N. Bertschinger
M. Kaschube
V. Ramesh

Machine Learning I
Exercise Sheet 1
Due on Monday, November 7, 12:15

Exercise 1. *Give a real-world example of a joint distribution $P(x, y)$ where x is discrete and y is continuous.* **1 point**

Exercise 2. *What remains if I marginalize a joint distribution $P(v, w, x, y, z)$ over five variables with respect to variables w and y? What remains if I marginalize the resulting distribution with respect to v?* **1 point**

Exercise 3. *If variables x and y are independent and variables x and z are independent, does it follow that variables y and z are independent?* **1 point**

Exercise 4. *Show that the following relation is true:*

$$P(w, x, y, z) = P(x, y)P(z|w, x, y)P(w|x, y)$$

2 points

Exercise 5. *In my pocket there are two coins. Coin 1 is unbiased, so the likelihood $P(h = 1|c = 1)$ of getting heads is 0.5 and the likelihood $P(h = 0|c = 1)$ of getting tails is also 0.5. Coin 2 is biased, so the likelihood $P(h = 1|c = 2)$ of getting heads is 0.8 and the likelihood $P(h = 0|c = 2)$ of getting tails is 0.2. I reach into my pocket and draw one of the coins at random. There is an equal prior probability I might have picked either coin. I flip the coin and observe a head. Use Bayes' rule to compute the posterior probability that I chose coin 2.* **3 points**

Exercise 6. *Consider a biased die where the probabilities of rolling sides $\{1, 2, 3, 4, 5, 6\}$ are $\{1/12, 1/12, 1/12, 1/12, 1/6, 1/2\}$, respectively. What is the expected value of the die? If I roll the die twice, what is the expected value of the sum of the two rolls?* **2 points**