

Alessandra Fais | CV

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SUMMARY

I am a Ph.D. student at the Information Engineering Department of the Università di Pisa, Italy. In 2016, I got my Bachelor's Degree in Computer Science from the same university. In 2019, I received my Master's Degree in Computer Science and Networking (*summa cum laude*) from the Computer Science Department of the Università di Pisa jointly with Scuola Superiore Sant'Anna. During my Master Degree's thesis, I started approaching the data stream processing research area.

My main research interests are related to data stream processing applications in the networking domain, high-performance network processing on multi-core end-host machines, data plane acceleration in Software Defined Networks, computation offloading to co-processors (e.g., GPUs, SmartNICs), parallel computing and high-performance computing.

EXPERIENCE

Course "Wireless Network Design" (Cod. 1041I, Università di Pisa) (2021/2022) Pisa, Italy

Teaching Assistant for the Laboratory Part ("Virtualization Lab") Feb. 2022 - Present

Topics: SDN, NFV, MEC, Cloud and Edge computing, SOA architectures, virtualization approaches (hypervisors, VMs, containers), RedHat OpenStack, VirtualBox, Docker, Kubernetes.

○ MATERIAL PRESENTED DURING THE COURSE: <https://github.com/alefais/virtualization-lab-unipi>

○ PROGRAM: <https://unimap.unipi.it/registri/dettregistriNEW.php?re=3324397:::&ri=9677>

Course "Basi di JavaScript" Portoferraio, Italy

External Lecturer, Project IFTS "I.T.E.M. in Elba" - C.E.S.C.O.T. Formazione srl Nov. 2021 - Dec. 2021

Topics: JavaScript programming language, event-driven programming paradigm, web development using JavaScript, HTML5 and CSS3, the jQuery library.

Attendee PRACE Autumn School on GPU Programming with CUDA Innsbruck, Austria

PRACE and University of Innsbruck Oct. 2021 - Oct. 2021

The Autumn School taught the necessary programming paradigms to write correct and efficient code for GPUs and to port existing code to use GPU acceleration. Many hands-on exercises were included in the program, so that the learned concepts could be applied immediately. The full program and description is available at <https://events.prace-ri.eu/event/1154/>.

Attendee DII Summer School on 5G technologies and research challenges Pisa, Italy

Università di Pisa - Department of Information Engineering (DII) Jul. 2021 - Aug. 2021

The Summer School "5G: Enabling Technologies, Opportunities and Research Challenges Ahead" provided lessons, from the industry and academic community, about the enabling technologies and methodologies in 5G networks and applications. The full program and description is available at <https://www.dii.unipi.it/5g-enabling-technologies-opportunities-and-research-challenges-ahead>.

Course "Linguaggi di Programmazione" Pontedera, Italy

External Lecturer, Project IFTS "Digital Media Designer" - Istituto Modartech Jun. 2021 - Jul. 2021

Topics: JavaScript programming language, event-driven programming paradigm, web development using JavaScript, HTML5 and CSS3.

Course "Wireless Networks" (Cod. 918II, Università di Pisa) (2020/2021) **Pisa, Italy**
Teaching Assistant for the Laboratory Part ("Virtualization Lab") *Feb. 2021 - Jun. 2021*
Topics: SDN, NFV, MEC, Cloud and Edge computing, SOA architectures, virtualization approaches (hypervisors, VMs, containers), RedHat OpenStack, VirtualBox, Docker, Kubernetes).
○ MATERIAL PRESENTED DURING THE COURSE: <https://github.com/alefais/virtualization-lab-unipi>
○ PROGRAM: <https://unimap.unipi.it/registri/dettregistriNEW.php?re=3311662:::&ri=9677>

Course "Wireless Networks" (Cod. 918II, Università di Pisa) (2019/2020) **Pisa, Italy**
Teaching Assistant for the Laboratory Part ("Virtualization Lab") *Feb. 2020 - Jun. 2020*
Topics: virtualization approaches (hypervisors, VMs, containers), VirtualBox, Docker, SDN, NFV, RedHat OpenStack.
○ PROGRAM: <https://unimap.unipi.it/registri/dettregistriNEW.php?re=3298109:::&ri=9677>

PUBLICATIONS

Journal Papers

- [J1] A. Fais, G. Lettieri, G. Procissi, S. Giordano, F. Oppedisano. **Data Stream Processing for Packet-Level Analytics**. 2021, MDPI Sensors, Vol. 21, Issue 5, Pages 1735. DOI: 10.3390/s21051735.
- [J2] G. Mencagli, M. Torquati, A. Cardaci, A. Fais, L. Rinaldi, M. Danelutto. **WindFlow: High-Speed Continuous Stream Processing with Parallel Building Blocks**. 2021, IEEE Transactions on Parallel and Distributed Systems (TPDS), Vol. 32, Issue 11, Pages 2748-2763. DOI: 10.1109/TPDS.2021.3073970.
- [J3] N. Bonelli, F. Del Vigna, A. Fais, G. Lettieri, G. Procissi. **Programming Socket-Independent Network Functions with Nethuns**. 2022, ACM SIGCOMM Computer Communication Review (CCR), Vol. XX, Issue X, Pages XXX-XXX. DOI: XXX. (to appear)

