

Homework 2

CIS4930/5930

Due in-class, Friday Sep. 27

Instructions: Graduate students must complete all problems. Undergraduates may receive extra credit for working problems marked with (*). Show all work for full credit. Partial credit for incomplete / incorrect arguments will be given at the discretion of the instructor / TA.

1. (5 points) Let $\mathcal{H}$ be the family of threshold functions over the real line: $\mathcal{H} = \{x \mapsto 1_{x \leq \theta} : \theta \in \mathbb{R}\} \cup \{x \mapsto 1_{x \geq \theta} : \theta \in \mathbb{R}\}$. Give an upper bound on the growth function $\Pi_m(\mathcal{H})$. Use that to derive an upper bound on the Rademacher complexity $\mathcal{R}_m(\mathcal{H})$.
2. (2 points) Let $\mathcal{H}$ be any hypothesis class and let $g : X \rightarrow \mathbb{R}$. Define $H - g = \{x \mapsto h(x) - g(x) : h \in H\}$. Show that $\mathcal{R}_m(\mathcal{H}) = \mathcal{R}_m(\mathcal{H} - g)$.
3. (3 points) Give an example of two infinite hypothesis classes $\mathcal{H}, \mathcal{F}$, satisfying (i) $\mathcal{H} \subseteq \mathcal{F}$, and (ii) $\mathcal{R}_m(\mathcal{H}) < \mathcal{R}_m(\mathcal{F})$. Show explicitly that (ii) holds.
4. (5 points) MRT, exercise 3.6.
5. (*) (5 points) MRT, exercise 3.8.