



UNIVERSITY OF NOVI SAD
TECHNICAL FACULTY
"MIHAJLO PUPIN"
ZRENJANIN



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INFORMATION TECHNOLOGY AND EDUCATION DEVELOPMENT



ZRENJANIN, May 14, 2026

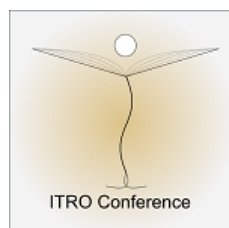


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TECHNICAL FACULTY "MIHAJLO PUPIN"
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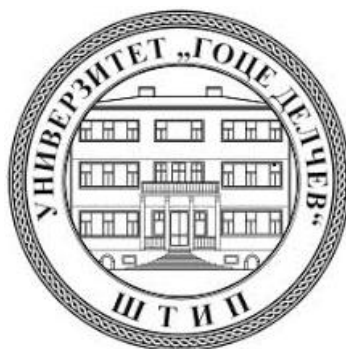


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INTRODUCTION

Technical Faculty “Mihajlo Pupin” in Zrenjanin, University of Novi Sad, Republic of Serbia, is proud to organize the XVI International Scientific Professional Conference “Information Technologies and Development of Education 2026” (ITRO 2026). The Conference is held on May 14th, 2026, at the Technical Faculty “Mihajlo Pupin” in Zrenjanin, Serbia.

The ITRO 2026 conference is established to bridge the gap between scientific research, professional practice, and education. With a long-standing tradition spanning sixteen years, the conference serves as a valuable platform for tracking the continuous evolution of education, particularly when viewed through the perspective of information and communication technologies. Its thematic core focuses primarily on the teaching process as the foundational cornerstone of the modern information society. Current global trends closely align with UNESCO's ongoing efforts to enhance this field, addressing the evolving demands of life and work in the 21st century. It is essential for competent professionals, researchers, and educators to assess the current state of education, identify underlying challenges, and outline future perspectives, while recognizing its profound impact on the development of society as a whole.

While the central pillar of the conference remains the model of dual education as a vehicle for building a strong foundation for industrial growth, recent global dynamics have highlighted a critical, overarching shift in pedagogical reality. Consequently, the primary focus and dominant theme of this year's conference is: AI in Education - Advantage, Problem or Something in Between.

The integration of Artificial Intelligence as a central theme is both deliberate and inevitable. As AI technologies rapidly reshape every aspect of professional and daily life, education stands at a historic crossroads. We are no longer merely discussing new digital tools, but a fundamental paradigm shift in how knowledge is acquired, processed, and evaluated. By examining whether AI acts as an advantage, a challenge, or a complex space in between, this Proceedings volume aims to provide a balanced, scientifically grounded perspective. It explores how intelligent systems can personalize learning, support educators, and optimize educational frameworks, while simultaneously addressing critical questions regarding ethics, data privacy, and the preservation of authentic human critical thinking.

The conference brings together university professors, researchers, directors of grammar and secondary vocational schools, members of the wider academic community, and other professionals dedicated to driving educational innovation forward. To capture the full scope of these contemporary educational challenges, the conference covers a diverse range of thematic fields, including:

- Digitalization of education
- Education in crisis situations
- Contemporary educational challenges
- Theoretical and methodological issues in modern pedagogy
- Digital didactics and media education
- Modern communication strategies in teaching
- Curriculum development for contemporary education
- E-learning advancements and trends
- Educational management practices
- Methodological approaches to teaching natural and technical sciences
- The integration of information and communication technologies (ICT) in education

- The concept and implementation of dual education
- Development and application of interactive e-books

Demonstrating strong international interest and geographical diversity, a total of 110 authors from 11 countries and 2 continents contributed to the conference. This includes 75 authors from the Republic of Serbia and international authors representing countries such as North Macedonia, Bulgaria, Slovakia, Hungary, India, Bosnia and Herzegovina, Croatia, Kyrgyzstan, United Kingdom and Romania.

This volume of the Proceedings contains 44 peer-reviewed papers, published entirely in the English language. We firmly believe that the research presented herein will offer valuable insights, spark meaningful dialogue, and contribute significantly to shaping the future of education in the AI era.

