# Find Pair Matching Sum

Source: <https://www.youtube.com/watch?v=XKu_SEDAykw>

Description:

You have a collection of numbers, and a sum s. Find a pair in the collection of numbers whose sum equals s.

Constraints:

* What type of numbers? Integers
* Size of collection? At least 2
* Does a matching pair always exist? Not necessarily
* Size of the collection of numbers? n
* What does the method need to output? Only if there exists a matching pair, or the matching pair itself? If there exists a pair, it should return the pair.
* What's the range of the numbers? Can be anything

Brute force:

* Take the sum of all possible pairs of numbers and check if it equals the sum s
* Complexity (worst case): for each of the n numbers, we combine it with at most n-1 other numbers. So the complexity is O(n^2)

Optimised:

* Iterate through the numbers and save each number read in a ~~hash table~~ it can just be a set
* For each number i read, check if the number sum-i exists in the hash table
  + If yes, then the sum of number 'i' and this number in the hash table equals 'sum', and we have found a pair
  + Else, store the number i in the hash table
* Complexity:
  + We iterate through the numbers once
  + Insert and lookup in a hash table are constant time
  + Thus, the time complexity is O(n)
  + The space complexity is O(n), because we need a hash table of the same size as the collection of numbers

Implementation:

import java.util.Set;

import java.util.HashSet;

class PairSum {

public static void main(String[] args) {

int[] numbers = new int[args.length-1];

for (int i = 0; i < args.size-1; i++) {

numbers[i] = Integer.parseInt(args[i]);

}

int sum = Integer.parseInt(args[args.length-1]);

Pair pair = findPair(numbers, sum);

if (pair == null) System.out.println("none");

else System.out.println(pair);

}

private static Pair findPair(int[] numbers, int sum) {

Set<Integer> seen = new HashSet<Integer>();

for (int i : numbers) {

if (seen.contains(sum-i)) return new Pair(i, sum-1);

seen.add(i);

}

return null;

}

class Pair {

public int x;

public int y;

public Pair(int x, int y) {

this.x = x;

this.y = y;

}

public String toString() {

return x + ", " + y;

}

}

}