

# Unit 9

# Cloud Computing

*Introduction;*

*The Basics of Cloud Computing;*

*Different Types of Clouds;*

*Cloud Computing Services;*

*The Benefits of Cloud Computing;*

*Concerns and Risks with Cloud Computing;*

*The “Big Three” Cloud Computing Vendors;*

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# Introduction

- Cloud computing refers to the delivery of on-demand computing services, including servers, storage, databases, networking, software, and analytics, over the internet ("the cloud").
- It allows individuals and organizations to access IT resources without needing to own or manage physical infrastructure, enabling flexibility, scalability, and cost efficiency.



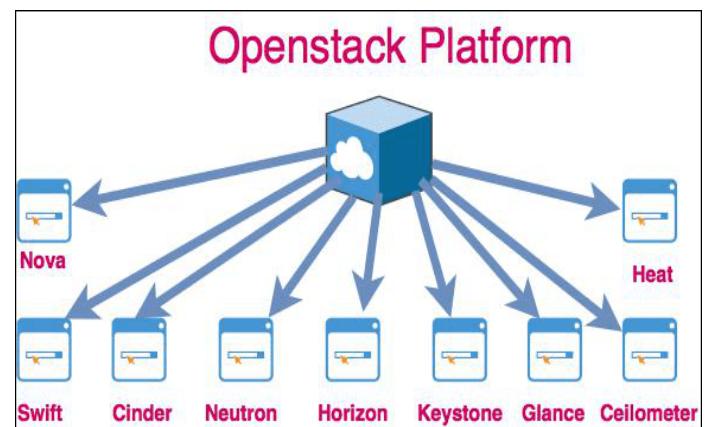
## ➤ Features:

- **On-Demand Service:** Resources can be accessed anytime without human intervention.
- **Scalability and Elasticity:** Easily scale resources up or down based on demand.
- **Resource Pooling:** Resources are shared among multiple users while maintaining data security.
- **Broad Network Access:** Accessible from any device with an internet connection.
- **Measured Service:** Pay only for what you use (utility-based pricing).
- **Automated Updates:** Service providers manage software updates and system maintenance.
- **Virtualization:** Enables efficient resource utilization by creating virtual versions of physical resources.



## ➤ Advantages

- **Cost-Effectiveness:** Reduces the need for upfront investment in IT infrastructure.
- **Flexibility and Accessibility:** Users can access services from anywhere in the world.
- **Disaster Recovery:** Ensures business continuity through backups and recovery solutions.
- **Increased Collaboration:** Teams can work together in real-time using shared tools and platforms.
- **Environmentally Friendly:** Efficient resource usage reduces carbon footprints.
- **Faster Deployment:** Applications and resources can be deployed quickly without setting up physical systems.



## ➤ Disadvantages

- **Security Concerns:** Data stored in the cloud may be vulnerable to breaches.
- **Downtime Risks:** Relies on internet connectivity, making it prone to outages.
- **Vendor Lock-In:** Transitioning between cloud providers can be challenging.
- **Compliance Issues:** Adhering to legal and regulatory requirements for data storage.
- **Hidden Costs:** Overuse of resources may lead to unexpected expenses.

## ➤ Examples in the World

- **Nepal:**
  - **eSewa:** Nepal's leading digital payment platform uses cloud services for secure and scalable payment processing.
  - **Nepal Telecom:** Implements cloud computing for data storage and CRM solutions.
- **India:**
  - **Flipkart:** Uses AWS to manage large-scale e-commerce operations during sales events like "Big Billion Days."
  - **Aadhaar System:** Cloud solutions are utilized to manage the massive database of biometric and demographic data.
- **China:**
  - **Alibaba Cloud:** Offers a range of cloud computing solutions for businesses in e-commerce and AI development.
  - **WeChat:** Relies on cloud computing to handle billions of messages and transactions daily.
- **Asia:**
  - **Grab (Southeast Asia):** Uses cloud computing to support its ride-hailing, food delivery, and financial services.
  - **Samsung (South Korea):** Leverages cloud infrastructure for its AI and IoT initiatives.
- **World:**
  - **Netflix:** Uses AWS to deliver seamless streaming services to millions of users worldwide.
  - **NASA:** Relies on cloud computing for data processing and collaborative research.

## The Basics of Cloud Computing

- Cloud computing refers to the delivery of computing services such as storage, databases, networking, software, and more over the internet ("the cloud") instead of relying on local servers or personal devices.
- It allows users to access and utilize resources on a pay-as-you-go basis, promoting efficiency and scalability.

## ➤ Core Principles

- **On-Demand Self-Service:** Users can provision resources like storage and computing power without human intervention from the provider.
- **Broad Network Access:** Resources are accessible over the internet through standard devices like laptops, smartphones, or tablets.
- **Resource Pooling:** Cloud providers serve multiple customers using shared resources while maintaining data security and separation.
- **Scalability and Elasticity:** Resources can scale dynamically to meet fluctuating demands.
- **Pay-as-You-Go Model:** Users are billed based on the amount of resources consumed, reducing unnecessary expenses.

## ➤ Key Components of Cloud Computing

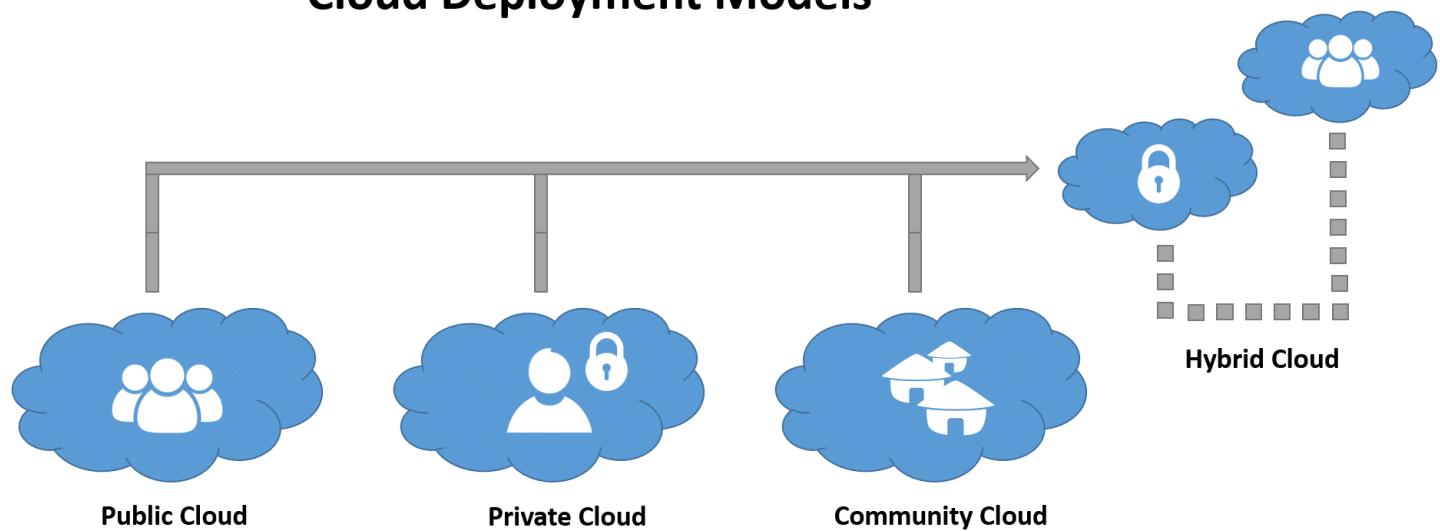
- **Virtualization:** Enables multiple virtual systems to operate on a single physical system, maximizing resource utilization.

- **Cloud Storage:** Stores data remotely, accessible anytime and from anywhere. Examples: Google Drive, Dropbox.
- **Cloud Networking:** Connects various resources over the internet, enabling seamless data exchange.
- **Cloud Applications:** Software hosted on the cloud that can be accessed without installation. Example: Microsoft Office 365.
- **Cloud Platforms:** Frameworks for building, testing, and deploying applications. Example: Google App Engine.

## Different Types of Clouds

- Cloud computing can be categorized into different types based on the deployment model.
- These models define how resources are shared and accessed by users.
- The four main types of clouds are:
  - Public Cloud
  - Private Cloud
  - Hybrid Cloud
  - Community Cloud

## Cloud Deployment Models



### 1. Public Cloud

- **Definition:** A cloud infrastructure made available to the general public or a large industry group, managed by a third-party cloud service provider. Resources are shared among multiple users (multi-tenancy).
- **Examples:** Amazon Web Services (AWS), Google Cloud Platform (GCP), Microsoft Azure.
- **Key Features:**
  - Cost-effective since resources are shared.
  - Highly scalable and elastic.

- Accessible from anywhere over the internet.

- **Use Cases:**

- Hosting websites and applications.
- Development and testing environments.

**Example in Nepal:** eSewa, a digital payment platform, uses public cloud services for scalability and availability.

## 2. Private Cloud

- **Definition:** A cloud infrastructure dedicated exclusively to one organization, either managed internally or by a third-party provider.
- **Key Features:**
  - Greater control and customization.
  - Enhanced security and privacy.
  - Suitable for organizations with strict regulatory requirements.
- **Use Cases:**
  - Financial institutions requiring secure environments.
  - Research organizations handling sensitive data.

**Example in India:** Banks like **HDFC Bank** and **SBI** implement private cloud solutions for secure data management.

## 3. Hybrid Cloud

- **Definition:** A combination of public and private clouds, allowing data and applications to be shared between them. This model offers flexibility by keeping sensitive data in a private cloud while leveraging public cloud resources for scalability.
- **Key Features:**
  - Balances security with scalability.
  - Supports dynamic workloads.
  - Reduces costs by using public cloud resources for non-critical tasks.
- **Use Cases:**
  - E-commerce platforms managing customer data privately but using public clouds for web traffic.

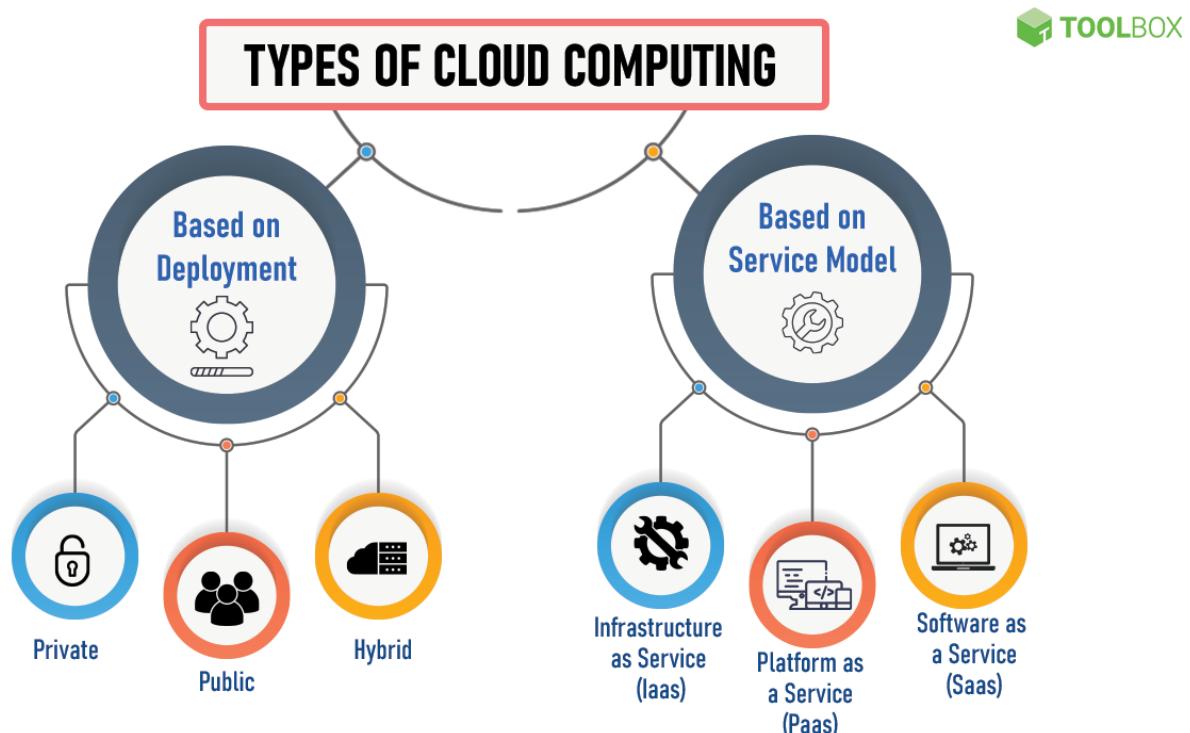
- Disaster recovery solutions.

**Example in China:** Alibaba Cloud provides hybrid cloud solutions to businesses that need to scale their operations while maintaining sensitive data privacy.

#### 4. Community Cloud

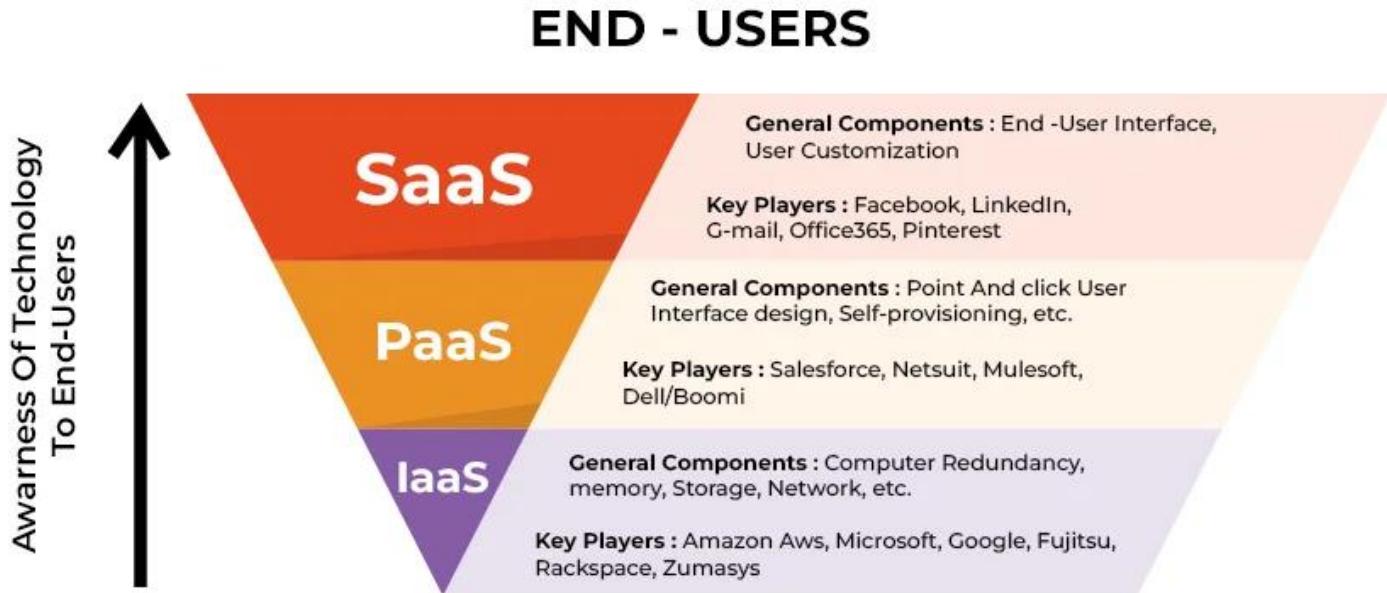
- **Definition:** A cloud infrastructure shared by several organizations with common concerns, such as compliance, security, or jurisdiction. It is managed collaboratively or by a third party.
- **Key Features:**
  - Cost-effective for organizations with shared goals.
  - Enhanced collaboration and data sharing.
  - Tailored to meet specific regulatory requirements.
- **Use Cases:**
  - Healthcare organizations sharing patient data.
  - Universities and research institutions collaborating on projects.

