Flavia Esposito

Curriculum Vitae et studiorum

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Personal information

First Name	Flavia
Surname	Esposito
Birth	Bari (Italy), 1 January 1989
Nationality	Italian
Sex	Female
Maternity Leaving	09/2021-02/2022 according to the Italian law.

Education

March 8, 2019 — **PhD in Computer Science and Mathematics (Curriculum Mathematics) with label Doctor Europaeus**.
PhD from University of Bari Aldo Moro, Italy, in Numerical Analysis (MAT/08 now MATH-05/A) to study low-rank decomposition model, optimization algorithms and their applications. Supervisor: Prof. Nicoletta Del Buono. Thesis Title: Nonnegative Matrix Factorizations for Knowledge extraction from Biomedical and other Real World Data.

July 16, 2015 — **Master's degree in Mathematics with full marks and honors**.
Degree from University of Bari Aldo Moro, Italy. Thesis in Numerical Analysis entitled "*Analisi di Microarray tramite la fattorizzazione non negativa*".

December 14, 2012 — **Bachelor's degree in Mathematics**.
Degree from University of Bari Aldo Moro, Italy in Mathematics. Thesis in Numerical Analysis entitled: "*Studio di equazioni lineari a tratti per le reti di geni*".

Academic and Research Positions

Ongoing: From December 2020 to May 2026 — **Assistant Professor (junior)/RTD-a**, *MAT/08 now MATH-05/A*.
Department of Mathematics, University of Bari Aldo Moro, Italy. Research project to study low-rank approaches (new models, optimization methods and algorithms) and their applications in real data analysis, with particular emphasis to biomedical data.
An extension of the position was granted following a positive evaluation of the work conducted by a committee of experts in the field.
During the period parental leave was taken for a total of 5 months in accordance with Italian law.

From February 2020 to December 2020 — **Research fellow**, Delibera del Direttore Generale n.47 del 21/01/2020.
Laboratorio di Ematologia of IRCSS-Tumori Giovanni Paolo II, Bari, Italy. Research project: "Analisi multidimensionale del microambiente nel linfoma di Hodgkin: un nuovo modello di predizione prognostica terapeutica in immuno-oncologia" (scientific director Dr. Attilio Guarini) to study low-rank decomposition techniques and prediction approaches to the analysis of GEP data in various blood tumors.

From May 2019 to February 2020 — **Research fellow**, *MAT/08 now MATH-05/A*, Decreto Rettorale 314 del 24 Aprile 2019, Politenico di Bari.
Dipartimento di Ingegneria Elettrica e dell'Informazione, Politecnico di Bari, Italy. Research project: "Sistema partecipativo attivo per la sensibilizzazione delle comunità al rischio di esposizione al gas RADON" (bando INNOLABS Regione Puglia 2017, scientific director Prof. Ing. Vincenzo Di Lecce) to study learning approaches for data from sensors to detect the Radon gas.

From April 2018 to July 2018 **Research project collaborator**, Decreto del Direttore Nr. 05/2018 del 26/01/2018.
Policlinico di Bari, Italy. Research project: "PON AMIDERHA" (PON02 00576 329762F1-2, scientific director Prof. Angela Sardaro) to manage and analyze biomedical data to evaluate the appropriateness of the proton therapy versus the radiotherapy with photon for neoplastic diseases in pediatric age and during the adolescence

From December 2015 to December 2017 **PhD students delegate for XXXI cycle**.
Doctoral school of Computer Science and Mathematics, University of Bari Aldo Moro.

Principal Investigator for Scientific Project

February 2024 **ERC Seeds Uniba grant**, *PI, 1 year project, 10k EUR*.
Designated by the University of Bari Aldo Moro, for managing the proposal research project: "Biomes Data Integration with Low-Rank Models", `https://www.uniba.it/it/ricerca/finanziamenti-alla-ricerca/erc-seeds-uniba`.

December 2021 **Social Science and Humanities Research Council of Canada (SSHRC) New Frontiers in Research Fund (NFRF)**, *WP lead, 7 years project, 252k Can$*.
Responsibility for Work Package 8 of the Project "**MBI**- Repurposing Marine by-products or raw materials for the development and production of functional foods and Bioactives to Improve human health and coastal community sustainability". The total funding is approximately 16M Can$ for 6 years of activity and 8 Work Packages distributed among international partners (Canada, Italy, Australia, Ireland, Japan). The activities will be devoted to evaluating mathematical approaches for analyzing data generated by other WPs and extracting knowledge from these data `https://mbiproject.ca/`.

March 2020 **ReFIn-Research For Innovation**, *3 years project, funded position*.
The project "Un modello numerico-matematico basato su metodologie di algebra lineare e multilineare per l'analisi di dati genomici," written by the candidate won the selection for financing a grant for an RTD-a at the Department of Mathematics, University of Bari Aldo Moro

Membership to Scientific Groups

From January 2021 to today **Member of UMI, gruppo Matematica per l' Intelligenza Artificiale e il Machine Learning**.
Subgroup of the Unione Matematica Italiana (UMI) association to study mathematical aspects related to Artificial Intelligence and Machine Learning, `https://umi.dm.unibo.it/gruppi-umi-2/gruppo-umi-aimlmat/`

From June 2020 to today **Member of PRIMO Research Group**.
Post Graduate Researchers in Inverse problems, Machine Learning and Optimization (PRIMO), `https://primomath.wordpress.com/`

From January 2019 to today **Member of Research group MIDAS**.
Mathematics in Data Analysis (MIDAS), group at the Department of Mathematics, University of Bari Aldo Moro, headed by Prof. Nicoletta Del Buono `https://sites.google.com/view/midasresearchgroup/home`

From January 2019 to today **Member of UMI**.
Unione Matematica Italiana (UMI), `https://umi.dm.unibo.it/`

From January 2016 to today **Member of GNCS INDAM Group**.
Gruppo Nazionale per il Calcolo Scientifico (GNCS), subgroup of Istituto di Alta Matematica (INDAM), `https://www.altamatematica.it/gncs/`

From January 2014 to April 2023 **ALUMNI MATHEMATICA**, *Roles held during the period: treasurer, vice president, and president*.

