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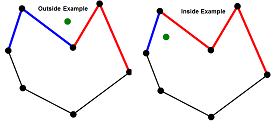
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**How to check if a given point lies inside or outside a polygon?**

July 11, 2013

Given a polygon and a point ‘p’, find if ‘p’ lies inside the polygon or not. The points lying on the border are considered inside.

[](http://d2o58evtke57tz.cloudfront.net/wp-content/uploads/polygon211.png)

We strongly recommend to see the following post first.  
[How to check if two given line segments intersect?](http://www.geeksforgeeks.org/check-if-two-given-line-segments-intersect/)

Following is a simple idea to check whether a point is inside or outside.

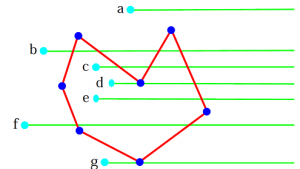
**1)** Draw a horizontal line to the right of each point and extend it to infinity

**1)** Count the number of times the line intersects with polygon edges.

**2)** A point is inside the polygon if either count of intersections is odd or

point lies on an edge of polygon. If none of the conditions is true, then

point lies outside.

[](http://d2o58evtke57tz.cloudfront.net/wp-content/uploads/polygon31.png)

**How to handle point ‘g’ in the above figure?**  
Note that we should returns true if the point lies on the line or same as one of the vertices of the given polygon. To handle this, after checking if the line from ‘p’ to extreme intersects, we check whether ‘p’ is colinear with vertices of current line of polygon. If it is coliear, then we check if the point ‘p’ lies on current side of polygon, if it lies, we return true, else false.

Following is C++ implementation of the above idea.

|  |
| --- |
| // A C++ program to check if a given point lies inside a given polygon  // Refer <http://www.geeksforgeeks.org/check-if-two-given-line-segments-intersect/>  // for explanation of functions onSegment(), orientation() and doIntersect()  #include <iostream>  using namespace std;    // Define Infinite (Using INT\_MAX caused overflow problems)  #define INF 10000    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)  {      int val = (q.y - p.y) \* (r.x - q.x) -                (q.x - p.x) \* (r.y - q.y);        if (val == 0) return 0;  // colinear      return (val > 0)? 1: 2; // clock or counterclock wise  }    // The 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;         // 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  }    // Returns true if the point p lies inside the polygon[] with n vertices  bool isInside(Point polygon[], int n, Point p)  {      // There must be at least 3 vertices in polygon[]      if (n < 3)  return false;        // Create a point for line segment from p to infinite      Point extreme = {INF, p.y};        // Count intersections of the above line with sides of polygon      int count = 0, i = 0;      do      {          int next = (i+1)%n;            // Check if the line segment from 'p' to 'extreme' intersects          // with the line segment from 'polygon[i]' to 'polygon[next]'          if (doIntersect(polygon[i], polygon[next], p, extreme))          {              // If the point 'p' is colinear with line segment 'i-next',              // then check if it lies on segment. If it lies, return true,              // otherwise false              if (orientation(polygon[i], p, polygon[next]) == 0)                 return onSegment(polygon[i], p, polygon[next]);                count++;          }          i = next;      } while (i != 0);        // Return true if count is odd, false otherwise      return count&1;  // Same as (count%2 == 1)  }    // Driver program to test above functions  int main()  {      Point polygon1[] = {{0, 0}, {10, 0}, {10, 10}, {0, 10}};      int n = sizeof(polygon1)/sizeof(polygon1[0]);      Point p = {20, 20};      isInside(polygon1, n, p)? cout << "Yes \n": cout << "No \n";        p = {5, 5};      isInside(polygon1, n, p)? cout << "Yes \n": cout << "No \n";        Point polygon2[] = {{0, 0}, {5, 5}, {5, 0}};      p = {3, 3};      n = sizeof(polygon2)/sizeof(polygon2[0]);      isInside(polygon2, n, p)? cout << "Yes \n": cout << "No \n";        p = {5, 1};      isInside(polygon2, n, p)? cout << "Yes \n": cout << "No \n";        p = {8, 1};      isInside(polygon2, n, p)? cout << "Yes \n": cout << "No \n";        Point polygon3[] =  {{0, 0}, {10, 0}, {10, 10}, {0, 10}};      p = {-1,10};      n = sizeof(polygon3)/sizeof(polygon3[0]);      isInside(polygon3, n, p)? cout << "Yes \n": cout << "No \n";        return 0;  } |

Output:

No

Yes

Yes

Yes

No

No

**Time Complexity:** O(n) where n is the number of vertices in the given polygon.

**Source:**  
[http://www.dcs.gla.ac.uk/~pat/52233/slides/Geometry1x1.pdf](http://www.dcs.gla.ac.uk/%7Epat/52233/slides/Geometry1x1.pdf)

Please write comments if you find anything incorrect, or you want to share more information about the topic discussed above

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How is method 1 different from method 2 ? Both...

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public class Palindrome { private static...

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Good Work. can we get the time and space...

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