

# Matteo Nardelli

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## Research Interests

My research interests are in the field of distributed computer systems, with a focus on the execution of data stream applications in a geographically distributed environment. Currently, I am investigating the QoS-aware deployment problem for self-adaptive and distributed data stream processing systems.

Since 2015, I have co-authored more than 25 papers in peer-reviewed international journals, book chapters, and conference proceedings. Two of these publications have received paper awards.

According to Google Scholar, in March 2019 there are more than 345 citations of all the articles that I co-authored, with a h-index equal to 9. According to Scopus, in March 2019, the total number of citations is 201 (with 27 indexed articles) and my h-index is 8.

## 1 Education and Positions

### Education

**2014-2018** Ph.D. European Label in Computer Science, Control and GeoInformation (XXX Cycle) at the University of Rome Tor Vergata, Italy. Thesis: “QoS-aware Deployment and Adaptation of Data Stream Processing Applications in Geo-distributed Environments”. Advisor: Valeria Cardellini.

Winner of a grant financed by the Italian Ministry for Education, University, and Scientific Research (MIUR) in 2014. Financial grant period: from November 2014 to October 2017.

**2012-2014** Laurea Magistrale (Master’s degree) cum laude in Computer Engineering at the University of Rome Tor Vergata, Italy. Thesis: “A network-aware approach for data stream processing” (Italian). Advisor: Valeria Cardellini.

**2008-2012** Laurea Triennale (Bachelor’s degree) cum laude in Computer Engineering at the University of Rome Tor Vergata, Italy. Thesis: “Analysis and simulation of throughput-optimal access protocol for wireless networks” (Italian). Advisor: Francesco Lo Presti.

### Current Position

**Dec 2018** Software engineer at Code Architects Automation.

## Past Position

**Nov 2017–Oct 2018** Research Associate (SSD ING-INF/05) at the University of Rome Tor Vergata, Italy.

**Sept 2016–Feb 2017** Visiting Researcher at TU Wien (Technische Universität Wien), Austria, in the Distributed Systems Group led by Schahram Dustdar and in the unit led by Stefan Schulte.

## Participation to Summer Schools

**2017** The Onassis Foundation Science Lecture Series: The 2017 Lectures in Computer Science “Big Data and Applications”, Heraklion, Crete. July 2017.

**2017** Summer School on “Optimization, Big Data and Applications”, Veroli, Italy. July 2017.

**2016** International Summer School on “Autonomous Control for Reliable Future Networks and Services”, organized by the COST Action IC1304 ACROSS. Opatija, Croatia. May 2016. The Summer School was co-located with the MIPRO 2016 conference, where I presented “QoS-aware Deployment of Data Streaming Applications over Distributed Infrastructures” [IC4].

**2015** International Summer School on “NFV meets Big Data”, organized by the COST Action IC1304 ACROSS. Würzburg, Germany. April 2015. During the poster session, I presented “A Storm-based Distributed Scheduler for QoS-aware Placement of Data Stream Applications”.

## 2 International Awards and Acknowledgements

### Awards

**2018** SPEC Kaivalya Dixit Distinguished Dissertation Award for my doctorate activity and thesis entitled “QoS-aware Deployment and Adaptation of Data Stream Processing Applications in Geo-distributed Environments”.

<https://research.spec.org/awards/past-winners/2018.html>

**2016** Honorable mention paper award for [IC5] at the 10th ACM International Conference on Distributed and Event-Based Systems (DEBS 2016).

**2015** Best poster award for [IC1] at the 9th ACM International Conference on Distributed Event-Based Systems (DEBS 2015).

### Student Grants

**2017** Heidelberg Laureate Forum: Travel Grant for attending the 5th **Heidelberg Laureate Forum**, in Heidelberg, Germany. September 2017.

**2017** The Onassis Foundation: Grant for attending the 2017 Science Lectures in Computer Science on “Big Data and Applications”, Heraklion, Crete. July 2017.

