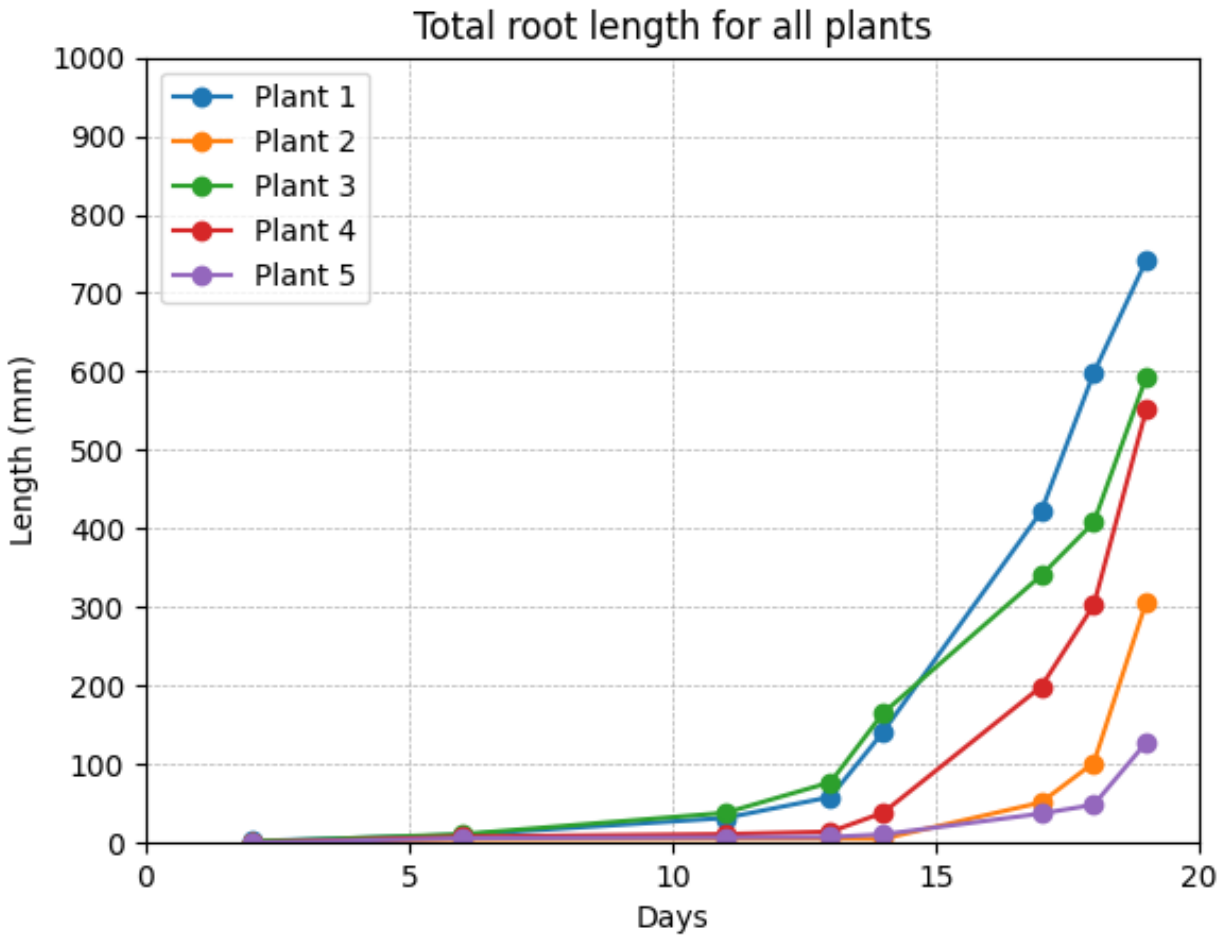
Breda University of Applied Sciences

Case Study

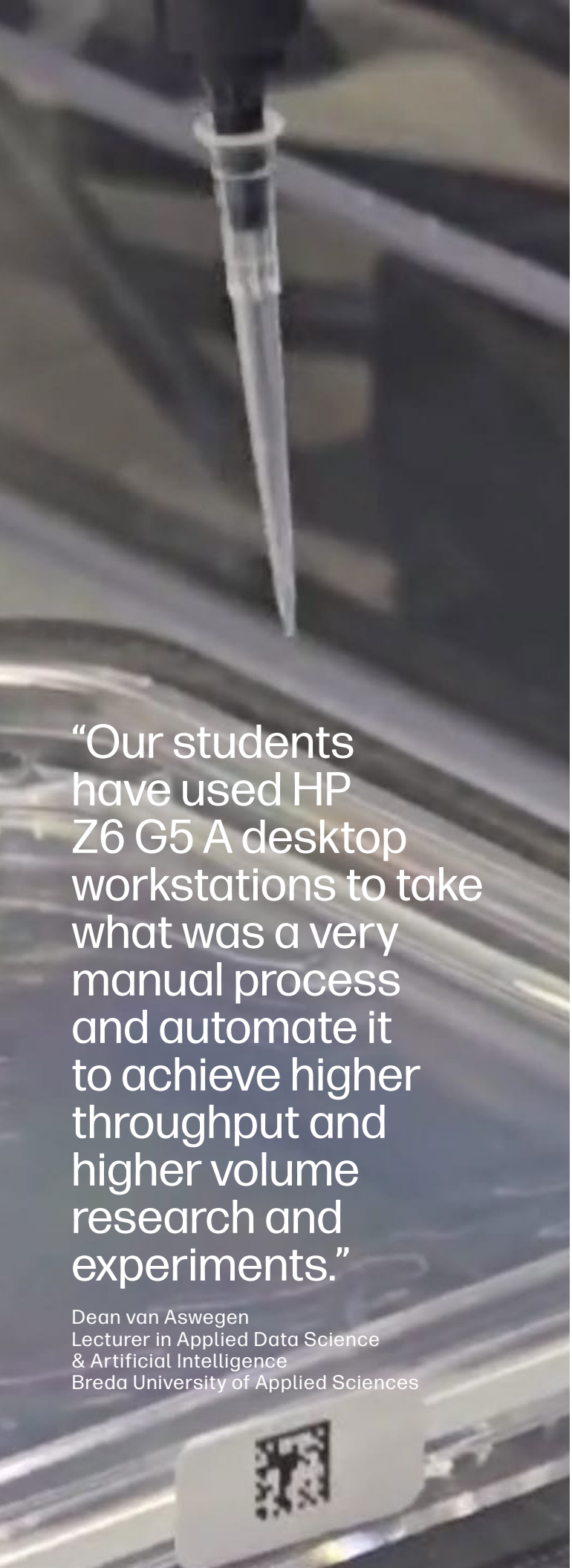
/ AMD

High-performance HP Z6 G5 A desktop workstation advances crop cultivation research by cutting roots system analysis from hours to seconds



The hard fact facing governments worldwide is how to feed growing and increasingly demanding populations. Unpredictable climate, harmful pesticides, less farmland, and soil exhaustion are just some of the challenges making it difficult for agriculture to meet the voracious need for more and better foods.

Encumbered by these formidable challenges, governments and academia are turning to science and technology to find solutions. One example is a collaboration between Breda University of Applied Sciences and NPEC (Netherlands Plant Eco-phenotyping Centre), a government-funded research institution. Data science, AI, and HP powered computer vision technology has been used to find ways to improve plant growth, yield, and resistance to disease.



“Our students have used HP Z6 G5 A desktop workstations to take what was a very manual process and automate it to achieve higher throughput and higher volume research and experiments.”

