Always Parameterize!

Parameterized Complexity News

Newsletter of the PC Community November 2010

Welcome

Frances Rosamond, Editor
Welcome to the Parameterized Complexity Newsletter. We are delighted to announce spectacular, well-deserved awards and honors. Altogether, the PC community has received over eight million euro in research grants this year. Success in highly competititive interdisciplinary competitions shows that PC wins the hearts and minds of more and more researchers! Next Newsletter will include open problems from WORKER and IPEC. Please update the Table of Races and event information with your latest results: **www.fpt.wikidot.com**.

IPEC2010

The *International Symposium on Parameterized and Exact Computation* will be held Dec 13–15 in Chennai, and colocated with FSTTCS, the annual India theory meeting (see `http://www.imsc.res.in/ipec`).

Igor Razgon wins PIYRA

Congratulations to **Igor Razgon** who has won the President of Ireland Young Researcher Award (PIYRA). The Award includes a massive grant of 700K Euros for 4 years. Igor's project, "Parameterized Complexity of Multiway Cut," succeeded against a prestigious interdisciplinary competition that included researchers from Biology and Medical Sciences. As Igor reports: It is hard to believe that parameterized complexity of multicut problems and kernelization can win against a medical application for cancer, and yet that is what happened. Congratulations also on a move from Cork to a permanent position in the Dept of Computer Science, Univ Leicester, UK.

Bergen Algorithmics Wins Big

Powerhouse Algorithmics at Univ Bergen. Bravo Bergen!

Figure 1: Fran enjoying the company of prize-winners Pinar and Daniel.

• **Fedor Fomin** awarded an ERC Advanced Grant for the project: "Rigorous Theory of Preprocessing," approx 2.2 million Eur. Congratulations!

• **Daniel Lokshtanov** awarded 12.5 million NOK over 4 years from the Bergen Research Foundation, together with an offer of a tenure track position at Univ Bergen. Daniel has also received a Simons Foundation Postdoc, from Summer 2010–2012, working with Ramamohan Paturi at UCSD.

• **Pinar Heggernes** awarded a Research Council of Norway award for her project: "SCOPE - Exploiting Structure to Cope with Hard Problems," 2010– 2014, approx 12M Nokia or 1.5 million Eur.

Contents of this issue:

Figure 2: Fedor Fomin beautifully singing.

Congratulations Grants

• **Vlad Estivil-Castro, Mike Fellows, Frances Rosamond**. (Griffith U. and Charles Darwin U., AU). "Algorithmic engineering and complexity analysis of protocols for consensus," ARC Discovery Project, 2011–2013, approx 250,000 AUD.

• **Petr Hlineny**(Masaryk Univ, Czech) has received a three year research award.

• **Klaus Jansen** (Christian-Albrechts-University). "Efficient Polynomial Time Approximation Schemes for Scheduling and Related Optimization Problems," 2011–2013, approx 400,000 Eur.

• **Saket Saraubh**. (MSRI, Chennai). Travel grant for next 5 years from Microsoft Research.

• **Todd Wareham**. (Memorial Univ, Newfoundland, Ca) "Parameterized complexity analysis in cognitive science," NSERC grant renewed as of April 2010; 15K/year for 5 years.

Anil Nerode honored at U. Chicago

Congratulations to **Anil Nerode**, Goldwin Smith Prof of Mathematics, Cornell Univ, who was awarded an Honorary Doctorate by the Univ Chicago in June. This is a prestigious honor, given to few mathematicians. Nerode joins Veblen, Birkhoff, Chern, Tukey, Brauer, Mosteller, and 4 or 5 more–along with notables famous in other fields such as Marie Curie and Albert Schweitzer.

Fellows wins Australian Award

Mike Fellows has been honored with the Australian Professorial Award, which is a five year research-only academic position. Both Mike and Frances Rosamond have shifted to Charles Darwin University, Northern Territories, Australia. The new email: Michael.Fellows@cdu.edu.au.

Marx awarded Humboldt

Dániel Marx as been awarded a Humboldt Fellowship for Experienced Researchers. He will be in Berlin for 18 months from this September, following a postdoc in Tel Aviv. Congratulations, Dániel.