Chairman of the Organizing Committee

Dragana Glušac, Ph.D, Professor

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The Use of Cloud Services for Scientific Research Purposes

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Abstract. Cloud services are used for a variety of purposes nowadays. They are used for computing activities, data storage and analysis, networking, database management, access to development tools, online available applications, etc. Some of the advantages of cloud services are: scalability, flexibility, reducing Information Technology (IT) infrastructure costs, availability, security and the support for new technologies. The researchers often need IT resources and ready-made software tools in their research that they can directly use for various proof-of-concept scenarios. This paper presents cloud services and cloud provider programs that researchers can leverage to achieve their scientific research goals in various fields.

Key words and phrases: Cloud, cloud services, IT resources, scientific research.

1 INTRODUCTION

Cloud is a model of using IT resources over the Internet. These are resources that are not located locally in companies or organizations, but rather external resources that are provided through the infrastructure of cloud service providers. This involves a complex infrastructure that is part of the data centers of cloud providers that are responsible for providing uninterrupted service to the end users. Data centers are large and sophisticated facilities that house servers and the entire cloud infrastructure. In addition to servers, data centers also contain networking devices, storage devices, power systems, temperature control systems, security systems, etc. A key concept in the cloud is the virtualization. It enables the creation of virtual resources based on physical resources in the cloud or the main infrastructure in the data centers. These virtual resources can then be used by multiple users. Although they are created based on physical resources, they still function as separate IT resources. This allows better utilization and sharing of data center infrastructure.

Cloud service providers offer ready-made services that can be used by the end users. There are three basic categories of cloud services: Infrastructure as a service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS) (Kavis, 2014), (Younis et al., 2024). IaaS services enable the availability of basic IT infrastructure such as: virtual machines, networking devices, storage disks, etc. This type of service is most often used by users, companies, or organizations that do not want to invest in expensive physical infrastructure and decide to somehow rent infrastructure from a remote cloud service provider. PaaS model enables the development and execution of applications without developers to worry about the servers, databases, or operating systems. This allows rapid development and testing of applications on different platforms. SaaS services allow the use of ready-made software applications over the Internet. Sometimes companies need quick access to applications and access from anywhere. Using applications that need to be installed can be a cumbersome process. This may include purchasing applications, expensive licenses, installing them on each individual device, etc. This can take a lot of time and may not achieve the desired goal in the end. That is the reason why many companies decide to use cloud services, that can be used from anywhere and at any time.

According the recommendations of the National Institute of Standards and Technology, there are 5 essential characteristics of cloud computing model: on-demand self-service, broad network access, resource pooling, rapid elasticity and measured service (Mell & Grance, 2011). The users themselves order the services they want to use without any human interaction with the service provider. The services can be accessed from

anywhere using a variety of devices and platforms. The resources of the cloud service provider are pooled in order to serve multiple users. The basis of this is the multi-tenant model, where the users only pay for the usage of the allocated resources. The resources can be elastically provisioned when needed, and released when no longer needed. Additionally, these resources can be scaled. There are two ways of scaling: vertical and horizontal. Vertical scaling allows increasing (scale-up) or decreasing (scale-down) the performance of resources depending on the utilization. Horizontal scaling allows addition or reduction of resources of the same type (e.g., virtual machines) to handle the ongoing usage according to the workload. Cloud services also have metering capability for different types of abstraction levels (e.g., processing, storage, bandwidth, etc.). Their usage can be controlled, monitored and reported. This provides transparency for the consumer of the services and also for the cloud service providers. It is especially important for users to track their spending and plan the budget for using the cloud services.

The use of cloud technologies is really popular nowadays. Many companies and organizations use these technologies to meet their goals. Some of them use cloud-based IT infrastructure, some use ready-made cloud services, while others use various services to develop and host their applications (Kiryakova et al., 2015), (Gevko et al., 2021).

The researchers in their research, and proof of concepts, often need IT infrastructure in order to be able to practically carry out the experiments. Sometimes experiments require better IT resources with more power, memory, and storage space. The physical IT infrastructure they possess often does not meet the demands of complex research. The scaling of physical infrastructure components required for certain stress tests or use cases in experiments is a rather difficult operation. Additionally, the researchers sometimes need to run the experiments on different devices or platforms. They are often limited in this because they must own those devices and platforms in order to be able to do the experiments and obtain appropriate results. The cloud services according to their models and characteristics, can play a major role in the scientific research. Given the potential they have and the offered opportunities, they can significantly help the researchers. This is the reason why in this paper we consider the use of cloud services for scientific research purposes.

This paper is structured as follows. Section 2 presents the related work for the use of cloud services in the research. In Section 3, we give an overview of cloud providers and the most used cloud services from different cloud providers. Section 4 presents the use of cloud services for scientific research purposes. Section 5 is a conclusion of our work.

