



The Transformational Power of AI for Medical Imaging

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Artificial intelligence (AI) is revolutionizing the business world. Organizations in nearly every industry are using AI to streamline operations and derive more insights from data. In many cases, this translates into cost savings and productivity gains. But there's one industry where AI is truly benefiting humanity.³

The healthcare industry is rapidly changing as AI technologies like machine learning and deep learning push the field forward. Although AI is a relative newcomer in the healthcare tech field, both providers and patients are feeling the transformative effects.

Take healthcare costs for example. According to the Committee for a Responsible Federal Budget, America spends \$3.5 trillion a year on healthcare – more than twice the average amongst developed countries.¹

By infusing AI into healthcare operations, machines can quickly and accurately perform tasks that once required a human. This brings efficiencies to logistics, administration, processes, customer relations and nearly every facet of the healthcare industry.

And while some express concern about AI replacing people in certain roles, AI technologies augment the capabilities of human workers, enabling them to be more productive.

The financial benefits are extraordinary. In fact, one Accenture study shows the use of AI applications could create up to \$150 billion in annual savings for the U.S. healthcare industry by 2026.²

AI can also improve job satisfaction for healthcare professionals. This is particularly beneficial at a time when demand for physicians continues to outstrip supply. By 2032, the U.S. is expected to be short more than 120,000 physicians, according to data published by the Association of American Medical Colleges.³

Burnout is largely to blame. Recent changes in healthcare policy and practices have increased the administrative burden on physicians. By automating many of the data entry tasks that overload physicians, AI will enable medical professionals to spend more time helping patients and less time on menial tasks.

But perhaps the biggest benefit is better patient outcomes. The ability of AI to sift through large amounts of data and perform human-like tasks represents a seismic shift in modern medicine.

AI can help providers identify infections sooner and predict which patients are more likely to have cardiac arrests. The technology can counter antimicrobial resistance by removing guesswork and help

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¹ Committee for a Responsible Federal Budget. "American Health Care: Health Spending and the Federal Budget." May 16, 2018.

² Accenture. "Artificial Intelligence (AI): Healthcare's New Nervous System." 2017.

³ Association of American Medical Colleges. "New Findings Confirm Predictions on Physician Shortage." [Press Release]. April, 23 2019.

doctors customize treatment plans for patients.

The benefits are far reaching. AI underpins many healthcare tech innovations such as robot-assisted surgery, virtual nurse assistants, dosage error reduction and preliminary diagnosis, among others.

To put it simply, AI is changing healthcare. And as data volumes continue to skyrocket and the technology continues to evolve, AI will play an increasing role in curbing costs, improving job satisfaction and delivering better health outcomes.

Revolutionizing Medical Imaging

Radiology, and specifically medical imaging, is an ideal use case to show the transformational power of AI to increase efficiencies and improve medical results.

Medical images captured by CT scans, MRI machines and X-rays can contain critical health information about patients. But detecting medical issues in a stack of high-resolution images can be challenging – even for experts.

Moreover, interpreting these images is subjective and missing a key detail can have major health consequences for patients. Even a marginal shift in misdiagnosis rates equates to many lives saved or lost.

AI allows medical professions like radiologists to see images in a whole new way. By instantly drilling down to the pixel level of

high-resolution images, AI models can be taught to identify nuances that escape the human eye.

In fact, multiple studies indicate that AI tools can identify features in images more quickly and accurately than human clinicians.

The American College of Radiology offers a number of use cases for AI which includes identifying cardiovascular abnormalities, detecting musculoskeletal injuries, aiding in the diagnosis of neurological diseases, flagging thoracic conditions and screening for common cancers.⁴

Evaluating tumors is a prime example. Manually evaluating tumors on CT scans is time consuming work. It can take a radiologist several hours to evaluate a single scan. Even then, only a handful of tumors can be measured to reveal if chemotherapy is working.

Deep learning models have fully automated the therapy evaluation process. By training a model using thousands of tumor images, AI systems can instantly evaluate the shape, size and color of all tumors on a given

CT scan, helping doctors more accurately determine if life-saving surgery is possible.

In some diagnostic processes, deep learning models have replaced the need for taking physical tissue samples from patients – a process which carries the risk of infection.

While the potential for AI in medical imaging is tremendous, the

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⁴ American College of Radiology. "ACR Data Science Institute Releases Landmark Artificial Intelligence Use Cases." October 26, 2018.

work is highly complex. Research efforts are underway to make AI more technically feasible and affordable for radiologists and other medical professionals.

And while AI for imaging won't come all at once, several early adopters have emerged.

Identifying Knee Tears

The University of California, San Francisco (UCSF) is using AI technology from Dell EMC and Intel to deploy a deep learning model that helps clinicians diagnose tears in knee cartilage.

One of the keys to addressing such tears – which can lead to osteoarthritis – is to identify and treat them early. But this requires clinicians to painstakingly review hundreds of 3D MRI slices to evaluate the knee from different angles.

Researchers at UCSF's Center for Digital Health Innovation (CDHI) are addressing this challenge by using AI in the diagnostic process. Specifically, researchers are developing and training a deep learning model to accomplish three tasks: examine MRI results, identify torn knee cartilage and classify meniscus tears.

