Kristina **ULICNA**

PhD in Computational Biology

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PhD Project Summary

Theme: **Quantitative labelling of single-cell trajectories in time-lapse microscopy**

1. *Trajectory reconstruction & lineaging*
   - Co-developed a robust, supervision-free, deep learning-based cell tracking pipeline for deep lineage analysis of live-cell microscopy 2D cell lines data
   - Analysed multi-generational lineage trees of >20k single-cell trajectories to interpret proliferation characteristics predisposing cells to fast divider rates
2. *Track representation & interpretation*
   - Generated an explainable AI model to learn dynamic image representations & interpretable latent space features to map similarities of cell cycle continuity
   - Transformed a sequence of image representations into an unsupervised trajectory annotation, classifying cell cycle phases & quantitative confidence scoring over time

Computational Skills

Strongest programming language: ***Python***

Experience with deep learning strategies, bioimage analysis & computer vision apps

- ***Fully supervised:*** U-Net, ConvNet, TCN
- ***Weakly supervised:*** multiple-instance
- ***Self-supervised:*** generative (VQ-) VAEs
- ***Unsupervised:*** hierarchical clustering
- ***Dimensionality reduction:*** PCA, UMAP

Skilled in image representation learning & time-sequence trajectory data analysis

- ***Machine learning libraries:*** skimage, sklearn, pytorch (lightning & geometic)
- ***Standard & scientific libraries:*** numpy, scipy, matplotlib, networkx, napari

Experienced in **software design** (virtual envs, git-based version control, iPython)

Laboratory Skills

- DNA sequencing data readout analysis
- Molecular biology & vector construction
- Cell-based assays & imaging platforms
- Cell / gene engineering & tissue culture
- Gene expression detection methods

Summary

*As a **Research Associate** at The Alan Turing Institute, I apply my **deep learning & bioimage analysis skills** across multi-disciplinary projects combining cell biology, computational single-cell tracking & **interpretable AI/ML**. I focus on **Python development** for time series image data analysis to identify **meaningful biological patterns** controlling cell cycle & fate. As a practical & detail-oriented scientist with **biomedical background**, I have demonstrated my **research & leadership skills** in individual & collective settings, gained via work experience in **academic biomedical research** groups, leading **technological companies** & through **community projects**.*

Education

Oct 2018 – Dec 2022 — **PhD in Biosciences, BBSRC LIDo DTP Programme, UCL** | London, UK
- Fully-funded doctoral thesis: 'Machine Learning for Single-Cell Trajectory Analysis'
- Advisors: Drs Alan Lowe & Guillaume Charras | Defended Feb 2023; no corrections
- 3x merit-based scholarships: *Yale School of Medicine, Tatra Bank Research Grants*

Sep 2014 – Jul 2018 — **BSc Biomedical Science (Hons), King's College London** | London, UK
- First Class Hons **(76%)** *Biomedical Science with Molecular Biology Extramural Year*
- Awards & Scholarships: *Desmond Tutu Scholarship '14, Best Lay Article Award '15*

Industrial & Academic Experience

Feb 2023 – Present — **Research Associate @ The Alan Turing Institute** | London, UK
- Co-developing graph representation analysis for connected embeddings (GRACE) for automated object identification of structural patterns in (bio-)imaging datasets
- Built an explainable, autoencoder-driven image representation learning framework for dynamic single-cell trajectory analysis for self-supervised cell cycle annotation
- ***"Best Poster Award"*** at 2023 ICML Comp Bio Workshop, sponsored by CZI & GSK

Apr 2021 – Sep 2021 — **Research Intern @ Microsoft Research Cambridge** | Cambridge, UK
- Developed an AI-based end-to-end pipeline to classify subcellular protein localisation from Human Protein Atlas' Kaggle dataset of weakly labelled microscopy images
- Trained a competitively-performing model, co- evaluated as best off-chart approach

Sep 2016 – Aug 2017 — **Industrial Trainee @ Crescendo Biologics Ltd.** | Cambridge, UK
- Engineered a novel, universal tool cell line for early drug discovery, i.e. phage display selection & functional screening of antibody fragment onco-therapeutics

Jun 2016 – Sep 2016 — **Cancer Research UK Intern @ Cambridge University** | Cambridge, UK
- S. Bohndiek Lab: Characterised anti-angiogenic drug effects via breast cancer cell-based growth, viability assays to evaluate oxygen role in cancer progression

