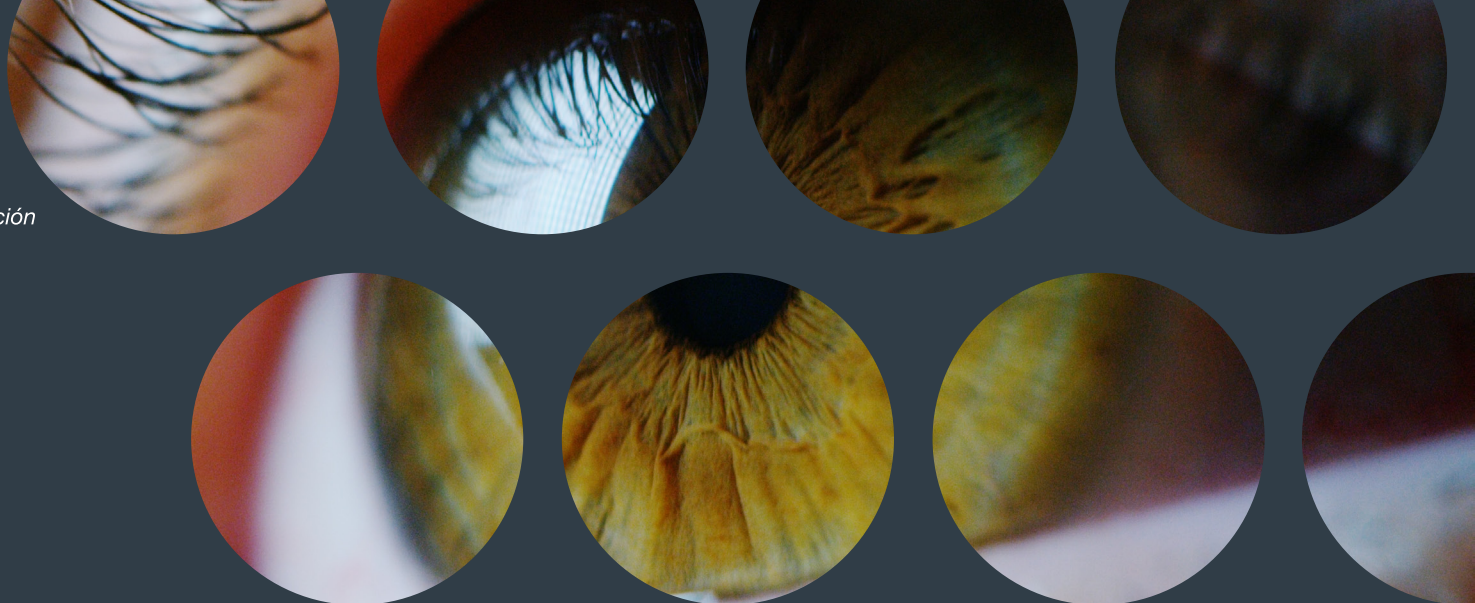




**Barcelona
Supercomputing
Center**
Centro Nacional de Supercomputación



BARCELONA SUPERCOMPUTING CENTER

Envisioning a better future for eye disease diagnosis.

Visual impairments affect millions of people, but there are many conditions that can easily be prevented. Researchers at the Barcelona Supercomputing Center teamed up with Lenovo to build and train an artificial intelligence model to enhance the accuracy of retinal disease screening – improving the outcome for patients and potentially saving their sight.

Lenovo





Many of us take our vision for granted, but according to the World Health Organization, visual impairment affects nearly [one in 20 people](#). Today, around 253 million people worldwide live with some form of visual impairment. But the fact is, up to 80% of cases can be prevented. As with all health issues, the earlier that retinal disease is diagnosed, the better the patient's outcome. When diagnosed early, the chances of developing severe vision loss can be reduced by up to 57%.

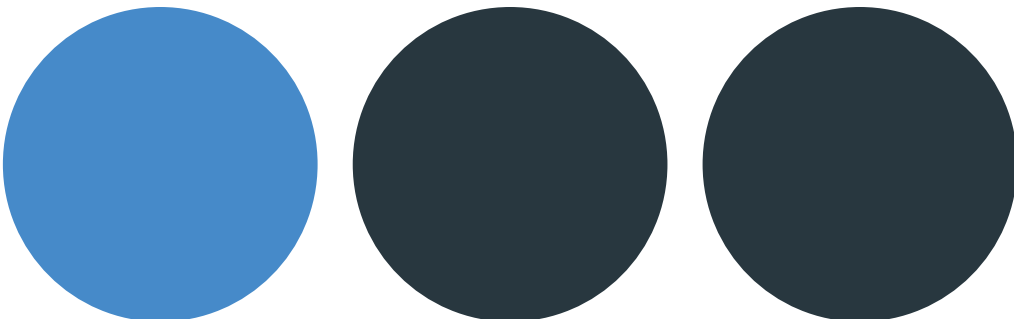
Despite the positive impact early diagnosis can have on the lives of patients, innovations in the retinal disease screening process have been few and far between.

