Quiz: Chapter 2

Printed Name:

Quiz rules:

1. You MAY use:

   (a) any notes (handwritten, printed, or electronic),

   (b) any computer programs (including websites like WolframAlpha or ChatGPT), and

   (c) any additional scratch paper.

2. You MAY NOT communicate with another student.

3. If you finish the quiz early, stay seated. I will collect all the quizzes at the same time.

Problem 1. For each statement below, circle `True` if the statement is known to be true, `False` if the statement is known to be false, and `Open` if the statement is not known to be either true or false. You will receive +2 point for each correct answer, **-1 points for each incorrect answer**, and 0 points for each blank answer.

1. `True`   `False`   `Open`   Let $\mathcal{H}_1$ and $\mathcal{H}_2$ be two hypothesis classes with $\mathcal{H}_2 \subseteq \mathcal{H}_1$. Then $d_{\mathrm{VC}}(\mathcal{H}_1) \geq d_{\mathrm{VC}}(\mathcal{H}_2)$.

2. `True`   `False`   `Open`   Let $\mathcal{H}_1$ and $\mathcal{H}_2$ be two hypothesis classes with $d_{\mathrm{VC}}(\mathcal{H}_1) \geq d_{\mathrm{VC}}(\mathcal{H}_2)$. Then if $\mathcal{H}_1$ can shatter some dataset X, then it is guaranteed that $\mathcal{H}_2$ will also be able to shatter that same dataset.

3. `True`   `False`   `Open`   Let $\mathcal{H}$ be a hypothesis class and X a dataset of size N. If $\mathcal{H}$ cannot shatter X, then $m_{\mathcal{H}}(N)$ must be strictly less than 2^N.

4. `True`   `False`   `Open`   Define the hypothesis class of concentric circles as

$$\mathcal{H}_{\text{circles}} = \left\{ \mathbf{x} \mapsto [\![\|\mathbf{x}\|_2 \geq \alpha]\!] : \alpha \in \mathbb{R} \right\}.$$

If $d \geq 100$, then 5 is guaranteed to be a breakpoint for $\mathcal{H}_{\text{circles}}$.