

Solution Brief

AI Machine Vision
Disease Detection



AI-Based Solution Helps Accelerate Diagnosis of Lung Diseases

With the help of Intel® AI Analytics Toolkit, Intel® Distribution of OpenVINO™ toolkit, and Intel® DevCloud, Accrad developed the AI-powered solution CheXRad to rapidly detect COVID-19 and 14 other thoracic diseases and deployed it in clinics and hospitals in Africa

Accrad
Accelerated Radiology

"With the help of Intel, we were able to train, optimize, and deploy a machine learning model in less time and at a lower operational cost than available alternatives, enabling us to get to market fast with a powerful solution that's optimized for Intel® architecture."

—Moloti Nakampe, R&D director, Accrad

Up to **160x**
faster
labeling of chest radiographs⁴



After chest X-rays are taken to detect COVID-19, viral pneumonia, and other diseases, days or weeks may pass before a radiologist reviews the images.^{1,2,3} Such delays can worsen patient outcomes and extend outbreaks of contagious diseases. This has led to growing interest in solutions powered by artificial intelligence (AI) that can rapidly and accurately evaluate large numbers of image results, supporting radiologists and helping medical teams prioritize care.

Accrad, a medical AI software company based in South Africa, has developed one such AI-powered solution, which is called CheXRad. Accrad's internal testing found that CheXRad is capable of labeling certain pathologies in chest radiographs up to 160x faster than radiologists, at comparable levels of accuracy, sensitivity, and specificity.⁴ The Windows-based CheXRad application is preconfigured with a COVID-19 and viral pneumonia classification neural network trained using the [Intel® AI Analytics Toolkit](#) on [Intel® DevCloud for oneAPI](#). It is optimized for deployment with the [Intel® Distribution of OpenVINO™](#) toolkit on [Intel® DevCloud for the Edge](#).

To create new machine learning models or refine an existing model, healthcare researchers can quickly retrain and optimize using the Intel® Optimization for TensorFlow, available as part of Intel AI Analytics Toolkit. In addition, a desktop application was developed using Intel Distribution of OpenVINO toolkit for easy deployment, so radiologists could evaluate large numbers of image results. CheXRad thus offers a powerful, flexible, and scalable solution for healthcare researchers and for system integrators with Intel® processor-powered systems that support the Windows 10 IoT Edge operating system.

Challenges: Overcoming radiologist shortages to rapidly identify deadly diseases

Accrad's solution is designed to help detect 15 thoracic diseases, including two of the most deadly: COVID-19 and viral pneumonia. Pneumonia is the largest cause of death in children worldwide, with overall mortality highest in sub-Saharan Africa, and COVID-19 caused over 1.5 million deaths worldwide in 2020 alone.^{5,6} The exponential rise in infections during the COVID-19 pandemic highlights the importance of early detection to curb infection and mortality rates.

Chest X-rays are widely recognized as an effective tool to screen, diagnose, and manage a variety of other thoracic diseases, including COVID-19, and the World Health Organization (WHO) identifies radiography as the best available method to diagnose pneumonia.⁷ The challenge is that billions of people worldwide, particularly those in rural and remote regions, do not have timely access to radiologists who can interpret the results of chest scans.

The WHO estimates that two-thirds of the world's population lacks access to basic radiology services like X-rays.³ Kenya has only about 200 radiologists to

serve a population of 43 million people,⁸ and many other countries—including Liberia, South Africa, Australia, the United States, and the United Kingdom—have identified similar shortages in the number of available radiologists. Even before the COVID-19 pandemic, people in many parts of the world sometimes had to wait weeks for a radiologist to read their chest scans, leading to worsened patient outcomes and increased spread of infectious diseases.^{9,10}

AI-powered solutions are designed to help radiologists manage their increasing workloads through a variety of methods, including by screening large volumes of radiographs to predict those with a high probability of disease.

Solution: Detecting and classifying diseases using machine learning at the edge

CheXRad is a machine learning–based desktop application designed for use on Intel processor-based PCs in clinics and hospitals in Africa. The easy-to-use Windows 10 application comes preconfigured with a COVID-19 and viral pneumonia classification neural network trained using Intel AI Analytics

Toolkit on Intel DevCloud for oneAPI and optimized with the Intel Distribution of OpenVINO toolkit on Intel DevCloud for the Edge.

Radiologists, physicians, and researchers can use CheXRad to help identify COVID-19, viral pneumonia, and other diseases on chest X-ray images and predict which patients are most likely to need a ventilator or medication. The solution provides the probability value of each pathology, as well as specifying regions of interest for radiologists to pursue. In internal testing, Accrad found that CheXRad could label certain pathologies in 140 chest radiographs in just 90 seconds—up to 160x faster than radiologists, at comparable levels of accuracy, sensitivity, and specificity.⁴

CheXRad has been deployed using Microsoft Partner Center and will be available on the Microsoft Store. The application is designed for use in the healthcare research field, including in radiology labs, clinics, and hospitals, and it can be used by systems integrators with Intel processor-based systems that support the Windows 10 IoT Edge operating system.

