I am a PhD student in computer vision who is passionate about theory and practice. I have five years of computer vision experience in industry, and in my PhD, I am applying computer vision techniques to digital pathology to improve the quality of cancer prognoses based on medical images. My research interests include weakly supervised learning, self-supervised learning, and vision-language models. I am always excited to work on new problems, not only by developing new deep learning models, but also seeing that they are deployed efficiently and have real-world impact.

Education

since Aug 2021 Doctor of Philosophy (PhD), Computer Science, University of St Andrews, Scotland.

My PhD is under the supervision of Dr Ognjen Arandjelović and lies at the intersection of deep learning and computer vision for computational pathology, funded by the NHS.

Sep 2017 – Jun 2021 Master in Science (MSci), Computer Science, University of St Andrews, Scotland.

(2nd year direct entry) First-Class Honours, GPA: 95%

Master's thesis: "Determining chess game state from an image" (grade: 20.0/20).

Honours level courses include machine learning, AI principles & practice, language & computation, data-intensive systems, information visualisation, concurrency & multi-core architectures, constraint programming, software architecture, software engineering, complexity, OS, databases, data encoding, component technology, logic, software verification, compiler design & implementation.

2005 – 2017 International Baccalaureate and Abitur, Dresden International School, Germany.

IB Diploma: 40 points, German Abitur: 1.3

Valedictorian. Higher level subjects: maths, physics, computer science.

Experience

Jul-Sep 2023 Research Intern, Else Kröner Fresenius Center for Digital Health (EKFZ), Dresden, Germany During an internship at Prof Jakob Kather's Clinical AI research group at EKFZ for Digital Health (part of Dresden University of Technology), I developed a novel multi-zoom deep learning model for whole slide image classification, performed an extensive benchmarking study of self-supervised feature extractors for histopathology, and participated in various other projects including a study assessing the use of LLMs in oncology. Papers are currently in preparation.

Jan-Mar 2023 PhD Placement, Lay Summaries Ltd, Glasgow, Scotland

Developed a NLP pipeline for automating the generation of lay summaries of EU clinical trials in a part-time PhD placement funded by The Data Lab.

May 2018 – May 2022

Working Student - Computer Vision, Robotron Datenbank-Software, Dresden, Germany Gained practical experience in deep learning and software engineering by developing deep learning models and deploying them to production in the Realtime Computer Vision (RCV) department.

- O Designed and implemented containerised infrastructure for automatically training, evaluating, and deploying TensorFlow and PyTorch models for industrial use cases.
- O Selected and trained deep learning models for various industrial use cases, including a system for a car manufacturer that reduced the error rate of detecting faulty parts by 90%.

Jun-Aug 2019 Software Engineering Intern, J.P. Morgan, Glasgow, Scotland

Developed a data visualisation and reporting dashboard for an automated testing framework using Python, React, TypeScript, and SQL that gave the team new insights. Gained hands-on experience with Scrum, working in a team, and prioritising requirements from different stakeholders.

Skills

Programming Python, C/C++, Java, SQL, JavaScript, TypeScript, Haskell, C#, LATEX

Technologies PyTorch, TensorFlow, Keras, JAX, Docker, Dask, Apache Spark, mongodb, Postgres, React

Languages German, English (mother tongue); French (B1)

Prizes and awards

2020 Adobe Prize (£750) for the highest GPA in Senior Honours Computer Science

2018 - 2021 4x Dean's List Award of Academic Excellence at the University of St Andrews

2017 Valedictorian at Dresden International School; subject awards for maths and computer science

2010 – 2017 12x High Honour Roll (GPA over 6.0 of 7) at Dresden International School

Publications

Unpublished preprints

- 2023 G. Wölflein, D. Ferber, A. R. Meneghetti, O. S. M. El Nahhas, D. Truhn, Z. I. Carrero, D. J. Harrison, O. Arandjelović, and J. N. Kather, A good feature extractor is all you need for weakly supervised learning in histopathology, under review, 2023. (link)
 - **G. Wölflein**, L. C. Magister, P. Liò, D. J. Harrison, and O. Arandjelović, *Deep multiple instance learning with distance-aware self-attention*, under review, 2023. (link)

Conference papers

2023 **G. Wölflein**, I. H. Um, D. J. Harrison, and O. Arandjelović, "HoechstGAN: Virtual lymphocyte staining using generative adversarial networks," in *Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)*, Jan. 2023, pp. 4997–5007. (link)

