

## Luca Console

Luca Console was born in Torino (Italy), May 4th, 1962.

- He received a laurea Degree in Computer Science at the Università di Torino in 1985 and a Ph>d in Computer Science in 1991.
- From July 1989 to October 1992 he has been a researcher at the Dipartimento di Matematica e Informatica, Università di Udine.
- From November 1992 to October 1993 he has been Associate Professor at, of Computer Science at the Università di Udine.
- From November 1993 he moved to Università di Torino As Associate Professor of Computer Science.
- From November 2000 he is Full Professor of Computer Science at the Università di Torino.
- From April 2001 to October 2005 he has been chair of the school (Corso di laurea) in Communication Sciences at the Faculty of Humanities, Università di Torino.

## Research Activity

In the last few years the research activity of Luca Console focused on two main topics concerning Artificial Intelligence and Knowledge-based intelligent agents: model-based diagnosis and adaptive intelligent systems.

### Diagnostic Systems.

Research in this area focused on both methodological and application issues

As regards methodological contributions, the work concentrated on the following topics:

- Diagnosis of temporal and dynamic systems; definition of strategies and algorithms for modeling and diagnosing devices with time-varying and dynamic behavior.
- Embedded diagnosis. Definition of a new concept of decision tree including the notion of time and of an algorithm for learning these trees from data (a temporal extension of ID3-like algorithms). This new notion of tree is motivated by the need of embedding diagnostic software into electronically controlled devices (e.g., in a car) whose behavior is time dependent and that thus cannot be diagnosed using static decision trees. In the approach the diagnostic trees can be learned automatically starting from data and using a model-based diagnostic engine to generate examples. Variants of the algorithm allows taking into account additional aspects such as costs of sensors, deadlines, recovery actions, ..
- Formalization of diagnosis using process algebras. A new formalization of the diagnostic process has been proposed based on the notion of process algebras. In this way all aspects concerning diagnosis (including time varying, temporal and dynamic behavior) have been formalized in an uniform way. Moreover notions such as diagnosability, detectability and discriminability have been studied and formalized.

These methodological studies have been carried on in strict connection with the analysis of real-world applications, mainly in two areas: automotive and aerospace. The former, in particular, is very interesting for model-based diagnosis and indeed several applications have been built recently. In particular Luca Console worked on the development of embedded diagnostic systems, to the design of a toolkit for developing model-based systems and of a toolkit for integrating

- Generation of on-board diagnostic software; projects carried on in co-operation with Centro Ricerche Fiat; diagnosis of hydraulic systems with application to the Common Rail Systems and to engine cooling systems.
- Development of SALVO, a toolkit for model-based diagnosis (modules for modeling, computing diagnosis, generation of the on-board diagnostic software in the form of decision trees). Work in co-operation with Centro Ricerche Fiat.
- Definition of a new design process including diagnostic issues (diagnosability, support for FMEA generation, generation of on-board diagnostic software). Extension of SALVO to deal with these activities. Automatic generation of qualitative models from Matlab models. Work carried on in the IDD EU project and in co-operation with Fiat.
- Support for FMECA generation for aircrafts. Work carried on in the AUTAS EU project and in co-operation with Alenia.

#### Intelligent Interfaces and Adaptive systems.

Also in this area the research activity of Luca Console concerned both methodological and application issues.

From the methodological point of view he concentrated on the study and design of (i) a framework and architecture for adaptive systems and (ii) a specialized framework for adaptive systems to be installed on-board vehicles. The main problem in this case is to provide a different range of services (e.g., information) in a way that is adapted to the location, context of use (mainly driving situation), the device being used and the specific user interests and preferences, in a way which is compatible with the task being carried on by the user on the car. From the software point of view, moreover, the problem is to distribute the intelligent agents and the information sources in a way that minimizes communication, yet guaranteeing a reliable and up-to-date service. A framework has been proposed and experimented on a specific application for the provision of tourist information.

From the application point of view, the attention focuses on three aspects:

- Design of adaptive systems for electronic commerce. This has been carried on in two projects: SETA (funded by Telecom Italia) and the EU project CAWICOMS. In the latter the attention focused also on the configuration of the services/products to be provided.
- Adaptation on-board vehicles. The work has been carried on in a project in co-operation with Centro Ricerche Fiat and Magneti Marelli and led to the design, implementation and experimentation (evaluation) of a prototype system Mastrocaronte.
- From May 2003 Luca Console is the Scientific director of M3Lab (then SmartLab), a laboratory for the study of Intelligent Systems in Mobile Communication. The laboratory has been created in co-operation with CSP (the research center of Piedmont Local administration) and is involving several companies. As a first application area the lab will concentrate on intelligent agents for adaptive personalized services to the citizen (with adaptation to the location, device, context of use, user).
- From 2007 Luca Console works on a Joint Program with telecom Italia for the design of Web2.0 applications for interactive Television (I-Dynamic-TV)

#### **Research projects**

In the last few years Luca Console has been and is in charge of the following research projects:

- VMBD (Vehicle Model-Based Diagnosis); partners: Fiat, Daimler Chrysler, Volvo, Bosch, Magneti Marelli, Genrad, University Paris XIII, TU Munich, University of Wales.
  - EU project Brite Euram BR-0138
  - Goal: design and implementation of on and off-board model-based diagnostic systems in the automotive domain.