Conference and Workshop Papers

- [C1] A. Fais, G. Procissi, S. Giordano, F. Oppedisano. **Data Stream Processing in Software Defined Networks: Perspectives and Challenges**. IEEE CAMAD 2020. Pisa, Italy (Virtual Conference), September 14-16, 2020. DOI: 10.1109/CAMAD50429.2020.9209303.
- [C2] A. Fais, S. Giordano, G. Procissi. **On the Design of Fast and Scalable Network Applications Through Data Stream Processing**. IEEE NFV-SDN 2020. Madrid, Spain (Virtual Conference), November 9-12, 2020. DOI: 10.1109/NFV-SDN50289.2020.9289855.
- [C3] A. Fais, G. Lettieri, G. Procissi, S. Giordano. **Towards Scalable and Expressive Stream Packet Processing**. IEEE GLOBECOM 2021. Madrid, Spain (Hybrid: In-Person and Virtual Conference), December 7-11, 2021. DOI: 10.1109/GLOBECOM46510.2021.9685436.

EDUCATION

Università di Pisa **Pisa, Italy**
Ph.D. in Information Engineering *Nov. 2019 - Present*

- SUPERVISORS: Prof. Stefano Giordano, Prof. Gregorio Procissi
- RESEARCH: My research mainly focuses on Data Stream Processing applications in the networking domain. The main aim is proving that this computational model is highly suitable for accelerating network applications performing near real-time processing of streams of packets by taking advantage of the full potential offered by latest breakthroughs in terms of hardware. The targeted systems are mainly scale up servers equipped with multi-core CPUs and co-processors, like GPUs and SmartNICs. Indeed, DaSP computation offloading to SmartNICs is part of the research investigation I'm carrying on during this last year of my PhD. The pursuit of high performance is always complemented by the desire to keep the proposed solutions as user-friendly as possible. To this end, high emphasis in my research project is given to the design of high-level abstractions, that

hide the complexity related to both network programming and parallelism and are made directly available to programmers.

○ PHD COURSES:

- English for Research Publication and Presentation Purposes, C1 and C1+ levels (Prof. Joanne Spataro, UniPi Language Center, Italy)
- On Cyber-Physical Social Systems (CPSSs): challenges and new research directions (Prof. Antonella Longo - UniSalento, Italy)
- Credibility assessment in social media with a focus on social bot detection (Dr. Stefano Cresci - IIT CNR Pisa, Italy)
- 5G and V2X communications (Dr. Dario Sabella - Intel Deutschland GmbH, Germany)
- Computing in Communication Networks for 5G and the Tactile Internet (Prof. Dr. Frank H. P. Fitzek - TU Dresden CeTI, Germany)
- 5G, Beyond 5G and 6G: the next frontier (Dr. Emilio Calvanese Strinati - CEA-LETI Grenoble, France)
- High-Performance Computing: architectures and systems (Dr. Vassilis Papaefstathiou - ICS-FORTH Heraklion, Crete, Greece)
- Arm Architectures for High-Performance Real-Time (Dr. Matteo Andreozzi - Arm, UK)

Università di Pisa and Scuola Superiore Sant'Anna

Pisa, Italy

Master's Degree in Computer Science and Networking

Sep. 2016 - Oct. 2019

- MARK: 110/110 *cum laude*
- MASTER'S THESIS TITLE: Benchmarking Data Stream Processing Frameworks on Multicores
- SUPERVISOR: Dr. Gabriele Mencagli
- ABSTRACT: The work shows a comparison in terms of performance (bandwidth and latency) between traditional Data Stream Processing (DaSP) systems and WindFlow (<https://paragroup.github.io/WindFlow/>), an efficient C++17 streaming library based on FastFlow's building blocks (<http://calvados.di.unipi.it/fastflow>). The goal is to quantify the benefit that may be achieved by using the C++ solution w.r.t. modern Java-based ones.
A benchmark of four real-world DaSP applications have been designed and implementations are provided using Apache Storm, Apache Flink and WindFlow. Experiments show a significant throughput improvement and latency reduction by using the C++ solution w.r.t. the state-of-the-art frameworks on single multi-core machines. The results obtained are encouraging for future works which aim at designing innovative DaSP frameworks based on C++ and providing high-level abstractions like Storm and Flink, that may be able to overcome modern Java-based Stream Processing Engines on distributed scenarios too.
- MASTER'S THESIS TEXT: <https://etd.adm.unipi.it/t/etd-09162019-220730/>
- PRODUCED SOFTWARE:
<https://github.com/alefais/storm-applications>
<https://github.com/alefais/flink-applications>
<https://github.com/alefais/windflow-applications>
- MASTER PROGRAMME: Relevant courses cover parallelization methodologies, parallel programming models, architectures of high-performance computing systems, management and configuration of IP networks, Software Defined Networks, analysis of packet switching architectures, SOA, cloud computing, microservices, virtualization techniques.

