CK0031: Homework 04

Exercise 04.00 (Events and probability rules).

1. Let A and B be two events and let $P(A \cup B) = 0.7$ and $P(A \cap B) = 0.4$ and $P(A|B) = 0.6$. Calculate $p(A)$, $p(B)$, $p(B|A)$
2. Let A and B be two events and let $P(A) = 3/10$ and $P(B) = 9/10$. Is it possible that $P(A \cap B) = 2/5$? Is it possible that $P(A \cap B) = 3/10$? And, $P(A \cap B) = 1/5$?
3. Let A and B be two independent events and let $P(A) = \alpha$ and $P(B) = \beta$. Calculate $p(A \cup B)$.

Exercise 04.01 (adapted from BRML 1.7). Analyse the Inspector Clouseau example and associated BRMLtoolbox demo (`demoClouseau.m`). Then, repeat the scenario with the restriction that either the Maid or the Butler or neither or both are the murderer(s). Explicitly, the probability of 'the Maid being the murderer and not the Butler' is 0.04, the probability of 'the Butler being the murderer and not the maid' is 0.64, the probability of 'neither being the murderer' is 0.32 and the probability of 'both being the murderers' is 0.00.

Modify the original demo to implement the modified scenario and report on all the probabilities of being the murderer(s), assuming (given) that the knife is the used weapon.

Exercise 04.02 (BRML 1.11). Implement the soft XOR gate example using the BRMLtoolbox. You may find `condpot.m` of use.

Exercise 04.03 (BRML 1.12). Implement the hamburger/KJ-disease example using the BRMLtoolbox for both scenarios (that is, $p(\textit{Hamburger eater}) = 0.5$ and $p(\textit{Hamburger eater}) = 0.001$).

To do so you will need to define the joint distribution $p(\textit{Hamburger eaters}, KJ)$ in which we have

$$\text{dom}(\textit{Hamburger eater}) = \text{dom}(KJ) = \{\texttt{true}, \texttt{false}\}.$$

Exercise 04.04 (BRML 1.13). Implement the two dice example using the BRMLtoolbox.

[*About code*]: As always, if the code is short (i.e., at most 3-page long), it is okay to paste it to your solution sheet. Otherwise, it is more appropriate to either package it together with your solution sheet, or provide a link in your submission for us to download it (Note: If you opt for the link, it is your responsibility to make sure that the link is functioning also after deadline.)

[*About the BRMLtoolbox*]: An official and full Matlab implementation of the toolbox exist. It comes in two flavours: i) object-oriented and ii) non object-oriented. The non-OO implementation is expected to work also with GNU Octave. The official Julia implementation is still incomplete. There is also, at least, one non-official and still incomplete Python implementation.

- `Official Matlab OO, Matlab non-OO and Julia implementations`;
- `Unofficial Python implementation`.