**Example in Asia:** Universities in Southeast Asia collaborate on research projects using community cloud infrastructures to share resources.



# Cloud Computing Services

- Cloud computing services are categorized based on the level of resources and control provided to users.
- These services are essential for businesses and individuals, allowing them to utilize computing resources without owning physical hardware or infrastructure.
- The three primary service models are:



## 1. Infrastructure as a Service (IaaS)

- **Definition:** IaaS provides virtualized computing resources such as servers, storage, and networking over the internet. It allows users to deploy and manage their own operating systems, applications, and databases.
- **Key Features:**
  - Full control over the infrastructure.
  - Scalable resources based on demand.
  - Pay-as-you-go pricing model.
- **Examples:**
  - Amazon Web Services (AWS EC2).
  - Microsoft Azure Virtual Machines.
  - Google Compute Engine.
- **Use Cases:**
  - Hosting websites and applications.
  - Setting up development and testing environments.
  - Disaster recovery and data backup solutions.

- **Example in Nepal:** Nepalese startups use IaaS for hosting their websites and applications to avoid the high cost of maintaining physical servers.

## 2. Platform as a Service (PaaS)

- **Definition:** PaaS offers a platform for developers to build, deploy, and manage applications without worrying about the underlying infrastructure. It provides tools, frameworks, and development environments.
- **Key Features:**
  - Simplified application development.
  - Built-in development tools and frameworks.
  - Supports multiple programming languages.
- **Examples:**
  - Google App Engine.
  - Microsoft Azure App Service.
  - Salesforce Platform.
- **Use Cases:**
  - Developing web and mobile applications.
  - Streamlining collaborative software development.
  - Prototyping and testing new applications.
- **Example in India:** Indian app developers use PaaS platforms like Google App Engine to create scalable applications.

## 3. Software as a Service (SaaS)

- **Definition:** SaaS delivers software applications over the internet, accessible through web browsers, eliminating the need for installation or maintenance.
- **Key Features:**
  - Subscription-based model.
  - Automatic updates and maintenance.
  - Accessible from any device with an internet connection.
- **Examples:**
  - Microsoft Office 365.
  - Google Workspace (formerly G Suite).
  - Zoom and Slack.
- **Use Cases:**

- Office productivity tools.
- Customer Relationship Management (CRM) systems.
- Online collaboration and communication platforms.
- **Example in China:** Tencent Cloud's WeChat SaaS platform supports communication and e-commerce for millions of users.

## Additional Cloud Service Models

### 1. Function as a Service (FaaS):

- Serverless computing where developers focus on building functions without managing servers.
- Example: AWS Lambda.

### 2. Database as a Service (DBaaS):

- Managed database services for storing and retrieving data.
- Example: Amazon RDS, Google Firebase.

## Applications in Context

### 1. Nepal:

- **eSewa:** SaaS solutions for digital payment and financial services.
- **Nepal Telecom:** Uses IaaS for data storage and network management.

### 2. India:

- **Flipkart:** Relies on IaaS for e-commerce infrastructure during large-scale sales events.
- **Paytm:** Utilizes SaaS solutions for payment gateways.

### 3. China:

- **Alibaba Cloud:** Provides PaaS for Chinese app developers.
- **WeChat:** SaaS platform integrating communication and e-commerce.

### 4. Global:

- **Netflix:** Uses AWS (IaaS) for content delivery.
- **Dropbox:** Offers SaaS for cloud storage and collaboration.

This breakdown of cloud computing services provides a clear understanding of how they function and their applications in different contexts.

# The Benefits of Cloud Computing

- Cloud computing has revolutionized how individuals and organizations access, manage, and utilize computing resources.
- Its numerous benefits make it a crucial technology for businesses, governments, and individuals worldwide.

## 1. Cost Efficiency

- Reduces capital expenditure on hardware, software, and maintenance.
- Operates on a pay-as-you-go model, where users only pay for the resources they use.
- Lowers energy and operational costs.

**Example:** Startups in Nepal use cloud services to save money on purchasing and maintaining servers.

## 2. Scalability and Flexibility

- Easily scale resources up or down based on business needs.
- Supports dynamic workloads and fluctuating user demands.
- Ideal for seasonal businesses or events with unpredictable traffic surges.

**Example:** Flipkart in India uses AWS to handle massive spikes during its "Big Billion Days" sales.

## 3. Accessibility and Mobility

- Provides access to applications and data from anywhere with an internet connection.
- Enables collaboration among remote teams and across geographical boundaries.
- Supports a mobile workforce by allowing access from smartphones, tablets, and laptops.

**Example:** Remote education platforms in Nepal utilize cloud services for e-learning.

## 4. Automatic Updates and Maintenance

- Service providers manage updates, security patches, and hardware maintenance.
- Ensures systems are always running with the latest technologies and features.

**Example:** Businesses in China benefit from Tencent Cloud's automatic updates for enterprise solutions.

## 5. Enhanced Collaboration

- Real-time file sharing and editing allow seamless teamwork.
- Facilitates cross-departmental collaboration within organizations.

**Example:** Google Workspace is used in universities in Asia for collaborative research projects.

## 6. Disaster Recovery and Business Continuity

- Offers backup and recovery solutions to ensure minimal downtime in case of a disaster.
- Provides quick recovery options to protect critical data and operations.

**Example:** Nepalese banks use cloud backup solutions to ensure data safety during natural disasters like earthquakes.

## 7. Security

- Cloud providers implement robust security measures such as encryption, multi-factor authentication, and regular audits.
- Protects data from unauthorized access and cyberattacks.

**Example:** Indian healthcare institutions use secure cloud solutions to protect patient data.

## 8. Environmentally Friendly

- Cloud computing reduces the need for physical data centers, saving energy and resources.
- Promotes shared resources, reducing carbon footprints.

**Example:** Green cloud initiatives in China support sustainable IT practices.

## 9. Innovation and Speed

- Accelerates innovation by providing tools and platforms for rapid application development.
- Reduces the time-to-market for new products and services.

**Example:** Startups in Asia leverage PaaS to quickly develop and test new applications.

## Global Examples

1. **Netflix:** Leverages AWS for streaming, saving costs on server management.
2. **Alibaba Cloud:** Supports businesses in China with scalable e-commerce solutions.
3. **eSewa:** Utilizes cloud technology in Nepal to handle secure digital transactions.
4. **Samsung:** Uses cloud computing for AI and IoT initiatives in South Korea.

# Concerns and Risks with Cloud Computing

- While cloud computing offers numerous benefits, there are also significant concerns and risks associated with its adoption.
- These challenges can impact businesses, organizations, and individual users, making it essential to understand and mitigate them.

## 1. Data Security and Privacy

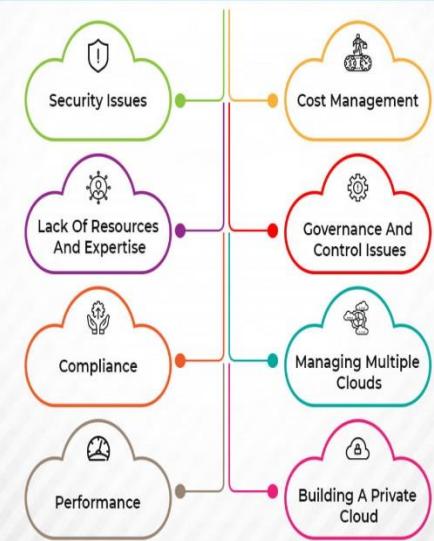
- **Risk:** Storing sensitive data on third-party servers raises concerns about unauthorized access, data breaches, and theft.
- **Issues:**
  - Cloud providers may not have the same level of security as an organization's internal infrastructure.
  - The potential for data being accessed by unauthorized parties, especially in public cloud environments.
- **Mitigation:**
  - Encrypt sensitive data before storing it on the cloud.
  - Implement strong access controls and multi-factor authentication.
  - Choose cloud providers with strong security certifications and compliance measures.

**Example:** In Nepal, some businesses have concerns about storing customer data in foreign-based cloud services due to data privacy laws.

## 2. Downtime and Service Reliability

- **Risk:** Cloud services rely on the internet, and any disruption in connectivity or server failure can lead to service downtime.
- **Issues:**
  - Service outages can disrupt business operations, leading to financial losses and damage to reputation.
  - Some cloud providers may not have the same level of uptime guarantees as on-premises solutions.
- **Mitigation:**
  - Ensure Service Level Agreements (SLAs) with providers include uptime guarantees and compensation for outages.

## Eight Risks and Challenges for Cloud Computing



- Consider hybrid cloud models for critical workloads that need higher reliability.

**Example:** In India, major e-commerce platforms like **Flipkart** rely on cloud infrastructure; any downtime could lead to significant sales losses, especially during high-traffic events like festivals.

### 3. Vendor Lock-In

- **Risk:** Moving data and applications from one cloud provider to another can be difficult and costly, especially if the services or technologies are proprietary.
- **Issues:**
  - Migrating from one cloud to another may involve compatibility issues and loss of functionality.
  - Organizations can become overly reliant on a single vendor, limiting flexibility.
- **Mitigation:**
  - Adopt open standards and use cloud platforms that support multi-cloud or hybrid cloud strategies.
  - Regularly assess cloud contracts and maintain the flexibility to switch providers if needed.

**Example:** Businesses in China, such as **Alibaba**, might face challenges in moving data out of Alibaba Cloud due to tight integration with its ecosystem.

### 4. Data Loss and Lack of Control

- **Risk:** Storing data on the cloud means that users are entrusting third parties with their most critical business data. There is also the risk of data loss in the event of a cloud provider's failure.
- **Issues:**
  - Data loss due to unexpected failures or corruption.
  - Limited control over how data is handled by cloud providers, especially with public cloud services.
- **Mitigation:**
  - Ensure regular backups of critical data, especially if using public clouds.
  - Use a multi-cloud or hybrid cloud strategy to mitigate risks of single provider dependency.
  - Understand and verify cloud providers' data management and backup policies.

**Example:** In Nepal, some small businesses may face risks of data loss if their cloud provider does not offer adequate backup solutions for important customer or transaction data.

## 5. Compliance and Legal Risks

- **Risk:** Cloud computing services are subject to different regulatory and compliance standards depending on the geographic location. Organizations must ensure that their cloud provider adheres to local laws and industry regulations.
- **Issues:**
  - Data stored in a cloud provider's data center in another country may be subject to foreign jurisdiction and regulations.
  - Many industries (e.g., healthcare, finance) have strict data privacy and compliance requirements that may be challenging to meet in the cloud.
- **Mitigation:**
  - Work with cloud providers that offer specific compliance certifications (e.g., GDPR, HIPAA, ISO 27001).
  - Understand the legal implications of where data is stored and the rights of both the organization and the provider.

**Example:** In India, financial institutions like **HDFC** need to ensure compliance with regulations such as the **RBI guidelines** for data storage and security before using cloud services.

## 6. Performance and Latency Issues

- **Risk:** Cloud-based applications rely on internet connectivity, and poor network performance can result in delays, low performance, and slow data processing.
- **Issues:**
  - Latency issues, especially when cloud servers are located far from users or critical resources.
  - Network bandwidth limitations can affect the quality of service, particularly for real-time applications.
- **Mitigation:**
  - Choose cloud providers with geographically distributed data centers to reduce latency.
  - Ensure internet connectivity is reliable and fast enough to support cloud-based operations.

**Example:** In rural areas of Nepal, slow or unreliable internet connections can hinder businesses' ability to fully utilize cloud services effectively.

## 7. Security of Endpoints

- **Risk:** Devices used to access cloud services (e.g., smartphones, laptops) may not be secure, leading to vulnerabilities.
- **Issues:**
  - Compromised devices can result in unauthorized access to cloud services and sensitive data.

- Malicious actors could exploit weak security on endpoints to breach cloud systems.
- **Mitigation:**
  - Implement endpoint protection solutions, including antivirus software and encryption.
  - Regularly update and patch devices to minimize vulnerabilities.

**Example:** In China, employees accessing company data on personal mobile devices could inadvertently expose sensitive information if their devices are not properly secured.

## The “Big Three” Cloud Computing Vendors

- The three leading cloud computing service providers globally, often referred to as "The Big Three," dominate the cloud market and offer comprehensive solutions across various industries.
- These vendors
  - **Amazon Web Services (AWS)**,
  - **Microsoft Azure**, and
  - **Google Cloud Platform (GCP)**
- each have unique strengths and cater to different business needs. Here's a breakdown of each:



### 1. Amazon Web Services (AWS)

- **Overview:**  
AWS is the largest and most established cloud computing provider globally, launched by Amazon in 2006. It offers a wide range of cloud services, including computing power, storage, databases, machine learning, networking, and analytics.
- **Key Features:**
  - **Compute:** Amazon EC2 for scalable computing power.
  - **Storage:** Amazon S3 for scalable object storage.
  - **Databases:** Amazon RDS for managed relational databases.
  - **Machine Learning:** SageMaker for building and deploying machine learning models.
  - **Networking:** Amazon VPC for isolated cloud networks.
  - **Security:** Tools like AWS Identity and Access Management (IAM) and AWS Shield for robust security.
- **Global Reach:**  
AWS operates in numerous regions worldwide, with a presence in North America, Europe, Asia, and more, making it highly scalable for businesses with global operations.

- **Example** in Nepal: Nepali e-commerce platforms use AWS to scale their infrastructure during peak traffic times, ensuring high availability and performance.
- **Use Case:** Netflix, the streaming giant, relies heavily on AWS to power its content delivery to millions of global users.

