Use cases of Map / set

- Search in O(1)
- Count queries / Key-value

Queries

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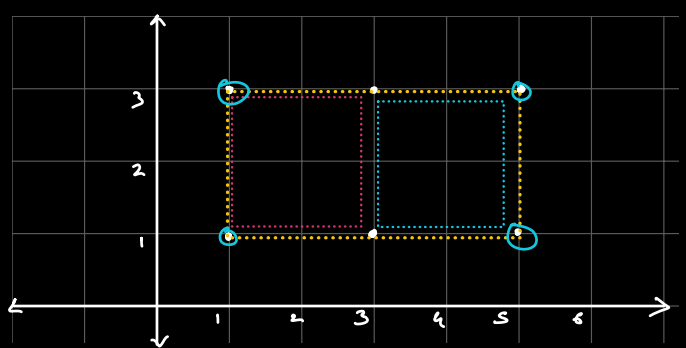
Q. Given N points in a 2D plane. (x,y)

How many rectangles can be created that have
- 2 sides parallel to x-axis
- & 2 sides parallel to y-axis



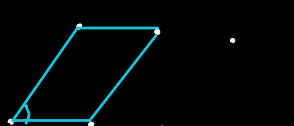
⇒ 3

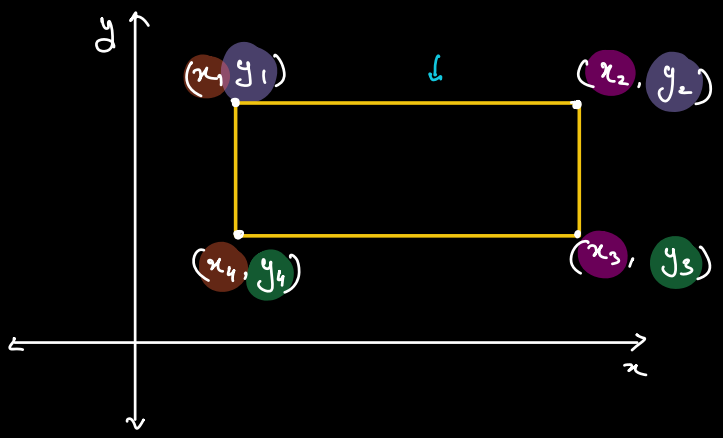
A : [[1,1], [1,3], [5,3], [3,1], [3,3], [5,1]]

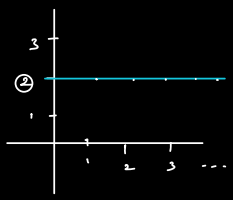
OR

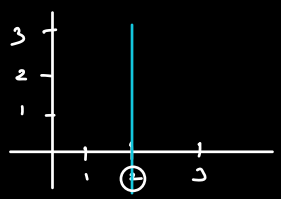
X : [1 , 1 , 5 , 3 , 3 , 5]

Y : [1 , 3 , 3 , 1 , 3 , 1]









Parallel to x-axis ⟶ y is cont. ⇒ $x_1 == x_4$, $x_2 == x_3$, $y_1 == y_2$, $y_4 == y_3$

Parallel to y-axis ⟶ x is cont.

Brute force

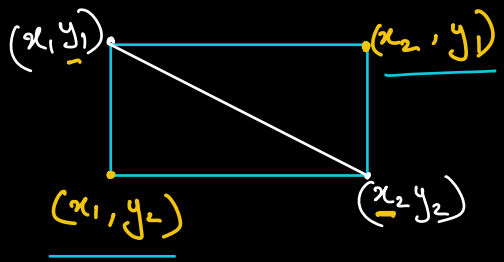
Iterate over all set of 4 co-ordinates ⇒ $O(N^4)$

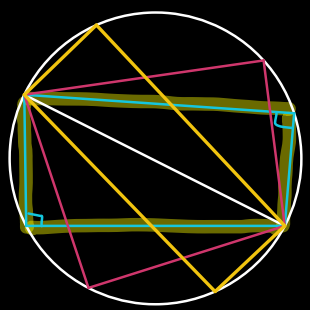
if ($x_1 == x_4$, $x_2 == x_3$, $y_1 == y_2$, $y_4 == y_3$ is true)

Count ++;

TC : $O(N^4)$

SC : $O(1)$





If (x_1, y_1) & (x_2, y_2) are diagonally opposite co-ordinates of a rectangle

OR

TL & BR of a rectangle

then there must exist two points (x_1, y_2) & (x_2, y_1) in the array.

