# Quiz: Chapter 1 definitions

**Definition 1.** The *perceptron hypothesis class* is defined to be

$$\mathcal{H} = \left\{ \mathbf{x} \mapsto \text{sign}(\mathbf{w}^T \mathbf{x}) : \mathbf{w} \in \mathbb{R}^d \right\},$$

where

$$\text{sign}(a) = \begin{cases} +1 & \text{if } a > 0 \\ -1 & \text{if } a < 0. \end{cases}$$

**Definition 2.** The *in-sample error* is defined to be

$$E_{\text{in}}(h) = \frac{1}{N} \sum_{i=1}^{N} [\![ h(\mathbf{x}_i) \neq y_i ]\!].$$

**Definition 3.** The *out-of-sample error* is defined to be

$$E_{\text{out}}(h) = \mathbb{P}\left( h(\mathbf{x}) \neq y \right).$$

**Definition 4.** The *test error* is defined to be

$$E_{\text{test}}(h) = \frac{1}{N_{\text{test}}} \sum_{i=1}^{N_{\text{test}}} [\![ h(\mathbf{x}_i) \neq y_i ]\!].$$

**Definition 5.** The *generalization error* of a hypothesis $g$ is defined to be

$$|E_{\text{in}}(g) - E_{\text{out}}(g)|.$$

**Definition 6.** The *true label function* is defined to be

$$f = \arg\min_{h \in \mathcal{H}^*} E_{\text{out}}(h),$$

where $\mathcal{H}^*$ is the union of all hypothesis classes.

**Definition 7.** The *true error* (also called the *bayes error*) is defined to be

$$E_{\text{out}}(f).$$