Collaborative A* Pathfinding (based on David Silver's WHCA*)

Solution Implementation & Demo

Yan

So far, so good.

Well.. not so good...

Let’s do a small demo first,

then we discuss system spec.

A little demo

I have a Problem:

- I have two agents, Y is Yan, H is Professor Hamada.
- Hamada starts at (1, 1), goal at (8, 1); Yan starts at (8, 1), goal at (1,1)
- Below, you see a map, its size is 8 by 16, 8 is width, 16 is height.
- (I made width in-between wider so you can see clearly)
- (X means border, or obstacles, for now, no obstacles...)
- Let’s see.

Is it working?

- If it worked, how?
- What is the magic?
- You just saw agents path find collaboratively. But how to achieve it?
- let’s take a look.

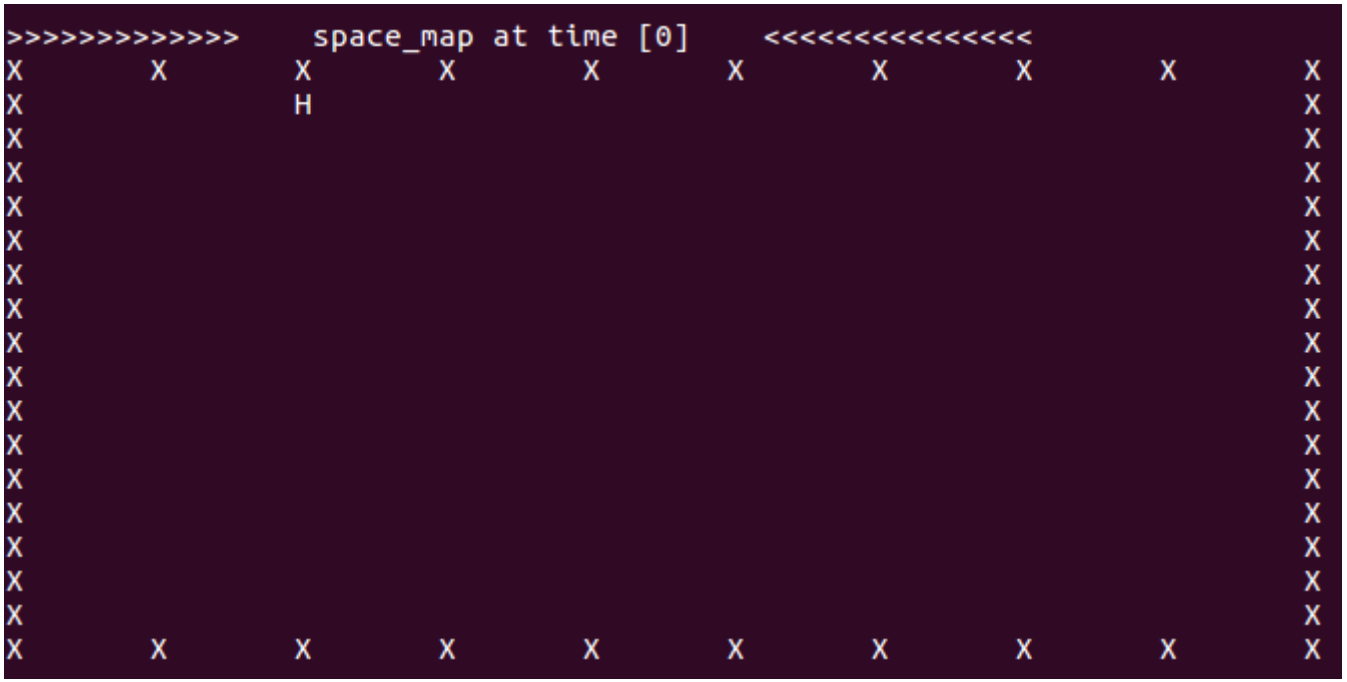
How I implemented (1)

We have 2 agents, Yan and Hamada, map is (8 x 16), H starts at (1, 1); Y starts at (8, 1).

How I implemented (2)

Hamada goes first. Yan stays put.