## Popular Vendors by Category often procured & deployed out of AWS Marketplace by customers

Operating Systems	Security	Storage	Networking	Database	Media	DevOps	BI
CentOS	SOPHOS	NetApp	CISCO	TERADATA	Adobe	Hewlett Packard Enterprise	tableau
ubuntu	paloalto NETWORKS	FORTINET	CN2W software	SAP	aspera	CHEF	splunk
debian	Barracuda	SoftNAS	CITRIX	MAPR	DATAGUISE	SIGNIANT	MATILLION
SUSE	Check Point SOFTWARE TECHNOLOGIES LTD	COMMVAULT	BROCADE	AEROSPIKE	bitfusion.io	zend	MicroStrategy
ORACLE LINUX	TREND MICRO	ATTUNITY	riverbed	Couchbase	WOWZA Streaming Engine	GitLab	TIBCO
Windows	IMPERVA					Parse Server	informatica

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## 2. Microsoft Azure

- **Overview:** Microsoft Azure, launched in 2010, is the second-largest cloud provider and offers an extensive array of cloud computing services. It integrates well with Microsoft products and services, making it a popular choice for enterprises with existing Microsoft software ecosystems (like Windows Server, Active Directory, and Office 365).
- **Key Features:**
  - **Compute:** Azure Virtual Machines for scalable computing.
  - **Storage:** Azure Blob Storage for object storage.
  - **Databases:** Azure SQL Database for managed relational databases.
  - **Machine Learning:** Azure Machine Learning for building AI models.
  - **Networking:** Azure Virtual Network for creating isolated cloud networks.

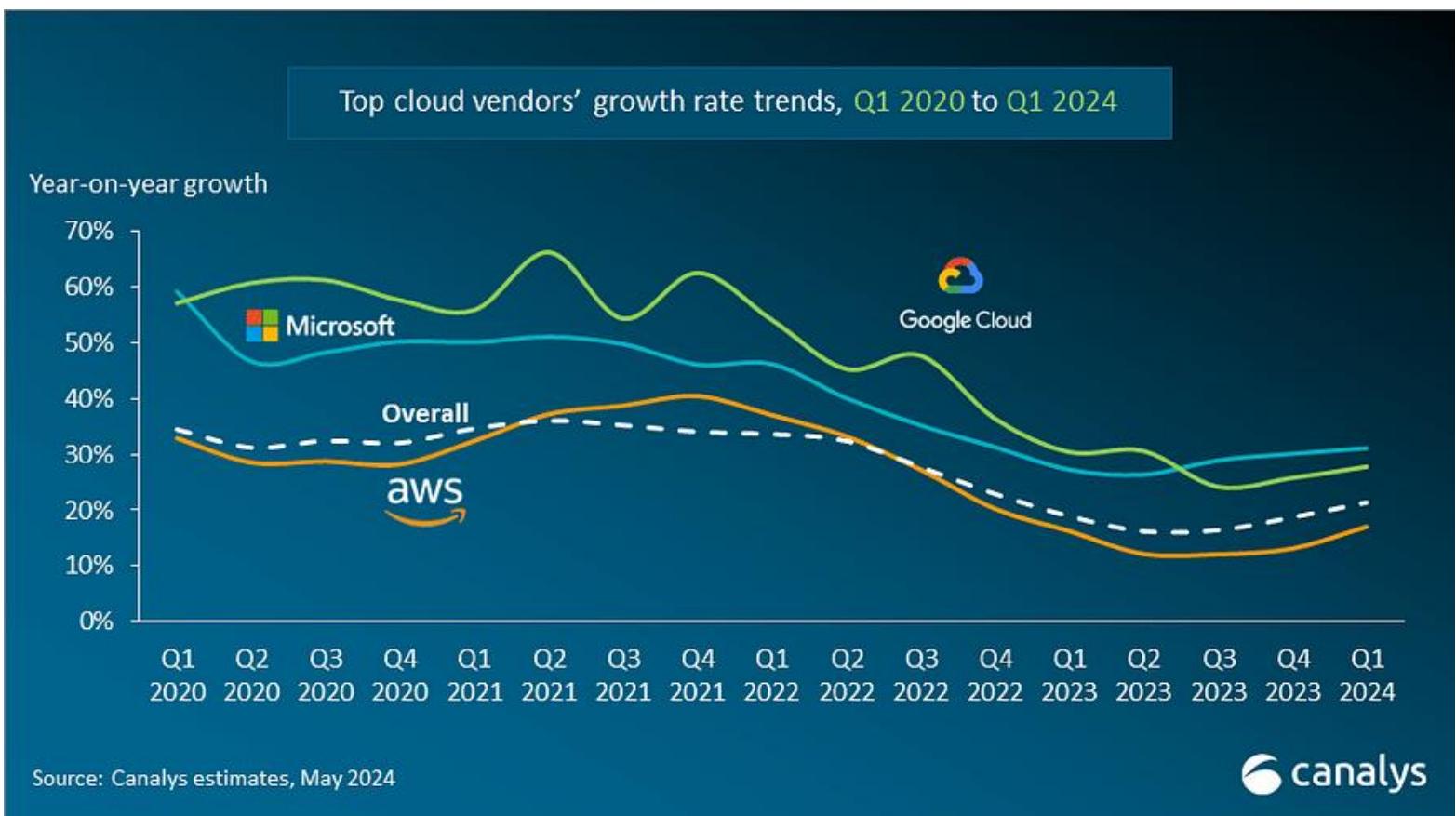
- **Security:** Azure Security Center and multi-factor authentication.
- **Global Reach:**  
Azure also has a strong global presence, with data centers in over 60 regions, allowing businesses to deploy solutions close to their customers.
- **Example in India:**  
Indian companies like **Wipro** and **HCL Technologies** use Azure to run their enterprise resource planning (ERP) systems, enhancing performance and scalability.
- **Use Case:**  
**Adobe** uses Microsoft Azure to run its cloud-based creative software, Adobe Creative Cloud, providing customers with the ability to access tools like Photoshop and Illustrator anywhere.

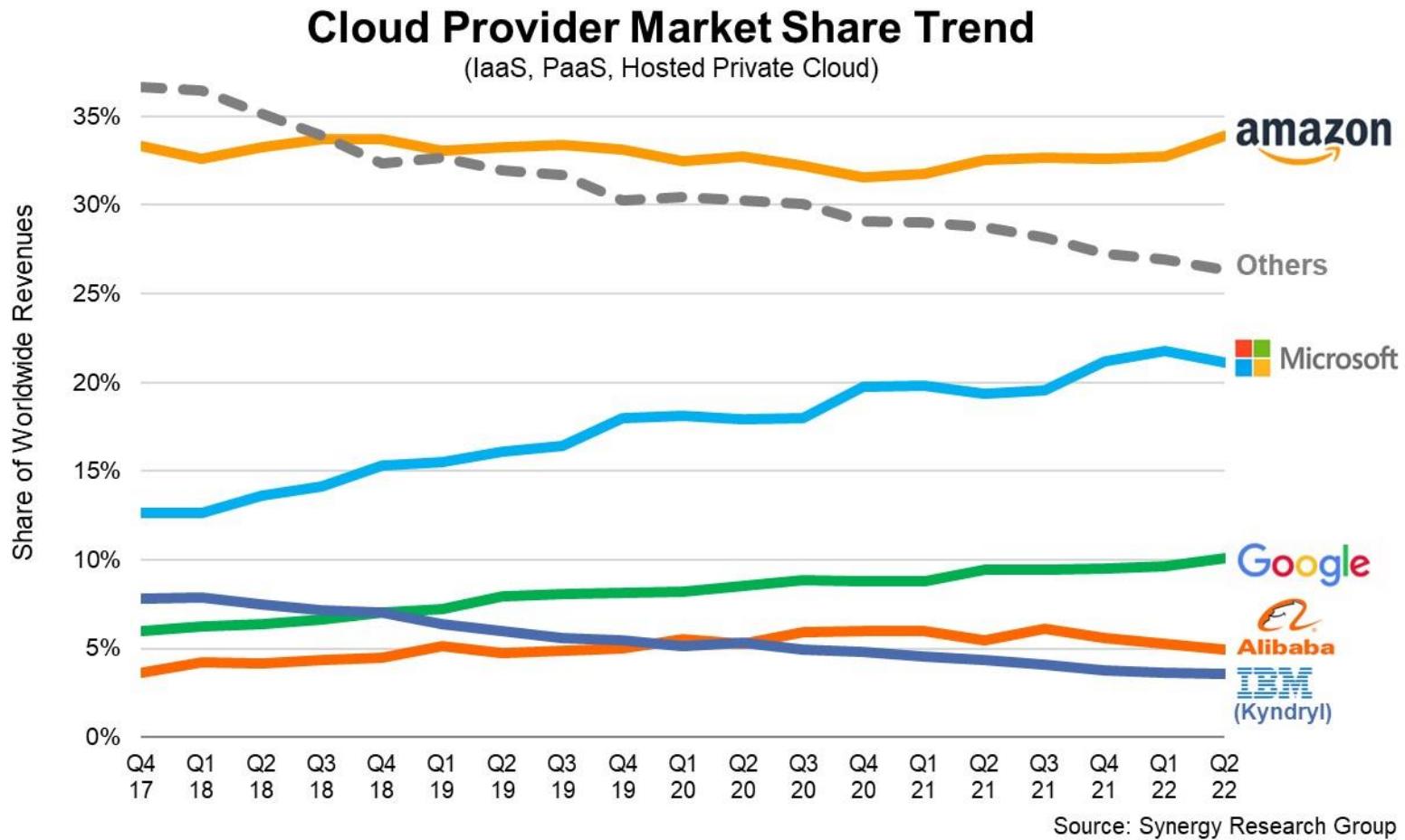


### 3. Google Cloud Platform (GCP)

- **Overview:**  
Google Cloud Platform, launched in 2008, is a leading provider of cloud services, particularly known for its data analytics, machine learning, and open-source solutions. GCP is favored by companies in industries like big data, AI, and high-performance computing.
- **Key Features:**
  - **Compute:** Google Compute Engine for scalable computing power.

- **Storage:** Google Cloud Storage for scalable object storage.
  - **Databases:** Cloud SQL and Bigtable for managed databases.
  - **Machine Learning:** Google AI and TensorFlow for AI/ML models.
  - **Networking:** Google Cloud VPC for network isolation and security.
  - **Security:** Google Cloud Identity and Google Security Command Center.
- **Global Reach:**  
GCP leverages Google's global network infrastructure, offering fast and reliable services with data centers around the world.
- **Example in China:**  
Chinese startups involved in AI and big data often turn to GCP for its advanced machine learning tools and data analytics platforms.
- **Use Case:**  
**Spotify** uses Google Cloud for its data storage and processing needs, supporting its music streaming services for millions of global users.





## Web Services and Service- Oriented Architecture

- In modern software development and cloud computing, **Web Services and Service-Oriented Architecture (SOA)** play a critical role in enabling seamless communication and integration between different applications and systems. Let's explore these concepts in detail.

### 1. Web Services

- **Web services** are software applications or components that allow different systems or applications to communicate with each other over a network (typically the internet) using standard protocols.
- Web services enable interoperability between different platforms, regardless of the underlying hardware, operating system, or programming language.

#### Key Characteristics of Web Services:

- **Interoperability:** Web services allow communication between applications built on different technologies and platforms.
- **Standardized Communication:** They communicate using widely accepted protocols such as HTTP, SOAP, REST, XML, and JSON.

- **Loose Coupling:** The client and server interact without requiring knowledge of each other's internal implementation.
- **Platform and Language Independent:** Web services allow systems written in different programming languages to communicate with one another.

### **Common Types of Web Services:**

#### **1. SOAP (Simple Object Access Protocol):**

A protocol used for exchanging structured information between applications over a network. It relies on XML to define its message format and typically uses HTTP for communication.

- **Advantages:**

- Highly standardized and extensible.
- Supports security features like WS-Security.
- Reliable for complex transactions.

#### **2. REST (Representational State Transfer):**

A more lightweight and flexible approach to building web services. It uses standard HTTP methods (GET, POST, PUT, DELETE) and data formats like JSON or XML.

- **Advantages:**

- Simpler and easier to implement than SOAP.
- Typically uses less bandwidth (more efficient).
- Preferred for mobile and web applications.

### **Example of Web Services:**

- **PayPal:** PayPal offers a set of web services that allow other applications to integrate payment solutions into their websites.
- **Google Maps API:** Google Maps offers a REST-based web service that allows developers to embed location-based services into their applications.

## **2. Service-Oriented Architecture (SOA)**

- **Service-Oriented Architecture (SOA)** is an architectural pattern in which software components, known as **services**, are designed to provide specific business functionalities and interact with each other over a network.
- SOA aims to organize software applications into loosely coupled, reusable, and distributed services that can be combined to form larger, more complex applications.

## Key Characteristics of SOA:

- **Loose Coupling:** Services in SOA are independent of one another and can be developed, deployed, and maintained separately.
- **Reuse:** Services are designed to be reusable across different applications and business processes.
- **Interoperability:** SOA allows applications running on different platforms and technologies to interact through standardized communication protocols.
- **Scalability:** Services can be scaled independently depending on the needs of the business.

## Components of SOA:

1. **Services:** Independent, reusable business functions that can be accessed remotely by other applications. Each service typically performs one task (e.g., calculating tax, verifying a user's identity).
2. **Service Registry:** A directory where services are published and discovered by other services or applications.
3. **Service Consumer:** The client or application that uses the web service to perform a function.
4. **Service Bus:** A middleware component (like an Enterprise Service Bus or ESB) that facilitates communication between services and handles tasks like message routing, security, and transaction management.

## Benefits of SOA:

- **Flexibility:** Businesses can modify or replace individual services without affecting the entire system.
- **Agility:** New services can be added or existing ones can be modified to adapt to changing business requirements.
- **Integration:** SOA facilitates the integration of heterogeneous systems within an organization or across organizations.

## Example of SOA:

- **Amazon:** Amazon uses SOA to break down its vast e-commerce platform into individual services (order management, inventory management, payment processing, etc.). These services interact with each other but can also be independently modified or scaled.
- **Netflix:** Netflix also employs SOA, with different services handling user profiles, streaming, billing, and content recommendations. This allows Netflix to scale its infrastructure based on demand.

## Case Study: Cloud Computing Adoption in Nepal

**Scenario:** A Nepali startup uses AWS for hosting its e-commerce platform. They leverage the scalability of AWS to handle peak shopping times like festivals and rely on its security features to ensure customer data protection.

### Questions and Answers

1. **Question:** What are the main types of cloud services?
  - o **Answer:** IaaS, PaaS, and SaaS.
2. **Question:** Name one risk associated with cloud computing.
  - o **Answer:** Data security and privacy.
3. **Question:** Why is hybrid cloud popular among organizations?
  - o **Answer:** It offers scalability while maintaining control over sensitive data.
4. **Question:** Which cloud computing vendor is known for AI and machine learning services?
  - o **Answer:** Google Cloud Platform (GCP).
5. **Question:** How does SOA benefit application development?
  - o **Answer:** It allows services to be loosely coupled and reusable, enabling modular development.

## Case Study: Implementing Cloud Infrastructure on OpenStack

**Background:** A medium-sized software development company, **Tech Innovators Pvt. Ltd.**, located in Kathmandu, Nepal, has been experiencing rapid growth. With an increasing number of projects and clients, the company is facing challenges managing its IT infrastructure. The company's on-premises servers are struggling to meet the demands of hosting large-scale applications, handling user data, and providing the flexibility to quickly scale up or down. The management team realizes the need for a more flexible, cost-efficient, and scalable cloud infrastructure.

After evaluating various cloud solutions, **Tech Innovators** decides to implement an **OpenStack-based private cloud**. OpenStack, being an open-source cloud computing platform, offers several benefits, including flexibility, cost-effectiveness, and the ability to control and customize the cloud environment according to the company's specific needs.

