Scientific Report of the Workshop on Weighted Automata: Theory and Applications March 27-31, 2006, Leipzig University, Germany

1 Summary

The workshop "Weighted Automata: Theory and Applications" took place from March 27-31, 2006 at the University of Leipzig, Germany. There were 38 participants from 10 countries (GE: 17, FI: 4, CZ: 4, F: 3, E: 3, SL: 2, GR: 2, I: 1, HU: 1, A: 1). Among the participants there was a good mixture of Master- and PhD students (appr. 10), research and teaching assistants, and professors (appr. 15).

The scientific programme consisted of

- two tutorials (each with a duration of 2 × 90 minutes),
- eight invited lectures (60 minutes), and
- nine technical contributions (30 minutes).

The workshop covered aspects of weighted automata both, from theory and applications. The tutorials were presented by Jürgen Albert, University of Würzburg, Germany ("Generating Images and Videoclips by Weighted Finite Automata") and Jozef Gruska, Masaryk University, Brno, Czech Republic ("Invitation to Quantum (Finite) Automata").

In addition to the successful scientific programme there were opportunities for social events (informal get together, visits of musea with special exhibitions, conference dinner, excursion).

The local organization worked perfectly.

2 Description of the scientific content of the event

At the workshop two tutorials were presented:

- by Jürgen Albert, University of Würzburg, Germany: "Generating Images and Videoclips by Weighted Finite Automata" and
- by Jozef Gruska, Masaryk University, Brno, Czeck Republic: "Invitation to Quantum (Finite) Automata".

Generating Images and Videoclips by Weighted Finite Automata

In his tutorial, Jürgen Albert started with the presentation of the basics of image generation (interpretation of words as addresses of pixels, recursive traversals for sets of pixels), he sketched the work of K. Culik II, J. Karhumäki, J. Kari on using weighted finite automata as finite state generators for smooth and fractal-like real-valued functions over the unit interval and unit square, he explained a cost driven recursive inference algorithm which effectively exploits self-similarities and produces small weighted finite automata for high quality approximations of given images, and compared the compression performance of this technique with the one of JPEG.

Invitation to Quantum (Finite) Automata

"Quantum automata are, on the one side, models of automata that go, in a natural way, beyond models of probabilistic automata and, on the other side, a natural way to get a deeper insight into the power of different quantum processing features and phenomena." With his tutorial, Jozef Gruska opened in a scientifically well-based way the perspectives, difficulties, and challenges of quantum computing to the audience. He presented the basics of quantum information processing and communication in many different aspects. Moreover, he showed how to "quantumize" classical models of automata.

In addition to the two tutorials eight invited lectures were presented.

Christel Baier talked about probabilistic ω-automata and showed that probabilistic Büchi-automata are more expressive than non-deterministic Büchi-automata. She identified a subclass of the former class of automata such that they become equivalent with the latter.

Symeon Bozapalidis presented a talk about picture deformation to overcome the inflexibility of picture transformation used so far.

Paul Gastin explained how to associate weights to monadic second-order logic such that it becomes equivalent to weighted finite automata (thereby generalizing Büchi's and Elgot's fundamental theorem).

Jarkko Kari reviewed basic algorithms related to finding a weighted finite automata (WFA) representation of a given image, he discussed state minimization, and showed how WFA transformations can be done directly on the WFA.

Werner Kuich introduced rational and algebraic transducers, and abstract families of elements (over starsemiring-omegasemimodule pairs); he proved that rational and algebraic closures are such abstract families of elements.

Werner Kuich presented a talk about fuzzy regular languages over finite and infinite words.

Ingmar Meinecke gave a survey on some weighted models of concurrency, showed several characterizations of these models, and discussed the benefits of quantitative aspects for concurrency.

George Rahonis introduced weighted Muller automata over infinite words and showed a characterization in terms of weighted monadic second-order logic. He also investigated weighted Muller on infinite trees.

The technical contributions covered aspects of algebra, automata theory, logic, computability theory, as well as topics motivated from practical applications:

- Burnside approach to the termination of Mohri's algorithm for polynomially ambiguous min-plus-automata
- characterization of recognizable picture languages
- recognizable skew formal power series over trace monoids
- weighted tree transducers and recognizability of tree series
- Lukasiewicz logic and automata over MV-algebras
- properties of real functions computed by weighted finite automata
- weighted automata for proving termination of string rewriting
- video compression with weighted finite automata
- parametric weighted finite automata

All abstracts are available publicly via the conference homepage
http://www.informatik.uni-leipzig.de/theo/wata06.html

3 Assessment of the results and impact of the event

As it can be seen from the description of the scientific content, the workshop covered weighted finite automata from the aspects of automata theory, algebra, and logic, as well as from the application point of view (in particular, image processing). Due to the relatively wide scope of the presentations, the participants received as good introduction to the state of the art in weighted finite automata. In particular, the participating young scientists took the opportunity to discuss weighted finite automata with the senior researchers.