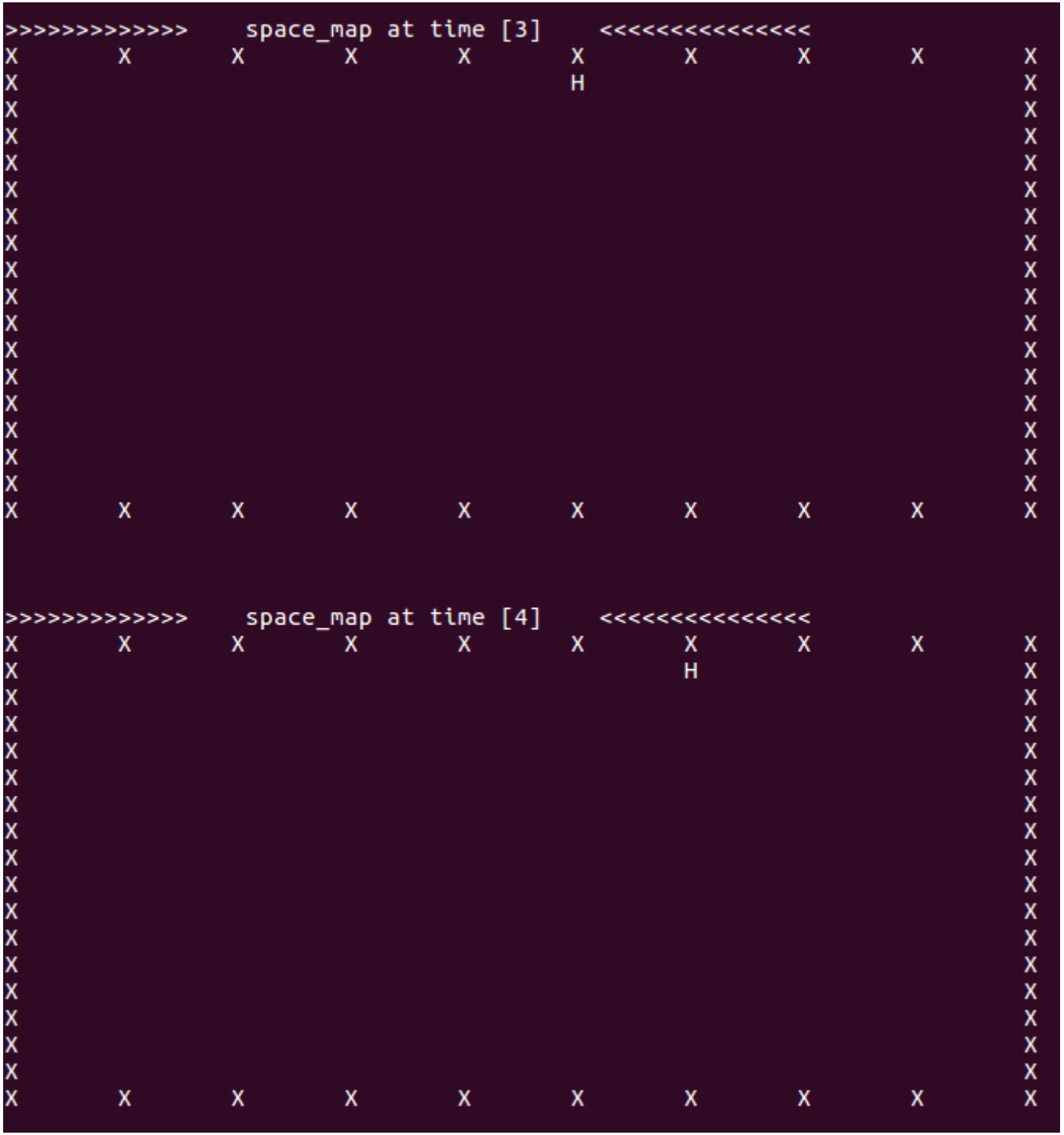
Hamada use basic A* search for pathfinding, while completely ignoring Yan.



