Intensifying Research into Plant Evolution at GMI

The SGI® ICE™ X supercomputer "Mendel" is analyzing the influence of individual DNA components on the evolution of plants.

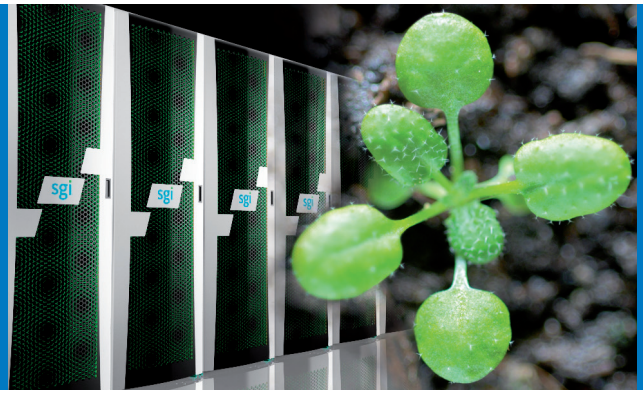
Background information

Organization:
Gregor Mendel Institute of Molecular Plant Biology (GMI)

Location:
Vienna, Austria

Field:
Basic research

GMI Greenhouses (Source GMI)



Model plant Arabidopsis thaliana (Source GMI)

Overview

The Gregor Mendel Institute of Molecular Plant Biology (GMI) was founded by the Austrian Academy of Sciences (ÖAW) in 2000 to promote research excellence in the area of plant molecular biology. GMI, which is based in Vienna, is one of very few institutions worldwide focusing on basic research using plants, and the only one in Austria. Its research focuses primarily on the underlying questions of plant biology and includes, above all, molecular biological aspects such as epigenetic mechanisms, population genetics, chromosome biology, stress resistance and evolutionary biology.

GMI employs around 100 scientists from 30 countries across a wide range of research groups. Its cutting-edge laboratory was designed by the Viennese architect Boris Podrecca, and is located in the heart of the Vienna Biocenter campus.

The Challenge

Modern molecular biological measuring methods generate huge volumes of data which will continue to grow exponentially in the future. Preparing, visualizing and analyzing this data requires special high-performance computers in order for useful, scientific results to be achieved without excessive demands on time.

One use of the SGI system is to examine the effect of various environmental conditions on how plant roots grow. To this end, the supercomputer analyzes hundreds of thousands of high-resolution digital photos and compares the data through billions of computer operations. This allows the impact of each individual DNA component in the plant genome – of which there are 120 million in total – to be calculated.

"The SGI ICE X enables us to assemble and compare genomes from a huge number of individual plants, and to investigate the genetic basis of naturally changing features and those that are significant for modification", states Dr Magnus Nordborg, Scientific Director of the Gregor Mendel Institute.

Although the Institute is housed in a vast and impressive laboratory complex, only 753 square feet of floor space was available for the computer center. This limited space meant that not only did the computer system itself have to be extremely compact but it also required a particularly efficient cooling system. In addition, the target solution had to guarantee maximum scalability and ensure that the pre-requisites for future expansions were already in place.

The Solution

The SGI ICE X fulfils these requirements in every respect. A platform which ensures seamless scalability from teraflop to petaflop. A solution that can be expanded over system generations guaranteeing uninterrupted working processes. An extremely compact blade design with redundant power supply and energy-efficient cooling. All in all, a system with unsurpassed efficiency, superior performance and the highest quality.

In its initial expansion stage, "Mendel", consists of an SGI ICE X Cluster made up of Dakota computer nodes with Intel® Xeon® Processor E5-2650 processors. In total, it uses 72 blades with 1,152 processors. The service nodes consist of system components used on the basis of the SGI summit server. Every other server is operated as a login or gateway node.

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GMI Plant Growth Chambers (Source GMI)

GMI Plant Growth Chamber (Source GMI)

This is supplemented by a Lustre data system with two storage servers, an SGI IS5500 as OSS and an SGI IS5000 for metadata with a gross capacity of 240 terabytes. Data transfer takes place across a high-speed network with a transfer rate of up to 7.3GB/s. Due to the task structure, data is normally transferred between two neighboring systems. The Hypercube network architecture of an SGI ICE X provides the optimal price/performance ratio for this.

All infrastructure components are designed for subsequent expansion, therefore the only change required is for additional computer nodes to be installed in the racks. This means the configuration can be expanded to up to 288 computer nodes in total without major work needing to be undertaken.

All servers use Novell SLES11 as its operating system. The software concept is supplemented by the SGI cluster administration software and the SGI management center for administering and monitoring the SGI ICE X. The system can run all standard software used in the fields of technology and science.

SGI Technology

Extremely compact in design, each SGI ICE X Dakota blade has 2 processor bases, 64 gigabytes of memory, an InfiniBand adapter and board management controller. The compact architecture uses internal InfiniBand hardware in full bandwidth with very low latencies.

M-Cell housings developed especially by SGI and installed in multiple places serve as housings. The inlet temperature of the cooling water for this cooling rack can reach up to 90°F. The Dakota blades themselves have no form of ventilation; instead the considerably more efficient “in-row” cooling racks provide the necessary air circulation. In this regard, no air is exchanged with the surrounding environment. The availability of the computer nodes and the efficiency of the cooling is dramatically increased by the ventilation-free blades. The circulating air and power needs of the cooling components can be controlled efficiently independent of the temperature and load.

The Collaboration

With the “Mendel” supercomputer, this highly prestigious Institute has succeeded in anchoring its reputation as a top-quality research institution with an outstanding technical infrastructure. According to Eckehard Siegmann, Head of IT at GMI, “This high-performance computer has equipped the Gregor Mendel Institute to meet its current and future needs and means it will continue to stand alongside other top international institutions, performing cutting-edge research at the highest level”.

This high-performance computer is also made available to other research groups from other institutions, especially those based on the Vienna Biocenter campus, allowing the investment to benefit the entire research complex.

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Dr. Magnus Nordborg
Scientific Director of the Gregor Mendel Institute

About SGI

As a recognized market leader in high performance computing (HPC), SGI offers solutions for the most demanding challenges. SGI develops excellent systems in the fields of technical computing, big data and cloud computing.

With experienced partners across a strong network, SGI supports the development of efficient and high-performance solutions to meet the requirements of each individual customer.

With its qualified experts, SGI can advise its customers on applications of any level of complexity and provides a comprehensive customer service to meet the highest demands.

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