**2017** SIGSOFT: Student Travel Grant for attending the **ACM 50th Celebration of the Turing Award**, in San Francisco, CA, USA. June 2017.

**2016** Student Travel Grant for attending the 2016 HPCS conference, in Innsbruck, Austria. July 2016.

**2016** SIGSOFT-CAPS: Student Travel Grant for attending the 2016 DEBS conference, in Irvine, CA, USA. June 2016.

### 3 Research Projects

**Jun-Nov 2017** Realization of a research and development project (pre-commercial procurement) on “Cloud for Europe” (Tender no. 5843932, FP7-610650), Phase II (Prototype development) for Lots 1, 2 and 3.

*Responsibility:* member of Rome Tor Vergata research unit.

### 4 Professional Activities

#### Conference Committees Member

- *11th Central-European Workshop on Services and their Composition* (ZEUS 2019).
- *Artifact Evaluation Committee, 24th International European Conference on Parallel and Distributed Computing* (Euro-Par 2018).
- *International Workshop on Autonomic Solutions for Parallel and Distributed Data Stream Processing* (Auto-DaSP 2018), co-located with Euro-Par 2018.
- *International Workshop on Container-based Systems for Big Data, Distributed and Parallel computing* (CBDP 2018), co-located with Euro-Par 2018.
- *10th Central-European Workshop on Services and their Composition* (ZEUS 2018).
- *1st International Workshop on Autonomic Management of Large-scale Container-based Systems* (AMLCS 2017).
- *International Workshop on Autonomic Solutions for Parallel and Distributed Data Stream Processing* (Auto-DaSP 2017), co-located with Euro-Par 2017.
- *International Workshop on Autonomic Systems for Big Data Analytics* (ASBDA 2017), co-located with IEEE ICCAC 2017 and IEEE SASO 2017.

#### Conference Organization

- *Publicity chair, International Workshop on Autonomic Systems for Big Data Analytics* (ASBDA 2017), co-located with IEEE ICCAC 2017 and IEEE SASO 2017.
- *Publicity chair, 1st Workshop on Automatic Management of Large Scale Container-based Systems* (AMLCS 2017), co-located with IEEE ICCAC 2017 and IEEE SASO 2017.
- *Publicity chair, 6th Workshop of the Italian group on Quantitative Methods in Informatics* (InfQ 2016)

## Reviewer for Journal and Conferences

Since 2015 I have reviewed more than 41 articles submitted to international journals and conferences:

- 11th IEEE/ACM International Conference on Utility and Cloud Computing (UCC 2018).
- IEEE Transactions on Cloud Computing (2018).
- IEEE Internet of Things Journal (2018).
- IEEE Transactions on Industrial Informatics (2018).
- Springer Cluster Computing (2018).
- Concurrency and Computation: Practice and Experience (2018).
- IEEE Transactions on Parallel and Distributed Systems (2018).
- Elsevier Big Data Research (2018).
- Elsevier Future Generation Computer Systems (2018, 2017).
- Elsevier Knowledge-based Systems (2018, 2017, 2016).
- IEEE International Symposium on Modeling, Analysis and Simulation of Computer and Telecommunications Systems (MASCOTS 2017, MASCOTS 2016).
- IEEE Transactions on Software Engineering (2017, 2016).
- International Journal of Distributed Sensor Networks (2017)
- WIREs Data Mining and Knowledge Discovery (2017, 2016).
- Springer Frontiers of Information Technology & Electronic Engineering (2017).
- IEEE Computer (2016).

## Membership and Responsibility for Professional Associations

**2016-** Secretary of the University of Rome Tor Vergata ACM Student Chapter

**2015-** Member, ACM

**2015-** Member, IEEE and IEEE Computer Society

## Invited Talks

“QoS-aware Deployment and Adaptation of Data Stream Processing Applications in Geo-distributed Environments”, invited talk at Inria Rennes - Bretagne Atlantique, Rennes, France, October 17th, 2018.

