HW4

50 points
Textbook Questions: 5.1 and 5.10
Due Monday, October 29th, 11:59pm, submitted on Canvas.

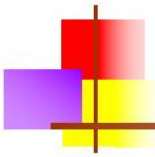
5.1 (30 points)

5.1 Given input {4371, 1323, 6173, 4199, 4344, 9679, 1989} and a hash function $h(x) = x \bmod 10$, show the resulting:
a. Separate chaining hash table.
b. Hash table using linear probing.
c. Hash table using quadratic probing.
d. Hash table with second hash function $h_2(x) = 7 - (x \bmod 7)$.

For d. Do not use their second hash function h2(x) = 7 - (x mod 7).
Use Double Hashing with Personalized Increment:

1 + x % 8 = PI (Personalized Increment)
x % 10 = table_location1, (if collision, find next table_location)
(table_location1 + PI) = table_location2, (if collision, find next table_location)...

As a reminder, here are the slides on Double Hashing with Personalized Increment



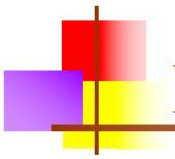
Double Hashing (Personalized Increment)

- For both linear and quadratic probing, the sequences checked are key independent.

Two different keys which hash to same location, keep competing.

IDEA: Have two functions, *Step* gives the increment for *Hash*.

- Define: Step(key) = 1 + key % (TABLESIZE - 2) – gives personalized increment.
- **Notice, the location of Step is never used directly as the hash value. It is only an auxiliary function.**
- If TABLESIZE and TABLESIZE–2 are primes, it works better.
- Hash(key) = key % TABLESIZE
- If Hash(key) is full, successively add increment as specified by Step(key).
- For example for key = 38 and TABLESIZE = 13 What is the series of locations probed?



Double Hashing

- For example for key = 38 and TABLESIZE = 13

  = 1 + 38 % 11 = 6 – gives personalized increment.
  = 38 % 13 = 12
  = (12 + 6) % 13 = 5
  = (5 + 6) % 13 = 11
  = (11 + 6) % 13 = 4
  = (4 + 6) % 13 = 10
  = (10 + 6) % 13 = 3
  = (3 + 6) % 13 = 9
  = (9 + 6) % 13 = 2
  = (2 + 6) % 13 = 8
  = (8 + 6) % 13 = 1
  = (1 + 6) % 13 = 7
  = (7 + 6) % 13 = 0
  = (0 + 6) % 13 = 6

- Notice how hash values jump around over the range of possible values at what appears to be random.
- Each of the probe sequences visits all the table locations if the size of the table and the size of the increment are relatively prime with respect to each other.

You can draw the 4 hash tables by hand, or in a spreadsheet, just make sure you submit a file that is easy for the grader to read.

5.10 (20 points)

5.10 What are the advantages and disadvantages of the various collision resolution strategies?

Write a short essay that compares: separate chaining hash table, hash table using linear probing, hash table using quadratic probing, hash table using double hashing, and cuckoo hashing.

Submit to Canvas:
Submit one zip file containing all your files. Please make your zip file well organized for the grader to easily navigate.

Grading Criteria:
5.1- 7 points for the first 3 hash tables. 9 points for the hash table using Double Hashing.

5.10- The Essay will be graded out of 20 points. I will be looking an understanding of each type of hash table, and the pros and cons of each.