

LUCA ALBERGANTE

Curriculum Vitae

PERSONAL DATA

First Name	Luca	Last Name	Albergante
Current Address	33 Rue Rambuteau 75004, Paris, France	Mobile Tel	+33 769047408
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ACADEMIC CAREER

September 2016 – **Postdoctoral research fellow in Bioinformatics and Systems Biology**. Computational present Systems biology of Cancer group, INSERM Unit 900, Institut Curie, Paris, France

My responsibilities in the computational systems biology of cancer team (lead by E Barillot and A Zinovyev) include the analysis of biological data (particularly single cell RNA-Seq), the development of innovative machine learning algorithms to identify large-scale trends in biological big data, the supervision of undergraduate students, the preparation of scientific manuscripts, the presentation of my work in international conferences, and the delivery of tutorial and courses focused on computational systems biology. To this end, I have been writing R scripts and implemented both algorithms and interactive interfaces using R and C++ in a parallel and distributed computing environment. I also made extensive use of version control, and virtualization tools (e.g., GitHub and Docker).

October 2017 – **Visiting Research Scholar in the group of Computational Biology**. Department of November 2017 Biomedical Informatics, Harvard Medical School, Boston, USA

As a part of my research activity, I visited the group of P Kharchenko to expand my knowledge in the context of single cell data analysis.

August 2011 – **Postdoctoral research fellow in Theoretical Systems Biology**. Division of August 2016 Computational Biology and Division of Cell and Developmental Biology, School of Life Sciences, University of Dundee, Dundee, UK

My responsibilities in the theoretical systems biology team (lead by T Newman) included the analysis of diverse biological data (e.g., networks, ChIP-Seq, images, epidemiological data), the development of statistical approaches to validate mathematical models, the supervision of B.Sc., M.Sc., and Ph.D. students, the preparation of scientific manuscripts, the presentation of my work in international conferences, and the delivery of tutorial and courses focused on computational statistics. To this end, I have been writing R and bash scripts and implemented different algorithms R in a parallel and distributed computing environment. I also collaborated with the Centre for Anatomy & Human Identification to design novel statistical approaches for the analysis of anatomical and forensic data.

March 2014 – **Fixed-term lecturer in Statistics and Data Analysis**. School of Science and Engineering, February 2016 University of Dundee, Dundee, UK

As a fixed-term lecturer, my responsibilities included the designed and delivered several courses on statistics and data analysis to B.Sc. and M.Sc. students in Anatomy, Forensic anthropology and Engineering. The courses included hand-on workshops focused on the use of Excel and R as tools to test statistical hypothesis testing and, more broadly, to perform data analysis.

November 2007 – **Fixed-term lecturer in Algorithms and Statistics.** Department of Mathematics, University of Milan, Milan, Italy
 July 2011

I designed and delivered several courses on Algorithms to B.Sc. and M.Sc. students in Mathematics. The courses focused on practical issues related to algorithm design and analysis using C, Matlab and R. I also taught Probability and Statistics to B.Sc. students in Biology.

November 2008 – **Visiting research scholar in the group of Non-Standard Computation.** Department of Computer Science, University of York, York, UK
 June 2009

As part of my Ph.D. research activity, I spent several months in York to collaborate with experimental biologists. I also researched complex systems modeling and analysis using both mathematical and computational approaches.

EDUCATION

November 2006 – **Ph.D. in Mathematics and Statistics for Computational Sciences.** Department of Mathematics, University of Milan, Milan, Italy
 December 2010

The research of my Ph.D., supervised by J Timmis (University of York) and G Naldi (University of Milan), focused on two main areas: the design and analysis of immune inspired algorithms and the development of mathematical models of infection. My Ph.D. training included exams on stochastic processes, statistics, computational biology, mathematical modeling, and sensitivity analysis. My Ph.D. thesis presents a model of experimental visceral leishmaniasis developed using stochastic Petri nets. The model is extensively validated via biological data either obtained from the literature or provided by the group of P Kaye (University of York). The robustness of the model was explored using sensitivity analysis.