How it works

To train its COVID-19 and Viral Pneumonia Classification neural network, Accrad used the Intel AI Analytics Toolkit and other tools, services, and infrastructure provided by the Intel DevCloud for oneAPI. The Intel Optimization for TensorFlow, a deep learning framework included in the Intel AI Analytics Toolkit, provided a high-level programming language based on Python to architect, train, and validate the deep neural network. The TensorFlow framework was specifically optimized for Intel® platforms like Intel® Xeon® Scalable processors, helping to improve the speed of an otherwise time-consuming training process.

To further optimize the trained model for fast deployment, Accrad employed the Intel Distribution of OpenVINO toolkit, an inference tool suite available through Intel DevCloud for the Edge. Accrad tested its model on three Intel processors: an Intel® Xeon® Gold 6258R processor, an Intel® Core™ i5-6500TE CPU, and an Intel® Core™ i5-6200TE GPU/HD530. Using the toolkit, processing time on the Intel Xeon Gold processor was just 6.8 seconds at 0.15 frames per second, making it 3x faster than the other processor options.¹¹

CheXRad uses the OpenVINO inference engine to classify and detect the probability of viral pneumonia and COVID-19 in preprocessed chest scan images. The toolkit helped Accrad accelerate time to market via an easy-to-use library of computer vision functions and preoptimized kernels. Intel® Deep Learning Boost (Intel® DL Boost) was also used for model quantization, resulting in a clear performance boost on the model's inference workloads.¹¹

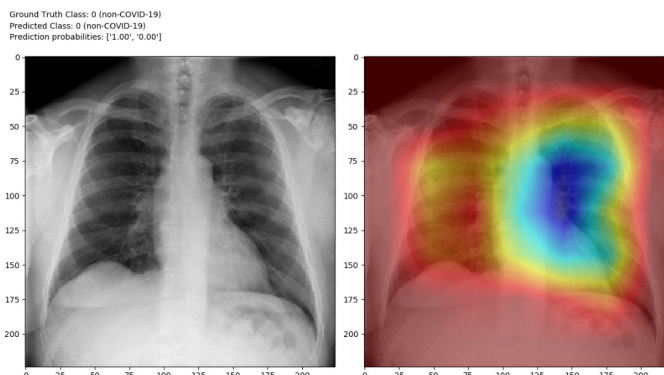


Figure 1. Locating COVID-19 using Class Activation Mapping (CAM)

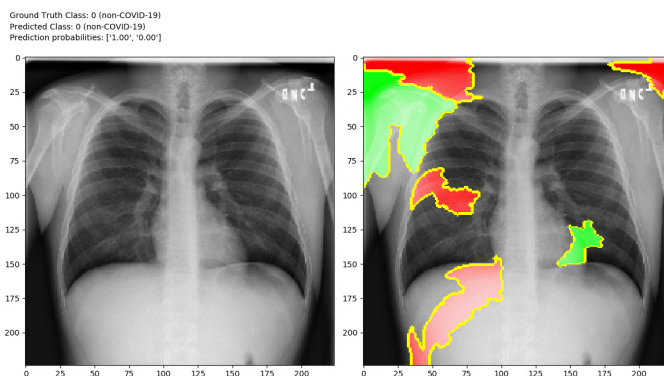


Figure 2. Locating COVID-19 using Local Interpretable Model-agnostic Explanations (LIME)

"The Intel® AI Analytics Toolkit and OpenVINO™ toolkit helped us reduce the amount of time required to develop our application for healthcare, making it easy to optimize and deploy the model on Intel® Xeon® Scalable and Intel® Core™ processors. It also helped us meet business requirements for performance, system power, and competitive pricing."

— Moloti Nakampe, R&D director, Accrad

Create new models

With the help of Intel® tools and technologies, Accrad has made it possible for radiologists and other medical experts to easily retrain and further optimize the COVID-19 and Viral Pneumonia Classification model, as well as to create other custom models.

- **Accrad Train:** CheXRad is preconfigured with the COVID-19 and Viral Pneumonia Classification machine learning model. Radiologists can easily add new data and images to the training set and retrain the model with the click of a button. The training is performed on an Azure Data Science Virtual Machine powered by Intel Xeon Scalable processors.
- **AI Model Manager:** Once retraining is complete, radiologists can export the updated model in ONNX/TensorFlow format onto their local system. The ONNX/TensorFlow model is then optimized using the OpenVINO™ Model Optimizer. Radiologists can also create other custom models using CheXRad as the base model, and model iterations can be stored in the cloud using the training and prediction API.
- **Performance:** The COVID-19 and Viral Pneumonia Classification model's predictions are 99.91 percent accurate on average across all classification thresholds.¹¹ Radiologists may also obtain better performance by retraining the models, and the CheXRad application will instantly provide performance statistics.
- **Accrad Deploy:** CheXRad provides an extensible reference development framework that facilitates turning AI models into AI-powered clinical workflows with built-in support for DICOM communication and the ability to interface with existing hospital infrastructures.