Mnich awarded Philips Prize

Matthias Mnich has been awarded the prestigious Philips Prize of the Royal Mathematical Society in the Netherlands, for the best PhD research project. He defended in Sept. Advisor Gerhard Weoginger, Dept. Mathematics and Computer Science Eindhoven Univ of Technology. His presentation was given to the Dutch Mathematical Congress in Utrecht. Matthias is now a member of the Algorithms group of Richard Karp, International Computer Science Institute, Berkeley. His postdoc is funded through a DAAD Fellowship. Congratulations, Matthias.

Breakthrough! Finding Topological Subgraphs is Fixed Parameterized Tractable.

Martin Grohe, Ken-ichi Kawarabayashi, Dániel Marx, Paul Wollan

`arxiv.org/abs/1011.1827`

A graph H is a *topological subgraph* (or *topological minor*) of graph G if a subdivision of H is a subgraph of G. Equivalently, H is a topological subgraph of G if H can be obtained from G by deleting edges, deleting vertices, and dissolving degree-2 vertices (which means deleting the vertex and making its two neighbors adjacent). This notion appears for example in the classical result of Kuratowski in 1935 stating that a graph is planar if and only if it does not have a topological subgraph isomorphic to K_5 or $K_{3,3}$.

Given graphs H and G, it is NP-complete to decide if H is a topological subgraph of G (e.g., a cycle of length $|V(G)|$ is a topological subgraph of G if and only if G is Hamiltonian). On the other hand, our result shows that finding topological subgraphs is fixed-parameter tractable parameterized by H: we give an $f(|V(H)|) \cdot |V(G)|^3$ time algorithm that decides if H is a topological subgraph of G. This result answers a longstanding open question, asked by Downey and Fellows already in one of the first papers on parameterized complexity [In *Structures in Complexity Theory Conference,* 36–49, 1992]. As a consequence, we are able to show the fixed-parameter tractability of immersion testing as well (immersions are similar to topological subgraphs, but the paths corresponding to

the subdivided edges need to be edge disjoint only, not vertex disjoint).

Our algorithm for finding topological subgraphs follows the general framework of Robertson and Seymour for minor testing [Graph Minors XIII], but it deviates from it significantly. If the treewidth of G is "small," then standard techniques allow us to solve the problem in linear time. If the treewidth of G is "large," then our goal is to find an *irrelevant vertex* whose deletion provably does not change the answer to the problem. By iteratively finding and deleting irrelevant vertices, we eventually arrive to a G whose treewidth is small. To find an irrelevant vertex if the treewidth of G is large, we use the the so-called *Weak Structure Theorem*, which allows us either to find a large clique minor or to show that the graph has a large "flat wall.". Proving that we can always find an irrelevant vertex in a flat wall is the technically most difficult part of the minor testing algorithm of Robertson and Seymour. Very recently, a much simpler proof of this claim was presented by Kawarabayashi and Wollan [STOC 2010]. With appropriate adaptations and new ideas, this method can be made to work for finding topological subgraphs.

The most significant difference between finding minors and topological subgraphs appears in the case where the weak structure theorem gives us a large clique minor. In the case of finding minors, this is an easy situation: it immediately solves the problem, as the large clique minor surely contains the minor H we are looking for. On the other hand, it is not obvious how it is of any use in the case of finding topological subgraphs. The problem is that the degrees of the vertices matter much more in finding topological subgraphs than in finding minors. If H is, say, 4-regular and we have found a large clique minor in a part of G that contains only degree-3 vertices, then this clique minor does not immediately solve the problem. We circumvent this problem by introducing a new operation that was not present in the framework of Robertson and Seymour. If a small number of vertices can separate away a large part of the graph, then we recursively "understand" this part and then replace it with an equivalent smaller graph. We show that if no such step can be performed, then we can completely understand how the large clique minor can be used by a topological subgraph, allowing us to simplify the problem. This new operation and the associated recursion changes the high-level structure of our algorithm considerably: it is no longer just an iterative removal of irrelevant vertices.

