



# Francesco Masulli

Full professor

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## *Education and training*

1976

### **Laurea in Physics**

110/110 e lode

University of Genova - Genoa - IT

## *Academic experience*

2016 - ONGOING

### **Full Professor of Computer Science**

University of Genova - Genova - IT

Research/Teaching/Management

2018 - ONGOING

### **Associate Teacher**

University of Zagreb - Zagreb - HR

Teaching

2009

### **Visiting Professor**

I3S University Nice- Sophia Antipolis - Nice - FR

Research

2008 - ONGOING

### **Adjunct Professor**

Center for Biotechnology - Temple University - Philadelphia PA - US

Research

2005 - 2016

### **Associate Professor of Computer Science**

University of Genova - Genoa - IT

Research/Teaching/Management

2001 - 2005

### **Associate Professor of Computer Science**

University of Pisa - Pisa - IT

Research/Teaching/Management

1991 - 1994

## **Senior Visiting Scientist (10 Months)**

ICSI International Computer Science Institute - Berkeley CA - US  
Research

1983 - 2001

### **Assistant Professor**

University of Genova - Genoa - IT  
Research/Teaching/Management

1983

### **Visiting Researcher**

University of Nijmegen - Nijmegen - NL  
Research

1979

### **Researcher**

Istituto Nazionale di Fisica Nucleare - Genoa - IT  
Research

## ***Work experience***

1980 - 1983

### **Researcher**

Ansaldo Automazione co - Genoa - IT  
Research/Development

## ***Language skills***

### **French**

Independent

### **English**

Proficient

### **Italian**

Mother tongue

## ***Teaching activity***

- Well-being Technologies, 2016/17, 2017/18
- Fundamentals of Computer Science, 2013/14, 2014/15, 2015/16, 2016/17, 2017/18
- Computer Programming, 2013/14, 2013/14, 2016/17, 2017/18
- Informatics, 2013/14
- Machine Learning, 2012/13;
- Laboratory of Software Development, 2012/13;
- Elements of Informatics, 2012/13;
- Computer Programming (University of Genova), 2009/10, 2010/11;
- Operating Systems (Univ. Pisa & Univ. Genoa-Joint Computer Science program at La Spezia), 2001/02, 2002/03, 2003/04, 2004/05, 2005/06, 2006/07, 2007/08;
- Evolutionary Computation (Univ. Pisa & Univ. Genoa - Joint Computer Science program at La Spezia), 2003/04, 2004/05, 2005/06, 2007/08;
- Computational Intelligence (Univ. Genoa) 2006/07, 2009/10;

- Neural Networks (Univ. Genoa) 2003/04, 2004/05;
- Soft Computing (Univ. Genoa) 2003/04, 2004/05, 2005/2006;
- Machine Learning (Univ. Pisa), 2003/04;
- Neural Networks 2 (Univ. Pisa), 2002/03;
- Lab. of system Programming (Univ. Pisa), 2001/02;
- Neural Networks 1 (Univ. Genoa), 1997/98, 1998/99, 1999/2000, 2001/02, 2002/03;
- Neural Networks 2 (Univ. Genoa), 1998/99, 1999/2000, 2000/01, 2001/02;
- Applied Electronics and Computer Architectures (Univ. Genoa), 1991/92, 1993/94, 1994/1995, 1995/96, 1996/97.

## ***Postgraduate research and teaching activity***

### **Supervision of PhD students, residents and post-doctoral fellows**

#### PhD Students:

- Alberto Cabri, Univ. Genova, 2016 -
- Zahra Shojaee, *An Investigation of Clustering Methods using Information Theory*, University of Yazd, Yazd, Iran. Supervisor: Dr. Abolfazl Shahzoh Fazeli. Co-tutela.
- Subhashis Banerjee, University of Calcutta, Kolkata, India, 2016 - (2 months leave in Masulli's research group in 2017)
- Amr Rashad Ahmed Abdullatif, *Unsupervised tracking of time-evolving data streams and an application to short-term urban traffic flow forecasting*, Univ. Genoa, 2013-2018.
- Hassan Mahmoud, *Semantic clustering and community detection in biological networks*, Univ. Genoa, 2011-2014.
- Maurizio Filippone, *Central Clustering in Kernel-Induced Spaces*, Univ. Genoa, 2004-2007.
- Giorgio Valentini, *Ensemble methods based on bias-variance analysis*, Univ. Genoa, 2000–2003.
- Anna Maria Massone, *Applications of Clustering Methods to Physics*, Univ. Genoa and Univ. Lausanne, 1999–2002.

