

Group Testing Exercise

Due May 14, 2026

1. Find a counterfeit coin in a set of 12 coins with as less steps as possible by using a weighing machine and adaptive algorithms. (The counterfeit coin may be heavier or lighter than a good coin.) Extend your algorithm to find one in a set of n coins.
2. Explain Hwang's "Generalized binary splitting algorithm G " in more details. Mainly, prove that $M_G(d, n) - M(d, n) \leq d - 1$.
3. Describe Li's s -stage algorithm in more details. (You may refer to his work: A sequential method for screening experimental variables in J. A. S. A.)
4. Find $M(2, n)$ for as many n as possible. Note that we may say n is of type 1 if $M(2, n)$ is equal to its information lower bound and type 2 otherwise. For example, $2^k + 1$ is of type one and 2^k is of type 2 for each positive integer k .
5. (a) Does there exist an 8×12 $(0, 1)$ -matrix which is 2-separable? Explain your answer in more details.
(b) Does there exist an 8×12 $(0, 1)$ -matrix which is 2-disjunct? Explain your answer in more details.
6. Use probabilistic method to construct a t by v $(3 ; 3)$ -disjunct matrix with t as small as possible. (Let $v = 30$.)
7. What is the Lovasz Local Lemma? Use a couple of examples to explain how to apply the Lemma.
8. If we are allowed to lie once in reporting the outcomes of adaptive algorithms, how many tests (as less as possible) do we need to find a hidden number in $[1, 63]$ by using an adaptive algorithm.
9. Let the defectives be complexes of size two. Find an efficient algorithm to find two defectives in 30 items.
10. Give five different applications of group testing. (Explain how the group testing be utilized.)