

Michał Matuszak, PhD

CONTACT INFORMATION	Mobica Ltd. Towarowa 36 87-746 Bydgoszcz, Poland	Mobile: +48 696459522 E-mail: gruby@mat.umk.pl WWW: http://mat.umk.pl/~gruby
SUMMARY	Machine learning and statistics scientist with software development background. Particularly interested in Probabilistic Graphical Models (Bayesian and Gaussian Networks), Spiking Neural Networks and Scale-free Graphs. Developed many large scale simulations on supercomputers and GPUs with NVIDIA CUDA technology. Enthusiast of Scala and Big Data processing with Apache Spark.	
COMPUTER SKILLS	<ul style="list-style-type: none">• Big Data: Apache Spark, Apache Cassandra• Languages: C, C for CUDA, C++, Scala, some experience in Python• Scientific software: R, Matlab, Maple, \LaTeX• Algorithms: Machine Learning/Statistics, Probabilistic Graphical Models, Random Graphs, Matrix algorithms, Parallel algorithms• Version control systems: Git, Subversion, Mercurial• Operating Systems: Windows/Linux/Solaris	
PROFESSIONAL EXPERIENCE	Mobica Ltd. , Bydgoszcz, Poland Software Engineer	07.2015 – present
	Adam Mickiewicz University , Poznan, Poland Assistant Professor Senior Lecturer and Postdoc	2014 – 09.2015 2013 – 09.2014
	Nicolaus Copernicus University , Torun, Poland Principal Investigator and Project Director in National Science Centre (NCN) grant.	2011 – 09.2015
	University of Warsaw , Warsaw, Poland Research internship, within project KNOW (Leading National Research Center) Research internship, within project SSDNM (National PhD Programme)	02.2013 – 06.2013 10.2010 – 02.2011
	IV High School of Tadeusz Kosciuszko , Torun, Poland Computer Science teacher in “university” class (class is under the supervision of the Faculty of Mathematics and Computer Science).	2011 – 2013
	Nicolaus Copernicus University , Torun, Poland Junior Network Administrator	2006 – 2009
	Gamelion Inc , Bydgoszcz, Poland Junior developer (summer internship)	08.2007 – 10.2007
EDUCATION	University of Warsaw , Warsaw, Poland <i>Faculty of Mathematics, Informatics and Mechanics</i> PhD in Computer Science Studies in National PhD Programme in Mathematical Sciences for outstanding students – conducted by 8 leading Mathematical and Computer Sciences centers in Poland. <ul style="list-style-type: none">• Dissertation Topic: “Bayesian Networks in Adaptation and Optimization of Behavioral Patterns”• Supervisor: Prof. Jacek Miękiś and Prof. Tomasz Schreiber• GPA: 4.77/5.0	2009 – 23.05.2013
	Nicolaus Copernicus University , Torun, Poland <i>Faculty of Mathematics and Computer Science</i> MSc in Computer Science (Programming and Information Processing) <ul style="list-style-type: none">• Thesis Topic: “Application of Monte Carlo Methods in Inference Algorithms in Continuous Time Bayesian Networks”• Advisor: Prof. Wojciech Niemiro• GPA: 4.59/5.0, Final grade: 5.0/5.0, Top 5%	2004 – 2009

HONORS AND
AWARDS

- Polish Ministry of Science and Higher Education Scholarship for outstanding PhD students, 2012
- Travel grant from the Heartie Foundation for the FENS–IBRO–Hertie Winter School: Brain Dynamics and Dynamics of Brain Disease, 2012
- Pro-quality Scholarship for outstanding PhD students, 2012
- Pro-quality Scholarship for outstanding PhD students, 2011
- Kuyavian-Pomeranian Voivodeship Marshall Scholarship for Ph.D students (funded by the European Social Fund and the Government of Poland), 2011
- Second degree team award of the NCU Rector, 2011
- Travel grant from organizers of OCNC 2011 (Okinawa Computational Neuroscience Course), 2011
- Kuyavian-Pomeranian Voivodeship Marshall Scholarship for Ph.D students (funded by the European Social Fund and the Government of Poland), 2010
- Kuyavian-Pomeranian Voivodeship Marshall Scholarship for Ph.D students (funded by the European Social Fund and the Government of Poland), 2009
- Chairman of the Computer Science Study Group, 2008–2009
- Polish Ministry of Science and Higher Education Scholarship for outstanding students, 2007
- Second place in the annual Team Programming Competition of the Faculty, 2007