Jun 2015 – Aug 2015 — **Visiting Scholar, Whitehead Institute @ MIT** | Cambridge, MA, USA
- R. Weinberg's Lab: Investigated determinants of cancer cell invasion, metastasis & tumour stroma immunomodulation upon epithelial-to-mesenchymal transition

Teaching & Outreach Experience

Nov 2023 — **Guest Lecturer, Data Science @ UCL STAT0042 module** | London, UK
- Co-designed iPython practical sessions for 70+ undergraduates to introduce common bioinformatics concepts in bioimage analysis to train a cell state classifier

Mar 2020 – Mar 2022 — **Graduate Teaching Assistant @ UCL BIOC0016 module** | London, UK
- Co-designed iPython practical sessions for 70+ undergraduate students to introduce concepts in bioimage analysis & bioinformatics to train an ML cell state classifier

Sep 2021 – May 2022 — **Master's Student Daily Supervisor @ UCL** | London, UK
- Directly supervised a Biochemistry Masters student's to develop an AI-driven cell segmentation tool from microscopy datasets via research guidance & references

Jan – Dec 2021 — **Google Certified Trainer for AI Tech & Tools** | Bratislava, Slovakia
- Empowering non-tech professionals by leveraging their expertise & leadership in AI technical field via AI-basics talks & workshops with Google Slovakia outreach team

May – Jun 2021 — **"Smart Microscopy" Workshop @ ZEISS** | Gothenburg, Sweden
- Trained 30+ intermediate-level attendees at "Train Your Own Model" hands-on workshop session to use python image analysis tools to annotate cell imaging data

May - Jun 2020 — **"Introduction to Deep Learning" @ UCL Cancer Domain** | London, UK
- Delivered beginner-friendly masterclass series for 100+ interdisciplinary scientists with real-life examples of deep learning-based bioimage analysis from PhD project

Awards & Scholarships

- 2023 **"Best Poster Award"** @ ICML Computational Biology Workshop
- 2023 ICML **Complimentary Registration** by Women in Machine Learning (WiML)
- 2022 **"Best Chalk Talk"** @ Marie Curie Summer School of Cell Biology & Cancer
- 2022 Full **Travel Grant Scholarship** for EMBO PhysCell2022 by LIDo Consortium
- 2021 **30 under 30** @ *Forbes Slovakia*
- 2019 **European Union** Council Delegate
- 2019 **Travel Grant:** *Students to the World*
- 2019 **Travel Grant:** *Talents of New Europe*
- 2017 **United Nations** Assembly Delegate
- 2017 **GSK Healthcare** STEM Awardee

Specialist Trainings

- 2022 **Advanced Science Institute, Rabat, Morocco** | 'AI for (Bio)Science' workshop
- 2022 **Weizmann Institute of Science, Tel Aviv & Ein Gedi, Israel** | EMBO PhysCell
- 2022 **Institute Curie & Sorbonne Université, Paris, France** | 'International course of Cell Biology & Cancer | Science & Life'
- 2019 **Hong Kong University** | 'Advanced Imaging: Deep Learning for Cell Biology'
- 2019 **University of Genova, Italy** | 'Deep Learning Crash Course' into ML theory
- 2016 **University of Cambridge** | 'Solving Biological Problems with Stat's Approach'
- 2012 **Johns Hopkins University, Baltimore, MD, USA** | Centre for Talented Youth's class 'The History of Disease'

Language Skills

Slovak — native proficiency

Czech — bilingual proficiency

English — full professional proficiency

IELTS & iBT TOEFL language test certificates

German — limited working proficiency

High-school certificate; German evening classes

Science Popularisation

- 2023 **Pint of Science** Event | London, UK
- 2022 **Reflect Festival** "AI to improve Biomedical Sciences" talk | Limassol, Cyprus
- 2021 **"Zijem Vedu"** researcher interview
- 2020 **PyLadies Dublin** key note interview
- 2020 **StartItUp** research profile interview
- 2015 **Universal Expo Milano** | Milan, Italy
- 2014 **Intel ISEF Finals | Los Angeles, USA**
- 2013 **Global Scholars Programme** @ ALA | Johannesburg, South Africa
- **2013 International Congress of Young Investigators | Zaragoza, Spain**

