

Asynchronous Programming in the Abstract Behavioural Specification Language

Azadbakht, K.

Citation

Azadbakht, K. (2019, December 11). Asynchronous Programming in the Abstract Behavioural Specification Language. Retrieved from https://hdl.handle.net/1887/81818

Version:	Publisher's Version
License:	<u>Licence agreement concerning inclusion of doctoral thesis in the</u> <u>Institutional Repository of the University of Leiden</u>
Downloaded from:	https://hdl.handle.net/1887/81818

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <u>http://hdl.handle.net/1887/81818</u> holds various files of this Leiden University dissertation.

Author: Azadbakht, K. Title: Asynchronous Programming in the Abstract Behavioural Specification Language Issue Date: 2019-12-11

Bibliography

- Gul Agha. Actors: A model of concurrent computation in distributed systems. Technical report, DTIC Document, 1985.
- Gul Agha. Actors: A Model of Concurrent Computation in Distributed Systems. The MIT Press, 1986.
- [3] Wolfgang Ahrendt, Bernhard Beckert, Richard Bubel, Reiner Hähnle, Peter H. Schmitt, and Mattias Ulbrich, editors. *Deductive Software Verification - The KeY Book - From Theory to Practice*, volume 10001 of *Lecture Notes in Computer Science*. Springer, 2016.
- [4] Maksudul Alam, Maleq Khan, and Madhav V Marathe. Distributed-memory parallel algorithms for generating massive scale-free networks using preferential attachment model. In Proceedings of SC13: International Conference for High Performance Computing, Networking, Storage and Analysis, page 91. ACM, 2013.
- [5] Elvira Albert, Puri Arenas, Jesús Correas, Samir Genaim, Miguel Gómez-Zamalloa, Germán Puebla, and Guillermo Román-Díez. Object-sensitive cost analysis for concurrent objects. *Software Testing, Verification and Reliability*, 25(3):218–271, 2015.
- [6] Joe Armstrong. Making reliable distributed systems in the presence of software errors. PhD thesis, Mikroelektronik och informationsteknik, 2003.
- [7] Joe Armstrong, Robert Virding, Claes Wikström, and Mike Williams. Concurrent programming in erlang. 1993.
- [8] Krste Asanovic, Ras Bodik, Bryan Christopher Catanzaro, Joseph James Gebis, Parry Husbands, Kurt Keutzer, David A Patterson, William Lester Plishker, John Shalf, Samuel Webb Williams, et al. The landscape of parallel computing research: A view from berkeley. Technical report, Technical Report UCB/EECS-2006-183, EECS Department, University of California, Berkeley, 2006.

- [9] James Atwood, Bruno Ribeiro, and Don Towsley. Efficient network generation under general preferential attachment. *Computational Social Networks*, 2(1):1, 2015.
- [10] Keyvan Azadbakht, Nikolaos Bezirgiannis, and Frank S de Boer. Distributed network generation based on preferential attachment in abs. In International Conference on Current Trends in Theory and Practice of Informatics, pages 103–115. Springer, 2017.
- [11] Keyvan Azadbakht, Nikolaos Bezirgiannis, and Frank S de Boer. On futures for streaming data in ABS. In International Conference on Formal Techniques for Distributed Objects, Components, and Systems, pages 67–73. Springer, 2017.
- [12] Keyvan Azadbakht, Nikolaos Bezirgiannis, Frank S de Boer, and Sadegh Aliakbary. A high-level and scalable approach for generating scale-free graphs using active objects. In *Proceedings of the 31st Annual ACM Symposium on Applied Computing*, pages 1244–1250. ACM, 2016.
- [13] Keyvan Azadbakht, Frank S de Boer, Nikolaos Bezirgiannis, and Erik de Vink. A formal actor-based model for streaming the future. *Science of Computer Programming*, 186:102341, 2019.
- [14] Keyvan Azadbakht, Frank S. de Boer, and Erik de Vink. Deadlock detection for actor-based coroutines. In Klaus Havelund, Jan Peleska, Bill Roscoe, and Erik de Vink, editors, *Formal Methods*, pages 39–54, Cham, 2018. Springer International Publishing.
- [15] Keyvan Azadbakht, Frank S. de Boer, and Vlad Serbanescu. Multi-threaded actors. In Proceedings 9th Interaction and Concurrency Experience, ICE 2016, volume 223 of EPTCS, pages 51–66, 2016.
- [16] David Bader, Kamesh Madduri, et al. Parallel algorithms for evaluating centrality indices in real-world networks. In *Parallel Processing*, 2006. ICPP 2006. International Conference on, pages 539–550. IEEE, 2006.
- [17] Thomas Ball, Rupak Majumdar, Todd Millstein, and Sriram K. Rajamani. Automatic predicate abstraction of C programs. In *Conference on Programming Language Design and Implementation*, pages 203–213, 2001.
- [18] Albert-László Barabási and Réka Albert. Emergence of scaling in random networks. *Science*, 286(5439):509–512, 1999.
- [19] Vladimir Batagelj and Ulrik Brandes. Efficient generation of large random networks. *Physical Review E*, 71(3):036113, 2005.