Association devoted to study and export Mathematics in the society. It organizes workshops, summer school, courses on various scientific topics (such as mathematics for data science) and events to bring Mathematics, Logic and the scientific method into society, to link people to science. (For details see the Section: Scientific Events Organization) `https://alumnimathematica.org/`

Grants for Scientific activity

December 2022 **INDAM-GNCS grant to organize the PRIMO Workshop 2023**, *800,00 EUR*.

Designated by the INDAM-GNCS to manage the grant for the organization of this workshop (For details see the Section: Scientific Events Organization).

September 2021 **Finanziamento Giovani Ricercatori INDAM-GNCS**, *1300,00 EUR*.

Grant from the INDAM-GNCS group to participate to conference, school, and workshop.

September 2019 **Finanziamento Giovani Ricercatori INDAM-GNCS**, *1200,00 EUR*.

Grant from the INDAM-GNCS group to participate to conference, school, and workshop.

December 2018 **Partnership for Adavance Computing in Europe grant**, *150,00 EUR*.

Grant to attend the course High Performance Bioinformatics held in Rome.

December 2017 **INDAM-GNCS grant to organize the XMaths Workshop 2017**, *500,00 EUR*.

Designated by the INDAM-GNCS to manage the grant for the organization of this workshop (For details see the Section: Scientific Events Organization).

Participation in Research Projects

Ongoing: From May 2024 to November 2026 **Computational approaches for the integration of multi-omics data**.

This project aims to develop novel computational methods for integrating multi-omics data, using advanced numerical and statistical techniques, optimization approaches, and matrix factorization. It address the challenges of large dimensionality, variable types, and high noise levels in omics data by combining information from multiple data matrices into a unified view. This project not only advances precision medicine but also enhances mathematical frameworks and computational techniques for integrating large, heterogeneous datasets. The project, with PI Prof. N. Del Buono and Co-PI Dr. C. Angelini, is funded by Piano Nazionale di Ripresa e Resilienza (PNRR), Missione 4 "Istruzione e Ricerca"-Componente C2 Investimento 1.1, "Fondo per il Programma Nazionale di Ricerca e Progetti di Rilevante Interesse Nazionale", Progetto PRIN-2022 PNRR, P2022BLN38, CUP: H53D23008870001

Ongoing: From March 2024 to March 2025 **Modelli con rango basso e algoritmi di ottimizzazione per l'analisi dati**.

This research aims to study both classical Non-negative Matrix Factorization (NMF) models and new non-linear low-rank approximation models. It proposes methods to solve complex optimization problems arising from these models, focusing on four types: constrained NMF, DeepNMF, and matrix completion models. The project will develop Riemannian optimization methods and alternating minimization techniques with randomization to handle large-scale data efficiently. This is a joint project with M. Porcelli, PI (UniBO), S. Bellavia (UniFI), S. Bonettini (UniMORE), B. Morini (UniFI), D. Palitta (UniBO), A. Papini (UniFI), F. Tudisco (GSSI), it is funded by GNCS-INDAM, CUP: E53C23001670001.

Ongoing: From December 2023 to March 2025 **Biomes Data Integration with Low-Rank Models**, *PI*.

This research tackles emerging health issues like allergies and diseases by developing low-rank models to integrate environmental and human data, guided by physical constraints. It emphasizes mathematical techniques to create joint optimization models for data integration, addressing challenges in data harmonization. The project focuses on constructing robust numerical algorithms to manage and analyze combined data from the human microbiome and environmental biomes. By leveraging these advanced mathematical methods, this interdisciplinary project aims to improve the understanding and mitigation of global health challenges through rigorous mathematical inquiry and collaboration. This research was funded by Università degli Studi di Bari Aldo Moro, CUP: E53C23001670001.

From February 2023 to February 2024 **Sistemi dinamici e modelli di evoluzione: tecniche funzionali, analisi qualitativa e metodi numerici**.

This research aims to study low-rank decomposition models. This is a joint project funded by GNCS-INDAM, CUP: E53C22001930001.

From February 2022 to July 2024 **L'intelligenza artificiale a tutela della salute in età pediatrica. Implementazione di una piattaforma digitale per il design di farmaci pediatrici sicuri**, *Participant*.

The project is dedicated to developing optimization methods for the analysis of biomedical data (PI: Prof. Orazio Nicolotti). It is one of the projects funded by the University of Bari under the competitive call: Horizon Europe Seeds (Notice Horizon Europe Seeds D.R. 1940 of 06/04/2021). The total funding for the project is 50,000 EUR. Dr. Esposito is part of the mathematics team, where the Key Person is Prof. Nicoletta Del Buono

Ongoing: From December 2021 to December 2027 **Repurposing marine by-products or raw materials for the development and production of functional foods and bioactives to improve human health and coastal community sustainability**, *WP lead*.

Leadership of WP8 and participation in the research project. The research project with PI Prof. Raymond Thomas aims to study how reused marine biomass can develop new products and create a more sustainable future for Canadian coastal communities. The project involves 6 years of activities and 8 Work Packages distributed among various international partners with whom Dr Esposito collaborates (Canada, Italy, Australia, Ireland, Japan). Dr. Esposito is leading the activities of WP8 'Informatics of marine biomass, rural or community assets, value-added products and applications'. Dr. Esposito's job in this project is to manage and coordinate research into mathematical approaches for analysing data generated by other WPs and extracting knowledge from these data. Online reference https://mbiproject.ca/.

Participation in PhD Board, and PhD courses

AY 2024-2025 **Mathematical Models and Numerical Methods for Omics Data Analysis.**, *23 hours, MAT/08 now MATH-05/A*.

Course for the PhD program in Computer Science and Mathematics at the Department of Computer Science, University of Bari Aldo Moro

AY 2022-2023 **Low-rank approaches for Data Analysis: Models, Numerical Methods and Applications**, *10 hours, MAT/08 now MATH-05/A*.

Course for the PhD program in Computer Science and Engineering at the Department of Computer Science, Science and Engineering, Alma Mater Studiorum Università di Bologna

AYs 2021-2022 **Low-rank methods for data science with practical session in R**, *8 hours*.