October 1997 – **Combined B.Sc. and M.Sc. in Computer Science** (5 year program). Graduated *magna cum laude*. Department of Computer Science, University of Milan, Italy. During the course of my studies, I worked part-time and took two breaks to attend the mandatory Italian National Service (1 year) and the Cisco Systems Networking Academy (1 year).
 October 2006

During my university studies, I enrolled in courses covering various aspects of computer science, including procedural and object-oriented programming, physics, computer architecture, operating systems, calculus, probability theory, statistics, networking, serial and parallel algorithms, programming language theory, cryptography, and information theory. My master thesis was centered on public key cryptography. In 2004/2005, I attended and passed all the 4 semesters of the Cisco System Networking Academy (CSNA).

PUBLICATIONS - “&” DENOTES EQUAL CONTRIBUTION

1. Palmer S, Albergante L, CC Blackburn, Newman TJ, **Further discussion on the immunological model of carcinogenesis**, 2018, PNAS; 115 (19) E4319-E4321
2. Palmer S, Albergante L, CC Blackburn, Newman TJ, **Thymic involution and rising disease incidence with age**, 2018, PNAS; 115 (8) 1883-1888 – In this article, I use statistical analysis on epidemiological data derived from different sources to show how a mathematical model based on immunosenescence is able to describe the incidence of various infectious diseases and cancers. A press release for this article is available here: <http://bit.ly/2E8PymR>
3. Liu D & Albergante L, Newman TJ, **Universal attenuators and their interactions with feedback loops in gene regulatory networks**, 2017, Nucleic Acid Research; 45(12), 7078–7093 – In this article, I use network analysis and statistics to study the role of regulatory cascades in gene networks. The analysis highlights the evolutionary pressures acting on these networks and provides new concepts to explore the emergence of heterogeneity in bacteria and cancer cells.
4. Moreno A, Carrington TJ, Albergante L, Al Mamum M, Haagensen EJ, Komseli E, Gourgolis VG, Newman TJ & Blow JJ, **Unreplicated DNA remaining from unperturbed S phases passes through mitosis for resolution in daughter cells**, 2016, PNAS; 113 (39) E5757-E5764 – In this article, I develop the bioinformatics pipeline to study the binding profile of 53BP1 using ChIp-Seq data. I also develop the necessary computational tools to explore the connections between this profile and the prediction of a mathematical model of DNA replication. The article

highlights the strong connection of 53BP1 with unreplicated DNA and shows how the propensity of different genomic areas to present DNA replication problems can be theoretically predicted.

5. Al Mamum M & Albergante L, Moreno A, Blow JJ, Newman TJ, **Inevitability and containment of replication errors as eukaryotic genome sizes increase from Megabase to Gigabase**, 2016 PNAS; 113 (39) E5765-E5774 – In this article, I contribute to the development of a mathematical model of DNA replication errors based on probability theory and I develop the necessary computational and statistical methods to test the predictions of the model using genomic data. The article shows how DNA replication is optimized to limit the number of replications errors, which are shown to be almost inevitable in human cells.
6. Albergante L, Liu D, Palmer S, Newman TJ, **Insights into Biological Complexity from Simple Foundations**, 2016, in M.C. Leake (ed.), Biophysics of Infection, Advances in Experimental Medicine and Biology 915.
7. Dayal JHS & Albergante L, Newman TJ, South A, **Quantitation of multiclonality in control and drug-treated tumour populations using high-throughput analysis of karyotypic heterogeneity**, 2015, Convergent Science Physical Oncology; 1(2):025001 – In this article, I use image analysis on spectral karyotypes in combination with multidimensional statistics to study the heterogeneity of cancer cell lines before and after a drug treatment.
8. Albergante L, Blow JJ & Newman TJ, **Buffered Qualitative Stability explains the robustness and evolvability of transcriptional networks**, 2014, eLife; 3:302863 – In this article, I use mathematical modelling, network theory and statistical data analysis to study the robustness of gene networks. The article shows how robustness is able to explain many topological features of gene networks and highlighted the peculiar structure of gene regulation in cancer. A press release for this article is available here: <http://bit.ly/1T9yoH1>
9. Tinti M, Dissanayake K, Synowsky S, Albergante L, MacKintosh C, **Identification of 2R-ohnologue gene families displaying the same mutation-load skew in multiple cancers**, 2014, Open Biology; 4(5):140029 – In this article, I develop a statistical approach to study a peculiar bias in gene mutations observed across different cancers. This bias can be explained using an evolutionary perspective that stresses the importance of non-mutated genes for the survival of cancer cells. A press release for this article is available here: <http://bit.ly/23JOHue>
10. Albergante L, Timmis J, Beattie L, Kaye PM, **A Petri net model of granulomatous inflammation: implications for IL-10 mediated control of *Leishmania donovani* infection**, 2013, PLoS Computational Biology; 9(11):e1003334 – In this article, I present the analysis of a Petri net model that I developed to study experimental visceral leishmaniasis in the liver. The model integrates biological data obtained from various sources and is extensively studied with statistical and computational approaches. The predictions of the models shed light on the dynamics of the infection and suggest new immune-based therapeutic options.
11. Albergante L, **Automatic Management of Forums via Artificial Immune Systems**, 2011, International Journal of Autonomous and Adaptive Communications Systems (IJAACS), Vol. 4, No. 2 – In this article, I present an immune-inspired algorithm that allows forums to self-manage.
12. Albergante L, Timmis J, Andrews PS, Beattie L, Kaye PM, **A Petri Net Model of Granulomatous Inflammation**, 2010, in Hart E, McEwan C, Timmis J, Hone A, eds., International Conference on Artificial Immune Systems (ICARIS), Vol. 6209 of Lecture Notes in Computer Science, Springer, pp. 1–3.
13. Albergante L, **Wireless Discussion Forums: Automatic Management via Artificial Immune Systems**, 2008, International Symposium on Performance Evaluation of Computer and Telecommunication Systems, 2008. (SPECTS 2008), pp. 74–81.

