Cheick Tidiane **Ba**

CV

Milan, Italy

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Current position

- Nov. 2020 - Now: PhD student in Computer Science (XXXVI cycle) - Last year.
  Supervisors: Prof. Dr. Sabrina Gaito, Dr. Matteo Zignani
  CONNETS Lab - Computer Science Department - University of Milan, Italy

  In the lab, I am the junior research group leader of the research line on temporal and multilayer networks and blockchains. I supervise the thesis work of both bachelor and master students and flank younger PhD students. I organize and lead weekly meetings on these topics. I am an assistant in courses on network science and machine learning.

Previous positions

- May. 2020 – Nov. 2020: Research assistant for project VASARI
  Supervisors: Prof. Dr. Sabrina Gaito, Prof. Dr. Gian Paolo Rossi,
  CONNETS Lab - Computer Science Department - University of Milan, Italy

Research interests

My research is in data mining and knowledge discovery, network science, and applied machine learning and statistics; with a focus on network evolution and prediction tasks on large-scale temporal data through effective and scalable computational methods.

Areas:

- Network science
- Multilayer temporal graph - modeling and mining
- Machine learning on graphs
- Blockchain-based systems
- Text mining
- Network visualization

Research activity

Temporal multilayer graphs from blockchain-based networks

Modeling and extracting knowledge from blockchain data is extremely challenging due to the intertwined and highly dynamic nature of these systems. From one side, blockchain-based transactions have been successfully modeled as temporal networks for a wide range of applications, including transaction analysis, anomaly and fraud detection, and transaction prediction; however, blockchain-based systems are often even highly interconnected and exhibit intricate interdependencies that span multiple blockchain networks. This latter aspect, still marginal in the current literature, is the main subject of my research activity. My main contributions are primarily focused on how to effectively represent the intricate relationships that exist within or among blockchain-based complex systems by temporal and multilayered graph models, an emerging yet powerful tool for handling a more realistic representation of the various and heterogeneous relationships that may characterize an entity in a graph-structured system. By leveraging the multilayer temporal graph representation I developed novel methodologies to cope with open problems resulting from the heterogeneity and the high dynamicity of blockchain-based networks. From mesoscopic and microscopical perspectives, I investigated how blockchain-based networks evolve by identifying the temporal network motifs and triadic closure mechanisms and found different footprints related to the growth processes of these systems. The temporal multilayer graph representation is also the basis of a few novel methods I proposed to deal with different new prediction tasks which arise in blockchain networks and broadly in temporal multilayer networks: i) graph neural networks for predicting whether users will migrate to another platform in case of a shocking

event on the original network, for instance, a hard-fork in the blockchain; ii) graph neural networks and feature-based machine learning algorithms for predicting future social interactions and economical transactions leveraging the multiplexity of blockchain-based systems; and iii) a novel method based on graph neural network for the simplification of multilayer networks driven by the classification tasks. In summary, the novel perspective based on temporal multilayer networks on blockchain data I adopted during my research activity has determined a few innovative solutions and, at the same time, is opening up different open questions where the key points are the interplay between the temporal and the heterogeneous dimensions characterizing blockchain-based systems.

