35th Annual Symposium on Combinatorial Pattern Matching

CPM 2024, June 25–27, 2024, Fukuoka, Japan

Edited by

Shunsuke Inenaga

Simon J. Puglisi

Editors

Shunsuke Inenaga
Kyushu University, Japan
inenaga.shunsuke.380@m.kyushu-u.ac.jp

Simon J. Puglisi
University of Helsinki, Finland
simon.puglisi@helsinki.fi

ACM Classification 2012
Theory of computation → Algorithm design techniques; Theory of computation → Data compression; Theory of Computation → Design and analysis of algorithms; Theory of computation → Fixed parameter tractability; Theory of computation → Parameterized complexity and exact algorithms; Theory of computation → Pattern matching; Theory of computation → Problems, reductions and completeness; Theory of computation → Sorting and searching; Theory of computation → Theory and algorithms for application domains; Mathematics of computing → Discrete mathematics; Mathematics of computing → Combinatorics on words; Mathematics of computing → Combinatoric problems; Applied computing → Computational biology

ISBN 978-3-95977-326-3

Published online and open access by
Schloss Dagstuhl – Leibniz-Zentrum für Informatik GmbH, Dagstuhl Publishing, Saarbrücken/Wadern, Germany. Online available at https://www.dagstuhl.de/dagpub/978-3-95977-326-3.

Publication date
June, 2024

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at https://portal.dnb.de.

Digital Object Identifier: 10.4230/LIPIcs.CPM.2024.0

ISBN 978-3-95977-326-3 **ISSN 1868-8969** **https://www.dagstuhl.de/lipics**

LIPIcs – Leibniz International Proceedings in Informatics

LIPIcs is a series of high-quality conference proceedings across all fields in informatics. LIPIcs volumes are published according to the principle of Open Access, i.e., they are available online and free of charge.

ISSN 1868-8969

https://www.dagstuhl.de/lipics

Dedicated to our inspirational friend, colleague, and teacher, Masayuki Takeda, 1964–2022.

Contents

Regular Papers

35th Annual Symposium on Combinatorial Pattern Matching (CPM 2024).
Editors: Shunsuke Inenaga and Simon J. Puglisi
Leibniz International Proceedings in Informatics
LIPICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

Preface

The Annual Symposium on Combinatorial Pattern Matching (CPM) has by now over 30 years of tradition and is considered to be the leading conference for the community working on Stringology. The objective of the annual CPM meetings is to provide an international forum for research in combinatorial pattern matching and related applications such as computational biology, data compression and data mining, coding, information retrieval, natural language processing, and image processing (i.e. 2D strings).

This volume contains the papers presented at the 35th Annual Symposium on Combinatorial Pattern Matching (CPM 2024) held on June 25–27, 2024 in Fukuoka, Japan. The conference program includes 28 contributed papers and three invited talks, by

- Martin Farach-Colton (New York University, USA),
- Zsuzsanna Lipták (University of Verona, Italy), and
- Tetsuo Shibuya (University of Tokyo, Japan).

For the sixth time, CPM includes the "Highlights of CPM" special session, for presenting the highlights of recent developments in combinatorial pattern matching. In this sixth installment we selected as highlight papers "Gapped String Indexing in Subquadratic Space and Sublinear Query Time", by Philip Bille, presented at STACS 2024, and "Optimal-Time Queries on BWT-Runs Compressed Indexes" and "An Optimal-Time RLBWT Construction in BWT-Runs Bounded Space", by Yasuo Tabei / Takaaki Nishimoto, presented at ICALP 2021 and ICALP 2022, respectively.

The contributed papers for CPM 2024 were selected out of 48 submissions, corresponding to an acceptance ratio of 58%. Each submission received at least three reviews. We thank the members of the Program Committee and all the additional external subreviewers, who are listed below, for their hard, invaluable, and collaborative effort that resulted in an excellent scientific program. We also thank the CPM Steering Committee for their support and advice. We thank the CPM 2024 Organising Committee chair Yuto Nakashima and all the other members for their excellent and hard work that made this conference a wonderful one.

The CPM 2024 conference was co-located with a StringMasters workshop held on June 24 and June 28, 2024 in Fukuoka. The StringMasters workshop was organized by Dominik Köppl. Preceding these events in Fukuoka, a two-day summer school was held at the University of Electro-Communications, in Tokyo, which provided lectures by Jesper Jansson (Kyoto University) and Philip Wellnitz (National Institute of Informatics). The summer school was organized by Paweł Gawrychowski, Hideo Bannai, and Takuya Meino.

