

# Modern Algorithm Design : Quiz 4

Full Marks : 15

Time : 40 minutes

2/12/2024

**Problem 1.** (5 points) Recall that we had analyzed an algorithm MAJORITY in class for the  $\{0, 1\}$  experts problem. We showed that the number of mistakes made by this algorithm is at most  $\mathcal{O}(\log n)$ , where  $n$  is the number of experts. Give an example to show that the analysis is tight - that is there is an instance such that MAJORITY will indeed make  $\Omega(\log n)$  mistakes. Note that you need to be the adversary to fool the algorithm.

**Problem 2.** (5 points) Consider the bin packing problem done in lecture. Show that if all items are of size less than  $\varepsilon$ , then the First-Fit algorithm uses at most  $(1 + \varepsilon)OPT$  many bins where  $OPT$  is the number of bins used by an optimal solution. (Hint: how much is each bin of First-Fit occupied?)

**Problem 3.** (5 points) Consider the  $\{0, 1\}$  experts game again with  $n$  experts. Let us forget about all the smart algorithms we studied and instead just consider the following greedy algorithm. On day  $t$ , just choose the expert that has made the least number of cumulative mistakes so far and follow him/her. Show an example where this algorithm can make at least  $n - 1$  times as many mistakes as the best expert.