GRANTS

- Principal Investigator and Project Director in National Science Centre (NCN) grant 2011/01 /N/ST6/00573 (2011 – 2015).
- Project Director in PL–GRID computational grant ”Scale-Free Graph with Preferential Attachment and Evolving Internal Vertex Structure” (rgraphs2013 and rgraphs2) (2012–2013).
- Principal Investigator and Project Director in Nicolaus Copernicus University (NCU) grant 1747-M (2013).
- Principal Investigator and Project Director in Nicolaus Copernicus University (NCU) grant 1086-M (2012).
- Principal Investigator and Project Director in Nicolaus Copernicus University (NCU) grant 187-M (2012).
- Investigator in Ministry of Science and Higher Education grant 3852/B/H03/2008/34 N N201 385234 (2008 – 2010), directed by dr hab. Tomasz Schreiber.

PUBLICATIONS

- MIĘKISZ, J., MATUSZAK, M., POLESZCZUK, J., “Stochastic Stability in Three-Player Games with Time Delays”, *Dynamic Games and Applications*, 1-10, DOI 10.1007/s13235-014-0115-1, May 2014.
- KAMINSKA, P., MATUSZAK, M., “Image Segmentation by Locally Specified Multi-coloured Polygonal Markov Fields”, *Proceedings of the 2nd International Conference on Intelligent Systems and Image Processing*, 2014.
- NOWICKI, M., MATUSZAK, M., KWIATKOWSKA, A.B., SYSŁO, M.M., BAŁA, P. “Teaching secondary school students programming using distance learning. A case study”, *Proceedings of the 10th IFIP World Conference on Computers in Education*, Vol. 2, pp. 246–254, 2013.
- CHOROMANSKI, K., MATUSZAK, M., MIĘKISZ, J. “Scale-Free Graph with Preferential Attachment and Evolving Internal Vertex Structure”, *Journal of Statistical Physics*, Volume 151, Issue 6, pp. 1175–1183, June 2013.
- MATUSZAK, M., MIĘKISZ, J. “Stochastic Techniques in Influence Diagrams for Learning Bayesian Network Structure”, *Proceedings of the International Conference on Artificial Neural Networks*, Lausanne, Switzerland, Part I, *Lecture Notes in Computer Science* 7552, pp. 33–40, ISBN 978–3–642–33268–5, Springer–Verlag, 2012.
- MATUSZAK, M., MIĘKISZ, J., SCHREIBER, T. “Solving Ramified Optimal Transport Problem in the Bayesian Influence Diagram Framework”, *Proceedings of the 11th International Conference on Artificial Intelligence and Soft Computing*, Zakopane, Poland, *Lecture Notes in Computer Science* 7268, pp. 582–590, ISBN 978–3–642–29349–8, Springer–Verlag, 2012.

- M. MATUSZAK, T. SCHREIBER, “Locally specified polygonal Markov fields for image segmentation”, *Mathematical Methods for Signal and Image Analysis and Representation*, Series: Computational Imaging and Vision, Vol. 41, Florack, L.; Duits, R.; Jongbloed, G.; Lieshout, M.-C. van; Davies, L. (Eds.), ISBN 978-1-4471-2352-1, pp. 261-274, 2012.
- MATUSZAK, M., MIĘKISZ, J., SCHREIBER, T. “Smooth Conditional Transition Paths in Dynamical Gaussian Networks”, *Proceedings of the 34th Annual German Conference on Artificial Intelligence: Advances in Artificial Intelligence*, Berlin, Germany, Lecture Notes in Artificial Intelligence 7006, pp. 204-215, ISBN 978-3-642-24454-4, Springer-Verlag, 2011.
- M. MATUSZAK, T. SCHREIBER, “GPU Accelerated Smooth Formation Redeployment in Multiagent Environment”, *MASYW 2010*, Institute of Computer Science, Polish Academy of Sciences, pp. 92-100, ISBN 978-83-63159-00-9, Warsaw 2011.
- MATUSZAK, M., SCHREIBER, T. “A new stochastic algorithm for strategy optimisation in Bayesian influence diagrams”, *Proceedings of the 10th International Conference on Artificial Intelligence and Soft Computing*, Zakopane, Poland, Lecture Notes in Artificial Intelligence 6114, pp. 574-581, ISBN 978-3-642-13231-5, Springer-Verlag, 2010.
- J. MATULEWSKI, M. PAKULSKI, D. BORYCKI, B. BIALY, P. PEPLOWSKI, M. MATUSZAK, D. SZLAG, D. URBANSKI, “Visual C++. Gotowe rozwiązania dla programistów Windows” (eng. “Visual C++-Practical Solutions for Windows Developers”), ISBN: 978-83-246-1928-3, 2010.
- M. MATUSZAK, J. MATULEWSKI, “CUDA i czyny”, *Software Developer’s Journal*, ISSN 1734-3917, Warsaw, 01.2010.
- M. MATUSZAK, J. MATULEWSKI, “Czyn CUDA”, *Software Developer’s Journal*, ISSN 1734-3917, Warsaw, 12.2009 (Cover article).