Course for PhD and master students at Memorial University, Newfoundland, Canada

Ongoing: From 2021 **PhD board**.

- Membership in the School of Graduate and Postdoctoral Studies, Western University, London Ontario, Canada,
  years: 2024-ongoing
- Committee member of PhD students Memorial University of Newfoundland Canada.
  years: 2021-2024

From 2020 **PhD Thesis Reviewer**.

- "A Novel Non-Negative Matrix Factorization Algorithm and Models for Practical Applications" Dr. Syed Muhammad Atif, University of Karachi Institute of Economics and Technology, Pakistan.

Visiting Position

13-17 June 2024 **Visiting Researcher**, *Memorial University, Saint John's, Newfoundland, Canada*.

Hosted by Prof. K. Hawboldt and Prof. S. Cheema in the framework of the MBI project.

5-12 June 2024 **Visiting Researcher**, *Western University, London Ontario, Canada*.

Hosted by Prof. R. Thomas.

13-17 June 2023 **Invited Professor**, *University of Koblenz, Germany*.
Teaching position in the framework of Erasmus Teaching assignment (10 hours), course: "Low-rank approaches for data analysis: models, numerical methods and applications". See Teaching Activities for details.
Representative of University of Bari Alsdo Moro during the international week 2023 at RheinAhrCampus Remagen, Hochschule Koblenz, Germany.

July 2018 **Visiting PhD student**, *Laboratory of Remote Sensing in the School of Rural and Surveying Engineering of the National Technical University of Athens, Greece*.
Hosted by Dott. K. Karamvasis.

Jan. 2018- March 2018
Nov. 2016- May 2017 **Visiting PhD student**, *Department of Mathematics and Operational Research, Facultè Polytechnique UMons, Belgium*.
Hosted by Prof. N. Gillis.

Scientific Events Organization

January 29-31, 2025 **3rd Workshop of UMI-Mathematics for Artificial Intelligence and Machine Learning**.
Member of scientific and organizing committee of the third edition of this Workshop, held in Bari. `https://umi-math4aiml2025.uniba.it/`

September 20-22, 2023 **PRIMO Workshop 3rd edition**.
Member of scientific and organizing committee of the third edition of this Workshop, held in Bari. `https://primo2023.uniba.it/`

June-September 2021 **Alumni Science Camp-second edition**.
Summer camp organized by Alumni Mathematica for children from 8-11 yo to introduce them to the knowledge of STEM disciplines. `http://alumnimathematica.org/`

July 12-16 2021 **Summer School Mathematical Methods in Data Science**.
Member of scientific and organizing committee of the third edition of this summer school held online caused by the Covid19 pandemic. `http://alumnimathematica.org/summer-school-in-data-science/`

July-September 2020 **Alumni Science Camp**.
Summer camp organized by Alumni Mathematica for children from 8-11 yo to introduce them into a knowledge of STEM disciplines . `http://alumnimathematica.org/`

July 13, 2020 **Waiting for...Summer School Mathematical Methods in Data Science: Third Edition**.
Member of scientific and and organizing committee for the Webinair to introduce to Summer School that has not been possible due to the Covid19 pandemic. `http://alumnimathematica.org/summer-school-in-data-science/`

July 15-19 2019 **Summer School Mathematical Methods in Data Science: Second Edition**.
Member of scientific and organizing committee of the second edition of this summer school which took place at the Department of Mathematics of University of Bari Aldo Moro. `http://alumnimathematica.org/summer-school-in-data-science/`

December 21, 2018 **Xmaths Workshop**.
Member of scientific and organizing committee of the workshop, Department of Mathematics of University of Bari Aldo Moro, Italy. `https://xmathsworkshop.weebly.com/`

July 16-20 2018 **Summer School Mathematical Methods in Data Science**.
Member of scientific and organizing committee of the first edition of the summer school, Department of Mathematics of University of Bari Aldo Moro. `http://alumnimathematica.org/summer-school-in-data-science/`

December 20-21 2017 **Xmaths Workshop**.
Member of scientific and organizing Committee of the workshop, Department of Mathematics of University of Bari Aldo Moro, Italy. `https://xmathsworkshop.weebly.com/` The workshop was economically supported by INDAM (GNCS and GNAMPA). The candidate was designed to manage the support given by GNCS group (see the Section: Grants for details).

May 24 2017 **Math on Job 5.0**.
Member of the organizing committee of the fifth edition of the event at the Department of Mathematics of the University of Bari Aldo Moro.

May 25 2016 **Math on Job 4.0**.
Member of the organizing committee of the fourth edition of the event at the Department of Mathematics of the University of Bari Aldo Moro.

October-December 2015 **Laboratorio di introduzione al Java**.
Member of the organizing committee of the laboratory of the introduction of the language Java (32h), with Alumni Mathematica and classroom tutor for the duration of the course.

May 27 2015 **Math on Job 3.0**.
Member of the organizing committee of the third edition of the event at the Department of Mathematics of the University of Bari Aldo Moro.

March-May 2015 **Cineforum: Science goes to Hollywood!**.
Member of the organizing committee of the scientific cineforum at the Mediateca regionale Pugliese, Bari.

June 5 2014 **Math on Job 2.0**.
Member of the organizing committee of the second edition, Department of Mathematics of the University of Bari Aldo Moro.

May 22 2014 **Math on Job: Warm up!**.
Member of the organizing committee. Department of Mathematics of the University of Bari Aldo Moro.

Conferences, Workshops, and Schools

Works Presented

September 16-20, 2024 **Numerical Analysis & Modelling in Applied Sciences (NAMAS24)**.
Talk:"A manifold approach to solve Chordal Nonnegative Matrix Factorization", Gaeta, Italy.

September 5-6, 2024 **2nd Workshop on MAThematical CHallenges to and from new technologiES (MATHCES24)**.
Poster: "A New Manifold-Based Method for Solving Chordal Nonnegative Matrix Factorization", Rome, Italy.

June 24-26, 2024 **Algorithms' Impact on Artificial Intelligence (AI2AI)**.
Talk: "A manifold approach to solve chordal nonnegative matrix factorization", Bari, Italy.

