

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 a 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.  
(2<sup>nd</sup> 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-Oct 2024 **Research Intern**, *Google*, London, UK  
Evaluated the performance of FitBit's activity recognition model with respect to activity classes and demographic groups. Identified and quantified failure modes of the current model, analysed their causes, and provided actionable steps to improve the model.
- 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.
  - Designed and implemented containerised infrastructure for automatically training, evaluating, and deploying TensorFlow and PyTorch models for industrial use cases.
  - 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#, L<sup>A</sup>T<sub>E</sub>X
- Technologies PyTorch, Triton, TensorFlow, Keras, JAX, Docker, Dask, Apache Spark, Postgres, React
- Languages German, English (*mother tongue*); French (*B1*)

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## 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

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## Publications

### Under review

- 2024 D. Ferber, O. S. M. El Nahhas, **G. Wölflein**, I. C. Wiest, J. Clusmann, M.-E. Leßman, S. Foersch, J. Lammert, M. Tschochohei, D. Jäger, M. Salto-Tellez, N. Schultz, D. Truhn, and J. N. Kather, *Autonomous artificial intelligence agents for clinical decision making in oncology*, under review, 2024. ([link](#))
- D. Ferber, L. Hilgers, I. C. Wiest, M.-E. Leßmann, J. Clusmann, P. Neidlinger, J. Zhu, **G. Wölflein**, J. Lammert, M. Tschochohei, H. Böhme, D. Jäger, M. Aldea, D. Truhn, C. Höper, and J. N. Kather, *End-to-end clinical trial matching with large language models*, under review, 2024. ([link](#))
- D. Ferber, **G. Wölflein**, I. C. Wiest, M. Ligerio, S. Sainath, N. G. Laleh, O. S. M. El Nahhas, G. Müller-Franzes, D. Jäger, D. Truhn, and J. N. Kather, *In-context learning enables multimodal large language models to classify cancer pathology images*, under review, 2024. ([link](#))
- 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, *Benchmarking pathology feature extractors for whole slide image classification*, under review, 2024. ([link](#))
- 2023 **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

- 2024 O. S. M. El Nahhas, **G. Wölflein**, M. Ligerio, T. Lenz, M. van Treeck, F. Khader, D. Truhn, and J. N. Kather, "Joint multi-task learning improves weakly-supervised biomarker prediction in computational pathology," in *International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI)*, Oct. 2024. ([link](#))
- 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 pathology slide classification," in *European Conference on Computer Vision (ECCV)*, *Biolmage Computing Workshop* (oral), Springer, Sep. 2024. ([link](#))
- 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

- 2024 O. S. M. El Nahhas, M. van Treeck, **G. Wölflein**, M. Unger, M. Ligerio, T. Lenz, S. J. Wagner, K. J. Hewitt, F. Khader, S. Foersch, D. Truhn, and J. N. Kather, "From whole-slide image to biomarker prediction: End-to-end weakly supervised deep learning in computational pathology," *Nature Protocols*, Sep. 2024. ([link](#))
- D. Ferber, I. C. Wiest, **G. Wölflein**, M. P. Ebert, G. Beutel, J.-N. Eckardt, D. Truhn, C. Springfield, D. Jäger, and J. N. Kather, "GPT-4 for information retrieval and comparison of medical oncology guidelines," *NEJM AI*, vol. 1, no. 6, 2024. ([link](#))
- 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](#))

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\*equal contribution

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. ([link](#))

### 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*, BioImage Archive, Dec. 2022. ([link](#))

2021 **G. Wölflein** and O. Arandjelović, *Dataset of rendered chess game state images*, Open Science Foundation, May 2021. ([link](#))

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## 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 ([link](#))

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)

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## 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, achieving a 23× reduction in error rate compared to the previous state of the art. It also includes a one-shot transfer learning approach to adapt to an unseen chess set based on just two images. This project received 90+ stars on GitHub.

2020 **Recap: configuration management for reproducible research**, *Python package*



Research should be reproducible. Especially in deep learning, it is important to keep track of hyperparameters 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.

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 skills whilst learning a lot about the internals of neural networks. The report is available [here](#).

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## Courses and training

Dec 2023 Focus on Peer Review, *Nature Masterclasses*.

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)*.

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## Service

2024 Reviewer for *ECCV BIC*

## Volunteering

- 2021 – 2022 **Developmental squad representative, 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.