Empowering researchers to achieve more with Microsoft Azure

Microsoft

Microsoft Azure: an open, flexible, global platform

All researchers need a cloud platform that's open, flexible, fast, cost-effective, scalable, efficient, and responsive. Microsoft Azure offers access to on-demand research capabilities with virtually unlimited computing to help accelerate discovery.

The rapid evolution of technology and the growing demand for answers has significantly increased the pressure on academic researchers to accelerate innovation. They need technology that gives them unlimited compute and data capabilities, allows them to quickly scale up and down, and helps them install whatever services they want at any time.

Microsoft Azure is the ideal platform to deliver on the needs of both researchers and IT departments. It acts as a critical bridge between the demands of researchers, and provides secure, managed, flexible self-service provision enabled by central IT and large research organisations.

## A strong foundation for agility and reliability

Academic institutions and researchers can achieve success through four unique values that Microsoft Azure combines.

Productive

Increase researcher productivity and streamline development lifecycles with a set of integrated tools and services that accommodate multiple languages, operating systems, and open-source technologies. Tools include mobile DevOps to serverless computing.

Hybrid

Go beyond connecting data centres to the cloud and ensure on-premises and cloud environments work consistently. Minimise the time, complexity, and risk involved when integrating cloud capabilities across your infrastructure.
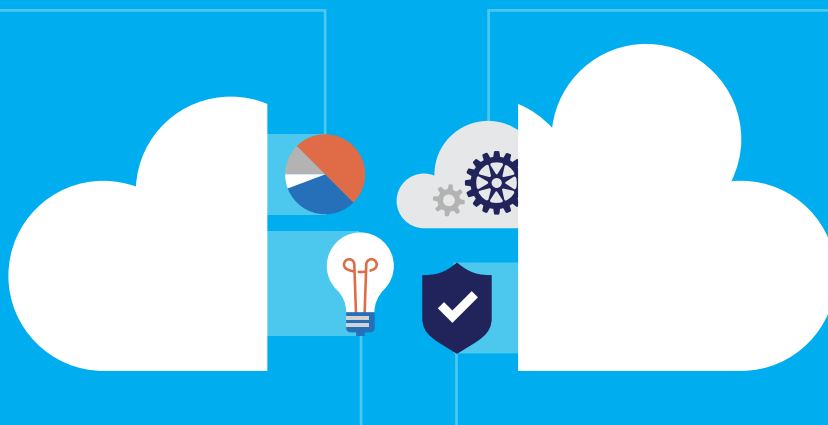
Intelligent

Using the powerful tools built into Microsoft Azure, customers can easily develop intelligent apps that deliver data-driven experiences. Users can move quickly from concept to release with Azure data services and artificial intelligence. Services can range from image recognition to bot services.

Trusted

Microsoft Azure is trusted by 90 percent of Fortune 500 companies globally, in addition to many startups and government organisations. It offers more security and privacy certificates than any other cloud provider across 50 regions with up to 1.6 petabytes per second of network bandwidth in a region.

Why Azure for universities?

Microsoft Azure is the perfect choice for researchers and the education community. It allows them to quickly and affordably process huge amounts of data, run Windows and Linux VMs in the cloud, and create, manage, and distribute media. It offers features that make it easier to maintain hybrid cloud and on-premises environments. And because institutions can scale compute and storage up and down as needed, it helps them manage their budgets while still having the resources to achieve their goals.

Supports open-source technologies

Open source is core to Microsoft's day-to-day approach to cloud innovation. That's why one in four Azure virtual machines (VMs) runs Linux.

With Azure, IT and researchers can bring their tools and skills together and run almost any application they desire using their data source, with their operating system, on their device. Whether they want to enhance an application with identity and access management or run Linux batch processes to support Python applications, they can find open-source solutions from a growing ecosystem of partners to drive fast deployment in the cloud.

Microsoft Azure provides support for infrastructure as a service (IaaS) on Linux, Java, and PHP web application platforms, so users can develop and test Linux and open-source components in the Azure cloud.