Traditional, in-person dilated eye examinations have a fairly low accuracy rate, and ophthalmologists often struggle to detect retinal diseases with this method.

With so many other potentially life-threatening illnesses snatching the headlines, it's hardly surprising that the public is not very aware of the prominence of retinal diseases, even though it's a serious health issue that can have a lasting impact on the lives of the visually impaired and their family.

In an attempt to help people retain their vision, researchers at the Barcelona Supercomputing Center (BSC) are investigating whether artificial intelligence (AI) technologies could help ophthalmologists detect retinal diseases more effectively.

Led by Dr. Dario Garcia-Gasulla, Postdoctoral Researcher at BSC, the research group teamed up with Lenovo to explore how AI could improve the accuracy of retinal disease screening processes.



Guided by the AI experts and with access to Lenovo's state-of-the-art high-performance computing (HPC) resources, the research group built and trained a machine-learning model to detect different retinal pathologies.

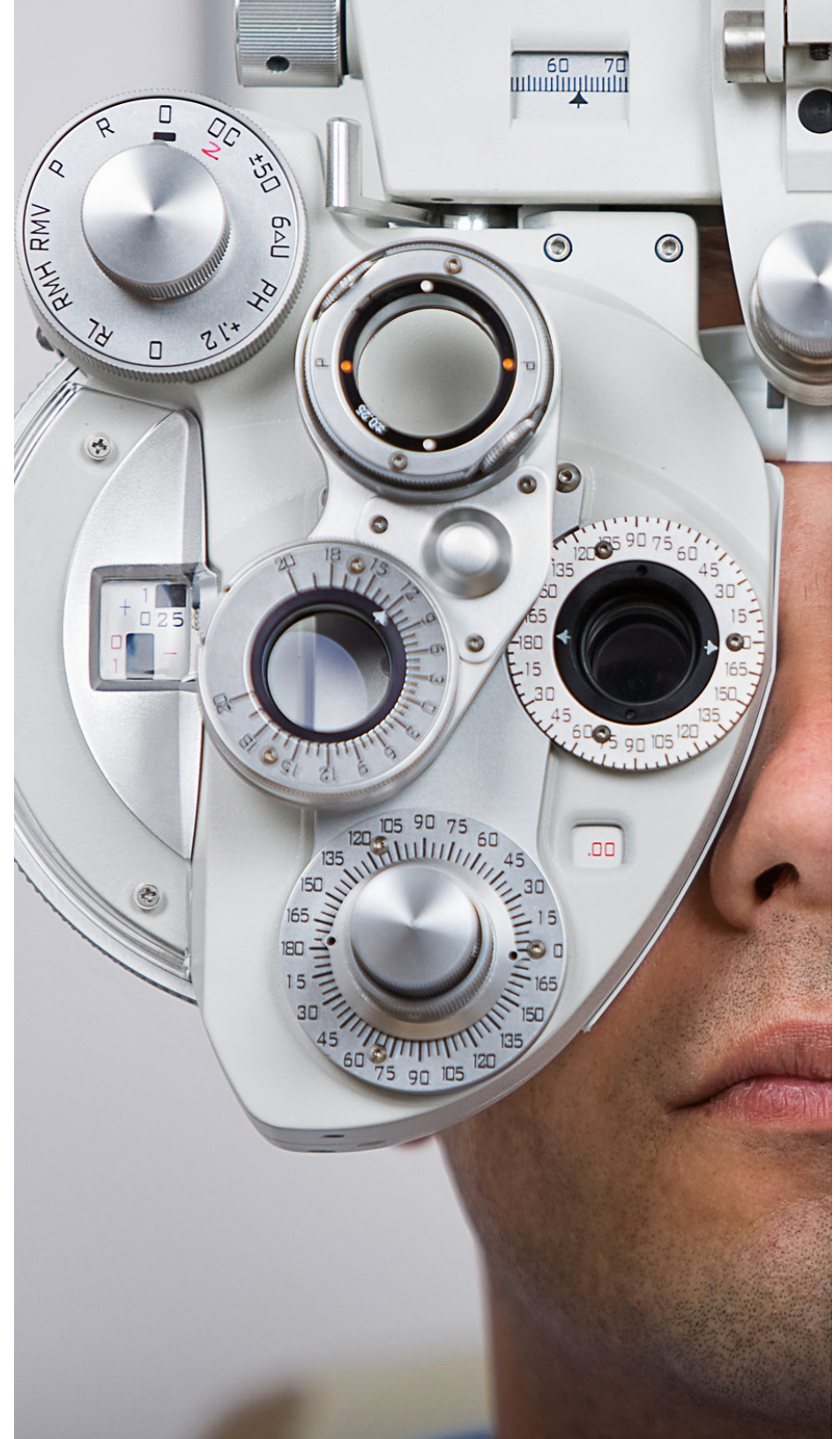
There are many different pathologies that can cause visual impairment, including diabetic retinopathy (damage to blood vessels caused by complications with diabetes), glaucoma (damage to the optic nerve), macular degeneration (which causes blurred or no vision in the center of the visual field), nevus (a growth similar to a mole that can occur inside the eye) or epiretinal membrane (tissue that develops on the surface of the eye, causing problems with central vision).

