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CS 478 HOMEWORK2  
  
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1. We know that, for two points in order to form counter clockwise cycle according to point P, 0 < Ɵab < 180 (positive orientation) must be true. Additionally, from the slides, we know that, positive orientation has same sign with sin(Ɵ) (sin(Ɵb – Ɵa) and, sin(Ɵ) has same sign with the   
   (y2-y0)(x1-x0)-(x2-x0)(y1-y0) where (x0,y0)is P in our case and the other points are points in the lists respectively.

function isCounterClockwise(HEAD ,P):

currentNode = HEAD

while currentNode.NEXT != HEAD :

x0 = P.x

y0 = P.y

x1 = currentNode.P.x

y1 = currentNode.P.y

x2 = currentNode.NEXT.P.x

y2= currentNode.NEXT.P.y

if ((y2-y0)\*(x1-x0)) - ((x2-x0)\*(y1-y0)) < 0 :

return False

currentNode = currentNode.NEXT

return True

1. We know that, elementary intervals represents only one number in the tree and they are the bottom level of the tree. In order to find maximum number of standard interval firstly we must take in to account at least 2 elementary interval and these two cannot be biggest and smallest elementary interval because these two use one standard interval. (The Top). So we take in to account second biggest and smallest intervals as b and e. So we can’t use top interval now but we must use all other level intervals in the both side which is equal to 2(log2n-1) for perfect binary tree(where log2n is integer). Segment trees are balanced binary trees so left side of the top and right side of the top can be expressed as ⎡log 2 n⎤ -1 (without top) ⎣log 2 n⎦ +1 for both sides. So, number of standard interval allocated to get an arbitrary interval [b, e] cannot be more than ⎡log 2 n⎤ + ⎣log 2 n⎦ - 2 .
2. To finding whether the polygon is convex or concave we can use left test to it’s edges. In order to do this firstly we must choose a point q inside the polygon (for example on the common edge) and see that if it is staying left of or on all N edges of polygon. For staying at the left of the near the angle between v1, v0 (vertices of the edge) and q must be smaller than 180 and bigger than 180. So, we can use (y2-y0)(x1-x0)-(x2-x0)(y1-y0) where (x0,y0)is v0 in our case.

function isConvex ( DCEL, Fa, Fb ):

//find common edge

e = null

for each edge in Fa.boundaryEdges:

if edge is also in Fb.boundaryEdges:

e = edge

break

q = e.middle

//traverse polygons opposite ways (one of them is from v0 side to v1 side the other is from //v1 side to v0 side

start = e.v1

next = start.next

for i = 1 to Fa.boundarySize – 1:

//middle point of the angle is start

if ((q.y - start.y)\*( next.x - start.x) - ( q.x - start.x)\*( next.y – start.y)) < 0 :

return False

start = next

next = start.next

start = e.v0

prev = start. prev

for i = 1 to Fb.boundarySize – 1:

//middle point of the angle is start

if ((q.y - start.y)\*( prev.x - start.x) - ( q.x - start.x)\*( prev.y – start.y)) < 0

return False

start = prev

prev = start. Prev

return True

1. To solve this question firstly we need to determine the neighbor faces of f and put them in a list. Then we can add them to F one by one.

Function expand ( F ) :

neighbors = []

for each edge in F.edges:

if edge.rightFace is not in neighbors:

neighbors.add(edge.rightFace)

foreach face in neighbors:

foreach edge in F.edges:

if edge also in face.edges:

DeleteEdge(edge)

F = F + face

return F

1. We know that Euler’s formula is v- e + f = 2.

* Since G is planar, each face has at least three edges, and each edge is incident to two faces. (triangle) Therefore, we can write:

3f <= 2e,

f <=2/3e.

* From Euler’s formula e = v + f – 2, if we substitute e with e<=3f-6

v+f-2<=3f-6,

v<=2f-4.

We know that v<= 2f-4 so, it holds.

* From Euler’s formula e = v + f - 2 we know that f<=2/3e if we substitute e

3f <= 2v+ 2f -4,

f <= 2v – 4

* To prove v<=2f-4, From Euler’s formula we know that v = e-f+2

e-f+2<=2f-4,

e<=3f-6 which is true.

* To prove v<=2/3e, From Euler’s formula we know that v = e-f+2

e-f+2<=2/3e,

3e-3f+6<=2e,

e+6<=3f,

e<=3f-6 which is true.

* To prove e<= 3v – 6, From Euler’s formula we know that e = v + f – 2

v+f-2<=3v-6,

f<=2v-4 which is true.