Report on IWOCA 2011

22nd International Workshop on Combinatorial Algorithms
20–22 July 2011, University of Victoria, Canada

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The 22nd IWOCA was held 20–22 July 2011 on the green and spacious campus of the University of Victoria (UVic), itself located on green and spacious Vancouver Island, off the coast of British Columbia, a few scenic kilometres by ferry from the city of Vancouver. The meeting was sponsored and supported financially by the Pacific Institute for the Mathematical Sciences (PIMS); hosted by the UVic Department of Computer Science. The Local Arrangements Committee, cochaired by **Wendy Myrvold** and **Venkatesh Srinivasan**, did an outstanding job; the Programme Committee was cochaired by **Costas Iliopoulos** and the author of this report; the intricacies of EasyChair were handled by **German Tischler**. The Proceedings, edited by Iliopoulos & Smyth, will be published by Springer in their *Lecture Notes in Computer Science* series as "post-proceedings" — that is, appearing three or four months after the workshop so as to enable changes to be incorporated that result from discussions with other workshop participants. In addition, authors of accepted papers will be invited to submit full versions of their work to a special issue of the *Journal of Discrete Algorithms*.

IWOCA descends from the original *Australasian* Workshop on Combinatorial Algorithms, first held in 1989, then renamed *International* in 2007 in response to consistent interest and support from researchers outside the Australasian region. The workshop's permanent website can be accessed at

`http://www.iwoca.org/`

where links to previous meetings, as well as to IWOCA 2011, can be found.

As IWOCA's very first meeting in North America, the northwest Pacific coastal area was perhaps particularly appropriate, due to the strength in combinatorics and combinatorial algorithms of the universities in the region. For more than a quarter-century the Combinatorial Potlatch ("*potlatch*": Pacific northwest native American term for ceremonial gift-giving) has been held yearly by one or another of these universities: Simon Fraser, Western Washington, Puget Sound, Seattle, Portland State, and of course (frequently) by UVic itself. Indeed, UVic rejoices in a robust Combinatorial Algorithms Group with 20 members drawn from the faculty of three departments: Computer Science, Mathematics & Statistics, Electrical & Computer Engineering. This group, together with their students, accounted for six of the accepted papers at IWOCA 2011; three more were co-authored by researchers from other regional universities.

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Using LISTSERVE and other e-mail lists, the IWOCA 2011 call for papers was distributed around the world, resulting in 71 submitted papers. The EasyChair system was used to facilitate management of submissions and refereeing, with three referees selected from the 40-member Program Committee assigned to each paper. A total of 30 papers were accepted, subject to revision, for presentation at the workshop and publication in the LNCS Proceedings; an addiitional seven papers were accepted for poster presentation. Authors, titles and abstracts of all 37 accepted contributions are available at the IWOCA 2011 website:

`http://webhome.cs.uvic.ca/~wendym/IWOCA/sched.html`

The workshop also featured a problem session, ably chaired — in the absence of IWOCA Problems Cochairs **Yuqing Lin** and **Zsuzsanna Lipták** — by UVic graduate student **Alejandro Erickson**. Four invited talks (see abstracts below) were given by **Tetsuo Asano**, **Pavol Hell**, **J. Ian Munro** and **Cenk Sahinalp**.

The 51 registered participants at IWOCA 2011 hold appointments at institutions in 15 different countries on four continents (Asia, Australia, Europe, North America). The nations represented were

> Australia (2), Canada (28), China (1), Czech Republic (2), Denmark (1), France (1), Germany (3), India (2), Israel (1), Iran (1), Italy (1), Japan (1), Russia (1), Taiwan (1), USA (5).

Here are brief summaries of the invited plenary talks:

(1) **Tetsuo Asano**, Osaka Electro-Communication University, Japan: *Nearest Larger Neighbours Problem and Memory-Constrained Algorithms* — "Given a set of n objects with keys, find for each object a nearest object with larger key, if any." Over various implementations (corresponding to 1-D or 2-D array representations), this problem can be solved efficiently provided sufficient work space is available. Moreover, using only $O(\log n)$ bits of work space, the 1-D problem can be solved in $O(n \log n)$ time, as can the 2-D problem also, but only if no duplicate elements occur. For the latter, no sub-quadratic algorithm is known if duplicate elements are allowed. Limited-work-space algorithms in computational geometry and image processing are discussed.