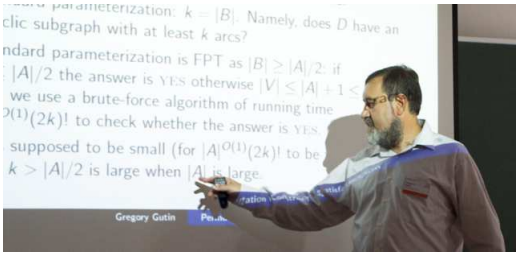

Figure 3: Gregory Gutin speaking at the Parameterized Computational Reasoning Workshop in Brno.

Computational Reasoning at Brno

Parameterized Complexity of Computational Reasoning

by Stefan Szeider and Stefan Woltran, Report on the workshop held 28 Aug 2010 in Brno, as a satellite event of the federated MFCS and CSL.

The workshop aimed to support a fruitful exchange of ideas between the research on parameterized complexity on one side and the research on various forms of computational reasoning. The program was scheduled around three broad topics: Constraint Satisfaction, Problem Decomposition, and Proof Complexity, and featured an invited keynote talk by Mike Fellows as well as several invited and contributed talks. The workshop attracted 21 registered participants.

• **Constraint Satisfaction.** *Gregory Gutin* presented new probabilistic methods for solving optimization problems above or below tight bounds. He demonstrated how these methods can be applied to Max-CSP with ternary permutation constraints. In his keynote talk, *Mike Fellows* presented fundamental ideas, techniques and research questions of parameterized complexity and discussed applications in Artificial Intelligence and Constraint Satisfaction. *Frances Rosamond* presented new FPT results on constraint satisfaction problems composed of all-different constraints where the scopes of constraints and/or the domains of variables form convex subsets.

• **Problem Decomposition.** *Reinhard Pichler* presented efficient dynamic programming techniques for solving various reasoning problems for instances of small treewidth, including propositional abduction, closed world reasoning, answer-set programming, and belief revision. He dedicated his talk to the memory of Marko Samer (1977–2010). *Petr Hliněný* presented a general framework for problems on decomposable structures, extending the classical Myhill-Nerode Theorem for finite tree automata. He exemplified this framework by demonstrating how propositional model counting can be accomplished efficiently for formulas with signed incidence graphs of small rank-width. *Praveen M.* presented parameterized complexity result for the satisfiability of formulas

of propositional modal logics. As parameters he considered treewidth of incidence graphs and the modal depth of formulas.

• **Proof Complexity.** *Nicola Galesi* presented new parameterized proof complexity results. He introduced a purely combinatorial approach to obtain lower bounds for tree-like parameterized resolution and showed that the pigeonhole principle is difficult for dag-like parameterized resolution. *Yijia Chen* presented equivalence results for the three questions of whether there is a p-optimal proof system for propositional tautologies, whether a specific natural parameterized halting problem is in uniform XP, and whether a logic introduced by Blass and Gurevich captures PTIME.

The program was closed with an open problems and discussion session (followed by free beer served in the yard of the faculty building).

Abstracts and presentation slides are available from the workshop web site www.kr.tuwien.ac.at/drm/pccr2010. Additional pictures at `http://www.kr.tuwien.ac.at/drm/pccr2010`.

The workshop was organized by Igor Razgon, Marko Samer, Stefan Szeider (chair), and Stefan Woltran. The organizers thank all speakers and participants for contributing to the success of the workshop.

(Editor Note: Congratulations to Stefan and Katja on new son Anton, born just before the workshop.)

Graph Decomposition at CIRM

Graph Decomposition: Theoretical, Algorithmic and Logical Aspects

by Frances Rosamond, Report on the workshop held 18–22 Oct 2010 at CIRM, Luminy, supported by French ANR projects GRAAL and AGAPE.

The workshop supported a fruitful exchange of ideas about many aspects of graph decomposition. There were 31 talks, and 68 participants. Only a few of the excellent presentations are described here.

Jarik Nesetril began the opening session with a presentation on classification of graph classes. *Daniel Lokshtanov* described Bidimensionality theory and how it can be used to give linear kernels and easier EPTASs. *Alexander Langer* presented a novel (compile as you go) approach to Courcelle's Theorem based on model checking games for constructing a tree automaton, and showed some of the implementation. A longer article on this project will appear in the next *PC Newsletter*. Recent results on lower bounds for MSO in relation to tree-width, together with a beautiful description of brambles (an obstruction to small tree-width) was presented by *Stephan Kreutzer*.