## Conference Presentations

**FiCloud 2018** (August 2018) International Conference on Future Internet of Things and Cloud (FiCloud 2018), where I presented the paper [IC17].

**Auto-DaSP 2017** (August 2017) International Workshop on Autonomic Solutions for Parallel and Distributed Data Stream Processing (Auto-DaSP 2017), where I presented the paper [IC14].

**ACPROSS 2017** (April 2017) 1st International Workshop on Autonomous Control for Performance and Reliability Trade-offs in Internet of Services (ACPROSS 2017), where I presented the paper [IC11].

**ZEUS 2017** (February 2017) 9th ZEUS Workshop on Services and their Composition (ZEUS 2017), where I presented the paper [IC10].

**InfQ 2016** (October 2016) Workshop of the Italian group on Quantitative Methods in Informatics, where I presented [IC9]. During the PhD Defense Corner, I presented my research activity.

**HPCS 2016** (July 2016) International Conference on High Performance Computing & Simulation (HPCS 2016), where I presented the paper [IC8].

**DEBS 2016** (June 2016) 10th ACM International Conference on Distributed and Event-Based Systems (DEBS 2016), where I presented the papers [IC5], receiving the **Honorable Mention Paper Award**, and [IC7].

**MIPRO 2016** (May 2016) 39th International Convention on Information and Communication Technology, Electronics and Microelectronics. During the PhD symposium, I presented the paper [IC4].

**ZEUS 2016** (January 2016) 8th Central-European Workshop on Services and their Composition (ZEUS 2016), where I presented the paper [IC3].

**MOCS 2015** (July 2015) 5th International Workshop on Management of Cloud and Smart City Systems (MOCS 2015) in conjunction with IEEE ISCC 2015, where I presented the paper [IC2].

**DEBS 2015** (July 2015) 9th ACM International Conference on Distributed Event-Based Systems (DEBS 2015), where I presented [IC1], receiving the **Best Poster Award**.

## 5 Teaching Activities

### Regular Courses

**A.Y. 2017/18, 2016/17** “Data Stream Processing Systems and Applications”, 2 ECTS, as an integrative course of “Systems and Architectures for Big Data”; graduate teaching for the master’s degree (Laurea Magistrale) in Computer Engineering at the University of Rome Tor Vergata.

### Short Courses

**A.Y. 2017/18, 2016/17, 2015/16** Hands-on Laboratory of Big Data, 1st Level Master degree in Data Science, at the University of Rome Tor Vergata.

**A.Y. 2017/18, 2016/17** Hands-on Hadoop, 2nd Level Master degree in Customer Experience & Social Media Analytics (CESMA), at the University of Rome Tor Vergata.

## Teaching Assistant

**A.Y. 2015/16, 2014/15** Distributed Systems and Cloud Computing, master's degree course taught by Valeria Cardellini, at the University of Rome Tor Vergata.

**A.Y. 2014/15** Foundations of Informatics, bachelor's degree course taught by Vincenzo Grassi, at the University of Rome Tor Vergata.

## Thesis Co-Advisor

I have been co-advisor of Laurea (L) and Laurea Magistrale (LM) theses.

**L1.** C. Zucchiatti, "A Cloud Application for Stream Processing Energy Consumption Data" (italian). April 2015.

**L2.** G. Marciani, "Optimal Placement of Data Stream Processing Applications" (italian). October 2015.

**LM1.** G. Rotundo, "Real-time Analysis and Prediction of Energy Consumptions in a Data Stream Processing System" (italian). October 2015.

**LM2.** D. Luzi, "Elastic Migration for Data Stream Processing Systems" (italian). February 2016.

**LM3.** M. Mastrogirolamo, "GMesos: a Manager for Resource Orchestration in Distributed Cloud Systems" (italian). February 2016.