- **Network structure.** Blockchain online social networks (BOSNs) are a noteworthy example of the difficulty in modeling blockchain-based systems. In BOSNs, multiple transactions type are available (such as various social actions but also monetary actions involving the cryptocurrency). Analysis of these systems requires both dealing with the heterogeneity of transactions (with a layer for each interaction type) as well as the modeling of cross-chain behaviors: in fact, we can observe fork i.e., a bifurcation of the main branch of the original blockchain, that allows users to create new platforms originating from the original one. In [19], we successfully modeled blockchain data from the ecosystem of social platforms based on the Steem blockchain, whose main member is Steemit, and Hive, the blockchain originating from a hard fork of the Steem blockchain. We were able to monitor network metrics and evaluate the effects of user migration on the graph structure of the interactions. Since multilayer temporal graphs proved to be an effective solution, we employed them for other open problems, such as the analysis of the role of densely connected communities during migration and fork events. The network-based analysis centered on the identification of communities on multilayer networks in [20] showed that communities are characterized by different migration behaviors: users in communities formed through economical transactions are more likely to stay. In addition, when we leveraged text mining approaches to characterize communities based on their posted content in [4], we observed how users are characterized by different discussion topics. Migration decisions are also influenced by other types of pressure/influences: hubs influence the user migration decision on their direct neighbors [27], as users directly interacting with hubs planning to leave, tend to migrate.
- **Motifs.** Studies on network motifs on both static and temporal networks have increased the knowledge about the principles and mechanisms leading to the formation and evolution of different types of networks, However, these structures have been barely explored in blockchain-based systems. In [8] we investigate triadic closure one of the fundamental mechanisms driving the formation of dense groups and communities. More precisely, we conducted an in-depth analysis of network structure centered on triads, i.e. 3-node subgraphs, and triadic motifs, i.e. statistically significant triads, both from a static and temporal standpoint. We found strong evidence of how triadic closure is relevant during the evolution of these platforms and, for a few aspects, more impactful than centralized online social networks, where triadic closure is also incentivized by recommendation systems.
- **Dynamics.** Few attempts have been focused on the dynamics of large-scale online social networks; especially on microscopical and high-resolution temporal dynamics of link creation or economical interactions. In blockchain-based online social platforms, network structure and the dynamics on top of it are strongly coupled with the cryptocurrency markets and reward systems. Therefore, we conducted several studies to assess the impact of the cryptocurrencies linked to a BOSN platform on the evolution of its social network and on the behavior of its users. As many human dynamics are heterogeneous and characterized by a bursty behavior, we decided to investigate the bursty dynamics of the link creation process in blockchain-based systems. In [22], we modeled blockchain data as a temporal-directed network from which we extract the time series characterizing link creation and reward claims. Adopting a user-centric approach, we evaluated the heterogeneity of the time series through the inter-event time distribution, the burstiness, the bursty train size distribution, and the fitting of inter-event times by power law models. The outcomes of the analysis highlight that the above processes show bursty traits typical of human dynamics. As for the interplay between cryptocurrency prices and users' actions, we found evidence of the influence of the cryptocurrency price on users' actions, particularly on actions that shape the structure of social networks [24, 10], by applying a time series correlation analysis. Moreover, the behavior of users, in terms of the production of content and/or its promotion through a voting and rewarding system was analyzed, showing that highly rewarded users prefer actions related to the promotion of content rather than the creation of high-quality content, exploiting the reward distribution mechanisms implemented by the platform [10]. Another important aspect of the interplay between currencies and temporal networks is related to understanding the behavior of selected accounts e.g important or anomalous accounts. We addressed the problem by analyzing monetary flows between users in Sarafu, a blockchain-based complementary currency used to provide humanitarian aid and promote sustain-

able development. We focused on flows involving a special type of account, the group account, to understand cooperative behavior, highlighting the presence of cooperation patterns and the importance of cooperation groups over time as well as differences over time in their spending behavior [18]. Moreover, leveraging geographical information underlined that reliance on cooperation is different across geographic locations, as time is an important factor; in addition, we observed significant interplay between geographic areas and the allocation of resources [9].

- **Machine learning on multilayer graphs.** We have tackled several prediction tasks in blockchain-based systems, relying on graph structure. In [19], we assessed the predictability of user migration i.e. the users' decision to stay or leave a social media platform, showing how network structure can be leveraged to predict users' decisions. We also found that in a stratified context where social and economical relationships are mixed together, both dimensions are important in describing and forecasting users' behaviors during and after a shocking event in the network. Similarly, in [29, 21] we conducted link prediction tasks focusing on the following relationships, isolating the layer to perform link prediction leveraging text mining. In these works, we show how the combination of structural and textual features enhances the prediction performance of traditional models. Deep learning architectures outperform traditional ones and they can also benefit from the addition of textual features.

  While good results can be obtained considering each layer separately, recent literature showed the superiority of machine learning methods more suited for multilayer graphs. Hence we focused on the use of multilayer graph neural networks (MLGNN). In order to leverage MLGNN on large-scale datasets, characterized by a wide set of different relationships among a large set of entities, it's fundamental to improve performance and scalability, to remove noise or redundant information. While various network simplification approaches based on machine learning are available for single-layer graphs, there was a lack of suitable ones for multilayer graphs. Therefore, we focused on the development of a framework to perform random simplification on multilayer graphs for predictions with MLGNN [26, 14]: while random simplification proved to be effective in some domains, simplification tailored to the task was still necessary. Therefore, by proposing TAMARA, a task-aware multilayer graph simplification framework [6], we are able to tune simplification and machine learning models at the same time: the strategy improves performances not only for user migration prediction but also with other node classification tasks on graphs in other domains.