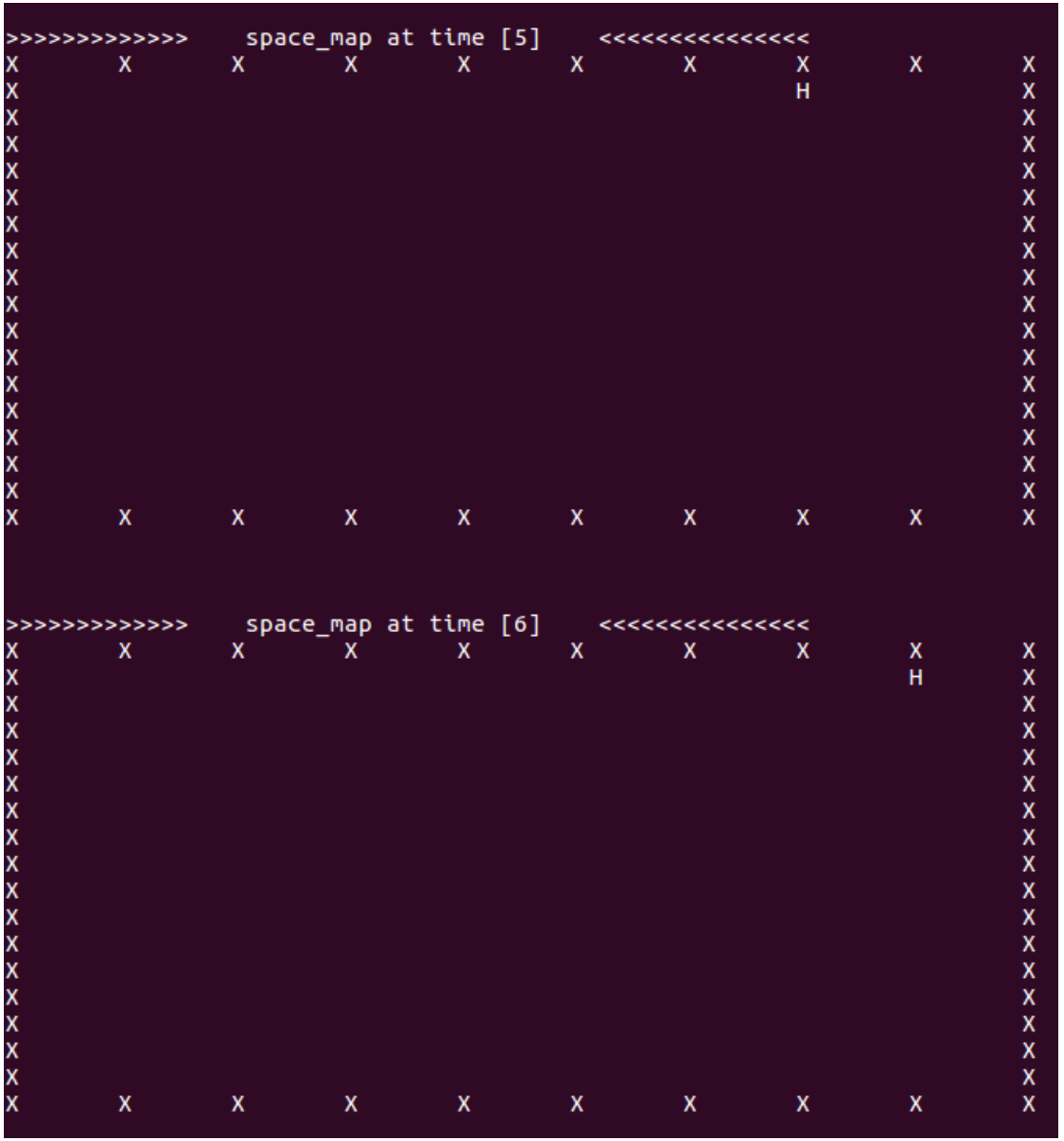
```
>>>>>>>>>>>>>    space_map at time [1]    <<<<<<<<<<<<<<<
X         X         X         X         X         X         X         X         X         X
X                             H                                                           X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X         X         X         X         X         X         X         X         X         X



>>>>>>>>>>>>>    space_map at time [2]    <<<<<<<<<<<<<<<
X         X         X         X         X         X         X         X         X         X
X                                       H                                                 X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X                                                                                         X
X         X         X         X         X         X         X         X         X         X
```


>>>>>>>>>>>>>   space_map at time [3]   <<<<<<<<<<<<<<<
>>>>>>>>>>>>>>   space_map at time [4]   <<<<<<<<<<<<<<<

Yes, Hamada succeeds!