**LM4.** A. Patacca, "Resource Allocation in Geographically Distributed Cloud Systems" (italian). February 2016.

**LM5.** G. Scolastri, "Network-aware Placement of Data Stream Processing Applications in a Distributed Cloud System" (italian). February 2016.

**LM6.** G. Catricalà, "A System for Real-time Analysis of Geospatial Data in a Metropolitan Setting" (italian). April 2016.

**LM7.** A. Marsicovetere, "Optimal Service Selection for SOA Applications using a Network-aware Approach" (italian). April 2016.

**LM8.** P. Casulli, "T10: Elasticity of DSP Applications Leveraging on a Reinforcement Learning Approach" (italian). October 2016.

**LM9.** A. Ferlazzo, "Multi-level Scheduling of Geographically Distributed Data Streaming Applications in Apache Aurora and Heron" (italian). February 2017.

**LM10.** G. Rossi, "Optimal Placement of Data Streaming Applications over Heterogeneous Infrastructures with Apache Flink" (italian). February 2017.

**LM11.** P. Verlotta, "A SDN Controller to Support the Optimal Placement of Data Streaming Applications in Apache Storm" (italian). April 2017.

**LM12.** G. Russo Russo, "Optimal Deployment and Run-time Reconfiguration for Data Stream Processing". April 2017.

- LM13.** L. Fulgieri, “Design and Development of a Hierarchical Decentralized Autonomous DSP System” (italian). October 2017.
- LM14.** M. Bonuglia, “Multi-level Elasticity of Data Stream Processing Applications in Apache Storm” (italian). April 2018.
- LM15.** M. Porretta, “Real-time analysis of geo-spatial maritime data for port destination prediction” (italian). April 2018.
- LM16.** M. Santangeli, “An efficient and distributed stateful migration protocol in Apache Storm” (italian). April 2018.
- LM17.** A. Nocera, “Design of an Optimal Auto-Scaling Policy for Kubernetes” (italian). July 2018.
- LM18.** F.A. Coira, “Design and Development of a framework for the composition of microservices in Kubernetes” (italian). July 2018.
- LM19.** M. Bidoli, “Integration of heuristics for the deployment of data stream processing applications in Apache Storm” (italian). October 2018.
- LM20.** C. De Petrillo, “An SDN-aware middleware for allocating network resources to data stream processing frameworks” (italian). October 2018.
- LM21.** A. Campagna, “Realization of a step-by-step backpressure mechanism for the Storm data stream processing framework” (italian). October 2018.

## 6 Publications

### International Journals

- IJ1.** V. Cardellini, V. Grassi, F. Lo Presti, M. Nardelli, “Optimal Operator Replication and Placement for Distributed Stream Processing Systems”, *ACM SIGMETRICS Performance Evaluation Review*, Vol. 44, No. 4, pp. 11–22, May 2017. doi: 10.1145/3092819.3092823.
- IJ2.** M. Nardelli, S. Nastic, S. Dustdar, M. Villari, R. Ranjan, “Osmotic Flow: Osmotic Computing + IoT Workflow”, *IEEE Cloud Computing*, vol. 4, no. 2, pp. 68–75, 2017. doi: 10.1109/MCC.2017.22.
- IJ3.** O. Skarlat, M. Nardelli, S. Schulte, M. Borkowski, P. Leitner, “Optimized IoT Service Placement in the Fog”, *Service Oriented Computing and Applications*, vol. 11, no. 4, pp. 427–443, 2017. doi: 10.1007/s11761-017-0219-8.
- IJ4.** V. Cardellini, F. Lo Presti, M. Nardelli, G. Russo Russo, “Optimal Operator Deployment and Replication for Elastic Distributed Data Stream Processing”, *Concurrency and Computation: Practice and Experience*, vol. 30, no. 9, 2018. doi: 10.1002/cpe.4334.
- IJ5.** V. Cardellini, F. Lo Presti, M. Nardelli, G. Russo Russo, “Decentralized self-adaptation for elastic Data Stream Processing”, *Future Generation Computer Systems*, vol. 87, pp. 171–185, 2018. doi: 10.1016/j.future.2018.05.025.