PUBLICATIONS UNDER REVIEW - “&” DENOTES EQUAL CONTRIBUTION

14. Albergante L, Mirkes EM, Chen H, Martin A, Faure L, Barillot E, Pinello L, Gorban AN, Zinovyev A, **Robust and scalable learning of complex dataset topologies via ElPiGraph**, 2018, arXiv, This article present ElPiGraph, a flexible tools to discover complex trajectories in data that I developed in collaborations with theoretical and computational colleagues. Extensive examples are presented in the context of biology and astronomy
15. Chen H, Albergante L, Hsu JY, Lareau CA, Lo Bosco G, Guan J, Zhou S, Gorban AN, Bauer DE, Aryee MJ, Langenau DM, Zinovyev A, Buenrostro JD, Yuan GC, Pinello L, **STREAM: Single-cell Trajectories Reconstruction, Exploration And Mapping of omics data**, 2018, bioRxiv, This article present STREAM,

powerful tool to discover trajectories in single cell data and to explore their biological significance. I contributed to the development of STREAM by developing key parts of the trajectory discovery procedure.

16. Liu D, Albergante L, Horn D, Newman T. **A VSG Hierarchy During African Trypanosome Infections: A Feint Attack By Parasites**, 2017, bioRxiv, In this article, I contribute to develop a statistical approach to study the cellular processes that contribute to the heterogeneity of variant surface glycoproteins (VSG) during an infection.

