Building a Community of Practice in Computational Pathology

Raghu Machiraju
Professor, Principal Data Scientist
Presenting on Behalf of

Prof. D. K. Panda,
Computer Science and Engineering
The Ohio State University
Midwestern Consortium for Computational Pathology (MCCP)

- Established through the Midwest Big Data Hub (MBDH)
- To foster a community of practice around computational pathology in the Midwest and beyond:
  - Scarcity of well-trained pathologists in the US negatively impacts patient care
  - Practice of pathology is rapidly undergoing a transformation
  - Enormous opportunity for the application of innovative human-machine teaming using AI technologies
- MCCP brings together experts from:
  - pathology, data science, and computer science
  - academia, government laboratories and industry

Aim to position the Midwest at the cutting edge of this new age of digital pathology
Dr. Anil Parwani, Ohio State
Goals and Objectives of the Consortium

- **Primary goals**: To collaborate on technology applications and resource development, best practices and knowledge sharing, and proposals for funding.

- **Specific objectives**:
  - Organize information exchanges to create closely coordinated working groups
    - workshops, hackathons, etc.
  - Define agenda and goals of the community to establish working groups with specific team-science, convergent research, educational and outreach purposes
    - interdisciplinary thrusts, short courses and programs, community engagement
  - Create data and computing assets for the consortium and larger MBDH community
    - Data and model commons and collections, computational tools, educational offerings
  - Outline clear and tangible value propositions and outputs to stakeholders in academia, industry, and healthcare organizations
  - Form engagements through a formal consortia involving academic institutions, companies dedicated to pathology and biotechnology, and medical and health facilities, including those in resource-poor areas
Consortium Members

- Affiliated Pathologists Medical Group
- American University of Beirut Medical Center, Lebanon
- ARUP Laboratories
- AQUYRE Biosciences, France
- Augmentiqs, Israel
- Bogazici University, Turkey
- Barretos Cancer Hospital, Brazil
- Bristol Myers Squibb
- Case Western Reserve University
- Caterpillar
- Cincinnati Children’s Hospital Medical Center
- COMSATS University, Pakistan
- Columbia University
- Deciphex
- Duke Health
- Duke University
- Ege University, Turkey
- Emory University
- Foundation University Islamabad, Pakistan
- French Medical Institute for Mothers and Children, Afghanistan
- Hospital de Amor, Brazil
- Hospital Italiano de Buenos Aires, Argentina
- H. Lee Moffitt Cancer Center and Research Institute
- Ibex Medical Analytics, Israel
- Imam Abdulrahman bin Faisal University, Saudi Arabia
- Imperial College London, United Kingdom
- International Medical Center, Saudi Arabia
- Kameda Medical Center, Japan
- King Faisal Specialist Hospital and Research Centre, Saudi Arabia
- Kitware
- Leaderzest, United Kingdom
- Mass General Hospital
- Mayo Clinic
- MD Anderson Cancer Center
- Mechanomind
- Medical College of Wisconsin
- Memorial Sloan Kettering
- Minia University, Egypt
- Nagasaki University, Japan
- National Institutes of Health
- Nference
- Northwestern University
- National University of Computer and Emerging Sciences, Pakistan
- NUST, Pakistan
- Ontario Institute for Cancer Research, Canada
- Ospital ng Makati, Philippines
- Philips
- Queen's University, Canada
- Roswell Park Cancer Center
- Siro Clinpharm
- SpIntellx
- Strand Life Sciences, India
- The Ohio State University
- The University Of Oklahoma Health Sciences Center
- The University of Texas Medical Branch
- UMass Medical School-Baystate
- University of California
- University of Cincinnati
- University of Florida
- University of Management and Technology, Pakistan
- University of Maryland
- University of Michigan
- University of Mississippi Medical Center
- University of New Mexico
- University of Pennsylvania
- University of Pittsburgh
- University of South Alabama
- University of Utah
- University of Waterloo, Canada
- University Hospital Cologne, Germany
- Upstate Medical University
- UT Southwestern Medical Center
- Walchand College of Engineering, India
- Washington University in St. Louis

253 registered attendees and 70 organizations across Industry, Academia, Government, National Labs from 17 Countries!
Objectives of MCCP workshop series

