NISARG UPADHYAYA 19CS30031

Q1) ~~This is correct.~~ ~~INCORRECT~~ Q1 Done on next page.

~~The quadrilateral will be the convex hull obviously of the n+4 points as the rest n are in the interior.~~

~~As it is a convex hull the points with minimum and maximum x-coordinates will be a part of it, i.e, L & R.~~

~~By a distance-preserving transformation same can be proved for T & B by rotating.~~

~~Hence, taking L, T, R, B indeed gives us the quadrilateral.~~

Q2) (a)

1. $\cap(L_3, L_5)$
2. $ES(L_1)$
3. $\cap(L_1, L_5)$
4. $LS(L_2)$
5. $LS(L_3)$
6. $ES(L_4)$
7. $\cap(L_4, L_1)$
8. $LS(L_1)$
9. $\cap(L_4, L_5)$
10. $LS(L_4)$
11. $LS(L_5)$

(b) All events except 3, 7 & 9.

[Only L_5 & L_3 are consecutive at current position hence only that $\cap$ will be stored]

Q3)

(a) We have 3 site events followed by a circle event.

1. Site event for P

2. Site event for R

3. Site event for Q

4. Circle event for PQR.

b. Before the circle event

P Q P R

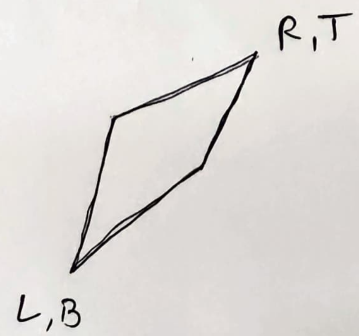
After the circle event

P Q R

c. Fork-out event

Q1) Wrong. It may to happen L&B and R&T coincide.

Like,



Q6) (a) If we have a certificate which is an assignment of truth value to the variables we can just evaluate each clause one by one and maintain a counter of the number of clauses evaluated to false. This can be done in time linear in the length of the formula. Hence, it is in NP.

(b). CNFSAT $\leq$ AB1SAT

$$\phi(x_1, x_2, \dots x_n) \longmapsto \phi(x_1, x_2, \dots x_n) \wedge y \wedge \bar{y}$$

$\Rightarrow$ This reduction takes linear time, just copy the old formula ϕ and add $y \wedge \bar{y}$ to it.

If ϕ is satisfiable then each of its clauses must be true. Whatever y be one of y & $\bar{y}$ will be false and other true.

So we will have $n+1$ true clauses and 1 false clause.

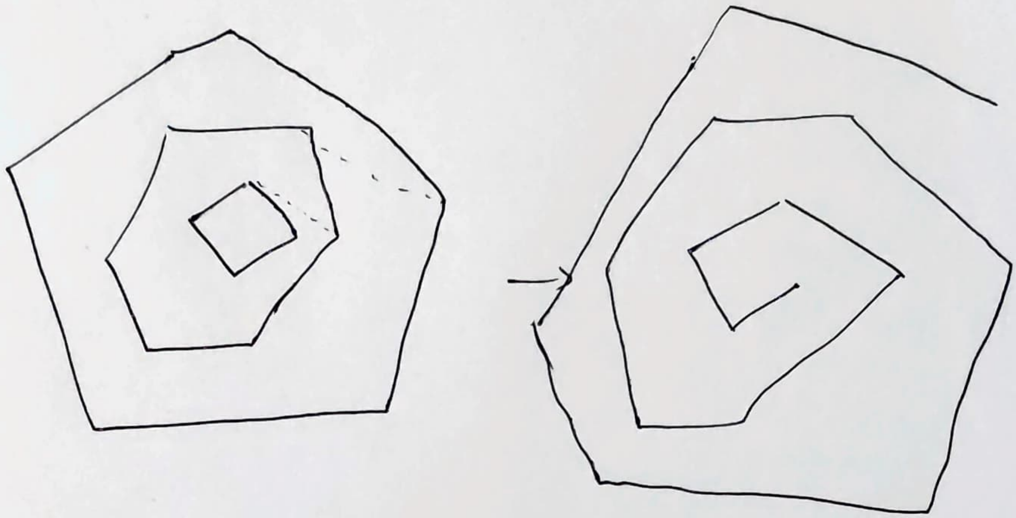
On the other hand if ϕ is not satisfiable its not possible all clauses are true. Also one of y & $\bar{y}$ will be false. So we will have at least 2 false clauses.

Hence, the reduction.

Thus, we have a linear time reduction from CNFSAT to ABISAT and ABISAT $\in$ NP. So it is NP-COMPLETE

Q4) We can create convex hulls from inside out. [ONION LAYERS]

Once we have this we can connect adjacent layers.



The final order of points will be clockwise from the innermost layer.

Onion layers can be found in $O(n^2)$ [Jarvis March].

Finding the next point while transitioning from one layer to another can be done in time linear of the outer layer. [By trying out all such points in outer layer] There are total n points. So we will go through at most n points. Overall complexity remains $O(n^2)$.

(c)

=> Find distances from each point to the edges of its voronoi cell.

=> These distances are stored in the edges. Each edge has information of sites around it. [storing the nearest point suffices]

=> Now for each site go through its edges.

If some point other than the point itself is at a distance $< r$ from this edge then this is not safe.

=> There are at most n edges.

Overall amortized complexity is $O(n)$.