

Alberto Apostolico Concettina Guerra  
Sorin Istrail Pavel Pevzner  
Michael Waterman (Eds.)

LNBI 3909

# Research in Computational Molecular Biology

10th Annual International Conference, RECOMB 2006  
Venice, Italy, April 2006  
Proceedings



Springer

Q7-53  
R433  
2006

Alberto Apostolico Concettina Guerra  
Sorin Istrail Pavel Pevzner  
Michael Waterman (Eds.)

# Research in Computational Molecular Biology

10th Annual International Conference, RECOMB 2006  
Venice, Italy, April 2-5, 2006  
Proceedings



E200603520



Springer

## Series Editors

Sorin Istrail, Brown University, Providence, RI, USA  
Pavel Pevzner, University of California, San Diego, CA, USA  
Michael Waterman, University of Southern California, Los Angeles, CA, USA

## Volume Editors

Alberto Apostolico  
Concettina Guerra  
University of Padova, Department of Information Engineering  
Via Gradenigo 6/a, 35131 Padova, Italy  
E-mail: {axa, guerra}@dei.unipd.it

Sorin Istrail  
Brown University, Center for Molecular Biology and Computer Science Department  
115 Waterman St., Providence, RI 02912, USA  
E-mail: sorin@cs.brown.edu

Pavel Pevzner  
University of California at San Diego  
Department of Computer Science and Engineering  
La Jolla, CA 92093-0114, USA  
E-mail: ppevzner@cs.ucsd.edu

Michael Waterman  
University of Southern California  
Department of Molecular and Computational Biology  
1050 Childs Way, Los Angeles, CA 90089-2910, USA  
E-mail: msw@usc.edu

Library of Congress Control Number: 2006922626

CR Subject Classification (1998): F.2.2, F.2, E.1, G.2, H.2.8, G.3, I.2, J.3

LNCS Sublibrary: SL 8 – Bioinformatics

|         |                                                       |
|---------|-------------------------------------------------------|
| ISSN    | 0302-9743                                             |
| ISBN-10 | 3-540-33295-2 Springer Berlin Heidelberg New York     |
| ISBN-13 | 978-3-540-33295-4 Springer Berlin Heidelberg New York |

This work is subject to copyright. All rights are reserved, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, re-use of illustrations, recitation, broadcasting, reproduction on microfilms or in any other way, and storage in data banks. Duplication of this publication or parts thereof is permitted only under the provisions of the German Copyright Law of September 9, 1965, in its current version, and permission for use must always be obtained from Springer. Violations are liable to prosecution under the German Copyright Law.

Springer is a part of Springer Science+Business Media

springer.com

© Springer-Verlag Berlin Heidelberg 2006  
Printed in Germany

Typesetting: Camera-ready by author, data conversion by Scientific Publishing Services, Chennai, India  
Printed on acid-free paper SPIN: 11732990 06/3142 5 4 3 2 1 0

Edited by S. Istrail, P. Pevzner, and M. Waterman

Editorial Board: A. Apostolico S. Brunak M. Gelfand  
T. Lengauer S. Miyano G. Myers M.-F. Sagot D. Sankoff  
R. Shamir T. Speed M. Vingron W. Wong

Subseries of Lecture Notes in Computer Science

# Lecture Notes in Bioinformatics

Vol. 3916: J. Li, Q. Yang, A.-H. Tan (Eds.), *Data Mining for Biomedical Applications*. VIII, 155 pages. 2006.

Vol. 3909: A. Apostolico, C. Guerra, S. Istrail, P. Pevzner, M. Waterman (Eds.), *Research in Computational Molecular Biology*. XVII, 612 pages. 2006.

Vol. 3886: E.G. Bremer, J. Hakenberg, E.-H.(S.) Han, D. Berrar, W. Dubitzky (Eds.), *Knowledge Discovery in Life Science Literature*. XIV, 147 pages. 2006.

Vol. 3745: J.L. Oliveira, V. Maojo, F. Martín-Sánchez, A.S. Pereira (Eds.), *Biological and Medical Data Analysis*. XII, 422 pages. 2005.