Education

Academic formation

- Mar. 2020: Master's degree: Computer science - 110/110 cum laude
  Computer Science Department - University of Milan, Italy
- Oct. 2017: Bachelor's degree: Computer science for New Media Communications
  Computer Science Department - University of Milan, Italy

Visiting periods

- May. 2023 – Aug. 2023: Visiting PhD student at Queen Mary University London
  Supervisor: Dr Richard G. Clegg
  Topics: temporal multilayer networks, blockchain modeling and mining
  Networks Research Group, QMUL, London, United Kingdom
- May. 2022 – Aug. 2022: Visiting PhD student at CIRAD Montpellier
  Supervisor: Dr Roberto Interdonato
  Topics: machine learning on multilayer networks, text mining for food security.
  Unité mixte de recherche (UMR) TETIS, CIRAD, Montpellier, France

International schools

- 2022: Lake Como School of advanced studies - Complex Networks: Theory, Methods, and Applications.
- 2022: Bertinoro spring school – BISS 2022
- 2021: Lake Como School of advanced studies - From Networks to Neural Networks in Finance.

Honors & awards

- Received, Runner-up for Best paper (2nd out of 140 submitted works) award at GoodIT '21: Conference, 2021
- Received, Grant of 4500 computing hours on Indaco HPC platform for project AI_for_Web3, 2022:
- Selected, 1st out of 39 candidates for Computer Science PhD selection. 3 years research grant, 2020
- Winner, Research grant for Italian national project VASARI

Publications

Also see my Google Scholar and DBLP pages.

Thesis

[1] **Evolution of a decentralized online social network** Cheick Tidiane Ba Supervisors: Prof. Sabrina Gaito and Ph.D. Matteo Zignani2020

[2] **Development of an android library for indoor positioning based on visual markers, Bluetooth and inertial sensors** Cheick Tidiane Ba Supervisors: Prof. Sergio Mascetti and Ph.D. Dragan Ahmetovic2017

Pre-prints

[3] **Mining User-Centric Temporal Motifs to Study Bitcoin Transaction Networks** Naomi Arnold, Peijie Zhong, Cheick Tidiane Ba, Felix Cuadrado, Richard G. Clegg Accepted to conference LIMBO: LearnIng and Mining for BlOckchains workshop at ECMLPKDD 2023.

[4] **Analyzing user migration in blockchain online social networks through network structure and discussion topics of communities on multilayer networks** Cheick Tidiane Ba, Alessia Galdeman, Manuel Dileo, Matteo Zignani, Sabrina Gaito Submitted to journal.

[5] **User migration prediction in blockchain socioeconomic networks using graph neural networks** Cheick Tidiane Ba, Alessia Galdeman, Manuel Dileo, Matteo Zignani, Sabrina Gaito Accepted at conference ACM 3rd International Conference on Information Technology for Social Good (GoodIT 2023).

[6] **TAMARA a task-aware multilayer graph simplification framework** Cheick Tidiane Ba, Roberto Interdonato, Dino Ienco, Sabrina Gaito Accepted to conference 20th International Workshop on Mining and Learning with Graphs (ECMLPKDD 2023)

[7] **Raphtory: The temporal graph engine for Rust and Python** Ben Steer, Naomi Arnold, Cheick Tidiane Ba, Renaud Lambiotte, Haaroon Yousaf, Lucas Jeub, Fabian Murariu, Shivam Kapoor, Pedro Rico, Rachel Chan, Louis Chan, James Alford, Richard G. Clegg, Felix Cuadrado, Matt Barnes, Peijie Zhong, John Pougué-Biyong, Alhamza Alnaimi Submitted to Journal of Open Source Software (JOSS).

Peer-reviewed international journal articles

[8] **Characterizing growth in decentralized socio-economic networks through triadic closure-related network motifs** Cheick Tidiane Ba, Matteo Zignani, Sabrina Gaito *Online Social Networks and Media* 37-38 (2023) p. 1002662023

[9] **Cooperative behavior in blockchain-based complementary currency networks through time: The Sarafu case study** Cheick Tidiane Ba, Matteo Zignani, Sabrina Gaito *Future Generation Computer Systems* (2023)2023

[10] **The role of cryptocurrency in the dynamics of blockchain-based social networks: The case of Steemit** Cheick Tidiane Ba, Matteo Zignani, Sabrina Gaito *PLOS ONE* 17.6 (June 2022) pp. 1–22Public Library of Science, 2022

