

### Exercise 1: Multiclass Classification with 0-1-Loss

Assume that the feature space is  $\mathcal{X} = \{1, \dots, 10\}$  and we are facing a multiclass classification learning problem with 10 classes, i.e.,  $\mathcal{Y} = \{1, \dots, 10\}$ . We consider the 0-1-loss:

$$L_{0-1}(y, h(\mathbf{x})) = \mathbb{1}_{\{y \neq h(\mathbf{x})\}},$$

where  $h$  is an element of  $\mathcal{H} = \{h : \mathcal{X} \rightarrow \mathcal{Y}\}$ . Further, suppose that  $p_x \sim \text{Unif}\{1, \dots, 10\}$  and that  $p_{y|x=x} \sim \text{Unif}\{1, \dots, x\}$ .

(i) What is  $h^*$ ?

(ii) What is its theoretical risk? (Hint:  $\sum_{i=1}^{10} \frac{1}{i} = \frac{7381}{2520}$ )

(iii) What is  $\bar{h}$ , i.e., the optimal constant model in terms of the theoretical risk we derived on Exercise Sheet 02?

(iv) What is its risk?

(v) Quiz time: Log in to Particify (<https://partici.fi/63221686>) and try to answer the questions for **Week 5**.