2 RELATED WORK

(Shakeabubakor et al., 2015) in their paper present the use of cloud services and applications in order to improve the productivity of university researchers. They identified and noted some of cloud services that can be useful for the researchers and also depict the impact of the usage of cloud services on research activities. An interview was conducted with the researchers. The main conclusion of the interview was that the lack of knowledge about the cloud had an effect on the attitude towards the trust and the usage of cloud services. In (Iatsyshyn et al., 2019) the authors emphasized the importance of the use of cloud services for the preparation of the future PhD students and improve their digital competence. According to the paper, it is recommended for PhD students to use cloud-based platforms and services that would help them with scientific and scientific-organizational activities which would have a positive impact on organization and implementation of scientific research. The authors in (Navale & Bourne, 2018) present a perspective of the use of cloud computing applications for biomedical science. They highlighted the opportunities offered by cloud services, and in particular the services related to processing of big data that is important in biomedical research. Examples of individual cloud tools, workflows, platforms, healthcare cloud services and general-purpose cloud-based tools are also shown in the paper. The usage of cloud computing in e-science and the research challenges and opportunities are described in (Yang et al., 2014). The authors in this paper provide an insight of the need for cloud resources and services in the research communities. They also considered the cloud-based High-Performance Computing (HPC) in e-science. In (Nosenko et al., 2018) the authors present the importance of usage of high-tech cloud-based tools for collaboration among research institutions and universities. They also proposed a method for improving the research environment of higher educational institutions. A survey of the European Open Science Cloud (EOSC) services for expanding the capacity and capabilities of multidisciplinary scientific applications is shown in (Calatrava et al., 2023). The EOSC initiative provides an open, trusted, virtual and federated computing environment that can be used for hosting of scientific applications and also to store, share and reuse research data. The authors in their paper describe 10 thematic services of EOSC synergy that are grouped by scientific

disciplines such as Earth observation, Biomedicine, Astrophysics, and Environmental domain. The services provided by EOSC could be very important for the researchers.

3 CLOUD SERVICE PROVIDERS AND CLOUD SERVICES

Over the years, a lot of companies have migrated their applications to the cloud, which has significantly increased the revenues of cloud service providers (Zdravev et al., 2021). The revenues from cloud services increased to \$330 billion last year (Richter, 2025). The development of generative AI and new trends in the cloud have contributed to revenue growth. According to the global cloud market share of cloud service providers, Amazon Web Services (AWS) is still on the top with 29% (Richter, 2025). Microsoft Azure is on the second place with 20% and Google Cloud Platform (GCP) is on the third place with 13%.

The access to services is through cloud portals that are provided by the cloud service providers. In their portals, service providers offer a catalog of cloud services consisting of categories in which the specific services are located (Figure 1). The categories serve to make it easier to find services and to identify services that have a similar purpose. This is especially important for cloud providers that offer a large number of services and with the categorization we can easily find the service in the service catalog.