About Accrad

Accrad is building Africa's largest medical AI software company. The company is devoted to conquering cancer and other pathologies across Africa and is developing AI software to help radiologists save time and diagnose with accuracy under pressure.

accrad.com

Conclusion: Accelerating chest radiology with an AI solution powered by Intel® technology

Chest X-rays are an effective screening tool for COVID-19, pneumonia, and other deadly diseases, but a shortage of radiologists, especially in rural and remote areas, can lead to long wait times before the images are read.^{1,2,3,7} By quickly and accurately predicting disease pathologies, AI-powered solutions like Accrad's CheXRad application can help reduce radiologists' workloads and potentially accelerate diagnoses and treatments.

CheXRad is preconfigured with a COVID-19 and Viral Pneumonia Classification neural network trained using Intel AI Analytics Toolkit on Intel DevCloud for oneAPI and optimized with the Intel Distribution of OpenVINO toolkit on Intel DevCloud for the Edge. The application is powerful, accurate, and easy to use, and it allows healthcare researchers and others to update the existing model or create new models to meet future challenges.

Learn more

For additional information about CheXRad, email mol@accrad.com today or visit accrad.com.

Intel AI Analytics Toolkit

The Intel AI Analytics Toolkit is free oneAPI-powered software that gives data scientists, ML/DL developers, and AI researchers familiar Python tools and frameworks to accelerate end-to-end data science and machine learning workflows on Intel® architectures. The toolkit provides seamless interoperability and out-of-box experience to streamline AI development.

Using this toolkit, you can:

- Deliver high-performance deep learning (DL) training on Intel platforms and integrate fast inference into your model creation workflow with Intel-optimized DL frameworks: TensorFlow and PyTorch, pretrained models, and low-precision tools.
- Achieve drop-in acceleration for data analytics and machine learning workflows with compute-intensive Python packages: Modin, NumPy, Numba, scikit-learn, and XGBoost optimized for Intel.
- Gain direct access to Intel analytics and AI optimizations in one place to ensure that your software works together seamlessly.

[Learn more >](#)

Intel Distribution of OpenVINO toolkit

The Intel Distribution of OpenVINO toolkit is free oneAPI-powered software for developers that accelerates performance, deep learning, and computer vision inference from edge to cloud. It supports heterogeneous processing and asynchronous execution across multiple types of Intel processors.

Introducing Long-Term Support

Developers can now choose between standard support releases or Long-Term Support (LTS) for the Intel Distribution of OpenVINO toolkit. Standard releases provide new versions of the toolkit every quarter, ideal for early-stage projects and developers looking to take advantage of the latest innovations in deep learning. LTS offers long-term maintenance and support, a great choice for later-stage developers focused on leveraging the toolkit's existing features and functionality.

Long-Term Support benefits:

- Focuses on deployment and is designed to be taken into production
- Includes critical bug fixes for one year and security patches for two years, postrelease
- Enables shipping applications with reliability in existing capabilities and compatibility

[Learn more >](#)

Intel DevCloud for oneAPI

Intel DevCloud for oneAPI is a development sandbox for data-centric workloads. Apply machine learning and deep learning algorithms for faster training and inference and develop, test, and run your workloads for free on a cluster of the latest Intel® hardware and software.

[Learn more >](#)

Intel DevCloud for the Edge

Intel DevCloud for the Edge is a cloud-based sandbox that empowers enterprise developers to test, prototype, and benchmark AI edge models across multiple platforms in real time from nearly anywhere in the world. This makes it easy to identify the best hardware configurations for AI edge applications, accelerating time to market and reducing costs.

[Learn more >](#)



1. <https://www.rsna.org/en/news/2019/May/uk-radiology-shortage>.
2. <https://www.theatlantic.com/health/archive/2016/09/radiology-gap/501803/>.
3. https://www.paho.org/hq/index.php?option=com_content&view=article&id=7410:2012-dia-radiografia-dos-tercios-poblacion-mundial-no-tiene-acceso-agnostico-imagen&Itemid=1926&lang=en.
4. Based on Accrad test results. The average time for radiologists to complete labeling of 420 chest radiographs was 240 minutes. The deep learning algorithm labeled the same 420 chest radiographs in 1.5 minutes.
5. https://www.who.int/maternal_child_adolescent/news_events/news/2011/pneumonia/en/.
6. <https://ourworldindata.org/pneumonia#where-do-children-die-from-pneumonia>.
7. https://apps.who.int/iris/bitstream/handle/10665/66956/WHO_V_and_B_01.35.pdf?sequence=1&isAllowed=y.
8. <https://radiology.ucsf.edu/blog/digital-x-ray-go-kenya>.
9. <https://www.aidoc.com/blog/is-radiologist-shortage-real/>.
10. <https://escholarship.umassmed.edu/cgi/viewcontent.cgi?referer=https://www.theatlantic.com/health/archive/2016/09/radiology-gap/501803/&httpsredir=1&article=1020&context=jgr>.
11. Based on Accrad test results.

Intel does not control or audit third-party data. You should consult other sources to evaluate accuracy.

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No product or component can be absolutely secure.

Your costs and results may vary.

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