Dean van Aswegen
Lecturer in Applied Data Science
& Artificial Intelligence
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Industry and academic collaboration

The recently formed Bachelor Program in Applied Data Science and AI at Breda University has adopted an innovative approach to education by focusing entirely on project-based learning. Dean van Aswegen, Lecturer in Applied Data Science & Artificial Intelligence at Breda University, explained, “We educate students to be far better prepared to add value as soon as they start work rather than needing six to twelve months before coming up to speed. It is similar to a hybrid between apprenticeship and traditional university education.”

The collaboration project between Breda University and the NPEC is an example of the university’s approach to learning. NPEC aims to develop novel adaptive crops and cropping systems required for future food production and food security without compromising the planet. But real-world projects like this need industry-class resources, and Breda University’s Data Science and AI department had already maxed out its two high-powered Lambda Labs servers. “It was a bit of a perfect storm and, in terms of the demand on our computing resources, all of the gauges were red,” said van Aswegen.

It was at an AI event that van Aswegen was introduced to high-performance HP Z workstations.

He commented, “We liked the HP Z6 G5 A desktop workstation because of technology features like the high video memory NVIDIA RTX™ 6000 ADA GPU and high core count AMD Threadripper CPU[1], added van Aswegen. “We have multiple users working on the same system, so it helps to have a CPU with lots of cores because it facilitates multi-user workflows. Most systems focus only on the GPU because they target single-user workloads whereas we needed a more well-rounded system.”

HP Z workstations enable ‘best work’

Van Aswegen also praised the small footprint and low noise of the HP Z6 G5 A desktop workstation which made it more flexible and easier to use compared to the existing rack-mounted servers. “Having the HP Z6 G5 A desktop workstation was very important because the power and graphics processing capabilities enabled our students working on the NPEC project to do their best work,” added van Aswegen.

For the project, the department used an HP Z6 G5A G5 workstation, like a server, with up to 10 students accessing the device simultaneously via Wi-Fi connected laptops. The HP Z6 G5 A desktop workstation has the AMD Ryzen® Threadripper™ PRO series CPU[1] and the NVIDIA RTX 6000 Ada GPU. van Aswegen explained, “The AMD CPU[1] has 96 cores and 192 threads which allows us to run multiuser workloads. Also, as a prosumer chip instead of a server chip, it runs at significantly higher clock speeds which improves performance over traditional server hardware.”

Programming was done in Python along with TensorFlow and PyTorch open-source platforms for machine learning, and Docker for virtual environments. Other software included the HP AI Studio data science platform.

“It used to take between two and four hours for an NPEC researcher to view, measure and label one image. With the HP Z6 G5 A desktop workstation, the model does the same process in seconds.”

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HP AI Studio empowers teams to streamline their AI development workflow by building with pre-built templates, creating shared workspaces for collaboration, connecting team members to track experiments and reproduce environments, and deploying trained models with containers – all within a cohesive local platform.

The HP Z6 G5 A desktop workstation was used by 10 2nd-year bachelor students to help the NPEC improve plant phenotyping, a set of methodologies and protocols used to measure plant growth, architecture, and composition. In its labs, the NPEC grows Arabidopsis plants to test root development under various conditions to find optimal ways to cultivate crops. Arabidopsis plants are used in agricultural research because of their small genome, low cost, and quick, easy growth. They are planted in transparent containers so root development can be photographed and labeled with data points such as root measurement and key points like root tip or where lateral roots grow.

NPEC produces thousands of root system photographs every day and spends hours measuring and labelling roots on each photograph. Two hundred images, each comprising 4,000 by 4,000 pixels and showing root systems for five plants, were given to students to develop an AI analysis model.

