How to check if two given line segments intersect?

Given two line segments (p1, q1) and (p2, q2), find if the given line segments intersect with each other.

Before we discuss solution, let us define notion of **orientation**. Orientation of an ordered triplet of points in the plane can be

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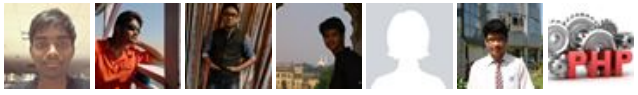

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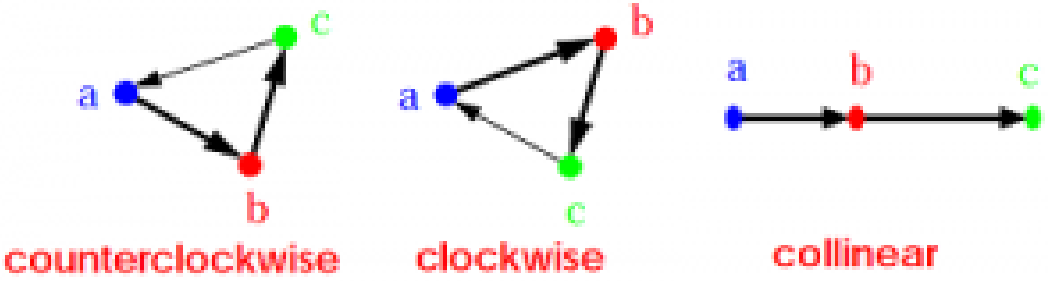
–counterclockwise

–clockwise

–colinear

The following diagram shows different possible orientations of (a, b, c)



How is Orientation useful here?

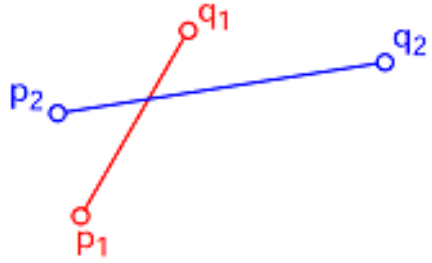
Two segments (p1,q1) and (p2,q2) intersect if and only if one of the following two conditions is verified

1. *General Case:*

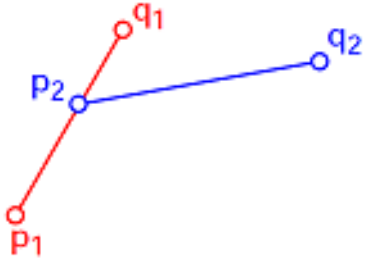
– (p1, q1, p2) and (p1, q1, q2) have different orientations and

– (p2, q2, p1) and (p2, q2, q1) have different orientations.

Examples:



Example 1: Orientations of (p1, q1, p2) and (p1, q1, q2) are different. Orientations of (p2, q2, p1) and (p2, q2, q1) are also different



Example 2: Orientations of (p1, q1, p2) and (p1, q1, q2) are different. Orientations of (p2, q2, p1) and (p2, q2, q1) are also different

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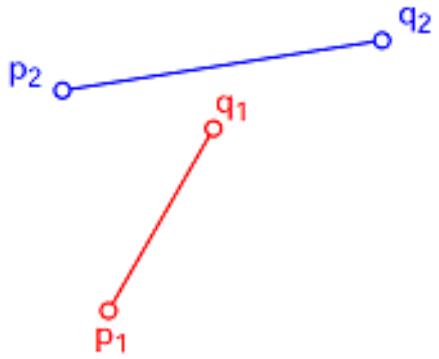
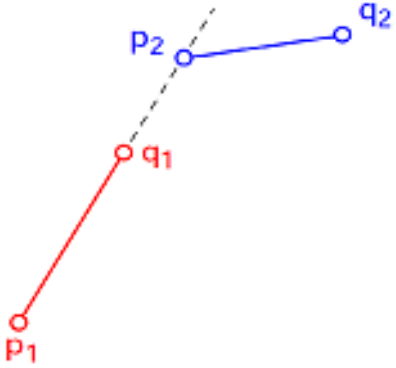


Example 3: Orientations of (p1, q1, p2) and (p1, q1, q2) are different. Orientations of (p2, q2, p1) and (p2, q2, q1) are **same**



Example 4: Orientations of (p1, q1, p2) and (p1, q1, q2) are different. Orientations of (p2, q2, p1) and (p2, q2, q1) are **same**