Leadership & Teamwork Experience

2019 – 2023 **Student Ambassador, LIDo PhD Programme @ UCL** | London, UK
- Outlined programme structure & shared own experience with new student cohorts
- Guided individual students through responsibilities with changing rotation projects

2016 – 2018 **University Mentor, Talent Guide @ LEAF** | Bratislava, Slovakia
- Counselled college choices with gifted high-schoolers & edited personal statements

2015 – 2017 **Jury Member, LEAF Award @ LEAF** | Bratislava, Slovakia
- Shortlisted self-driven, talented students with community involvement in jury team

Invited Talks

2023
Speaker | Howard Hughes Medical Institute (HHMI) Janelia Research Campus | Ashburn
Speaker | Crick BioImage Analysis Symposium (CBIAS) | The Francis Crick Institute
Speaker | Network of EU BioImage Analysts Symposium (NEUBIAS) | Porto, Portugal

2021
Speaker | Machine Learning Methods Advances | Recursion CytoData Society Meeting
Speaker | AI Microscopy Symposium | The Allen Institute for Brain Science | Seattle
Panelist | "See the Hidden": Future of AI in Microscopy Workshop | Leica Microsystems
Panelist | "Women in AI for Global Health" Session | Mozilla Festival Tech Conference

2020
Speaker | UCL BioImage Analysis Interest Group | Laboratory of Molecular Cell Biology
Speaker | Imperial College Brain Sciences Seminar | UK Dementia Research Institute
Speaker | Python Software Foundation Pro Network Meetup | #PyLadies Dublin 2020

Contributed Talks

2023
Speaker | Spotlight talk + poster @ ICML Comp Bio Workshop | Honolulu, Hawaii, USA
Speaker | 'Work-in-progress' spotlight @ CVPR CVMI Workshop | Vancouver, Canada

2022
Poster | 'AI for Science' Workshop @ Advanced Science Institute | Rabat, Morocco
Poster | EMBO Workshop: Physics of Cells (PhysCell Conf 2022) | Ein Gedi, Israel
Poster | Women in Machine Learning (WiML) Panel | ICML Conference Workshop
Speaker | The Crick Annual PhD Student Symposium | The Francis Crick Institute

2021
Speaker | Health Intelligence Lab | Internship project summary | Microsoft Research
Poster | Women in Machine Learning (WiML) Panel | NeurIPS Conference Workshop
Poster | Crick BioImage Analysis Symposium (CBIAS) | The Francis Crick Institute
Poster | Women in Data Science (WiDS) Worldwide Conference | Stanford University
Speaker | Virtual Seminars in Biomedical Science | Imperial College London

2020
Poster | London Stem Cell Network Annual Symposium | The Francis Crick Institute
Poster | Society of Biomolecular Imaging & Informatics High Content Conference
Speaker | UCL Institute of Structural & Molecular Biology Postgraduate Symposium

2019
Speaker | UCL Institute of Structural & Molecular Biology Friday Wrap | Uni of Birkbeck
Speaker | Quantitative Systems Biology Workshop | Strand, King's College London
Poster | UCL Biomedical Graduate Student Symposium | The Francis Crick Institute

Publications

Ulicna, K., Kelkar, M., Soelistyo, C.J., Charras, G.T. & Lowe, A.R. (**2023**). *Learning dynamic image representations for self-supervised cell cycle annotation.* ICML Comp Bio Workshop. doi.org/10.1101/2023.05.30.542796 | ICML Comp Bio Workshop | BioRxiv | GitHub repository

Soelistyo, C.J., ***Ulicna, K.*** & Lowe, A.R. (**2023**). *Perspective: Machine learning enhanced cell tracking.* Frontiers in Bioinformatics, Expert Opinions in Computational Bioimaging | Frontiers

Ulicna, K., Ho, L.T.L., Soelistyo, C.J., Day, N.J. & Lowe, A.R. (**2022**). *Convolutional neural networks for classifying chromatin morphology in live cell imaging.* Methods in Molecular Biology, Chromatin Architecture, Springer Nature Protocols | Springer | GitHub repository

Ulicna, K., Vallardi, G., Charras, G. & Lowe, A.R. (**2021**). *Automated deep lineage tree analysis using a Bayesian single cell tracking approach.* Frontiers in Computer Science, Computer Vision: Methods & Tools for Bioimage Analysis | Frontiers | BioRxiv | GitHub repository