Helps control costs

Microsoft Azure offers flexible purchasing and pricing options for any cloud scenario, and provides extensive tools that make it easier to manage cloud spending. With Microsoft Azure, institutions benefit from on-demand resources and pay only for what they use. This helps them avoid upfront capital expense while giving them the capacity they need, when they need it.

Taking advantage of the Azure Hybrid Use Benefit when migrating Windows Server VMs to Azure helps institutions save up to 40 percent because Microsoft covers the cost of the operating system on up to two VMs for each licence.

This can be used with Windows Server Datacenter and Standard edition licences covered with Software Assurance. Licences can be re-used or converted to run Windows Server VMs in Azure and pay a lower base compute rate (Linux VM rates).

Azure customers can also save money by using Azure Reserved VM Instances. By reserving VMs in advance, customers can experience cost savings of up to 82 percent on pay-as-you-go prices when used with the Azure Hybrid Use Benefit.

> "Working with Microsoft, our growing community of researchers has been tooled up with skills and access to Azure for cloud computing. As a result, they've been able to undertake complex data science tasks at speed and with maximum efficiency."
>
> Andrew Blake, Research Director, The Alan Turing Institute

Accelerates discovery and innovation

With Microsoft Azure, researchers have access to all kinds of AI tools that can speed time-to-discovery. Azure is the only public cloud that provides integrated capabilities—including cognitive APIs, bots, machine learning, and blockchain as a service (BaaS)—that researchers and data scientists can combine with powerful GPU-based compute to accelerate deep learning, enable high-performance computing (HPC) simulations, and conduct real-time data analytics.
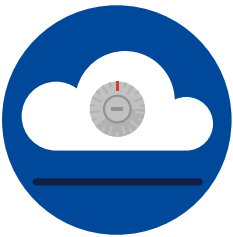
Protects data

Microsoft embeds security, privacy, and compliance into its development methodology, which helps protect data and has earned Microsoft Azure more security and privacy certifications than any other cloud provider. This supports compliance with global and industry-specific data protection requirements, including the General Data Protection Regulation (GDPR).

Delivers unmatched hybrid capabilities

Using Microsoft Azure doesn't mean moving away from sizable investments already made in data and compute capabilities. Those investments can be easily extended from on-premises to the cloud, or vice versa. Microsoft Azure provides a consistent data platform and easy-to-use solutions to connect on-premises data centres to the cloud, create single sign-on access for both environments, and integrate management and security across a hybrid environment.

Drives powerful scalability

Azure offers on-demand access to near-infinite computing and data services from anywhere on the internet. Microsoft has the largest global footprint of data centres in the industry, so higher education institutions can expand their existing data centres with Microsoft Azure. It gives them the ability to collaborate globally, and deploy and store data in specific regions according to local privacy, security, and compliance requirements.

Enhances data sharing and collaboration

Collaboration is key to successful research. But sending documents via email or accessing documents on shared servers isn't always easy, depending on the size of the research team and where they are located. Microsoft Azure simplifies data sharing and collaboration so data, workbooks, and computing can be hosted together in one place to help ensure the integrity and accuracy of the shared data.

Microsoft Azure lets researchers be researchers
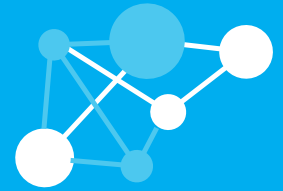
Academic research is one of the major innovation engines driving every leading higher education institution around the world. It transcends all disciplines and addresses challenges ranging from finding cures for diseases to predicting the weather.

Providing an environment that meets these needs is a big challenge for research organisations and IT departments. It is difficult to predict how much data or what types of compute resources researchers will need, and procurement and provisioning are often long and expensive processes. Researchers want powerful platforms fast, so they can speed time to discovery.

Much more is expected because so much more is possible. Regardless of the topic or the scope, successful academic research still requires three key actions: analyse, explore, and share. Having the right technology is key to successfully executing those actions.

