University of Salzburg — Lecturer: Roland Kwitt

Machine Learning (911.236)

Exercise sheet **A**

Background (Probability, inequalities, ...)

Exercise 1. 1 P.

Let X be a random variable that captures rolling a fair dice with 6 sides. Use Markov's inequality to bound $\mathbb{P}[X \geq 4]$ and also compute the exact probability. Is the bound loose or tight?

Exercise 2. 2 P.

Assume we have a random variable X which takes on values > -90 and we know $\mathbb{E}[X] = -30$. Bound $\mathbb{P}[X \geq -20]$.

Hint: How about defining a new (appropriate) random variable Y such that we can apply Markov's inequality?

Exercise 3. 2 P.

Consider the following problem with (binary) inputs $x_i \in \{0, 1\}$, $i = 1, \ldots, 4$ and (binary) output $y \in \{0, 1\}$:

x_1	x_2	x_3	x_4	y
1	0	0	1	0
1	1	0	1	1
1	0	1	1	1
1	0	0	0	0
⋮	⋮	⋮	⋮	⋮

Lets say our learning objective is to learn a function

$$y = f(x_1, x_2, x_3, x_4)$$

which maps our four boolean inputs to one boolean output $y \in \{0, 1\}$. To get a feeling for the (size of the) problem, we want to know how many such functions exist? When you have the solution, think about what happens for n inputs $x_1, \ldots, x_n$? What do you think is the big problem here? Plot the number of functions as a function of the number of inputs n.

Total #points: 5 P.