[11] **City consumption profile: a city perspective on the spending behavior of citizens** Alessia Galdeman, Cheick T. Ba, Matteo Zignani, Christian Quadri, Sabrina Gaito *Applied Network Science* 6.1 (Aug. 2021)Springer Science and Business Media LLC, 2021

[12] **Multi-resolution visualization and analysis of biomolecular networks through hierarchical community detection and web-based graphical tools** Paolo Perlasca, Marco Frasca, Cheick Tidiane Ba, Jessica Gliozzo, Marco Notaro, Mario Pennacchioni, Giorgio Valentini, Marco Mesiti *PloS one* 15.12 (2020) e0244241Public Library of Science San Francisco, CA USA, 2020

[13] **UNIPred-Web: a web tool for the integration and visualization of biomolecular networks for protein function prediction** Paolo Perlasca, Marco Frasca, Cheick Tidiane Ba, Marco Notaro, Alessandro Petrini, Elena Casiraghi, Giuliano Grossi, Jessica Gliozzo, Giorgio Valentini, Marco Mesiti *BMC bioinformatics* 20.1 (2019) pp. 1–19BioMed Central, 2019

Peer-reviewed international conferences

[14] **Une méthode à base de réseaux de neurones pour la simplification des graphes multicouches dans un contexte de classification des noeuds** Cheick Tidiane Ba, Roberto Interdonato, Dino Ienco, Sabrina Gaito *Actes de la 23ème conférence francophone sur l'èxctraction et la gestion des connaisance. Revue des Nouvelles Technologies de l'Information. Extraction et Gestion des Connaissances, RNTI-E-39.* 2023

[15] **Integration and Visual Analysis of Biomolecular Networks Through UNIPred-Web** Paolo Perlasca, Marco Frasca, Cheick Tidiane Ba, Jessica Gliozzo, Marco Notaro, Mario Pennacchioni, Giorgio Valentini, Marco Mesiti *Current Trends in Web Engineering: ICWE 2022 International Workshops, BECS, SWEET and WALS, Bari, Italy, July 5–8, 2022, Revised Selected Papers*, 2023

[16] **Web3 social platforms: modeling, mining and evolution** C.T. Ba, A. Galdeman, M. Dileo, C. Quadri, M. Zignani, S. Gaito *Proceedings of the 1st Italian Conference on Big Data and Data Science (ITADATA 2022)*, 2022, Milan, Italy.

[17] **Explaining Food Security Warning Signals with YouTube Transcriptions and Local News Articles** Cheick Tidiane Ba, Chloé Choquet, Roberto Interdonato, Mathieu Roche *Proceedings of the 2022 ACM Conference on Information Technology for Social Good*, 2022, Limassol, Cyprus

[18] **Temporal Analysis of Cooperative Behaviour in a Blockchain for Humanitarian Aid during the COVID-19 Pandemic** Cheick Tidiane Ba, Alessia Galdeman, Matteo Zignani, Sabrina Gaito *Proceedings of the 2022 ACM Conference on Information Technology for Social Good*, 2022, Limassol, Cyprus

[19] **Fork-Based User Migration in Blockchain Online Social Media** Cheick Tidiane Ba, Andrea Michienzi, Barbara Guidi, Matteo Zignani, Laura Ricci, Sabrina Gaito *14th ACM Web Science Conference 2022*, 2022, Barcelona, Spain

[20] **The role of groups in a user migration across blockchain-based online social media** Cheick Tidiane Ba, Matteo Zignani, Sabrina Gaito *2022 IEEE International Conference on Pervasive Computing and Communications Workshops and other Affiliated Events (PerCom Workshops)*, 2022

[21] **Link Prediction with Text in Online Social Networks: The Role of Textual Content on High-Resolution Temporal Data** Manuel Dileo, Cheick Tidiane Ba, Matteo Zignani, Sabrina Gaito *Discovery Science: 25th International Conference, DS 2022, Montpellier, France, October 10–12, 2022, Proceedings*, 2022

[22] **Social and rewarding microscopical dynamics in blockchain-based online social networks** Cheick Tidiane Ba, Matteo Zignani, Sabrina Gaito *Proceedings of the Conference on Information Technology for Social Good*, 2021

[23] **A Multilayer Network Perspective on Customer Segmentation Through Cashless Payment Data** Alessia Galdeman, Cheick Ba, Matteo Zignani, Sabrina Gaito *2021 IEEE 8th International Conference on Data Science and Advanced Analytics (DSAA)*, 2021

