Bayesian A (difficulty 1)
A patient takes a lab test and the result comes back positive. It is known that the test returns a correct positive result in only 98% of the cases ($p(+|\text{cancer}) = 0.98$) and a correct negative result in only 97% of the cases ($p(-|\text{no cancer}) = 0.97$). Furthermore, only 0.001 of the entire population has this disease.

- What is the probability that this patient has cancer?
- What is the probability that he does not have cancer?
- What is the diagnosis?

Bayesian C (difficulty 1)
Assume you calculated the posterior probabilities of the state $k \in \{1, \ldots, 4\}$ as $p_{K|X}(\cdot | x) = 0.4, 0.2, 0.2, 0.2$, respectively. The task is to decide whether $k = 1$. What is the optimal Bayesian decision in the following cases (explain):

- if the penalty for the wrong decision is constant;
- if mistakenly deciding $k = 1$ costs twice more than mistakenly deciding that $k \neq 1$.

Bayesian D (difficulty 2)
A digital signal transmitting system reads 3 binary digits and for $i$th digit outputs the probability that the digit is 1, the resulting numbers are $0.3, 0.4, 0.7$. It is known that the true digits form an error correcting code where the last digit is always the sum (modulo 2) of the first two digits.

- Recognize which number is encoded by the first two digits.
- Decide whether this packet of 3 digits has to be requested again considering that the cost of skipping an error is 100 more than requesting to repeated the packet.

Bayesian D (difficulty 4)
A student prepares to the exam. There are $K$ tickets in total, one for each lecture. Because the lectures are sequential, he prepares sequentially. He learns the first ticket with probability $q$. If he already learned $k$ tickets, he learns the next one again with probability $q$ or otherwise stops preparing.

At the exam a ticket is drawn randomly. Assume the student answered well the ticket with number $x$. The task is to recognize whether he has prepared at least half of the tickets (assume $K$ is even). Model the problem as a Bayesian decision:

1. in this problem what is the hidden state, observation, decision?
2. What is the probability that he learned at least half of the tickets?
3. Derive the optimal Bayesian decision strategy.