16,000,000 pixels per image

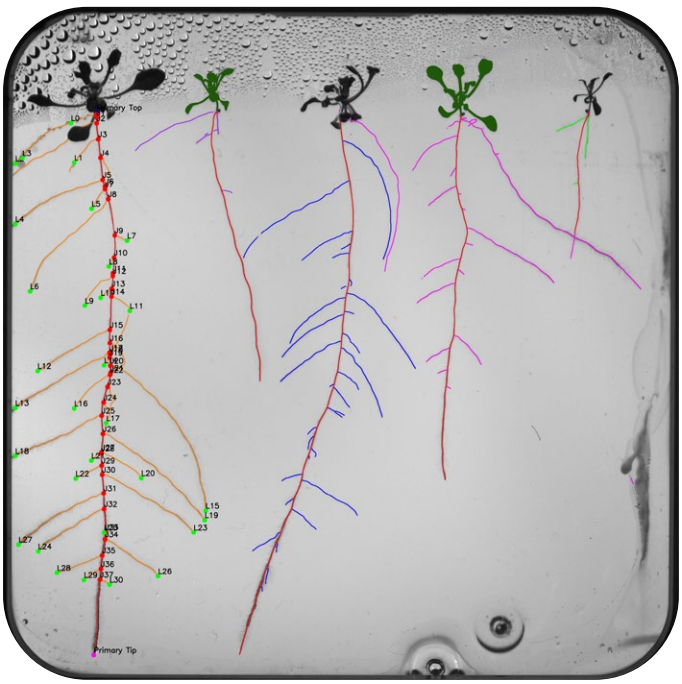
The model 'learned' the labeling process and developed a segmentation mask which automates the manual labeling process. Because the root structure is thin, sometimes no thicker than a human hair, the model needed the powerful HP Z6 G5 A desktop workstation to analyze 16,000,000 pixels in each photograph to identify if a pixel contained part of a root or just soil.

A combination of more memory and more robust graphics processing speeds in the HP Z6 G5 A desktop workstation meant students could work simultaneously and process more than 3.2 billion pixels during the training process to develop the root analysis model.

"Our students have used HP Z6 G5 A desktop workstation computing power to take what was a very manual process and automate it to achieve higher throughput and higher volume research and experiments," stated van Aswegen. "It used to take between two and four hours for an NPEC researcher to view, measure, and label one image. With the HP Z6 G5 A desktop workstation, the model does the same process in seconds."

