Forums

Problem Background | Feedback: (+2/-0) | [+] [-] | Reply

3 edits | Thu, Dec 24, 2020 at 1:39 PM BDT

dimkadimon

4499 posts

The idea for this problem came to me a long time ago, but I couldn't write it because interactive problems were not supported by the system. Big thank you to wleite for making it happen!

I've always enjoyed playing Minesweeper. It was usually one of a handful of games installed at school/uni so it was quite convenient to play. Although I've never got particularly good at it, I've often wondered if a bot can play it well. Some time later, my friend and I investigated this question and wrote a report about it. We used a graphical model (Conditional Random Field) with Loopy Belief Propagation for inference. We compared our method with some classic approaches including Constraint Satisfaction Problem solver (state-of-art at the time) and surprisingly it came close. You can read about it here:
http://users.cecs.anu.edu.au/~dkamen/mines_report.pdf

Initially this problem didn't have the "STOP" command, so the game terminated as soon as you hit the first mine (like in real Minesweeper). The score was just the percentage of cells opened. JacoCronje suggested that we allow hitting multiple mines and add a penalty for each hit. This is how the current version of the problem came about. I think this change makes the problem much deeper and more interesting. The solutions need to decide whether they should "STOP" or continue and risk hitting a mine and losing points. One of the most consuming parts of this problem was making the example gif. Thank you to kphmd for helping out with this.

Overall I am happy with how this problem turned out. I hope to do more interactive problems in the future.

Re: Problem Background (response to post by dimkadimon) | Feedback: (+3/-0) | [+] [-] | Reply

1 edit | Thu, Dec 24, 2020 at 3:47 PM BDT

Daiver19

95 posts

That was a really nice problem indeed!

What puzzles me is the the case of D=8. Here are the average scores for my solution:

D avg
1 0.6586568147
2 0.7831359474

4 0.9685394429
5 0.9680503887
8 0.8597342683
9 0.9776122933
10 0.9772888571

The most interesting part is that 4,5,9 and 10 are relatively easy to solve most of the time, while 8 was really hard to improve on. Of course, it may be just my solution. Has anyone experienced the same distribution? If so, is there any idea on why could it be harder than 5 and 9 which seem really similar?

Re: Problem Background (response to post by **Daiver19**) | Feedback: (+0/-0) | [+] [-] | Reply — Thu, Dec 24, 2020 at 7:04 PM BDT

ika
260 posts

I never calculated the averages but the hardness of D=8 is not hard to spot. Without any deeper analyses I think that squares and intersections of squares (equations and there *linear combinations) does not increase the diversity between cells well making the system of linear equations to have a more solutions and reducing 100% sure moves

Re: Problem Background (response to post by **dimkadimon**) | Feedback: (+3/-0) | [+] [-] | Reply — Thu, Dec 24, 2020 at 7:15 PM BDT

ika
260 posts

The lucky coincidence was that I challenged windows minesweeper about 12 years ago and I already had a statistically optimal solver which was able to calculate the probability of each cell being bomb and choose the safest one but the code didn't helped a lot :)

Nice problem indeed - enjoyed a lot :) but there must be noted that in 90% of tests I'm pretty much sure in decisions and only 10% "really affects the score" so having 10 test leaderboard and finals standings based on 200 tests are some drawbacks

Re: Problem Background (response to post by **Daiver19**) | Feedback: (+3/-0) | [+] [-] | Reply — Fri, Dec 25, 2020 at 1:55 AM BDT

sullyper
279 posts

For D=8 is similar to D=4, it's a square, this means that adjacent cells, have very similar information, especially around the edges, so it's much easier to be stuck in a configuration where you have to guess.
For example I spotted few 2x2 squares with some mines to prevent progress:

```
X****X
******
**..**
**..**
******
X****X
```

This is even more likely to happen close to an edge, because you only need 2 mines in addition of the 2 unknown mines to be stuck.

Unfortunately I didn't have time to spend too much time on this problem, I just wrote a quick solver that can figure out most of the safe moves (very few grids would time out). I was also surprised that in most of the cases you can solve it without ever have to guess a single move (~60% I believe).

Re: Problem Background (response to post by ika) | Feedback: (+1/-0) | [+] [-] | Reply — Fri, Dec 25, 2020 at 7:16 PM BDT

dimkadimon
4499 posts

Interesting point about only 10% of cases being "useful". During testing we had no idea that this would be the case. Very hard to predict such things unless you already have a strong solution.

Re: Problem Background (response to post by dimkadimon) | Feedback: (+0/-0) | [+] [-] | Reply — Sat, Jan 9, 2021 at 5:15 AM BDT

tuff
37 posts

I'm sorry you spend so much time making the animated GIF. I find it much more difficult to read the problem statement, and impossible to keep a window open displaying the problem statement for reference, when there is an animation running. In the future some option for turning off those animations would be welcome, maybe just a link to a copy of the HTML with a different image?