Vol. 3737: C. Priami, E. Merelli, P. Gonzalez, A. Omicini (Eds.), *Transactions on Computational Systems Biology III*. VII, 169 pages. 2005.

Vol. 3695: M.R. Berthold, R.C. Glen, K. Diederichs, O. Kohlbacher, I. Fischer (Eds.), *Computational Life Sciences*. XI, 277 pages. 2005.

Vol. 3692: R. Casadio, G. Myers (Eds.), *Algorithms in Bioinformatics*. X, 436 pages. 2005.

Vol. 3680: C. Priami, A. Zelikovsky (Eds.), *Transactions on Computational Systems Biology II*. IX, 153 pages. 2005.

Vol. 3678: A. McLysaght, D.H. Huson (Eds.), *Comparative Genomics*. VIII, 167 pages. 2005.

Vol. 3615: B. Ludäscher, L. Raschid (Eds.), *Data Integration in the Life Sciences*. XII, 344 pages. 2005.

Vol. 3594: J.C. Setubal, S. Verjovski-Almeida (Eds.), *Advances in Bioinformatics and Computational Biology*. XIV, 258 pages. 2005.

Vol. 3500: S. Miyano, J. Mesirov, S. Kasif, S. Istrail, P.A. Pevzner, M. Waterman (Eds.), *Research in Computational Molecular Biology*. XVII, 632 pages. 2005.

Vol. 3388: J. Lagergren (Ed.), *Comparative Genomics*. VII, 133 pages. 2005.

Vol. 3380: C. Priami (Ed.), *Transactions on Computational Systems Biology I*. IX, 111 pages. 2005.

Vol. 3370: A. Konagaya, K. Satou (Eds.), *Grid Computing in Life Science*. X, 188 pages. 2005.

Vol. 3318: E. Eskin, C. Workman (Eds.), *Regulatory Genomics*. VII, 115 pages. 2005.

Vol. 3240: I. Jonassen, J. Kim (Eds.), *Algorithms in Bioinformatics*. IX, 476 pages. 2004.

Vol. 3082: V. Danos, V. Schachter (Eds.), *Computational Methods in Systems Biology*. IX, 280 pages. 2005.

Vol. 2994: E. Rahm (Ed.), *Data Integration in the Life Sciences*. X, 221 pages. 2004.

Vol. 2983: S. Istrail, M.S. Waterman, A. Clark (Eds.), *Computational Methods for SNPs and Haplotype Inference*. IX, 153 pages. 2004.

Vol. 2812: G. Benson, R.D. M. Page (Eds.), *Algorithms in Bioinformatics*. X, 528 pages. 2003.

Vol. 2666: C. Guerra, S. Istrail (Eds.), *Mathematical Methods for Protein Structure Analysis and Design*. XI, 157 pages. 2003.

## Preface

This volume contains the papers presented at the 10th Annual International Conference on Research in Computational Molecular Biology (RECOMB 2006), which was held in Venice, Italy, on April 2–5, 2006. The RECOMB conference series was started in 1997 by Sorin Istrail, Pavel Pevzner and Michael Waterman. The table on p. VIII summarizes the history of the meetings. RECOMB 2006 was hosted by the University of Padova at the Cinema Palace of the Venice Convention Center, Venice Lido, Italy. It was organized by a committee chaired by Concettina Guerra. A special 10th Anniversary Program Committee was formed, by including the members of the Steering Committee and inviting all Chairs of past editions. The Program Committee consisted of the 38 members whose names are listed on a separate page.

From 212 submissions of high quality, 40 papers were selected for presentation at the meeting, and they appear in these proceedings. The selection was based on reviews and evaluations produced by the Program Committee members as well as by external reviewers, and on a subsequent Web-based PC open forum. Following the decision made in 2005 by the Steering Committee, RECOMB Proceedings are published as a volume of *Lecture Notes in Bioinformatics* (LNBI), which is co-edited by the founders of RECOMB. Traditionally, the *Journal of Computational Biology* devotes a special issue to the publication of archival versions of selected conference papers.

