Machine Learning II: Assignment #3
14 performance points (max),
email: PDF+code to jan.nagler@gmail.com
due: Wed, April 25, 2024

1. Study the uploaded EM Python Notebook!

2. Expectation-Maximization (EM), 14 Points, if EM task is unique among submissions; if not, max 12 Points; so better do not copy or spread your ideas

   Implement for a useful nontrivial use case of your choice the EM Algorithm (e.g., three coins, two dice, two Gaussians, two different non-Gaussians), surrogate data creation included. Nice documentation, commenting, presentations, take homes and animations are welcome.

   In addition, the best submission receives a mystery reward (if unique).

3. OPTIONAL TASK: Unlucky Optimization Competition (No Points but Chocolate Award)

   Modify the Expectation-Maximization (EM) Python program for the two coins, as discussed in class. Generate unrepresentative series of exactly $n = 125$ total coin flips (5 times 25 flips with a randomly selected coin), given two coins are chosen with equal probability (1/2). The coins must have the following heads biases, $\theta_A = 0.9$ (coin A), and $\theta_B = 0.1$ (coin B), and the generation must follow exactly this random process. In a nutshell, the task is to generate a series of (H)eads and (T)ails that are highly unlikely, given the ground truth, by brute forcing an unlucky realization by massive repetitions. The more realizations you generate and scan, the better will be the score, so it is about optimization (and computational power). Monitor the MLE estimates for $\hat{\theta}_A$ and $\hat{\theta}_B$. The solution with the largest value of $score = \min[abs(\log(\hat{\theta}_A/\theta_A)), abs(\log(\hat{\theta}_B/\theta_B))]$ (that you need to compute and print) wins a price, handed over by the lecturer but only if this value is unique among the submissions. If it is not, the 2nd largest score wins, if unique, and so on. If there is no winner, the present may, sadly, be thrown out of one randomly selected window. Good unluck!