Isolde Adler discussed how to improve the parameter dependency for some algorithms, while *Archontia Giannopoulou* showed an improved algorithmic version of the Graph Minor Theory Trinity Lemma.

Various graph measures and decompositions were discussed. Both *Jan Arne Telle* and *Remy Belmonte* discussed the parameter boolean-width. *Jan Obdrzalek* surveyed digraph measures, and *Petr Hlineny* reported on rank-width and bi-rank-width. *Ignasi Sau* discussed a new, unifying type of branch decomposition that allows faster dynamic programming. Optimal tree decomposition of planar graphs was used by *Ioan Todinca* to find an exact algorithm for the Maximum Induced Planar Subgraph problem. *Mathilde Bouvel* reported on substitution decomposition of permutations in enumerative combinatorics. Various generalizations of modular decomposition were presented by *M. Habib*, and *Binh-Minh Bui-Xuan* presented a generic approach to digraph decomposition.

Jean Daligault spoke on Parameterized Multicut. Forbidden structures were described by *Yngve Villanger* that allowed solving Proper Interval Vertex Deletion. *Anthony Perez* showed modular decomposition applied to graph modification kernels. *Maathieu Chapelle* showed a new infinite collection of bounded tree-width, yet W-hard σ, ρ-domination problems.

First-order formulas were discussed by *Patrice Ossona de Mendez* (H-colorings), and *Daniel Kral* (a linear time algorithm for deciding FOL properties in certain graph classes). Verification of MSO graph properties were spoken of by *Bruno Courcelle* (using edge-set quantifications), and *Irene Durand* (graphs of bounded clique-width). *Reinhard Pichler* discussed a DP approach to Courcelle's Theorem for reasoning and belief revision problems.

Monatic Second Order evaluations involving counting was discussed by *Labrini Kalantzi*. *Barbara Konig* spoke on graph automata, and *Eugenie Foustoucos* described reducing MSO evaluation problems on graphs to a corresponding problem on words. *Nicolas Trotignon* described progress on detection of induced subgraphs. *Steve Chaplick* presented a new data structure (PR-trees).

Quote of the day: *We played the locals and they were far better than us. But we stayed organized and played rationally. and we won!!!* Ignasi Sau re the football game at CIRM.

Not About Graphs! Workshop July in Darwin

Mike Fellows and Frances Rosamond are organizing a workshop to take place in Northern Territory, AU on 11, 12, 13 July 2011 • **Parameterized Complexity: Not About Graphs! (NAB)** To date, much of the

work in parameterized algorithmics has been focused in the area of graph algorithms. However, computational complexity is an issue that arises everywhere. The focus of the workshop is on reporting new advances regarding the parameterized computational complexity of problems in algebra, number theory, analysis, topology, game theory, geometry-anything that takes the field into new and unexplored directions of relevance. It is also focused on identifying and promoting the key unsolved problems in these new directions.

There will be an informal proceedings, published by CDU Press. We expect the discussions and presentations at the workshop to be rich with possibilities for further development of entire research areas, and programmatic themes that can be developed into future research proposals. There will be a website devoted to open problems, progress on which we would like to see reported at the workshop, and that will in any case serve to collect and publicize key open problems to promote these new directions of parameterized complexity research. The website will be ready soon: `www.cdu.edu.au/parameterized-nag`. Please email `Frances.Rosamond@cdu.edu.au` or `mathgypsie@yahoo.com` for more information.

Figure 4: Pinar leading a hike up Anker Hytte.

Table of Races

The results are improving ever more rapidly. Please add your latest to www.fpt.wikidot.com. Ioannis Koutis and Ryan Williams have improved a few rows with randomized algorithms. Henning Fernau suggested adding additional rows for deterministic 'D', and randomized 'R'. Kernel sizes are measured in the number of vertices.

