Team uses 'Deep Learning' to assist overburdened diagnosticians

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Some 2 billion X-rays are performed around the world every year. But the average radiology clinic is understaffed. Radiologists are burdened with a growing workload, allowing little time to comprehensively evaluate images—leading to misdiagnoses and more serious consequences.

Now a Tel Aviv University lab is engineering practical solutions to meet the demands of radiologists. Prof. Hayit Greenspan's Medical Image Processing Lab in the Department of Biomedical Engineering in the TAU Faculty of Engineering has developed a wide variety of tools to facilitate computer-assisted diagnosis of X-rays, CTs and MRIs, freeing

radiologists to attend to complex cases that require their full attention and skills.

"There is a shortage of radiologists, and their workload continues to grow. This means that some X-rays are never read or are only read following a long, life-endangering delay," said Prof. Greenspan. "Our goal is to use computer-assisted 'Deep Learning' technologies to differentiate between healthy and non-healthy patients, and to categorize all pathologies present in a single image through an efficient and robust framework that can be adapted to a real clinical setting."

"Deep learning" for accurate diagnosis

Prof. Greenspan discussed her lab's plan to implement "Deep Learning," a new area of Machine Learning research that harnesses artificial intelligence for various scientific fields, at the Israeli Symposium on Computational Radiology held at TAU last December. Her goal is to use Deep Learning to develop diagnostic tools for the automated detection and labelling of pathologies in radiographic images.

Prof. Greenspan's lab is one of only a few labs in the world dedicated to the application of Deep Learning in medicine. She and her team have already developed the technology to support automated chest X-ray pathology identification using Deep Learning, liver lesion detection, MRI lesion analysis and other tasks.

"We have developed tools to support decision-making in radiology with computer vision and machine learning algorithms. This will help radiologists make more accurate, more quantitative and more objective decisions," said Prof. Greenspan. "This is especially crucial when it comes to initial screenings. Such systems can improve accuracy and efficiency in both basic and more advanced radiology departments around the world."

Prof. Greenspan is also exploring the use of "transfer learning" in her research on the medical applications of Deep Learning. "Crowdsourcing was essential for the application of Deep Learning on general image searches such as Google search," said Prof. Greenspan. "But when it comes to medical imaging, there are privacy issues and there's very little comprehensive data available at this point.

"In 'transfer learning,' we use networks originally trained on regular images to categorize medical images. The features and parameters that represent millions of general images provide a good signature for the analysis of medical images as well."

Prof. Greenspan's work is supported by the INTEL Collaborative Research Institute for Computational Intelligence (ICRI-CI) and the Israeli Finance Ministry, in collaboration with Sheba Medical Center. She is also head co-editor of a special issue on "Deep Learning in Medical Imaging," which will be published in the journal *IEEE Transactions on Medical Imaging* in May.

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