RECOMB 2006 featured seven keynote addresses by as many invited speakers: Anne-Claude Gavin (EMBL, Heidelberg, Germany), David Haussler (University of California, Santa Cruz, USA), Ajay K. Royyuru (IBM T.J. Watson Research Center, USA), David Sankoff (University of Ottawa, Canada), Michael S. Waterman (University of Southern California, USA), Carl Zimmer (Science Writer, USA), Roman A. Zubarev (Uppsala University, Sweden). The Stanislaw Ulam Memorial Computational Biology Lecture was given by Michael S. Waterman. A special feature presentation was devoted to the 10th anniversary and is included in this volume.

Like in the past, an important ingredient for the success of the meeting was represented by a lively poster session.

RECOMB06 was made possible by the hard work and dedication of many, from the Steering to the Program and Organizing Committees, from the external reviewers, to Venice Convention, Venezia Congressi and the institutions and corporations who provided administrative, logistic and financial support for the conference. The latter include the Department of Information Engineering of the University of Padova, the Broad Institute of MIT and Harvard (USA), the College of Computing of Georgia Tech. (USA), the US Department of Energy, IBM Corporation (USA), the International Society for Computational Biology

(ISCB), the Italian Association for Informatics and Automatic Computation (AICA), the US National Science Foundation, and the University of Padova.

Special thanks are due to all those who submitted their papers and posters and who attended RECOMB 2006 with enthusiasm.

April 2006

Alberto Apostolico  
RECOMB 2006 Program Chair

# Organization

## Program Committee

|                     |                                                                          |
|---------------------|--------------------------------------------------------------------------|
| Tatsuya Akutsu      | (Kyoto University, Japan)                                                |
| Alberto Apostolico  | Chair (Accademia Nazionale Dei Lincei, Italy,<br>and Georgia Tech., USA) |
| Gary Benson         | (Boston University, USA)                                                 |
| Mathieu Blanchette  | (McGill, Canada)                                                         |
| Philip E. Bourne    | (University of California San Diego, USA)                                |
| Steve Bryant        | (NCBI, USA)                                                              |
| Andrea Califano     | (Columbia University, USA)                                               |
| Andy Clark          | (Cornell University, USA)                                                |
| Gordon M. Crippen   | (University of Michigan, USA)                                            |
| Raffaele Giancarlo  | (University of Palermo, Italy)                                           |
| Concettina Guerra   | (University of Padova, Italy, and Georgia Tech., USA)                    |
| Dan Gusfield        | (University of California, Davis, USA)                                   |
| Sridhar Hannenhalli | (University of Pennsylvania, USA)                                        |
| Sorin Istrail       | (Brown University, USA)                                                  |
| Inge Jonassen       | (University of Bergen, Norway)                                           |
| Richard M. Karp     | (University of California, Berkeley, USA)                                |
| Simon Kasif         | (Boston University, USA)                                                 |
| Manolis Kellis      | (MIT, USA)                                                               |
| Giuseppe Lancia     | (University of Udine, Italy)                                             |
| Thomas Lengauer     | (GMD Sant Augustin, Germany)                                             |
| Michael Levitt      | (Stanford, USA)                                                          |
| Michal Linial       | (The Hebrew University in Jerusalem, Israel)                             |
| Jill Mesirov        | (Broad Institute of MIT and Harvard, USA)                                |
| Satoru Miyano       | (University of Tokyo, Japan)                                             |
| Gene Myers          | (HHMI, USA)                                                              |
| Laxmi Parida        | (IBM T.J. Watson Research Center, USA)                                   |
| Pavel A. Pevzner    | (University of California San Diego, USA)                                |
| Marie-France Sagot  | (INRIA Rhone-Alpes, France)                                              |
| David Sankoff       | (University of Ottawa, Canada)                                           |
| Ron Shamir          | (Tel Aviv University, Israel)                                            |
| Roded Sharan        | (Tel Aviv University, Israel)                                            |
| Steve Skiena        | (State University of New York at Stony Brook, USA)                       |
| Terry Speed         | (University of California, Berkeley, USA)                                |
| Jens Stoye          | (University of Bielefeld, Germany)                                       |
| Esko Ukkonen        | (University of Helsinki, Finland)                                        |
| Martin Vingron      | (Max Planck Institute for Molecular Genetics,<br>Germany)                |
| Michael Waterman    | (University of Southern California, USA)                                 |
| Haim J. Wolfson     | (Tel Aviv University, Israel)                                            |