- [20] Nikolaos Bezirgiannis and Frank de Boer. ABS: a high-level modeling language for cloud-aware programming. In International Conference on Current Trends in Theory and Practice of Computer Science (SOFSEM), pages 433–444. Springer, 2016.
- [21] Stephan Brandauer, Elias Castegren, Dave Clarke, Kiko Fernandez-Reyes, Einar Broch Johnsen, Ka I Pun, S Lizeth Tapia Tarifa, Tobias Wrigstad, and Albert Mingkun Yang. Parallel objects for multicores: A glimpse at the parallel language encore. In *Formal Methods for Multicore Programming*, pages 1–56. Springer, 2015.
- [22] Denis Caromel. Keynote 1-strong programming model for strong weak mobility: The proactive parallel suite. In *Mobile Data Management, 2008. MDM'08. 9th International Conference on*, pages xvi–xvi. IEEE, 2008.
- [23] Deepayan Chakrabarti, Yiping Zhan, and Christos Faloutsos. R-mat: A recursive model for graph mining. In SDM, volume 4, pages 442–446. SIAM, 2004.
- [24] Melvin E. Conway. Design of a separable transition-diagram compiler. Commununications of the ACM, 6(7):396–408, 1963.
- [25] Leonardo Dagum and Rameshm Enon. Openmp: an industry standard api for shared-memory programming. Computational Science & Engineering, IEEE, 5(1):46-55, 1998.
- [26] Frank S. de Boer, Mario Bravetti, Immo Grabe, Matias David Lee, Martin Steffen, and Gianluigi Zavattaro. A Petri net based analysis of deadlocks for active objects and futures. In *FACS*, volume 7684, pages 110–127. Springer, 2012.
- [27] Frank S De Boer, Dave Clarke, and Einar Broch Johnsen. A complete guide to the future. In *Programming Languages and Systems*, pages 316–330. Springer, 2007.
- [28] Frank S. de Boer and Stijn de Gouw. Being and change: Reasoning about invariance. In Correct System Design - Symposium in Honor of Ernst-Rüdiger Olderog on the Occasion of His 60th Birthday, Oldenburg, Germany, September 8-9, 2015. Proceedings, pages 191–204, 2015.
- [29] Frank S. de Boer, Mohammad Mahdi Jaghoori, Cosimo Laneve, and Gianluigi Zavattaro. Decidability problems for actor systems. In CONCUR 2012 - Concurrency Theory - 23rd International Conference, CONCUR 2012, Newcastle upon Tyne, UK, September 4-7, 2012. Proceedings, pages 562–577, 2012.