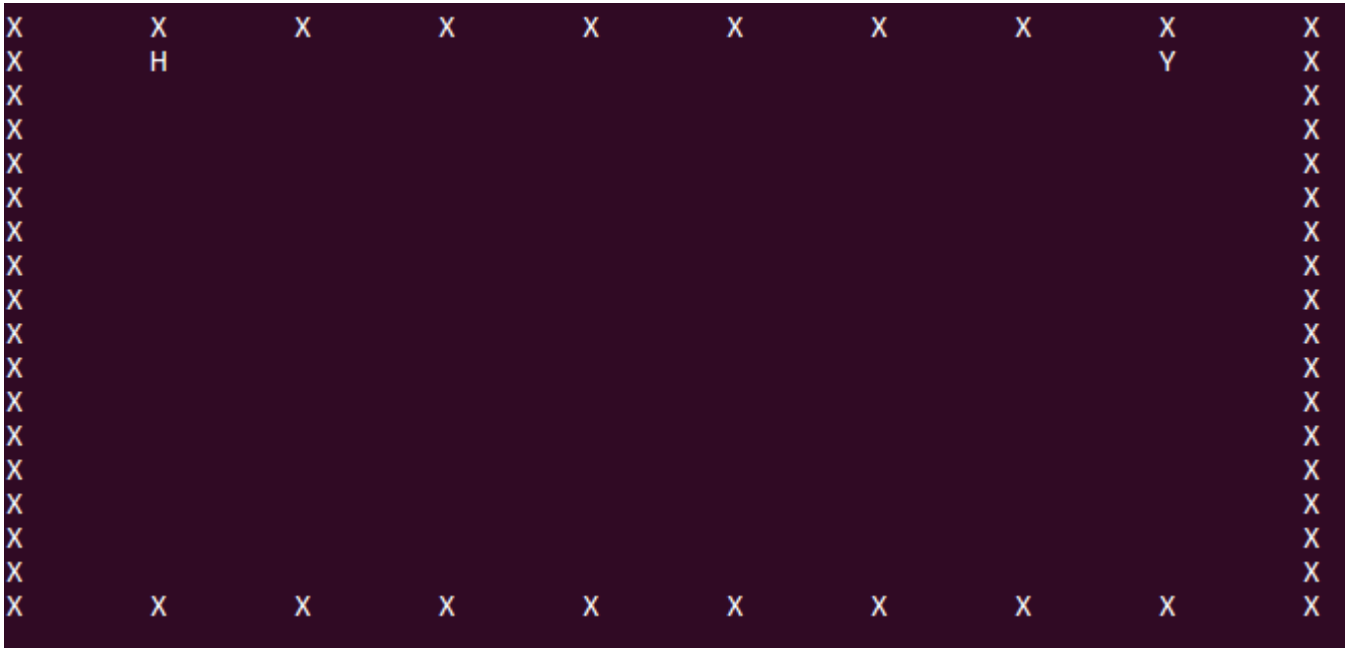


How I implemented (3)

Now, it is Yan’s turn. Yan will take Hamada’s path into account.