- IJ6.** G. Russo Russo, M. Nardelli, V. Cardellini, F. Lo Presti, “Multi-Level Elasticity for Wide-Area Data Streaming Systems: A Reinforcement Learning Approach”, *Algorithms*, vol. 11(9), 2018. doi: 10.3390/a11090134.
- IJ7.** M. Borkowski, W. Fdhila, M. Nardelli, S. Rinderle-Ma, S. Schulte, “Event-based Failure Prediction in Distributed Business Processes”, *Information Systems*, Vol. 81, pp. 220–235, 2019. doi: 10.1016/j.is.2017.12.005.
- IJ8.** M. Nardelli, V. Cardellini, V. Grassi, F. Lo Presti, “Efficient Operator Placement for Distributed Data Stream Processing Applications”, *IEEE Transactions on Parallel and Distributed Systems*, 2019. doi: 10.1109/TPDS.2019.2896115.

### Referred Chapters in International Books

- BC1.** V. Cardellini, T. G. Grbac, M. Nardelli, N. Tanković, H. L. Truong, “QoS-based Elasticity for Service Chains in Distributed Edge Cloud Environments”, *Autonomous Control for a Reliable Internet of Services: Methods, Models, Approaches, Techniques, Algorithms and Tools*, Lecture Notes in Computer Science, Springer, vol. 10768, pp. 182–211, 2018. doi: 10.1007/978-3-319-90415-3\_8.
- BC2.** V. Cardellini, T. G. Grbac, A. Kassler, A. Marotta, P. Kathiravelu, F. Lo Presti, M. Nardelli, L. Veiga, “Integrating SDN and NFV with QoS-aware Service Composition”, *Autonomous Control for a Reliable Internet of Services: Methods, Models, Approaches, Techniques, Algorithms and Tools*, Lecture Notes in Computer Science, Springer, vol. 10768, pp. 212–240, 2018. doi: 10.1007/978-3-319-90415-3\_9.

### International Conferences and Workshops

- IC1.** V. Cardellini, V. Grassi, F. Lo Presti, M. Nardelli, “Distributed QoS-aware scheduling in Storm”, In *Proceedings of the 9th ACM International Conference on Distributed Event-Based Systems (DEBS 2015)*, pp. 344–347, Oslo, Norway, July 2015. doi: 10.1145/2675743.2776766. **Best Poster Award**
- IC2.** V. Cardellini, V. Grassi, F. Lo Presti, M. Nardelli, “On QoS-aware scheduling of data stream applications over fog computing infrastructures”, *5th International Workshop on Management of Cloud and Smart City Systems 2015 (MOCS 2015)*, in conjunction with ISCC 2015. Published in *Proceedings of the 2015 IEEE Symposium on Computers and Communication (ISCC 2015)*, pp. 271–276, Larnaca, Cyprus, July 2015. doi: 10.1109/ISCC.2015.7405527.
- IC3.** M. Nardelli, “A Framework for Data Stream Applications in a Distributed Cloud”, In *Proceedings of the 8th ZEUS Workshop 2016 (ZEUS 2016)*, pp. 56–63, Vienna, Austria, January 2016. CEUR-WS.org/Vol-1562, urn:nbn:de:0074-1562-4, online: <http://ceur-ws.org/Vol-1562/paper9.pdf>.
- IC4.** M. Nardelli, “QoS-aware Deployment of Data Streaming Applications over Distributed Infrastructures”, In *Proceedings of the 39th IEEE International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO 2016)*, pp. 736–741, Opatija, Croatia, May 2016. doi: 10.1109/MIPRO.2016.7522238.