## Project Implementation:

The company forms a team of IT professionals and cloud engineers to deploy OpenStack in their data center. They begin by installing the necessary components:

- **Compute (Nova)**: For managing virtual machines.
- **Storage (Cinder and Swift)**: For block and object storage.
- **Networking (Neutron)**: For managing networking services.
- **Identity and Access Management (Keystone)**: To handle authentication and authorization.
- **Dashboard (Horizon)**: For the management interface.
- **Orchestration (Heat)**: To automate the deployment of infrastructure resources.

The implementation process involves setting up a **private cloud infrastructure**, ensuring that it's capable of handling multiple virtualized environments and that the team can easily manage and monitor all resources. The engineers configure high-availability features and implement backup and disaster recovery solutions. The project is designed to deliver a multi-tenant environment, allowing the company to host several clients' applications securely while keeping their data isolated.

## Challenges Faced:

1. **Technical Complexity**: Implementing OpenStack involves complex configuration, especially for advanced features such as networking and high availability. The team faces initial hurdles in setting up **Neutron** for networking.
2. **Integration with Existing Systems**: The company had to integrate OpenStack with its legacy systems, such as its internal billing software and database management systems, which involved significant customization.
3. **Training and Knowledge Gap**: Some team members were not familiar with OpenStack, so they had to undergo training and work with experts to ensure that the platform was deployed correctly.

## Benefits Realized:

1. **Scalability**: OpenStack allows the company to scale resources up and down quickly. As the client base grows, the company can add more virtual machines and storage without the need for significant hardware investments.
2. **Cost Savings**: By switching to OpenStack, the company reduces the costs associated with maintaining on-premises hardware and physical infrastructure. The use of open-source software means no licensing costs.
3. **Improved Performance**: With a private cloud, Tech Innovators experiences better performance and reduced downtime. The team can allocate resources based on demand, ensuring that critical applications have the computing power they need.
4. **Security and Control**: OpenStack provides the company with greater control over security configurations. By using its own cloud infrastructure, Tech Innovators can set up custom security policies tailored to the company's needs.

## Future Plans:

- **Hybrid Cloud**: Tech Innovators plans to extend its cloud infrastructure to a hybrid model, integrating OpenStack with public clouds for increased redundancy and the ability to handle larger workloads during peak times.
- **Automation**: The team intends to further automate operations using OpenStack's orchestration tools (Heat) and integrate CI/CD pipelines into the cloud infrastructure to improve deployment efficiency.

## Questions:

1. What were the key reasons Tech Innovators Pvt. Ltd. decided to implement OpenStack for its cloud infrastructure?
2. Which OpenStack components did Tech Innovators implement to build their private cloud?
3. What were the major challenges faced during the implementation of OpenStack in the company?
4. How did the use of OpenStack benefit Tech Innovators in terms of scalability and cost savings?
5. What are Tech Innovators' plans for the future in terms of cloud infrastructure?

## Answers:

1. **Key Reasons for Implementing OpenStack:** Tech Innovators Pvt. Ltd. decided to implement OpenStack for the following reasons:
  - **Scalability:** To scale resources up or down as needed to accommodate the growing number of projects and clients.
  - **Cost-Effectiveness:** OpenStack being open-source allows the company to reduce licensing costs associated with proprietary cloud solutions.
  - **Control:** To have more control over their infrastructure, ensuring security, customization, and better performance for their specific needs.
2. **OpenStack Components Implemented:** Tech Innovators implemented the following OpenStack components to build their private cloud:
  - **Nova** (Compute): To manage and provision virtual machines.
  - **Cinder** (Storage): For block storage.
  - **Swift** (Storage): For object storage.
  - **Neutron** (Networking): To handle networking and connect virtual machines.
  - **Keystone** (Identity & Access Management): For authentication and authorization.
  - **Horizon** (Dashboard): For the web-based management interface.
  - **Heat** (Orchestration): To automate and orchestrate the deployment of cloud resources.
3. **Major Challenges Faced:**
  - **Technical Complexity:** Setting up and configuring the networking component (Neutron) was challenging.
  - **Integration with Legacy Systems:** The company faced difficulty integrating OpenStack with its existing internal software, such as billing systems and database management.
  - **Training and Knowledge Gap:** Some team members were unfamiliar with OpenStack, requiring additional training to ensure proper implementation.
4. **Benefits of OpenStack in Scalability and Cost Savings:**

- **Scalability:** OpenStack allowed Tech Innovators to quickly scale up and down based on business needs without relying on physical hardware. This flexibility supported the growing client base.
- **Cost Savings:** By switching to an open-source cloud platform, the company saved on licensing fees associated with proprietary cloud solutions. Additionally, the private cloud infrastructure eliminated the need for ongoing hardware maintenance costs.

## 5. Tech Innovators' Future Plans:

- **Hybrid Cloud:** The company plans to expand its cloud infrastructure to a hybrid model, combining OpenStack with public cloud services to ensure higher redundancy and the ability to handle large spikes in demand.
- **Automation:** The company aims to improve operational efficiency by automating more processes using OpenStack's orchestration tools (Heat) and integrating continuous integration/continuous deployment (CI/CD) pipelines into their workflow.

This case study highlights how OpenStack provides a flexible and cost-efficient solution for businesses looking to implement cloud infrastructures, especially in growing companies that need to scale quickly while maintaining control over their resources.

# Q/A

## Fill-in-the-Blank Questions (20)

1. Cloud computing allows users to access computing resources, such as servers, storage, and applications, over the \_\_\_\_\_ (internet).
2. A key characteristic of cloud computing is its ability to provide \_\_\_\_\_, allowing resources to be scaled up or down based on demand.
3. \_\_\_\_\_ clouds are designed to be accessible by a single organization, offering complete control over data and resources.
4. In a \_\_\_\_\_ cloud, the infrastructure is shared by multiple organizations, often with each organization's data and processes isolated.
5. \_\_\_\_\_ is an example of a public cloud service provider that offers computing resources over the internet.
6. One of the key benefits of cloud computing is \_\_\_\_\_, which helps reduce the need for large upfront investments in hardware and software.
7. \_\_\_\_\_ computing is a model that involves distributing applications, services, and infrastructure over the internet, rather than hosting them locally.
8. \_\_\_\_\_ clouds provide a combination of private and public cloud services, allowing data and applications to move between the two environments.
9. The term \_\_\_\_\_ refers to the way resources in a cloud environment can be billed based on usage rather than flat-rate pricing.
10. \_\_\_\_\_ clouds typically involve a specific cloud platform or service being provided by a third party, with customers renting access to the infrastructure and services.

11. \_\_\_\_\_ is an important feature of cloud computing that allows users to pay only for the computing resources they use.
12. \_\_\_\_\_ are standardized ways in which web-based services communicate with each other across different platforms using common protocols.
13. \_\_\_\_\_ cloud models use shared infrastructure and resources for multiple organizations, such as public cloud environments.
14. In cloud computing, \_\_\_\_\_ allows businesses to outsource applications and storage to a cloud service provider, reducing their own IT responsibilities.
15. \_\_\_\_\_ involves computing resources being provided as services over the internet, which are then consumed by users on-demand.
16. Cloud computing has a major \_\_\_\_\_ benefit by allowing businesses to quickly scale up or down resources based on their current needs.
17. The \_\_\_\_\_ model is used in cloud computing where services such as storage, networking, and computing resources are shared between multiple users.
18. The \_\_\_\_\_ is responsible for the security, management, and delivery of services in a cloud environment.
19. \_\_\_\_\_ is a service-oriented architecture for building and deploying software applications across networks, allowing different systems to communicate.
20. One of the major concerns with cloud computing is the \_\_\_\_\_ of sensitive data when it is stored or processed on third-party servers.

### Multiple Choice Questions (25)

1. **What is cloud computing?**
  - a) Storing data on a physical server
  - b) Renting computing resources over the internet
  - c) Storing data only on local hard drives
  - d) Using external storage devices for data backup
2. **Which of the following is a key feature of cloud computing?**
  - a) Limited access to resources
  - b) High upfront investment in hardware
  - c) Scalability and on-demand resource availability
  - d) Fixed storage capacity
3. **What type of cloud is available for use by multiple organizations, where resources are shared and isolated?**
  - a) Private Cloud
  - b) Hybrid Cloud
  - c) Public Cloud
  - d) Community Cloud
4. **Which cloud service model provides users with software applications that can be accessed over the internet?**
  - a) IaaS
  - b) PaaS
  - c) SaaS
  - d) DaaS

5. **Which of the following is an example of a public cloud service?** a) Amazon Web Services (AWS)  
b) Google Cloud Platform  
c) Microsoft Azure  
d) All of the above
6. **Which cloud computing model provides resources that are shared across multiple organizations, but the infrastructure is isolated for each?** a) Private Cloud  
b) Hybrid Cloud  
c) Public Cloud  
d) Community Cloud
7. **Which of the following is a primary benefit of cloud computing?** a) Control over data centers  
b) Reduced need for physical hardware  
c) Fixed pricing structure  
d) Limited access to data
8. **What is one concern regarding cloud computing security?** a) Inability to access data remotely  
b) Risks of data breaches and loss of control  
c) Increased power usage  
d) Limited internet speed
9. **What does SaaS (Software as a Service) provide to users?** a) Virtual servers and storage  
b) Software applications over the internet  
c) Development tools for building applications  
d) Cloud-based operating systems
10. **Which of the following is NOT a typical cloud computing benefit?** a) Flexibility  
b) On-demand resource access  
c) High upfront investment  
d) Cost efficiency
11. **Which cloud service model provides users with access to virtualized computing resources such as servers and storage?** a) IaaS  
b) PaaS  
c) SaaS  
d) DaaS
12. **Which cloud service allows businesses to rent hardware and infrastructure but manage applications themselves?** a) IaaS  
b) PaaS  
c) SaaS  
d) FaaS
13. **What is a risk associated with cloud computing?** a) Unlimited storage  
b) Loss of data privacy and control  
c) Complete independence from internet providers  
d) Unlimited scalability
14. **Which of the following is a key feature of private clouds?** a) Public access to all data  
b) Exclusively for single organizations  
c) Shared resources among organizations  
d) No data security measures

- 15. What is OpenStack?** a) A cloud service provider  
 b) An open-source platform for building cloud infrastructures  
 c) A cloud-based web browser  
 d) A cloud storage provider
- 16. Which of the following is NOT one of the "Big Three" cloud vendors?** a) Microsoft Azure  
 b) Google Cloud  
 c) IBM Cloud  
 d) Amazon Web Services
- 17. In a hybrid cloud model, what is true?** a) Only public cloud resources are used  
 b) Only private cloud resources are used  
 c) Both private and public cloud resources are used  
 d) No external services are used
- 18. Which of the following is an advantage of using a hybrid cloud?** a) Complete isolation from public cloud resources  
 b) Flexibility to move workloads between public and private clouds  
 c) Lower security risks  
 d) Eliminates the need for data backup
- 19. Which of the following best defines 'service-oriented architecture (SOA)'?** a) A system architecture based on client-server computing  
 b) A method for designing distributed applications with loosely coupled services  
 c) A type of database system  
 d) A programming language for building cloud applications
- 20. Which of the following is a well-known cloud computing service provider?** a) Oracle  
 b) Microsoft  
 c) Amazon  
 d) All of the above
- 21. What is the role of 'Neutron' in OpenStack?** a) Compute resources  
 b) Storage management  
 c) Networking  
 d) Orchestration
- 22. What is a major advantage of using IaaS (Infrastructure as a Service)?** a) Provides applications to end-users  
 b) Eliminates the need for software development  
 c) Provides virtualized computing resources on demand  
 d) Offers ready-to-use cloud applications
- 23. Which of the following is true for SaaS (Software as a Service)?** a) Users can install and manage the software on their own servers  
 b) Software is accessed through a web browser  
 c) Users need to maintain the infrastructure themselves  
 d) It is focused on offering infrastructure and development tools
- 24. Which cloud model is most likely to be used by large enterprises with stringent security and compliance requirements?** a) Public Cloud  
 b) Private Cloud

- c) Hybrid Cloud
- d) Community Cloud

- 25. What is a key concern when adopting cloud computing for businesses?**
- a) Limited scalability
  - b) Security and data privacy
  - c) Slow internet speeds
  - d) High costs for customers
- 

### Short Answer Questions (15)

1. What is cloud computing and why is it important for businesses?
  2. Name three types of cloud computing services and briefly describe each.
  3. What are the main differences between public, private, and hybrid clouds?
  4. How does cloud computing help organizations scale their resources efficiently?
  5. What is the role of virtualization in cloud computing?
  6. What are some key concerns businesses face when using cloud computing services?
  7. How does cloud computing help reduce costs for businesses?
  8. Define SaaS and provide an example of a SaaS application.
  9. What is the purpose of OpenStack in cloud computing?
  10. How does a public cloud differ from a private cloud in terms of security?
  11. What are the benefits of using the hybrid cloud model?
  12. How do web services work in cloud computing?
  13. What is a potential risk associated with using cloud computing for storing sensitive data?
  14. Why is service-oriented architecture (SOA) important in cloud computing?
  15. What factors should a company consider when choosing a cloud service provider?
- 

### Comprehensive Questions (10)

1. **Explain the concept of cloud computing and discuss its different deployment models, including public, private, and hybrid clouds.**
  - In your answer, describe the fundamental concept of cloud computing, highlighting how it involves delivering IT resources over the internet. Discuss the three primary deployment models—public, private, and hybrid clouds—by explaining their differences, use cases, and the level of control and security provided in each model.
2. **What are the key differences between IaaS, PaaS, and SaaS? Provide examples of services or platforms for each.**
  - Provide a detailed explanation of the three main service models in cloud computing: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS). Discuss their unique

features, what they offer to users, and provide examples of popular platforms or services for each model (e.g., AWS for IaaS, Google App Engine for PaaS, and Gmail for SaaS).

**3. Discuss the major benefits and risks associated with cloud computing. How can organizations mitigate the risks?**

- In your answer, explore the benefits cloud computing offers to organizations, such as cost efficiency, scalability, and flexibility. Also, discuss the risks, including security concerns, data privacy issues, and dependency on internet connectivity. Provide strategies or best practices organizations can use to mitigate these risks, such as encryption, multi-cloud strategies, and regular security audits.

**4. Explain the role of the "Big Three" cloud providers (Amazon Web Services, Microsoft Azure, and Google Cloud Platform). What makes them leaders in the cloud market?**

- Provide an in-depth analysis of the "Big Three" cloud computing vendors: Amazon Web Services (AWS), Microsoft Azure, and Google Cloud Platform (GCP). Discuss the strengths of each platform, their market share, the services they offer, and how their global reach and innovations have contributed to their leadership in the cloud computing industry.

**5. How do web services and Service-Oriented Architecture (SOA) work in the context of cloud computing? Explain their importance.**

- Define web services and SOA, and explain their role in cloud computing. Describe how web services allow applications to communicate over the internet, enabling interoperability and data exchange. Discuss the importance of SOA in cloud computing, emphasizing how it facilitates the development of scalable, reusable, and maintainable applications.

