Homework of Week 3

Deadline: 9:00am, November 12 (Thursday), 2020

1. The set balancing problem aims at dividing the data into two groups that are balanced in every feature. We formulate it into the problem of finding $b \in \{-1, 1\}^m$ such that $\|Ab\|_\infty$ is minimized. Now suppose the objective is not balanced but 1:2 in every feature. Obviously, the domain of the vector b should not be $\{-1, 1\}^m$. Then, what should the domain be? Please design an approximate algorithm for finding the optimum b and show that $\|Ab\|_\infty$ is small with high probability.

2. Suppose X is a Bernoulli random variable with $\Pr(X = 1) = \frac{1}{2}$. Calculate $I(\frac{5}{6}) \triangleq \sup_{\lambda>0} \frac{5\lambda}{6} - \ln \mathbb{E}[e^{\lambda X}]$. Compare the result with 0.2426.

3. Do Bernoulli experiment for 20 trials, using a new 1-Yuan coin. Record the result in a string $s_1 s_2 ... s_i ... s_{20}$, where s_i is 1 if the i^{th} trial gets Head, and otherwise is 0.