Thomas Kesselheim
Anna Heuser

December 11, 2023
Due: December 18, 2023 at 10:00 p.m.

Algorithms and Uncertainty

Winter Term 2023/24

Exercise Set 10

If you want to hand in your solutions for this problem set, please send them via email to anna.heuser@uni-bonn.de *by Monday evening – make sure to send a pdf-file which contains your name and your email address. Of course, submitting solutions in groups is also possible.*

If you would like to present one of the solutions in class, please also send an email to anna.heuser@uni-bonn.de *containing the* ***task*** *which you would like to present and in* ***which of the tutorials*** *you would like to do so. Deadline for the email is Monday, 10:00 pm. Please note that the tasks will be allocated via a first-come-first-served procedure, so sending this email earlier than Monday evening is highly recommended.*

Exercise 1: (4 Points)
Consider the following explore-exploit algorithm. In the first $\frac{T}{2}$ steps (so $k = \frac{T}{2n}$), we explore. Afterwards, we exploit the most promising arm. Use the approach from Lecture 17 to derive an upper-bound for the expected regret of this algorithm.

Exercise 2: (4 Points)
Consider the modified update rule for Multiplicative Weights that sets $w_i^{(t+1)} = w_i^{(t)} \cdot (1 - \ell_i^{(t)} \eta)$. Show that Theorem 18.3 still holds.

Exercise 3: (4 Points)
We consider a generalization of the algorithm *Weighted Majority* for classifiers with k different classes. (The case covered in the lecture, binary classification, is $k = 2$.) In each step, the algorithm chooses a class, which is recommended by the largest number of classifiers (so the class has a plurality).
Show that this algorithm makes at most $(2 + 2\eta) \min m_i + 2 \ln n/\eta$ errors, where m_i is the number of errors of classifier i.