**6. What are the environmental impacts of cloud computing, and how can the industry mitigate its carbon footprint?**

- Discuss the environmental impact of cloud computing, focusing on energy consumption, cooling requirements, and the carbon footprint of large data centers. Explore how cloud providers are working towards sustainability, such as using renewable energy sources, improving energy efficiency, and optimizing data center designs.

**7. What is OpenStack, and how does it contribute to building a private cloud?**

- Explain the OpenStack project and its role as an open-source cloud platform for building and managing private clouds. Describe its components (e.g., Nova for compute, Swift for storage) and how it helps businesses create flexible, cost-efficient cloud infrastructures on their own hardware.

**8. How does cloud computing support business continuity and disaster recovery planning?**

- Discuss how cloud computing can be leveraged for business continuity and disaster recovery. Explain the benefits of using cloud-based backup and recovery solutions, data replication, and geographic redundancy to ensure minimal downtime and data loss during system failures or disasters.

**9. What are the key concerns related to data security and privacy in cloud computing, and what best practices should organizations follow?**

- Identify and discuss key concerns regarding data security and privacy in cloud computing, such as data breaches, unauthorized access, and compliance with regulations like GDPR. Offer best practices that organizations should implement, including encryption, identity and access management (IAM), and secure APIs.

10. Discuss the future trends in cloud computing and how emerging technologies such as artificial intelligence (AI) and machine learning (ML) are integrated with cloud services.
- Explore the future of cloud computing, focusing on how emerging technologies like AI and ML are being integrated into cloud platforms to enhance services. Discuss the role of AI and ML in improving cloud computing capabilities, such as predictive analytics, automation, and intelligent resource management.

#### *Answers to Fill-in-the-Blank Questions*

1. *internet*
2. *scalability*
3. *Private*
4. *Community*
5. *Amazon Web Services (AWS)*
6. *cost efficiency*
7. *Cloud*
8. *Hybrid*
9. *pay-as-you-go*

10. *Public*

11. *Elasticity*

12. *Web Services*

13. *Public*

14. *Cloud computing*

15. *Cloud*

16. *Scalability*

17. *Multitenancy*

18. *Cloud service provider*

19. *SOA (Service-Oriented Architecture)*

20. *security*

#### *Answers to Multiple Choice Questions (MCQs)*

1. *What is cloud computing?*
  - b) Renting computing resources over the internet
2. *Which of the following is a key feature of cloud computing?*
  - c) Scalability and on-demand resource availability
3. *What type of cloud is available for use by multiple organizations, where resources are shared and isolated?*
  - d) Community Cloud
4. *Which cloud service model provides users with software applications that can be accessed over the internet?*
  - c) SaaS
5. *Which of the following is an example of a public cloud service?*
  - d) All of the above
6. *Which cloud computing model provides resources that are shared across multiple organizations, but the infrastructure is isolated for each?*
  - d) Community Cloud
7. *Which of the following is a primary benefit of cloud computing?*
  - b) Reduced need for physical hardware
8. *What is one concern regarding cloud computing security?*
  - b) Risks of data breaches and loss of control
9. *What does SaaS (Software as a Service) provide to users?*
  - b) Software applications over the internet
10. *Which of the following is NOT a typical cloud computing benefit?*
  - c) High upfront investment
11. *Which cloud service model provides users with access to virtualized computing resources such as servers and storage?*
  - a) IaaS
12. *Which cloud service allows businesses to rent hardware and infrastructure but manage applications themselves?*
  - a) IaaS
13. *What is a risk associated with cloud computing?*
  - b) Loss of data privacy and control
14. *Which of the following is a key feature of private clouds?*
  - b) Exclusively for single organizations
15. *What is OpenStack?*

- b) An open-source platform for building cloud infrastructures

16. Which of the following is NOT one of the "Big Three" cloud vendors?

- c) IBM Cloud

17. In a hybrid cloud model, what is true?

- c) Both private and public cloud resources are used

18. Which of the following is an advantage of using a hybrid cloud?

- b) Flexibility to move workloads between public and private clouds

19. Which of the following best defines 'service-oriented architecture (SOA)'?

- b) A method for designing distributed applications with loosely coupled services

20. Which of the following is a well-known cloud computing service provider?

- d) All of the above

21. What is the role of 'Neutron' in OpenStack?

- c) Networking

22. What is a major advantage of using IaaS (Infrastructure as a Service)?

- c) Provides virtualized computing resources on demand

23. Which of the following is true for SaaS (Software as a Service)?

- b) Software is accessed through a web browser

24. Which cloud model is most likely to be used by large enterprises with stringent security and compliance requirements?

- b) Private Cloud

25. What is a key concern when adopting cloud computing for businesses?

- b) Security and data privacy



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**CEO:** Matt Garman (Jun 2023)

**Headquarters:** Seattle, Washington, United States

The screenshot shows the AWS Free Tier landing page. At the top, there's a navigation bar with links for About AWS, Contact Us, Support, English, My Account, Sign In, Create an AWS Account, re:Invent, Products, Solutions, Pricing, Documentation, Learn, Partner Network, AWS Marketplace, Customer Enablement, and a search bar. Below the navigation is a section titled "AWS Free Tier" with sub-links for Overview, Free Tier Categories, How to Create an Account, Featured Offers for Business, FAQs, and Terms and Conditions. The main content area features a large white "AWS Free Tier" title, a sub-headline "Gain free, hands-on experience with the AWS products and services", a blue "Learn more about AWS Free Tier" button with an info icon, and a yellow "Create a Free Account" button. A dark blue wavy background graphic is at the bottom.

The screenshot shows the AWS Console Signup page at [signin.aws.amazon.com/signup?request\\_type=register](https://signin.aws.amazon.com/signup?request_type=register). The page has a light blue header with the AWS logo and the text "AWS Console - Signup". Below the header, there's a banner with the text "Explore Free Tier products with a new AWS account." and a link to [aws.amazon.com/free](https://aws.amazon.com/free). To the right of the banner is a hand holding three small cubes floating in a cloud-like space. The main form area starts with a section for the "Root user email address", which is set to "apple@meromail.com". Below it is the "AWS account name" field, containing "Bir Kaji". There are two large orange buttons: "Verify email address" and "Sign in to an existing AWS account". A horizontal line labeled "OR" separates these buttons. In the bottom right corner, there's a graphic of a large stack of blue cubes.

## Sign up for AWS

**Root user email address**  
Used for account recovery and some administrative functions

**AWS account name**  
Choose a name for your account. You can change this name in your account settings after you sign up.

**Verify email address**

OR

**Sign in to an existing AWS account**

The screenshot shows the Amazon Web Services (AWS) sign-in page. On the left, there are two options: "Root user" (selected) and "IAM user". Below these is a field for "Root user email address" containing "maximus.innase@gmail.com". A large blue "Next" button is centered below the email field. To the right of the sign-in form is a prominent purple and blue promotional banner with the text "Save now with Amazon Aurora Optimized Reads" and a "Learn more" link. At the bottom of the page, there is a copyright notice ("© 2024, Amazon Web Services, Inc. or its affiliates. All rights reserved."), a language selection dropdown set to "English", and links for "New to AWS?" and "Create a new AWS account".

The screenshot shows a web browser window for the AWS Sign-In page. The URL in the address bar is `signin.aws.amazon.com/signin?client_id=arn%3Aaws%3Asignin%3A%3A%3Aconsole%2Fcanvas&redire...`. The page header includes the AWS logo and the text "Root user sign in". A form is present for entering an email and password, with a "Sign in" button. Below the form are links for "Sign in to a different account" and "Create a new AWS account". To the right of the sign-in form is a large, semi-transparent promotional banner with a pink-to-purple gradient. It features the AWS logo at the top and the text "Learn how customers use AWS Marketplace to innovate in the cloud" in bold black font. At the bottom of the banner is a link "Read success stories »". At the bottom of the page, there is a copyright notice "© 2024, Amazon Web Services, Inc. or its affiliates. All rights reserved." and a language selection dropdown set to "English".

## First AWS dashboard

The screenshot shows the AWS Console Home page. At the top, there's a header bar with the AWS logo, a search icon, and various navigation icons. Below the header, the title "Console Home" is displayed with a "Info" link. To the right of the title are two buttons: "Reset to default layout" and "+ Add widgets". A "Recently visited" section follows, listing several AWS services with their corresponding icons: EC2, CloudShell, Lambda, Red Hat OpenShift Service on AWS, VPC, Systems Manager, EC2 Global View, and Elastic Kubernetes Service. On the right side of this section, there are three more items: CloudWatch, IAM, and S3. At the bottom of the dashboard, there are links for "Feedback", "Privacy", "Terms", and "Cookie preferences", along with a copyright notice: "© 2024, Amazon Web Services, Inc. or its affiliates."

## For Infra or IaaS get EC2

The screenshot shows the AWS EC2 Dashboard for the US East (N. Virginia) Region. The left sidebar includes links for Dashboard, EC2 Global View, Events, Instances (with sub-links for Instances, Instance Types, Launch Templates, Spot Requests, Savings Plans, Reserved Instances, Dedicated Hosts, Capacity Reservations), Images (with sub-links for AMIs and AMI Catalog), CloudShell, and Feedback. The main content area features a 'Resources' summary with counts for Instances (running), Auto Scaling Groups, Capacity Reservations, Dedicated Hosts, Elastic IPs, Instances, Key pairs, Load balancers, Placement groups, Security groups, Snapshots, and Volumes. Below this is a 'Launch instance' section with a large orange 'Launch instance' button and a 'Migrate a server' link. To the right is a 'Service health' section with a link to the AWS Health Dashboard.

Instances (running)	0	Auto Scaling Groups	0	Capacity Reservations	0
Dedicated Hosts	0	Elastic IPs	0	Instances	1
Key pairs	3	Load balancers	0	Placement groups	0
Security groups	5	Snapshots	0	Volumes	1

## Create first LINUX-OS as UBUNTU machine

The screenshot shows the AWS EC2 'Launch an instance' wizard. The user is on the 'Name and tags' step, where they have entered 'my\_demo\_ubuntu\_linux\_machine' as the instance name. There is a link to 'Add additional tags'. Below this, there is a section for 'Application and OS Images (Amazon Machine Image)', which includes a search bar and tabs for 'Recents' and 'Quick Start'. The 'Quick Start' tab is currently selected.

Launch an instance | EC2 | us-east-1

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances:

EC2 > Instances > Launch an instance

**Launch an instance** Info

Amazon EC2 allows you to create virtual machines, or instances, that run on the AWS Cloud. Quickly get started by following the simple steps below.

**Name and tags** Info

Name

my\_demo\_ubuntu\_linux\_machine

Add additional tags

**▼ Application and OS Images (Amazon Machine Image)** Info

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. Search or Browse for AMIs if you don't see what you are looking for below

Search our full catalog including 1000s of application and OS images

Recents Quick Start

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Launch an instance | EC2 | us-east-1

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances:

Search [Alt+S] N. Virginia Sanjeev Thapa

EC2 Instances Launch an instance

Recents Quick Start

Amazon Linux macOS Ubuntu Windows Red Hat SUSE Linux Debian

ubuntu® Microsoft Red Hat SUSE debian

Browse more AMIs Including AMIs from AWS, Marketplace and the Community

**Amazon Machine Image (AMI)**

Ubuntu Server 24.04 LTS (HVM), SSD Volume Type Free tier eligible

ami-0e2c8caa4b6378d8c (64-bit (x86)) / ami-0932ffb346ea84d48 (64-bit (Arm))  
Virtualization: hvm ENA enabled: true Root device type: ebs

**Description**  
Ubuntu Server 24.04 LTS (HVM),EBS General Purpose (SSD) Volume Type. Support available from Canonical (<http://www.ubuntu.com/cloud/services>).  
Canonical, Ubuntu, 24.04, amd64 noble image

**Architecture**: x86\_64 (64-bit)  
**AMI ID**: ami-0e2c8caa4b6378d8c  
**Username**: ubuntu  
**Verified provider**

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The screenshot shows the AWS EC2 'Launch an instance' wizard. The top navigation bar includes the AWS logo, a search bar, and account information for 'Sanjeev Thapa'. The main content area is titled 'Amazon Machine Image (AMI)'. It displays a single AMI entry: 'Ubuntu Server 24.04 LTS (HVM), SSD Volume Type'. The entry includes the AMI ID 'ami-0e2c8caa4b6378d8c', a note that it's 'Free tier eligible', and details about its configuration: 'Virtualization: hvm', 'ENA enabled: true', and 'Root device type: ebs'. Below this, there's a 'Description' section with a link to Canonical's website. The 'Architecture' dropdown is set to '64-bit (x86)'. To the right, the 'AMI ID' is shown as 'ami-0e2c8caa4b6378d8c', 'Username' is 'ubuntu', and there's a 'Verified provider' badge. A section for 'Instance type' is partially visible below, showing 't2.micro' selected with 'Free tier eligible' status. The footer contains links for 'CloudShell', 'Feedback', 'Privacy', 'Terms', and 'Cookie preferences', along with a copyright notice for 2024.

The screenshot shows the AWS EC2 'Launch an instance' wizard. The current step is 'Instance type'. It lists the 't2.micro' instance type as selected, with details: Family: t2, 1 vCPU, 1 GiB Memory, Current generation: true. Pricing: On-Demand Windows base pricing: 0.0162 USD per Hour, On-Demand Ubuntu Pro base pricing: 0.0134 USD per Hour, On-Demand SUSE base pricing: 0.0116 USD per Hour, On-Demand RHEL base pricing: 0.026 USD per Hour, On-Demand Linux base pricing: 0.0116 USD per Hour. It also indicates 'Free tier eligible'. A dropdown menu is open, showing 'All generations' and a link to 'Compare instance types'. Below this, a note states 'Additional costs apply for AMIs with pre-installed software'. The next step, 'Key pair (login)', is shown below with a note about using a key pair for secure connection. A dropdown menu for 'Key pair name - required' is open, showing 'Select' and a 'Create new key pair' button.

Launch an instance | EC2 | us-east-1

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances:

EC2 Instances Launch an instance

**Instance type** [Info](#) | [Get advice](#)

**Instance type**

t2.micro Free tier eligible

Family: t2 1 vCPU 1 GiB Memory Current generation: true

On-Demand Windows base pricing: 0.0162 USD per Hour

On-Demand Ubuntu Pro base pricing: 0.0134 USD per Hour On-Demand SUSE base pricing: 0.0116 USD per Hour

On-Demand RHEL base pricing: 0.026 USD per Hour On-Demand Linux base pricing: 0.0116 USD per Hour

All generations

[Compare instance types](#)

**Additional costs apply for AMIs with pre-installed software**

**Key pair (login)** [Info](#)

You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.