#### Assegnisti/Post-Doc

- Mahdi Amina (PhD University of Westminster, London – UK), Machine learning algorithms for the discrimination of patient status, 2013-2015.
- Raffaella Rosasco (PhD University of Genoa -Italy), Machine learning algorithms for the discrimination of patient status, 2012-2013.
- Manjunath Aradhya V.N. (PhD University of Mysore, Mysore-India), Computer Science and Applied Mathematics, 2009.
- Subbaiya Rammohan Kannan (PhD Indian Institute of Technology, Madras-India), Soft-computing methods for computerized support to surgery, 2003-2004.

- Piotr Bogus (PhD Univ. Gdansk, Poland), Neuro-fuzzy methods for the analysis of multimodal medical images, 1996-1997.
- Leonard Studer (PhD Univ. Lausanne, Switzerland), Fuzzy systems for time series forecasting, 1996-1997.

## PhD committees membership

Ateneo proponente: **Università degli Studi di GENOVA**

Titolo: **'INFORMATICA E INGEGNERIA DEI SISTEMI/ COMPUTER SCIENCE AND SYSTEMS ENGINEERING'**

Anno accademico di inizio: **2018/2019** - Ciclo: **34**

## Postgraduate (PhD) teaching activity

*Machine Learning: A Computational Intelligence Approach* (AA 2013/14, 2014/15, 2015/16, 2016/17, 2017/18)

## Research interests

Until the early nineties I worked on visual perception modeling at the Department of Physics of the University of Genoa. Starting from my first sabbatical leave at the International Computer Science Institute in Berkeley CA (USA), in 1991, my research interests were oriented on the theoretical and applicative aspects of the Artificial Intelligence based on data that is currently called Computational Intelligence and which includes the methodologies of the Neural Networks, of the Fuzzy Logic and of the Evolutionary Algorithms. Since 1991 I have been responsible for the Computational Intelligence research group of the Department of Computer Science of the University of Genoa, which later merged with the Department of Computer Science, Bioengineering, Robotics and Systems Engineering. The main theoretical results obtained concern the unsupervised clustering of data for which I have proposed a 'graduated' model that allows us to preserve the properties of good modeling of data typicality to clusters and of rejecting outliers typical of possible clustering and at the same time the efficiency in convergence typical of fuzzy clustering. I have also extended this model to non-parametric clustering for data densities of generic form through the use of kernel techniques. Other theoretical results have been the study of the properties of committees of neural networks, of predictive methods for time series and data flows and of methods for comparing data partitions.

Over the years, I have developed various applications of Computational Intelligence in sectors ranging from industry (in collaboration with Ansaldo Ricerche, Genoa), to physics (in collaboration with the Institute de Physique of the University of Lausanne, CH, National Council of the Researches and the National Institute of Nuclear Physics), to biomedicine (in collaboration with the National Institute for Research on Cancer, IST-Genoa and the Sbarro Institute for Cancer Research and Molecular Medicine of Temple University, Philadelphia PA, USA), and Smart City and Well-Being Technologies, in various funded projects.

The recent applicative results concern the development of a system based on machine learning for the short-term forecasting of urban traffic and a system for monitoring and analyzing the data of mobility and socialization of the guests of a protected home, starting from the data of wearable and environmental sensors.

## **Grants**

**2015 - ONGOING**

### **CHiPSet - High-Performance Modelling and Simulation for Big Data Applications - EU Cost Action IC1406**

Commission EU - IT

Principal investigator

The Big Data era poses a critically difficult challenge and striking development opportunities in High-Performance Computing (HPC): how to efficiently turn massively large data into valuable information and meaningful knowledge. Computationally effective HPC is required in a rapidly-increasing number of data-intensive domains, such as Life and Physical Sciences, and Socioeconomic Systems.

