ricardo kirkner

msc in computer science

General information

Age	30
Nationalities	Argentinian, German
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Education

1998 - 2007 **MSc in Computer Science**, *Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires*, Buenos Aires, Argentina.

1997 **Deutsches Abitur** - **German High School**, *Goethe Schule Buenos Aires*, Buenos Aires, Argentina.

1991 - 1996 **Bachillerato Nacional Bilingüe en Ciencias y Humanidades con Orientación Científica** - **High School**, *Goethe Schule Buenos Aires*, Buenos Aires, Argentina.

Relevant Academic Courses

2005 **Introduction to Behaviour based robotics**, *Universidad de Buenos Aires*, 1 semester: ∼100 hours.
Topics covered:

Introduction to autonomous robots: Definitions. Types of robots. History and motivations from artificial intelligence, cybernetics and biology. Definition of behaviour based robotics.

Perception and Action: Environment types. Sensing devices. Perception schemes. Action oriented perception. Odometry.

Reactive behaviours: Ethology-driven behaviour design; situation-activity driven designs; experimentation driven design; learning driven design. General behaviour classification. Methods for expressing behaviour: Stimulus-response diagrams, functional notation, finite state acceptor. Stimulus representation. Actions and mappings. Response encoding.

Multiple behaviour coordination: Competitive coordination: Subsumption. Cooperative coordination: motor schema.

Braitenberg: Introduction. Vehicles.

Control theory introduction: From temporal space to frequency space. Control schema. PID control.

Reinforcement learning: Introduction. Markov decision process. Value function and Action-value. Policy. Dynamic programming. Policy evaluation. Model-free reinforcement learning. Montecarlo methods. State space representation.

2004 **Algorithms for Rational Agents**, *Universidad de Buenos Aires*, 1 week: ∼25 hours. Short one-week course on how to apply game theory for solving a certain class of problems. In this course the focus was set on the problem of routing packets through a set of parallel links that connect two points in a network. **Topics covered:**

Game Theory and Nash Equilibria: Strategic Games. Nash Equilibria and Fixed Points. Mixed Strategies.

Worst-case Equilibria: The Parallel links routing problem: two links, more than two links.

The Complexity of Finding Nash Equilibria

Implementation Theory: How to design a game that will have an equilibrium for some desired outcome.

2004 **Game theory**, *Universidad de Buenos Aires*, 1 semester: ∼100 hours.
Topics covered:

Introduction: Concepts: rationality, pareto optimality, irrelevant alternative independence.

Games: Matrix form of a game. Normal and reduced form. Pure and mixed strategies. Game value. Perfect information games. Zero-sum games. Minimax theorem. Dominance and pure and mixed Nash equilibria. Existence theorem. Moves and Stackelberg theorem.

Selection functions and preference relations: Ordinality. Axiomatic utility over lotteries (Von Neumann-Morgenstern-Kreps). Representation theorem.

Negotiation problems: Geometric formulation. Von Neumann-Morgenstern model. Nash axioms and solution. Alternative characterizations: fair division, utility measures and partition games.

Combinatorial games (Berlekamp-Conway): Nim and Hackenbush. Numbers and Nimbers. Cold games and warm games.

2004 **Introduction to Machine Learning**, *Universidad de Buenos Aires*, 1 semester: ∼100 hours.
Topics covered:

Introduction: Version state algorithm. Candidate elimination.

Decision trees: ID3, C4.5. Overfitting. Attribute selection.

Neural networks: Perceptron. Multilayer networks. Backpropagation.

Data processing and analysis: Hypothesis evaluation.

Bayesian learning: Bayes theorem and concept learning. Minimal description length principle. Bayesian optimal classifier, Gibbs algorithm, Naive Bayes classifier.

Ensemble learning: Bagging, boosting. PAC theory. Sample complexity. Error boundary. Precision.

Instance-based learning: Nearest neighbours. Locally weighted regression. Radial base functions. Lazy vs eager learning. Local vs global learning.

Genetic algorithms: Hypothesis representation. Genetic operators. Fitness and selection functions.

Rule set learning: Sequential coverage learning. First-order rules learning. FOIL. Induction vs deduction. Inverse resolution.

