Probabilistic Machine Learning

Exercise Sheet #1

due on Monday, 24 April 2023, 10am sharp

1. **Theory Question** Assume that, if A is true, B becomes more plausible. That is,

$$P(B|A) \geq P(B).$$

Using the rules of probability (sum rule and product rule) as stated in the lecture, show the following relationships (stated in the lecture without proof)

(a) $P(B|\neg A) \leq P(B)$ ("If A is false, B becomes *less* plausible")

(b) $P(A|B) \geq P(A)$ ("If B is true, A becomes *more* plausible")

(c) $P(A|\neg B) \leq P(A)$ ("If B is false, A becomes *less* plausible")

Additionally show that probabilistic reasoning includes Boolean logic as a special case, by showing that if $A \Rightarrow B$ is interpreted as equivalent to $P(B \mid A) = 1$, then the following two statements hold:

(d) $P(\neg A \mid \neg B) = 1$ ("modus tollens")

(e) $P(B \mid \neg A) \leq P(B)$ ("If A is false, B becomes less plausible")

(f) $P(A \mid B) \geq P(A)$ ("if B is true, A becomes more plausible")

2. **Practical Question** Can be found in `Ex01.ipynb`