Modelling and Simulation (MS) offer suitable abstractions to manage the complexity of analysing Big Data in various scientific and engineering domains. Unfortunately, Big Data problems are not always easily amenable to efficient MS over HPC. Also, MS communities may lack the detailed expertise required to exploit the full potential of HPC solutions, and HPC architects may not be fully aware of specific MS requirements.

Therefore, there is an urgent need for European co-ordination to facilitate interactions among data-intensive MS and HPC experts, ensuring that the field, which is strategic and of long-standing interest in Europe, develops efficiently – from academic research to industrial practice. This Action will provide the integration to foster a novel, coordinated Big Data endeavour supported by HPC. It will strongly support information exchange, synergy and coordination of activities among leading European research groups and top global partner institutions, and will promote European software industry competitiveness.

**2014 - 2018**

### **MIE - Intelligent Sustainable Mobility**

MIUR - IT

Participant

The International Energy Agency estimates that 22% of all CO<sub>2</sub> emissions are generated by the transport sector, of which 73% is generated by road transport. In Europe, road transport accounts for 93% of total CO<sub>2</sub> emissions related to transport and just over 19% of total methane gas emissions used in homes. The MIE project - Intelligent eco-sustainable mobility aims to define hardware / software methodologies, indicators and mobility management policies aimed at minimizing environmental impact and improving the service provided to users (travel time and optimization of consumption required to carry out the movements). The project aims to

develop a mobility management model, through a monitoring and control system that uses innovative technologies (low energy consumption wireless sensors, smartphone applications, smart traffic lights, control gates, computerized access to optimize the traffic management of people and goods in ordinary traffic situations or in extraordinary situations) and a decision support system to support policies for smart mobility, with models on historical data or data in real time.

The project is supported by the following partners: Leonardo Company, Intecs, STMicroelectronics, IVECO, Meridionale Impianti, Telecom Italia, Polytechnic of Turin, Polytechnic of Milan, University of Genoa, National Research Council, EICAS Automation, Negentis, Hyla Soft, Aitek, BMS Impianti, MI Welding Technology. The Politecnico di Milano collaborates in the initiative. The project, launched in January 2014, will end in September 2018.

**2012 - 2015**

### **Remote monitoring for health safety quality of life and assisted independence of older and fragile people**

Regione Liguria - IT

Participant

The project aims at the continuous monitoring and support of the activities and therapy of elderly and fragile people at home after hospital discharge. The physical activity and biomedical wearable sensors data will be collected by smartphone and sent via Internet to a data centre where sophisticated machine learning mechanisms will identify critical situations, and will analyze temporal trends of the health of the patient. Data, alarms and trends will be made available to the medical staff for monitoring and decision making.

The results of acquisitions and elaborations will be able to classify

- motor activities (risers and seats from a chair / bed, room to room trips, falls, etc.),
- trajectories of the paths in domestic journeys,
- remarkable audio events (crying, moaning, etc.).

The terminal will perform many functions including:

- collecting and storing data from wearable biosensors in particular for body vital parameters (temperature, pulse, pressure, body weight, body impedance, trans thoracic impedance, performed physical activity, heart rate and O2 saturation, etc.).
- interfacing both on the telephone network and on local network and then on the Internet
- sending periodic reports to specified recipients (doctors, hospitals, relatives)
- triggering alarms and automatic distress calls.

The project will consider as a case study precisely the assistance of elderly

people with Heart Failure assessing the impact of an extra-hospital management, carried out by nursing staff, supported by telemedicine tools based.

2013 - 2015

### **IANUS - Integrated Assistance on Unguarded Systems**

Regione Liguria - IT

Principal investigator

IANUS: monitoring of frail elderly people, promoted by IFM, adds knowledge and support to promote the independent and participatory life of the elderly through an integrated system of instruments for detection at home and with mobile devices.

The specific fragility of the elderly target significantly reduces the freedom to participate in social life and also makes the domestic routine potentially risky. The IANUS project aims to create a home-based monitoring system, easy to use, based on a mobile device system capable of continuously evaluating the motor characteristics of the subjects, so as to define any pre-alarm / alarm situations and launch appropriate reports via direct or indirect feedback.