- Main result of the Unit coordinated by Luca Console: definition of a methodology for the automated generation of on-board diagnostic software; experimentation on the Common Rail System; idemonstration on a Lancia car.
- IDD (Integrating Diagnosis and Design, partners: Fiat, Daimler Chrysler, Renault, PSA Peugeot-Citroen, Magneti Marelli, Occ'm, , University Paris XIII, TU Munich)
  - EU project GRD1-1999-11263 (2000-2003)
  - Goal : redefine the design process in automotive systems to included activities related to diagnosis (diagnosability, support for FMEA generation)
  - Main result of the Unit coordinated by Luca Console: co-operation to the definition of the new process; design of software agents supporting the process; implementation as and extension of the SALVO diagnostic engine. Experimentation and demonstration.
- CAWICOMS. Partners Telecom Italia Lab, British Telecom, Siemens, DFKI, ILOG, Università di Klagenfurt)
  - EU project IST-1999-10688 (2000-2002)
  - Goal: Design of adaptive systems for the electronic commerce of configurable products and services
  - Main result of the Unit coordinated by Luca Console: design of the software modules for adaptation and personalization. Experimentation and demonstration on applications provided by BT and Telecom Italia.
- AUTAS (Automating FMECA for Aircarfts), partners Alenia, Eurocopter, Israelian Areonautic Industries, NLR Netherland Research Center for Aircrafts, Sofreten, Occ'm, TU Munich.
  - EU Project GRD1-2001-40133 (July 2002 – 2005)
  - Goal: supporting FMECA generation for aircraft systems
- M3Lab. Multimedia Mobile Communication Lab. In cooperation with CSP
  - Goal: Developing Intelligent agent for Mobile services
- WS-DIAMOND (Web Services – Diagnosability, Monitoring and Diagnosis). Main contractor University of Torino; Luca Console coordinator. Partners: IRISA University of Rennes I, LAAS CNRD Toulouse, Politecnico di Milano, University of Klagenfurt, Free University of Amsterdam, University of Paris Sud
  - FET Project
  - Goal: developing a framework for supporting monitoring and diagnosis of Web services; supporting the design of diagnosable Web Services
- I-DYNAMIC-TV, co-operation with Telecom Italia
  - Gaol: Web2.0 portal for Interactiev Television
- PIEMONTE. Partners Telecom Italia, Università di Scienze Gastronomiche, SlowFood. Main contractor University of Torino; Luca Console coordinator.
  - Funded by Regioen Piemonte, 2009-2012
  - Goal: Enhanced reality

### **Coordination of EU research**

Luca Console is member of the executive board and of the Steering Committee of the Network of Excellence MONET (1996-2005), funded by EU (IST) for the coordination of research in the rae of Model-based Systems. The network includes some 100 centers (Universities, Research Centers and industries). Luca Console is in charge of the task group concerning automotive applications, which recently produced a roadmap on the state of the art and future goals of the filed (with contribution of companies such as Fiat, Daimler Chrysler, Audi, BMW, PSA Peugeot-Citroen, Bosch, Scania, Siemens Automotive, Actia, among others)

## Committees

Luca Console is member of the Editorial board of the AI Communications Journal and has been in the program committee of several international conferences. Recently he has been the area chair for the area “qualitative and model-based reasoning” at ECAI-2002. He has been the program chair of DX (International Workshop on Principles of Diagnosis) in 1991 and in 1997 and the general chair of DX-2001.

## Teaching activity

Since 1989 Luca Console taught several different courses: Programming, Operating Systems, Database systems, Artificial Intelligence, Information systems, introduction to computer science.

## Publications

### Books

- [B1] L. Console, P. Torasso: Diagnostic Problem Solving: Combining Heuristic, Approximate and Causal Reasoning, Van Nostrand Reinhold, 1989.
- [B2] L. Console, E. Lamma, p. Mello: Programmazione Logica e Prolog, I edizione, UTET 1991.  
L. Console, E. Lamma, p. Mello, M. Milano: Programmazione Logica e Prolog, II edizione ampliata, UTET 1997.
- [B3] L. Console: Introduzione all'informatica, I edizione, UTET 199  
L. Console, M. Ribaud: Introduzione all'informatica, II edizione ampliata, UTET 1997.  
L. Console, M. Ribaud, U. Avale: Introduzione all'informatica III edizione ampliata, UTET 2004.