- [30] Crystal Chang Din, Richard Bubel, and Reiner Hähnle. Key-abs: A deductive verification tool for the concurrent modelling language abs. In *International Conference on Automated Deduction*, pages 517–526. Springer International Publishing, 2015.
- [31] Johan Dovland, Einar Broch Johnsen, and Olaf Owe. Verification of concurrent objects with asynchronous method calls. In 2005 IEEE International Conference on Software - Science, Technology and Engineering (SwSTE 2005), 22-23 February 2005, Herzelia, Israel, pages 141–150, 2005.
- [32] Jeff Epstein, Andrew P Black, and Simon Peyton-Jones. Towards haskell in the cloud. In *ACM SIGPLAN Notices*, volume 46, pages 118–129. ACM, 2011.
- [33] Paul Erdös and Alfréd Rényi. On the central limit theorem for samples from a finite population. Publ. Math. Inst. Hungar. Acad. Sci, 4:49–61, 1959.
- [34] Patrick Th Eugster, Pascal A Felber, Rachid Guerraoui, and Anne-Marie Kermarrec. The many faces of publish/subscribe. ACM computing surveys (CSUR), 35(2):114–131, 2003.
- [35] Kiko Fernandez-Reyes, Dave Clarke, and Daniel S. McCain. Part: An asynchronous parallel abstraction for speculative pipeline computations. In COOR-DINATION. To appear, 2016.
- [36] Alain Finkel and Ph. Schnoebelen. Well-structured transition systems everywhere! *Theoretical Computer Science*, 256(1):63–92, 2001.
- [37] David Gelernter. Generative communication in linda. ACM Transactions on Programming Languages and Systems (TOPLAS), 7(1):80–112, 1985.
- [38] Elena Giachino, Ludovic Henrio, Cosimo Laneve, and Vincenzo Mastandrea. Actors may synchronize, safely! In 18th International Symposium on Principles and Practice of Declarative Programming, pages 118–131, 2016.
- [39] Elena Giachino, Cosimo Laneve, and Michael Lienhardt. A framework for deadlock detection in core ABS. Software & Systems Modeling, 15(4):1013– 1048, 2016.
- [40] Susanne Graf and Hassen Saïdi. Construction of abstract state graphs with PVS. In International Conference on Computer Aided Verification, pages 72– 83. Springer, 1997.
- [41] Douglas Gregor and Andrew Lumsdaine. The parallel bgl: A generic library for distributed graph computations. *Parallel Object-Oriented Scientific Computing* (POOSC), page 2, 2005.

- [42] Philipp Haller and Martin Odersky. Scala actors: Unifying thread-based and event-based programming. *Theoretical Computer Science*, 410(2):202–220, 2009.
- [43] Max Haustein and Klaus-Peter Löhr. Jac: declarative java concurrency. Concurrency and Computation: Practice and Experience, 18(5):519–546, 2006.
- [44] Ludovic Henrio, Fabrice Huet, and Zsolt István. Multi-threaded active objects. In COORDINATION, pages 90–104. Springer, 2013.
- [45] Ludovic Henrio, Cosimo Laneve, and Vincenzo Mastandrea. Analysis of synchronisations in stateful active objects. In *International Conference on Integrated Formal Methods*, pages 195–210, 2017.
- [46] Ludovic Henrio and Justine Rochas. From modelling to systematic deployment of distributed active objects. In *International Conference on Coordination Lan*guages and Models, pages 208–226. Springer, 2016.
- [47] Carl Hewitt. Description and theoretical analysis (using schemata) of planner: A language for proving theorems and manipulating models in a robot. Technical report, Massachusetts Inst of Tech Cambridge Artificial Intelligence Lab, 1972.
- [48] Einar Broch Johnsen, Reiner Hähnle, Jan Schäfer, Rudolf Schlatte, and Martin Steffen. ABS: A core language for abstract behavioral specification. In *International Symposium on Formal Methods for Components and Objects*, pages 142–164. Springer, 2010.
- [49] Einar Broch Johnsen and Olaf Owe. An asynchronous communication model for distributed concurrent objects. Software & Systems Modeling, 6(1):39–58, 2007.
- [50] Einar Broch Johnsen, Olaf Owe, Dave Clarke, and Joakim Bjørk. A formal model of service-oriented dynamic object groups. Science of Computer Programming, 115:3–22, 2016.
- [51] Einar Broch Johnsen, Olaf Owe, and Ingrid Chieh Yu. Creol: A type-safe object-oriented model for distributed concurrent systems. *Theoretical Computer Science*, 365(1-2):23–66, 2006.
- [52] Eduard Kamburjan, Crystal Chang Din, and Tzu-Chun Chen. Session-based compositional analysis for actor-based languages using futures. In *International Conference on Formal Engineering Methods*, pages 296–312, 2016.
- [53] Eric Kerfoot, Steve McKeever, and Faraz Torshizi. Deadlock freedom through object ownership. In 5th International Workshop on Aliasing, Confinement and Ownership in Object-Oriented Programming, 2009.