The existence of automated systems that can guarantee continuous and discrete monitoring of the activities of the elderly is an important opportunity both to support the safety of frail elderly and as a source of help in leading a life as active as possible and, possibly, participatory.

Partner:

- IFM Group SpA
- FIDES Medica SpA
- Circle CAP Srl
- Department of Naval, Electrical, Electronic and Telecommunications Engineering (DITEN) of the University of Genoa
- Department of Computer Science, Bioengineering, Robotics and Systems Engineering (DIBRIS) of the University of Genoa

2013 - 2015

### **STARC - Remote-Control System for Home Rehabilitation Activities**

Regione Liguria - IT

Participant

STARC: more and more at home and less at the hospital, even for small patients with chronic diseases. The telemonitoring system of rehabilitation activities carried out at home aims to build a remote support system to ensure continuity of care and rehabilitation treatments. Promoted by Circle CAP, it is designed to reduce hospitalization needs and increase the acceptability of pediatric rehabilitation interventions.

The project stems from the need to improve the efficiency and effectiveness of clinical care given to the weak, especially children, outside the hospital. IT, telematics and multimedia technology offers great possibilities also in the pediatric field to provide health services to the

patient in his home, through tele-monitoring.

Remote patient management can help optimize therapy, increase the level of acceptance, support the patient and his / her family, and prevent relapse resulting in hospitalization. The STARC project aims to develop and make available technological tools and procedures that allow an improvement in the management and control of home-based rehabilitation activities, with particular attention to the population in childhood.

Partner

- Circle CAP (coordinator)
- IFM Infomaster SpA
- GGallery srl
- Giannina Gaslini Institute
- Department of Computer Science, Bioengineering, Robotics and Systems Engineering (DIBRIS) of the University of Genoa

2013 - 2015

### **PLUG-IN Platform for Urban Mobility with Heterogeneous Sources Information Management**

MIUR - IT

Principal investigator

The main objective of the PLUG-IN project is the design and implementation of an urban mobility platform able to integrate data from heterogeneous sources. The platform estimates the current state of the traffic, foresees the evolution, defines the possible strategies to manage the congestions and provides real-time information, both for the community and customized, to all users.

2011 - 2015

### **Machine Learning methods applied to an experiment in Ambient Assisted Living**

E.O. Ospedali Galliera - IT

Participant

The research on Ambient Assisted Living (AAL) is aimed at promoting the development of products, services and innovative systems to improve the independence, participation in social life, employability and overall quality of life of people elderly or sick (see, e.g., here).

This project, funded by E. O. Ospedali Galliera, is aimed at the intelligent analysis of behavior on the basis of sensed data obtained from the interaction of the individual with the assistive environment. We will make use of sensors of various kinds (e.g., ultra-sound, RFID, video, blood pressure, temperature), that will be installed in the pilot plant (the Special Unit for dementia of the Galliera Hospital in Genoa-Italy). Data will be concentrated, mined using Machine Learning and Computational Intelligence methods, and made available to the medical and paramedic staff interactivity on video screens, tablets and smart phones. The expected results of the project are: (a) allowing the constant monitoring of



the health of the subject; (b) increasing the security; (c) optimizing the work of the paramedical staff.

2012 - 2013

## **Clustering of data in high dimensional spaces**

GNCS-INDAM - IT

Principal investigator

One of the strongest problems afflicting current machine learning techniques is dataset dimensionality. In many applications to real world problems, we deal with data with anywhere from a few dozen to many thousands of dimensions. Such high-dimensional data spaces are often encountered in areas such as medicine or biology, where DNA microarray technology can produce a large number of measurements at once, the clustering of text documents, where, if a word-frequency vector is used, the number of dimensions equals the size of the dictionary, and many others, including data integration and management, and social network analysis. In all these cases, the dimensionality of data makes learning problems hardly tractable.

