

#### Situation 1: Sorted

For the first situation, the points needed to play the arcade games are given in are already sorted. To ensure a runtime of  $O(N)$  for the solution, a two pointer tracker is used to navigate the array. There are two trackers, one tracker set to 0, to indicate the start of the array, while another tracker is set to the array length minus 1, to ensure there are no out of bounds issues. Using a while loop, there are three conditions to acquire the correct result. First if sum is equal to target and the two values of the array are not equal to each other. Set the class arcadeInfo lower equal to the lower array value and arcadeInfo Higher to the higher array value or do the opposite. Then if the value of the array at the first tracker is less than the value of the array at the second tracker increment the first tracker by one. If the reverse is true, decrement the value by 1. By using this method the array is traversed through only once while updating the trackers as needed, this will guarantee a  $O(N)$  runtime as the same array is not traversed multiple times.

#### Situation 2: Unsorted

In situation 2 the points needed to play the arcade games at Knights Arcade are given unsorted. In order to get an  $O(n)$  runtime a hash set is implemented in order to insert and lookup the values of the arcade game's points. Placing items into a hash set is always  $O(1)$  during each insertion, for each lookup called in the hash set is also  $O(1)$ . After all of the values are inserted into the hash set a for loop is called to traverse through each value in the hash set. Each value in the hash set is subtracted from the amount of tickets needed and then passed into hash set contains. If hash set the contains returns true and the current value of the hash set is not equal to the remaining tickets needed, the appropriate values are updated, the hash set is cleared, and then break is called to leave the loop. Since each value in the hash set is only checked once this will cause an  $O(N)$  runtime due to only check if the remaining amount of points needed exist in the hash set.