The Mathematics of Machine Learning
Homework Set 10

Due 25 May 2022 before midnight
via Canvas

You are allowed to work on this homework in pairs. One person per pair submits the answers via Canvas. Make sure to put both names on the submission.

With the exam week approaching, this homework is intended to be less work than the other homeworks, but you also have to finish one day earlier than in previous weeks:

Note the early submission deadline on Wednesday!

1 The Double Descent Phenomenon

Read the paper by Belkin et al. [2019] in sufficient detail to understand what is being shown in Figure 3.

1. [1 pt] At approximately which number of parameters are the peaks observed?
2. [1 pt] To which number of hidden units H does this correspond?
3. [1 pt] How does the number of parameters at which the peak occur compare to the sample size n?
4. [1 pt] Is the 0/1-loss exactly equal to 0 at the peak?
5. [2 pt] Compare the shape of the plots to the usual bias-variance trade-off shown in Figure 2.11 in the Elements of Statistical Learning book. How does the behavior of the train and test errors differ? Why is this surprising?

References

M. Belkin, D. Hsu, S. Ma, and S. Mandal. Reconciling modern machine-learning practice and the classical bias-variance trade-off. *Proceedings of the National Academy of Sciences*, 116(32):15849–15854, 2019. doi: 10.1073/pnas.1903070116. URL `https://www.pnas.org/doi/abs/10.1073/pnas.1903070116`.