# PathLAKE Masterclasses 2021

## AI for Pathologists

WARWICK

PathLAKE
Computational Pathology Excellence

## ABSTRACT INFORMATION

### Day 1: Tuesday 18th May

| Time | Day 1 Session Abstracts |
|---|---|
| **13.30-13.45*** | **Welcome and Introduction to PathLAKE** |
| | **Nasir Rajpoot** (Warwick, UK) **&**<br>**David Snead** (UHCW NHS Trust, UK) |
| **13.45-14.25** | **Opening talks – CPath from a Pathologist Viewpoint (Part I)** |
| 13.45-14.00 | **Clare Verrill** (Oxford, UK)<br>*The potential for computational pathology to transform cellular pathology is great, but the challenges are also significant. In this talk we will describe the journey from zero to full digitisation of a cellular pathology laboratory and creating a digital pathology network. We will also describe building of proof of concept algorithms for urological cancer as part of the PathLAKE programme and what full NHS implementation of these and commercially available algorithms might look like.* |
| 14.00-14.15 | **Emad Rakha** (Nottingham, UK)<br>*Cancer tissue is not only different from normal tissue but it also carries lots of information that represent the underlying molecular profiles and determine the behaviour of the tumours. The introduction of artificial intelligence coupled with whole slide image technology have revolutionised the field of histopathology. The application of AI in breast pathology is attracting most attention and it is significantly expanding. AI in breast pathology can be applied to various domains including workflow management, diagnosis and classification of the disease and prognosis and prediction of the patient outcome and the response to therapy. We expect AI based algorithms to replace many costly assays that are routinely used in breast pathology, save pathologist time and improve efficiency of the service and accuracy of the pathology results leading to improvement in patients care.* |
| 14.15-14.25 | **Q&A** |

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| 14.25-15.30 | Flashtalks – Introduction to CPath (Part I) |
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| 14.25-14.37 | **AI for Breast Pathology**<br>**Inti Zlobec** (Bern, Switzerland)<br>*Ki-67 is an important biomarker for the clinical management of patients with breast cancer, but is prone to inter-observer variability.*<br>*Here, we compare the Ki-67 tumor scores from two classifiers (in-house with QuPath and a commercially available one) to ground truth counts, two pathologists' daily scores and a zero-click (no manual interaction) algorithm on 100 cases.*<br>*Results suggest excellent agreement for Ki-67 analysis with manual annotation of ROIs.*<br>*Areas for improvement of the fully automated one include optimization of the number and size of individual ROIs and removal of scan artefacts.* |
| 14.37-14.49 | **Intro to CPath & Issues with WSI processing**<br>**Lee Cooper** (Northwestern, USA)<br>*This talk will discuss fundamental topics in computational pathology (CPath) including image handling, viewing, annotation, and interactions between pathologists and CPath developers. We will present successful collaborations from our lab and talk about the opportunities for CPath to transform practice.* |
| 14.49-15.01 | **How to solve a CPath problem: Steps/workflow**<br>**Scott Doyle** (Buffalo, USA)<br>*In this talk, I will discuss some of the most important early-to-mid-stage considerations when approaching a computational pathology project, both from a scientific and a practical point of view. I will review some critical questions to ask when designing a project, drawn from my own experiences working with several collaborators across multiple institutions. By the end of this talk, attendees should have strategies in mind for how to avoid time- and resource-consuming setbacks in the early-to-mid phase of a CPath project, both from the "computational" and the "pathology" side of the project.* |
| 15.01-15.13 | **CPath for Head and Neck cancers**<br>**Ali Khurram** (Sheffield, UK)<br>*Head and Neck Cancers (HNC) are amongst the top 10 cancers in the world with rapidly increasing numbers and no improvement in patient survival for the last 30-40 years. This is partially related to the late diagnosis of these cancers as well as the heterogeneity seen within them. At present, there are no head and neck cancer specific biomarkers that can be used for patient stratification. Recent developments in digital pathology, artificial intelligence and machine learning have the potential to be a game changer and reveal new digital biomarkers of disease prognosis that can inform patient treatment. This talk will cover how computational pathology can aid diagnosis and even open sources software can objectively quantify and analyse features that may be beneficial for the patient.* |
| 15.13-15.30 | Q&A |