- IC5.** V. Cardellini, V. Grassi, F. Lo Presti, M. Nardelli, “Optimal Operator Placement for Distributed Stream Processing Applications”, In *Proceedings of the 10th ACM International Conference on Distributed and Event-Based Systems (DEBS 2016)*, pp. 69-80, Irvine, CA, USA, June 2016. doi: 10.1145/2933267.2933312. **Honorable Mention Paper Award**
- IC6.** G. Marciani, M. Piu, M. Porretta, M. Nardelli, V. Cardellini, “Grand Challenge: Real-time Analysis of Social Networks Leveraging the Flink Framework”, In *Proceedings of the 10th ACM International Conference on Distributed and Event-Based Systems (DEBS 2016)*, pp. 386-389, Irvine, CA, USA, June 2016. doi: 10.1145/2933267.2933517.
- IC7.** M. Nardelli, “Doctoral Symposium: Placement of Distributed Stream Processing over Heterogeneous Infrastructures”, In *Proceedings of the 10th ACM International Conference on Distributed and Event-Based Systems (DEBS 2016)*, pp. 422-425, Irvine, CA, USA, June 2016. doi: 10.1145/2933267.2933432.
- IC8.** V. Cardellini, M. Nardelli, D. Luzi, “Elastic Stateful Stream Processing in Storm”, In *Proceedings of the 2016 International Conference on High Performance Computing & Simulation (HPCS 2016)*, pp. 583-590, Innsbruck, Austria, July 2016. doi: 10.1109/HPCSim.2016.7568388.
- IC9.** V. Cardellini, V. Grassi, F. Lo Presti, M. Nardelli, “Joint Operator Replication and Placement Optimization for Distributed Streaming Applications”, In *Proceedings of InfQ 2016 - New Frontiers in Quantitative Methods in Informatics (in conjunction with ValueTools 2016)*, pp. 263–270, Taormina, Italy, October 2016.<sup>1</sup> doi: 10.4108/eai.25-10-2016.2266628.
- IC10.** M. Nardelli, “Elastic Allocation of Docker Containers in Cloud Environments”, In *Proceedings of the 9th ZEUS Workshop 2017 (ZEUS 2017)*, pp. 59–66, Lugano, Switzerland, February 2017. CEUR-WS.org/Vol-1826, urn:nbn:de:0074-1826-4, online: <http://ceur-ws.org/Vol-1826/paper10.pdf>.
- IC11.** M. Nardelli, C. Hochreiner, S. Schulte, “Elastic Provisioning of Virtual Machines for Container Deployment”, *1st International Workshop on Autonomous Control for Performance and Reliability Trade-offs in Internet of Services (ACPROSS 2017)*, in conjunction with ACM/SPEC ICPE 2017. Published in *Proceedings of the 8th ACM/SPEC on International Conference on Performance Engineering Companion (ICPE '17 Companion)*, pp. 5–10, L’Aquila, Italy, April 2017. doi: 10.1145/3053600.3053602.
- IC12.** O. Skarlat, M. Nardelli, S. Schulte, S. Dustdar, “Towards QoS-aware Fog Service Placement”, In *Proceedings of the 2017 IEEE 1st International Conference on Fog and Edge Computing (ICFEC 2017)*, pp. 89–96, Madrid, Spain, May 2017. doi: 10.1109/ICFEC.2017.12.
- IC13.** G. Marciani, M. Porretta, M. Nardelli, G. F. Italiano, “A Data Streaming Approach to Link Mining in Criminal Networks”, In *Proceedings of the 5th International Conference on Future Internet of Things and Cloud Workshops (FiCloudW 2017)*, pp. 138–143, Prague, Czech Republic, August 2017. doi: 10.1109/FiCloudW.2017.88.
- IC14.** V. Cardellini, F. Lo Presti, M. Nardelli, G. Russo Russo, “Towards Hierarchical Autonomous Control for Elastic Data Stream Processing in the Fog”, *International Workshop*

