



Hashing

1. [TA] Insert the numbers 12, 18, 13, 2, 3, 23, 5, 15 into a hash-table using the hash function: $\text{key} \bmod 10$. First, use linear probing for addressing collisions and then use quadratic probing.
2. Insert the numbers 19, 27, 36, 10 into a hash-table using the double hashing technique where two hash functions are used: the primary function $h_1(x) = x \bmod 13$ and $h_2(x) = 7 - (x \bmod 7)$. In double hashing, we use the collective function in case of collisions:
 $h(x, i) = (h_1(x) + i * h_2(x)) \bmod 13$. We repeat by increasing i when collision is still present.
3. Show why in case of a deletions from a hash-table (the one discussed in lecture), one has to indicate that the position, where the target value to be deleted resides, was occupied before.
4. Given an integer array A of size N , find the first repeating element in it. We need to find the element that occurs more than once and whose index of first occurrence is smallest. Indicate that if there is no repeating element.
5. [TA] Given an unsorted array, find all pairs of numbers that the sum of each pair is equal to a certain target value in $\mathcal{O}(n)$ time. (Hint: use a hash-table)
6. Given n points on a 2D plane as pairs of (x, y) co-ordinates, we need to find maximum number of points which lie on the same line. Consider that the slope between two points (x_1, y_1) and (x_2, y_2) is equal to $(y_2 - y_1) / (x_1 - x_2)$. You may use a hash-map (with keys and values) and it is fine to do the task in $\mathcal{O}(n^2)$.
7. [TA] Given an unsorted array of duplicate numbers, find the K most frequent numbers in $\mathcal{O}(n)$ time. You may use extra $\mathcal{O}(n)$ space. For example, for the list of numbers 4, 2, 2, 4, 3, 2, 3, 1 and $K = 2$, the K most frequent numbers are 4 and 2 and for $K = 3$, the K most frequent numbers are 4, 2 and 3. (Hint: use a hash-table and an auxiliary array)
8. Given an array of integers, check, in $\mathcal{O}(n)$ if the array is formed by consecutive integers. For example, the list of numbers -5, 0, 4, -4, 1, 2, 3, -3, -2, -1 is a list formed by consecutive integers while the lists of numbers 1, 2, 2, 3 and -1, 0, 8 and are not formed by consecutive integers.

Good Luck