Store all co-ordinates in Set/Map

Iterate over all pairs of points (x_1, y_1) (x_2, y_2) $\Rightarrow O(N^2)$

(Considering them as TL & BR)

only if $((x_1 != x_2)$ && $(y_1 != y_2))$ {

// [Search] if other co-ordinates are present $[(x_1, y_2), (x_2, y_1)]$

if (Set.contains (x_1, y_2) && Set.contains (x_2, y_1)){

count + 1;

} }

TC : $O(N^2)$

SC : $O(N)$

TC: $O(N^4)$ → $O(N^2)$

SC: $O(1)$ → $O(N)$

A : [[1,1], [1,3], [5,3], [3,1], [3,3], [5,1]]

S : {[1,1], [1,3], [5,3], [3,1], [3,3], [5,1]}

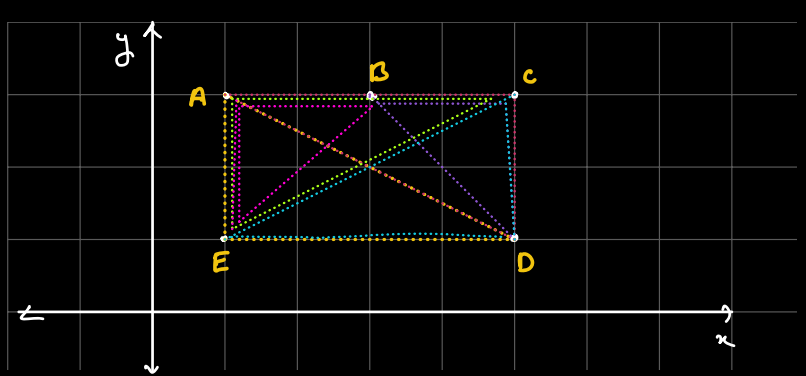
[1,3] ⇒ "1_3" [x_y]

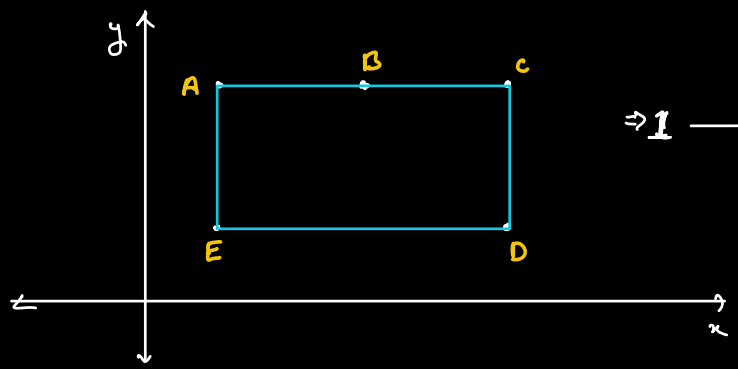
Todo :
- Edge cases
- Creating hashMap / set for objects of user defined classes

Google

Q Given N points in a 2-D plane.
Count the no of right angled triangles for which,
One non-hypotenuse side is parallel to x-axis
& the other non-hypotenuse side is parallel to y-axis.

AED
ACD
BCD
CDE ⇒ 6
ACE
EAB





⇒ 1 ⟶ 2

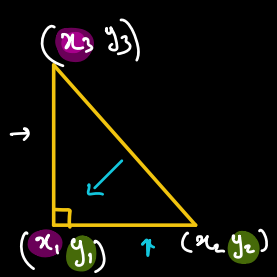
$(x_1 == x_3) \&\& (y_1 == y_2)$

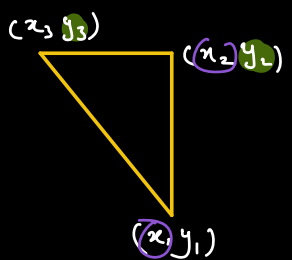
OR

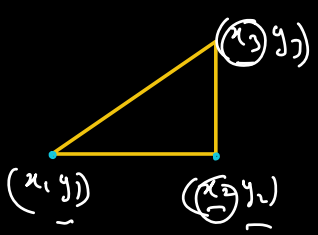
$(x_1 == x_2) \&\& (y_3 == y_2)$

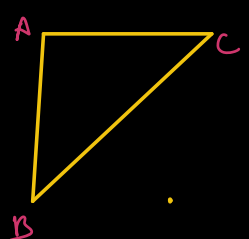
OR

$(x_2 == x_3) \&\& (y_1 == y_2)$









A

(1, 1)