**Key pair name - required**

Select

CloudShell Feedback Privacy Terms Cookie preferences

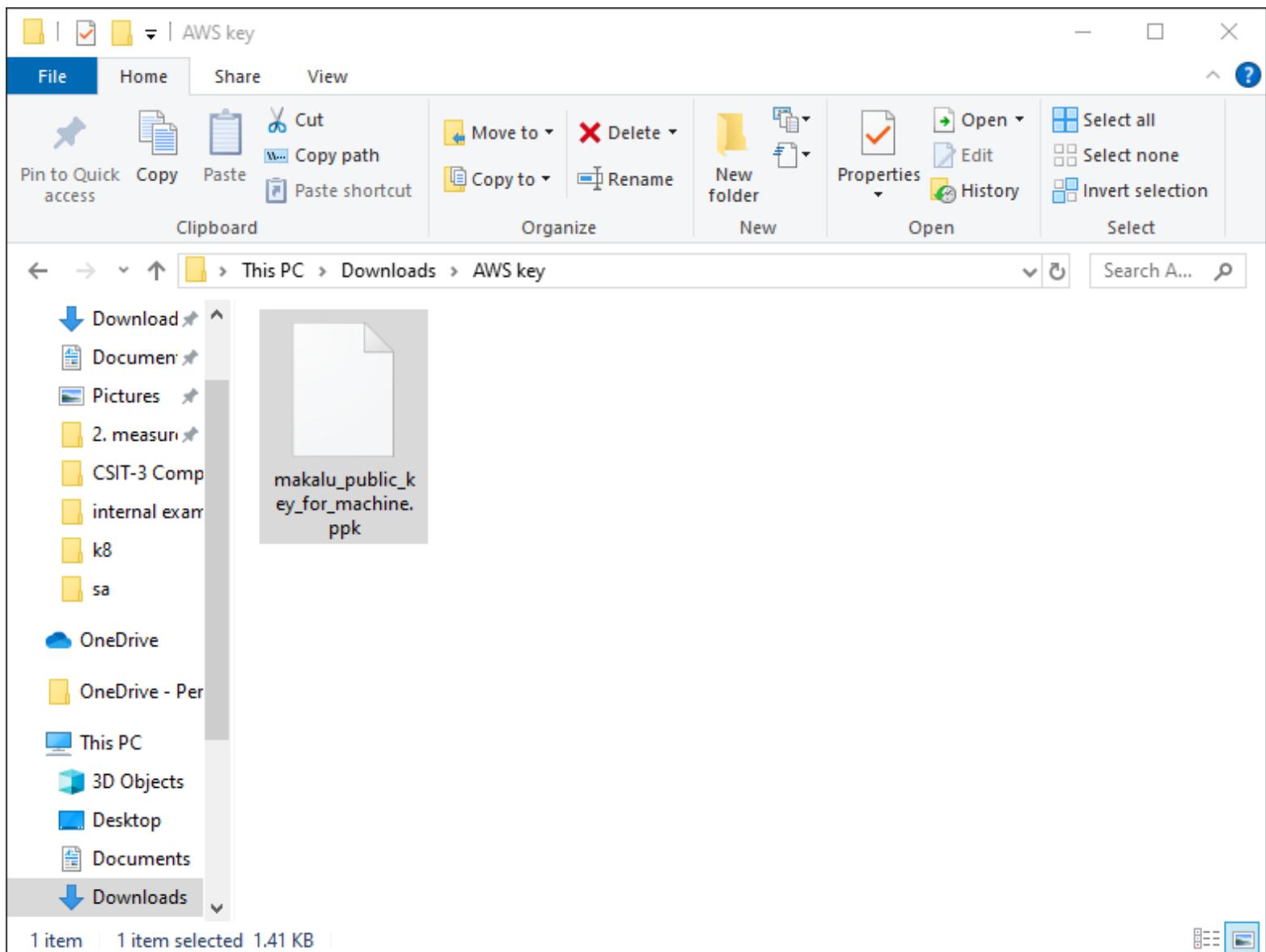
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**Public key need to kept secure in your laptop**

**This key is for connecting the machine via PUTTY(ppk)**

**For Linux client as terminal use (pem)**

The screenshot shows the AWS EC2 console interface for launching a new instance. A modal window titled "Create key pair" is open, prompting for a key pair name. The name "makalu\_public\_key\_for\_machine" is entered. Below it, there are two options for "Key pair type": "RSA" (selected) and "ED25519". Under "Private key file format", the ".ppk" option is selected. At the bottom right of the modal are "Cancel" and "Create key pair" buttons, with "Create key pair" being highlighted.



The screenshot shows the AWS EC2 'Launch an instance' wizard. The user has selected the 'Create security group' option. Under the 'Firewall (security groups)' section, three checkboxes are checked: 'Allow SSH traffic from Anywhere', 'Allow HTTPS traffic from the internet', and 'Allow HTTP traffic from the internet'. A note below the checkboxes states: 'Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.' At the bottom of the page, there are links for 'Configure storage', 'Advanced', 'CloudShell', 'Feedback', 'Privacy', 'Terms', and 'Cookie preferences'.

The screenshot shows the AWS EC2 'Launch an instance' configuration page. At the top, the URL is [us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances](https://us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances). The page title is 'Launch an instance | EC2 | us-east-1'. The navigation bar includes 'Search', [Alt+S], and various AWS service icons. The user is in the 'EC2 > Instances > Launch an instance' section. A sidebar on the left lists 'Advanced details' and 'Summary'. The main content area is titled 'Summary' and contains the following configuration:

- Number of instances:** 1
- Software Image (AMI):** Canonical, Ubuntu, 24.04, amd64... [read more](#)
- Virtual server type (instance type):** t2.micro
- Firewall (security group):** New security group

At the bottom right, there are 'Cancel' and 'Launch instance' buttons. The footer includes links for CloudShell, Feedback, Privacy, Terms, and Cookie preferences, along with a copyright notice: © 2024, Amazon Web Services, Inc. or its affiliates.

The screenshot shows the AWS EC2 Instances page with a progress bar indicating the status of launching an instance. The progress bar is blue and shows 'Creating security group rules' at 33%. Below the progress bar, there is a section titled 'Details' with three items: 'Initializing requests' (Succeeded), 'Creating security groups' (Succeeded), and 'Creating security group rules' (Loading). A message below the progress bar says 'Please wait while we launch your instance. Do not close your browser while this is loading.'

Launch an instance | EC2 | us-east-1

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances:

aws | Search [Alt+S] | N. Virginia | Sanjeev Thapa

EC2 > Instances > Launch an instance

Launching instance  
Creating security group rules 33%

▼ Details

Initializing requests	✔ Succeeded
Creating security groups	✔ Succeeded
Creating security group rules	>Loading

Please wait while we launch your instance.  
Do not close your browser while this is loading.

CloudShell Feedback Privacy Terms Cookie preferences

Launch an instance | EC2 | us-east-1

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances:

Search [Alt+S] N. Virginia Sanjeev Thapa

EC2 Instances Launch an instance

**Success**  
Successfully initiated launch of instance ([i-0ad5d0b5c677a5453](#))

**Launch log**

Initializing requests	<span style="color: green;">✔ Succeeded</span>
Creating security groups	<span style="color: green;">✔ Succeeded</span>
Creating security group rules	<span style="color: green;">✔ Succeeded</span>
Launch initiation	<span style="color: green;">✔ Succeeded</span>

**Next Steps**

What would you like to do next with this instance, for example "create alarm" or "create backup"

1 2 3 4 5 6 >

Create billing and free trial CloudShell Feedback Connect to your instance Connect an RDS instance Create EBS snapshot Privacy Terms Cookie preferences

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The screenshot shows the AWS EC2 Instances Launch an instance page. At the top, there's a navigation bar with the AWS logo, a search bar, and various icons. The main content area is divided into eight cards:

- Create billing and free tier usage alerts**: To manage costs and avoid surprise bills, set up email notifications for billing and free tier usage thresholds. Includes a [Create billing alerts](#) button.
- Connect to your instance**: Once your instance is running, log into it from your local computer. Includes a [Connect to instance](#) button and a [Learn more](#) link.
- Connect an RDS database**: Configure the connection between an EC2 instance and a database to allow traffic flow between them. Includes a [Connect an RDS database](#) button and a [Create a new RDS database](#) link.
- Create EBS snapshot policy**: Create a policy that automates the creation, retention, and deletion of EBS snapshots. Includes a [Create EBS snapshot policy](#) button.
- Manage detailed monitoring**: Enable or disable detailed monitoring. Includes a [CloudShell](#) and [Feedback](#) link.
- Create Load Balancer**: Create a application, network gateway or classic Elastic Load balancer. Includes a [Learn more](#) link.
- Create AWS budget**: AWS Budgets allows you to create budgets, forecast. Includes a [Learn more](#) link.
- Manage CloudWatch alarms**: Create or update Amazon CloudWatch alarms. Includes a [Privacy](#), [Terms](#), and [Cookie preferences](#) link.

At the bottom, there's a copyright notice: © 2024, Amazon Web Services, Inc. or its affiliates.

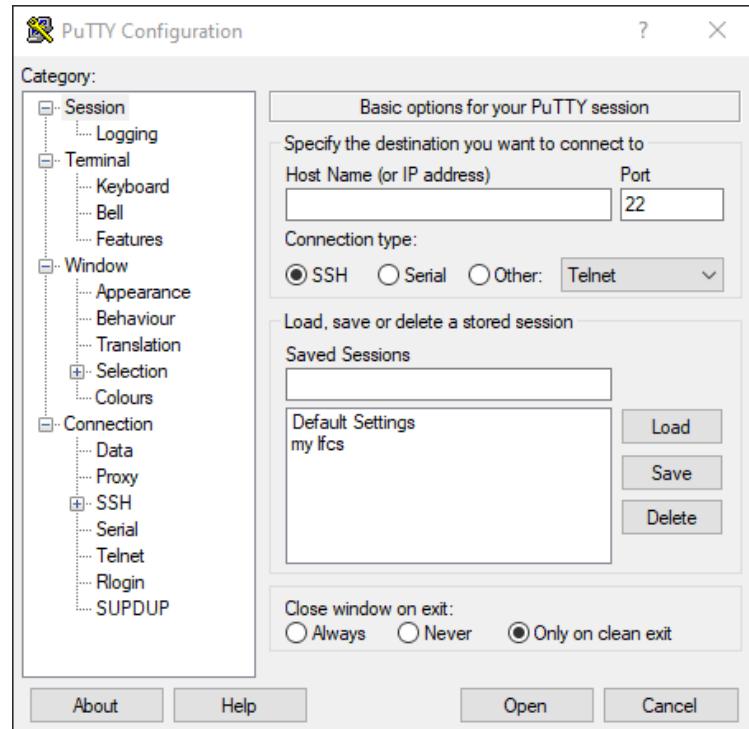
The screenshot shows the AWS EC2 Connect to instance page. At the top, there are two tabs: "Launch an instance | EC2 | us-east-1" and "Connect to instance | EC2 | us-east-1". The main content area has a breadcrumb navigation: EC2 > Instances > i-0ad5d0b5c677a5453 > Connect to instance. Below this, a section titled "Connect to instance" includes a link to "Info". A sub-section titled "EC2 Instance Connect" is visible. The "SSH client" tab is selected, indicated by a blue underline. The "Instance ID" section shows "i-0ad5d0b5c677a5453 (my\_demo\_ubuntu\_linux\_machine)". Below it, a numbered list provides instructions for connecting via SSH:

1. Open an SSH client.
2. Locate your private key file. The key used to launch this instance is `makalu_public_key_for_machine.pem`
3. Run this command, if necessary, to ensure your key is not publicly viewable.  
 `chmod 400 "makalu_public_key_for_machine.pem"`
4. Connect to your instance using its Public DNS:  
 `ec2-23-23-0-155.compute-1.amazonaws.com`

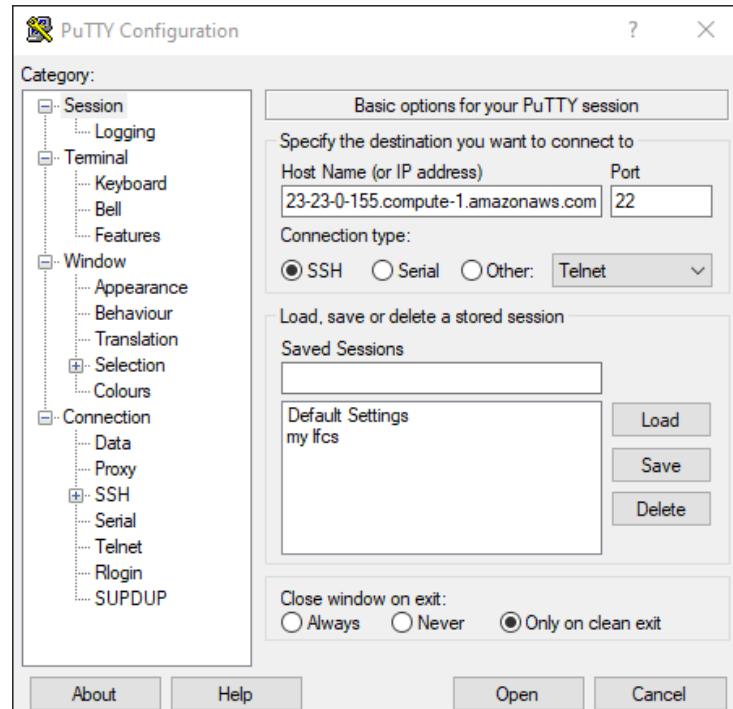
An "Example:" section shows the command to run:  `ssh -i "makalu_public_key_for_machine.pem" ubuntu@ec2-23-23-0-155.compute-1.amazonaws.com`. A note in a callout box states: "Note: In most cases, the guessed username is correct. However, read your AMI usage instructions to check if the AMI owner has changed the". The bottom of the page includes links for "CloudShell", "Feedback", "Privacy", "Terms", and "Cookie preferences".