**Workshop #1**
- Bring **computation scientists** and **pathologists** together
- Computational scientists are introduced to pathology data sets and state-of-the-art tools and workflows
- Pathologists are introduced to cutting edge trends in data science and data management
- Breakout groups to **identify gaps in state-of-the-art computational pathology workflows**

**Workshop #2**
- Discuss solutions to **bridge the gap** in state-of-the-art computational pathology workflows
- Arrange hackathons to use ML, DL, and data science techniques for digital pathology data sets with the **goal of creating new tools to enable optimized workflows**
- Learn latest techniques being developed in the industry from industry partners
- Exploration of collaborative funding opportunities

**Workshop #3**
- Identify future directions
- Discuss opportunities and challenges of **developing these tools into future products** with industry partners
- Discuss educational materials to **train next-generation of digital pathologists**
- Share experiences in pursuing collaborative funding opportunities and aim for large scale collaboration
The First MCCP workshop

• Theme: “Building Convergence”
• Specific objectives:
  • Breakout groups to identify gaps in computational pathology workflows, datasets, and tools
  • Discuss plans for outreach in both academia and industry
  • Identify interdisciplinary research thrusts

Workshop website: http://nowlab.cse.ohio-state.edu/mccp_prog/
All talks and their videos are available on the workshop website
Focus areas of first MCCP workshop

- Digital Pathology and Imaging
- Machine Learning and Artificial Intelligence
- Human-Machine Teaming
- Big Data Management
- High-Performance Computing
- Outreach and Industry Connections
<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
<th>Speaker(s)</th>
<th>Institution(s)</th>
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</thead>
<tbody>
<tr>
<td>12:00 - 12:15</td>
<td>Welcome and Opening</td>
<td>Anil Parwani and DK Panda, The Ohio State University, USA</td>
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<tr>
<td>12:15 - 1:00</td>
<td><strong>Keynote Talk:</strong> Supporting the NIDDK Kidney Precision Medicine Project (KPMP): Standing up the U-M Pathology AI / Data Visualization Center and Core Lab - Five years in retrospect</td>
<td>Ulysses Balis, University of Michigan, USA</td>
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<tr>
<td>1:00 - 1:30</td>
<td>How Computational Pathology is Improving Predictive Analytics?</td>
<td>Michael Becich, University of Pittsburgh, USA</td>
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<tr>
<td>1:30 - 2:00</td>
<td>Digital Pathomics - An Alternative to Deep Learning to Prognosticating Disease Outcome</td>
<td>Anant Madabhushi, Case Western Reserve University, USA</td>
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<td>2:00 - 2:30</td>
<td>How Digital Pathology will Transform Drug Development and Cancer Diagnosis?</td>
<td>Jason Hipp and Khan Baykaner, AstraZeneca</td>
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<td>2:30 - 3:00</td>
<td>Machine learning for placental pathology: Why, How, and What Now?</td>
<td>Jeffrey Goldstein, Northwestern, USA</td>
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<td><strong>Breakouts and Discussion</strong></td>
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<td>3:00 - 3:45</td>
<td><strong>Breakout #1 Digital Pathology and Imaging</strong></td>
<td>Breakout leaders: Jennifer Picarsic (Cincinnati Children) and Jeffrey Goldstein (Northwestern)</td>
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<td><strong>Breakout #2 Machine Learning and Artificial Intelligence</strong></td>
<td>Breakout leaders: Michael Becich (Pittsburgh) and Anant Madabhushi (CWRU)</td>
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<td>3:45 - 4:05</td>
<td>Reporting from two breakout sessions (10 mins each)</td>
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<tr>
<td>4:05 - 4:15</td>
<td>Closing for Day 1 and Plans for Day 2 and Day 3</td>
<td>Anil Parwani and DK Panda, The Ohio State University, USA</td>
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<td>12:00 - 12:15</td>
<td>Updates from Day 1 and Day 2 Overview</td>
<td>Anil Parwani and DK Panda, The Ohio State University, USA</td>
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<td>12:15 - 1:00</td>
<td><strong>Keynote Talk:</strong> Highlighting Challenges for Machine Learning in the Pathology Clinic through Specific Use Cases</td>
<td>Raghu Machiraju, The Ohio State University, USA</td>
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<td>1:00 - 1:30</td>
<td>Understanding how to Understand Teammates</td>
<td>Eric Fossler-Lussier, The Ohio State University, USA</td>
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<td>1:30 - 2:00</td>
<td>Stochastic Flow Clustering: Consolidation, Renewed Bearing and Applications to Image Segmentation</td>
<td>Srinivasan Parthasarathy, The Ohio State University, USA</td>
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<td>2:00 - 2:30</td>
<td>Providing molecular insight for resource-strained patients with machine learning-based workflows</td>
<td>Jose Otero, The Ohio State University, USA</td>
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<td>2:30 - 3:00</td>
<td>BERT - Transformers, NLP, and Pathology Reports</td>
<td>Hamid Tizhoosh, University of Waterloo, Canada</td>
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<td>Breakouts and Discussion</td>
<td>Breakout #3 Human-Machine Teaming</td>
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<td>Breakout leaders: Eric Fossler-Lussier (OSU) and Jose Otero (OSU)</td>
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<td>Breakout #4 Big Data Management</td>
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<td>Breakout leaders: Srinivasan Parthasarathy (OSU) and Hamid Tizhoosh (Waterloo)</td>
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<td>Updates from Day 2 and Day 3 Overview</td>
<td>Anil Parwani and DK Panda, The Ohio State University, USA</td>
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<td>12:15 - 1:00</td>
<td><strong>Keynote Talk:</strong> Charting a Future Course for Computational Pathology</td>
<td>Lee Cooper, Northwestern, USA</td>
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<td>1:00 - 1:30</td>
<td>Explainable AI (xAI) for Anatomic Pathology</td>
<td>Chakra Chennubhotla, University of Pittsburgh, USA</td>
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<td>1:30 - 2:00</td>
<td>AI-Based Pathology in Clinical Stage Biopharmaceutical Drug Development</td>
<td>Mike Montalto, PathAI, USA</td>
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<td>AI Promise to the Practice of Hematopathology</td>
<td>Mohammad Salama, Mayo Clinic, USA</td>
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<td>High-Performance Deep Learning with Large Pathology WSI Images</td>
<td>Hari Subramoni, The Ohio State University, USA</td>
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<td>Breakout #5</td>
<td>High-Performance Computing</td>
<td>Mike Montalto (PathAI) and Hari Subramoni (OSU)</td>
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<td>Breakout #6</td>
<td>Outreach and Industry Connections</td>
<td>Mohammad Salama (Mayo Clinic) and Chakra Chennubhotla (Pittsburgh)</td>
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<td><strong>Closing for Day 3 and Plans for Workshop #2</strong></td>
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Plans Ahead