[24] **The Effect of Cryptocurrency Price on a Blockchain-Based Social Network** Cheick Tidiane Ba, Matteo Zignani, Sabrina Gaito, Gian Paolo Rossi *International Conference on Complex Networks and Their Applications*, 2020

[25] **A Graphical Tool for the Exploration and Visual Analysis of Biomolecular Networks** Cheick Tidiane Ba, Elena Casiraghi, Marco Frasca, Jessica Gliozzo, Giuliano Grossi, Marco Mesiti, Marco Notaro, Paolo Perlasca, Alessandro Petrini, Matteo Re *International Meeting on Computational Intelligence Methods for Bioinformatics and Biostatistics*, 2018

Peer-reviewed contributions not in proceedings

[26] **A framework for multilayer network simplification: task-aware approach with graph neural networks** Cheick Tidiane Ba, Roberto Interdonato, Dino Ienco Conference on complex systems (CCS 2022). Accepted abstract,2022

[27] **The Hub-bit: traits, role and influence of central nodes during a user migration** Galdeman, C.T. Ba, A. Caputo, M. Zignani, S. Gaito International Conference on Network Science 2022 (NetSciX 2022). Accepted extended abstract,2022

[28] **Triadic closure process in distributed online social networks** C.T. Ba, M. Zignani, S. Gaito, G.P. Rossi 11th International Conference on Complex Networks (CompleNet 2020). Accepted extended abstract,2020

[29] **The impact of textual context on link prediction in online social networks** M. Dileo, C.T. Ba, M. Zignani, S. Gaito 13th International Conference on Complex Networks (CompleNet 2020). Accepted extended abstract,2020

Teaching

- Teaching assistant for Artificial Intelligence course (2022/2023)
  Master's degree in Artificial Intelligence for Science and Technology
  Department of Mathematics - University of Pavia, Italy
- Teaching assistant for Social network analysis course (2021/2022)
  Master's degree in Data Science
  Department of Economics, Management, and Quantitative Methods - University of Milan, Italy
- Teaching assistant for Social network analysis course (2020/2021)
  Master's degree in Data Science
  Department of Economics, Management, and Quantitative Methods - University of Milan, Italy

Advising & mentoring

Thesis co-advisor

- Topic: Web-based exploration of citation graphs. Claudia Pariotti (Bachelor's degree in Computer science for New Media Communications)
- Title: A machine learning approach for transaction link prediction in blockchain-based online social networks. Maria Giustiniano (Master's degree in Data science for economics).
- Title: Discrete choice models for network evolution in socio-economic contexts. Marco Del Treppo (Master's degree in Data science for economics).

- Title: Link prediction in blockchain online social networks with contextual information. Manuel Dileo (Master's degree in Computer Science)
- Topic: Monitoring and analysis of economical transactions on blockchain. Cucchi Matteo (Bachelor's degree in Computer Science)
- Topic: Graph-based database modeling of blockchain-based social networks. Luca Bottoli (Bachelor's degree in Computer Science for New Media Communications).
- Topic: Evolution of blockchain-based online social networks. Caputo Alessia (Master's degree in Computer Science).
- Title: Cryptocurrency price prediction with contextual information. Murat Aydin (Data science for economics).
- Title: User migration prediction across online social networks through graph neural networks. Naomi Demolli (Master's degree in Computer Science).

Community activities

Conference and workshops organization

Session Chair:

- 25th International Conference on Discovery Science (DS2022) for Session 6: Text, Ontologies and Cross-modal learning

Web Chair:

- Urban Complex Systems A Workshop Satellite of the Conference on Complex Systems 2021
- Urban Complex Systems A Workshop Satellite of the Conference on Complex Systems 2020

Program Committee Member:

- 3rd ACM Conference on Information Technology for Social Good (GoodIt23) - for the accepted special track on AI on Networks for social GOod (AIN4GO)

Publication chair:

- ECML PKDD 2023 - for the accepted workshop LIMBO: LearnIng and Mining for BlOckchains

Reviewer

Performed revision of submitted works for the following international journals and conferences:

- Applied Network Science
- PLOS ONE
- ACM Transactions on Information Systems
- Springer Machine Learning Journal
- 15th ACM International WSDM Conference (WSDM'22)
- 9th International Conference on Computational Social Science (ic2s2 '23)

Conference participation

- *35th Multi-Service Networks workshop (MSN 2023)*. Abingdon, Oxfordshire. Presenter, the title of the talk: Analyzing and predicting user cross-chain behaviour with temporal multilayer graphs.
- *The 11th International Conference on Complex Networks and their Applications 2022*. Palermo, Italy. Co-author of presented abstract: Link prediction in blockchain online social networks with textual information.
- *Conference on complex systems* (CCS 2022). Palma de Mallorca, Spain. Presenter for poster: A framework for multilayer network simplification: task-aware approach with graph neural networks.