Analytical learning: Perfect domain theory learning. Prolog-EBG. Explanation-based learning.

Combining inductive and analytical learning: Hypothesis initialization: KBANN. Objective modification: Tangent-prop, EBNN. Search operators: FOCL.

Reinforcement learning: Markov decision process. Cumulative reward and Q function. Q-learning convergence.

2003   **Multi-agent Technologies: Deliberation, Reaction, Mobility**, *Universidad de Buenos Aires*, 1 week: ∼25 hours.

Short one-week course on how to program agents that can autonomously perform certain tasks and interact with humans. The focus was mainly set on interface agents designed using the frameworks developed by the speakers. **Topics covered:**

Agent Programming: Integration between objects and logic. Object oriented programming vs Logic programming. JavaLog. Distributed JavaLog

Multi-agent System Architectures: Software architecture. Architectural styles. Object oriented frameworks. Sample architectures: Subsumption, Competitive Tasks, InteRRaP, Brainstorm.

Bubble: Framework structure, Usage samples.

SmartBooks: An agent for frameworks instantiation. HiFi environment.

Mobile Agents: Mobile computation: Concept and support technologies. Mobile code: Concept and mobility models.

AgLets

BrainLets: MoviLog.

2003   **Numerical methods**, *Universidad de Buenos Aires*, 1 semester: ∼180 hours.
Topics covered:

Computer arithmetic: Number representation. Rounding errors. Relative and absolute error. Arithmetic operations. Stability and convergence.

Algorithms for solving non-linear single-variable equations: Bisection, Fixed-point, Newton.

Linear system resolution: Gauss and LU decomposition. Pivoting strategies. Error analysis. Condition number. Special matrices: symmetrical, band, etc. QR decomposition. Autovalues: powers method and QR.

Linear inequations systems: Simplex method.

Non linear system resolution: Newton. Broyden. Local and global convergence.

Interpolation: Lagrange, divided differences, splines.

Approximation: Least minimum squares.

Numerical integration: Interpolation based methods.

Master Thesis

date   March 2007

title   Reinforcement Learning in Self-Reconfigurable Modular Robots

university   Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires

abstract Reinforcement Learning has been found repeatedly missing in the literature about re-configuration and locomotion tasks in Self-Reconfigurable Modular Robots. This methodology, however, has been proved to produce significant benefits in those cases where it was used to solve problems related to dynamic and unpredictable environments. This kind of environments is very common when dealing with Self-Reconfigurable Modular Robots. In this work, we first survey the state of the art in the field of Self-Reconfigurable Modular Robots, in order to determine what the yet unsolved problems and the possible niches of research are. We then develop a simulator in order to study the Reinforcement Learning methodology applied to the generation of behaviours that efficiently solve reconfiguration and locomotion tasks using the M-TRAN Self-Reconfigurable Modular Robot. Finally, several experiments are suggested in order to test this methodology. For those experiments it is necessary to define the best representation for the state-action space, and the way to discretize it in order to make those experiments computationally feasible. Another issue analyzed is the impact of several aspects involved in Reinforcement Learning problems, such as the definition of an episode, the learning velocity and policy evaluation. Since this kind of study involves a significant experimental component, after designing and performing the experiments, the results are analyzed and conclusions are drawn about the effectiveness and possibilities of Reinforcement Learning when applied to these kind of robots.

notes *The complete document is available upon request.*

Work Experience

January 2009 - present

Technical Leader, *Globant (www.globant.com)*.

Working as a contractor for Active Broadband Networks. In charge of leading a team of people developing a system for collecting large volumes of data from cablemodem devices in order to gather usage statistics for a whole network. The current implementation is deployed in the Comcast network, handling around 17 million cablemodem devices. Due to the sheer amount of data involved, several ad-hoc solutions had to be developed in order to manage this data while still complying to performance and hardware requirements, and being able to provide a rich dataset for performing deeper analysis on the stored data.

July 2008 - January 2009

Senior Software Engineer, *Globant (www.globant.com)*.

Worked as a contractor for Yahoo!. Designed and developed the UI for an internal application for the Sponsored Search Management System. One of the challenges faced was the integration between the application and Yahoo!'s internal bug management system.