About Breda University of Applied Sciences

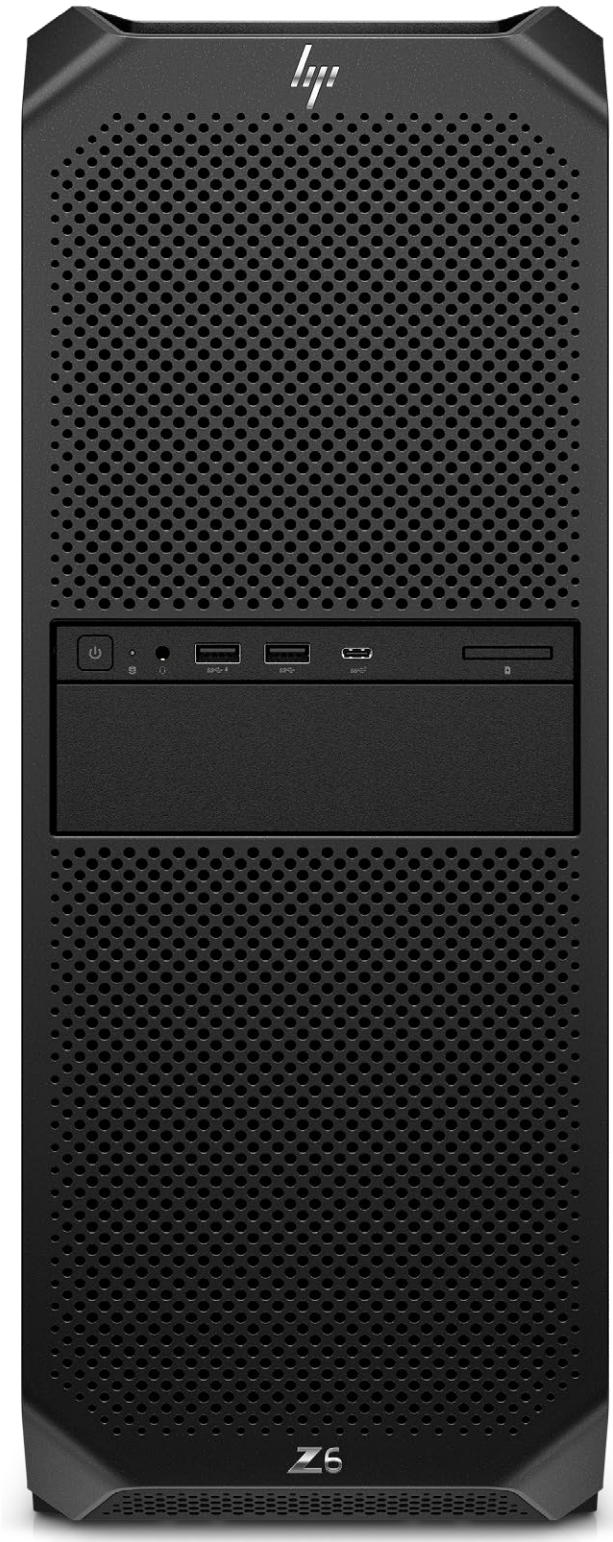
The four-year Data Science and AI Bachelor Program at Breda University was set up in 2020. It offers students training in Data Science, AI, consultancy skills, and programming skills. Education is based on Project- Based Learning (PBL), a teaching method where students gain knowledge and skills by working for an extended period of time to investigate and respond to complex questions, problems, or challenges. The focus is on facilitating students to become self-driven learners who can analyze a problem and use all of the resources around them to find solutions. Currently, the program has 200 students and can accommodate up to 400.



As a result of the project, students at Breda University have created what van Aswegen believes is one of the largest Arabidopsis root labeling databases in the world. Among the students who contributed to this project, Fedya Chursin, Borislav Nachev, Francisco Ribeiro Mansilha, Wesley van Gaalen, and Vlad Matache are most recognized for exceeding expectations. They are now preparing to publish an academic paper on their research, a testament to their dedication and innovative thinking.

Advancing better food production

With the model, students are now building a web application that NPEC researchers can use to upload future images to dramatically improve root development analysis. In addition, the AI model is being used to



Industry

Agriculture

Objective

Advance research into improving plant and crop growth, development, and yield using data science and AI to automate root system analysis.

Approach

Maximize the power of the HP Z6 G5 A desktop workstation platform to develop AI and machine learning models that dramatically reduce R&D time and effort.

develop applications that will drive robots in NPEC labs so operations, such as inoculating roots at different locations, are automated, saving further R&D time and costs.

However, overarching all the benefits is the potential impact on people's lives. As van Aswegen concluded, "It is true to say the work that our data science and AI students have done using HP Z workstation technology, in collaboration with the NPEC, has contributed to the ultimate goal of advancing better food production."

IT matters

- HP Z6 G5 A desktop workstation multi-core CPU enables simultaneous multi-user workflows
- Small footprint and low noise output enable flexible working
- AMD Ryzen® Threadripper™ PRO series CPU[1]
- NVIDIA RTX™ 6000 Ada GPU
- Software included Python, TensorFlow, PyTorch, and HP AI Studio

Business matters

- Dramatic improvement in plant development analysis
- Cuts manual root labeling process from four hours to two seconds
- Creates one of the world's largest Arabidopsis root labeling databases
- Student-authored academic R&D paper planned for publication

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[1] Multi-core is designed to improve performance of certain software products. Not all customers or software applications will necessarily benefit from use of this technology. Performance and clock frequency will vary depending on application workload, and your hardware and software configurations. AMD's numbering is not a measurement of clock speed.

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