In particular, the high dimensionality of data is a highly critical factor for the clustering task. The following problems need to be faced for clustering high-dimensional data:

- When the dimensionality is high, the volume of the space increases so fast that the available data becomes sparse, and we cannot find reliable clusters, as clusters are data aggregations (curse of dimensionality).
- The concept of distance becomes less precise as the number of dimensions grows, since the distance between any two points in a given dataset converges (concentration effects).
- Different clusters might be found in different subspaces, so a global filtering of attributes is not sufficient (local feature relevance problem).
- Given a large number of attributes, it is likely that some attributes are correlated. Hence, clusters might exist in arbitrarily oriented affine subspaces.
- High-dimensional data could likely include irrelevant features, which may obscure the effect of the relevant ones.

The project is aimed to the study the current approaches for clustering high-dimensional data with particular stress on relational clustering, data reduction using rough and fuzzy sets, biclustering/co-clustering and related methods for intrinsic dimension estimation and for clustering comparison.

### ***Editorial activity***

- Associate Editor of Internations Scientific Journal
- International Journal on Current Science & Technology, (2013-);
- International Journal of Reasoning-based Intelligent Systems (IJRIS), (2007-);

- International Journal on Intelligent Decision Technologies, IOS Press (2007-2010);
- Source Code for Biology and Medicine, Biomed Central (2006-);
- KES, International Journal of Knowledge - Based Intelligent Engineering Systems (2000);
- Intelligent Automation and Soft Computing (1994-2010).
- Advisory Board Member:
  - International Journal of Knowledge Engineering and Soft Data Paradigms (KESDP) (2008-);
  - The Open Medical Informatics Journal Bentham Science Publishers (2007-);
  - International Series on Advanced Intelligence Advanced Knowledge International Pty Ltd (Adelaide, Australia) serie di libri (2004-).
- Guest co-editor special issue on Advances in Handwriting and Drawing Analysis della rivista scientifica internazionale Intelligent Automation and Soft Computing .
- Guest co-editor special issue on New Developments and Applications of Soft Computing della rivista scientifica internazionale KES - International Journal of Knowledge - Based Intelligent Engineering Systems.
- Guest co-editor special issue on Advances in Fuzzy sets and Rough sets della rivista scientifica internazionale Approximate Reasoning.
- Guest co-editor special issue on Natural Computing in Bioinformatics della rivista scientifica internazionale Information Fusion.
- Guest co-editor special issue on Computational Intelligence and Machine Learning Methods in Bioinformatics della rivista scientifica internazionale Artificial Intelligence in Medicine .
- Guest co-editor special issue on Advances in Computational Intelligence and Bioinformatics della rivista scientifica internazionale Soft Computing, A Fusion of Foundations, Methodologies and Applications.
- Editor of Parts: D (III) Modeling Regulatory Networks, E (IV) Bioinformatics Databases and Ontologies, F (V) Bioinformatics in Medicine, Health and Ecology, K (X) Information Modeling Brain Diseases, dello "Springer Handbook of Bio- and Neuroinformatics" (2013), Principal Editor N. Kasabov .
- Editor of the proceedings of more than 30 conferences and paper collections.
- Referee of international journals:
  - AI Communications;

- Artificial Intelligence in Engineering;
- Artificial Intelligence in Medicine;
- Computación y Sistemas -Ibero-American Journal of Computing;
- Engineering Intelligent Systems;
- Fuzzy Sets and Systems;
- IEEE Computer Journal;
- IEEE Transactions on Fuzzy Systems;
- IEEE Transactions on Knowledge and Data Engineering;
- IEEE Transactions on Systems Man and Cybernetics;
- IEEE Transactions on Neural Networks;
- IEEE Transactions on Signal Processing;
- IEEE Internet Computing;
- Industrial and Engineering Chemistry Research;
- Information Science;
- Information Fusion Journal;
- Intelligent Automation and Soft Computing;
- Intelligent Data Analysis;
- International Journal of Computer Science & Applications
- IJMLR - International Journal of Machine Learning Research;
- KES - International Journal of Knowledge - Based Intelligent Engineering Systems;
- IJKESDP - International Journal of Knowledge Engineering and Soft Data Paradigms;
- International Journal of Pattern Recognition and Artificial Intelligence;
- Knowledge and Information Systems;
- Knowledge Engineering and Soft Data Paradigms, An International Journal;
- Natural Hazards;
- Neural Computing and Applications;
- Neural Processing Letters;
- Neurocomputing;
- Open Medical Informatics Journal;
- Optical Engineering;
- Pattern Recognition;
- Pattern Recognition Letters;
- Soft Computing;
- Stochastic Environmental Research and Risk Assessment (SERRA).
- Scientific Committee Member and Referee of many scientific international conferences.

