

Preface

Group testing has been around for fifty years. It started as an idea to do large scale blood testing economically. When such needs subsided, group testing stayed dormant for many years until it was revived with needs for new industrial testing. Later, group testing also emerged from many nontesting situations, such as experimental designs, multiaccess communication, coding theory, clone library screening, nonlinear optimization, computational complexity, etc.. With a potential world-wide outbreak of AIDS, group testing just might go the full cycle and becomes an effective tool in blood testing again. Another fertile area for application is testing zonal environmental pollution.

Group testing literature can be generally divided into two types, probabilistic and combinatorial. In the former, a probability model is used to describe the distribution of defectives, and the goal is to minimize the expected number of tests. In the latter, a deterministic model is used and the goal is usually to minimize the number of tests under a worst-case scenario. While both types are important, we will focus on the second type in this book because of the different flavors for these two types of results.

To find optimal algorithms for combinatorial group testing is difficult, and there are not many optimal results in the existing literature. In fact, the computational complexity of combinatorial group testing has not been determined. We suspect that the general problem is hard in some complexity class, but do not know which class. (It has been known that the problem belongs to the class PSPACE, but seems not PSPACE-complete.) The difficulty is that the input consists of two or more integers, which is too simple for complexity analysis. However, even if a proof of hardness will eventually be given, this does not spell the end of the subject, since the subject has many, many branches each posing a different set of challenging problems.

This book is not only the first attempt to collect all theory and applications about combinatorial group testing in one place, but it also carries the personal perspective of the authors who have worked on this subject for a quarter of a century. We hope that this book will provide a forum and focus for further research on this subject, and also be a source for references and publications. Finally, we thank E. Barillot, A.T. Borchers, R.V. Book, G.J. Chang, F.R.K. Chung, A.G. Dyachkov, D. Kelley, K.-I Ko, M. Parnes, D. Raghavarao, M. Ruzinko, V.V. Rykov, J. Spencer, M. Sobel, U. Vaccaro, and A.C. Yao for giving us encouragements and helpful discussions at various stage of the formation of this book. Of course, the oversights and errors are our sole responsibility.