In addition to the presented talks there was time for bilateral discussions and cooperative work.

There will be a special issue of the Journal of Automata, Languages, and Combinatorics (JALC) on the topic of this workshop. The deadline for submission of papers is May 10, 2006. All submissions will be refereed according to the usual journal standards.

Due to the success of this workshop (and its two predecessors) the organizers feel encouraged to organize in the year 2008 another "Workshop on Weighted Automata: Theory and Applications (WATA 2008)", this time again in Dresden.

4 Final programme of the meeting

Monday, March 27, 2006

08.30 – 09.00	Registration
09.00 – 10.30	J. Albert (Würzburg) Tutorial *Generating images and videoclips by weighted finite automata*
10.30 – 11.00	Break
11.00 – 12.00	W. Kuich (Wien) Invited Lecture *Transducers for ω-languages – an algebraic generalization*
12.00 – 14.00	Lunch
14.00 – 15.00	J. Kari (Turku/Iowa) Invited Lecture *Survey: Finite state methods for image analysis and manipulation*
15.00 – 15.30	P. Steinby (Turku) *Observations on the smoothness properties of real functions computed by weighted finite automata*
15.30 – 16.00	Break
16.00 – 16.30	G. Tischler (Würzburg) *Parametric weighted finite automata with unary alphabet*
16.30 – 17.00	A. Maletti (Dresden) *Preservation of recognizability for* o*-substitution*

Tuesday, March 28, 2006

08.30 – 09.00	Registration	
09.00 – 10.30	J. Albert (Würzburg)	Tutorial
	Generating images and videoclips by weighted finite automata	
10.30 – 11.00	Break	
11.00 – 12.00	P. Gastin (Paris-Cachan)	Invited Lecture
	Weighted automata and weighted logics	
12.00 – 14.00	Lunch	
14.00 – 15.00	I. Meinecke (Leipzig)	Invited Lecture
	Weighted concurrency	
15.00 – 15.30	I. Mäurer (Leipzig)	
	Characterizations of recognizable picture series	
15.30 – 16.00	Break	
16.00 – 16.30	Ch. Mathissen (Leipzig)	
	Recognizable skew formal power series over trace monoids	
16.30 – 17.30	Short communication & research session	

Wednesday, March 29, 2006

08.30 – 09.00	Registration	
09.00 – 10.30	J. Gruska (Brno)	Tutorial
	Quantum (finite) automata: an invitation	
10.30 – 11.00	Break	
11.00 – 12.00	Z. Ésik (Szeged)	Invited Lecture
	Iteration theories and weighted automata	
12.00 – 14.00	Lunch	
14.00 –	Excursion & free time	

Thursday, March 30, 2006

08.30 – 09.00	Registration	
09.00 – 10.30	J. Gruska (Brno) *Quantum (finite) automata: an invitation*	Tutorial
10.30 – 11.00	Break	
11.00 – 12.00	C. Baier (Bonn) *Probabilistic ω-automata*	Invited Lecture
12.00 – 14.00	Lunch	
14.00 – 15.00	S. Bozapalidis (Thessaloniki) *Picture deformation*	Invited Lecture
15.00 – 15.30	J. Waldmann (Leipzig) *Weighted automata for proving termination of string rewriting*	
15.30 – 16.00	Break	
16.00 – 17.30	Short communication & research session	
19.00 –	Conference dinner	

Friday, March 31, 2006

08.30 – 09.00	Registration	
09.00 – 10.00	G. Rahonis (Thessaloniki) *Weighted logics on infinite words and trees*	Invited Lecture
10.00 – 10.30	Break	
10.30 – 11.00	G. Tischler (Würzburg) *Hybridization of near random to random access video compression with weighted finite automata*	
11.00 – 11.30	D. Kirsten (Dresden) *A Burnside approach to the termination of Mohri's algorithm for polynomially ambiguous min-plus-automata*	
11.30 – 12.30	Lunch	