Worked as a contractor for Google. Designed and developed the UI for a VoIP application intended to serve as a high-performance and scalable PBX. The initial requirement was for the application to handle up to 10K simultaneous SIP connections with a foreseen demand for up to 100K. The system would be used worldwide across several locations, in a distributed fashion.

December 2007 - July 2008

Project Manager, *EasyTech (www.easytech.com.ar)*.

Designed and lead the development of a system for taking the Buenos Aires city's Driver's Licence exam. This system would be used by roughly 1500 persons each day. Also designed and lead the development of an application for creating and editing print-media products while off-line, for a major chilean web-based company.

February 2005 - September 2006

Python Web Developer (Plone), *EuskoSare (www.euskosare.org)*.

Designed and developed a four-language multilingual web portal on top of the Plone CMS, with a completely redesigned interface; the multilingual system was novel in that it would present content to the user in several languages simultaneously, according to each user's personal preferences. Also designed and implemented a news gathering system that would screen-scrape several news sites and then integrate the gathered content into the portal, so that it could be searched like any other user generated content.

June 2001 - May 2005	**System and Network Administrator**, *Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires*. Was in charge of managing the whole network infrastructure for the university; this included installing and administering web-, mail-, ldap- and file-servers, as well as routers, both hardware devices, like Cisco routers, and custom built GNU/Linux boxes working as routers. Also dealt with monitoring and ensuring availability of all these services. Some achievements include setting up an anti-spam mail filtering system that filtered 40000 spam emails daily, and setting up a single sign on infrastructure using OpenLDAP and Kerberos for simplifying granting access to the different servers to faculty members.
June 2000 - December 2000	**Web Developer (PHP)**, *Nexitel*.

Languages

Spanish	**Native**
German	**Native**
English	**Advanced**
French	**Basic**

Language Certificates

1996	**Deutsches Sprachdiplom Zweite Stufe**, *Kultusministerkonferenz (German State) by means of Goethe Schule Buenos Aires*, Buenos Aires, Argentina.
1995	**Certificate of Proficiency in English**, *The University of Michigan*, MI, USA.

Operating Systems

- GNU/Linux (Debian, Ubuntu, ArchLinux, RedHat, Fedora, Slackware, Gentoo)
- OpenBSD

Programming Languages

Advanced Skills	Python, Java, JavaScript, C, C++, Perl, Bash, SQL, HTML, PHP, Flex, ActionScript
Medium Skills	C#, Visual Basic, QuickBasic, Pyrex
Basic Skills	Assembler, Haskel, Prolog, Smalltalk, Pascal

Software

Advanced Skills	Sendmail, Apache, MySQL, PostgreSQL, Named/Bind, Perdition, Mailman, Nagios, LaTeX
Medium Skills	Postfix, Exim, Dovecot, Courier-IMAP, NTP, MRTG, Monit, OpenLDAP
Basic Skills	Kerberos, Zebra

Activities

2005 - present	**Member**, *Python Argentina - PyAr (www.python.com.ar)*.
2002 - present	**Member**, *Vocal Sospir (www.sospir.com.ar)*.

Research

2008	**Research**, *On the possibilities of using previous knowledge in the form of Behaviour Trees in order to speed up Q-learning*. Currently in progress.
2006	**Research**, *Reinforcement Learning in Self-reconfigurable Modular Robots*.
2005	**Survey**, *State of the Art in the field of Self-reconfigurable Modular Robots*.

Publications

March 2007   **Master Thesis**, *Reinforcement Learning on Self-reconfigurable Modular Robots*, Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires.
The full document is available upon request.

Open Source Projects

September 2008   **0AI: Team entry at Pyweek #7**, *(pyweek.org)*.
Implemented the AI for our game 0AI.

2008   **reply**, *(reply.googlecode.com)*.
A reinforcement learning library written in python.

March 2008   **Robo-T2: Team entry at Pyweek #6**, *(pyweek.org)*.
Implemented the AI for our game Robo-T2.

2006 - 2007   **MrSim: M-TRAN Robot Simulator**.
The source code for this simulator is available upon request.

References

Available upon request.