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Artificial intelligence in fighting cancer: A short review and trends

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ABSTRACT

The current trends of artificial intelligence (AI) and machine learning, specifically the amazing success achieved by artificial refurbished neural network architecture deep learning (DL), algorithms used like in alpha go, could greatly benefit cancer detection, personalized cancer treatment, and cancer drug discovery. New models like DL have recently arrived and are offering a leap step into classifying cancer types and even potential drug discoveries. These targeted AI will continue emerging and will build up toward the final fight of cancer: When AI, with the help of advance sensors that will provide data, can diagnosis cancer in stage zero.

Key words: Artificial intelligence, Classification methods, Applied computer science, A.I. for good, Information systems for medical applications

Introduction

The current trends of artificial intelligence (AI) and machine learning, specifically the amazing success achieved by artificial refurbished neural network architecture deep learning (DL), algorithms used like in alpha go, could greatly benefit fighting cancer, specifically in cancer detection, personalized cancer treatment, and cancer drugs discovery. Among those, the holy grail is zero-stage disease detection, in which computers managing many different types of data dimensionality, could impact greatly humanity by identifying cancer as soon as it is started. In this short review, Author will enumerate the main different AI techniques that have been used for fighting cancer, from different fronts.

In general, AI is a big collection of algorithms, mathematical functions, theory and practice interrelated, and overlapping areas of mathematics and statistics. Inside AI, there can be found different subdisciplines such as machine learning, classification systems, intelligent agents, and among others. Machine learning is the subuniverse of algorithm and computational tools that permit the understanding and/or clustering of data, from a big collection of it. Artificial neural networks (ANN), for instance, are one technique used in other subdisciplines of classification systems. Moreover, inside ANN, DL has gained much attention, and one can find many different types of subalgorithms derived by the advance of fast processing, memory and new models and architectures of such paradigm.

AI has been used in the field of cancer leading to various advances:

Artificial Narrow Intelligence (Weak AI)

Weak AI is very targeted, with the use of data that train the program and produces a way to test new samples against the trained data. These kinds of algorithms can be classified as or be in the subset called artificial narrow intelligence (also known as weak AI), which is just concentrated to a narrow problem.

Vector support machine has been used to classify tissues of ovarian cancer from normal ovarian tissues,[1] breast cancer diagnostics with a classification accuracy of 99.51%,[2] and using gene expression data.[3] As decomposing a multivariate signal into additive subcomponents, independent component analysis has also been used in gene microarray data, characterizing the malignant samples of postmenopausal endometrial biopsies,[4] and colon and prostate cancer data,[5] and breast cancer in digital mammographs.[6] Hidden Markov models are a technique to decompose in different states a system that uses a Markov process and have shown promising results in colonoscopy;[7] while wavelets, a function that correlates data with unknown signal, have been used in breast cancer feature extraction[8] and colon cancer.[9] Another machine learning technique that has to be used in cancer recognition is random forest classification has helped in classify breast cancer.[10]

Another important aspect in AI is evolutionary computation, where a model gives parameters to a newer self-created model in an iterative sequence until finding a satisfactory level of optimization. This technique has been used in breast cancer diagnosis[11] and even in the scheduling of cancer chemotherapy.[12]

Pattern recognizer/classifiers

By providing sufficient examples and different categories of classification, the algorithm can provide a good performance of prediction of new data. For instance images, or tissues of could be labeled into healthy and unhealthy, and the classifier

could learn from the provided labeled images and distinguish between those.

Some techniques like regression-tree models (non-parametric regression, where the classification is taken from data) lay into the gray area of statistics with AI. This specific technique has been used in diagnosis of gastric cancer[13] and liver cancer.[14]

ANNs are a computational technique that permits learning, from supervised and unsupervised (labeling or not data that is used to train the algorithm). There have been cytology evaluation for detection in breast cancer,[15] colon cancer and thyroid cancers classification,[16] and early prostate cancer diagnosis.[17]

Another aspect in cancer affected by AI is the therapeutics field. There have been applications machine learning and support vector machines[18] and simulations in drug discovery via evolutional computation.[19]

Other AI Systems

There are also other types of AI used also for fighting cancer. An example is expert systems, which is a set of rules and databases, originated from medical human experts, which usually offer suggestions about a problem that is tackled in a tree-like solution classification system. They have been used in cytologic and histologic diagnosis cancer[20] and radiology.[21]

Watson

Cognitive computing efforts through natural language processing, directed by Robert High in IBM, concluded in the creation of Watson,[19] a system that simulates certain cognition parameters after data (usually journal articles, or encyclopedia articles) are fed to the system. This system became famous when it defeated the two champions of Jeopardy in 2011.[22] Since then, there have been many applications of the system, in particular in cancer medicine, comparing "a patient's medical information against this array of information to help guide clinical decisions" while "comparing a patient's medical information against the universe of open clinical trials to help oncologists identify additional clinical options for their patients."[22-24] The power of cognitive computing like Watson is that this kind of system can be fed with newer information and it can make new discoveries from those, saving years or decades of reading for any scientist.

DL

This technique has gained a lot of attention in the past years. DL is a subset of machine learning, inside ANNs, in which deeper nodes and different more computation-intensive calculations methods make the feature extraction of data (i.e., images and genes) more accurate. This technique has increasingly been used to correctly classify large amount of data and it is especially advanced and accurate in image classifications. Related with fighting cancer, DL has started increasing its usage in carcinoma cancer detection from images,[25] mitosis detection in breast cancer,[26] prostate magnetic resonance segmentation,[27] computer-aided diagnostic images classification for lung cancer detection,[28] image classification for skin cancer,[29] furthermore, for potential drug discovery via chemoinformatics.[30]

The cancer moonshot

As part of an ambitious program from USA Government, the "Cancer Moonshot"[31] is an effort that seeks coordinate multiple hospitals and their accumulated multidimensional data, open source it, and use state-of-the-art methodologies to gain not just more understanding but to also cut dramatically future new cases of cancer. In this effort, companies such as NVIDIA and CANDLE[32] joined so AI could be used in supercomputing to find patterns in large datasets of text and images. Amazon also offered its computing power to this noble initiative that seeks to unleash AI for fighting cancer.[32]

Future of AI in Fighting Cancer

It is an intelligent guess to say that more narrow AI will continue emerging and to be applied to specific types of cancer. If cancer data, any type and at any stage could be compiled or represented onto images or other structured data that could be labeled, DL techniques could be easily used to correctly classify such data. Following the natural evolution of AI, many people expect that new paradigms can emerge, like general purpose AI that could help providing virtual oncologists. Furthermore, besides IBM and NVIDIA, companies such as Numenta, Vicarious, and DeepMind could offer specific cancer-related solutions using AI, and programs like Cancer Moonshot could also benefit humanity combating cancer from the machine learning/AI front.

Summary

Historically AI has been a collection of algorithms. They can be applied mainly to cancer diagnostics. New models like DL have come and are offering a leap step into classifying cancer types and even potential drug discoveries. These targeted AI will continue emerging and will build up toward the final fight of cancer: When AI, with the help of advance sensors that will provide data, can diagnosis cancer in stage zero.

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