Using Microsoft Azure, researchers can focus on their research—not technology. Microsoft understands the key challenges researchers face today and has developed the Azure platform to allow researchers to meet those challenges successfully, efficiently, and affordably.

How Azure addresses top research workloads

Microsoft Research has worked with hundreds of researchers in every discipline to develop best practices for how cloud computing can be best used for research. Microsoft has found that the following five scenarios cover the most common research situations, and has built solutions to address each one.

Unlock the benefits of Azure

Go beyond the desktop

Researchers' demands can be difficult to cater for. With Azure, researchers are no longer limited by the capacity of their desktop computers or servers. In fact, they often need to go beyond the desktop and access a workstation with more cores or memory. Azure brings virtually unlimited data processing capacity to the desktop through VMs.

Azure Virtual Machines supports a wide range of computing solutions—including deep science, deep learning, geosciences, SQL Server, Oracle, IBM, and SAP—on Linux or Windows Server. With load balancing and auto scaling available at no extra charge with all current-generation Azure Virtual Machines, researchers have the exact amount of capacity they need to be effective.

> "Cloud computing brings the power and data processing ability of huge machines to any researcher's desk."
>
> **Jason Atkin, Assistant Professor, University of Nottingham**

Case study: University of Stirling / University of Nottingham

Challenge

One of the biggest pain points at airports is the time aircrafts spend taxiing down the runway. Manchester airport in the UK wanted to shorten aircraft taxiing time to reduce delays, fuel costs, and CO_2 emissions.
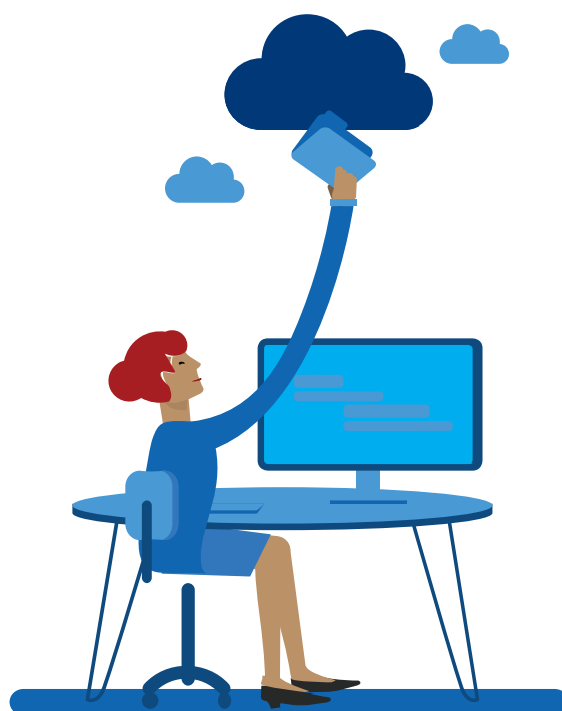
Solution

Sandy Brownlee, Senior Research Assistant at the University of Stirling and Jason Atkin, Assistant Professor at the University of Nottingham used their computer science expertise to explore the problem. They used Microsoft Azure to store data on thousands of taxiways at different airports and open-source tools, now available to anyone on GitHub, to model and improve aircraft taxiing to reduce pollution and improve efficiency.

Benefits

• Provides more comprehensive picture of the effect of taxiing delays to optimise systems.

• Processes large amounts of data in one-tenth of the time it would have taken on desktop computer, producing results in weeks not months.

• Expects to reduce CO_2 emissions.

Computing at scale

It is typical for researchers to run lots of computations. They can easily do that with Azure. It supports running a HPC simulation that requires high-bandwidth, low-latency supercomputer networking to scale to hundreds of cores. Performance-tuned CPU and BIOS provide supercomputing-class VM performance to run jobs faster and reduce costs, while engineering in the platform enables Azure to deliver speeds comparable to (and sometimes better than) bare-metal hardware on premises.