### Edited collections

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- [R2] L. Console, G. Friedrich: Annals of Mathematics and Artificial Intelligence: Special Issue on Model-Based Diagnosis; Volume 11 (no. 1-4), November 1994.
- [R3] L. Console: Second Int. Workshop on Principles of Diagnosis (DX-91), Editor of the proceedings.
- [R4] L. Console: AI\*IA Notize, periodico della Associazione Italiana per l'Intelligenza Artificiale, Numero Speciale su Problem Solving Diagnostico, Anno X, no. 3, Settembre 1997. Include un articolo introduttivo sul tema “Problem Solving diagnostico: stato dell'arte e prospettive”.

### International Journals

- [J1] G. Molino, C. Cravetto, L. Console, P. Torasso: CHECK: a diagnostic expert system Combining HEuristic and Causal Knowledge; in International Journal of Biomedical Measurement, Informatics and Control, vol 1 (4) 1986: pp 182-193.

- [J2] L. Console, G. Rossi: Using Prolog for building FROG: a Hybrid Knowledge Representation System; in *New Generation Computing*, Vol. 6 (4), 1989: pp 361-388.
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- [J5] L. Console, M. Fossa, P. Torasso: Acquisition of causal Knowledge in the CHECK system; in *Computers and Artificial Intelligence*, vol 8 (4), 1989, pp. 323-345.
- [J6] L. Console, A. Janin Rivolin, P. Torasso: Fuzzy Temporal Reasoning on Causal Models; in *International Journal of Intelligent Systems*, vol 6 (2), 1991, pp. 107-133.
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- [J8] L. Console, P. Torasso: Temporal Constraint Satisfaction on Causal Models, in *Information Sciences*, vol. 68 (1), 1993, pp. 1-32.
- [J9] L. Console, P. Torasso: A Spectrum of Logical Definitions of Model-based Diagnosis; in *Computational Intelligence*, vol 7 (3), 1991, pp. 133-141. Also in *Readings in Model-based Diagnosis*, (eds. W. Hamscher, L. Console, J. de Kleer). Morgan Kaufmann, 1992, pp. 78-88.
- [J10] L. Console, P. Torasso: On the co-operation between abductive and temporal reasoning in medical diagnosis, in *Artificial Intelligence in Medicine*, vol 3 (6), 1991, pp. 291-311.
- [J11] L. Console, L. Portinale, D. Theseider Duprè, P. Torasso: Focusing Abductive Diagnosis; in *AI Communications*, vol. 4, no 2-3, 1991, pp. 88-97.
- [J12] L. Console, P. Torasso: An Approach to the Compilation of Operational Knowledge from Causal Models; in *IEEE Transactions on Systems Man and Cybernetics*, vol. 22 (4), 1992, pp. 772-789.
- [J13] L. Console, F. Molino, G. Molino, P. Torasso: LIED: Liver Information, Education and Diagnosis; in *Methods of Information in Medicine*, vol 31(4), 1992, pp. 1233-1244.
- [J14] L. Console, M.L. Sapino, D. Theseider Duprè: The role of abduction in database view updating; in *Journal of Intelligent Information Systems*, vol. 4, 1995, pp. 261-280.
- [J15] L. Console, L. Portinale, D. Theseider Duprè, P. Torasso: Diagnosing Time-Varying Misbehavior: an Approach Based on Model Decomposition; in *Annals of Mathematics and Artificial Intelligence*, vol 11 (1-4), 1994, pp. 381-398.
- [J16] L. Console, G. Friedrich: Model-Based diagnosis; An introductory overview; in *Annals of Mathematics and Artificial Intelligence*, vol 11 (1-4), 1994, pp. 1-10.
- [J17] V. Brusoni, L. Console, P. Terenziani: On the computational complexity of querying bounds on differences constraints; in *Artificial Intelligence*, vol. 74 (2), 1995, pp. 367-379.
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- [J19] L. Console, L. Portinale, D. Theseider Duprè, P. Torasso: On the role of abduction; in *ACM Computing Surveys*, vol. 33 no. 3, 1995, pp. 353-356.
- [J20] V. Brusoni, L. Console, B. Pernici, P. Terenziani: LaTeR: an efficient, general purpose manager of temporal information; in *IEEE Expert*, Vol. 12, no. 4, August 1997, pp. 56-64.
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- [J26] L. Ardissono, L. Console, I Torre: An adaptive system for the personalized access to news, *AI Communications*, Vol 14, no. 3, 2001: pp. 129-147.
- [J27] L. Console, D. Theseider Duprè, P. Terenziani: Local reasoning and knowledge compilation for efficient temporal abduction; in *IEEE Transactions on Knowledge and Data Engineering*, Vol. 14, No. 6, 2002, pp. 1230-1248.
- [J28] L. Console, C. Picardi, M. Ribaudò: Process algebras for systems diagnosis, in *Artificial Intelligence*, vol 142 no. 1, 2002, pp. 19-51.
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- [J30] L. Console, C. Picardi, D. Theseider Duprè: Temporal Decision Trees: Model-based Diagnosis of Dynamic Systems On-Board, *Int Journal of Artificial Intelligence Research*, vol 19, 2003, pp 469-512.
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- [J32] L. Console, M.G. Fugini, and the WS-Diamond Team. WS-DIAMOND: an Approach to Web Services – DIAGNOSABILITY, MONITORING and DIAGNOSIS. ERCIM (European Research Consortium for Informatics and Mathematics), News 70, Special Theme: "Service-Oriented Computing", July 2007
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#### Chapters in International Book