Problem	*f(k)*	**kernel**	**Ref**
Clique Cover	$2^{\Delta k}$	2^k	1
Clique Partition		2^k	2
Cluster Editing	1.82^k	$2k$	3
1-Sided Crossing Min	1.4656^k		4
Planar DS	$2^{11.98\sqrt{k}}$	$67k$	5
Edge Dominating Set	2.3819^k	$8k^2$	6
Feedback Vertex Set	3.83^k	$4k^2$	7
3-Hitting Set	2.076^k	$O(k^2)$	8
Interval Completion/ Minimum Fill	$O(k^{2k}n^3m)$		9
3-D Matching-D	2.77^{3k}		10
3-D Matching-R	2^k		11
Max Leaf-D	3.4581^k	$4k$	12
Max Leaf-R	2^k		13
Directed Max Leaf	3.72^k	k^2	14
Nonblocker	2.5154^k	$5k/3$	15
k-Path-D	4^k	no $k^{O(1)}$	16
k-Path-R	2^k		17
Convex Recolouring	4^k	$O(k^2)$	18
Max-r-SAT-AA/ Max-r-SAT-Above-Average	$2^{O(klogk)}$	$O(klogk)$	19
Set Splitting	1.96^k	$2k$	20
Steiner Tree	2^k	no $k^O(1)$	21
Vertex Cover	1.2738^k	$2k$	22
VC-max degree 3	$O^*(1.1616^k)$		23
Connected VC	2.4882^k	no $k^{O(1)}$	24

1) J. Gramm, J. Guo, F. Hüffner, and R. Niedermeier. Data reduction, exact, and heuristic algorithms for clique cover. *ALENEX 2006*.

2) E. Mujuni and F. Rosamond. Parameterized Complexity of the Clique Partition Problem. *CATS 2008*.

3) Sebastian Böcker, Sebastian Briesemeister, Quang Bao Anh Bui, and Anke Truss. Going weighted: Parameterized algorithms for cluster editing Theor. Comput. Sci., 410(52):5467-5480, 2009. For the kernel: Jianer Chen and Jie Meng. A $2k$ Kernel for the Cluster Editing Problem. *COCOON 2010*. Peter Damaschke has Cluster Deletion 1.47 bound.

4) V. Dujmovic, H. Fernau and M. Kaufmann. Fixed parameter algorithms for one-sided crossing minimization revisited. *GD 2003*.

5) Frederic Dorn. Dynamic Programming and Fast Matrix Multiplication. *Proceedings of 14th Annual European Symposium (Algorithms/ESA 2006)*, LNCS 4168, 280-291.

6) D. Raible's dissertation: 2.3819^k with poly-space-requirements. H. Fernau. EDGE DOMINATING SET: Efficient Enumeration-Based Exact Algorithms. *IWPEC 2006*, for the kernel.

7) Yixin Cao, Jianer Chen, Yang Liu. On Feedback Vertex Set, New Measure and New Structures. *SWAT 2010* S. Thomassé. A quadratic kernel for feedback vertex set. *SODA 2009*.

8) M. Wahlström. Algorithms, Measures and Upper Bounds for Satisfiability and Related Problems. PhD Thesis, Department of Computer and Information Science, Linköpings universitet, Sweden, 2007. F. Abu-Khzam. Kernelization Algorithms for d-hitting Set Problems. *WADS 2007*.

9) P. Heggernes, C. Paul, J. A. Telle, and Y. Villanger. Interval completion with few edges. *STOC 2007*.

10) Y. Liu, S. Lu, J. Chen and S-H. Sze. Greedy Localization and Color-Coding: Improved Matching and Packing Algorithms. *IWPEC 2006*.

11) Ioannis Koutis, Ryan Williams: Limits and Applications of Group Algebras for Parameterized Problems. ICALP (1) 2009: 653-664.

12) D. Raible, The run time is 3.4581^k with poly-space-requirements. There is a SOFEM 2010 version: H. Fernau and D. Raible SOFSEM, the more detailed version is to be found in Raible's dissertation. V. Estivill-Castro, M. Fellows, M. Langston and F. Rosamond. Fixed-Parameter Tractability is Polynomial-Time Extremal Structure Theory I: The Case of Max Leaf. *ACiD 2004*, for the kernel.