For even more powerful high-volume computation, Azure Batch delivers a true HPC-as-a-service model. This unique service makes it easy to create many machines to simultaneously run jobs to get results in a few hours or days. Researchers wrap an application with a simple template, and then run the HPC job without worrying about cluster management. Cycle computing provides simple, managed access to big compute by orchestrating workflows, managing data, and enabling users in a secure, controlled way.

Case study: WorldPop Research Team, University of Southampton

Challenge
The WorldPop research team at the University of Southampton provides critical data for tracking the UN Sustainable Development Goals. They do this by mapping the location of every person on Earth to provide an accurate population count.

Solution
Built an HPC cluster on Azure to process 800 million cells of data and uses Azure HDInsight and open-source R programming with Microsoft R Server to analyse data. This approach enables predictive models and maps nonlinear relationships.

Benefits
• Highlights how multiple factors contribute to poverty.

• Gets results 90 percent faster to expedite decisions on how to move forward.

• Gains more time to focus on quality of population mapping.

"Microsoft Azure was the only cloud that gave us true supercomputing performance...The datasets can be so large and complex that it's impractical or impossible to build them on a single workstation, but now our researchers are able to cut them down to size with the compute clusters and parallel computing that Microsoft Azure provides."

Andy Tatem, Professor of Geography and Environment, University of Southampton

Big data, data science, and machine learning

Microsoft Azure provides the tools researchers need to analyse massive amounts of data in real time, and removes much of the complexity of setting up systems. Azure Machine Learning provides an integrated, end-to-end data science and advanced analytics solution. Using Azure Machine Learning, data scientists can prepare data, develop experiments, and deploy models at scale quickly and easily to accelerate time to discovery.

Case study: University of Oxford

Challenge

When he was growing up in Kenya, Jacob Katuva, Researcher at the University of Oxford, used to cycle 12 miles from his village to collect water. Now, he's part of a research team, which includes Associate Professor David Clifton. Their work includes scaling out a system that collects data from sensors installed in pump handles to monitor groundwater and detect broken pumps in rural wells in Africa and Asia.

Solution

University of Oxford researchers are integrating the data from tens of thousands of pumps into Microsoft Azure and using AML algorithms to analyse and predict ground water availability. Microsoft Intelligent Cloud helps them to move straight from the lab and into practice using R and Python. Tools can be shared easily, making this ideal for collaboration with their partners.

Benefits

- Ports existing R and Python-based machine learning tools directly into a cloud-based system.

- Collects data at scale that is usable to help decisionmakers make better decisions.

- Reduces hand pump repair time from 30 days to 2 to 3 days.
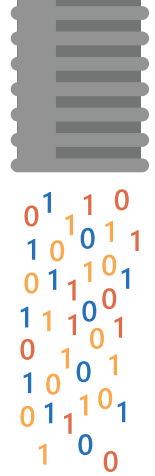
> "Imagine you have multiple intelligent nodes. They're all transmitting data. You have to integrate data in a cloud-based system from data nodes across an entire region, tens of thousands of pumps, in our case."

