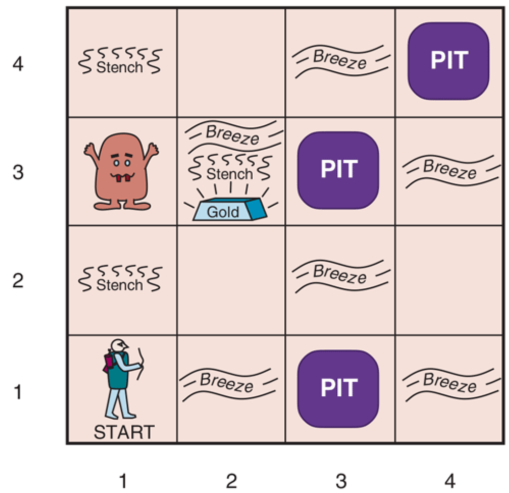
A5 – 20 points each

1. A world model consists of three variables, A, B, and C. The domain of each variable is True and False
    a. How many worlds are possible?
    b. If our knowledge base is A = True and B = False, show whether or not $(A \land C) \lor \neg B$ is entailed by model checking.

Questions 2 and 3 ask you to use portions of the knowledge base for Wumpus world. In both cases, you do not need to write the entire knowledge base, just the portions that are relevant. The figure only applies to question 2.



2. Consider the Wumpus world of Fig. 7.2 in your book (repeated here for your convenience) with an x, y coordinate system, e.g., the Wumpus is at 1,3.
    a. An agent faces east at position 4,3 and moves forward. What percepts does the agent receive?
    b. Write a set of logical sentences (see section 7.4.3) that describe the predicates that can be inferred by a stench percept when an agent is at 1,4, and the knowledge base consists of:
        - the rules for the Wumpus world (e.g., biconditionals giving the relationship between breezes and pits, Wumpus and stench, etc.).
        - The agent has visited 2,4 and knows $\neg S_{2,4}$.

        Use the inference notation we defined in class (see slide 38 for an example).
3. Proof using the resolution rule: In addition to what we know about the starting conditions of a wumpus world, assume that a stench has been observed at locations (2,1) and (1,2). Write the knowledge base in conjunctive normal form and show whether or not the question $W_{2,2}$ (there is a wumpus at location 2,2) is entailed by the knowledge base using the resolution rule.
4. Let P(B) be the probability that Brazil, the number one ranked FIFA team wins a match in the world cup. Let P(B|australia) be the probability that Brazil wins given that their opponent is the Australian team which is ranked 38th. How would you expect these two probabilities to relate to one another.

For questions 5 and 6, consider the following Bayes net model for surfing which is only loosely grounded in reality. In this boolean model, distant storms (S) and local wind (W) drive the presence of surf (U; surf's up!) which in turn affects the presence of clean surfable waves (C), groms (G; newbie surfers), and the potential to surf through the backdoor (B; type of surfing through the barrel of a wave).

P(S)	true	false
	.02	.98

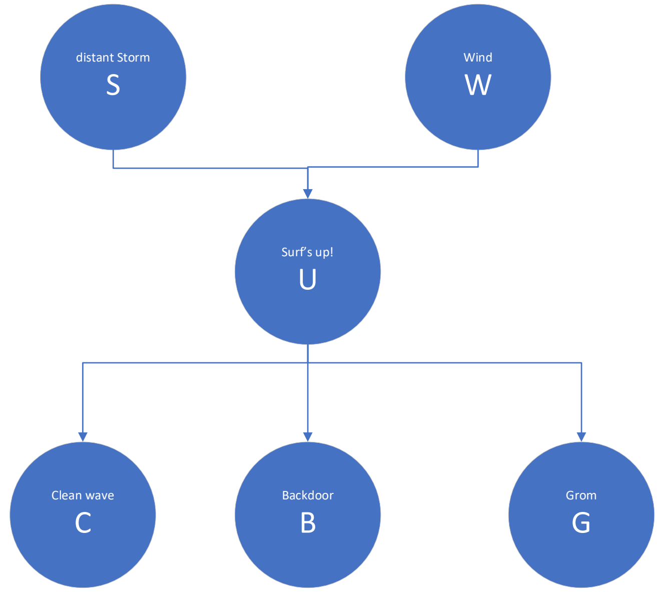
P(W)	true	false
	.55	.45

P(U|S,W)	true	false
false, false	.05	.95
false, true	.60	.40
true, false	.75	.25
true, true	.97	.03

P(C|U)	true	false
true	.5	.5
false	.2	.8

P(B|U)	true	false
true	.10	.90
false	.01	.99

P(G|U)	true	false
true	.15	.85
false	.80	.20



5. Compute the probability of a grom (newbie) surfer being present given that a distant storm is present and there is no local wind generating surf and surf's up being false.

6. Suppose that we know that a distant storm is present, but we do not know whether or not there is a local wind. Calculate the probability of a clean wave (good for surfing) occurring.

7. Consider the following Bayesian coin toss model with two coins

   Initial state probabilities: $\pi = \begin{bmatrix} .6 \\ .4 \end{bmatrix}$

   State transition matrix: A=$\begin{bmatrix} .2 & .8 \\ .1 & .9 \end{bmatrix}$

   State probability distributions: $b_1(x) = \begin{cases} .7 & x = heads \\ .3 & x = tails \end{cases}$,

   $$b_2(x) = \begin{cases} .5 & x = heads \\ .5 & x = tails \end{cases}$$

   Showing your work, compute the all-path probability of H, H, T.