April 8-12, 2024 **Workshop on Nonsmooth Optimization and Applications (NOPTA24)**.
Poster: "A manifold approach to solve chordal nonnegative matrix factorization ", Antwerp, Belgium.

February 14-16, 2024 **8th Young Associazione Italiana Ricerca Operativa (AIRO) Workshop**.
Talk: "Accelerated SVD-based Initialization for Nonnegative Matrix Factorization", Rende, Cosenza Italy.

August 28-September 1, 2023 **Società Italiana di Matematica Applicata e Industriale meeting (SIMAI 2023)**.
Invited Talk: "Optimizing penalty hyperparameters in Nonnegative Matrix Factorization with bi-level strategy", Minisymposium organized by Prof. Iuliano, Prof. Cuomo , Matera Italy.

July 3-6, 2023 **Numerical Analysis and Scientific Computation with Applications conference (NASCA23)** .
Talk: "Optimizing penalty hyperparameters in Nonnegative Matrix Factorization with bi-level strategy", Athens, Greece.

September 26-30, 2022 **Society Industrial and Applied Mathematics Conference on Mathematics of Data Science (SIAM-MDS22)**.
Talk: "Optimizing penalty hyperparameters in Nonnegative Matrix Factorization with bi-level strategy", San Diego, USA.

September 15-16, 2022 **Workshop on Low-Rank Models and Applications**.
Talk: "Optimizing penalty hyperparameters in Nonnegative Matrix Factorization with bi-level strategy", Mons, Belgium.

June 7-10, 2022 **Structural dynamical systems: Computational Aspects (SDS2022)**.
Talk: "SVD-based initialization with Accelerated Progressive Residual Projection for Nonnegative Matrix Factorization", Hotel Resort Rosa Marina, Bari, Italy.

August 30-September 3, 2021 **Società Italiana di Matematica Applicata e Industriale conference 2020+2021 meeting (SIMAI 2020+2021)**.
Invited Talk: "Low rank approaches for the analysis of real data from pre to post processing", during the Minisymposium "Mathematics of inferring, computing and learning from data" organized by Prof. Tudisco and Prof. Cipolla, Parma Italy (partially held online cause the Covid19 Pandemy).

July 31, 2021 **International Conference on Computational and Mathematical Biology**.
Keynote Spearker: "Constrained Nonnegative Matrix Factorization in Microarray Data Analysis", Bangladesh (held online cause the Covid19 Pandemy).

July 14, 2021 **COLORAMAP retreat by Nicolas Gillis**.
Invited Talk: "Optimizing penalization hyperparameters in NMF problems", Belgium (partially held online cause the Covid19 Pandemy).

June 30, 2021 **FuturoINAREA by CNR (Consiglio Nazionale delle Ricerche)**.
Invited Talk: "Low rank approaches for the analysis of biomedical data from pre to post processing", Bari (held online cause the Covid19 Pandemy).

March 15-19, 2021 **91st Annual Meeting of the International Association of Applied Mathematics and Mechanics**.
Invited Talk: "Low rank approaches for the analysis of biomedical data from pre to post processing", minisymposioum YRM2Rank structured matrix and tensor techniques, in Germany (held online cause the Covid19 Pandemy).

December 20-21, 2020 **XMaths Workshop 2020**.
Invited Talk: "Nonnegative Matrix Factorization models for knowledge extraction from biomedical and other real world data.", Bari Aldo Moro (held online cause the Covid19 Pandemy).

September 12-13, 2019 **Workshop on Low-Rank Models and Applications**.
Talk: "Nonnegative Matrix Factorization approach for color images segmentation", Mons, Belgium.

September 2-7, 2019 **XXI CONGRESSO DELL'UNIONE MATEMATICA ITALIANA**.
Talk: "Constrained Nonnegative Matrix Factorization in Microarray Data Analysis", session Algebra lineare numerica ed applicazioni, Pavia, Italy.

June 12-15, 2018 **Structural dynamical systems: Computational Aspects, 10th Workshop SDS2018**.
Talk: "A new model for Nonnegative Matrix Factorization in Microarray Data Analysis", Hotel Porto Giardino Resort Capitolo-Monopoli, Bari, Italy.

February 1-2, 2018 **32nd annual conference of the Belgian Operational Research Society (Orbel32)**.
Talk: "Orthogonal Joint Sparse NMF for 3D-Microarray Data Analysis", Liège, Belgium.

June 14-17, 2016 **Structural dynamical systems: Computational Aspects 9th Workshop (SDS2016)**.
Poster: "Microarray data analysis: gene detection using Nonnegative Matrix Factorization", Hotel Porto Giardino Resort Capitolo-Monopoli, Bari, Italy.

Congress Partecipation

January 17-19, 2024 **Mathematics for Artificial Intelligence and Machine Learning**.
Meeting of the UMI-Group, Milan, Italy.

June 21-23, 2023 **19th Annual Meeting Bioinformatics Italian Society, BITS**.
Meeting, Bari, Italy.

June 27-29, 2022 **Assemblea Nazionale del GNCS**.
Meeting, Montecatini, Italy.

February 11-13, 2020 **Assemblea Nazionale del GNCS**.
Meeting, held in Montecatini, Italy.

June 3, 2019 **One Day Workshop on Applied Mathematics 2019**.
Workshop on analytical, numerical and physical aspects of mathematics, organised by Department of Mathematics of University of Bari Aldo Moro and Department of Mechanics, Mathematics and Management of Politecnico of Bari.

January 28, 2019 **Intelligent Machines and Mathematics**.
Meeting organized by the Department of Mathematics of University of Bologna.

October 12, 2018 **Giornata di Algebra Lineare Numerica**.
Workshop organized by the Department of Mathematics of University of Bari Aldo Moro.

June 8, 2017 **One day workshop on Applied Mathematics**.
Workshop organized by the Department of Mathematics of University of Bari Aldo Moro and Department of Mechanics, Mathematics and Management of Politecnico of Bari.