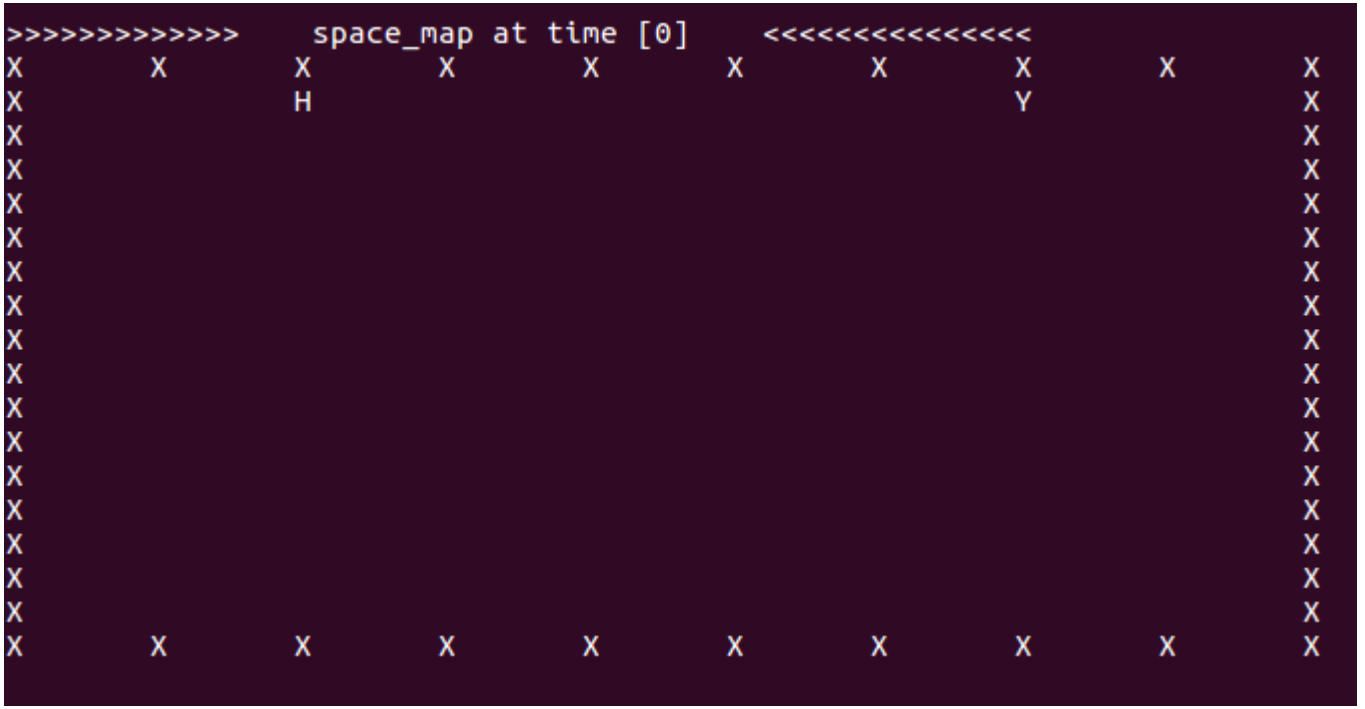
In other words, Yan try his best to avoid running into Professor Hamada, because he did not submit his report ~>_<

- Yan starts at (8, 1).
- In the beginning, Yan is at (8, 1), while Professor is at (1, 1);