Early Spring 2022

Workshop #1
Bring computation scientists and pathologists together

Workshop #2
Discuss solutions to bridge the gap in state-of-the-art computational pathology workflows

Late Summer 2022

Workshop #3
Identify future directions
http://icicle.ai
NSF-Funded AI Institute
An Overview of ICICLE

- Plug-and-play characteristics exists in current generation electricity and power grid
- No such plug-and-play AI exists for modern scenarios

Can we democratize AI for current societal needs?

- Democratizing AI will require new Cyberinfrastructure that enables:
  - Plug-and-play AI capabilities that are accessible to diverse stakeholders
  - Intelligent Cyberinfrastructure – CI4AI & AI for CI4AI
  - Use-inspired research for co-design in select target domains
  - Advances in foundational AI that support
    - Model commons
    - Conversational AI
    - Privacy-preserving AI
    - Adaptive AI

- Inclusive growth of next generation of AI-capable workforce trained in transdisciplinary settings
ICICLE: Computational Learning in the Environment

Driving Use Cases from Smart Foodsheds, Animal Ecology, Digital Agriculture, etc.

- Systems provide a continuum of field-to-edge-to-cloud/HPC centers
- Provide very large, complex, heterogeneous data for a plethora of scientific and operational questions
- ICICLE will augment current cloud-based AI models by:
  - Facilitating decision-making in the field plagued by low network bandwidth
  - Allowing data to be private but facilitating collaborative intelligence
  - Provisioning models to use and plan computation and data movement
- Adding more verticals!
Thanks to our Sponsors!

Joining the Consortium

All interested are welcome to join the MCCP consortium by visiting our website (http://nowlab.cse.ohio-state.edu/mccp/) and filling an application form