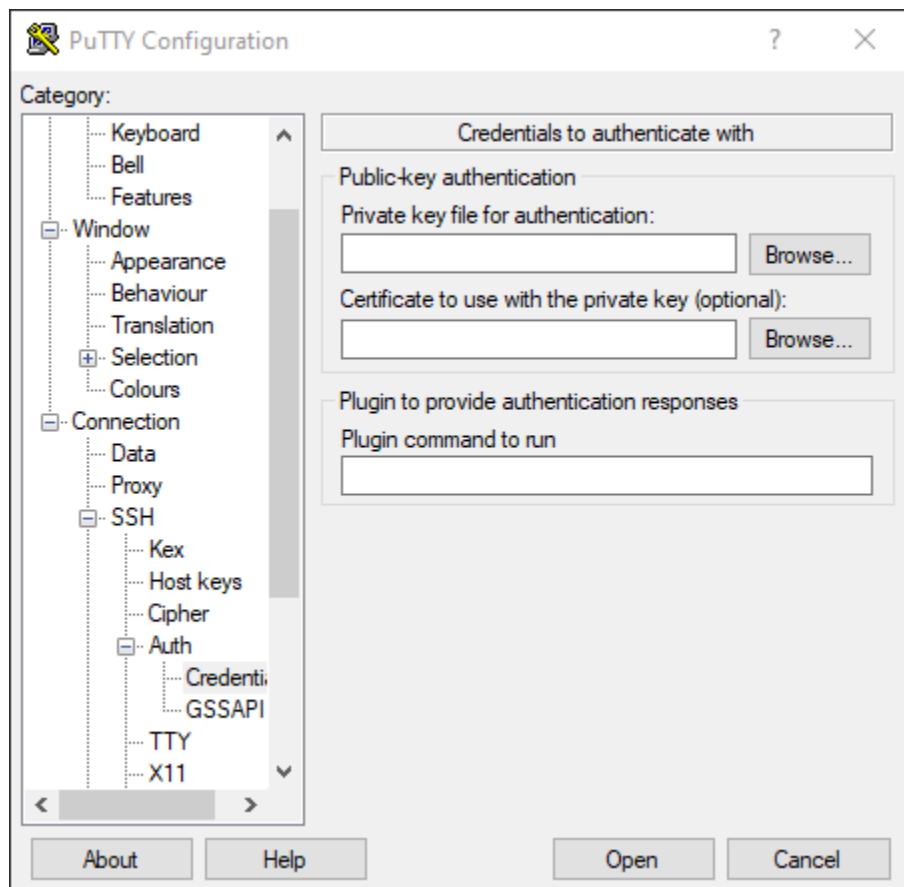
## Now connect the machine remotely using key

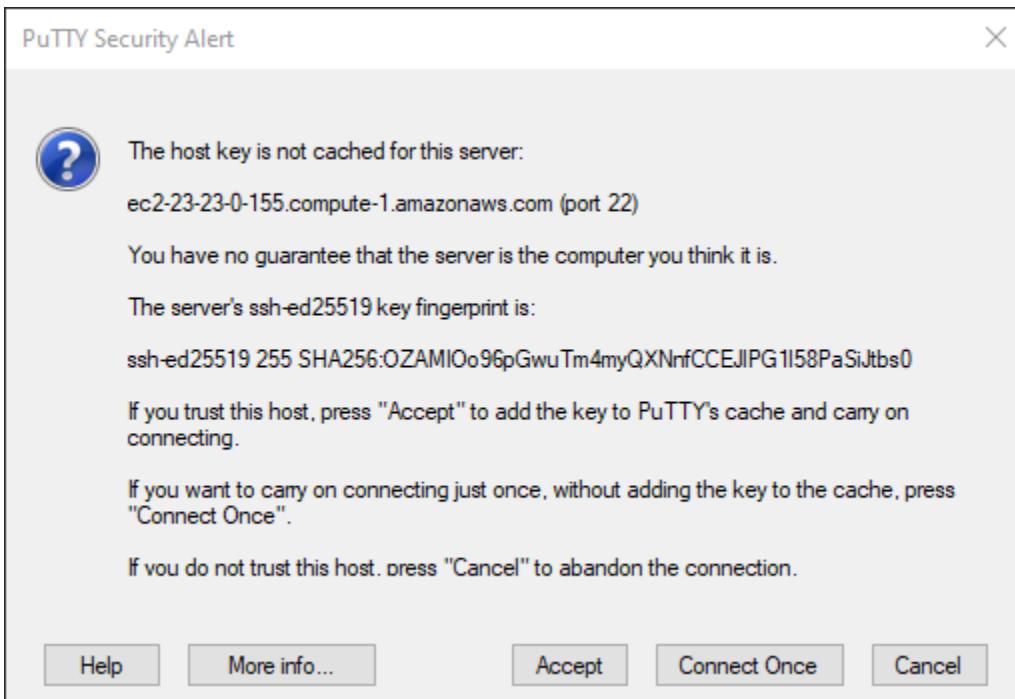
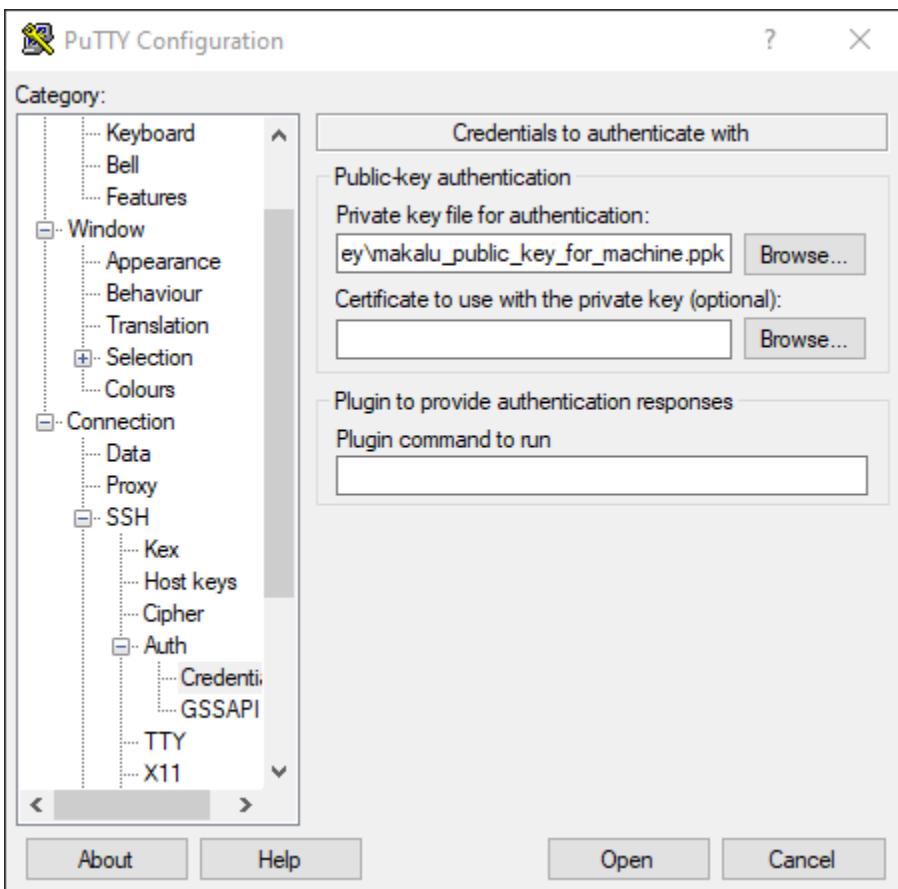
<https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html>

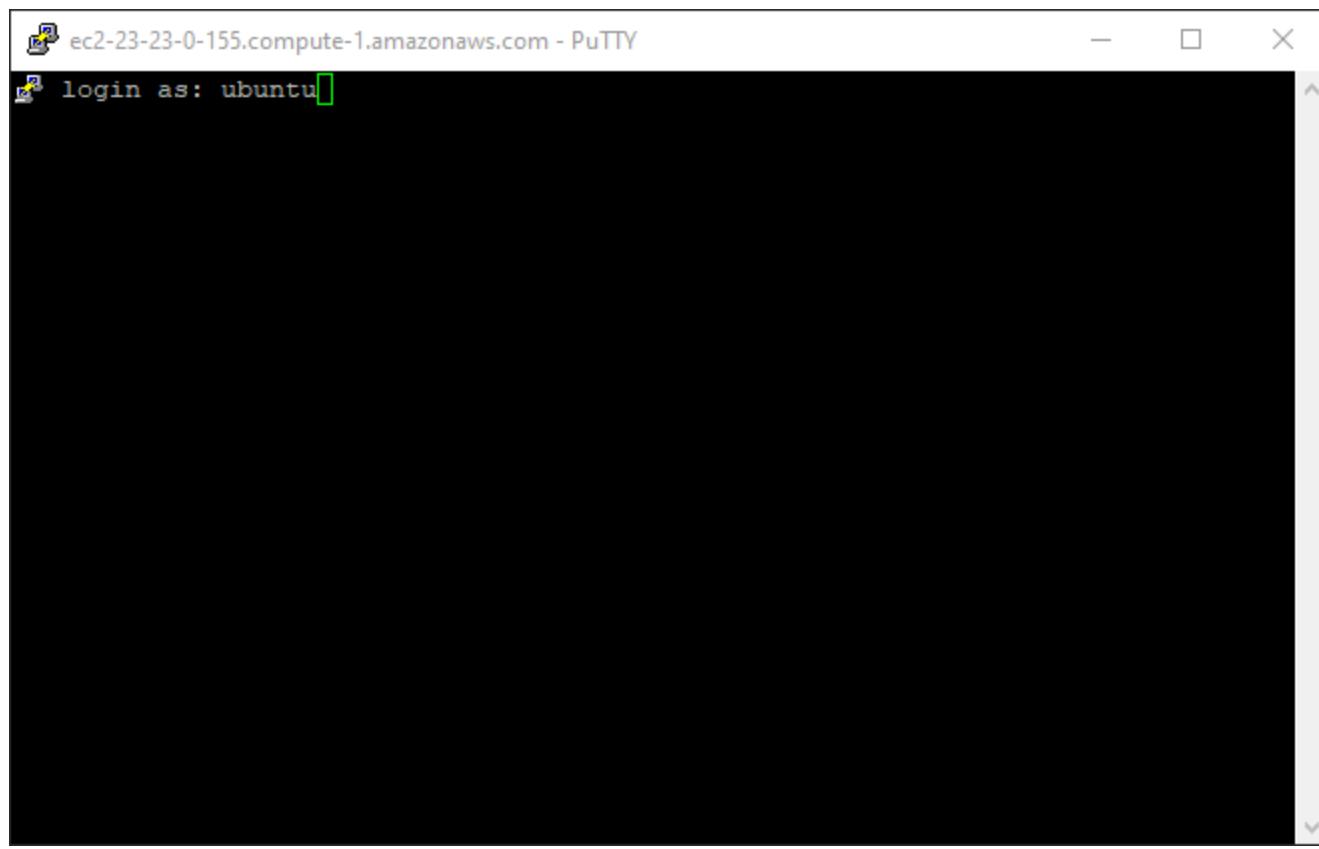


```
ssh -i "makalu_public_key_for_machine.pem" ubuntu@ec2-23-23-0-155.compute-1.amazonaws.com
```









```
ec2-23-23-0-155.compute-1.amazonaws.com - PuTTY
login as: ubuntu

ubuntu@ip-172-31-81-196: ~
login as: ubuntu
Authenticating with public key "makalu_public_key_for_machine"
Welcome to Ubuntu 24.04.1 LTS (GNU/Linux 6.8.0-1018-aws x86_64)

 * Documentation: https://help.ubuntu.com
 * Management: https://landscape.canonical.com
 * Support: https://ubuntu.com/pro

System information as of Mon Dec 16 09:33:55 UTC 2024

System load: 0.04      Processes:          106
Usage of /: 24.6% of 6.71GB   Users logged in:    0
Memory usage: 21%           IPv4 address for enX0: 172.31.81.196
Swap usage:  0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@ip-172-31-81-196:~$
```

```

ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~$ free -mh
      total        used        free      shared  buff/cache   available
Mem:    957Mi     307Mi     496Mi     888Ki     305Mi     649Mi
Swap:      0B       0B       0B
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~$ lscpu | grep "CPU(s)"
CPU(s):                          1
On-line CPU(s) list:            0
NUMA node0 CPU(s):              0
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~$ cat /etc/os-release | grep NAME
PRETTY_NAME="Ubuntu 24.04.1 LTS"
NAME="Ubuntu"
VERSION_CODENAME=noble
UBUNTU_CODENAME=noble
ubuntu@ip-172-31-81-196: ~$ [REDACTED]

```

The screenshot shows the AWS EC2 Instances page with the following details:

Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Available
praveesh_ubu	i-0a7d220db7d8f469e	Terminated	t2.micro	-	<a href="#">View alarms +</a>	us-east
my_demo_ub...	i-0ad5d0b5c677a5453	Running	t2.micro	2/2 checks passed	<a href="#">View alarms +</a>	us-east

Below the table, there is a section titled "Select an instance" with a dropdown menu.

## Delete or Removing instance (iaas)

The screenshot shows the AWS EC2 Instances page with two instances listed. The second instance, 'my\_demo\_ub...', has a checkmark next to its name and is selected. A context menu is open over this instance, displaying options: Stop instance, Start instance, Reboot instance, Hibernate instance, and Terminate (delete) instance. The 'Terminate (delete) instance' option is highlighted with a red box.

Name	Instance ID	State	Type
praivesh_ubu	i-0a7d220db7d8f469e	Terminated	t2.micro
my_demo_ub...	i-0ad5d0b5c677a5453	Running	t2.micro

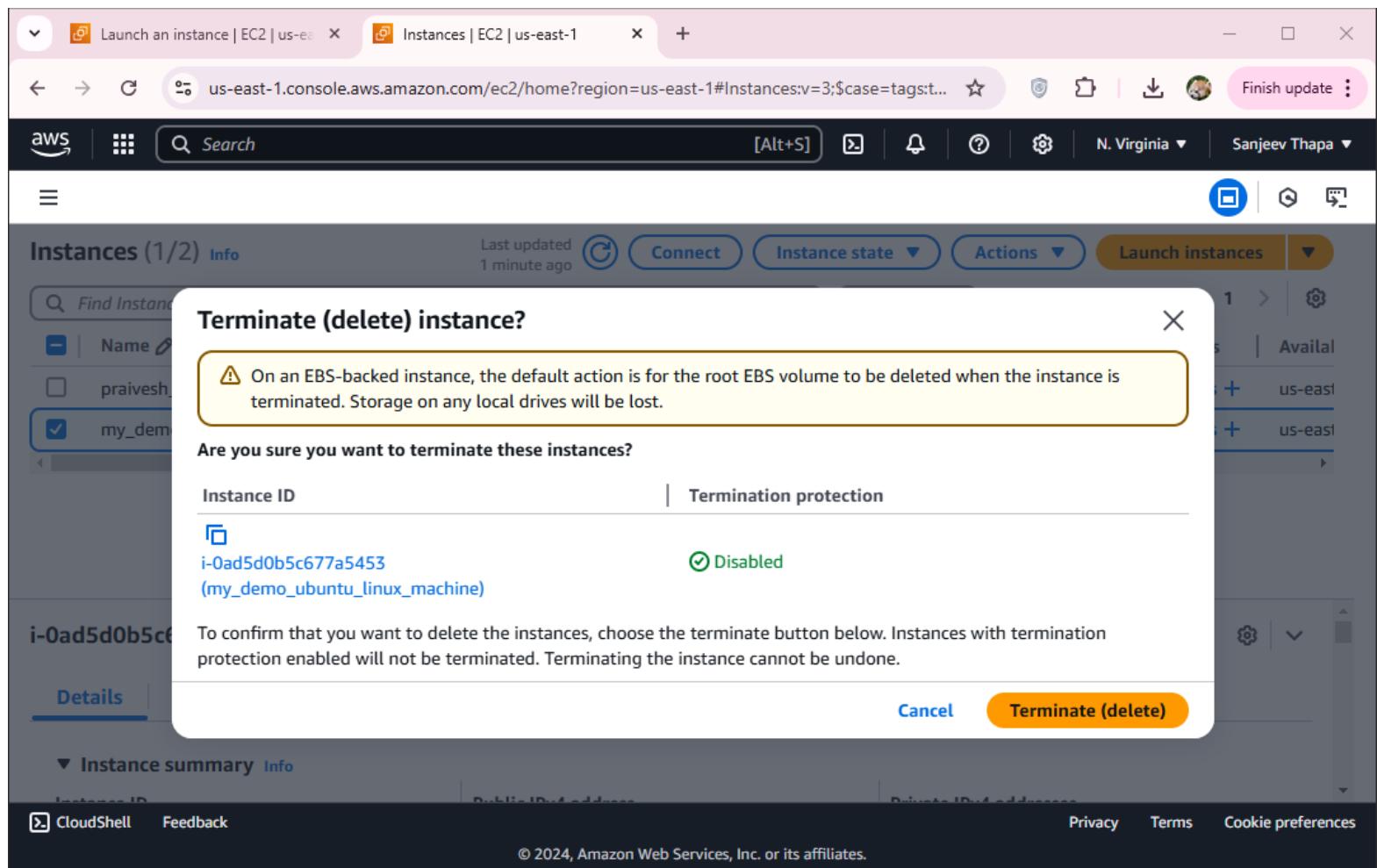
**i-0ad5d0b5c677a5453 (my\_demo\_ubuntu\_linux\_machine)**