The ultimate goal of this work is to develop an accurate, data-driven system for grading meniscus lesions immediately after scanning, allowing for better treatment.

To support this initiative, researchers used BigDL – an open source, distributed deep learning framework for Apache Spark – to define and train models on a data analytics cluster. The cluster is based on Dell EMC PowerEdge servers, Intel Xeon Scalable processors and the Cloudera Distribution of Apache Hadoop for storing, processing and analyzing data.

By deploying this approach, UCSF successfully trained 3D models where the data resides, taking advantage of a system memory footprint that is much larger than the currently available hardware accelerator for deep learning.

The results are promising. Described in Intel's case study on the project, phase one accuracy goals are being met, demonstrating real progress in the fight to improve knee tear diagnosis, treatment planning and clinical productivity using AI.⁵

This is a win not only for patients with knee tears but for the country at large. Better, faster diagnosis will result in fewer cases of osteoarthritis – a serious condition which the Arthritis Foundation says affects 30 million Americans and costs the U.S. economy more than \$100 billion annually.⁶

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⁵ Intel. "Using Artificial Intelligence Solutions to Improve Patient Care." 2018.

⁶ Arthritis Foundation. "Arthritis By The Numbers." 2018.

Training AI Models Faster

AI is a proven tool for quickly and precisely reading medical images. But training deep learning models to read images isn't easy.

This is why more than half of analytical models are never fully deployed – becoming shelfware that brings no value to healthcare organizations.

Conversely, properly developing, training and deploying deep learning models provides significant value by allowing organizations to replicate knowledge at virtually no cost.

Think about the implications in radiology. To train 100 radiologists, each individual must be taught how to identify diseases in medical images. On the flip side, to create 100 AI-enabled radiologist assistants, a neural network model trained to read medical images can be loaded onto 100 different devices.

The productivity gains are obvious, but training the model is challenging. It can take months to train a neural network, which is the underlying architecture of deep learning models. Even once the model is trained, it still might be unable to perform the desired task. In this case, the model must be retrained until it's usable in production.

The Dell EMC team has developed a process that will significantly cut the time to train a neural network model using distributed deep learning so you can get your AI projects into production faster.

Works at Stanford University provided the starting point. In a project

called CheXNet, Stanford aimed to demonstrate a neural network's ability to accurately classify cases of pneumonia in chest X-ray images.

The massive and unbalanced dataset provided by the U.S. National Institutes of Health (NIH) contains more than 120,000 images of frontal chest X-rays – each potentially labeled with one or more of 14 different pathologies.

Over the course of 18 months, Dell EMC's AI engineering team worked with the dataset to develop highly accurate models for pathology classification in frontal chest X-rays. It did so by testing the models on a range of scalable Intel platforms including bare metal HPC environments, BigDL with Spark and Kubernetes with open source Nauta – a multi-user, distributed computing environment for running deep learning model training experiments – to show the power and flexibility of distributed deep learning.

Via a combination of distributed deep learning, optimizer selection and neural network topology selection, researchers were able to speed up the process of training models by 47X, slashing training time for 10 epochs of the NIH dataset from two days to less than two hours, while significantly improving classification accuracy.⁷

This project offers a compelling case study on how model training can be expedited using distributed deep learning. By speeding this step, models can be tuned faster, resulting in better models and ultimately better outcomes for patients and providers.

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⁷ Dell EMC. "Training an AI Radiologist with Distributed Deep Learning." August 2018.

How Dell EMC and Intel Can Help

As AI surges toward ubiquity in healthcare, the global market is set for incredible growth. Accenture reports that in America alone, the AI healthcare market is expected to reach \$6.6 billion by 2021, with a compound annual growth rate of 40%.⁸

Dell EMC Ready Solutions for AI offer everything your healthcare organization needs to get up and running with AI. This includes a portfolio of technologies spanning workstations, servers, networking, storage, software and services to create successful AI, machine learning and deep learning implementations.

And because AI technologies are emerging quickly, and many organizations haven't had the time to develop the necessary skills, Dell EMC has experts who can help.

The Dell EMC HPC and AI Innovation Lab team stays on the cutting edge of AI, testing new technologies and tuning algorithms and applications to help you keep pace with the constantly evolving landscape.

The lab is housed in a 13,000 square foot data center, providing access to thousands of Dell EMC servers in HPC clusters powered by Intel Xeon processor, and sophisticated storage and network systems.

In addition to cutting edge infrastructure, the lab also has a global team of healthcare technology experts that can shorten the design cycle and configuration times. And because AI now offers powerful applications across the entire care continuum, Dell EMC will customize your AI environment to meet any need or budget.

⁸ Accenture. "Artificial Intelligence (AI): Healthcare's New Nervous System." 2017.

Summary and Conclusion

The explosion of healthcare data combined with rising demand for healthcare services and skilled labor has created the ideal environment for AI to thrive.

As AI and deep learning capabilities continue to advance, the opportunities in healthcare and medical imaging are profound. AI has already shown potential to cut costs and boost employee morale while providing better health outcomes for patients.

But gains don't come easy. Dell EMC Ready Solutions for AI offer the tools, infrastructure and expertise needed to realize the promise of AI and easily scale as your computational demands change in the future.

To learn more about how Dell EMC and Intel can help jumpstart your healthcare AI initiatives, visit dell EMC.com/readyforai.

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