RESEARCH
EXPERIENCE

Firstly, the period of my studies has given me a vast background, mostly in mathematics and theoretical computer science. During CS studies, I have completed many maths related courses e.g. differential equations, linear/abstract algebra, signal processing (Fourier and wavelet transforms). What I am mostly familiar with is probability and statistics. I am also interested in computer graphics and parallel programming.

In 2007, I started working with Prof. Tomasz Schreiber (1975-2010) on polygonal Markov fields for image segmentation. Our algorithm is based on the Markovian optimization dynamics combining the simulated annealing ideas with those of the Chen-style stochastic optimization, where successive segmentation updates are carried out simultaneously with the adaptive optimization of the local activity functions.

Afterward, Prof. Schreiber drew my attention to Neural and Bayesian networks and became my Ph.D. dissertation supervisor. In the meantime, I wrote my Master thesis about stochastic algorithms for inference in Continuous Time Bayesian Networks, under supervision of Prof. Niemiro. I implemented some inference algorithms as well as compared them and participated in developing new ones.

From 2009 to 2012, I was working on my PhD thesis. We have presented several new methods and algorithmic results related to probabilistic graphical models. One of the most important outcomes was optimization developed for the strategy, in Bayesian influence diagrams. It is a well-known NP-complete problem. The proposed stochastic algorithm generates optimal decision strategies by an iterative self-annealing reinforced search procedure, gradually acquiring new information while driven by information already obtained. In the foundation of the method, there lies the Chen-style stochastic optimization which was originally proposed for travelling salesman problems (TSP). The algorithm, after a substantial extension, is applied to the NP-hard problem of learning Bayesian network structure. Another use of the algorithm occurs in the NP-hard ramified optimal transport problem.

In Gaussian-network set up, we develop an algorithm for determining optimal transition paths between given configurations of systems consisting of many objects. The method is applied to a system controlling the motion and redeployment among unit formations and to a realistic transformation between two sequences of character animations in a virtual environment.

During the internship at the University of Warsaw (1.10.2010-11.02.2011), I started working on co-evolutionary dynamic mechanisms of cooperation in growing populations which form scale-free graphs with various exponents. The project was conducted under the supervision of Prof. Jacek Miekisz.

We introduce a co-evolutionary model of growing scale-free graphs with vertices occupied by agents playing the Prisoner’s Dilemma or the Snow Drift game. The evolution of the strategies is governed by stochastic imitation dynamics. In our generalized preferential attachment procedure, the probability of a new link is proportional to the payoff of a player placed at a given vertex. We show by computer simulations that the co-evolution of a graph structure and strategies gives rise to scale-free graphs with various exponents

and clustering coefficients. We also show that co-evolution is beneficial in maintaining high levels of cooperation.

Furthermore, I participated in Okinawa Computational Neuroscience Course (OCNC) in 2011. My tutor was Ping Wang from Salk Institute. We were working on an application whose main goal was to simulate and visualize the persistent sodium and potassium neuron model (Na-K) on irregular meshes with cable equation. During the course we significantly extended the capabilities of the application.

Next, in 2012–2013, we extended with Choromanski, the classical Barabasi–Albert preferential attachment procedure to graphs with internal vertex structure given by weights of vertices. In our model, weight dynamics depends on the current vertex degree distribution and the preferential attachment procedure takes into account both weights and degrees of vertices. To the best of our knowledge, our model is the first coupled dynamics with analytically derived power-law exponents. To support the analytical calculation we also provide numerical simulations.

In 2013, I worked in Warsaw Center of Mathematics and Computer Science, which has been selected as the Leading National Research Center in Poland engaged in investigating the influence of finite time delays on stationary states of various models and the stochastic stability of their states. Concerning the areas above, I have focused particularly on two sub-problems:

- Finding frequencies of various strategies in population of agents in the presence of time delays, in particular extinctions and fixations of strategies and studying impact of time delays on the equilibrium states.
- Impact of time delays on the variance of the number of protein molecules, constructing analytical (symbolic) expressions for variance along with correlation functions.

From 2013/2014 to 2015, I was working in Adam Mickiewicz University in Poznan. I was working on polygonal Markov fields for image segmentation, parallel programming on GPU and Spiking Neural Networks.

