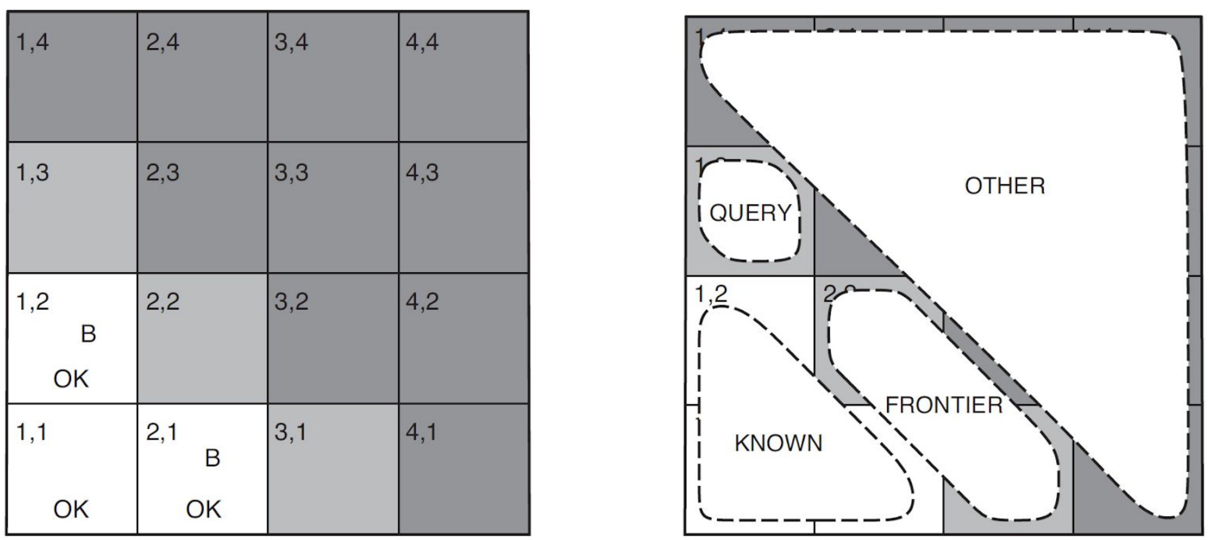
13.24 Redo the probability calculation for pits in [1,3] and [2,2], assuming that each square contains a pit with probability 0.01, independent of the other squares. What can you say about the relative performance of a logical versus a probabilistic agent in this case?

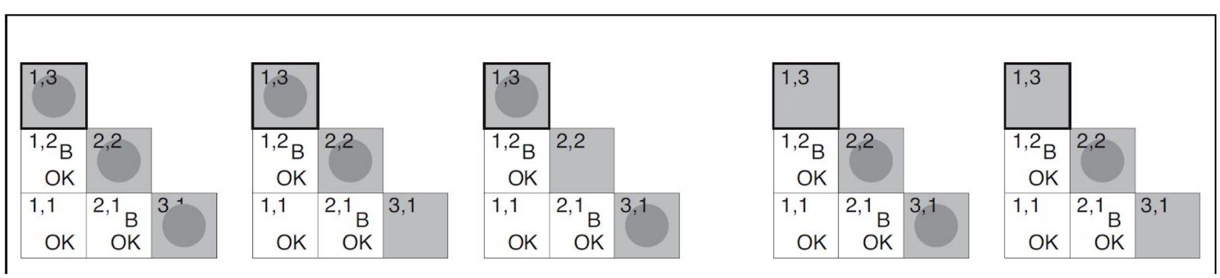
Being the probability of a pit in an square independent of the other squares, the probability of a particular configuration of cells with exactly n pits for the entire Wumpus World is:

$$P(P_{1,1}, \dots , P_{4,4}) = 0.01^{n} \times 0.99^{(16-n)}$$

Now, suppose that after some moves we discover that $P_{1,2} = 0$ and $P_{2,1} = 0$ and that $B_{2,1}$ and $B_{1,2}$ are true. Then there are five consistent models in the frontier that we can use to analyze every frontier cell and select the best one.



(a) (b)



$$P(p_{1,3},\ p_{2,2}\ ,p_{3,1}) = 0.01^{3} \times 0.99^{0} = 0.000001$$
$$P(p_{1,3},\ p_{2,2}\ ,\neg p_{3,1}) = 0.01^{2} \times 0.99^{1} = 0.000099$$
$$P(p_{1,3},\ \neg p_{2,2}\ ,p_{3,1}) = 0.01^{2} \times 0.99^{1} = 0.000099$$
$$P(\neg p_{1,3},\ p_{2,2}\ ,p_{3,1}) = 0.01^{2} \times 0.99^{1} = 0.000099$$
$$P(\neg p_{1,3},\ p_{2,2}\ ,\neg p_{3,1}) = 0.01^{1} \times 0.99^{2} = 0.009801$$

$$P(P_{1,3} \mid known,\ b) \ = \ \alpha \times \ < P_{1,3} = True \mid known,\ b);\ P_{1,3} = False \mid known,\ b) >$$

$$P(P_{1,3} \mid known,\ b) \ = \ \alpha \times \ < 0.000001 + 0.000099 + 0.000099;\ 0.000099 + 0.009801) >$$
$$P(P_{1,3} \mid known,\ b) \ = \ \alpha \times \ < 0.000199;\ 0.0099) >$$
$$P(P_{1,3} \mid known,\ b) \ = \ < 0.000199/0.010099;\ 0.0099/0.010099) >$$
$$P(P_{1,3} \mid known,\ b) \ \simeq \ < 0.0197;\ 0.9803 >$$

$$P(P_{2,2} \mid known,\ b) = \alpha \times \ < P_{2,2} = True \mid known,\ b) :\ P_{2,2} = False \mid known,\ b) >$$
$$P(P_{2,2} \mid known,\ b) = \alpha \times \ < 0.000001 + 0.000099 + 0.000099 + 0.009801;\ 0.000099 >$$
$$P(P_{2,2} \mid known,\ b) = \alpha \times \ < 0.01;\ 0.000099 >$$
$$P(P_{2,2} \mid known,\ b) = \ < 0.01 / 0.010099;\ 0.000099 / 0.010099 >$$
$$P(P_{2,2} \mid known,\ b) \simeq \ < 0.9902;\ 0.0098 >$$

The probabilistic agent will not choose $P_{2,2}$ for sure!

A logical agent would use a lot of resources just to arrive a situation where it will have to take risk to select the next cell between possible ones to go (in the frontier here). A logical agent does not have the required information here to make a good choice. Then, it could try to improvise and select a random cell between the risk ones. Based on our own example, the probability that the agent select $P_{2,2}$ as the next step is $1/3$. And we already know that it is not a good decision.

Another option for the logical agent is to make the decision based on the cell that presents the greatest number of consistent models (in its own belief states) where the cell has no pit al all. Looking at the consistent models we see that there are 2 models (of five) where $P_{3,1}$ is *false* and 1 model (of five) where $P_{2,2}$ is *false*. In this case the agent would select to move to $P_{3,1}$ (the same choice than the probabilistic agent does).