CMPT 310, Spring 2019, Written Assignment 06

Due date: February 25, 2019

Problem 1. After your yearly checkup, the doctor has bad news and good news. The bad news is that you tested positive for a serious disease and that the test is 99% accurate (i.e., the probability of testing positive when you do have the disease is 0.99, as is the probability of testing negative when you don't have the disease). The good news is that this is a rare disease, striking only 1 in 10,000 people of your age. Why is it good news that the disease is rare? What are the chances that you actually have the disease?

Problem 2. Considering the set of all possible five-card poker hands dealt fairly from a standard deck of fifty-two card.

(a) How many atomic events are there in the joint probability distribution (i.e., how many five-cards hands are there)?

(b) What is the probability of each atomic event?

(c) What is the probability of being dealt a royal straight flush? Four of a kind?

Problem 3 (Optional). Suppose you are given a coin that lands *heads* with probability x and *tails* with probability $1-x$. Are the outcomes of successive flips of the coin independent of each other given that you know the value of x? Are the outcomes of successive flips of the coin independent of each other if you do *not* know the value of x? Justify your answer.

Problem 4 (Optional). Show that the three forms of independence in Equation 1 are equivalent.

$$P(a|b) = P(a) \text{ or } P(b|a) = P(b) \text{ or } P(a \wedge b) = P(a)P(b) \tag{1}$$

Problem 5 (Optional). We wish to transmit an n-bit message to a receiving agent. The bits in the message are independently corrupted (flipped) during transmission with ϵ probability each. With an extra parity bit send along with the original information, a message can be corrected by the receiver if at most one bit in the entire message (including the parity bit) has been corrupted. Suppose we want to ensure that the correct message is received with probability at least $1 - \delta$. What is the maximum feasible value of n? Calculate this value for the case $\epsilon = 0.001, \delta = 0.01$.