

PREFACE

Part One

Since fall semester, 2000, Professor Stephen S-T Yau organized a seminar on Bioinformatics and started the research study, I am an active participant since. Also Professor Yee-Kin Ho from Department of Biochemistry and Molecular Biology, University of Illinois at Chicago, is an enthusiast about the seminar. Other early or late participants in the seminar are Professor Yau's students and Ph. D. candidates. They are Amir Neknadj, Changchuan Yin, Chaoxiao Lu, Libin Liu, Armah Ebenezer, Bo Zhao, Mo Dang and so on. Dr. Ning Jin and Professor Naicheng Li also participated the seminar when they were visiting UIC. Especially, in the past nine more years we asked panel of professors or experts in the fields of Bioinformatics, computational Molecular Biology, Bioengineering, Biology and their related disciplines, to give us some talks in the seminar. Those presentations are inspiring and helpful for our research.

In the seminar, we studied some basic concepts of Biology, then we might use mathematical methods to investigate the biological problems; discussed the numerical and graphical representations for DNA sequence and protein sequence; suggested the new idea of the graphical representation of DNA sequence without degeneracy; used spectrum analysis of discrete Fourier transform for predicting the protein coding regions in DNA sequence and for doing protein comparison; applied wavelet transform to protein analysis and DNA sequence comparison; introduced dynamic model, principal component analysis, generalized singular value decomposition technique and statistics methods for microarray analysis; recommended the genome space concept developed a new research range opened up some new methods such as several novel clustering techniques, moment vector method and so on; focused on the study of origins and evolution of human immunodeficiency virus (HIV) which illustrated the efficiency and the practicality of the genome space; tried several methods for protein analysis such as support vector machines and so on, and investigated some mathematically theoretical problems came from the Bioinformatics research, for instance, fast algorithm of 3-base periodicity and its theoretical base, the interesting result of total Fourier spectrum, missing data inputting and the proof of the properties of the matrix

corresponding to the quadrate form yielding by the Fourier spectrum of the real sequence, and so on.

The contents of this book are consist of the Ph. D. theses written by Dr. Changchuan Yin and Dr. Libin Liu; several reports that were presented in the seminar by the participants; a few notes that I took and the published papers written by professor Yau, Chenglong Yu, Department of Mathematics, The Chinese University of Hong Kong, Rong He, Department of Pharmacology, University of Illinois at Chicago, Weiqun Wang, Department of Human Nutrition, Kansas State University, me, and so on. And many papers we discussed in the seminar are referenced in the book. This book is a summarization of our study on numerical methods in Bioinformatics. It should say that all the persons mentioned above are the authors, and their contributions in the seminar or in the papers published helped me to bring in the writing of this book.

I would like to thank the Ph. D. candidates, Bo Zhao and Mo Dong, for helping me collect some papers and draw several figures.

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Part Two

In fall 2010, Professor Guoqing Liu from School of Science, Nanjing University of Technology, organized the seminar on Bioinformatics studies for both graduate students and teachers from College of Biotechnology and Pharmaceutical Engineering and College of Automation and Electrical Engineering. I attended the seminar, and lectured based on the content of this book. There are a lot of helpful discussions, and the participants made a lot of suggestions, especially from Associate Professor Ming Yan from College of Biotechnology and Pharmaceutical Engineering who has taught Bioinformatics course many times in his college. Professor Yan made valuable improvements on the subject of biology, and rewrote the first chapter of the book. We started the revision in the summer of 2011, and finished at the end of 2011.

The authors want to express gratitude towards the group who attended the seminar. They have made valuable suggestion for the final revision of this book.

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