February 2-5 2016 **Numerical Methods for multiparametric boundary value problems Workshop**.
Department of Mathematics of the University of Bari Aldo Moro, Bari, Italy

Courses and Schools

June 21-25 2021 **Regularization Methods for Machine Learning**.
School organized by Prof. Lorenzo Rosasco, within the PhD Program in Computer Science of the University of Genova and the MaLGa (Machine Learning Genova Center) group (online due the Covid19 pandemic).

September 28-October 2 2020 **Mathematics of Life: Modelling molecular mechanism**.
School at European Bioinformatics Institute-European Molecular Biology Laboratory (online due the Covid19 pandemic)

October 7-11 2019 **Mathematical and Computational Aspects of Machine Learning school**.
School at Centro di Ricerca Matematica E. Giorgi, Scuola Normale Superiore di Pisa, Italy.

December 10-12 2018 **High Performance Bioinformatics course, PRACE**.
High Performance Bioinformatics course Cineca, Roma, Italy. For participate to the course the candidate received a grant from the organizing istitution (For details see the Section: Grants).

September 18-22 2017 **4th European Data Science Summer School**.
Saarland University, Saarbrücken, Germany

February 13-17 2017 **BigDat2017 3rd International Winter School**.
School organized by Universitat Rovira i Virgili Research Group on Mathematical Linguistics and the Department of Computer Science, University of Bari Aldo Moro, Bari, Italy.

November 23, 25, 30, December 2, 7, 9, 2016 **Graph Theory and Large Scale Applications at KU Leuven**.
Belgian Interuniversity Attraction Poles on "Dynamical Systems, Control and Optimization" (DYSCO) Course by Prof. Paul Van Dooren (UCL), Leuven, Belgium.

September 14-16 2016 **IEEE Italy Section Medical Informatics Summer school**.
IEEE Italy Section Medical Informatics Summer school, Trani, Italy

June 27- July 8 2016 **Bioinformatics Summer school**.
University of Angers, Angers, France

Editor activities and Reviewer

From 2017 **Reviewer for journals**.

- "Journal of Computer Science Applications and Information Technology"
- "Information Sciences"
- "Signal Processing"
- "Bioinformatics"
- "Computer Methods and programs in Biomedicine"
- "Symmetry"
- "Applied Science"
- "Statistics in Medicine"
- "Mathematics"

From 2020 **Guest editor for special issues in different journals**.

- Journal: "Mathematics", special issue: "Computational Approaches for Data Inspection in Biomedicine". This special issue aimed to gather contributions from numerical analysis and applied mathematics in the context of biomedical data analysis.
- Journal: "Journal of Computational Mathematics and Data Science", special issue: "Learning from data: from Optimization to Inverse problems". This special issue aimed to gather contributions from numerical analysis and applied mathematics in the context of learning methods from data.

Teaching Activities

Bachelor and Master Degree

AYs 2023-2024, 2022-2023 **Fondamenti di Matematica per l'analisi dei Dati**, *MAT/08 to be MATH-05/A*.
Course for the Master degree in Bioinformatics, Università degli Studi di Bari Aldo Moro

AYs 2023-2024 **Metodi Numerici per la Bioinformatica**, *MAT/08 to be MATH-05/A*.
Course for the Master degree in Bioinformatics, Università degli Studi di Bari Aldo Moro

AY 2023-2024 **Teaching Assignment (STA) Erasmus+ network**.
Course for master and PhD students, entitled "Low-rank approaches for Data Analysis: Models, Numerical Methods and Applications" in the framework of the Erasmus Teaching assignment

AYs 2022-2023, 2021-2022, 2020-2021 **Metodi Numerici per la Data Science**, *MAT/08 to be MATH-05/A*.
Course for the Bachelor degree in Mathematics, Department of Mathematics, Università degli Studi di Bari Aldo Moro `https://www.dm.uniba.it/didattica/cds-matematica/aa-2022-2023/insegnamenti-programmi-docenti-l35-2022-2023`

AYs 2022-2023, 2021-2022 **Laboratorio di Programmazione e Calcolo**, *MAT/08 to be MATH-05/A*.
Course for the Bachelor degree in Chemestry, Università degli Studi di Bari Aldo Moro

July 2021 **Session 1: Introduzione al linguaggio di programmazione R** .
First session at the Summer School "Mathematical Methods in Data Science". The session consisted in teaching the basis of the programming language R for data analysis. (For details of the event see the Section: Scientific Events Organization).

From December 2019 to May 2020 **Mathematics tutor at Department of Pharmacology**.
Didactic tutor for students of the bachelor degree in Pharmacology and Drugs Science teaching Real Analysis (function study, limits, ode).

July 2019 **Session 1: Introduzione ai linguaggi di programmazione R e Python per la Data Science**.
First session at the Summer School "Mathematical Methods in Data Science". The session consisted in teaching the basis of the programming languages R and Pyhton for data analysis. (For details of the event see the Section: Scientific Events Organization).

July 2019 **Produzione di materiale didattico micro-learning per il recupero dei debiti formativi degli studenti del Corso di Studio in Informatica e Informatica e Tecnologia per la Produzione del Software**, *Decreto del Direttore n.18 del 15/02/2019*.
Production of micro-learning material to the recovery of training debts of the students of the Department of Computer Science.

2018-2019 AY **Cultore della materia in "Tecniche di Ottimizzazione"**, *MAT/08 to be MATH-05/A*.
Entitled, from the Department of Mathematics of University of Bari Aldo Moro, in the subject "Tecniche di Ottimizzazione", SSD MAT/08 in accordance to the italian law Art. 42 del R.D. 4 giugno 1938, n. 1269

November-December 2018 **Intensive remedial course on basic mathematics**.
Informatica e Tecnologia per la Produzione del Software degree at Department of Computer Science, University of Bari Aldo Moro.

September-October 2018 **Intensive remedial course on basic mathematics**.
Computer Science degree at Department of Computer Science, University of Bari Aldo Moro.

July 2018 **Session 1: Analisi descrittiva e esplorativa dei dati at MMDS Summer School**.
First session at the Summer School "Mathematical Methods in Data Science". The session consisted in teaching the basis of descriptive and explorative statistical analysis with an additional practical session on R (For details of the event see the Section: Scientific Events Organization).