The research group developed [Tiramisu](#), a specialized data analytics tool for processing, transforming and exploiting data generated by machine-learning models, and ran the workloads on BSC's HPC cluster, MareNostrum 4. Made up of 3,456 Lenovo ThinkSystem SD530 nodes equipped with Intel® Xeon® Platinum processors, MareNostrum 4 is one of Europe's largest supercomputers and benchmarks at 11.1 PFLOPS.

Dr. Dario Garcia-Gasulla says: "The issue with training a machine-learning model to detect different pathologies and retinal diseases is that there often isn't enough clean data available to train an AI neural network. For pathologies with limited dataset availability, those with fewer than 3,000 images, for example, training a reliable deep neural network from scratch may not be feasible."

That's where transfer learning comes in. Transfer learning is based on models trained for problems with larger datasets, which are then reused to solve other problems with limited data availability.

"You can use pre-trained neural network models as a starting point for training simpler models," explains Dr. Dario Garcia-Gasulla.



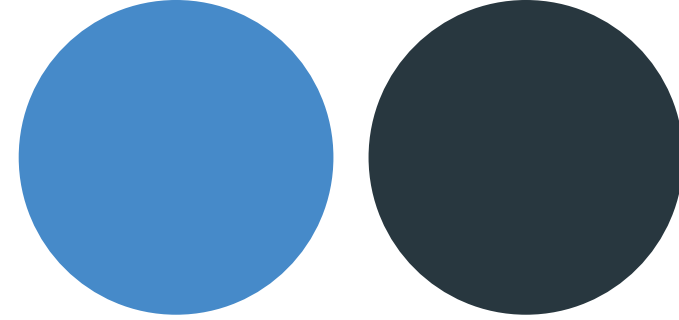
“So rather than building and training a deep net for every kind of retinal pathology, we can re-use our ‘base’ model and train it to detect a second pathology, and then train a third model to detect another kind of pathology, and so on. This enables us to produce new models really quickly and very easily.”

BSC and Lenovo’s transfer-learning research project enables users to select which retinal pathology they want to create a machine-learning model for. Users simply select the pre-trained neural network they want to use as a feature extractor, and images of the target pathology will be fed into the model.

“BSC’s transfer-learning research project has demonstrated that AI and machine-learning development will, in the near future, become simplified and intuitive. By using Lenovo technologies, BSC has created easy-to-use AI with fantastic results,” says Patrick Moakley, Director of HPC and AI Marketing in Lenovo’s Data Center Group.

Madhu Matta, Vice President and General Manager, High Performance Computing and Artificial Intelligence, adds: “We are very excited to collaborate with BSC on solving a challenging problem with great human impact, particularly by leveraging transfer learning techniques. It has broader implications for the adoption of AI in many industries, not just healthcare. Many organizations are challenged with having access to large amounts of quality data suitable for training effective AI methods like deep learning, where transfer learning comes to the rescue by relaxing those requirements.”

Dr. Dario Garcia-Gasulla notes: “The goal of the project is to show how easy it is to use pre-trained deep neural networks as feature extractors to feed other simpler and faster models. Instead of spending six months trying different network architectures and hyperparameter configurations, we can design, train and validate the performance of a machine-learning model to detect a retinal pathology in under 10 minutes using CPUs – or in just 3 minutes using GPUs.”



Supported by Lenovo, the research group is harnessing AI technology in exciting new ways – pushing the boundaries of what’s possible with machine learning to improve the accuracy of retinal disease screening. Further, the collaboration is continuing to bring the transfer learning capabilities to Lenovo intelligent Computing Orchestration (LiCO), a software tool powering AI efforts in research and enterprises. The ultimate goal? To help ophthalmologists to detect the signs of retinal diseases earlier than ever before, potentially saving the sight of millions of people.

For more information

To learn more about the research group’s work, visit: arxiv.org/abs/1705.07706

Watch this [video](#) to learn more about BSC’s world-class HPC cluster, MareNostrum4.



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Solution components

Hardware

MareNostrum 4 supercomputer,
based on Lenovo ThinkSystem
SD530 with Intel® Xeon® Platinum
processor family

Software

Lenovo intelligent Computing
Orchestration (LiCO)
BSC Tiramisu project (HPAI group)

Services

Lenovo AI Innovation Center
Services
BSC HPC Services



“We can design, train and validate the performance of a machine-learning model to detect a retinal pathology in under 10 minutes using CPUs - or in just 3 minutes using GPUs.”

—Dr. Dario Garcia-Gasulla, Postdoctoral Researcher, Barcelona Supercomputing Center

Researchers at Barcelona Supercomputing Center teamed up with Lenovo to build and train a machine-learning model that has the potential to improve the accuracy of eye disease screening. This will empower ophthalmologists to diagnose visual impairments sooner, improving the outcome for patients.