13) Ioannis Koutis, Ryan Williams: Limits and Applications of Group Algebras for Parameterized Problems. ICALP (1) 2009: 653-664.

14) J. Daligault, G. Gutin, E.J. Kim, and A. Yeo, FPT Algorithms and Kernels for the Directed k-Leaf Problem. *J. Comput. Sys. Sci.* **76** (2010).

15) F. Dehne, M. Fellows, H. Fernau, E. Prieto, and F. Rosamond. Nonblocker: Parameterized Algorithms for Minimum Dominating Set. *SOFSEM 2006*. H. Fernau. Parameterized Algorithmics: A Graph Theoretic Approach. *HabSchrift. Wilhelm-Schickard Institut für Informatik, Universität Tübingen, 2005*, for the kernel.

16) J. Chen, S. Lu, S-H. Sze, F. Zhang. Improved Algorithms for Path, Matching, and Packing Problems. *SODA 2007*. J. Kneis, D. Mölle, S. Richter and P. Rossmanith. Divide-and-Color. *WG 2006* (independently found the same algorithm). H. Bodlaender, R. Downey, M. Fellows and D. Hermelin. On Problems Without Polynomial Kernels. *ICALP 2008*. From Moritz Mueller: Pointed Path (the starting point of the length k path is given) has no strong subexponential kernelization ('strong' means that it doesn't increase the parameter) unless ETH fails. Or: Path has no poly kernel even when restricted to planar and connected graphs. An open problem is the subexponential kernelizability for Path, and finding methods for excluding subexponential kernelizations.

17) R. Williams. Finding Paths of Length k in $O^*(2^k)$ Time. IPL 109(6):315–318, 2009, which builds on Ioannis Koutis: Faster Algebraic Algorithms for Path and Packing Problems. ICALP (1) 2008: 575-586.

18) O. Ponta, F. Hüffner and R. Niedermeier. Speeding up Dynamic Programming for Some NP-hard Graph Recoloring Problems. *TAMC 2008*. H. Bodlaender, M. Fellows, M. Langston, M. Ragan, F. Rosamond and M. Weyer. Kernelization for Convex Recoloring. *ACiD 2006*.

19) N. Alon, G. Gutin, E.J. Kim, S. Szeider and A. Yeo, Solving MAX-r-SAT above a Tight Lower Bound. Proc. ACM-SIAM Symposium on Discrete Algorithms (SODA 2010), pp. 511–517. According to Gutin, the algorithmic part will soon be improved to $2^{O(k)}$, but the kernel remains the same (so far). Previously $O(k^2)$ kernel and $2^{O(k^2)}$ algorithm by R. Crowston, G. Gutin, M. Jones, E.J. Kim, and I.Z. Ruzsa, Systems of Linear Equations over $\mathbb{F}_2$ and Problems Parameterized above Average. Proc. SWAT 2010, LNCS 6139 (2010), 164–175.

20) Daniel Lokshtanov, Saket Saurabh: Even Faster Algorithm for Set Splitting! IWPEC 2009: 288-299

21) A. Björklund, T. Husfeldt, P. Kaski and M. Koivisto. Fourier meets Möbius: Fast Subset Convolution. *STOC 2007*.

22) J. Chen, I. Kanj and G. Xia. Improved Parameterized Upper Bounds for Vertex Cover. *MFCS 2006*.

23) Mingyu Xiao. A note on Vertex Cover in graphs with maximum degree 3. *COCOON 2010*.

24) Daniel Raible, with polynomial space-requirements in dissertation *Amortized Analysis of Exponential Time and Parameterized Algorithms: Measure and Conquer and Reference Search Trees* (`http://www.informatik.uni-trier.de/~raible/Dissertation.pdf`), 2010.

Promotions and Moves

Faisal Abukhzam has received promotion to Associate Professor, Computer Science and Mathematics, Lebanese American University, Beirut. Abukhzam is the organizer for the International Programming Competition in Beirut. Faisal is the proud father of a new baby girl, born just before the WORKER conf. Congratulations, Faisal.

