

SMCDEL Exercises

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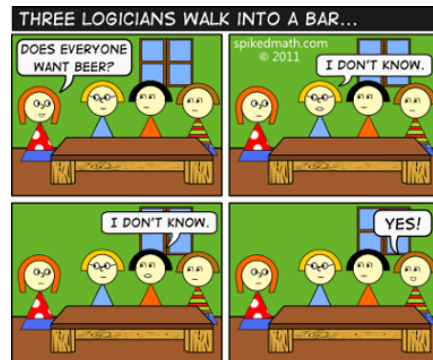
Practicalities

You can use SMCDEL online: <https://w4eg.de/malvin/illc/smcDELweb>. Installing it on your own computer is also possible, but can be a bit difficult because you also need the BDD package HasCacBDD. See <https://github.com/jrclogic/SMCDEL>.

Exercise 1: From Muddy Children to Drinking Logicians

Read and understand the Muddy Children example. Write a model for the drinking logicians and check:

- After the first logician says “I don’t know.” it is common knowledge that she wants beer.
- The sequence of all four announcements is possible iff everyone wants beer.
- After the second logician says “I don’t know.” it is common knowledge that the third logician knows whether everyone wants beer.



Use your model to verify or falsify the following statements:

- After the second logician says “I don’t know.” it is common knowledge that the third logician knows *that* everyone wants beer.
- If the third logician would say *No!* it would be common knowledge that only the first two want beer and the third does not.

Exercise 2: Binary Decision Diagrams

Draw binary decision diagrams for the following formulas and statements. First try to do it by hand, then check your results with *HasCacBDD* or *SCMDEL web*.

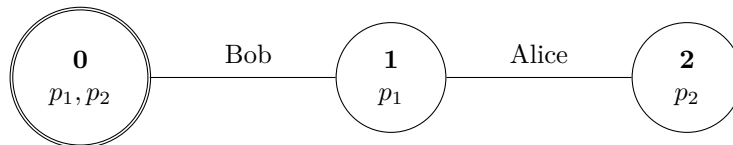
- $p \vee q$
- $(p \wedge q) \rightarrow (p \wedge r)$
- At least one of the propositions p , q and r is true.
- Exactly two of the propositions p , q and r are true.

Exercise 3: Kripke Models and Knowledge Structures

Part i) Find a Kripke model which is equivalent to this knowledge structure:

$$\mathcal{F} = (V = \{p, q, r\}, \theta = (p \vee q) \rightarrow r, O_a = \{p\}, O_b = \{q\})$$

Part ii) Find a knowledge structure which is equivalent to this Kripke model:



Exercise 4: Finding Cheryl's Birthday

The following is Question 24 from the Singapore and Asian Schools Math Olympiad 2015.

Albert and Bernard just become friends with Cheryl, and they want to know when her birthday is. Cheryl gives them a list of 10 possible dates:

May 15, May 16, May 19,
June 17, June 18,
July 14, July 16,
August 14, August 15, August 17

Cheryl then tells Albert and Bernard separately the month and the day of her birthday respectively. Then the following dialogue takes place.

Albert: I don't know when Cheryl's birthday is, but I know that Bernard does not know too.

Bernard: At first I don't know when Cheryl's birthday is, but I know now.

Albert: Now I also know when Cheryl's birthday is.

So when is Cheryl's birthday?

Can you solve this puzzle using SMCDEL?

You can find a solution using DEMO-S5 at <https://w4eg.de/malvin/illc/cheryl>.

Exercise 5: The Dining Cryptographers

Read about the [Dining cryptographers problem on Wikipedia](#), then look at the SMCDEL formalization of it. Extend it to also check the case with four agents.