David Clifton, Associate Professor, University of Oxford
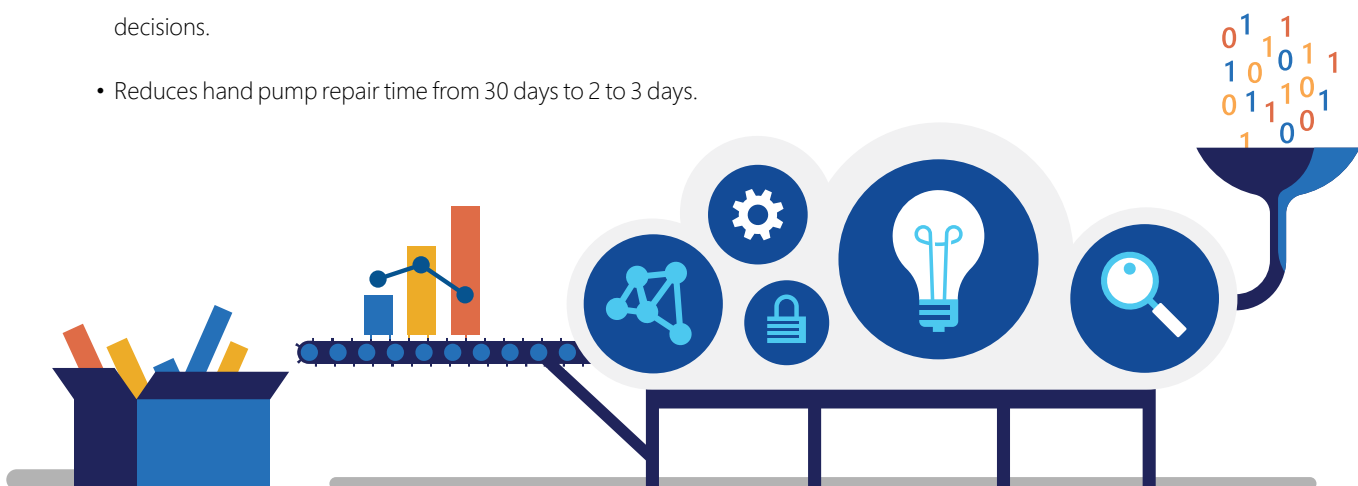
Internet of Things

Researchers often spend a lot of time figuring out how to deploy and manage devices, and gather data from them. The Azure IoT Suite provides an out-of-the-box solution to streamline that process. These Azure IoT solution accelerators are templates researchers can use to create fully customisable solutions for common Internet of Things (IoT) scenarios. They make it easy to scale from just a few sensors to millions of simultaneously connected devices and rely on the global availability of Azure. Researchers can also turn to IoT Central for a fully-managed IoT software-as-a-service (SaaS) solution, that makes it even easier to deploy research quickly, securely, and at any scale. Researchers can use Azure Machine Learning to forecast future behaviours, outcomes, and trends. They can also use Azure Stream Analytics event-processing engine to examine high volumes of data to identify patterns and relationships.

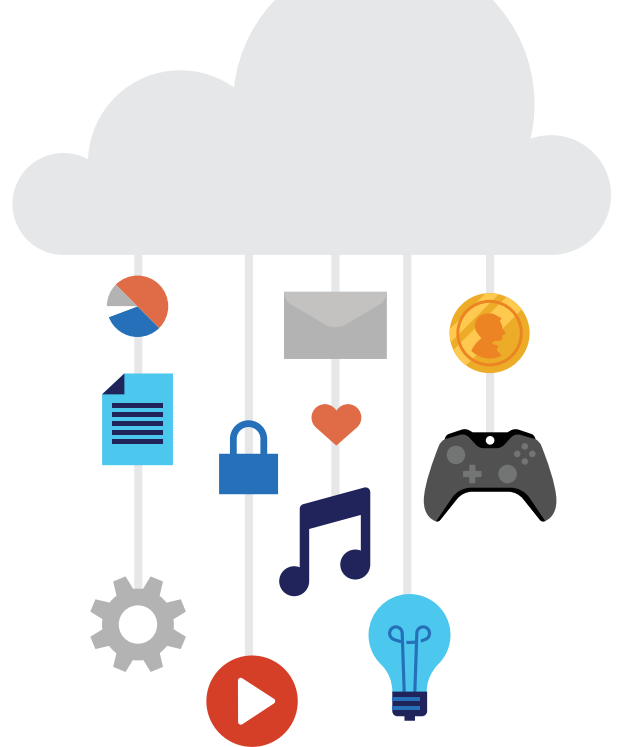## Case study: Politecnico di Milano

Challenge

When archaeologists discovered ruins below the Opera House in Rome, they had a challenge on their hands: how to determine whether humidity, temperature, and other environmental factors were destroying ancient friezes and sculptures at the site. To support automated remote monitoring of the site, the Politecnico di Milano engineering team sought an end-to-end solution that did not require the engineering expertise typically required for such a project.