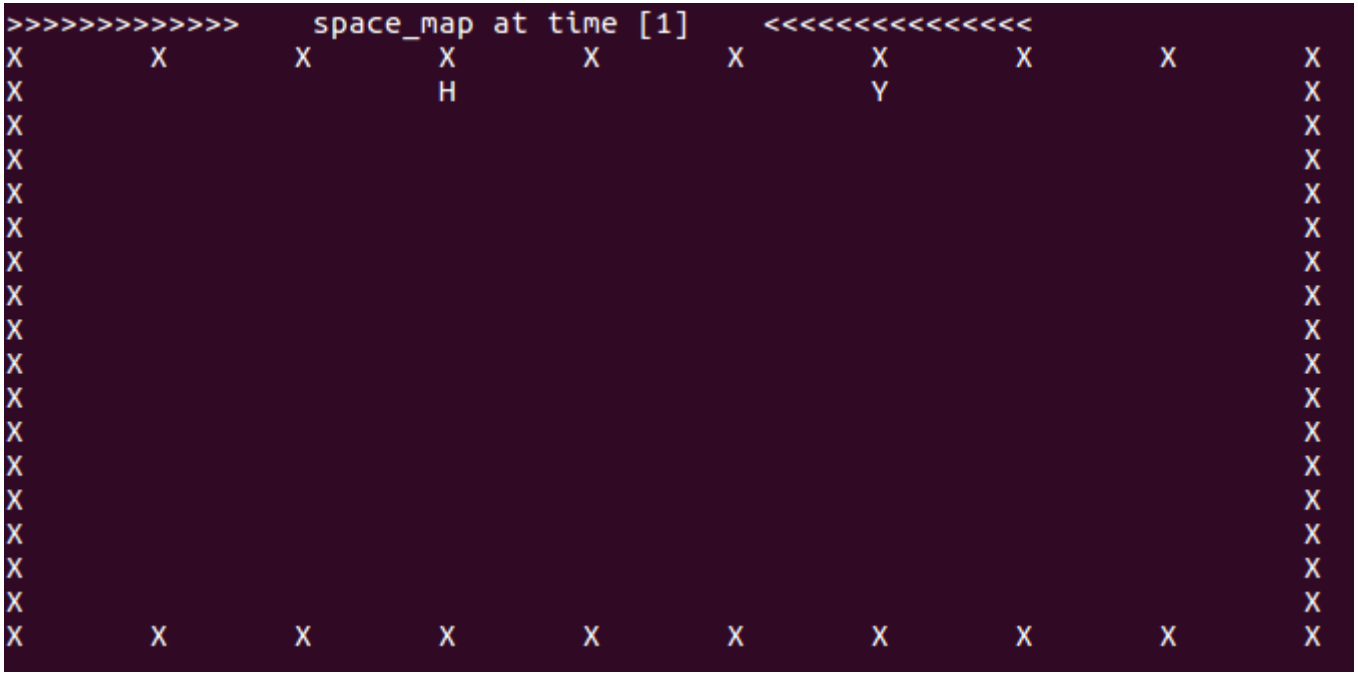


Yan is a smart guy. He knows every move of Hamada.

- So he just path finding use basic A* if Hamada isn’t nearby.

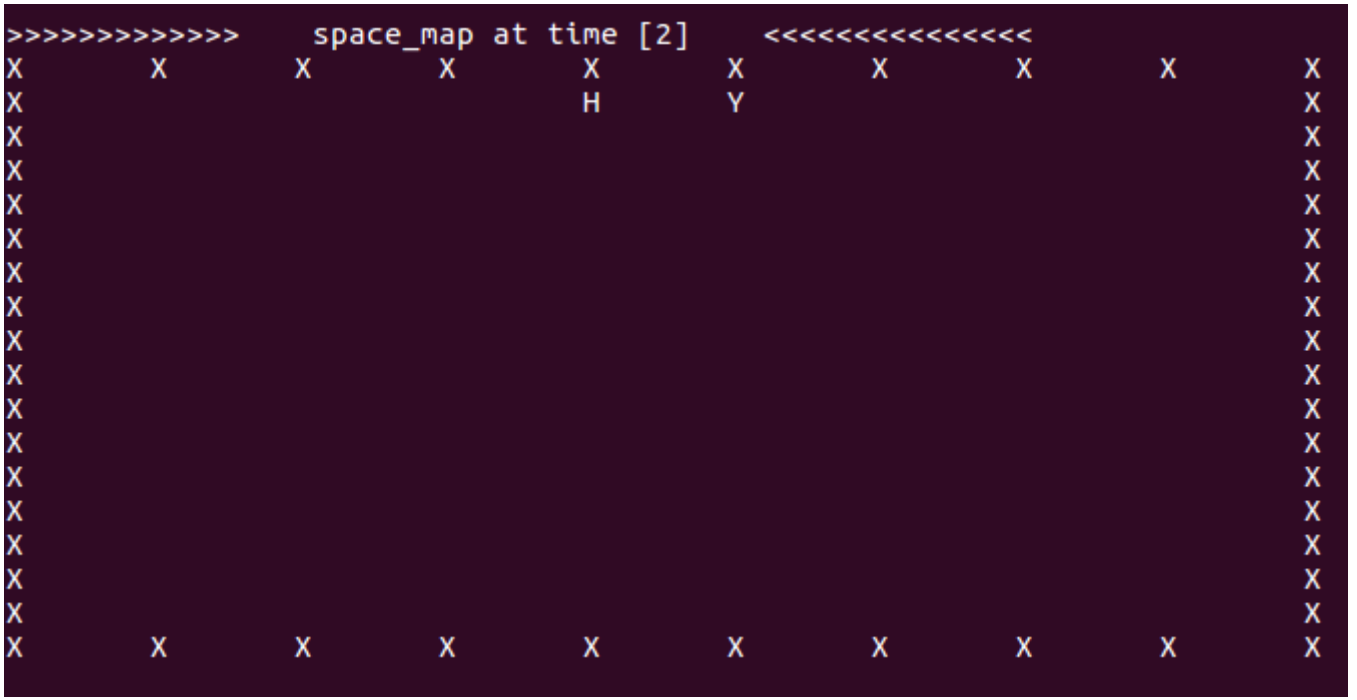


Still, Hamada is far away from Yan.