Steering Committee

|                  |                                                                 |
|------------------|-----------------------------------------------------------------|
| Sorin Istrail    | RECOMB General Vice-chair (Brown, USA)                          |
| Thomas Lengauer  | (GMD Sant Augustin, Germany)                                    |
| Michal Linial    | (The Hebrew University of Jerusalem, Israel)                    |
| Pavel A. Pevzner | RECOMB General Chair (University of California, San Diego, USA) |
| Ron Shamir       | (Tel Aviv University, Israel)                                   |
| Terence P. Speed | (University of California, Berkeley, USA)                       |
| Michael Waterman | RECOMB General Chair (University of Southern California, USA)   |

Organizing Committee

|                    |                                                                         |
|--------------------|-------------------------------------------------------------------------|
| Alberto Apostolico | (Accademia Nazionale dei Lincei, Italy, and Georgia Tech., USA)         |
| Concettina Guerra  | Conference Chair (University of Padova, Italy, and Georgia Tech., USA)  |
| Eleazar Eskin      | Chair, 10th Anniversary Committee (University of California, San Diego) |
| Matteo Comin       | (University of Padova, Italy)                                           |
| Raffaele Giancarlo | (University of Palermo, Italy)                                          |
| Giuseppe Lancia    | (University of Udine, Italy)                                            |
| Cinzia Pizzi       | (University of Padova, Italy, and Univ. of Helsinki, Finland)           |
| Angela Visco       | (University of Padova, Italy)                                           |
| Nicola Vitacolonna | (University of Udine, Italy)                                            |

Previous RECOMB Meetings

| Date/Location                            | Hosting Institution                              | Program Chair    | Conference Chair             |
|------------------------------------------|--------------------------------------------------|------------------|------------------------------|
| January 20-23, 1997<br>Santa Fe, NM, USA | Sandia National Lab                              | Michael Waterman | Sorin Istrail                |
| March 22-25, 1998<br>New York, NY, USA   | Mt. Sinai School of Medicine                     | Pavel Pevzner    | Gary Benson                  |
| April 22-25, 1999<br>Lyon, France        | INRIA                                            | Sorin Istrail    | Mireille Regnier             |
| April 8-11, 2000<br>Tokyo, Japan         | University of Tokyo                              | Ron Shamir       | Satoru Miyano                |
| April 22-25, 2001<br>Montréal, Canada    | Université de Montréal                           | Thomas Lengauer  | David Sankoff                |
| April 18-21, 2002<br>Washington, DC, USA | Celera                                           | Gene Myers       | Sridhar Hannenhalli          |
| April 10-13, 2003<br>Berlin, Germany     | German Federal Ministry for Education & Research | Webb Miller      | Martin Vingron               |
| March 27-31, 2004<br>San Diego, USA      | UC San Diego                                     | Dan Gusfield     | Philip E. Bourne             |
| May 14-18, 2005<br>Boston, MA, USA       | Broad Institute of MIT and Harvard               | Satoru Miyano    | Jill P. Mesirov and S. Kasif |

**The RECOMB06 Program Committee gratefully acknowledges the valuable input received from the following external reviewers:**

