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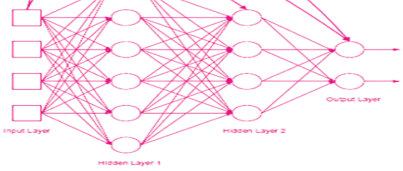

Practitioner Takeaway: Endless Summer School

Health Roundup

The Endless Summer School (ESS) session features Vector Faculty and industry leaders who are breaking ground research and applications of AI in healthcare.

Agenda

Thursday, Mar 16, 2023

10:05	**Rahul G. Krishnan**, University of Toronto, Vector Institute Talk Title: From data to decision making in Medicine
10:30	**Jennifer Yu,** University of Toronto, Vector InstituteTalk Title: Time for Baby: leveraging wearable data to enhance personalized pregnancy outcomes - Delivery Readiness
11:00	**Chris McIntosh,** University of Toronto, Vector Institute Talk Title: Building AI Models from Bench to Bedside
11:30	**Xindi Wang,** Western University, Vector Institute Talk Title: KenMeSH: Knowledge-enhanced End-to-end Biomedical Text Labeling

Playback

Meeting Recording:
https://vectorinstitute.zoom.us/rec/share/fIeHMGhoqSdTE4v1c-XvV3oO0fj6PfN6AqylBGY6JpISJV5jOViPygkEChy__J37.kdbPDasIr0ihJWh9

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From data to decision making in Medicine

Rahul G. Krishnan is an Assistant Professor at the University of Toronto in both the Department of Computer Science and the Department of Laboratory Medicine and Pathobiology. He is also the CIFAR AI Chair at the Vector Institute. With a focus on machine learning algorithms, he aims to develop a learning healthcare system using digitized clinical and biological data to improve clinical care and understanding of human and disease biology. His research interests include deep learning, causal inference, and reliable machine learning, where he focuses on developing unsupervised and self-supervised learning algorithms for extracting predictive patterns from noisy, high-dimensional data, developing methods for estimating causal effects, and creating guardrails for reliable deployment of machine learning models Learn more

Summary

This talk focuses on using machine learning to analyze histopathological images, which are very large and have a nested hierarchical structure. The speaker and his colleagues propose a new method (Hierarchical Image Pyramid Transformers-HIPT) to scale Vision Transformers (ViTs) to handle images of gigapixel sizes, which are commonly found in satellite imagery, microscopy, and medical imaging. The method involves cutting the images into small patches, learning representations of each patch using self-supervised learning, and then aggregating those representations at increasingly higher levels of the hierarchy. This approach allows for the creation of slide-level representations that can be used for predictive modeling in oncology. The speaker also gives a brief background of Neural Causal Models.

Paper link HERE; GitHub: HERE

Practitioner Takeaway

- Histopathological images are a key part of clinical decision making in oncology, and the field of computational histopathology aims to use machine learning models to build predictive models from histopathological data.
- Hierarchical Image Pyramid Transformers is a new approach to computational histopathology that leverages the nested hierarchical structure of whole slide images to overcome the memory requirements of handling large images and build more accurate predictive models.

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Time for Baby: Leveraging Wearable Data to Enhance Personalized Pregnancy Outcomes - Delivery Readiness

Jennifer Yu is a Graduate student at Computer Science, University of Toronto under the supervision of Dr. Anna Goldenberg. Before joining UofT, she studied biomedical engineering with a specialization in AI at the University of Waterloo. Her research interests include digital health, wearable technology, time series forecasting and more. Currently, her research is to utilize AI-based methods to understand pregnancy-related physiology such as symptoms, complications and delivery readiness. Learn more

Summary

This research project aims to use data from wearable devices to assess delivery readiness during pregnancy on an individual basis. The study collects physiological data from pregnant women to identify specific maternal indicators that could predict delivery readiness and potentially reduce the risk of adverse outcomes for both mothers and infants.

Practitioner Takeaway

- Wearable devices can potentially be used to monitor physiological signals during pregnancy and identify specific maternal indicators that may indicate delivery readiness, which could have significant implications for predicting delivery readiness and reducing the risk of adverse outcomes for both mothers and infants.