POSTERS PRESENTATIONS

1. Albergante L, Gorban A, Zinovyev A, Barillot E, **Complex data structure discovery and analysis of large biological datasets via ELPiGraph**, 2018, 26th Conference on intelligent Systems for Molecular Biology (ISMB2018), Chicago, USA
2. Albergante L, Gorban A, Zinovyev A, Barillot E, **Complex data structure discovery and analysis of large biological datasets via ELPiGraph**, 2018, Single-Cell Revolution (BITS2018), Turin, Italy
3. Albergante L, Gorban A, Zinovyev A, Barillot E, **Single cell transcriptional dynamics reconstruction via manifold learning with Elastic Principal Graphs (ELPiGraph)**, 2017, Single Cell Analyses, Cold Spring Harbor Laboratories, Cold Spring Harbor, USA
4. Albergante L, Gorban A, Zinovyev A, Barillot E, **Transcriptional dynamics reconstruction via single cell transcriptomics and principal graphs**, 2017, Single Cell Genomic Workshop, Institut du Cerveau et de la Moelle épinière (ICM), Paris, France
5. Albergante L, Zinovyev A, Barillot E, **Cell cycle characterization and discovery using principal graphs**, 2017, Keystone Simposia – Single Cell Omics (E3), Stockholm, Sweden
6. Liu D, Newman TJ, Albergante L, Newman TJ, **Universal attenuators and their interactions with feedback loops in gene regulatory networks**, 2016, ISCB Latin America, Buenos Aires, Argentina
7. Liu D, Albergante L, Newman TJ, **A modular view of gene regulatory networks: universal attenuators and feedback loops**, 2016, Advanced Lecture Course on Systems Biology (SysBio), Innsbruck, Austria
8. Liu D, Albergante L, Newman TJ, **A modular view of gene regulatory networks: universal attenuators and feedback loops**, 2016, Topical Research Meeting - Physical Principles of Biological and Active Systems, University of Edinburgh, Edinburgh, UK
9. Barfoot S, Albergante L, Wilkinson CM, **Craniofacial Sexual Dimorphism in Southeast Asia: Assessing the Viability of 11 Craniometric Measurements for Sex Determination in Archaeological Context**, 2016, For the love of death: Human Osteoarchaeology in Southeast Asia and the Pacific, University of Philippines, Quezon City, Philippines
10. Donnelly L, Meadows H, Albergante L, Black S, **A novel methodology for regional superficial pattern quantification on the hand dorsum**, 2015, The Anthropology of Hands Conference, University of Kent, Canterbury, UK
11. Al Mamun M, Albergante L, Moreno A, Blow JJ, Newman TJ, **From yeast to human: evolutionary transition of DNA repair for larger genomes**, 2015, College of Life Sciences Research Symposium, Crieff, UK
12. Stratton H, Albergante L, Meadows H, Black S, **Dorsal hand feature analysis: An aid to forensic human identification**, 2014, Scottish student forensic research Symposium, University of Strathclyde, Glasgow, UK (1st prize winner)
13. **Vein pattern quantification using network analysis: An investigation of spatial regions of the hand dorsum for forensic utility**, 2014, Scottish Student Forensic Research Symposium. University of Strathclyde, Glasgow, UK
14. Liu D, Albergante L, Newman TJ, **Long transcriptional cascades may contribute to regulation of heterogeneity and plasticity in microorganisms and cancer**, 2014, College of Life Sciences Research Symposium, Crieff, UK
15. Albergante L, Blow JJ & Newman TJ, **How gene networks tick: the BQS theory of evolvable robustness**, 2013, College of Life Sciences Research Symposium, Crieff, UK
16. Albergante L, Blow JJ & Newman TJ, **Robustness and evolvability determine the structure of transcriptional networks**, 2013, 5th Annual SULSA Conference, Edinburgh, UK.
17. Stratton H, Albergante L, Meadows H, Black S, **Dorsal hand feature analysis: An aid to forensic human identification**, 2013, International policing conference, Scottish Institute for police research, Edinburgh, UK
18. Stratton H, Albergante L, Meadows H, Black S, **Dorsal hand feature analysis: An aid to forensic human**

identification, 2013, Poster session for 2nd year PhD Students, College of Life Sciences, University of Dundee, Dundee, UK

19. Stratton H, Albergante L, Meadows H, Black S, **Dorsal hand feature analysis: An aid to forensic human identification**, 2013, International policing conference, Scottish Institute for police research, Edinburgh, UK
20. Stratton H, Albergante L, Meadows H, Black S, **Dorsal hand feature analysis: An aid to forensic human identification**, 2013, Winter meeting of the “British association for human identification”, Manchester, UK (1st prize winner)