- *25th International Conference on Discovery Science* (DS2022). Montpellier, France. Presenter for the paper: Link prediction with text in online social networks: the role of textual content on high-resolution temporal data.
- *2nd ACM Conference on Information Technology for Social Good* (GoodIT22) Limassol, Cyprus. Presenter for papers: Temporal analysis of cooperative behavior in a blockchain for humanitarian aid during the COVID-19 pandemic> and Explaining food security warning signals with YouTube transcriptions and local news articles.
- *14th ACM Web Science Conference 2022* (WebSci '22). Barcelona, Spain. Presenter for the paper: Fork-based user migration in Blockchain Online Social Media.
- *20th IEEE International Conference on Pervasive Computing and Communications* (PerCom 2022) - Third Workshop on Blockchain Theory and Applications (BRAIN 2022). Remote. Presenter for the paper: The role of groups in a user migration across blockchain-based online social media.
- *International School and Conference on Network Science* (NetSci-X 2022). Porto, Portugal. Presenter for poster: The Hub-bit: traits, role, and influence of central nodes during a user migration.
- *10th International Conference on Computational Data and Social Networks* (CSONet2021). Remote. Presenter for abstract: Social activity and decentralized applications in blockchain-based social networks.
- *ACM Conference on Information Technology for Social Good* (GoodIT21). Rome, Italy. Presenter for the paper: Social and rewarding microscopical dynamics in blockchain-based online social networks.
- *The 9th International Conference on Complex Networks and their Applications 2020* (CNA2020). Remote. Presenter for the paper: The Effect of Cryptocurrency Price on a Blockchain-Based Social Network.

Research Projects

Participates/participated actively in the following research projects:

- Customer segmentation and behavioral risk analysis for an Italian financial group. Improved code scalability with parallelization and LSH algorithms. Publications [23, 11]
  Sept. 2020 - Now
- Research project PON: VASARI - "VAlorizzazione Smart del patrimonio ARtistico delle città Italiane" - Code: ARS01_00456 – objectives OR 4.3, OR 5.1 e OR 5.3;
  2020
- Unipred-Web integration and prediction on bio-molecular networks -
  Collaboration with Dr. Paolo Perlasca, Prof. Dr. Marco Mesiti, Prof. Dr. Valentini Giorgio, Prof. Dr. Marco Frasca, MSc. Jessica Gliozzo, Dr. Alessandro Petrini, Prof. Dr. Elena Casiraghi, Prof. Dr. Matteo Re, Prof. Dr. Giuliano Grossi, researchers at Anacleto Lab, for the design and development Unipred-Web integration and prediction on bio-molecular networks. Works: [25, 13, 12].
  2018 - Now
- Collaboration with Dr. Andrea Michienzi, Dr. Barbara Guidi, and Prof. Dr. Laura Ricci researchers at the University of Pisa, Italy for the analysis of data from blockchain-based systems. Works: [19].
  2021 - Now
- Collaboration with Dr. Roberto Interdonato and Dr. Dino Ienco, researchers at CIRAD, Montpellier, France for the development of methodologies for machine learning on graphs. Works : [26, 14, 6]
  2022 - Now

Skills

Programming	Python (Advanced), JavaScript (Advanced), SQL, Java, PHP, Perl, Latex
Databases	Spark, MongoDB, Postgres, Oracle, MySql
Machine learning	Scikit-learn, PyTorch, Deep graph library, PyTorch geometric
Data mining and graph modeling	pandas, statsmodels, neo4j, networkx, networkit, Gephi
Back-end	MongoDB, Express, REST API
Front-end	React, AngularJS, HTML5/CSS/JavaScript
Languages	English (C2), Italian (native), French (native), Spanish (beginner)
Extracurricular	Basketball, hiking, board games

References

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  University of Milan
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- Dr. **Zignani Matteo**, Assistant professor
  Computer Science Department
  University of Milan
  Giovanni Celoria, 18
  20133 Milan, MI
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- Dr. **Roberto Interdonato**, Researcher
  UMR TETIS
  CIRAD Montpellier
  500 rue Jean-François Breton
  34000 Montpellier, France
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