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| **15.30-15.50** | **Industry Exhibition I - Scanner vendors (10 minutes each)** |
| 15.30-15.40 | **3D Histech** |
| 15.40-15.50 | **Fujifilm/Sysmex** |
| **15.50-16.00** | **Coffee Break** |
| **16.00-16.30** | **Introduction to Classical ML** |
| | **Abhir Bhalerao** (Warwick, UK)<br>*This session will introduce some fundamental concepts on how images are represented for computation, what image features are and how they can be extracted, descriptions of frequency, texture and shape features, and how extracted features can be classified using two classical machine learning techniques: linear classification and naive Bayes'. These concepts will be illustrated with simple examples from computational pathology.* |
| **16.30-17.30** | **Hands-on '0 to AI' (Part I) – Classical ML** |
| | **Scott Doyle** (Buffalo, USA) **&**<br>**Andrew Janowczyk** (Case Western, USA)<br>*In this 60 minute session, we will demonstrate a "classical" machine learning pipeline. We will begin with an open-source dataset of features extracted from breast cancer cytology images, and demonstrate some common "data wrangling" techniques and how to implement them. Next, we will go through data exploration and visualization techniques to help understand the data prior to beginning classification. These include building feature histograms, scatter plots, and looking for correlations between features. Finally, we will demonstrate how to train, test, and evaluate a classical machine learning pipeline using this dataset. All of the code examples will be implemented in a Google Colaboratory notebook which participants are free to download or copy and use on their own (Google Suite account required, e.g. a Gmail email account).* |
| **17.30-17.50** | **Panel Discussion** |

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# ABSTRACT INFORMATION

## Day 2: Thursday 20th May

| Time | Day 2 Session Abstracts |
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| **13.30-14.10*** | **Opening talks – CPath from a Clinical Viewpoint (Part II)** |
| 13.30-13.45 | **Digital Pathology: An End or a Means?**<br>**Manuel Salto-Tellez** (Queen's Belfast & ICR, UK)<br>*There is an increasing perception among practicing pathologists of the advantages of operating diagnostically in a digital pathology environment. This brief presentation with review: a) the arguments in favour of digitization of histopathology services, b) the IT framework that would allow the best possible deployment of such service; and c) the types of tools under development to use digital images as an enabler to apply digital pathology algorithms and artificial intelligence tools in routine diagnostics.* |
| 13.45-14.00 | **Mutation prediction**<br>**Jakob Kather** (Aachen, Germany)<br>*Precision oncology requires molecular and genetic testing of tumor tissue. For many tests, universal implementation in clinical practice is limited because these biomarkers are costly, require significant expertise and are limited by tissue availability. However, virtually every cancer patient gets a biopsy as part of the diagnostic workup and this tissue is routinely stained with hematoxylin and eosin (H&E). Recently, multiple research groups have demonstrated that with deep learning, tumor genotype, prognosis and treatment response can be inferred directly from routine H&E histology images. An application of particular clinical relevance is detection of microsatellite instability (MSI) in colorectal cancer. MSI has prognostic impact and is predictive of immunotherapy response. We have validated a deep learning-based diagnostic test for MSI and other clinically relevant genetic alterations from H&E images in large patient cohorts, reaching clinical-grade performance. Beyond that, validation of deep learning biomarkers in breast cancer, lung cancer and gastric cancer is ongoing. This talk will summarize the state of the art of deep learning in oncology, demonstrate emerging use cases and discuss the clinical implications of these novel biomarkers* |
| 14.00-14.10 | **Q&A** |