INVITED TALKS

1. **Reconstructing gene dynamics via single-cell snapshot data**, 2018, Journées Scientifiques & Médicales de l’Institut Curie, Institut Curie, Paris, France
2. **Finding a way into biology with manifold learning**, 2017, Peter Kharchenko Group, Harvard Medical School, Boston, USA
3. **Single cell data analysis methodology: overdispersion, pseudotime, deconvolution and beyond**, 2017, Single Cell Genomic Workshop, Institut du Cerveau et de la Moelle épinière (ICM), Paris, France
4. **Characterising transcriptional programs in high-dimensional space using principal graphs and single-cell RNA-Seq**, 2017, ABS4NGS meeting, AgroParis Tech, Paris, France
5. **Robustness and evolutionary optimization in cell survival: examples from gene regulation and DNA replication**, 2016, Department of Mathematics, University of Dundee, UK
6. **Robust design of biological processes**, 2016, Institut Curie, Paris, France
7. **Network robustness of biological Systems: from genes to cells**, 3rd journée Bio & Math sur la Montagne, 2015, Collège de France, Paris, France
8. **Uncovering cancer heterogeneity via computer-assisted karyotyping**, Dundee Medical Image Analysis Workshop, 2015, University of Dundee, UK
9. **Network biology: finding simplicity beneath complexity**, 2014, University of York, UK
10. **Robustness in interaction systems: lessons from biology**, 2014, School of Computing, University of Dundee, UK
11. **The three R's of biology: Robustness, Randomness and Recognition**, 2014, Third Systems Biology Workshop, University of Dundee, UK
12. **Robustness and evolvability explain the structure of genetic networks**, 2014, Biomathematics Seminar, Imperial College, London, UK
13. **Buffered Qualitative Stability explains why transcriptional networks are robust and evolvable**, 2013, Quantitative Methods in Gene Regulation, Cambridge, UK
14. **Robustness and evolvability determine the organization of transcriptional networks**, 2013, 14th International Conference on Systems Biology (ICSB2013), Copenhagen, Denmark
15. **How gene networks tick: the BQS theory of evolvable robustness**, 2013, Second Systems Biology Workshop, University of Aberdeen, UK
16. **Duality Between Data and Process: an Enriched Categorical Point of View**, 2010, International Category Theory Conference (CT2010), Genoa, Italy.
17. **Granuloma formation in Leishmaniasis: a complex immunological response**, 2010, University of York, York, UK.
18. **How Conscious Can the Immune System Be?**, 2010, 8th European Conference on Philosophy and Computing (E-CAP 2010). Contributing author. Presented by C Porcelluzzi.
19. **Identity in the Real World**, 2009, 7th European Conference on Philosophy and Computing (E-CAP 2009). Presented with M Casu.

REVIEWING

I reviewed articles for *PLOS One*, *Computation*, *Natural Computing*, and *Multiscale Modeling and Simulation*. I also wrote for the British Society for Cell Biology (BSCB) Newsletter.

LANGUAGES

Italian	Excellent (Mother tongue).
English	Excellent. Excellent proficiency in spoken and written English.
French	Intermediate. Intermediate knowledge of spoken and written French.
Spanish	Basic. Basic knowledge of spoken and written Spanish.
Japanese	Basic. Basic knowledge of spoken and written Japanese.

THESIS SUPERVISION/CONTRIBUTION

2017-2018	Supervisor of Louis Faure (MSc). As supervisor I provided guidance on the analytical approaches to study single cell data. Especially in the context of pseudotime analysis.
2013-2016	Statistical, mathematical and statistical supervision of the PhD projects of Rana Al Mamun and of Dianbo Liu. Both projects involved the combination of mathematical modelling, computational simulations and statistical data analysis to explore complex biological processes such as DNA replication and gene regulation.
2013-2015	Supervision of network analysis of the veins pattern on the hand for the projects of Harriet Stratton (PhD thesis) and of Lindsay Donnely (MSc thesis). The project of Harriet Stratton was shortlisted for the Research Project of the Year category of the Times Higher Education Award (2014) and was awarded the Queen's anniversary prize for higher and further education (2013/2014).
2009	Co-Supervisor for Marco Frank (B.Sc. thesis in Italian), DRM and cryptographic methods: a reasoned review. Computer science curriculum, University of Milan.