|                       |                      |                   |
|-----------------------|----------------------|-------------------|
| Josep F. Abril        | Oranit Dror          | Juha Kärkkäinen   |
| Mario Albrecht        | Bjarte Dysvik        | Hans-Michael      |
| Gabriela Alexe        | Nadia El-Mabrouk     | Kaltenbach        |
| Julien Allali         | Rani Elkon           | Simon Kasif       |
| Miguel Andrade        | Sean Escola          | Klara Kedem       |
| Brian Anton           | Eleazar Eskin        | Alon Keinan       |
| Sebastian Böcker      | Jean-Eudes Duchesne  | Wayne Kendal      |
| Vineet Bafna          | Jay Faith            | Ilona Kifer       |
| Melanie Bahlo         | David Fernandez-Baca | Gad Kimmel        |
| Nilanjana Banerjee    | Vladimir Filkov      | Jyrki Kivinen     |
| Ali Bashir            | Sarel Fleishman      | Mikko Koivisto    |
| Amir Ben-Dor          | Kristian Flikka      | Rachel Kolodny    |
| Asa Ben-Hur           | Menachem Former      | Vered Kunik       |
| Yoav Benjamini        | Iddo Friedberg       | Vincent Lacroix   |
| Chris Benner          | Menachem Fruman      | Quan Le           |
| Gyan Bhanot           | Irit Gat-Viks        | Soo Lee           |
| Trond Hellem Bø       | Gad Getz             | Celine Lefebvre   |
| Elhanan Borenstein    | Apostol Gramada      | Hadas Leonov      |
| Guillaume Bourque     | Alex Gray            | Jie Liang         |
| Frederic Boyer        | Steffen Grossmann    | Chaim Linhart     |
| Dan Brown             | Jenny Gu             | Zsuzsanna Lipták  |
| Trevor Bruen          | Roderic Guigo        | Manway Liu        |
| Renato Bruni          | Matthew Hahn         | Aniv Loewenstein  |
| David Bryant          | Yonit Halperin       | Claudio Lottaz    |
| Jeremy Buhler         | Tzvika Hartman       | Claus Lundegaard  |
| Nello Cristianini     | Christoph Hartmann   | Hannes Luz        |
| Jo-Lan Chung          | Nurit Haspel         | Aaron Mackey      |
| Barry Cohen           | Greg Hather          | Ketil Malde       |
| Inbar Cohen-Gihon     | Morihiro Hayashida   | Kartik Mani       |
| Matteo Comin          | Trond Hellem Bø      | Thomas Manke      |
| Ana Teresa Freitas    | D. Hermelin          | Yishay Mansour    |
| Miklos Csuros         | Katsuhisa Horimoto   | Adam Margolin     |
| Andre Dabrowski       | Moseley Hunter       | Florian Markowetz |
| Alessandro Dal Palù   | Seiya Imoto          | Setsuro Matsuda   |
| Sanjoy DasGupta       | Yuval Inbar          | Alice McHardy     |
| Gianluca Della Vedova | Nathan Intrator      | Kevin Miranda     |
| Greg Dewey            | David Jaffe          | Leonid Mirny      |
| Zhihong Ding          | Martin Jambon        | Stefano Monti     |
| Atsushi Doi           | Shane Jensen         | Sayan Mukherjee   |
| Dikla Dotan           | Euna Jeong           | Iftach Nachman    |
| Agostino Dovier       | Tao Jiang            | Masao Nagasaki    |

|                        |                         |                      |
|------------------------|-------------------------|----------------------|
| Rei-ichiro Nakamichi   | Simone Scalabrin        | Nobuhisa Ueda        |
| Tim Nattkemper         | Klaus-Bernd Schürmann   | Igor Ulitsky         |
| Ilya Nemenman          | Michael Schaffer        | Sandor Vajda         |
| Sebastian Oehm         | Stefanie Scheid         | Roy Varshavsky       |
| Arlindo Oliveira       | Alexander Schliep       | Balaji Venkatachalam |
| Michal Ozery-Flato     | Dina Schneidman         | Stella Veretnik      |
| Kimmo Palin            | Russell Schwartz        | Dennis Vitkup        |
| Kim Palmo              | Paolo Serafini          | Yoshiko Wakabayashi  |
| Paul Pavlidis          | Maxim Shatsky           | Jianying Wang        |
| Anton Pervukhin        | Feng Shengzhong         | Junwen Wang          |
| Pierre Peterlongo      | Tetsuo Shibuya          | Kai Wang             |
| Kjell Petersen         | Ilya Shindyalov         | Li-San Wang          |
| Nadia Pisanti          | Tomer Shlomi            | Lusheng Wang         |
| Gianluca Pollastri     | A. Shulman-Peleg        | Tandy Warnow         |
| Julia Ponomarenko      | Abdur Sikder            | Arieh Warshel        |
| Elon Portugaly         | Gordon Smyth            | David Wild           |
| John Rachlin           | Yun Song                | Virgil Woods         |
| Sven Rahmann           | Rainer Spang            | Terrence Wu          |
| Jörg Rahnenführer      | Mike Steel              | Yufeng Wu            |
| Daniela Raijman        | Israel Steinfeld        | Lei Xie              |
| Ari Rantanen           | Christine Steinhoff     | Chen Xin             |
| Ramamoorthi Ravi       | Kristian Stevens        | Eric Xing            |
| Marc Rehmsmeier        | Aravind Subramanian     | Zohar Yakhini        |
| Vicente Reyes          | Fengzhu Sun             | Nir Yosef            |
| Romeo Rizzi            | Christina Sunita Leslie | Ryo Yoshida          |
| Estela Maris Rodrigues | Edward Susko            | John Zhang           |
| Ken Ross               | Yoshinori Tamada        | Louxin Zhang         |
| Juho Rousu             | Amos Tanay              | Degui Zhi            |
| Eytan Ruppín           | Haixu Tang              | Xianghong J. Zhou    |
| Walter L. Ruzzo        | Eric Tannier            | Joseph Ziv Bar       |
| Michael Sammeth        | Elisabeth Tillier       | Michal Ziv-Ukelson   |
| Oliver Sander          | Wiebke Timm             |                      |
| Zack Saul              | Aristotelis Tsirigos    |                      |