October-November 2017 **Intensive remedial course on basic mathematics**.
Computer Science degree at Department of Computer Science, University of Bari Aldo Moro.

October-November 2016 **Intensive remedial course on basic mathematics**.
Computer Science degree at Department of Computer Science, University of Bari Aldo Moro.

April-November 2014 **Mathematics tutor at the Department of Geology of the University of Bari Aldo Moro**.
Didactic tutor for students of the Department of the Earth and Geoenvironmental Science of the University of Bari Aldo Moro (Real Analysis, Statistics and Probability Theory).

Thesis supervision

Ongoing: From 2023 **Co-supervisor of Bachelor degree theses in Mathematics**, *University of Bari Aldo Moro*.

- *thesis title*: "Decomposizioni low-rank per l'analisi dei dati Tweedie: caso di studio in oncologia",
  student: Claudio De Cesare
  supervisors: Prof.ssa Nicoletta Del Buono, Dr. Flavia Esposito
  period: June-October 2024
- *thesis title*: ""Equivalenza tra NMF, clustering spettrale e kernel k-means: teoria ed applicazioni" ",
  student: Davide Rizzi
  supervisor: Prof.ssa Nicoletta Del Buono
  co-supervisor: Dr. Flavia Esposito
  period: June-October 2024
- *thesis title*: "Multivariate data analysis on matrix manifold",
  student: Danilo Giannoccaro
  supervisor: Prof.ssa Nicoletta Del Buono
  co-supervisor: Dr. Flavia Esposito
  period: June-October 2023

Ongoing: From 2016 **Co-supervisor of Master degree theses in Mathematics**, *University of Bari Aldo Moro*.

- *thesis title*: "Metodi di ottimizzazione Free-derivative",
  student: Dott.ssa Lucia Falconetti
  supervisors: Prof.ssa Nicoletta Del Buono
  co-supervisor: Dr. Flavia Esposito
  period: January-July 2024
- *thesis title*: "Metodi numerici per decomposizioni tensoriali e loro applicazioni",
  student: Dott.ssa Mariagrazia Antonacci
  supervisor: Prof.ssa Nicoletta Del Buono
  co-supervisor: Dr. Flavia Esposito
  period: January-July 2024
- *thesis title*: "Predictive optimization methods for nanostring technologies",
  student: Dott.ssa Alessandra Catalano
  supervisor: Prof.ssa Nicoletta Del Buono
  co-supervisor: Dr. Flavia Esposito
  period: June 2021-March 2022
- *thesis title*: "Tecniche di normalizzazione per microarray",
  student: Dott.ssa Alessia Perrini
  supervisor: Prof.ssa Nicoletta Del Buono
  co-supervisor: Dr. Flavia Esposito
  period: March-September 2021
- *thesis title*: "Approcci algoritmici per l'estrazione di geni rilevanti nell'analisi di linfomi di tipo grey",
  student: Dott.ssa Alessia Notarnicola
  supervisor: Prof.ssa Nicoletta Del Buono
  co-supervisor: Dr. Flavia Esposito
  period: March-September 2021
- *thesis title*: "E-nose: analisi di dati e modelli predittivi",
  student: Dott.ssa Isabella Leoci
  supervisor: Prof.ssa Nicoletta Del Buono
  co-supervisor: Dr. Flavia Esposito
  period: February 2019-July 2020
- *thesis title*: "Analisi di microarray: studio dell'influenza delle tecniche di inizializzazione per fattorizzazioni non negative",
  student: Dott. Mariapaola Cavaliere
  supervisor: Prof. Nicoletta Del Buono
  co-supervisor: Flavia Esposito
  period: November 2015-December 2016

AY 2019-2020 **Co-supervisor of Master degree theses in Computer Engeniriing**, *Politecnico di Bari*.

- *thesis title*: "Tecniche di Intelligenza Artificiale nell'analisi e completamento di serie numeriche multidimensionali",
  student: Dott. Marco Minoia
  supervisor: Prof. Ing. Vincenzo Di Lecce
  co-supervisor: Dr. Flavia Esposito
  period: July 2019-December 2019
- *thesis title*: "Validazione dataset per applicazioni di intelligenza artificiale",
  student: Dott. Luigi Bisceglia
  supervisor: Prof. Ing. Vincenzo Di Lecce
  co-supervisor: Dr. Flavia Esposito
  period: July-December 2019

Teaching Activity Abroad Italy

From 2021 **Memorial University of Newfoundland, Canada**.

Co-Supervisor master and PhD degree:

- degree: PhD degree of Biochemestry, Memorial University of Newfoundland Canada,
  Project title: "Use of metabolomics to assess the Myconutrient applications of mushrooms in health and food domains",
  student: Ajibola Olaide
  supervisor: Prof. S. Cheema
  co-supervisor: Prof. R. Thomas
  committee Member: Dr. Flavia Esposito
  year: 2021-2024
- degree: master degree of Boreal Ecosystems and Agricultural Sciences, School of Science and the Enviroment, Memorial University of Newfoundland Canada,
  thesis title: "Innovations in Lipid Bioinformatics and Applications in Assesing Enviromental Stress and Brain Health",
  student: Grace Callahan
  supervisor: Prof. Raymond Thomas
  co-supervisor: Dr. Flavia Esposito
  year: 2021-2024

From 2024 **Western University, London Ontario, Canada**.

Membership in the School of Graduate and Postdoctoral Studies

Invited Seminars

Ongoing: **Invited Seminars**.

From 2019

- place: Western University, London Ontario, Canada
  title: "Integrated Data Analysis using low-rank models thought computational and statistical methods to better understand response in different biomes",
  date: June 2024
- place: Memorial University, Saint John's Newfoundland, Canada,
  title: "Learning from data: optimization and low-rank factorization",
  date: June 2024
- place: master course Numerical Methods in Data Science, degree Data Science at University of Bari Aldo Moro,
  title: "Can Data Science support Biomedical Research?",
  date: May 2020
- place: master course Numerical Methods in Data Science, degree Data Science at University of Bari Aldo Moro,
  title: "Can Data Science support Biomedical Research?",
  date: May 2020
- place: master course Design for Interaction, degree Design for interaction, Intelligent systems at Politecnico di Bari.,
  title: "Explorative Data Analysis",
  date: November 2019
- place: master course Engineered intelligent systems at Politecnico di Bari,
  title: "Low-rank methods for data science",
  date: May 2019
- place: master course Engineered intelligent systems at Politecnico di Bari,
  title: "Microarray data analisys with numerical linear algebra",
  date: May 2019

Other Information

Languages

Italian, English, French **Mothertongue, Intermediate, Basic**, *respectively*.