In 2015, I have started to work for Mobic Ltd.

CONFERENCE PRESENTATIONS

- "Concurrent Image Segmentation by Locally Specified Polygonal Markov Fields on the GPU". Poster at the GPU Technology Conference, San Jose, USA.
- "Image segmentation by locally specified multi-coloured polygonal Markov fields". Presentation for the ICISIP 2014, Kitakyushu, Fukuoka, Japonia
- "Concurrent learning of a Probabilistic Graphical Model on the GPU". Poster at the GPU Technology Conference, San Jose, USA.
- "Concurrent structure learning of a Probabilistic Graphical Model on the GPU". Poster at the Programming and Tuning Massively Parallel Systems, Barcelona, Spain
- "Image segmentation by locally specified multi-coloured polygonal Markov Fields". Poster at the 17th Workshop on Stochastic Geometry, Stereology and Image Analysis, Torun, Poland
- "Bayesian Networks in Adaptation and Optimization". Presentation for the Forum of Theoretical Informatics, Torun, Poland
- "Simulation of Na-K model on irregular meshes". Poster at the FENS-IBRO-Hertie Winter School, Obergurgl, Austria
- "Influence Diagrams in Strategic Games". Poster at the Vienna Game/AI Conference, Vienna, Austria
- "Stochastic Techniques in Influence Diagrams for Learning Bayesian Network Structure". Poster at the International Conference on Artificial Neural Networks, Lausanne, Switzerland
- "Application of the Bayesian Influence Diagram Framework to the Ramified Optimal Transport Problem". Presentation for the Applied Bayesian Statistics School: Stochastic Modelling for Systems Biology, Pavia, Italy
- "Solving Ramified Optimal Transport Problem in the Bayesian Influence Diagram Framework". Poster at the 11th International Conference on Artificial Intelligence and Soft Computing, Zakopane, Poland
- "Smooth Conditional Transition Paths in Dynamical Gaussian Networks". Presentation for the 34th Annual German Conference on Artificial Intelligence, Berlin, Germany
- "Neurons in CUDA". Presentation for the Okinawa Computational Neuroscience Course, Okinawa, Japan
- "Smooth Formation Redeployment in Multiagent Environment". Poster at the Okinawa Computational Neuroscience Course, Okinawa, Japan

- "GPU Accelerated Smooth Formation Redeployment in Multiagent Environment". Presentation for the Mathematical Methods in Modeling and Analysis of Concurrent Systems, Tlen nad Wda, Poland
- "Optimal Formation Redeployment in Multiagent Environment". Poster at Summer School on Neural Networks in Classification, Regression and Data Mining, Porto, Portugal
- "A new stochastic algorithm for strategy optimisation in Bayesian influence diagrams". Poster at the 10th International Conference on Artificial Intelligence and Soft Computing, Zakopane, Poland

SEMINAR
TALKS

- "Image segmentation by locally specified multi-coloured polygonal Markov fields", Stochastic Seminar, Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic, 22.04.2014.
- "Probabilistic Graphical Models in Optimization", Research Seminar, Brain Corporation, San Diego, USA, 31.03.2014.