(2) **Pavol Hell**, Simon Fraser University, Canada: *Graph Partitions* — A general model for graph partitions is described that includes many well-known partition and colouring problems, particularly those arising in the study of perfect graphs. Attempts to classify both the complexity and the forbidden subgraph characterizations of these problems are discussed.

(3) **J. Ian Munro**, University of Waterloo, Canada: *Creating a Partial Order and Finishing the Sort, with Graph Entropy* — "Given a set S of n distinct values satisfying a partial order, compute a total order of S." In 1975 Fredman showed that this problem can be solved using $Opt+2n$ comparisons, where Opt is the information theoretic lower bound. However, determining exactly which comparisons to use could require exponential time. This problem is traced over 35 years, culminating in the 2009/2010 result of Cardinal/Fiorini/Joret/Jungers that the comparisons can be determined in $Opt+o(Opt)+O(n)$ time.

(4) **Cenk Sahinalp**, Simon Fraser University, Canada: *Algorithmic Methods for Structural Variation Detection among Multiple High Throughput Sequenced Genomes* — The Laboratory for Computational Biology at Simon Fraser University develops algorithms for analyzing large collections of HTS (high throughput sequencing) genomes and transcriptomes. These algorithms, collectively called CommonLAW (Common Loci structural Alteration Widgets), go beyond currently available models. One such method, Comrad, enables integrated analysis of RNA and DNA sequence data simultaneously for multiple (possibly related) individuals.

Atypical for IWOCA, the contributed talks were split into concurrent streams, A (Combinatorics) and B (Graph Theory). This strategy allowed 30-minute talks and so encouraged a relaxed atmosphere; still, one was often forced to choose between two attractive alternatives. Stream A included such topic areas as combinatorics on words, string algorithms, codes, Venn diagrams, set partitions; Stream B dealt with several graph theory areas of current interest: Hamiltonian & Eulerian properties, graph drawing, colouring, dominating sets, spanning trees, and others. It is one man's opinion, supported by discussion with other participants, that the quality of the papers contributed to IWOCA this year was exceptional.

IWOCA 2011 really began on Sunday the 19th with a climb (well, a stroll) up neighbouring Mount Tolmie, which, though only 120 m. high, provides a breathtaking 360° view round the southern portion of Vancouver Island, including Victoria, then across the verdant islands dotting Puget Sound to Mount Baker and the Olympic Peninsula Mountains of Washington State. For various photos of these happy combinatorial athletes, see

`http://webhome.cs.uvic.ca/~wendym/IWOCA/ptolmie.html`

and for the IWOCA 2011 participants all together:

`http://webhome.cs.uvic.ca/~wendym/IWOCA/group.html`

IWOCA meetings are already scheduled for the next four years, through 2015, spread (like this year's participants) over four continents:

2012 Kalasalingam University (KLU), India (**Subramanian Arumugam**)

2013 Université de Rouen, France (**Thierry Lecroq**)

2014 University of Newcastle, Australia (**Joe Ryan**)

2015 University of Minnesota, Duluth, USA (**Dalibor Froncek**)

In particular, IWOCA 2012 takes place in the exotic (to many of us) Indian province of Tamil Nadu, hosted by n-CARDMATH, the National Centre for Advanced Research in Discrete Mathematics

http://www.ncardmath.com/

directed by Professor Arumugam. The meeting features a three-day all-expense-paid tour of magnificent archaeological sites and natural wonders in the vicinity of KLU. See

http://www.cas.mcmaster.ca/~bill/tamilnadu/

for a picture gallery and

http://www.iwoca.org/iwoca12/

for the preliminary IWOCA 2012 homepage.