(x_1, y_1)

B

(5, 1)

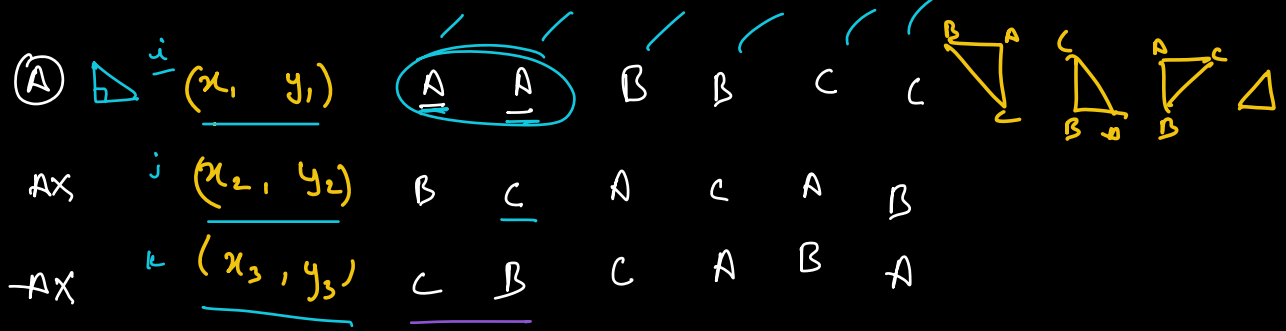
(x_2, y_2)

C

(5, 4)

(x_3, y_3)

A B C

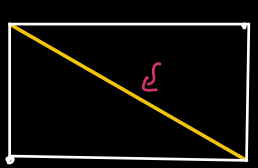


Loops

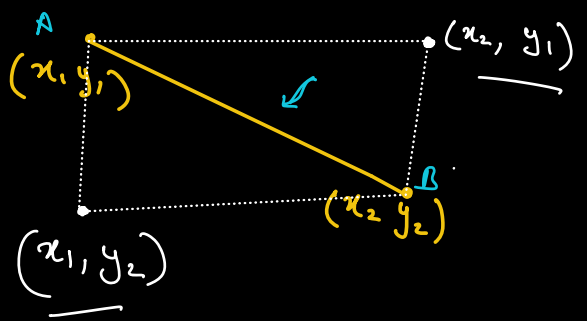
```
for(i=0; i<N; i++){ ⟶ (x1, y1)
    for(j=0; j<N; j++){ ⟶ (x2, y2)
        if(i == j) continue;
        for(k=0; k<N; k++){ ⟶ (x3, y3)
            if(i==k || j==k) continue;
            if(X[i] == X[k] &&
               Y[i] == Y[j]){
                count++;
            }
        }
    }
}
```

TC : $O(N^3)$

SC : $O(1)$



Iterate over all pairs of co-ordinates (x_1, y_1), (x_2, y_2)

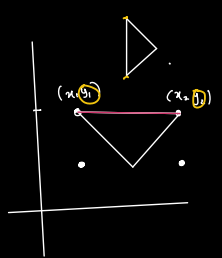


- if (x_1, y_2) is present → Count ++
- if (x_2, y_1) is present → Count ++

X[], Y[]

