
Improving health
outcomes using
advanced computing

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Atos

Rapid developments in high performance computing, edge technology and artificial intelligence are creating new opportunities to accelerate research and deliver innovative solutions into frontline healthcare.

Understanding and treating inflammatory bowel disease

Millions of people suffer from digestive-related health problems; inflammatory bowel diseases (IBDs) alone affect 1.5 million Americans, 2.2 million Europeans and hundreds of thousands of people in other developed countries. IBDs can be highly impairing and are often misdiagnosed because their causes aren't clear.

They also place a heavy burden on social and healthcare systems; in the UK, for example, the average cost of IBD treatment has been estimated at around £3,000 per patient per year, totaling over £1 billion in annual costs and rising, given the increasing prevalence of these diseases globally. Early interventions, however, can significantly improve patients' quality of life and reduce costs, hospitalization and surgery rates.

An early and precise diagnosis is therefore crucial to the effective management of IBDs. Unfortunately, clinical investigations to diagnose and monitor IBD are often invasive (for example, colonoscopies and biopsies).

Recent research has offered new hope. Studies suggest that changes to gut microbiota may be a cause of IBDs. This means that studying a patient's complete intestinal flora and measuring the gut microbiome could offer a non-invasive way of better understanding and monitoring IBDs and the efficacy of different treatments.

Thanks to advances in genome sequencing technology and edge computing combined with simplification of sample preparation, there are new opportunities to study, diagnose and treat IBDs out of the lab.

Atos, Arm and Marvell work in partnership to support and advance innovation using the power of technology

Atos is a global digital services company and systems integrators specializing in digital transformation across all industry sectors

Arm is the world's leader in semiconductor IP as well as providing IoT device and data management platforms to customers across all industry sectors.

Marvell is a US-based multinational semiconductor company delivering storage, processing, networking, security and connectivity solutions to customers across sectors

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Innovation happens at the junction of info tech and bio tech. Growing IoT technology, and increasing genome analysis needs in academia and individual are tailwind for us. I believe that in 21st century, our humankind's main products will become living materials such as a body and mind from machines in 20th century. In the era, a genome sequencing device is a key and gateway technology for the products. ”

**Jun Aruga, Software Engineer,
Red Hat Czech**

Gaining insight from genomes and biodata

In July 2018, a two-day BioData hackathon was held at the Wellcome Genome Campus near Cambridge, UK.

The event was devised as a way for scientists and academics to work in a creative and collaborative environment to hack genomic and other biodata and progress solutions that offer real-world impact for patients.

As sponsors of the hackathon, Atos, Arm and Marvell were jointly invited to set participants a Grand Challenge in health and innovation. Their challenge was to develop innovative solutions for biological data processing. In particular, participants were encouraged to explore the convergence between high performance computing (HPC) and artificial intelligence (AI) to process and extract insight from genomic information. 17 Judges from academic and research institutions, business angels and CEOs of leading health tech companies selected the winners.

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The device will be the only one of its kind: no other solution has so far been proposed for monitoring the gut microbiome of IBD patients in their own home. Currently, samples are posted to centralized laboratory, without repeated measurements to assess the effects of each intervention.

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Alessia Visconti, Research Fellow,
King's College of London

Team GoGut: genome sequencing on a mobile device

The winners of the biological data processing challenge were Team GoGut, whose vision is a new device that enables the constant monitoring, diagnosis and management of IBDs in the comfort of patients' own homes.

This unique solution is designed to empower both the patient and their clinician by offering a portable device that measures and monitors the gut microbiome in a non-invasive way.

A next-generation portable sequencer is attached to a mobile device, with integrated HPC and AI solutions at the edge.

As this is augmented with AI analytics, it can quickly respond to downward trends or identify positive stimuli; this enables patients and their clinicians assess the disease, then monitor its progression and the effectiveness of different treatments.



Team GoGut:

Jun Aruga
Red Hat Czech

Alessia Visconti
King's College London

Oliver Giles
SciBite

Chen Zhang
University of Copenhagen

Ioannis Valasakis
KANO Computing

“ I am amazed by how fast portable computation technology is evolving and getting closer to frontline healthcare. Before participating in the hackathon, I thought using portable genome analyzing hardware at home or in a clinic could only happen in a sci-fi movie. Now I've realized the technology is already knocking at the door. ”

Chen Zhang,
University of Copenhagen

Generating vital data

During the BioData Hackathon, Team GoGut successfully and easily ported a metagenomic data processing pipeline onto Arm's 64-bit architecture.

There, the data could be processed in a few hours, proving that the analysis of microbial data can be successfully taken out of centralized data centers. At the same time, the solution also implemented a neural network; by receiving as input the microbial profile produced by the analysis pipeline, this could predict the disease status.

Team GoGut proposed a derivative score from the neural network's output. By tracking this score over time, patients and their clinicians could measure the effects of lifestyle/medication changes on the disease's progression in order to assess their efficacy in almost real time.

The next step would be to use the data generated by this monitoring process to craft indicative models. Using these, recommendation systems could propose lifestyle, diet or medication changes based on reactions observed in patients with similar microbiome profiles. As more and more patients use the device, more and more data could be collected and analyzed, making diagnoses and recommendations even more powerful.

“ At the hackathon, we developed a neural network to accurately diagnose IBD using a very limited set of sequencing data. We're now taking this to the next stage: predicting disease severity by integrating sequencing data with sparse data around diet and lifestyle. This will give sufferers actionable advice and hopefully, over time, give researchers insights into disease mechanisms at macro and microscopic levels. ”

Oliver Giles,
Data Scientist, SciBite

What next?

Team GoGut's conceptualized device will enable less invasive diagnostics and monitoring of IBDs in order to improve patients' quality of life while generating vital data for clinicians.

The next stage of development is to further test the solution using the most advanced high performance computing platform in Europe. This is in collaboration with Arm, Atos and Marvell on Mont-Blanc, a series of projects to investigate and develop new processors for HPC based on European technologies.

Mont-Blanc has paved the way for a future efficient European processor for Exascale computing (under the European Processor Initiative).

Dibona: a world first

As part of Mont-Blanc, Atos built a highly-efficient Arm-based supercomputing cluster called Dibona. This is one of the first Arm-based HPC systems in the world and is available to Mont-Blanc collaborators and end-users to test Atos' software and scientific applications on a state-of-the-art Arm architecture.

Dibona will be used to move Team GoGut's idea to the next level. It is a high performance computing platform based on 64-bit Marvell® ThunderX2® processors, relying on the Arm® v8 instruction set. The prototype leverages the BullSequana X1000 infrastructure, including ultra-efficient Direct Liquid Cooling - cooling with warm water. The system also features the Mont-Blanc optimized software stack and an InfiniBand EDR interconnect.



About Atos

Atos is a global leader in digital transformation with over 110,000 employees in 73 countries and annual revenue of over € 11 billion.

European number one in Cloud, Cybersecurity and High-Performance Computing, the Group provides end-to-end Orchestrated Hybrid Cloud, Big Data, Business Applications and Digital Workplace solutions. The group is the Worldwide Information Technology Partner for the Olympic & Paralympic Games and operates under the brands Atos, Atos Syntel, and Unify. Atos is a SE (Societas Europaea), listed on the CAC40 Paris stock index.

The purpose of Atos is to help design the future of the information technology space. Its expertise and services support the development of knowledge, education as well as multicultural and pluralistic approaches to research that contribute to scientific and technological excellence. Across the world, the group enables its customers, employees and collaborators, and members of societies at large to live, work and develop sustainably and confidently in the information technology space.

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Let's start a discussion together



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