

All of these problems count as bonus problems, i.e. they do not count towards the maximum possible homework problems, but if you solve them they count towards your score.

1. **Belief Quality:** Given the epistemic state shown in Figure 1, what is the quality of  $B$ 's belief that at least one of the cards is spades? How would you express this as a formula, using left and right as the predicates for the left and right card, and  $Q[\alpha]_B$  as the modal operator for " $B$ 's weighted quality of belief is  $\alpha$ "?

2. **Belief Quality:** Given the epistemic state shown in Figure 1, for each of the following sentences, determine if the state is a model for that sentence (and why). Note that left and right refer to the left and right card, respectively, which may either be clubs ( $\clubsuit$ ) or spades ( $\spadesuit$ )

- $Q[> 0.2]_A \text{ left}(\clubsuit)$
- $Q[> 0.4]_A \text{ left}(\clubsuit)$
- $Q[> 0.99]_A \text{ left}(\clubsuit)$
- $Q[> 0.2]_B \text{ right}(\clubsuit)$
- $Q[> 0.4]_B \text{ right}(\clubsuit)$
- $Q[> 0.99]_B \text{ right}(\clubsuit)$

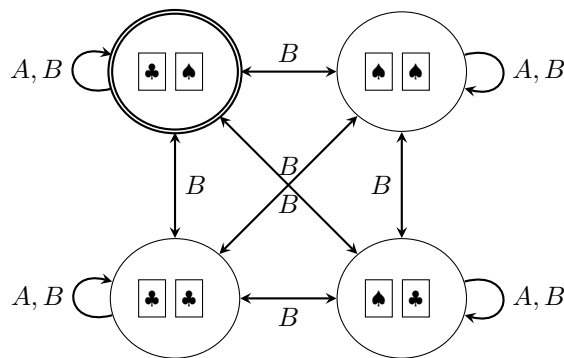


Figure 1: An Epistemic State.

3. **Weighted Belief Quality:** Given the epistemic state shown in Figure 1, assign weights to each world, such that the resulting state is a model for the sentence  $(W[> 0.7]_B \text{ left}(\spadesuit)) \wedge (\neg W[> 0.9]_B \text{ left}(\spadesuit))$

4. **Planning with DEL:** Assume you,  $A$ , have one possible operator,  $\text{claim}(c,s)$ , which is to claim that one of the cards  $c$  (can be **left** or **right**) has a particular suit ( $\spadesuit$  or  $\clubsuit$ ). When you use an action defined by this operator, agent  $B$  will increase the weight of all worlds which are inconsistent with your statement by 1 (i.e. they count lies). Find a plan that causes  $B$  to believe that the left card is a spades with a weighted quality of at least 0.7.

5. **Planning with DEL:** Assume you,  $A$ , have one possible operator,  $\text{claim}(c,s)$ , which is to claim that one of the cards  $c$  (can be **left** or **right**) has a particular suit ( $\spadesuit$  or  $\clubsuit$ ). When you use an action defined by this operator, agent  $B$  will increase the weight of all worlds which are inconsistent with your statement by 1 (i.e. they count lies). Find a plan that causes  $B$  to believe that the the two cards are the same with a weighted quality of at least 0.8.