- [BC1] L. Console, P. Torasso: Heuristic and Causal Reasoning in CHECK; in *Artificial Intelligence in Scientific Computing: Towards Second Generation Systems*; eds. J.M.David, R.Huber, J.P.Krivine, C.A.Kulikowski, (Vol. 2 of *Imacs Transactions of Scientific Computing* 88), pp. 155-164, Baltzer Pub. Co. 1989.
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- [BC8] V. Brusoni, L. Console, B. Pernici, P. Terenziani: Extending Temporal Relational Databases to Deal with Imprecise and Qualitative Temporal Information; in *Recent Advances in Temporal Databases* (J. Clifford, A. Tuzhilin Eds.), Springer Verlag 1995.
- [BC9] L. Console, L. Saitta: On the Relations between Abductive and Inductive Explanation; in *Topics in Abduction and Induction* (P. Flach, A. Kakas Eds.), Kluwer Academic Press, 1998.
- [BC10] L. Console et al.: WS-DIAMOND: Web Services Diagnosis, Diagnosability and Design, in *your service: Service Engineering in the Information Society Technologies Program*, MIT Press 2008 to appear

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- [L1] L. Console, G. Rossi: Implementing Inference Strategies in Prolog based Expert Systems; in *Cybernetics and System Research 1986*, ed. R. Trappl, Reidel Pub. Co. 1986, pp. 767-774.
- [L2] L. Console, M. Fossa, P. Torasso, G. Molino, C. Cavetto: Man-Machine Interaction in CHECK; in *AIME 87*, eds. J.Fox, M.Fieschi, R.Engelbrecht, *Lecture Notes in Medical Informatics 33*, Springer Verlag (1987), pp 205-212.
- [L3] L. Console, G. Rossi: FROG: A Prolog-based system for Prolog-based Knowledge Representation; in *Artificial Intelligence and Information Control Systems of Robots*, ed. I. Plander, North Holland (1987), pp. 179-184.
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- [L6] L. Console, P. Torasso, G. Molino, C. Cavetto: Generating Causal Explanations on Simulated Situations; in *Medical Informatics 88*, British Computer Society 1988, pp.1-7.
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- [L9] L. Console, con G. Molino, R. Pavia, M. Signorelli, P. Torasso: Simulating Generic Situations on Causal Models; in *AIME 89*, eds. J. Hunter, R. Cookson, J. Wyatt, *Lecture Notes in Medical Informatics 38*, Springer Verlag 1989, pp. 177-186.

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- [L14] C. Borlo, A. Casale, L. Console, P. Torasso: Dealing With Uncertainty in a Distributed Expert System Architecture; in *Uncertainty in Knowledge Bases*, *Lecture Notes in Computer Science 521*, Springer Verlag 1991, pp. 568-577.
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- [L18] L. Ardissono, L. Console, I. Torre: On the application of personalization techniques to news servers on the WWW, *Lecture Notes in Computer Science*, 1999.
- [L19] L. Console, I. Torre, I. Lombardi, S. Gioria, V. Surano: Adaptation and personalization on-board cars: a framework and its application to tourist services; in *Adaptive Hypermedia 2002*, *Lecture Notes in Computer Science 2347*, 2002.
- [L20] I. Amendola, F. Cena, L. Console, A. Crevola, C. Gena, A. Goy, S. Modeo, M. Perrero, I. Torre, A. Toso: UbiquiTO, A Multi device Adaptive Guide, in *Proc. Mobile HCI 2004*, *Lecture Notes in Computer Science 3160*, pp. 409-414.
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- [C3] L. Console, P. Torasso: Approximate Reasoning and Prototypical Knowledge; in *Proc. Second IFSA Congress*, Tokyo 1987, pp. 686-689.



- [C4] L. Console, P. Torasso: Heuristic and Causal Reasoning in Medical Diagnosis; in Proc. AAAI Symposium on Artificial Intelligence in Medicine, Stanford University, March 1988, pp. 16-17.
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