## RECOMB Tenth Anniversary Venue: il Palazzo Del Cinema del Lido di Venezia



## Sponsors



DEPARTMENT OF  
INFORMATION  
ENGINEERING  
UNIVERSITY OF PADOVA



National Science Foundation  
WHERE DISCOVERIES BEGIN



# Table of Contents

|                                                                                                                                                                                                                                                |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Integrated Protein Interaction Networks for 11 Microbes<br><i>Balaji S. Srinivasan, Antal F. Novak, Jason A. Flannick,<br/>Serafim Batzoglou, Harley H. McAdams</i> .....                                                                      | 1   |
| Hypergraph Model of Multi-residue Interactions in Proteins:<br>Sequentially-Constrained Partitioning Algorithms for Optimization of<br>Site-Directed Protein Recombination<br><i>Xiaoduan Ye, Alan M. Friedman, Chris Bailey-Kellogg</i> ..... | 15  |
| Biological Networks: Comparison, Conservation, and Evolutionary<br>Trees<br><i>Benny Chor, Tamir Tuller</i> .....                                                                                                                              | 30  |
| Assessing Significance of Connectivity and Conservation in Protein<br>Interaction Networks<br><i>Mehmet Koyutürk, Ananth Grama, Wojciech Szpankowski</i> .....                                                                                 | 45  |
| Clustering Short Gene Expression Profiles<br><i>Ling Wang, Marco Ramoni, Paola Sebastiani</i> .....                                                                                                                                            | 60  |
| A Patient-Gene Model for Temporal Expression Profiles in Clinical<br>Studies<br><i>Naftali Kaminski, Ziv Bar-Joseph</i> .....                                                                                                                  | 69  |
| Global Interaction Networks Probed by Mass Spectrometry (Keynote)<br><i>Anne-Claude Gavin</i> .....                                                                                                                                            | 83  |
| Statistical Evaluation of Genome Rearrangement (Keynote)<br><i>David Sankoff</i> .....                                                                                                                                                         | 84  |
| An Improved Statistic for Detecting Over-Represented Gene Ontology<br>Annotations in Gene Sets<br><i>Steffen Grossmann, Sebastian Bauer, Peter N. Robinson,<br/>Martin Vingron</i> .....                                                       | 85  |
| Protein Function Annotation Based on Ortholog Clusters Extracted<br>from Incomplete Genomes Using Combinatorial Optimization<br><i>Akshay Vashist, Casimir Kulikowski, Ilya Muchnik</i> .....                                                  | 99  |
| Detecting MicroRNA Targets by Linking Sequence, MicroRNA and<br>Gene Expression Data<br><i>Jim C. Huang, Quaid D. Morris, Brendan J. Frey</i> .....                                                                                            | 114 |