2. *Special Case*

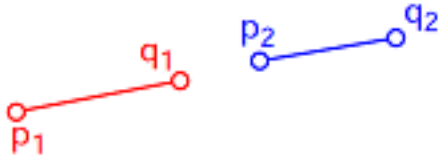
– (p1, q1, p2), (p1, q1, q2), (p2, q2, p1), and (p2, q2, q1) are all collinear and

– the x-projections of (p1, q1) and (p2, q2) intersect

– the y-projections of (p1, q1) and (p2, q2) intersect

Examples:

Example 1: All points are colinear. The x-projections of (p1, q1) and (p2, q2) intersect. The y-projections of (p1, q1) and (p2, q2) intersect



Example 2: All points are colinear. The x-projections of (p1, q1) and (p2, q2) do not intersect. The y-projections of (p1, q1) and do not (p2, q2) intersect

Following is C++ implementation based on above idea.

```
// A C++ program to check if two given line segments intersect
#include <iostream>
```

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```
using namespace std;

struct Point
{
    int x;
    int y;
};

// Given three colinear points p, q, r, the function checks if
// point q lies on line segment 'pr'
bool onSegment(Point p, Point q, Point r)
{
    if (q.x <= max(p.x, r.x) && q.x >= min(p.x, r.x) &&
        q.y <= max(p.y, r.y) && q.y >= min(p.y, r.y))
       return true;

    return false;
}

// To find orientation of ordered triplet (p, q, r).
// The function returns following values
// 0 --> p, q and r are colinear
// 1 --> Clockwise
// 2 --> Counterclockwise
int orientation(Point p, Point q, Point r)
{
    // See http://www.geeksforgeeks.org/orientation-3-ordered-poi
nts/
    // for details of below formula.
    int val = (q.y - p.y) * (r.x - q.x) -
              (q.x - p.x) * (r.y - q.y);
```


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heisenberg 3*3 + 5*5 + 6*6 = 70

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```
    if (val == 0) return 0;  // colinear

    return (val > 0)? 1: 2; // clock or counterclock wise
}

// The main function that returns true if line segment 'p1q1'
// and 'p2q2' intersect.
bool doIntersect(Point p1, Point q1, Point p2, Point q2)
{
    // Find the four orientations needed for general and
    // special cases
    int o1 = orientation(p1, q1, p2);
    int o2 = orientation(p1, q1, q2);
    int o3 = orientation(p2, q2, p1);
    int o4 = orientation(p2, q2, q1);

    // General case
    if (o1 != o2 && o3 != o4)
        return true;

    // Special Cases
    // p1, q1 and p2 are colinear and p2 lies on segment p1q1
    if (o1 == 0 && onSegment(p1, p2, q1)) return true;

    // p1, q1 and p2 are colinear and q2 lies on segment p1q1
    if (o2 == 0 && onSegment(p1, q2, q1)) return true;

    // p2, q2 and p1 are colinear and p1 lies on segment p2q2
    if (o3 == 0 && onSegment(p2, p1, q2)) return true;
```

YashLet us suppose we have a single element array...

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Mussab ElDash Unfortunately this test case fails it root =...

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Mussab ElDash I guess this code needs modification else...

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Puneet Singh if(fibMMm1 && arr[offset+1]==x)return offset+1;...

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```
     // p2, q2 and q1 are colinear and q1 lies on segment p2q2
    if (o4 == 0 && onSegment(p2, q1, q2)) return true;

    return false; // Doesn't fall in any of the above cases
}

// Driver program to test above functions
int main()
{
    struct Point p1 = {1, 1}, q1 = {10, 1};
    struct Point p2 = {1, 2}, q2 = {10, 2};

    doIntersect(p1, q1, p2, q2)? cout << "Yes\n": cout << "No\n";

    p1 = {10, 0}, q1 = {0, 10};
    p2 = {0, 0}, q2 = {10, 10};
    doIntersect(p1, q1, p2, q2)? cout << "Yes\n": cout << "No\n";

    p1 = {-5, -5}, q1 = {0, 0};
    p2 = {1, 1}, q2 = {10, 10};
    doIntersect(p1, q1, p2, q2)? cout << "Yes\n": cout << "No\n";

    return 0;
}
```

Output:

```
No
Yes
No
```


- Median of two sorted arrays
- Topological Sorting
- Intersection point of two Linked Lists
- Lowest Common Ancestor in a BST.
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http://www.dcs.gla.ac.uk/~pat/52233/slides/Geometry1x1.pdf

Introduction to Algorithms 3rd Edition by Clifford Stein, Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest

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Raghav Dua • a day ago

Could anyone please explain to me how the onSegment () functio
p = (3, 3) r = (10, 10) q = (7, 5)
The function suggests that q DOES exist on the line since 7 <= 1(
According to my understanding, this function classifies all the poir
& r as lying on the line segment pr.
I could be wrong, so I'd appreciate if anyone could clear this doubt

^ | v • Reply • Share ›

Amar Yadav • 9 days ago

In OnSegment(p,q,r) , checking only if one of x or y co-ordinates c
do the job .

^ | v • Reply • Share ›

Billionaire • 3 months ago

https://www.topcoder.com/commu...

The top coder explanation is better

1 ^ | v • Reply • Share ›

ddd • 4 months ago

val is the twice the (signed) area of the triangle determined by p,q,
The area is zero iff the three points are collinear. The area is posit
are in clockwise order, negative if in anticlockwise order.

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Shantanu • 4 months ago

https://ideone.com/Qkg7A8

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Baba Shantanu • 3 months ago

Plz explain the Logic...

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Shantanu Baba • 3 months ago

apply your basic mathematics and find slope of line

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amn Shantanu • 20 days ago

Check this input; It returns Yes, but this two

struct Point x1 = {482, -246}, y1 = {736, 176

struct Point x2 = {832, -138}, y2 = {1282, -3

Your algorithm works fine for lines intersect

Reply • Share ›

Shantanu amn • 20 days ago

Ya I have consider straight line of infinite ler

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Garvit • 5 months ago

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A simpler version of the above program!

https://ideone.com/fGDEN0

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Deepak Sharma • 5 months ago

This explains much better.
https://users.cs.fiu.edu/~giri...

1 Reply • Share ›

Klaus Deepak Sharma • 5 months ago

Thanks for the Link.It is very nice.

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Vivek Kumar • 5 months ago

A simple solution just checks intersection point of two lines are in
http://ideone.com/dVb3K4

Reply • Share ›

basaisehi Vivek Kumar • 5 months ago

hi...
i think its better to not use division in this problem as it wou
suggested by Deepak Sharma says).
So this method is better than finding the intersection of two

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Hung • 5 months ago

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I don't know what I concern is unecessary or not but I feel like in d
case when 4 points are collinear and they don't have any segmen
Adding
if (o1 == o2 && o2 == o3 && o3 == o4) return true; may sound go
segment

• Reply • Share ›

sairam • 6 months ago

let line segment be AB and CD
find the line equations and find intersection point if exists
if the intersection point lies between both A, B and C,D then lines

• Reply • Share ›

acodebreaker • 6 months ago

here is the better version of this
your code is a shit

http://ideone.com/0uZfKE

i have to handle only these cases separately
when lines donot cross and just touch
when points are collinear

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Krishna Kumar • 6 months ago

I think, if we just calculate the slope of two lines and compare both
will intersect or not.

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Using the m = (y2-y2)/(x2-x1)
We need to handle certain cases like 0 and 180 slopes will not int

Somebody please let me know if this solution will not work.

• Reply • Share ›

name Krishna Kumar • 6 months ago
The solution works but for a different question . Read the c

• Reply • Share ›

Krishna Kumar name • 6 months ago
Ok, got it, thanks for clarification.

• Reply • Share ›

codelearner • 6 months ago
in code of special case , in case 2 comments , it should be p1,q1,

• Reply • Share ›

rama.rajesh100120@gmail.com • 6 months ago
Hi, for the following input
p1 = {13688, 13706}, q1 = {41866, 13706};
p2 = {1014, 2820}, q2 = {1014, 73427};
it says that the line segments intersect but when I plot them on the
that they don't.

• Reply • Share ›

Ved Sinha • 7 months ago

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Prasenjit Mondal • 8 months ago

onSegment implementation is wrong. It considers parallel lines als
and close to the line.

The point is on the line segment or not can be checked using seve
1) Using line equation
2) Using linear interpolation technique
3) Using dot product
4) Calculating length of the two segments and sum must be equa

Admin please correct the post.

• Reply • Share ›

Amar Vashishth Prasenjit Mondal • 7 months ago

no, its correct

• Reply • Share ›

gaurav Prasenjit Mondal • 8 months ago