TEACHING

2018	Transcriptomique et épigénomique en cellule unique: théorie et pratique (sincellTE / Ecole thématique CNRS) , Lecturer (Pseudotime reconstruction and cell cycle), Station Biologique Roscoff, Roscoff, France (graduate course – 3 hours).
2017	Modélisation et ingénierie pour les systèmes biologiques , Lecturer (Design principles of biological networks), Institut de Technologie et d'innovation, PSL Research University Paris, France (graduate course – 4 hours).
2017	Research Methods (CA32002) , Lecturer (Workshop: applied statistics with R), Forensics and anatomy curriculum, University of Dundee, UK (Undergraduate course – 2 hours).
2016	Research Methods (CA32002) , Lecturer (Workshop: applied statistics with R), Forensics and anatomy curriculum, University of Dundee, UK (Undergraduate course – 2 hours).
2015-2016	Research Methods (CE50028) , Lecturer (Applied statistics with Excel workshops), Civil engineering curriculum, University of Dundee, UK (Undergraduate course – 25 hours).
2015	Research Methods (CA32002) , Lecturer (Workshop: applied statistics with R), Forensics and anatomy curriculum, University of Dundee, UK (Undergraduate course – 2 hours).
2015	Statistical Data Analysis: a Primer , Lecturer (Computational statistics and data analysis with R), Forensics and anatomy curriculum, University of Dundee, UK (Graduate course – 15 hours).
2014	A Primer in Statistics for Researchers , Lecturer (Computational statistics and data analysis with R), Forensics and anatomy curriculum, University of Dundee, UK (Graduate course – 9 hours).
2010-2011	Mathematical and statistical methods , Lecturer (Introduction to probability theory and statistics), Biology curriculum, University of Milan, Italy (Undergraduate course – 40 hours).
2010-2011	Algorithms , Lecturer (Algorithm design and implementation in MATLAB, essential bioinformatics, computational intelligence approaches), Mathematics curriculum, University of Milan, Italy (Undergraduate and graduate course – 44 hours).
2008-2009	Algorithms , Lecturer (Algorithm design and implementation in C), Mathematics curriculum, University of Milan, Italy (Undergraduate course – 24 hours).
2007-	Algorithms , Lecturer (Algorithm design and implementation in C), Mathematics curriculum,

- 2008 University of Milan, Italy (Undergraduate course – 24 hours).
 2007- **Cryptography**, Teaching assistant, Computer science curriculum, University of Milan, Italy
 2008 (Graduate course – 10 hours).
 2007- **Information theory**, Teaching assistant, Computer science curriculum, University of Milan, Italy
 2008 (Graduate course – 6 hours).

TECHNICAL SKILLS

- Programming and Algorithm Design** I have an extensive experience in analyzing and designing single processor, parallel and distributed algorithms. I have a theoretical and practical knowledge of various general-purpose and scientific-oriented programming languages (C, C++, Java, R, python, and MATLAB). I have an advanced knowledge of R as a tool for (bio)statistics, data analysis, simulations and interactive interface design (via Shiny). I have teaching experience with C, MATLAB and R. I have experience using version control systems (GitHub) and virtual machine deployment (Docker).
- Applied Statistics / Machine Learning** I have a theoretical and practical knowledge of various statistical and machine learning techniques, including univariate and multivariate statistics, A/B testing, supervised and unsupervised clustering, manifold learning, feature selection, and regression. I have teaching experience in theoretical and computational statistics, and experience in designing and delivering applied statistics courses using R and Excel.
- Mathematical Modeling** I have a theoretical and practical knowledge of various mathematical and computational techniques to build and validate models, including Markov processes, UML, differential equations, agent-based modeling, Petri nets, and sensitivity analysis.
- Biostatistics and Biological Data Analysis** I have an extensive theoretical and practical knowledge of analysis (e.g. via bash and R) and visualization (e.g., via ggplot) of large biological big data. I have been analyzing images, bulk and single cell genomic data, molecular data, and epidemiological data.
- Databases** I have a theoretical and practical knowledge of SQL and database development in both Oracle and MySQL.
- Networking** I successfully passed the CISCO System Network Academy (CSNA) and I have a theoretical and practical knowledge of network configuration management (with CISCO and SOHO appliances).

OTHER WORK EXPERIENCE

- 2015-2016 **Graphic designer**. I designed the poster for a number of international art exhibitions organized in Milan, Roma and Florence.
- 2014 **Translator**. RAW: Pictures from liquid days by Corradi C., curated by Mola A.; 2014, Ed. Blurb
- 2010-2011 **Web Programmer**. Freelance web programmer on PHP/MySQL architectures.
- 2007-2009 **ICT Manager**, Servizi e Consulenze Doganali di Albergante Glauco & C. s.a.s. Manager of the computer infrastructure of a SOHO company working in international transports.
- 2004 **Cisco System Networking Academy (CSNA)**, Department of Computer Science, Università degli Studi di Milano (Milan, Italy).
- 2001-2002 **Office Employee**, Servizio Istruzione e Formazione Professionale del Comune di Novara. Office worker in the Education Offices of the municipality of Novara