CONFERENCES,
SUMMER SCHOOLS
AND WORKSHOPS

- PUMPS 2015, Programming and Tuning Massively Parallel Systems, 6–10.07.2013, Barcelona, Spain
- GTC 2015, GPU Technology Conference, 16–20.03.2015, San Jose, USA
- ICISIP 2014: The 2nd International Conference on Intelligent Systems and Image Processing 2014, Kitakyushu, Fukuoka, Japan, 26–29.09.2014
- GTC 2014, GPU Technology Conference, 23–27.03.2014, San Jose, USA
- PUMPS 2013, Programming and Tuning Massively Parallel Systems, 8–12.07.2013, Barcelona, Spain
- SGSIA 2013, 17th Workshop on Stochastic Geometry, Stereology and Image Analysis, 11–14.06.2013, Torun, Poland
- Tomasz Schreibers Memorial Session, 10.06.2013, Torun, Poland
- Summer School in Network Science, 20–31.05.2013, Columbia, SC, USA
- FENS-IBRO-Hertie Winter School: Brain Dynamics and Dynamics of Brain Disease, 9–16.12.2012, Obergurgl, Austria
- Vienna Game/AI Conference 2012, 17-19.09.2012, Vienna, Austria
- ICANN 2012, International Conference on Artificial Neural Networks, 11–14.09.2012, Lausanne, Switzerland
- ABS12, Applied Bayesian Statistics School: Stochastic Modelling for Systems Biology, 3–7.09.2012, Pavia, Italy
- ICAISC 2012, 11th International Conference on Artificial Intelligence and Soft Computing, 29.04–3.05.2012, Zakopane, Poland
- GPUs in Computational Statistics, 25.01.2012, Coventry, United Kingdom
- KI 2011, 34th Annual German Conference on Artificial Intelligence, 4.10–7.10.2011, Berlin, Germany
- OCNC 2011, Okinawa Computational Neuroscience Course, 13.06–30.06.2011, Okinawa, Japan
- MASYW'10, Mathematical Methods in Modeling and Analysis of Concurrent Systems, 19–23.07.2010, Tlen nad Wda, Poland
- NN2010, Summer School on Neural Networks in Classification, Regression and Data Mining, 12–16.07.2010, Porto, Portugal
- ICAISC 2010, 10th International Conference on Artificial Intelligence and Soft Computing, 13–17.06.2010, Zakopane, Poland
- How to model neurons and neural systems? Integrating biophysics, morphology, and connectivity. Second Polish-Norwegian Neuroinformatics Workshop, 14–15.01.2010, Warsaw, Poland
- KI 2009, 32nd Annual Conference on Artificial Intelligence, AI and Automation, 15–18.09.2009, Paderborn, Germany
- Tango Conference 2008, First International D language Community Meeting, 26–28.09.2009, Torun, Poland

CONFERENCES,
SUMMER SCHOOLS
AND WORKSHOPS
(NATIONAL)

- FIT 2013, Forum of Theoretical Informatics, 11–14.04.2013, Torun, Poland
- Minikonferencja 5, 19 – 20.10.2012, Wroclaw, Poland
- WGK 2012, II Krajowa Konferencja Wytwarzania Gier Komputerowych, 31.08 – 2.09.2011, Gdansk, Poland
- TLSM 2012, Torunska Letnia Szkola Matematyki, 27 – 31.08.2011, Torun, Poland
- IwE 2012, Informatyka w Edukacji, 3 – 4.07.2012, Torun, Poland
- Minikonferencja 4, 13 – 14.04.2012, Torun, Poland
- Minikonferencja 3, 14 – 15.10.2011, Krakow, Poland
- WGK 2011, I Krajowa Konferencja Wytwarzania Gier Komputerowych, 2 – 4.09.2011, Gdansk, Poland
- TLSM 2011, Torunska Letnia Szkola Matematyki, 22 – 26.08.2011, Torun, Poland
- Minikonferencja 2, 8 – 9.04.2011, Poznan, Poland
- Krok w przyszosc – stypendia dla doktorantow III edycja, 5.04.2011, Torun, Poland
- Krok w przyszosc – stypendia dla doktorantow III edycja, 29.03.2011, Torun, Poland
- Krok w przyszosc – stypendia dla doktorantow III edycja, 2 – 3.12.2010, Torun, Poland
- MASYW'10, Mathematical Methods in Modeling and Analysis of Concurrent Systems, 19 – 23.07.2010, Tlen nad Wda, Poland
- Komercjalizacja wiedzy (Fundacja Centrum Innowacji FIRE) 17 – 18.12.2009, Torun, Poland
- Krok w przyszosc – stypendia dla doktorantow III edycja, 10.12.2009, Torun, Poland
- Spin-off – biznesowa szansa dla studentow i doktorantow, 26.11.2009, Torun, Poland

REVIEWING

- IEEE Transactions on Neural Networks and Learning Systems (one paper)

TEACHING
EXPERIENCE

- Introduction to Programming (for Geographic Information Science) (AMU) – laboratories (30h)
- Algorithms and Programming (AMU) – laboratories (60h)
- Operating Systems (AMU) – laboratories (120h)
- Object-oriented programming (AMU) – laboratories (90h)
- Computer Networks (AMU) – laboratories (90h)
- Information Technology (AMU) – laboratories (150h)
- Introduction to Computer Science II (UW) – laboratories (30h)
- Computer Science – advanced course (IV High School) – lessons (240h)
- Graphics and Multimedia (NCU) – laboratories (45h)
- Operating Systems (NCU) – laboratories (30h)
- D-language (NCU) – laboratories (co-lecturer)

MEMBERSHIP IN
PROFESSIONAL
SOCIETIES

- ACM (Association for Computing Machinery)
- IEEE (Institute of Electrical and Electronics Engineers)
- OCNS (Organization for Computational Neuroscience)

OTHER SKILLS

- Driving license

HOBBIES

- Swimming, Running, Cycling
- Computer Games
- Formula 1