## ***Assignments abroad***

- Adjunct Professor at the Sbarro Institute for Cancer Research and Molecular Medicine, Center for Biotechnology della Temple University - Philadelphia - PA, USA, with research collaboration assignment (1 Jan 2008 - ).
- Associate Teacher at University of Zagreb - Croatia) since 2018 with the assignment of the course for the PhD Advanced Transport Management Systems.

## *Other professional activities*

- Founding partner of Vega Research Laboratories s.r.l.s., Spin-Off of the University of Genoa established in November 2017 (<http://www.vegaresearchlabs.com/>). Vega Research Laboratories supports his customers in creating value for their business through the implementation of solutions based on artificial intelligence and related disruptive technologies.
- Founder and head of the research group on Machine Learning and Computational Intelligence since 1991 at the DISI - Department of Informatics and Computer Science of the University of Genoa (Italy) which in 2012 merged into the DIBRIS - Department of Computer Science, Bioengineering, Robotics and Systems Engineering.
- Principal Investigator of the national project Clustering high dimensionality data financed by the GNCS-INDAM (2012-2013).
- Chair elected IEEE Italy Section Computational Intelligence Society Chapter (2017-2019).
- Vice-Chair elected IEEE Italy Section Computational Intelligence Society Chapter (2013-2017).
- Chair of the Task Force on Neural Networks in Bioinformatics of the Bioinformatics and Bioengineering Technical Committee - IEEE-CIS (IEEE Computational Intelligence Society), 2009-continuing.
- Vice-chair Bioinformatics and Bioengineering Technical Committee IEEE-CIS (IEEE Computational Intelligence Society), 2011-13.
- Founder and President of the Special Interest Group Bioinformatics and Intelligence of the International Neural Network Society (INNS), 2006-continuing.
- Founding Member Italian Chapter of Computational Intelligence Society (IEEE-CIS), 1996-continuing.
- Member of the Steering Committee, Special Interest Group Italy of the International Neural Network Society (INNS), 1996-continuing.
- Member of the Steering Committee, Italian Society for Neural Networks Society (SIREN), term 2000-2004.
- Member of the Steering Committee, International Graphonomics Society (IGS), term 1994-1999.
- Founding Steering Committee and Member, of International Workshop on Fuzzy Logic and Applications (WILF), 1995-continuing.
- Founding Steering Committee and Member, of the International Meeting on Computational Intelligence Methods for Bioinformatics and Biostatistics (CIBB), 2004-continuing.
- Member of the International Advisory Committee of the International Conference on Reliability, Infocom Technology and Optimization (ICRITO), 2016-continuing.
- Member of the Advisory Board / Steering Committee International Conference on Big Data Analytics & Computation Intelligence, 2016-continuing.
- Steering Committee member for IEEE IC3I & iCATccT Conference
- Steering Committee member for ICBDACI-International Conference on Big Data Analytics and Computational Intelligence, 2016-continuing.

- Steering Committee member for IC3TSN First International Conference on Computing and Communication Technologies for Smart Nation, 2016-continuing.
- Evaluator of research projects for the Val d'Aosta Region, the Luxembourg National
- Research Fund, the Polish National Science Center, MIUR, the Government of Estonia, EW-SEE-ERA.NET, EU-INTAS.
- Chair of various post-graduate schools, including: International School on Neural Networks, E. R. Caianiello on Ensemble Methods in Learning Machines (Vietri sul Mare-Salerno, Italy Sept 22 - Oct 1, 2002); ICANN 2012, International Conference on Artificial Neural Networks, 11-14 September 2012 Lausanne, Switzerland (Program Co-Chair); DeepLearn 2018 - 2nd International Summer School on Deep Learning, 23-27 Jul 2018, Genoa, Italy (Co-Chair), c.a. 1000 registered participants.