|                                                                                                                                                                                                                                                  |     |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| RNA Secondary Structure Prediction Via Energy Density Minimization<br><i>Can Alkan, Emre Karakoc, S. Cenk Sahinalp,<br/>Peter Unrau, H. Alexander Ebhardt, Kaizhong Zhang,<br/>Jeremy Buhler</i> . . . . .                                       | 130 |
| Structural Alignment of Pseudoknotted RNA<br><i>Banu Dost, Buhm Han, Shaojie Zhang, Vineet Bafna</i> . . . . .                                                                                                                                   | 143 |
| Stan Ulam and Computational Biology (Keynote)<br><i>Michael S. Waterman</i> . . . . .                                                                                                                                                            | 159 |
| CONTRAlign: Discriminative Training for Protein Sequence Alignment<br><i>Chuong B. Do, Samuel S. Gross, Serafim Batzoglou</i> . . . . .                                                                                                          | 160 |
| Clustering Near-Identical Sequences for Fast Homology Search<br><i>Michael Cameron, Yaniv Bernstein, Hugh E. Williams</i> . . . . .                                                                                                              | 175 |
| New Methods for Detecting Lineage-Specific Selection<br><i>Adam Siepel, Katherine S. Pollard, David Haussler</i> . . . . .                                                                                                                       | 190 |
| A Probabilistic Model for Gene Content Evolution with Duplication,<br>Loss, and Horizontal Transfer<br><i>Miklós Csűrös, István Miklós</i> . . . . .                                                                                             | 206 |
| A Sublinear-Time Randomized Approximation Scheme for the<br>Robinson-Foulds Metric<br><i>Nicholas D. Pattengale, Bernard M.E. Moret</i> . . . . .                                                                                                | 221 |
| Algorithms to Distinguish the Role of Gene-Conversion from<br>Single-Crossover Recombination in the Derivation of SNP Sequences in<br>Populations<br><i>Yun S. Song, Zhihong Ding, Dan Gusfield, Charles H. Langley,<br/>Yufeng Wu</i> . . . . . | 231 |
| Inferring Common Origins from mtDNA (Keynote)<br><i>Ajay K. Royyuru, Gabriela Alexe, Daniel Platt, Ravi Vijaya-Satya,<br/>Laxmi Parida, Saharon Rosset, Gyan Bhanot</i> . . . . .                                                                | 246 |
| Efficient Enumeration of Phylogenetically Informative Substrings<br><i>Stanislav Angelov, Boulos Harb, Sampath Kannan, Sanjeev Khanna,<br/>Junhyong Kim</i> . . . . .                                                                            | 248 |
| Phylogenetic Profiling of Insertions and Deletions in Vertebrate<br>Genomes<br><i>Sagi Snir, Lior Pachter</i> . . . . .                                                                                                                          | 265 |

|                                                                                                                                                                                                                       |     |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| Maximal Accurate Forests from Distance Matrices<br><i>Constantinos Daskalakis, Cameron Hill, Alexandar Jaffe,<br/>Radu Mihaescu, Elehanan Mossel, Satish Rao</i> .....                                                | 281 |
| Leveraging Information Across HLA Alleles/Supertypes Improves<br>Epitope Prediction<br><i>David Heckerman, Carl Kadie, Jennifer Listgarten</i> .....                                                                  | 296 |
| Improving Prediction of Zinc Binding Sites by Modeling the Linkage<br>Between Residues Close in Sequence<br><i>Sauro Menchetti, Andrea Passerini, Paolo Frasconi,<br/>Claudia Andreini, Antonio Rosato</i> .....      | 309 |
| An Important Connection Between Network Motifs and Parsimony<br>Models<br><i>Teresa M. Przytycka</i> .....                                                                                                            | 321 |
| Ultraconserved Elements, Living Fossil Transposons, and Rapid Bursts<br>of Change: Reconstructing the Uneven Evolutionary History of the<br>Human Genome (Keynote)<br><i>David Haussler</i> .....                     | 336 |
| Permutation Filtering: A Novel Concept for Significance Analysis of<br>Large-Scale Genomic Data<br><i>Stefanie Scheid, Rainer Spang</i> .....                                                                         | 338 |
| Genome-Wide Discovery of Modulators of Transcriptional Interactions<br>in Human B Lymphocytes<br><i>Kai Wang, Ilya Nemenman, Nilanjana Banerjee, Adam A. Margolin,<br/>Andrea Califano</i> .....                      | 348 |
| A New Approach to Protein Identification<br><i>Nuno Bandeira, Dekel Tsur, Ari Frank, Pavel Pevzner</i> .....                                                                                                          | 363 |
| Markov Methods for Hierarchical Coarse-Graining of Large Protein<br>Dynamics<br><i>Chakra Chennubhotla, Ivet Bahar</i> .....                                                                                          | 379 |
| Simulating Protein Motions with Rigidity Analysis<br><i>Shawna Thomas, Xinyu Tang, Lydia Tapia, Nancy M. Amato</i> .....                                                                                              | 394 |
| Predicting Experimental Quantities in Protein Folding Kinetics Using<br>Stochastic Roadmap Simulation<br><i>Tsung-Han Chiang, Mehmet Serkan Apaydin, Douglas L. Brutlag,<br/>David Hsu, Jean-Claude Latombe</i> ..... | 410 |