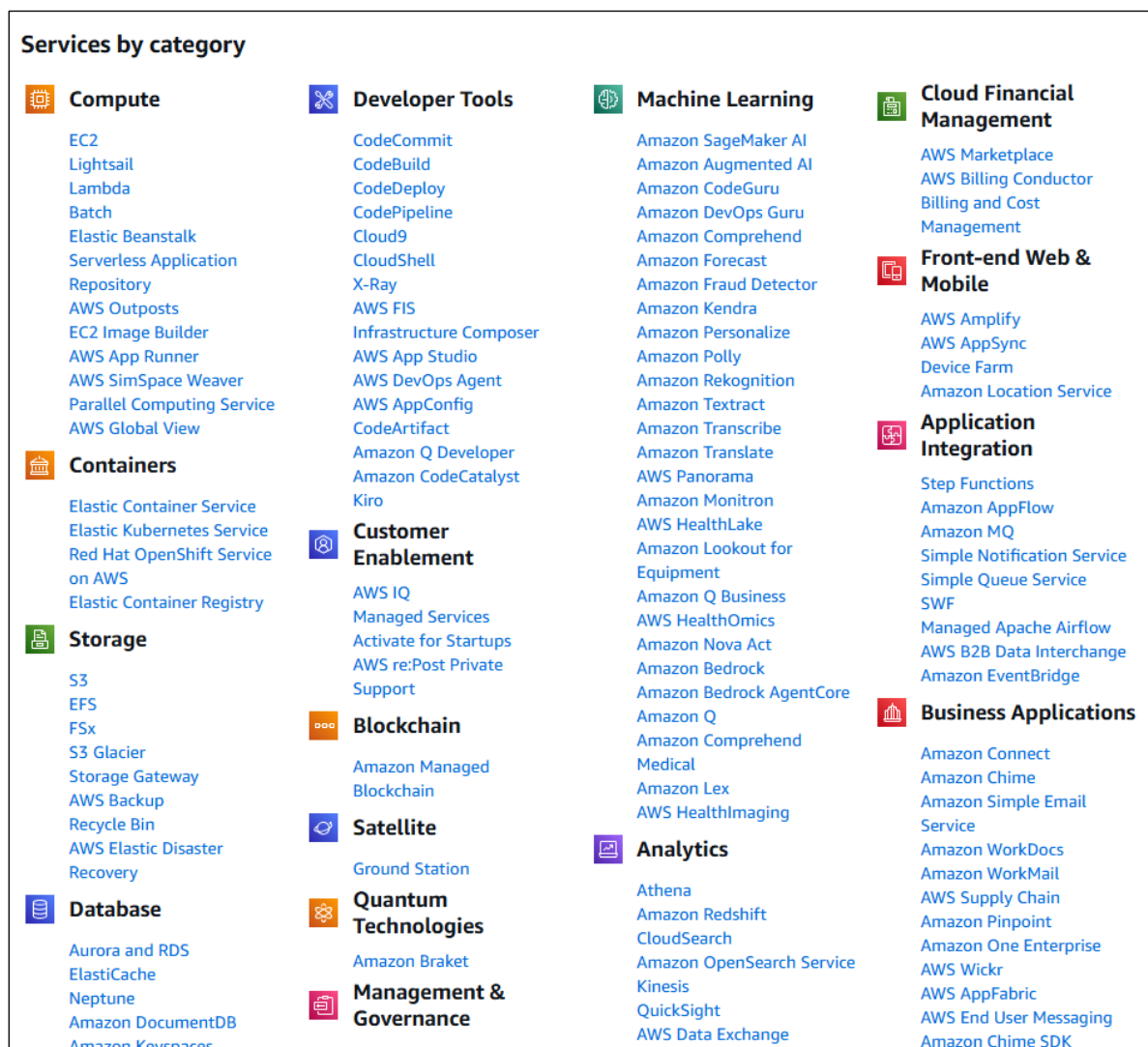


Figure 1. Categories of services in AWS

Table 1 shows services from different cloud service providers divided into 6 different categories: Compute, Storage, Databases, AI & Machine Learning, Internet of Things (IoT) and Analytics. Although there are other categories, some of the more recent ones are presented here.

Table 1. Cloud services from multiple cloud service providers in different categories

Category	Amazon Web Services	Microsoft Azure	Google Cloud Platform
Compute	EC2, Lambda, Lightsail	Virtual Machines, App Services, Virtual Machine Scale Sets	Compute Engine, Kubernetes Engine, VMware Engine
Storage	S3, EFS, FSx	Disks, Storage accounts, Data Lake Storage	Cloud Storage, Filestore, Managed Lustre
Databases	Aurora and RDS, DynamoDB, Neptune	Azure Database for MySQL/PostgreSQL flexible servers, Azure SQL Database, Azure Cosmos DB	Database Center, Cloud SQL, Firestore
AI & Machine Learning	Amazon SageMaker AI, Amazon Bedrock, Amazon Rekognition	Azure Machine Learning, AI Search, Bot Services	Vertex AI, Document AI, AI Applications
Internet of Things (IoT)	IoT Core, IoT Analytics, IoT Greengrass	IoT Central Applications, IoT Hub, Device Update for IoT Hubs	Combination of various GCP services is used such as Pub/Sub, Dataflow
Analytics	Athena, QuickSight, EMR	Analysis Services, Data factories, Data Lake Analytics	BigQuery, Pub/Sub, Dataflow

4 CLOUD SERVICES FOR SCIENTIFIC RESEARCH PURPOSES

Nowadays, the researchers often encounter the need for certain IT infrastructure, tools or services that can be used in their research. This especially applies to the practical part, the proof-of-concept part, the results analysis part, etc. Although we can also use physical IT infrastructure for this purpose, it is not always sufficient. This primarily depends on the complexity of the experiments or the practical tasks that are part of the research. If we have a complex practical part that requires good infrastructure and dedicated services, in that case we can use cloud resources.