The Annual Symposium on Combinatorial Pattern Matching started in 1990, and has since then taken place every year. Previous CPM meetings were held in Paris, London (UK), Tucson, Padova, Asilomar, Helsinki, Laguna Beach, Aarhus, Piscataway, Warwick, Montreal, Jerusalem, Fukuoka, Morelia, Istanbul, Jeju, Barcelona, London (Ontario, Canada), Pisa, Lille, New York, Palermo, Helsinki, Bad Herrenalb, Moscow, Ischia, Tel Aviv, Warsaw, Qingdao, Pisa, Copenhagen (on-line), Wrocław, Prague, and Marne-la-Vallée. From 1992 to the 2015 meeting, all proceedings were published in the LNCS (Lecture Notes in Computer Science) series. Since 2016, the CPM proceedings have appeared in the LIPIcs (Leibniz International Proceedings in Informatics) series, as volume 54 (CPM 2016), 78 (CPM 2017), 105 (CPM 2018), 128 (CPM 2019), 161 (CPM 2020), 191 (CPM 2021), 223 (CPM 2022), and 259 (CPM 2023). The entire submission and review process was carried out using the EasyChair conference system.

35th Annual Symposium on Combinatorial Pattern Matching (CPM 2024).
Editors: Shunsuke Inenaga and Simon J. Puglisi
Leibniz International Proceedings in Informatics
LIPICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

This proceedings of CPM 2024 is dedicated to the memory of Masayuki Takeda, who passed away in December 2022, in Fukuoka. As a professor at the Department of Informatics, Kyushu University, Masayuki was one of the pioneers of the field of pattern matching and compressed string processing in Japan. He was a passionate researcher, and published over 200 articles, including 34 papers in the CPM series of conferences – more than all but one other author. Masayuki also co-chaired CPM 2002 in Fukuoka with late Alberto Apostolico. Masayuki was a great teacher, and he supervised a number of students at the undergraduate, master, and PhD levels, many of whom have gone on to have successful research careers. Implicitly, and explicitly, he is the reason the CPM conference returns to Fukuoka this year.

Shunsuke Inenaga and Simon J. Puglisi
CPM 2024 Program Committee Chairs

Program Committee

- Golnaz Badkobeh, City, University of London
- Giulia Bernardini, University of Trieste
- Philip Bille, Technical University of Denmark
- Manuel Cáceres, University of Helsinki
- Panagiotis Charalampopoulos, Birkbeck, University of London
- Gabriele Fici, University of Palermo
- Daniel Gibney, University of Texas at Dallas
- Veronica Guerrini, University of Pisa
- Shunsuke Inenaga, Kyushu University (Chair)
- Jesper Jansson, Kyoto University
- Artur Jeż, University of Wrocław
- Dominik Köppl, University of Yamanashi
- Gregory Kucherov, Gustave Eiffel University
- Susana Ladra, University of A Coruna
- Avivit Levy, Shenkar College
- Gonzalo Navarro, University of Chile
- Nicola Prezza, Ca' Foscari University of Venice
- Simon J. Puglisi, University of Helsinki (Chair)
- Giulia Punzi, NII
- Marinella Sciortino, Università di Palermo
- Kana Shimizu, Waseda University

35th Annual Symposium on Combinatorial Pattern Matching (CPM 2024).
Editors: Shunsuke Inenaga and Simon J. Puglisi
Leibniz International Proceedings in Informatics
LIPICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany

List of External Reviewers

Adrián Gómez Brandón
Alejandro Pacheco
Alessandro Berti
Alexandru I. Tomescu
Arnab Ganguly
B. Riva Shalom
Bartlomiej Dudek
Binhai Zhu
Bojana Kodric
Carlo Tosoni
Chiaki Sakama
Chiara Epifanio
Conrado Martínez
Cristian Urbina
Cyril Gavoille
Daniel Puttini
Davide Rucci
Diego Arroyuelo
Diego Seco
Diptarama Hendrian
Djamal Belazzougui
Dominika Draesslerová
Duncan Adamson
Dustin Cobas
Eitan Kondratovsky
Elena Biagi
Estéban Gabory
Felipe A. Louza
Florin Manea
Francisco Olivares
Gabriel Bathie
Giovanna Rosone
Giuseppa Castiglione
Hideo Bannai
Hongyu Zheng
Itai Boneh
Jakub Radoszewski
Jamshed Khan
Jonas Ellert
Jouni Sirén
Kevin Ryan
Laurent Bulteau
Louisa Seelbach Benkner
Massimo Equi
Md Helal Hossen
Meng He
Mikołaj Marciniak
Nicola Rizzo
Nicolaos Matsakis
Paniz Abedin
Rahul Shah
Rocco Ascone
Romina Doz
Ruben Becker
Sharma V. Thankachan
Shay Golan
Simon Rumle Tarnow
Solon Pissis
Sung-Hwan Kim
Sven Rahmann
Takuya Mieno
Teresa Anna Steiner
Tomasz Walen
Travis Gagie
Vincent Jugé
Vitaly Aksenov
Wiktor Zuba
William Kuszmaul
Wojciech Janczewski
Yinzhan Xu
Yuto Nakashima

35th Annual Symposium on Combinatorial Pattern Matching (CPM 2024).
Editors: Shunsuke Inenaga and Simon J. Puglisi
Leibniz International Proceedings in Informatics
LIPICS Schloss Dagstuhl – Leibniz-Zentrum für Informatik, Dagstuhl Publishing, Germany