Università di Pisa

Pisa, Italy

Bachelor's Degree in Computer Science

Sep. 2011 - Mar. 2016

- MARK: 105/110
- BACHELOR'S THESIS TITLE: Programming techniques for FPGA devices
- SUPERVISOR: Prof. Marco Danelutto
- ABSTRACT: The thesis is a dissertation about FPGA programming methodologies (Hardware De-

- scription Languages, Chisel and OpenCL), with an overview of current technological trends.
- BACHELOR PROGRAMME: Relevant courses cover theory of programming languages, architectures of calculators and networks, network management and IP network monitoring, traffic monitoring and elements of operational research, cryptography, software engineering.

MAIN ACADEMIC AND RESEARCH PROJECTS

A more complete list is available on my GitHub profile.

Contributions to Research Projects.....

Nethuns

Nov. 2020 - Present

A C software library which provides a unified API for fast and portable network programming on multi-core end-host machines. Nethuns allows network programmers to access and manage low-level network operations over different underlying network sockets and operating systems. Network applications based on Nethuns only need to be re-compiled to run over a different socket/OS. The supported underlying capturing solutions are libpcap, AF_PACKET, Netmap and AF_XDP. The related publication is [J3].

- Link to the project: <https://github.com/larthia/nethuns>

WindFlow

Jul. 2019 - Present

A C++ software library for parallel data stream processing targeting heterogeneous shared-memory architectures equipped with multi-core CPUs and NVIDIA GPUs. The library provides traditional stream processing operators like map, flatmap, filter, fold/reduce as well as sliding-window operators designed with complex parallel processing modes. The related publication is [J2].

- Link to the project: <https://github.com/ParaGroup/WindFlow>

Academic Projects.....

Parallel and Distributed Systems (paradigms and models) project

Sep. 2018 - Nov. 2018

C++ and FastFlow implementation of the parallel scan Blelloch algorithm with a master-worker architecture schema and tests.

- Link to the code: <https://github.com/alefais/spm-18>

Networks and Technologies for Telecommunications project - FPGA part

Jul. 2018 – Jul. 2018

Verilog implementation of Adders, Subtractors and Multipliers and tests on both the Quartus University Program Waveform Simulator and on the DE2-115 series FPGA board.

- Link to the code: <https://github.com/alefais/rtt-18-fpga>

Packet Switching and Processing Architectures project

Mar. 2018 – May 2018

C++ monitoring application that captures traffic with Libpcap and identifies and analyses different flows.

- Link to the code: <https://github.com/alefais/aed-18>

Network Management project

Jul. 2014 – Aug. 2014

Lua script (chisel) that monitors system events with Sysdig to measure the performance of an application and the amount of resources required.

- Link to the code: <https://github.com/alefais/net-man>

Computer Networks project

May 2014 – Jun. 2014

Java implementation of a distributed chat system.

- Link to the code: <https://github.com/alefais/rc1-14>

OTHER ACTIVITIES

Università di Pisa and Scuola Superiore Sant'Anna
Master's Degree in Computer Science and Networking
Master Students' Representative.

Pisa, Italy
Oct. 2016 - Oct. 2018

SCHOLARSHIPS, GRANTS, AWARDS

IEEE NFV-SDN '20 // Virtual Conference
Intel Award "Student Participation Grant"

Leganes - Madrid, Spain
Nov. 2020

NetResults S.r.l.
Ph.D. scholarship within the Information Engineering Ph.D. Programme

Pisa, Italy
Nov. 2019

Istituto di Istruzione Superiore "G. A. Pischedda" Bosa and Rotary Club Bosa
Rotary Award for top performing students during their last year of high school

Bosa, Italy
Jul. 2011

SKILLS

Programming Languages:

- C, C++, Java
- basic knowledge of Bash scripting, GNU Make and CMake, Verilog, Python, C#, F#, OCaml, Scala, HTML5, JavaScript and jQuery

Parallel Programming and Stream Processing Frameworks:

- FastFlow, WindFlow, Apache Storm, Apache Flink, Apache Spark Streaming

Network Programming Tools:

- Libpcap, AF_XDP, XDP, eBPF
- basic knowledge of Netmap, P4, ONOS, OpenFlow, Mininet

Tools:

- Docker
- basic knowledge of OpenStack and Kubernetes

Libraries:

- GDAL, GeoTools, Alglib (Descriptive Statistics package)

Version Control and IDEs:

- git, JetBrains suite, Visual Studio Code

Productivity:

- LaTeX, Office suite
- basic knowledge of gnuplot, R

LANGUAGES

- Italian: mother tongue
- English: C1+ level (C1+ CEFR certification)

Last updated on May 22, 2022.