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| **14.10-15.00** | **Flashtalks – Introduction to CPath (Part II)** |
| **14.10-14.22** | **Ethical issues in CPath**<br>**Tom Sorrell** (Warwick, UK)<br>*- In what sense does CP involve personal data?*<br>*- Data hunger, data minimisation*<br>*- Informed consent to use of WSIs of tissue for diagnosis*<br>*- Communication of diagnostic results of CP by medics unfamiliar with AI or ML*<br>*- Business ethics and CP* |
| **14.22-14.34** | **QC Issues in CPath**<br>**Andrew Janowczyk** (Case Western, USA)<br>*1) Why is quality control needed?*<br>*2) Potential Consequences of batch effects*<br>*3) How to detect batch effects* |
| **14.34-14.46** | **Challenges in CPath**<br>**Faisal Mahmood** (Harvard, USA)<br>*This brief talk will cover challenges in computational pathology including but not limited to:*<br>*(a) weak supervision and data-efficiency trade-off*<br>*(b) domain adaptation*<br>*(c) structured prediction (d) deploying cPath models in low resource settings.* |
| **14.46-15.00** | **Q&A** |
| **15.00-15.30** | **Industry Exhibition II – AI vendors Part A** |
| **15.00-15.10** | **Paige AI** |
| **15.10-15.20** | **Visiopharm** |
| **15.20-15.30** | **Ibex** |
| **15.30-15.45** | **Coffee Break** |
| **15.45-16.15** | **Introduction to Deep Learning for Computational Pathology** |
| | **Fayyaz Minhas** (Warwick, UK)<br>*The goal of this talk is to expose the audience to how deep learning functions and what machine learning problems lie at the core of computational pathology. We shall cover various algorithms in deep learning at a high level with the aim of giving a conceptual knowledge of these algorithms so that pathologists can imagine and identify how deep learning can be applied in their domains.*<br>*1. Conceptual knowledge of deep learning*<br>*2. Pointers to other resources on learning deep learning*<br>*3. Applications of deep learning in CPath* |

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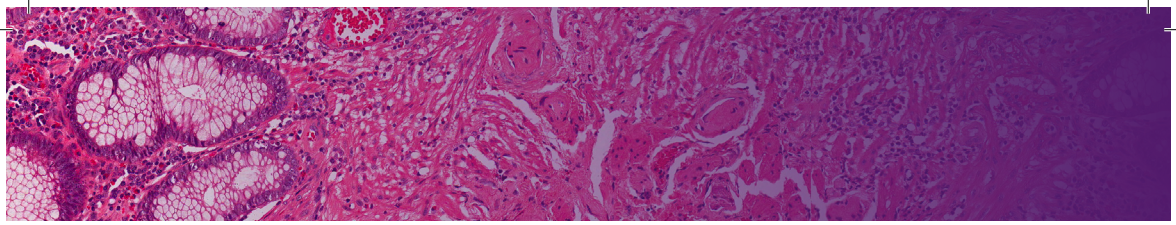

| 16.15-17.15 | Hands-on '0 to AI' (Part II) – Deep Learning |
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| | **Shan Raza, Simon Graham, John Pocock, Mostafa Jahanifar & Dang Vu** (Warwick, UK)<br>*This session will deliver hands-on experience on using AI tools for computational pathology. It will be aimed at attendees who are both new and experienced in this field. The session will consist of python notebooks which will help to gain knowledge on training and deployment of AI models for computational pathology. Tiatoolbox will be introduced with example notebooks which is a computational pathology toolbox designed and developed at the TIA Centre. The aim of this tool is to simplify, standardise and benchmark the usage of state-of-the-art AI models and make them accessible to the community, especially those with limited coding and computational experience. The examples will include notebooks on whole slide image reading, patch extraction, stain normalisation, tissue extraction and using AI models for WSI classification.* |
| **17.15-17.45** | **Industry Exhibition II – AI vendors Part B** |
| 17.15-17.25 | **Indica Labs** |
| 17.25-17.35 | **Aiforia Technologies** |
| 17.35-17.45 | **TRIBVN Healthcare** |
| **17.45-17.50** | **Closing remarks** |

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