Kristina **ULICNA**

PhD in Computational Biology

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PhD Project Summary

Theme: **Quantitative following 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 & temporal landscape visualisation of diverse cell fates

Directly supervised a Masters student's project to develop an AI-driven cell segmentation tool from microscopy datasets

Computational Skills

Strongest programming language: ***Python***

Experience with deep learning strategies for image analysis & computer vision apps

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

Skilled in "image2seq" representations & time-sequence trajectory data analysis

- ***Machine learning libraries:*** skimage, sklearn, torch, pytorch lightning, pytorch geometric, btrack, arboretum
- ***Standard & scientific libraries:*** numpy, scipy, pandas, matplotlib, seaborn, h5py, networkx, napari, dtaidistance

Experienced in **conda** envs, **GitHub** (git), **LaTeX** (overleaf), **iPython** (jupyter & colab)

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-developed 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

Apr 2021 – Sep 2021 — **Research Intern @ Microsoft Research Cambridge** | Cambridge, UK
- Developed an AI-based end-to-end pipeline to classify subcellular protein localisation in single cells from Human Protein Atlas' Kaggle dataset of weakly labelled microscopy images using Azure computing & InnerEye Deep Learning OS toolkit
- Trained a competitively-performing model (MIL / SimCLR & BYOL methodology) in collaboration with competition organisers evaluated as best approach off-chart

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, USA
- R. Weinberg's Lab: Investigated determinants of cancer cell invasion, metastasis & tumour stroma immunomodulation upon epithelial-to-mesenchymal transition

Teaching & Outreach Experience

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

Jan – Dec 2021 — **Google Certified Trainer for AI Tech & Tools** | Bratislava, Slovakia
- Empowering non-tech professionals by leveraging their expertise & leadership in AI tech 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 (bio-)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

Leadership & Teamwork Experience

Sep 2019 – Feb 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

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

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

Awards & Scholarships

- 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
- 2014 *'Absolute Winner at the Festival of Science & Technology'* @ AMAVET
- 2013 *'The Special Award by the Dean of the Faculty of Natural Sciences'*

Science Popularisation & Lay Audience Engagement

- 2023 **Pint of Science** Event | London, UK
- 2022 **Reflect Festival** | Limassol, Cyprus
- 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**

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

Hobbies & Interests

- Ballroom dancing; standard & Latin style (UK national partner competitions level)
- Bachata & salsa social dancing (int/adv)
- Long-distance running (half-marathons)
- Playing tennis (competitively at school)

Press Releases

- 2022 **Reflect Festival** "AI for Science" talk
- 2022 **Forbes Slovakia** laureate survey
- 2021 **Forbes Slovakia** 30 under 30 chart
- 2021 **"Zijem Vedu"** researcher interview
- 2020 **PyLadies Dublin** key note interview
- 2020 **UCL Cancer Domain** masterclass
- 2020 **StartItUp** research profile interview

General

- Member of the University of London DanceSport Society (active competitor)
- Member of London Stem Cell Network
- Member of British Pharmacol Society
- EU / Slovak driving licence | *B type*

Specialist Trainings & Summer Schools

Dec 2022 — **Moroccan Advanced Science Institute** | Rabat, Morocco
- 'AI for Science' Workshop with poster presentation to research industry sponsors

Sep 2022 — **Weizmann Institute of Science** | Rehovot, Israel
- 'International School of Biological Physics of Cells', part of EMBO PhysCell 2022

Apr 2022 — **Institut Curie & Sorbonne Université** | Paris, France
- 'International course of Cell Biology & Cancer' with the 'Science & Life' workshop

Dec 2020 — **Jumping Rivers Ltd.** | London, UK
- Two intermediate courses: *'Machine Learning with Python'*, *'Python & Tensorflow'*

Aug 2019 — **University of Hong Kong** | Hong Kong
- Practical course *'Advanced Imaging: Deep Learning in Live Imaging & Cell Biology'*

Jun 2019 — **University of Genova** | Genova, Italy
- *'Machine Learning Crash Course'* covering theoretical foundations & core concepts

Sep 2016 — **University of Cambridge** | Cambridge, UK
- Two beginners courses: *'Solving Biological Problems'*, *'Statistical Analysis'* using *R*

Jun - Jul 2012 — **Johns Hopkins University** | Baltimore, USA
- Interactive class *'The History of Disease'* by Centre for Talented Youth (CTY JHU)

Invited Talks

2023
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, US
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

Contributed Talks

2023
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 @ Birkbeck Univ.
Speaker | Quantitative Systems Biology Workshop @ King's College London
Poster |. UCL 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.* bioRxiv 2023.05.30.542796; doi: https://doi.org/10.1101/2023.05.30.542796 | BioRxiv | GitHub repository (under review)

Soelistyo, C.J., ***Ulicna, K.*** & Lowe, A.R. (**2023**). *Perspective: Machine learning enhanced cell tracking.* (under review)

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