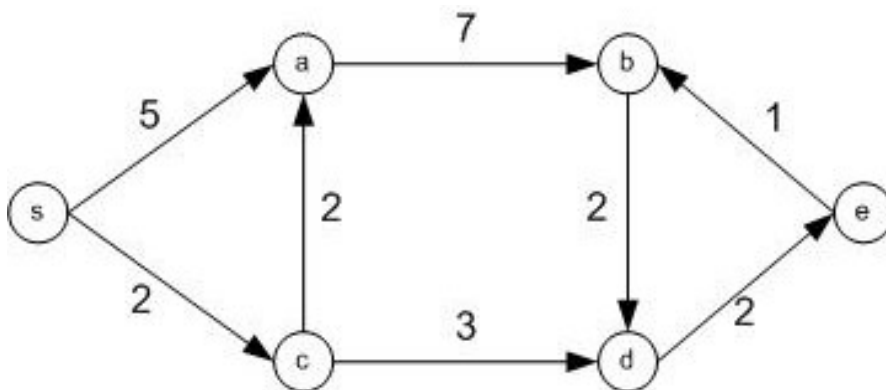
Table T1	Table T2
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Name _____

[0]		
[1]		
[2]		
[3]		
[4]		
[5]		
[6]		
[7]		
[8]		
[9]		
[10]		
[11]		
[12]		
[13]		
[14]		
[15]		
[16]		

Hint: consider a two-dimensional table of strings t , where $t[0]$ is $T1$ and $t[1]$ is $T2$. Consider a variable `index` that oscillates between 0 and 1 as it would have oscillated between $T1$ and $T2$. In C++, the value of `index` could be changed using the tertiary operator: `index = index ? 0 : 1`. Depending on the value of `index`, either apply hash function f_1 (`index == 1`) or f_2 (`index == 0`).

Q2. Consider the queue-based algorithm which visits all the vertices of the graph G reachable from node s in breadth-first order. Show the queue at each step.



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Answer:

Queue Q[1..7]

[1]	[2]	[3]	[4]	[5]	[6]	[7]

Q3. Consider a three-dimensional array $A[i,j,k]$ where $-2 \leq i \leq 9$, $4 \leq j \leq 12$, $0 \leq k \leq 15$. We consider the 3-D array A to be stored in column-major order. The first element $A[-2, 4, 0]$ is stored at memory location 1024. Each item has size three (3). What is the memory location of $A[3,9,4]$?
Note that all numerals are in base 10.

Answer: