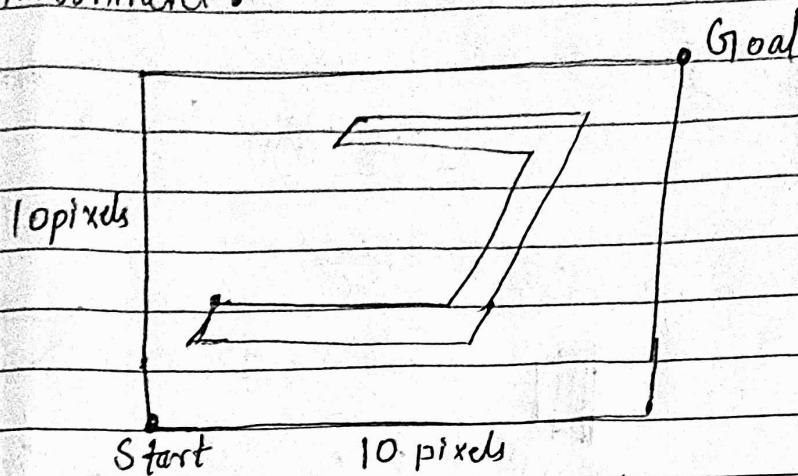


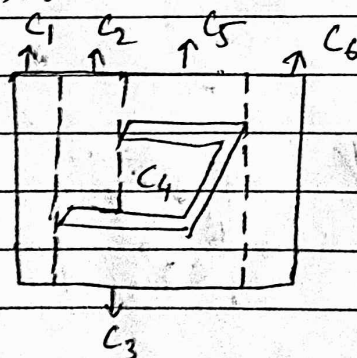
Q.1. → Environment:



Now, we need to find the time taken by a robot with sensing radius of ~~1m~~ 1 pixel at a time to cover all the empty space.

• We will be doing this using Moore decomposition.
→ Connectivity We send a line 'L' through environment and look for critical points, as connectivity of 'L' changes in free space at critical points.

Following are the cells and critical points we get, & as we get the critical points we start covering the environment.

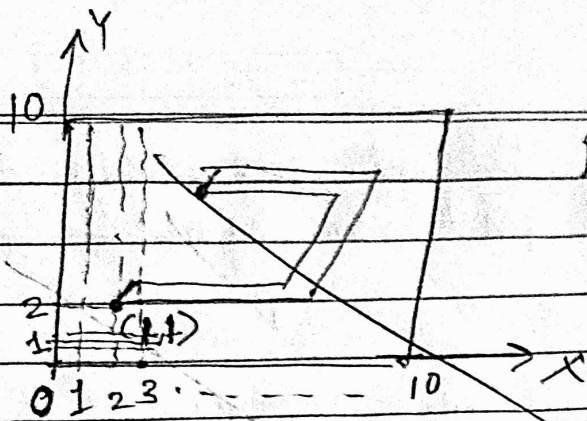


(Assumption:
Robot takes
one step in 1 sec)
i.e. 1 pixel/step

Now, ~~when~~ we pass line L, we cover the cells & detect critical points

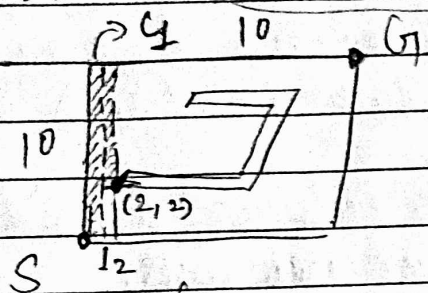
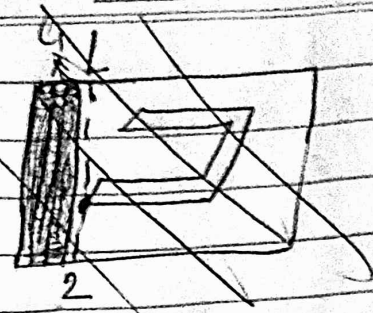
① we ~~cover~~

→ We choose upper cell to cover whenever there is a split in free space due to obstacle.