Solution

Azure made it simple to create a single platform as a service (PaaS) that offered the functionality the project required. The sensors were configured to send data to the gateway in packages that could be parsed, and the gateway manipulated and aggregated the data so it could send about 1 kilobyte of data to the Azure IoT Hub every 30 minutes.

Benefits

- Data visualisation is automated on Azure, with charts presenting humidity, temperature, soil moisture, light, CO2, and ground movement data.

- Discovery of high humidity means archaeologists are able to request a second entrance to the site, so air can circulate and humidity can escape.

"We tried several solutions and found that many cloud-based IoT platforms are overly complicated for what they do. Among the possible options, Azure was the best choice to get this done."

Luca Mottola, Associate Professor, Politecnico di Milano, Italy

Research data sharing and collaboration

Successful research typically requires effective collaboration at multiple points. The problem is that it's not always easy to share data, workflows, and software with others in the lab, research group, or around the world.

The Azure cloud makes collaboration easier by allowing research teams to host data, workbooks, and computing together in one place. Researchers can share as much data as they like, with easy-to-use tools such as Azure Storage Explorer, Python, and command-line tools.

Case study: University of Cambridge

Challenge

To encourage innovative problem-solving, the University of Cambridge wanted to develop a style of teaching that reflects the way people work, in industry and in the open-source community.

Solution

As a first step to realise this vision, Dr. Garth Wells revamped an entry-level computing course, using libraries of sharable Jupyter Notebooks containing text, equations, visualisations, and code.

In partnership with Microsoft Research Cambridge, Wells adopted the Azure Notebooks service, a software-as-a-service version of executable Jupyter Notebooks.

Benefits

• Promotes greater innovation and accelerates the potential for scalable research initiatives.

• Teaches students how to use increasingly popular open-source technologies and collaborative workflows.

• Simplifies collaboration, and helps students get results faster by working with more people.

"By keeping all technologies in-house, you inevitably have to rein in your ambitions to fit available resources. With Azure Notebooks, we don't have to worry about scalability or whether systems will crash if someone does something out of the ordinary."

Dr. Garth Wells, Hibbit Reader in Solid Mechanics, Department of Engineering, University of Cambridge

Microsoft Azure and GÉANT:
Making it easy to transition to the cloud

GÉANT, Europe's leading collaboration on network and related infrastructure for research and education, has partnered with Microsoft and the European National Research and Education Network (NREN) community on an IaaS framework agreement.

Under the agreement, 10 approved Microsoft resellers across Europe, the Middle East and Africa are offering a Microsoft Azure—based solution for research and education. The 10 resellers are: Atea, Cacttus, Comparex, Dom-Daniel, Infosoft, Micromail, Nextsense, Axians, SoftwareOne, and Span.

Thousands of universities, schools, and research institutions can now take advantage of special pricing and experience the benefits of the Microsoft Azure cloud with procurement, contracting, and integration provided by GÉANT and the NREN community. Benefits to research institutions include:

- The ability to buy and use Microsoft Azure directly, without the need for complex and time-consuming tenders and contract procedures.

- Volume discounts.

- Framework contracts compliant with EU privacy and data security regulations.

- Single sign-on to Microsoft Azure services via institutional identity management solutions.

- Significantly reduced network traffic costs, with Microsoft Azure services connected to the high-performance data networks provided by GÉANT and its NREN partners.

- Support in moving workloads to Microsoft Azure.

- The ability to leverage existing Microsoft licensing arrangements for BYOL (bring your own licensing).

- Enterprise cloud management tools for control, oversight, and delegation to a community of users and group.

Final thoughts

With over 30 years' experience developing solutions for the academic research community, Microsoft understands exactly what researchers need to succeed.

Microsoft Azure is the right solution for education and research. It is a flexible, open, and secure cloud computing platform that gives researchers access to a broad collection of integrated services that accommodate multiple languages and operating systems.

Using Azure tools and services allows researchers to focus more time on their research, which accelerates time to discovery, reduces costs, and provides more opportunities for creativity and innovation.

To find out more go to:
https://aka.ms/geant