Computer skills

Advanced **OS Microsoft Windows and application Microsoft office**.

Advanced **Matlab, Python, R, S+ and LaTeX**.

Research activity

Ongoing: From August 2023 to today

Manifold optimization methods.

This activity focuses on the study of optimization approaches based on manifolds. The research involved exploring various techniques that leverage the geometric properties of manifolds to improve optimization processes, with the aim of achieving more efficient and robust solutions. This project was conducted in collaboration with several colleagues, allowing us to combine our expertise in different areas and explore innovative methodologies within the field (Prof. Andersen Ang University of Southampton, UK). Results of this research can be found in [1].

Ongoing: From November 2016 to today

Low-rank models.

This research focuses on the study of numerical approaches for developing low-rank decomposition models on nonnegative matrices. The work involved the formulation and implementation of new models and algorithms, including methods for initializing these decompositions, to enhance the performance and accuracy of low-rank approximations. The research aimed at advancing techniques for efficient and scalable matrix factorization, particularly in handling nonnegative data. This project was conducted in collaboration with several colleagues (Prof. Nicolas Gillis-University of Mons, Belgium, Dr. Syed Muhammad Atif-College of Computing and Software Engineering, Karachi, Pakistan). Results of this research can be found in [2, 4, 3].

Ongoing: From October 2020 to today

Algorithms for Automatic hyperparameter tuning.

This research focuses on developing numerical algorithms for the automatic tuning of hyperparameters in learning models. The work involved creating methods to optimize hyperparameters automatically, significantly reducing the need for manual adjustment and enhancing the efficiency and performance of machine learning systems. By integrating variational analysis approaches, we aimed to make the hyperparameter tuning process more adaptive and effective across different models. This research was conducted in collaboration with several colleagues, whose diverse expertise contributed to the development of more robust and innovative solutions (Prof. Rafal Zdunek- Wroclaw University of Science and Technology, Poland, Dr. Laura Selicato- Consiglio Nazionale delle Ricerche, Italy, Dr. Caterina Sportelli- University of Western Australia, Australia. Results of this research can be found in [5, 6, 25]

Ongoing: From January 2022 to today

Numerical Approaches for the analysis of real data.

This research activity is dedicated to studying numerical approaches for the analysis of data from real-world contexts, such as environmental studies. The work is carried out in collaboration with colleagues, combining interdisciplinary expertise to develop and refine methods that can effectively address the complexities of data-driven challenges in these fields. Results of this research can be found in [22, 23, 25]

Ongoing: From October 2015 to today

Numerical approaches for the analysis of biomedical data.

This research is devoted to the study and develop new approaches for the analysis of biomedical data. Part of the research is devoted to study low-rank decomposition techniques and prediction approaches for the analysis of different omics data. This research is conducted in collaboration with several colleagues to study different biomedical data:

- Gene Expression Profiles data in various blood tumors, in collaboration with Dr. Ciavarella, Istituto Tumori Giovanni Paolo II, Bari, Italy [11, 8, 9, 10, 7];
- Microarrays data from different environments in collaboration with Dr. Boccarelli, Department of Human Oncology of the Policlinico di Bari, Italy [12, 13, 14, 15, 16];
- Lipidomics data, in collaboration with Prof. Thomas, Western University, London Ontario, Canada [17].

Publications

Track records according to Scopus:

- h-index: 9

- pubblications: 26
- citations: 190

Journal Papers

[1] Flavia Esposito and Andersen Ang. "Chordal-NMF with Riemannian Multiplicative Update". In: *submitted* (2024).

[2] Flavia Esposito, Atif Syed Muhammad, and Nicolas Gillis. "Accelerated SVD-based Initialization for Nonnegative Matrix Factorization". In: *to appear on Computational and Applied Mathematics* (2024).

[3] Flavia Esposito. "A review on initialization methods for nonnegative matrix factorization: towards omics data experiments". In: *Mathematics* 9.9 (2021), p. 1006.

[4] Flavia Esposito, Nicolas Gillis, and Nicoletta Del Buono. "Orthogonal joint sparse NMF for microarray data analysis". In: *Journal of mathematical biology* 79 (2019), pp. 223–247.

[5] Nicoletta Del Buono et al. "Bi-level algorithm for optimizing hyperparameters in penalized nonnegative matrix factorization". In: *Applied Mathematics and Computation* 457 (2023), p. 128184.

[6] Flavia Esposito, Laura Selicato, and Caterina Sportelli. "Theoretical aspects in penalty hyperparameters optimization". In: *Mediterranean Journal of Mathematics* 20.6 (2023), p. 300.

[7] Gian Maria Zaccaria et al. "A decision-tree approach to stratify DLBCL risk based on stromal and immune microenvironment determinants". In: *HemaSphere* 7.4 (2023), e862.

[8] Maria Carmela Vegliante et al. "A Digital Gene-Expression Signature Supports Mediastinal Gray Zone Lymphoma Stratification within Classical Hodgkin or Primary Mediastinal B-Cell Lymphoma". In: *Blood* 140.Supplement 1 (2022), pp. 9312–9313.

[9] Maria Carmela Vegliante et al. "NR1H3 (LXRα) is associated with pro-inflammatory macrophages, predicts survival and suggests potential therapeutic rationales in diffuse large b-cell lymphoma". In: *Hematological Oncology* 40.5 (2022), pp. 864–875.

[10] Gian Maria Zaccaria et al. "Electronic case report forms generation from pathology reports by ARGO, automatic record generator for onco-hematology". In: *Scientific Reports* 11.1 (2021), p. 23823.

[11] Laura Selicato et al. "A new ensemble method for detecting anomalies in gene expression matrices". In: *Mathematics* 9.8 (2021), p. 882.