we are going for onSegment(..) checking only if points are
End points of two parallel line segments are not co-linear .

• Reply • Share ›

Abhishek • 10 months ago

How does below code confirms whether a point falls on a line seg

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// Given three collinear points p, q, r, the function checks if

// point q lies on line segment 'pr'

bool onSegment(Point p, Point q, Point r)

{

if (q.x <= max(p.x, r.x) && q.x >= min(p.x, r.x) &&

q.y <= max(p.y, r.y) && q.y >= min(p.y, r.y))

return true;

return false;

}

It would say true, for points which are slightly not on the line as we between of x's and y's of p and r.

1 ^ | v • Reply • Share ›

sandeep • a year ago

i meant to say the best

^ | v • Reply • Share ›

Morgan ➦ sandeep • 10 months ago

good post, clear enough for me to understand!!

^ | v • Reply • Share ›

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sandeep ➚ Morgan • 10 months ago

so what? why r u telling me?

^ | v • Reply • Share ›

sandeep • a year ago

this is the worst geeksforgeeks post I've seen so far

5 ^ | v • Reply • Share ›

Rajarshee Mitra • a year ago

Two line segments will intersect only if they have different slopes. p1=(xp1,yp1);q1=(xq1,yq1); p2=(xp2,yp2) and q2=(xq2,yq2) it is s (yq1-yp1)/(xq1-xp1). If equal, they don't intersect , else they do.

^ | v • Reply • Share ›

mike ➚ Rajarshee Mitra • a year ago

they are line segments, not lines.

2 ^ | v • Reply • Share ›

Deepesh Maheshwari • a year ago

Hi, above algo fails for this case.
{10, 0},{10, 10},{5,5},{12344,5}
Here, when we compute orientation for following case :
orienation({10, 0},{10, 10},{5,5})
orienation({10, 0},{10, 10},{12344,5})

This is giving same orientation.
Please explain how to resolve this bug.

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Harry Potter • a year ago

Is there any other way for the orientation to be 0 ? If not then why a checking that the the point lies on the segment ?

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Sandu Robert Harry Potter • a year ago

orientation is 0 if p,q,r are colinear but we can have p1-p2-

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ali • a year ago

Hi
this code is good.
but I'm looking for this code in matlab.
is there any one help me.time is running out. and I don't do anythir
I have to find the coordinate of intersection of all lines in a chess b
my email address is: adelanteh1365@yahoo.com
thanks in advance.

Reply • Share ›

Bijoy Singh • a year ago

Cant we do something of this sort: Given the 2 points on the line s intersection point , say P(x,y). Now find the ratio P divides both of lines this means the points in inside the line segments, hence the

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I think this can be better solved using geometry and vector knowle
http://community.topcoder.com/...

1 ^ | v • Reply • Share ›

Guest • 2 years ago

I don't think this implementation distinguishes between "collinear"
Compare two lines, (10,10) - (20,20) against (11,11) - (21,21) - Or

^ | v • Reply • Share ›

Ikreinitz ➚ Guest • a year ago

the orientation conditions preclude this case

^ | v • Reply • Share ›

Kaidul Islam Sazal • 2 years ago

Is it possible in this code to determine in which point the lines inter

^ | v • Reply • Share ›

Amit • 2 years ago

onSsegment should be

if (p.x * (q.y - r.y) + q.x * (r.y - p.y) + r.x*(p.y - q.y) == 0)
return true;

^ | v • Reply • Share ›

Fredrik • 2 years ago

The code seems to be optimized for the case where the segment
code for the case where the segments probably do not intersect?

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clotho • 2 years ago

An easier way:
Segment L1 has edges A=(a1,a2), A'=(a1',a2').
Segment L2 has edges B=(b1,b2), B'=(b1',b2').
Segment L1 is the set of points tA'+(1-t)A, where 0<=t<=1.
Segment L2 is the set of points sB'+(1-s)B, where 0<=s<=1.
Segment L1 meet segment L2 if and only if for some t and s we h
tA'+(1-t)A=sB'+(1-s)B
The solution of this with respect to t and s is

t=((-b?'a?+b?'b?+b?a?+a?b?'-a?b?-b?b?')/(b?'a?'-b?'a?-b?a?'+b?

s=((-a?b?+a?'b?-a?a?'+b?a?+a?'a?-b?a?')/(b?'a?'-b?'a?-b?a?'+b

So check if the above two numbers are both >=0 and <=1.
:)

Mayur Shah • 2 years ago

You can check it by using slope of lines whether the two lines are
slopes will never intersect at all and vice-versa!

GradLifeWoes ➚ Mayur Shah • 2 years ago

That would be the case if they are lines and not line segme

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So we should check they are not collinear and have same

2 ^ | v • Reply • Share ›

sarat G • 2 years ago

Hey,

What's the point in doing all this stuff...if the slopes of two line seg any other case the two line segments always intersects..

```
/* Paste your code here (You may delete these lines if no
```

^ | v • Reply • Share ›

kartik ➚ sarat G • 2 years ago

That is why the topic says line *Segments* :)

7 ^ | v • Reply • Share ›

Mohan • 2 years ago

I appreciate the efforts taken by geeksforgeeks community in post this one was very poorly explained.

^ | v • Reply • Share ›

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