

Exercise: write a function that takes an integer "target"  $x$  and a vector of integers  $V$  and answers the question:  $\exists a, b \in V$  s.t.

(Translation to English: "Does there exist two elements  $a, b$  in  $V$  such that  $a+b=x$ ?" )

Idea: "brute force". We'll check, for each  $a \in V$  if any  $b = x - a$ . (so that  $a+b=x$ )

Conceptually, look at the space  $V \times V = \{(v_1, v_2) \mid v_1, v_2 \in V\}$ :

Say  $V$  has 4 elements:

(Notation: write  $V[i] \equiv v_i$ )

$V \times V$ :

$(v_0, v_0)$	$(v_0, v_1)$	$(v_0, v_2)$	$(v_0, v_3)$
$(v_1, v_0)$	$(v_1, v_1)$	$(v_1, v_2)$	$(v_1, v_3)$
$(v_2, v_0)$	$(v_2, v_1)$	$(v_2, v_2)$	$(v_2, v_3)$
$(v_3, v_0)$	$(v_3, v_1)$	$(v_3, v_2)$	$(v_3, v_3)$

Print all ordered pairs:

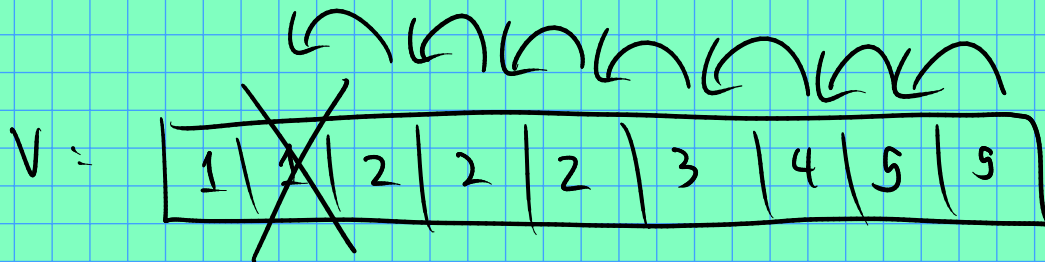
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for (i=0; i < V.size(); i++) {  
    for (j=0; j < V.size(); j++) {  
        cout << "(" << V[i] << ", " << V[j] << ") ";  
    }  
    cout << "\n";  
}
```

Note: for our problem, only need to go through  $\approx 1/2$  the entries:

$(v_0, v_0)$	$(v_0, v_1)$	$(v_0, v_2)$	$(v_0, v_3)$
$(v_1, v_0)$	$(v_1, v_1)$	$(v_1, v_2)$	$(v_1, v_3)$
$(v_2, v_0)$	$(v_2, v_1)$	$(v_2, v_2)$	$(v_2, v_3)$
$(v_3, v_0)$	$(v_3, v_1)$	$(v_3, v_2)$	$(v_3, v_3)$

for this, just start  $j=i$  for the inner for-loop!

Another exercise from last time: make a sorted vector to have unique elements, and do so "in-place".



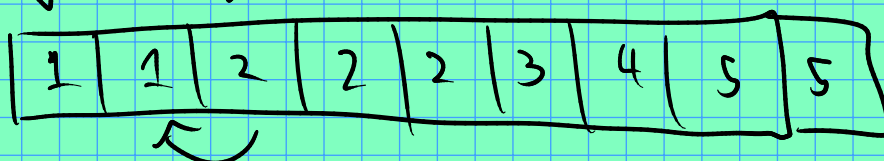
Say  $n = V.size()$ . This process would take

$$(n-1) + (n-2) + (n-3) + \dots + 1$$

$$= \frac{n(n-1)}{2} \approx n^2$$

last unique item  
↓

"next candidate"  
↓



$\approx n$  steps!