eCornell

CHEAT SHEET

Kernels

Algorithm Name	Kernel Trick
Description	A way to reduce model bias and allows us to learn a linear model efficiently in high dimensional space.
Applicability	Any ERM paradigm. Essentially replacing all inner products with a kernel function.
Assumptions	The loss function can be expressed as inner products of the datapoints. The kernel function has to be positive semi-definite.
Underlying Mathematical Principles	Kernel function Positive semi definite matrix
Examples of Kernel Functions	**Linear:** $\mathsf{K}(\mathbf{x}, \mathbf{z}) = \mathbf{x}^\top \mathbf{z}$ **RBF:** $\mathsf{K}(\mathbf{x}, \mathbf{z}) = e^{\frac{-\|\mathbf{x}-\mathbf{z}\|^2}{\sigma^2}}$ **Polynomial:** $\mathsf{K}(\mathbf{x}, \mathbf{z}) = (1 + \mathbf{x}^\top \mathbf{z})^d$
Examples of Kernelizable Algorithms	SVM Logistic regression Ridge regression
Additional Details	Kernelized SVM is one of the most widely used kernelized ML models. A lot of the packages allow users to specify different kernels, such as the following: **scikit-learn:** https://scikit-learn.org/stable/modules/svm.html **libsvm:** https://www.csie.ntu.edu.tw/~cjlin/libsvm/