<sup>1</sup>Selected and published as extended journal version in ACM SIGMETRICS Performance Evaluation Review, 2017. Reference: [IJ1].

on *Autonomic Solutions for Parallel and Distributed Data Stream Processing (Auto-DaSP 2017)*, in conjunction with Euro-Par 2017. Published in *Euro-Par 2017: Parallel Processing Workshops*, Lecture Notes in Computer Science Vol. 10659, pp. 106–117, 2018. doi: 10.1007/978-3-319-75178-8\_9.

- IC15.** V. Cardellini, F. Lo Presti, M. Nardelli, G. Russo Russo, “Auto-scaling in Data Stream Processing Applications: A Model Based Reinforcement Learning Approach”, *InfQ 2017 - New Frontiers in Quantitative Methods in Informatics*, in conjunction with ValueTools 2017. Communications in Computer and Information Science, Vol. 825, pp. 97–110, 2018. doi: 10.1007/978-3-319-91632-3\_8.
- IC16.** C. Hochreiner, M. Nardelli, B. Knasmueller, S. Schulte, S. Dustdar, “VTDL: A Notation for Data Stream Processing Applications”, in *Proceedings of the 2018 IEEE Symposium on Service-Oriented System Engineering (SOSE 2018)*, pp. 76–85, Bamberg, Germany, March 2018. doi: 10.1109/SOSE.2018.00019.
- IC17.** M. Nardelli, V. Cardellini, E. Casalicchio, “Multi-level Elastic Deployment of Containerized Applications in Geo-distributed Environments”, in *Proceedings of the IEEE 6th International Conference on Future Internet of Things and Cloud (FiCloud-2018)*, pp. 1–8, Barcelona, Spain, 6-8 August 2018. doi: 10.1109/FiCloud.2018.00009.
- IC18.** M. Nardelli, G. Russo Russo, V. Cardellini, F. Lo Presti, “A Multi-level Elasticity Framework for Distributed Data Stream Processing”, *International Workshop on Autonomic Solutions for Parallel and Distributed Data Stream Processing (Auto-DaSP 2018)*, in conjunction with Euro-Par 2018. Published in *Euro-Par 2018: Parallel Processing Workshops*, Lecture Notes in Computer Science Vol. 11339, pp. 53–64, 2018. doi: 10.1007/978-3-030-10549-5\_5.
- IC19.** F. Rossi, M. Nardelli, V. Cardellini, “Horizontal and vertical scaling of container-based applications using reinforcement learning”, in *Proceedings of the 2019 IEEE International Conference on Cloud Computing (IEEE CLOUD 2019)*, Milan, Italy, July 8-13 2019. To appear.

## Technical Reports

- TR1.** V. Cardellini, V. Grassi, F. Lo Presti, M. Nardelli, “Distributed QoS-aware scheduling in Storm”. *Technical Report RR-15.07, Dip. di Ingegneria Civile e Ingegneria Informatica, Università di Roma “Tor Vergata”*, Italy, March 2015. <http://hdl.handle.net/2108/169392>
- TR2.** V. Cardellini, F. Lo Presti, M. Nardelli, G. Russo Russo, “Optimal operator deployment and replication for elastic distributed data stream processing”. *Technical Report RR-17.11, Dip. di Ingegneria Civile e Ingegneria Informatica, Università di Roma “Tor Vergata”*, Italy, February 2017. <http://hdl.handle.net/2108/181557>
- TR3.** V. Cardellini, F. Lo Presti, M. Nardelli, G. Russo Russo, “Towards hierarchical autonomous control for elastic data stream processing in the Fog”. *Technical Report RR-17.12, Dip. di Ingegneria Civile e Ingegneria Informatica, Università di Roma “Tor Vergata”*, Italy, June 2017. <http://hdl.handle.net/2108/194789>