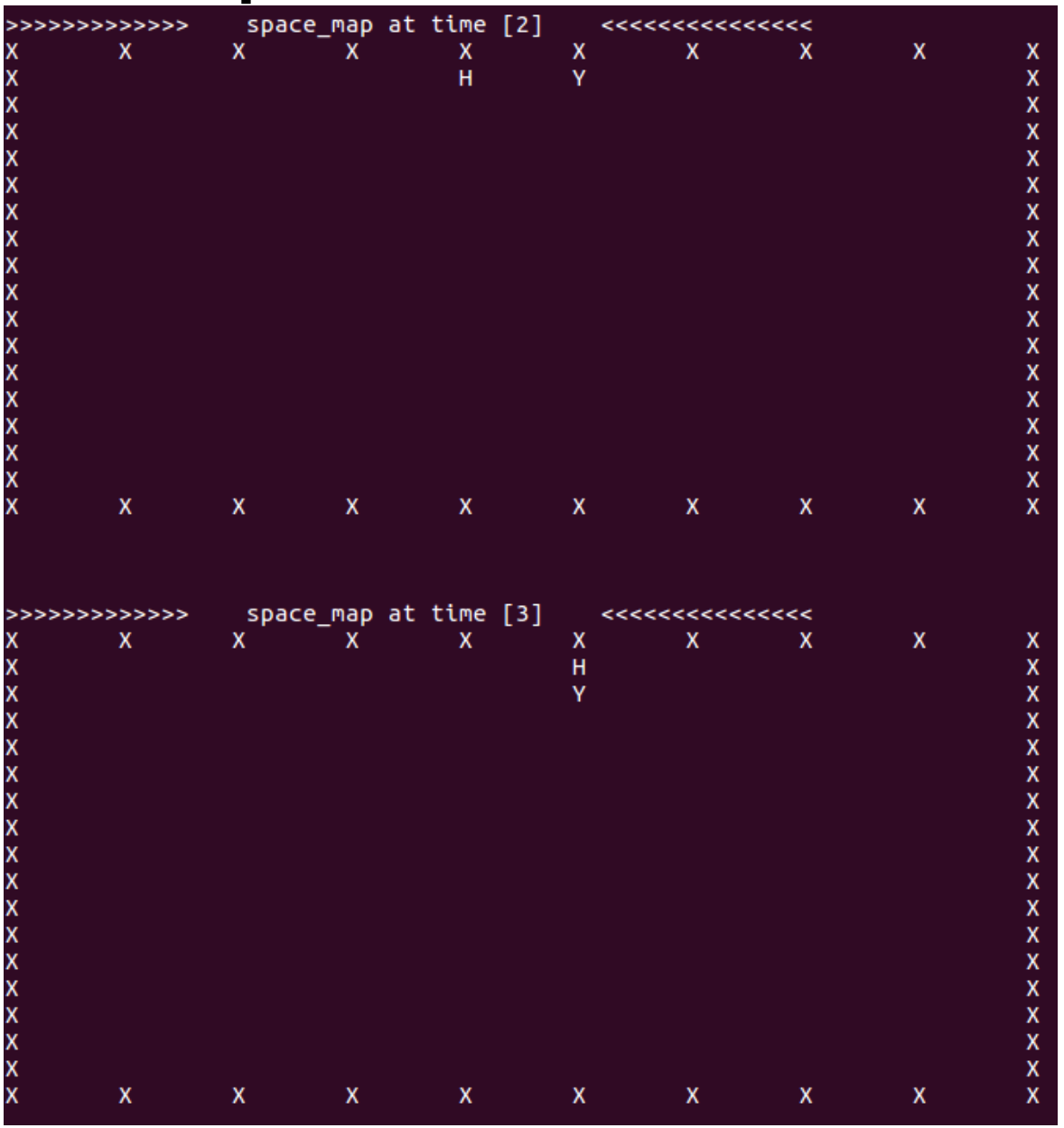


Professor is nearby ....

> Hello,
>
> I **have NOT received** your report and presentation slide-deck.