Another thing that cloud services enable is that we do not have to buy expensive equipment that will be used for a short period of time. With cloud services, we can use the infrastructure we need, and then when we no longer need it, we can delete the allocated resources. With the removal of the resources, the payment we have for them ceases. In this case, we only pay for what we have used (pay-as-you-go model) for a certain period of time.

Another thing that is also important for researchers is the rapid acquisition of the appropriate IT infrastructure or services needed to conduct the research. The procurement of physical IT infrastructure can sometimes be a complicated process, from compliance with procedures and laws when it comes to state institutions, to the time required for procurement and delivery, to the people who need to be hired for installation, etc. On the other hand, with the use of cloud services, the necessary resources are obtained upon request by the user and delivered immediately. This is especially important if the researchers have experiments that need to be conducted quickly. The cloud services and corresponding resources can be used immediately for research.

Sometimes the access to the appropriate infrastructure and services needs to be from different locations and on different devices. This is especially evident in research involving multiple researchers from different countries or locations. The physical infrastructure may have certain limitations in terms of access to it. Cloud services, by setting access rules, offer the possibility of accessing resources and services from anywhere and from any device. This can also be very significant for the researchers.

Additionally, with cloud services, the researchers can allocate as many resources as they need, instead of the usage of expensive infrastructure that need to be provided in advance. The feature of cloud services that is also important for researchers is the scaling. Sometimes when conducting experiments, we cloud start with infrastructure that is not performing at its best. In some cases, we have experiments where we need to examine how certain stress test passes when the number of users of certain application increases sharply. This also leads to a demand for resources (e.g., virtual machines) with better performance that can handle the user workload. The cloud services provide auto-scaling functionality that can immediately address the above situation.

The researchers often have a limited budget for purchasing equipment for their research. If they use cloud services, they need to have a control over costs. Typically, cloud service providers provide functionality for tracking accumulated costs through their cloud portals. The costs can be displayed by specific categories or by specific resources. Additionally, there is a possibility for tracking and analyzing costs in terms of a timeframe, for example daily accumulated costs, monthly, yearly or custom defined time period. Service providers also provide charts for the costs and consumption of resources, which also facilitates the process of analysis and cost trends.

Often, cloud service providers offer services for specific fields of research that have emerged as relevant over the years (Table 1). This is especially interesting for researchers who conduct research in these areas and need tools that are offered as cloud services. Sometimes some of the researchers look for tools or applications that can be installed on their computers and pay expensive licenses for that, without knowing that there are tools which cloud providers offer as a services. In this way, they can save money and use the services according to the pay-as-you-go model if it is a matter of short-term research and gain access to tools that have a specialized purpose in the research.

Cloud providers also provide access to services for academic purposes through special platforms intended for educational institutions (Velinov et al., 2024). Most often, through these platforms, the students and the researchers receive a free budget for using the services for a certain period of time. This budget they receive is not much, but it can help with some smaller research work in context of using appropriate cloud resources and services. This may include creating appropriate virtual machines for research purposes, using database management services, gaining access to SaaS solutions, etc. When using these platforms, we should only pay attention to the budget, because after it is used up, the access to the resources is not allowed. In context of this, we need to do timely data migration and other important things regarding the research work.

Cloud service providers also promote campaigns and programs for researchers to obtain free credits for using cloud services. For example, AWS offers the AWS Cloud Credit for research program (AWS Cloud Credit for Research, 2026). The following individuals can apply for this program: full-time faculty members at an accredited research institution, full-time research staff at an accredited research institution and graduate, post-graduate, or PhD students that are enrolled at an accredited research institution. Microsoft offers the Azure Cloud Computing Services for Education program that can be used by the students and researchers for free cloud credits and access to free cloud services (Inspire innovation in education with Microsoft Azure, 2026). Google Cloud promotes the Google Cloud for research program (Google Cloud for research, 2026). It offers a full stack, collaborative and AI-optimized platform that can be used for state-of-the-art research. Eligible to apply for this program are: faculty, PhD students and postdoctoral researchers from accredited higher education institutions and nonprofit research institutions in approved countries.

5 CONCLUSION

Cloud services are really widely used nowadays. They offer many advantages and full potential for future development and usage in different fields. Many researchers today require IT infrastructure and services that can be used in their research. In context of this, they can take advantage of the opportunities and benefits offered by cloud services. Nowadays, there are many academic programs for cloud technologies that can be used by students and researchers. Additionally, there are also campaigns and initiatives for obtaining free credits for using cloud services. This paper presents the opportunities for using cloud technologies for scientific research purposes.

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