

Kerry Ojakian's CSI 33 Class
Class Work #10

1. Suppose you want to store all five-letter words consisting of uppercase English letters in an array, using each word as a key. How many possible keys are there? Why would an array with one location for every possible key be wasteful if only 100 words are actually stored?

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2. A hash table has 10 locations, numbered 0 through 9. Use the hash function

$$H(k) = k \bmod 10.$$

Find the location assigned to each key: 17, 32, 45, and 60. Which keys cause a collision?

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3. Let the keys be ordered pairs (x, y) with $1 \leq x, y \leq 10$. Consider the hash function

$$H((x, y)) = xy \bmod 10.$$

Find the hash values of $(2, 3)$, $(1, 6)$, and $(3, 2)$. Identify any collision and explain why it occurs.

4. A hash table has 7 locations, numbered 0 through 6. Consider the hash function

$$H(k) = (2k + 1) \bmod 7.$$

Find the locations assigned to the keys 1, 2, 3, and 4. Does this hash function assign different locations to these keys?

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5. A hash table has 5 locations, numbered 0 through 4, and uses

$$H(k) = k \bmod 5.$$

Insert the keys 12, 7, and 22, using separate chaining to resolve collisions. Show the contents of each location after all insertions.

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6. A hash table has 7 locations, numbered 0 through 6. It uses $H(k) = k \bmod 7$ and resolves collisions by linear probing. Insert the keys 10, 17, and 24, in that order. Where does each key end up?
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7. An open-addressing hash table has 6 locations, and all 6 locations are occupied. What happens if you try to insert another key? Explain why.

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8. Two hash functions are used for the keys 10, 20, 30, and 40 in a table of length 10:

$$H_1(k) = k \bmod 10, \quad H_2(k) = k \bmod 7.$$

For each function, determine the locations of the four keys. Which function produces fewer collisions?