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Building AI Models from Bench to Bedside

Chris McIntosh is a Scientist at the Techna Institute, the Peter Munk Cardiac Centre, and the Joint Department of Medical Imaging, at the University Health Network. He is an Assistant Professor in the Departments of Medical Biophysics, Computer Science, and Medical Imaging at the University of Toronto, and a Faculty Affiliate of the Vector Institute. He further holds a joint research Chair in Medical Imaging and Artificial Intelligence at JDMI and the Department of Medical Imaging at the University of Toronto. His lab focuses on the theory and clinical application of AI in medicine for improving patient care including transfer learning, meta-learning, computer vision, and explainable AI. Applications include deep learning for automated diagnosis, segmentation, quality assurance, and treatment planning. His past work on AI in radiation therapy has been approved for clinical use by regulatory bodies, commercialized, and deployed in hospitals around the world, using AI to deliver reproducible, high-quality cancer care. Learn more

Summary

The talk highlights the application of AI in radiation therapy for prostate cancer treatment. The use of AI is explained in detail, including its ability to produce more intricate radiation distributions, facilitate iterative treatment planning, develop a database of patient models, predict dose delivery probability, and optimize dose spatial arrangement for specific regions. The importance of duplicating patient care and utilizing inverse optimization to create feasible treatment plans is emphasized. Lastly, the talk presents the outcomes of a clinical trial on a deep learning model for prostate cancer, which demonstrated exceptional accuracy and voxel similarity to clinical plans.
Paper Link HERE

Practitioner Takeaway

- AI is playing an increasingly important role in radiation therapy for cancer treatment, allowing for more complex and personalized treatment plans.
- Techniques such as Atlas regression forests and probabilistic dose prediction are used to learn which patients are the most similar and predict the dose distribution for a novel case, respectively.
- The use of deep learning models has shown promising results in improving the accuracy of radiation therapy for prostate cancer, highlighting the potential for AI to continue advancing cancer treatment in the future.

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Sparse Non-local CRF

Xindi Wang is a PhD student in the Department of Computer Science at Western University and Vector Institute supervised by Dr. Robert E. Mercer and Dr. Frank Rudzicz. Previously, she obtained her MSc. at the Western University with Dr. Robert E. Mercer, and did her undergraduate at the University of British Columbia. Her research focuses on natural language processing in healthcare and the clinical domain.
Learn more

Summary

This talk discusses automatic MeSH (Medical Subject Headings) indexing, which assigns MeSH terms to the MEDLINE citations. MeSH indexing is currently done by human annotators, which is time-consuming and costly. An automatic annotation system is highly desired to help with the indexing of large-scale articles. The occurrence of MeSH terms follows a long-tail distribution, where some terms are much more frequent than others. Assigning the correct number and terms of MeSH is the main challenge for the task. Previous work has focused on leveraging the power of neural networks to improve thematic recognition of the text.
Paper link HERE

Practitioner Takeaway

- A multi-channel document representation module is designed to capture local correlations and long-term dependencies from text using bidirectional LSTM and multi-level dilated convolution.
- The proposed method integrates information from the complete MeSH hierarchy using graph convolutional neural networks, which is a first in the field.
- A novel dynamic knowledge-enhanced mask attention mechanism is proposed to handle the large universe of possible labels in the MeSH indexing task, incorporating external information from journal-MeSH co-occurrence and document similarity in PubMed.

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About

About Endless Summer School

Vector holds what we call Endless Summer School (ESS) 6 times per year to keep practitioners up to date on key topics in the field of artificial intelligence. This ongoing series of technical seminars are inspired by a program first run by Dr. Geoffrey Hinton and features the latest machine learning advancements relevant to technical industry leaders. If you have any questions about the speakers or the event, please don't hesitate to contact industry@vectorinstitute.ai.

About the Vector Institute

The Vector Institute is an independent, not-for-profit corporation dedicated to advancing artificial intelligence, excelling in machine learning and deep learning. Our vision is to drive excellence and leadership in Canada's knowledge, creation, and use of AI to foster economic growth and improve the lives of Canadians. The Vector Institute is funded by the Province of Ontario, the Government of Canada through the Pan-Canadian AI Strategy administered by CIFAR, and industry sponsors.

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