[12] Angelina Boccarelli, Nicoletta Del Buono, and Flavia Esposito. "Review of Patient Gene Profiles Obtained through a Non-Negative Matrix Factorization-Based Framework to Determine the Role Inflammation Plays in Neuroblastoma Pathogenesis". In: *International Journal of Molecular Sciences* 25.8 (2024), p. 4406.

[13] Angelina Boccarelli, Nicoletta Del Buono, and Flavia Esposito. "Cluster of resistance-inducing genes in MCF-7 cells by estrogen, insulin, methotrexate and tamoxifen extracted via NMF". In: *Pathology-Research and Practice* 242 (2023), p. 154347.

[14] Angelina Boccarelli, Nicoletta Del Buono, and Flavia Esposito. "Colorectal cancer in Crohn's disease evaluated with genes belonging to fibroblasts of the intestinal mucosa selected by NMF". In: *Pathology-Research and Practice* 229 (2022), p. 153728.

[15] Angelina Boccarelli, Nicoletta Del Buono, and Flavia Esposito. "Analysis of fibroblast genes selected by NMF to reveal the potential crosstalk between ulcerative colitis and colorectal cancer". In: *Experimental and Molecular Pathology* 123 (2021), p. 104713.

[16] Angelina Boccarelli et al. "Improving knowledge on the activation of bone marrow fibroblasts in MGUS and MM disease through the automatic extraction of genes via a nonnegative matrix factorization approach on gene expression profiles". In: *Journal of Translational Medicine* 16 (2018), pp. 1–16.

[17] Moganatharsa Ganeshalingam et al. "Role of lipidomics in assessing the functional lipid composition in breast milk". In: *Frontiers in Nutrition* 9 (2022), p. 899401.

[18] Filippo Giordano et al. "Effect of music therapy intervention on anxiety and pain during percutaneous renal biopsy: a randomized controlled trial". In: *Clinical Kidney Journal* 16.12 (2023), pp. 2721–2727.

[19] Flavia Esposito, Angelina Boccarelli, and Nicoletta Del Buono. "An NMF-Based methodology for selecting biomarkers in the landscape of genes of heterogeneous cancer-associated fibroblast Populations". In: *Bioinformatics and Biology Insights* 14 (2020), p. 1177932220906827.

[20] Filippo Giordano et al. "The influence of music therapy on preoperative anxiety in pediatric oncology patients undergoing invasive procedures". In: *The Arts in Psychotherapy* 68 (2020), p. 101649.

[21] Flavia Esposito, Nicoletta Del Buono, and Laura Selicato. "Nonnegative matrix factorization models for knowledge extraction from biomedical and other real world data". In: *PAMM* 20.1 (2021), e202000032.

Conference Papers

[22] Ciro Castiello, Nicoletta Del Buono, and Flavia Esposito. "Improving Color Image Binary Segmentation Using Nonnegative Matrix Factorization". In: *International Conference on Computational Science and Its Applications*. Springer. 2023, pp. 623–640.

[23] Nicoletta Del Buono et al. "Anomalies Detection in Gene Expression Matrices: Towards a New Approach." In: *BIOINFORMATICS*. 2021, pp. 162–169.

[24] Alessandra Scarcelli et al. "RADON Project: From Children's Game To Intelligent Personal Dosimeter". In: *2020 IEEE International Workshop on Metrology for Industry 4.0 & IoT*. IEEE. 2020, pp. 146–151.

Book's Chapter

[25] Gaetano Settembre et al. "Machine Learning Approaches for Predicting Crystal Systems: A Brief Review and a Case Study". In: Springer, 2022. Chap. Machine Learning, Optimization, and Data Science, Lecture Notes in Computer Science.

[26] Nicoletta Del Buono et al. "Detecting Anomalies in Marine Data: A Framework for Time Series Analysis". In: Springer, 2022. Chap. Machine Learning, Optimization, and Data Science, Lecture Notes in Computer Science.

[27] Nicoletta Del Buono, Flavia Esposito, and Laura Selicato. "Toward a new approach for tuning regularization hyperparameter in NMF". In: Springer, 2021. Chap. Machine Learning, Optimization, and Data Science, Lecture Notes in Computer Science.

[28] Nicoletta Del Buono, Flavia Esposito, and Laura Selicato. "Methods for hyperparameters optimization in learning approaches: an overview". In: Springer, 2020. Chap. Machine Learning, Optimization, and Data Science, Lecture Notes in Computer Science.

[29] Nicoletta Del Buono and Flavia Esposito. "Investigating NMF Initializations: A survey and a microarraycase study." In: Universitas Studiorum, 2019. Chap. Series in Applied Sciences.

[30] Nicoletta Del Buono and Flavia Esposito. "On some practical issues related to Nonnegative Matrix Factorization in Microarray Data Analysis context". In: Universitas Studiorum, 2018. Chap. Series in Applied Sciences.

[31] Gabriella Casalino et al. "Q-matrix extraction from real response data using nonnegative matrix factorizations". In: Springer, 2017. Chap. Lecture Notes in Computer Science.

[32] Nicoletta Del Buono et al. "Breast cancer's microarray data: pattern discovery using nonnegative matrix factorizations". In: Springer, 2016. Chap. Lecture Notes in Computer Science.

Theses

[33] Flavia Esposito. "Nonnegative Matrix Factorizations for Knowledge Extraction from Biomedical and other real world data". In: *Department of Computer Science*. University of Bari Aldo Moro, Italy, 2019.

[34] Flavia Esposito. “Analisi di Microarray tramite la fattorizzazione non negativa”. In: *Department of Mathematics*. University of Bari Aldo Moro, Italy, 2015.

[35] Flavia Esposito. “Studio di equazioni lineari a tratti per le reti di geni”. In: *Department of Mathematics*. University of Bari Aldo Moro, Italy, 2012.

In compliance with the GDPR and Italian Legislative Decree no. 196 dated 30/06/2003, I hereby authorize the recipient of this document to use and process my personal details for the purpose of recruiting and selecting staff and I confirm to be informed of my rights in accordance to art. 7 of the above mentioned Decree.

Bari, August 26, 2024