DATE

1st step



Rebb Graph

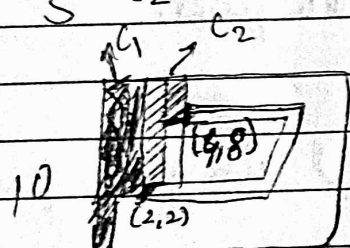
Time taken

To cover C_1

$$\Rightarrow 10 + 8$$

$$\Rightarrow 18 \text{ sec}$$

Rebb Graph



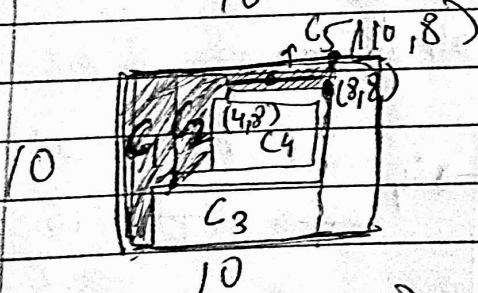
Cover C_2

$$\Rightarrow 8 + 2$$

$$\Rightarrow 10 \text{ sec}$$

\therefore Total $C_1 + C_2$

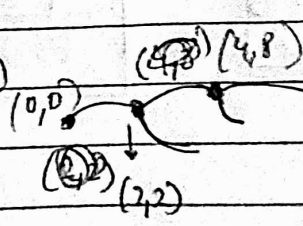
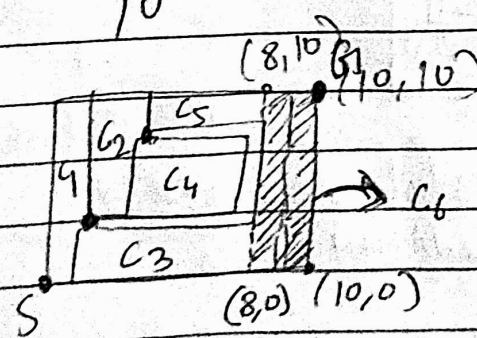
$$\Rightarrow 28 \text{ sec}$$



Cover C_3

$$C_3 = 8$$

$$\text{Total} = 36 \text{ sec}$$



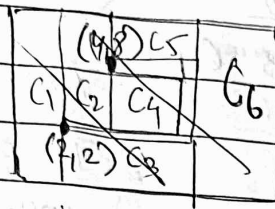
$(10,10) C_5$

$$\text{Total} = 56 \text{ sec}$$

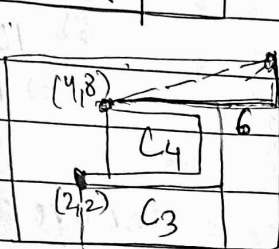
Now, we search for critical points that have uncovered cells in using Rebb Graph

So, two critical cells are not covered C_3 & C_4 & their critical points are $(2,2)$ for C_3 & $(4,8)$ for C_4

Now, we by using Tangent Bug Algorithm we traverse to critical points one by one & cover the remaining cells.



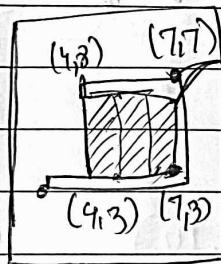
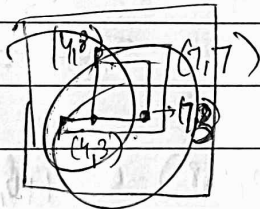
Current position is (10,10) so, we traverse to nearest one first, which is (4,8)



We go to each critical point & cover lower area parts.

1st case: Now, (10,10) to (4,8) using Bug tangent Algo $\Rightarrow 2\sqrt{10} \Rightarrow 6 \text{ steps} - ①$

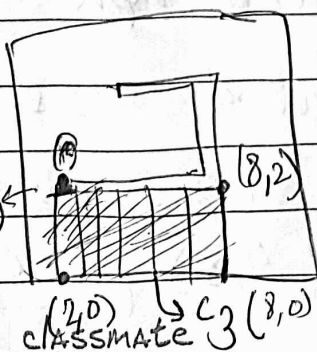
Now, we reached (4,8) critical point & we cover C4.



For C4 coverage $\rightarrow 15 \text{ pix} \times 15 \text{ secs} + 6 \text{ secs} \Rightarrow 21 \text{ secs}$

$\therefore \text{Total} = \underline{\underline{77 \text{ secs}}}$
Until Now

Now, going ~~(4,8)~~ ^(7,3) to (2,2) using ~~bug~~ tangent Algorithm.



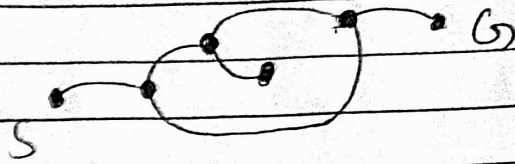
For tangent bug ~~Total~~ steps = 6 steps $\Rightarrow 6 \text{ secs}$

Total steps to cover C3 = 6 secs + 12 sec $\Rightarrow 18 \text{ secs}$

~~Total Time~~

\therefore Total Time taken = $77 + 18 \text{ sec}$
 $\Rightarrow 95 \text{ sec}$

Reb graph in the end:



\therefore Total Time ~~is~~ cover = 95 sec