Journal articles

- 2023 **G. Wölflein***, I. H. Um*, D. J. Harrison, and O. Arandjelović, "Whole-slide images and patches of clear cell renal cell carcinoma tissue sections counterstained with Hoechst 33342, CD3, and CD8 using multiple immunofluorescence," *Data*, vol. 8, no. 2, Feb. 2023. (link)
- 2022 R. De Filippis*, G. Wölflein*, I. H. Um, P. D. Caie, S. Warren, A. White, E. Suen, E. To, O. Arandjelović, and D. J. Harrison, "Use of high-plex data reveals novel insights into the tumour microenvironment of clear cell renal cell carcinoma," *Cancers*, vol. 14, no. 21, Nov. 2022. (link)
- 2021 G. Wölflein and O. Arandjelović, "Determining chess game state from an image," Journal of Imaging, vol. 7, no. 6, Jun. 2021. (link)

Abstracts

2023 D. Alouges, G. Wölflein, I. H. Um, D. Harrison, O. Arandjelović, C. Battail, and S. Gazut, Performance comparison between federated and centralized learning with a deep learning model on Hoechst stained images, ISMB/ECCB Abstracts, Jul. 2023

Datasets

- 2022 **G. Wölflein**, I. H. Um, D. J. Harrison, and O. Arandjelović, *Whole slide images and patches of clear cell renal cell carcinoma counterstained with multiple immunofluorescence for Hoechst, CD3, and CD8*, Biolmage Archive, Dec. 2022. (link)
- 2021 **G. Wölflein** and O. Arandjelović, *Dataset of rendered chess game state images*, Open Science Foundation, May 2021. (link)

Invited talks

Feb 2024 **Tissue Image Analytics (TIA) Centre, University of Warwick**A good feature extractor is all you need for weakly supervised learning in histopathology

Apr 2022 KATY EU Project

High-plex data reveal novel insights into the tumour microenvironment of clear cell renal cell carcinoma (with Raffaele De Filippis)

Selected projects and coursework

- 2021 Determining chess game state from an image, master's thesis, grade: 20.0/20
 - For my master's thesis, I developed a system for identifying the chess position from a photo of a chess game using deep learning and traditional computer vision techniques. The system improves the state of the art error rate by a factor of 23 and includes a one-shot transfer learning approach to adapt to an unseen chess set based on just two images.
- 2020 Recap: configuration management for reproducible research, Python package
- Research should be reproducible. Especially in deep learning, it is important to keep track of hyper-parameters and configurations used in experiments. I had to write similar configuration management code in several projects, so I created a Python package and published it on PyPI.

^{*}equal contribution

- 2020 Freeing neural training through surfing, SH project, grade: 19.0/20
 - For my undergraduate thesis, I investigated the local minimum problem in neural networks and developed a novel technique for training neural networks. Through this project, I developed independent research and academic writing skills whilst learning a lot about neural networks and machine learning. The report is available here, and a paper is currently in preparation.

Courses and training

- Mar 2023 Clinicum Digitale, *Dresden University of Technology*: attended a two-week interdisciplinary spring school on medicine and technology.
- Jun 2020 Deep Learning Specialisation, Coursera.
- May 2020 PyTorch for Deep Learning and Computer Vision, *Udemy*.
- Sep 2019 Mathematics for Machine Learning Specialisation, Coursera.
- Sep 2019 TensorFlow 2.0: A Complete Guide on the Brand New TensorFlow, *Udemy*.
- 2013 2014 C/C++ Course, Volkshochschule Dresden (Community College Dresden).

Volunteering

- 2021 2022 **Developmental squad representive**, *University of St Andrews Volleyball Club*I was elected to represent the recreational volleyball team within the committee and club decision-making process. This role helped me improve communication and organisational skills.
- 2018 2020 **Secretary**, *University of St Andrews Muscle and Athletics Sports Society (MASS)*As secretary of MASS, I was in charge of coordinating meetings, writing minutes, and taking care of administrative tasks. This position has helped me develop teamwork and organisational skills.
- 2010 2017 **Volunteer firefighter**, *Freiwillige Feuerwehr Possendorf*I am passionate about giving back to the community. Since age eleven, I was a youth fire fighter in my local fire department. In 2015, I completed the training qualification to become a member of the adult fire department, and participated in active service until I moved to Scotland in September 2017.

In my free time, I enjoy playing chess, volleyball, lifting weights, and improvising on the piano.