|                                                                                                                                                                                                                  |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
| An Outsider's View of the Genome (Keynote)                                                                                                                                                                       |     |
| <i>Carl Zimmer</i> .....                                                                                                                                                                                         | 425 |
| Alignment Statistics for Long-Range Correlated Genomic Sequences                                                                                                                                                 |     |
| <i>Philipp W. Messer, Ralf Bundschuh, Martin Vingron,</i><br><i>Peter F. Arndt</i> .....                                                                                                                         | 426 |
| Simple and Fast Inverse Alignment                                                                                                                                                                                |     |
| <i>John Kececioglu, Eagu Kim</i> .....                                                                                                                                                                           | 441 |
| Revealing the Proteome Complexity by Mass Spectrometry (Keynote)                                                                                                                                                 |     |
| <i>Roman A. Zubarev</i> .....                                                                                                                                                                                    | 456 |
| Motif Yggdrasil: Sampling from a Tree Mixture Model                                                                                                                                                              |     |
| <i>Samuel A. Andersson, Jens Lagergren</i> .....                                                                                                                                                                 | 458 |
| A Study of Accessible Motifs and RNA Folding Complexity                                                                                                                                                          |     |
| <i>Ydo Wexler, Chaya Zilberstein, Michal Ziv-Ukelson</i> .....                                                                                                                                                   | 473 |
| A Parameterized Algorithm for Protein Structure Alignment                                                                                                                                                        |     |
| <i>Jinbo Xu, Feng Jiao, Bonnie Berger</i> .....                                                                                                                                                                  | 488 |
| Geometric Sieving: Automated Distributed Optimization of 3D Motifs<br>for Protein Function Prediction                                                                                                            |     |
| <i>Brian Y. Chen, Viacheslav Y. Fofanov,</i><br><i>Drew H. Bryant, Bradley D. Dodson,</i><br><i>David M. Kristensen, Andreas M. Lisewski, Marek Kimmel,</i><br><i>Olivier Lichtarge, Lydia E. Kavasaki</i> ..... | 500 |
| A Branch-and-Reduce Algorithm for the Contact Map Overlap Problem                                                                                                                                                |     |
| <i>Wei Xie, Nikolaos V. Sahinidis</i> .....                                                                                                                                                                      | 516 |
| A Novel Minimized Dead-End Elimination Criterion and Its Application<br>to Protein Redesign in a Hybrid Scoring and Search Algorithm for<br>Computing Partition Functions over Molecular Ensembles               |     |
| <i>Ivelin Georgiev, Ryan H. Lilien,</i><br><i>Bruce R. Donald</i> .....                                                                                                                                          | 530 |
| 10 Years of the International Conference on Research in Computational<br>Molecular Biology (RECOMB) (Keynote)                                                                                                    |     |
| <i>Sarah J. Aerni, Eleazar Eskin</i> .....                                                                                                                                                                       | 546 |
| Sorting by Weighted Reversals, Transpositions, and Inverted<br>Transpositions                                                                                                                                    |     |
| <i>Martin Bader, Enno Ohlebusch</i> .....                                                                                                                                                                        | 563 |