- [54] Ravi Kumar, Prabhakar Raghavan, Sridhar Rajagopalan, D Sivakumar, Andrew Tomkins, and Eli Upfal. Stochastic models for the web graph. In Foundations of Computer Science, 2000. Proceedings. 41st Annual Symposium on, pages 57–65. IEEE, 2000.
- [55] R Greg Lavender and Douglas C Schmidt. Active object–an object behavioral pattern for concurrent programming. 1995.
- [56] Jurij Leskovec. Dynamics of large networks. ProQuest, 2008.
- [57] Kai Li and Paul Hudak. Memory coherence in shared virtual memory systems. ACM Transactions on Computer Systems (TOCS), 7(4):321–359, 1989.
- [58] Yi-Chen Lo, Hung-Che Lai, Cheng-Te Li, and Shou-De Lin. Mining and generating large-scaled social networks via mapreduce. *Social Network Analysis and Mining*, 3(4):1449–1469, 2013.
- [59] Yi-Chen Lo, Cheng-Te Li, and Shou-De Lin. Parallelizing preferential attachment models for generating large-scale social networks that cannot fit into memory. In Privacy, Security, Risk and Trust (PASSAT), 2012 International Conference on and 2012 International Conference on Social Computing (SocialCom), pages 229–238. IEEE, 2012.
- [60] Sadegh Nobari, Xuesong Lu, Panagiotis Karras, and Stéphane Bressan. Fast random graph generation. In Proceedings of the 14th International Conference on Extending Database Technology, pages 331–342. ACM, 2011.
- [61] Gordon D Plotkin. A structural approach to operational semantics. 1981.
- [62] John C Reynolds. The discoveries of continuations. Lisp and symbolic computation, 6(3-4):233-247, 1993.
- [63] Jan Schäfer and Arnd Poetzsch-Heffter. Jcobox: Generalizing active objects to concurrent components. In ECOOP 2010–Object-Oriented Programming. Springer, 2010.
- [64] Jan Schäfer and Arnd Poetzsch-Heffter. Jcobox: Generalizing active objects to concurrent components. In ECOOP 2010–Object-Oriented Programming, pages 275–299. Springer, 2010.
- [65] Christophe Scholliers, Éric Tanter, and Wolfgang De Meuter. Parallel actor monitors: Disentangling task-level parallelism from data partitioning in the actor model. *Science of Computer Programming*, 80:52–64, 2014.
- [66] Yury Selivanov. Asynchronous generators. https://www.python.org/ dev/peps/pep-0525/, 2016.

- [67] Koushik Sen and Mahesh Viswanathan. Model checking multithreaded programs with asynchronous atomic methods. In *International Conference on Computer Aided Verification*, pages 300–314. Springer, 2006.
- [68] Vlad Şerbănescu, Keyvan Azadbakht, and Frank de Boer. A java-based distributed approach for generating large-scale social network graphs. In *Resource Management for Big Data Platforms*, pages 401–417. Springer, 2016.
- [69] Marjan Sirjani. Rebeca: Theory, applications, and tools. In Formal Methods for Components and Objects, pages 102–126. Springer, 2007.
- [70] Streams. Version 2.4.17. http://doc.akka.io/docs/akka/2.4/ scala/stream/index.html, 2017.
- [71] Herb Sutter. The free lunch is over: A fundamental turn toward concurrency in software. Dr. Dobb's journal, 30(3):202–210, 2005.
- [72] Ming-Chit Tam, Jonathan M Smith, and David J Farber. A taxonomy-based comparison of several distributed shared memory systems. ACM SIGOPS Operating Systems Review, 24(3):40–67, 1990.
- [73] Roberto Tonelli, Giulio Concas, and Mario Locci. Three efficient algorithms for implementing the preferential attachment mechanism in yule-simon stochastic process. WSEAS Transactions on Information Science and Applications, 7(2):176–185, 2010.
- [74] Thierry Van Cutsem, Stijn Mostinckx, Elisa Gonzalez Boix, Jessie Dedecker, and Wolfgang De Meuter. Ambienttalk: object-oriented event-driven programming in mobile ad hoc networks. In *Chilean Society of Computer Science*, 2007. SCCC'07. XXVI International Conference of the, pages 3–12. IEEE, 2007.
- [75] Duncan J Watts and Steven H Strogatz. Collective dynamics of 'smallworld'networks. *nature*, 393(6684):440–442, 1998.
- [76] Peter Welch and Neil Brown. Communicating sequential processes for javatm (jcsp). https://www.cs.kent.ac.uk/projects/ofa/jcsp/, 2014.
- [77] Antonty S Williams, Alexander A Mitchell, Robert G Atkinson, C Douglas Hodges, Johann Posch, and Craig H Wittenberg. Method and system for multithreaded processing, January 30 2001. US Patent 6,182,108.
- [78] Akinori Yonezawa and Mario Tokoro. Object-oriented concurrent programming. 1986.
- [79] Andy Yoo and Keith Henderson. Parallel generation of massive scale-free graphs. *arXiv preprint arXiv:1003.3684*, 2010.