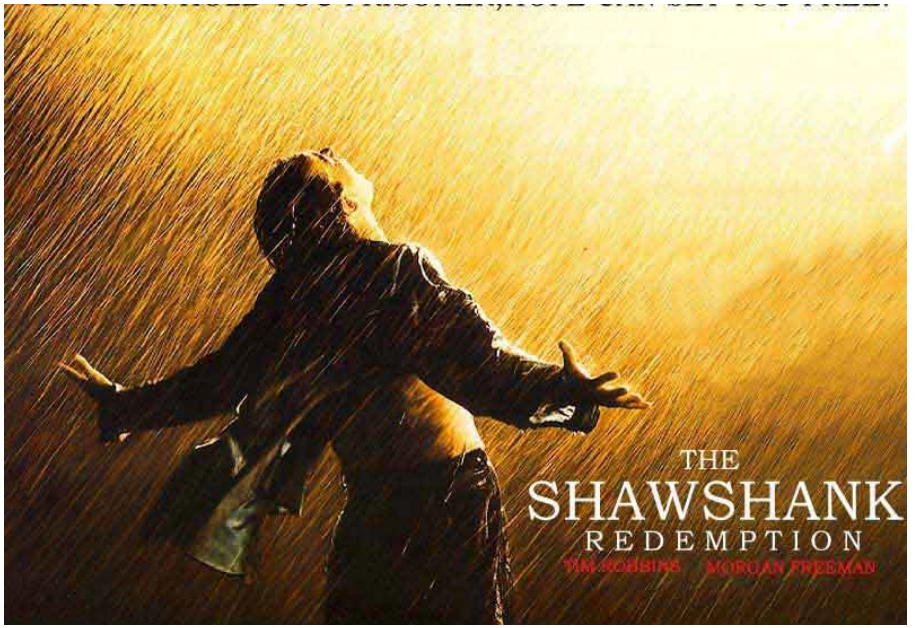
Ahhh.... Yan got nervous, he did not write report. Yan must run....



Yes! I avoided Professor.
I am a free-man!

```
>>>>>>>>>>>>>>    space_map at time [4]    <<<<<<<<<<<<<<<
X       X       X       X       X       X       X       X       X       X
X                               Y       H                               X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X       X       X       X       X       X       X       X       X       X


>>>>>>>>>>>>>>    space_map at time [5]    <<<<<<<<<<<<<<<
X       X       X       X       X       X       X       X       X       X
X                               Y                       H               X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X       X       X       X       X       X       X       X       X       X
```



Yan successfully avoided avoid Prof and found his goal.

```
>>>>>>>>>>>>>    space_map at time [7]    <<<<<<<<<<<<<<<
X       X       X       X       X       X       X       X       X       X
X       Y                                                       H       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X                                                                       X
X       X       X       X       X       X       X       X       X       X


>>>>>>>>>>>>>>>>>    Do all agents reach destination?    <<<<<<<<<<<<<<<<
Success! All agents reached goal!
```

Professor, I am sorry for delaying report... I will try not to avoid next time.

So, how did I avoid it?

Here is how.

- Yan knows the gScore of every single node of the map.

  So does Hamada.
- What is gScore?

  True distance heuristic.
- How to get gScore?

  Reverse resummable A-star seach.
- Is it expensive to calculate gScore?

  You bet! I plan to do it on GPU. They are independently calculated.

Yan’s gScore hash map
True distance to (1, 1)

X	X	X	X	X	X	X	X	X	X
X	0	10	20	30	40	50	60	70	X
X	10	20	30	40	50	60	70	80	X
X	20	30	40	50	60	70	80	90	X
X	30	40	50	60	70	80	90	100	X
X	40	50	60	70	80	90	100	110	X
X	50	60	70	80	90	100	110	120	X
X	60	70	80	90	100	110	120	130	X
X	70	80	90	100	110	120	130	140	X
X	80	90	100	110	120	130	140	150	X
X	90	100	110	120	130	140	150	160	X
X	100	110	120	130	140	150	160	170	X
X	110	120	130	140	150	160	170	180	X
X	120	130	140	150	160	170	180	190	X
X	130	140	150	160	170	180	190	200	X
X	140	150	160	170	180	190	200	210	X
X	150	160	170	180	190	200	210	220	X
X	X	X	X	X	X	X	X	X	X

Let’s do another demo if time allows

- This time, we have obstacles.
- We can even have random obstacles. You can set percentage. More percentage, more obstacles, more fun.
- Cross fingers! I hope it works!

Sorry I don’t have a UI

If I had much more time, I still won’t put effort into UI design. Haha, I dont care user experience.

But I do love algorithm.

The future is unlimited. Amazon has deployed its warehouse robot...

Human will embrace smart-object / Agents.

When that day comes, I hope they truely cooperate.

Thank you

Special thanks to Professor Hamada Ghenniwa for his unlimited support

And I will continue to explore more on multi-agent pathfinding.

I suggest you do as well, its amazing.