Binh-Minh Bui-Xuan has received a CNRS (Centre National de la Recherche Scientifique) tenure research position (Charg de Recherche) taking effect at the UMR7606 (Unit Mixte de Recherche 7606) hosted by the University of Paris 6 Pierre and Marie Curie. Bin will be part of research unit APR (Algorithms, Programs and Resolutions) led by Michle Soria. Congratulations, Bin.

Britta Dorn has accepted a permanent position in the Mathematics Dept, Univ Ulm. Recently she has taught a class on parameterized algorithms with 60 students! Well done, Britta. Congratulations.

Christian Knauer has accepted a permanent position in the Institut fur Informatik at Univ. Bayreuth. Congratulations, Christian.

Chunmei Liu has received tenure and promotion to Associate Professor in the Dept of Systems and Computer Science, Howard Univ. Prof Liu has developed a graph tree decomposition model and used it to solve a number of computational biology problems such as noncoding RNA gene search in genomes, protein structure prediction, and tandem mass spectral analysis. She also developed machine learning based techniques for protein domain prediction and protein fold classification. Liu has developed new parameterized algorithms. Liu's advisor was Liming Cai. Best wishes, Chunmei.

Rolf Niedermeier Moving from Jena to TU Berlin, newly establishing a group on Algorithms and Complexity in the Faculty of Electrical Engineering and Computer Science. Berlin is so lucky!

Yiannis Koutis tenure-track position at University of Puerto Rico. Congratulations, Yiannis.

Mohammad-Taghi Hajiaghayi tenure-track position at University of Maryland. Congratulations, Mohammad.

Ignasi Sau has received a permanent CNRS position in Montpellier, and will continue working on the bidimensionality already begun with Thilikos. Congratulations, Ignasi.

Pim van 't Hof University of Bergen postdoc with Pinar Heggernes in the Algorithms Group. Congratulations, Pim.

Serge Gaspers has accepted a postdoc position with the research group of Stefan Szeider at University of Vienna. Congratulations, Serge.

Siamak Tazari. Siamak will be joining the Algorithms Group led by Erik Demaine at MIT, as a postdoc beginning January 2011. Congratulations, Siamak.

CONGRATULATIONS New PhDs

Eun Jung Kim, *Parameterized Algorithms on Digraphs and Constraint Satisfaction Problems*, Royal Holloway University of London. Advisor: Gregory Gutin. Eun Jung Kim has been awarded a postdoc at Montpellier to work with the research groups of Christophe Paul and Stéphan Thomassé. Congratulations, Dr. Kim.

Ildi Schlotter, *Parameterized Complexity of Graph Modification and Stable Matching Problems*, Budapest University. Advisor: Dániel Marx. Ildi has a permanent position in the Dept of Computer Science and Information Theory, at the Budapest University of Technology and Economics. Congratulations, Dr. Schlotter.

Positions Available

(1)The Institute for Logic, Language and Computation (ILLC) at the University of Amsterdam currently has three opening for PhD positions, starting in September 2011:

`http://www.illc.uva.nl/NewsandEvents/newsitem.php?id=3688`

One of the (many) eligible topics is computational social choice (candidates interested in COMSOC should apply for the "Faculty of Science" position, deadline 15 March 2011).

If you know of (or are yourself) a strong candidate who might be interested in joining the ILLC as a PhD student working on COMSOC or a related topic, please do not hesitate to get in touch with with Prof. Ulle Endriss (`u.endriss@uva.nl`.

(2) Lecturer in Multi-Agent Systems, Dept Computer Science, University of Liverpool - Faculty of Science and Engineering. The Department, ranked in the top 10 UK Computer Science Departments in RAE2008, is seeking to further strengthen their current research portfolio around existing themes in the Agent ART group including: Logical Approaches to Multi-agent Systems, Co-operation and Game Theory, The Semantic Web and Argumentation and Dialogue. The Agent ART group enjoys close collaborative links with other research groups in the Department (Economics and Computation, Logic and Computation, Complexity Theory and Algorithms). You should have a PhD in computer science or a related discipline, and demonstrated the ability to carry out independent research to a high standard. Job Ref: A-557059/JAC, Closing date : 4 January 2011.

For full details, or to request an application pack, visit `www.liv.ac.uk/working/job_vacancies/` or e-mailjobs–at–iv.ac.uk.