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Editorial

Artificial intelligence in surgical pathology

Artificial intelligence (AI) is machine intelligence that mimics human cognitive function. It denotes the intelligence presented by some artificial entities including computers and robots. In supervised learning, a machine is trained with data that contain pairs of inputs and outputs. In unsupervised learning, machines are given data inputs that are not explicitly programmed.[1] Machine learning refines a model that predicts outputs using sample inputs (features) and a feedback loop. It relies heavily on extracting or selecting salient features, which is a combination of art and science ("feature engineering"). A subset of feature learning is deep learning, which harnesses neural networks modeled after the biological nervous system of animals. Deep learning discovers the features from the raw data provided during training. Hidden layers in the artificial neural network represent increasingly more complex features in the data. Convolutional neural network is a type of deep learning commonly used for image analysis.

Digital pathology

It represents the digitalization of all pathology slides to permit higher order processes that add value to the practice of pathology. With the rise in whole slide imaging technology, large numbers of tissue slides are being scanned and represented and archived digitally. While digital pathology has substantial implications for telepathology, second opinions, and education, there are also huge research opportunities in image computing with this new source of "big data". There has been a recent substantial interest in combining and fusing radiologic imaging and proteomics and genomics based measurements with features extracted from digital pathology images for better prognostic prediction of disease aggressiveness and patient outcome. The variety of image analysis tasks includes segmentation (region of interest, morphology, density, texture), detection, classification, quantification, grading and prognostic prediction.[2]

WSI of previously diagnosed nodular basal cell carcinomas, dermal nevi, and seborrheic keratoses were annotated for areas of distinct morphology. AI system accurately classified 123/124 (99.45%) nodular basal cell carcinoma, 113/114 (99.4%) dermal nevi, and 123/123 (100%) seborrheic keratoses.[3]

Computational pathology

AI applied to pathology is a form of computational pathology. It is an approach to diagnosis that incorporates multiple sources of raw data like clinical electronic medical record and laboratory data including "omics," and imaging, generate diagnostic inferences and predictions; and presents this clinically actionable knowledge to customer through dynamic and integrated reports enabling physician to make the best possible medical decisions.[4]

The development of intuition and creativity combined with the raw computing of AI heralds an age where well-designed and well-executed AI algorithms can solve complex medical problems, including the interpretation of diagnostic images.

A general AI that could replace a pathologist is far off. Of note, in a prior work, the microscope was predicted to have a 75% chance of remaining in use for another 144 years.[5] Our cognitive lead will narrow as AI products like IBM Watson demonstrate valid cognition of patient and population information. It would be more reasonable to see AI as synergistic technologies to pathology.

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