

Tutorial Proposal to SAC 2008

Self-Managing Systems through Biological Inspiration

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Title:

Self-Managing Systems through Biological Inspiration

Duration:

Half-Day or Full-Day

Abstract:

Biologically-inspired autonomous and autonomic systems (AAS) are essentially concerned with creating self-directed and self-managing systems based on metaphors from nature and the human body, such as the autonomic nervous system. Agent technologies have been identified as a key enabler for engineering autonomy and autonomicity in systems, both in terms of retrofitting into legacy systems and in designing new systems. Of course, handing over responsibility to systems themselves raises concerns for humans with regard to safety and security.

We present a strand of research on how to engineer self-management mechanisms into systems to assist in encouraging confidence in complex systems when utilizing autonomy and autonomicity. We introduce the principles of various paradigms such as autonomic computing and self-managing systems, and illustrate inspiration from biology and nature in developing new mechanism for self-protection, self-management and ultimately self-government. We illustrate the approach with reference to NASA concept future missions which will exploit the use of swarm technologies in space exploration missions heretofore infeasible. We describe safety and security approaches that may be incorporated into such missions and indeed into many conventional computer-based systems. Finally, we describe the importance of policies, which are akin to very high-level requirements for self-management, in achieving self-governance, and illustrate an approach to specifying, analyzing, and automatically programming such systems.

The approaches described in this tutorial are based substantially on NASA technologies.

Outline:

1. Overview
2. Motivation for Autonomic Computing
3. Conquering Complexity
4. Introduction to Autonomic Computing
5. Self-* properties
6. Autonomic Managers and Autonomic Elements
7. Example: NASA Sensor Network Applications
8. New and Emerging Biological Metaphors
9. Biological Inspiration
10. Example: NASA Swarm-based Missions

11. Policies
12. Specification and Automatic Generation of Policies for Self-Managing Systems
13. Example: NASA's Hubble Servicing Mission
14. Managing Evolution in Self-Managing Systems
15. Future Directions
16. Conclusions and Summary

Biosketches:

Mike Hinchey is Professor of Computer Science and Director of the Graduate Program at Loyola College, Baltimore, MD, USA. Until January 2007, he was Director of the NASA Software Engineering Laboratory, located at NASA Goddard Space Flight Center in Greenbelt, MD. He now serves as a NASA expert consultant. Prior to joining the US government, at various times he held positions at the level of full professor in the US, Australia, Sweden, Ireland and the UK. In 2007, he was Visiting Professor at Pontificia Universidade Católica do Rio de Janeiro. He received a B.Sc. in Computer Science from University of Limerick, Ireland, an M.Sc. in Computation from University of Oxford, UK, and a Ph.D. in Computer Science from University of Cambridge, UK. He is Chair of the IEEE Technical Committee on Complexity in Computing, Vice Chair of the IEEE Technical Committee on Autonomous and Autonomic Systems, and is the IEEE Computer Society's representative to IFIP Technical Committee 1 (Foundations of Computer Science), which he currently chairs. In August 2007, he was elected to the board of IFIP. He is the author of more than 100 technical papers, 12 books, and has presented tutorials at ICSE and several other high-profile international conferences.

Roy Sterritt is an academic in the Department of Computing and Mathematics at University of Ulster. Prior to returning to academia, he worked for several years with IBM. He is Chair of the IEEE Technical Committee on Autonomous and Autonomic Systems and Chair of the Engineering of Autonomic Systems (EASe) workshop to be held in Belfast in April 2008. He has been a keynote speaker at several international conferences on Autonomic Computing and Autonomic Communications. He holds an M.Sc. from University of Ulster and is the author of dozens of papers on various aspects of autonomic computing and communications. He has presented tutorials at several autonomic computing conferences and symposia.

Between them, Hinchey and Sterritt are the inventors of more than a dozen NASA patent-pending technologies.

Expected background of the audience:

The audience will be developers or researchers in various areas of software engineering and computer science. This tutorial will be of particular interest to those working in complex systems, embedded and real-time systems, command-and-control systems, and autonomous systems

Audio/Visual Requirements:

LCD projector

Distribution Materials:

- Copy of slides used in the presentation
- Reprints of some of the authors relevant papers
- Draft chapters of the forthcoming book:
Walter F. Truskowski, Christopher A. Rouff, Lou Hallock, Jay Karlin, James L. Rash, **Michael G. Hinchey and Roy Sterritt**, *Autonomous and Autonomic Systems: with application to NASA intelligent space exploration missions*, Springer, NASA Monographs in Systems and Software Engineering, 2008, to appear