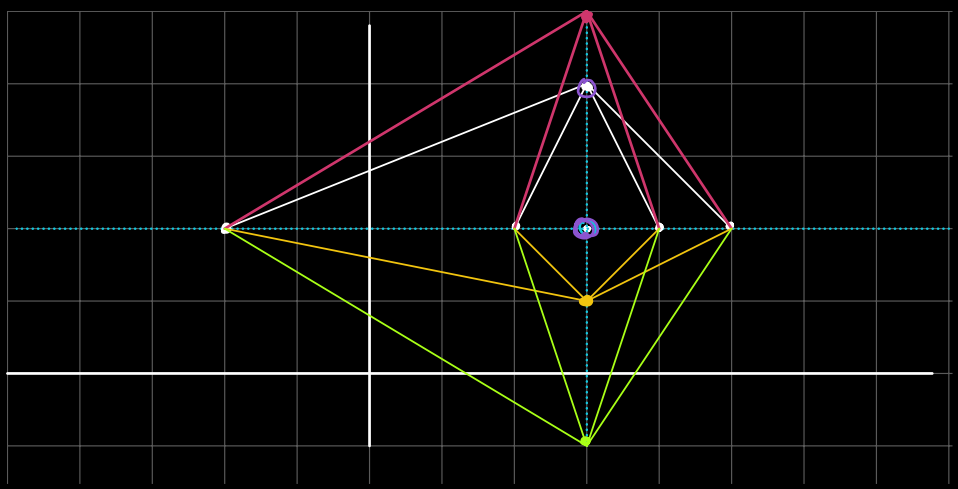
// Insert all the co-ordinates in a Set → S O(N)

```
for(i=0; i<N; i++) {  ---> (x1, y1)
    for(j=i+1; j<N; j++) {  ---> (x2, y2)
        if(X[i]==X[j] || Y[i]==Y[j]) Common
            if(S.contains(X[i], Y[j]))
                Count++;
            if(S.contains(X[j], Y[i]))
                Count++;
    }
}
```



TC : $O(N^2)$

SC : $O(N)$



For (x, y)

If there are

n points having same x co-ordinate $(x, -)$

m points having same y co-ordinate $(-, y)$

No. of rt angled $\triangle$ having rt $\angle$ at (x, y)

$= n \times m$? $(n-1) \times (m-1)$

A : (1, 3)
B : (2, 3)
C : (3, 3)
D : (3, 1)
E : (1, 1)

x map

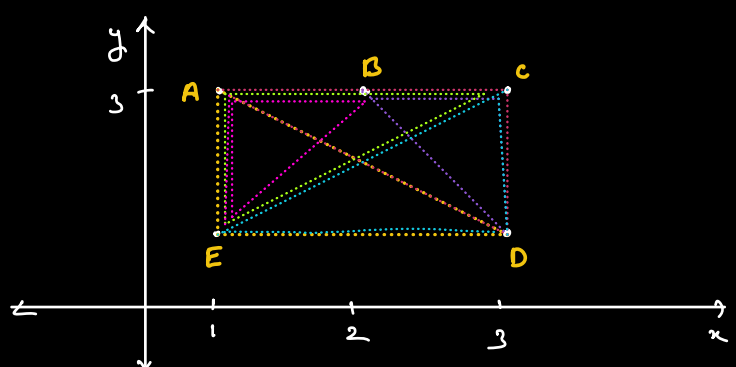
x	freq (x)
1	2
2	1
3	2

y map

y	freq (y)
3	3
1	2

(x, y)	No of points with Same x	No of points with Same y	No of Δ (n-1) × (m-1)
A (1,3)	2	3	~~6~~ 2
B (2,3)	1	3	~~3~~ 0
C (3,3)	2	3	~~6~~ 2
D (3,1)	2	2	~~4~~ 1
E (1,1)	2	2	~~4~~ 1

Σ : ~~23~~ 6



HashMap < x_i , freq(x_i) > xMap ; → O(N)

HashMap < y_i , freq(y_i) > yMap ; → O(N)

TC : O(N)
SC : O(N)

```
ans = 0
for (i = 0; i < N; i++)
    n = xMap.get(X[i]);
    m = yMap.get(Y[i]);
    ans += (n-1) * (m-1);
}
ret ans.
```

TC O(N^3) → O(N^2) → O(N)

SC O(1) → O(N) → O(N)

Q Given a large Text & a small string (pattern)
Count the no of occurences of the pattern in the Text.

Text : abcxycl mo xycl j P Q xyc m K r t xycl
Pattern : xycl → M
↳ N

⇒ 3

O(NM)
O(N+M)