- [Details](#)
- [Status and alarms](#)
- [Monitoring](#)
- [Security](#)
- [Networking](#)
- [Storage](#)
- [Tags](#)

**Instance summary**

Instance ID	Public IPv4 address	Private IPv4 address
i-0ad5d0b5c677a5453	54.177.111.111	172.31.1.111

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Launch an instance | EC2 | us-east-1 Instances | EC2 | us-east-1 us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#Instances:v=3;\$case=tags:t... Finish update

aws Search [Alt+S] N. Virginia Sanjeev Thapa

Successfully initiated termination (deletion) of i-0ad5d0b5c677a5453

Instances (1/2) Info Last updated less than a minute ago Connect Instance state Actions Launch instances

Find Instance by attribute or tag (case-sensitive) All states

Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Available
<input checked="" type="checkbox"/> my_demo_ub...	i-0ad5d0b5c677a5453	Shutting-d...	t2.micro	-	View alarms +	us-east
<input type="checkbox"/> pravesh_uba...	i-0a7d220db7d8f469e	Terminated	t2.micro	-	View alarms +	us-east

i-0ad5d0b5c677a5453 (my\_demo\_ubuntu\_linux\_machine)

Details Status and alarms Monitoring Security Networking Storage Tags

Instance summary Info

CloudShell Feedback Privacy Terms Cookie preferences

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```
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~$ free -mh
      total        used        free      shared  buff/cache   available
Mem:       957Mi       307Mi       496Mi       888Ki       305Mi       649Mi
Swap:          0B          0B          0B
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~$ lscpu | grep "CPU(s)"
CPU(s):           1
On-line CPU(s) list:          0
NUMA node0 CPU(s):
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~
ubuntu@ip-172-31-81-196: ~$ PRETTY_NAME="Ubuntu 24.04."
NAME="Ubuntu"
VERSION_CODENAME=noble
UBUNTU_CODENAME=noble
ubuntu@ip-172-31-81-196: ~$ Broadcast message from root@ip-172-31-81-196 (Mon Dec 16 09:38:01 UTC):
The system will power off now!

```

PuTTY Fatal Error

Remote side unexpectedly closed network connection

OK

The screenshot shows the AWS EC2 Instances page in the us-east-1 region. A green success message at the top states: "Successfully initiated termination (deletion) of i-0ad5d0b5c677a5453". The main table displays two instances:

	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Available
<input type="checkbox"/>	pravesh_ubu	i-0a7d220db7d8f469e	Terminated	t2.micro	-	<a href="#">View alarms</a> +	us-east-1
<input type="checkbox"/>	my_demo_ub...	i-0ad5d0b5c677a5453	Terminated	t2.micro	-	<a href="#">View alarms</a> +	us-east-1

Below the table, a section titled "Select an instance" is shown, which is currently empty.

At the bottom of the page, there are links for CloudShell, Feedback, Privacy, Terms, and Cookie preferences. The footer also includes the copyright notice: "© 2024, Amazon Web Services, Inc. or its affiliates."

## IaaS on Windows -server machine

The screenshot shows the AWS EC2 Instances page. The left sidebar includes links for Dashboard, EC2 Global View, Events, Instances (selected), Instance Types, Launch Templates, Spot Requests, Savings Plans, Reserved Instances, Dedicated Hosts, Capacity Reservations, Images (AMIs, AMI Catalog), CloudShell, and Feedback. The main content area displays 'Instances (2)'. A table lists two terminated instances: 'pravesh\_ubu' (ID i-0a7d220db7d8f469e) and 'my\_demo\_ub...' (ID i-0ad5d0b5c677a5453). The 'Actions' button is highlighted, and a dropdown menu is open, showing options: 'Launch instances' (highlighted), 'Launch instance from template', and 'Migrate a server'. The status bar at the bottom indicates '© 2024, Amazon Web Services, Inc. or its affiliates.'

The screenshot shows the AWS EC2 'Launch an instance' wizard. The browser title bar reads 'Launch an instance | EC2 | us-east-1'. The main content area is titled 'Launch an instance' with a sub-section 'Name and tags'. A 'Name' field contains 'my\_windows\_iwas'. Below this is a section titled 'Application and OS Images (Amazon Machine Image)'. It includes a search bar with placeholder text 'Search our full catalog including 1000s of application and OS images' and tabs for 'Recents' and 'Quick Start' (which is selected). At the bottom, there are links for CloudShell, Feedback, Privacy, Terms, and Cookie preferences.

Launch an instance | EC2 | us-east-1

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances:

EC2 > Instances > Launch an instance

## Launch an instance Info

Amazon EC2 allows you to create virtual machines, or instances, that run on the AWS Cloud. Quickly get started by following the simple steps below.

### Name and tags Info

Name

my\_windows\_iwas

Add additional tags

### ▼ Application and OS Images (Amazon Machine Image) Info

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. Search or Browse for AMIs if you don't see what you are looking for below

Search our full catalog including 1000s of application and OS images

Recents Quick Start

CloudShell Feedback Privacy Terms Cookie preferences

S Launch an instance | EC2 | us-east-1 X Launch an instance | EC2 | us-east-1 X +

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances: [Finish update](#)

waws Search [Alt+S] N. Virginia Sanjeev Thapa

EC2 Instances Launch an instance

Search or Browse for AMIs if you don't see what you are looking for below

Search our full catalog including 1000s of application and OS images

Recents Quick Start

Amazon Linux macOS Ubuntu Windows Red Hat SUSE Linux Debian

aws Mac ubuntu Microsoft Red Hat SUSE debian

Browse more AMIs Including AMIs from AWS, Marketplace and the Community

**Amazon Machine Image (AMI)**

Microsoft Windows Server 2025 Base ami-05b1a50d6798f63cb (64-bit (x86)) Free tier eligible

Virtualization: hvm ENA enabled: true Root device type: ebs

Description

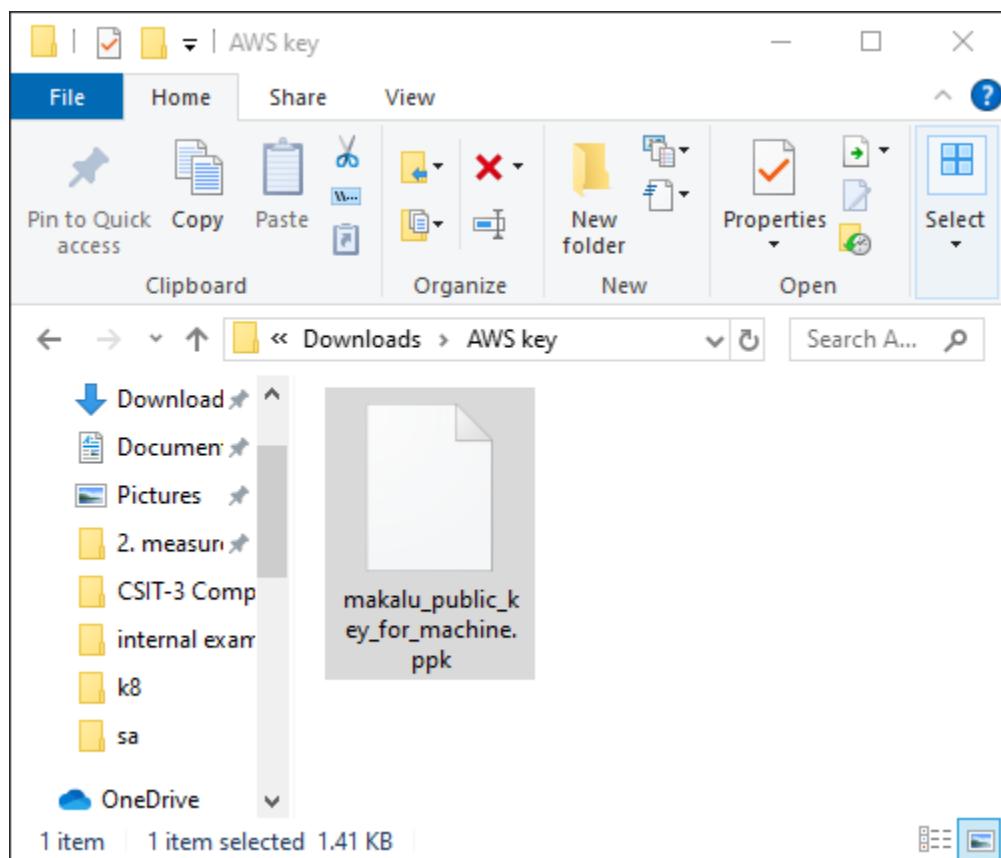
Microsoft Windows 2025 Datacenter edition. [English]

CloudShell Feedback Privacy Terms Cookie preferences

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The screenshot shows the AWS EC2 'Launch an instance' wizard. The top navigation bar includes tabs for 'Launch an instance | EC2 | us-east-1' and 'Launch an instance | EC2 | us-east-1'. The main content area has a breadcrumb trail: 'EC2 > Instances > Launch an instance'. The first step, 'Instance type', is currently selected. It shows the 't3.micro' instance type, which is part of the 't3' family. It has 2 vCPU, 1 GiB Memory, and is the Current generation. On-Demand Ubuntu Pro base pricing is 0.0139 USD per Hour, and On-Demand SUSE base pricing is 0.0104 USD per Hour. Other options like Linux, RHEL, and Windows are also listed. A note states 'Additional costs apply for AMIs with pre-installed software'. To the right, there's a link to 'All generations' and a 'Compare instance types' button. The second step, 'Key pair (login)', is shown below. It asks for a key pair name, with a dropdown menu showing 'Select' and a 'Create new key pair' button. A note says for Windows instances, a key pair is used to decrypt the administrator password. The bottom of the page includes links for CloudShell, Feedback, Privacy, Terms, and Cookie preferences, along with a copyright notice for 2024.

The screenshot shows the AWS EC2 'Launch an instance' wizard. The browser tabs are titled 'Launch an instance | EC2 | us-east-1' and 'Launch an instance | EC2 | us-east-1'. The URL is 'us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances'. The page header includes the AWS logo, a search bar, and navigation links for 'EC2', 'Instances', and 'Launch an instance'. A notification bar at the top right says 'Finish update'. The main content area displays 'On-Demand Windows base pricing: 0.0196 USD per Hour' and a note: 'Additional costs apply for AMIs with pre-installed software'. A section titled '▼ Key pair (login) Info' contains instructions: 'You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.' It includes a dropdown menu for 'Key pair name - required' set to 'makalu\_public\_key\_for\_machine', a 'Create new key pair' button, and a note for Windows instances. Below this is a 'Network settings' section with 'Edit' and 'Network' tabs, showing 'vpc-067758bd9d7552786'. There is also a 'Subnet' tab and a note about subnet preference. At the bottom, there are links for 'CloudShell', 'Feedback', 'Privacy', 'Terms', and 'Cookie preferences'.



Launch an instance | EC2 | us-east-1   Launch an instance | EC2 | us-east-1   +

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances:

aws | Search [Alt+S] | N. Virginia | Sanjeev Thapa

EC2 > Instances > Launch an instance

**Enable**  
Additional charges apply when outside of free tier allowance

**Firewall (security groups)** | [Info](#)  
A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

Create security group    Select existing security group

We'll create a new security group called 'launch-wizard-6' with the following rules:

Allow RDP traffic from Anywhere  
Helps you connect to your instance

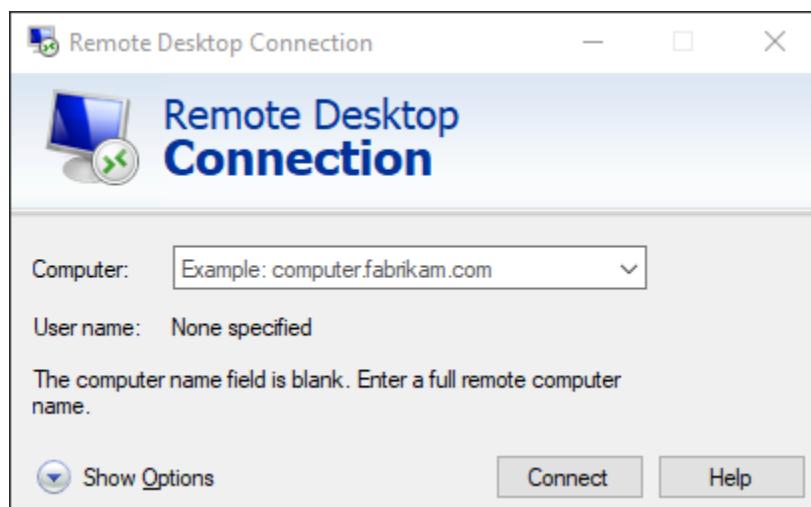
Allow HTTPS traffic from the internet  
To set up an endpoint, for example when creating a web server

Allow HTTP traffic from the internet  
To set up an endpoint, for example when creating a web server

**⚠ Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.**

CloudShell Feedback   Privacy Terms Cookie preferences

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The screenshot shows the AWS EC2 'Launch an instance' configuration page. In the 'Configure storage' section, a root volume of 30 GiB gp3 is selected as a Root volume (Not encrypted). A tooltip indicates that free-tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage. There is an 'Add new volume' button. A note states that the selected AMI contains more instance store volumes than the instance allows, and only the first 0 instance store volumes from the AMI will be accessible from the instance. A 'Click refresh to view backup information' note is also present. The bottom navigation bar includes CloudShell, Feedback, Privacy, Terms, and Cookie preferences.

The screenshot shows the AWS EC2 console interface for launching an instance. At the top, there are two tabs: "Launch an instance | EC2 | us-east-1" and "Launch an instance | EC2 | us-east-1". The URL in the address bar is "us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances:". The main content area has a blue header bar with the text "Launching instance" and "Creating security group rules" followed by a progress bar indicating 33% completion. Below this, a section titled "Details" lists three tasks: "Initializing requests" (Succeeded), "Creating security groups" (Succeeded), and "Creating security group rules" (Loading). A central message reads: "Please wait while we launch your instance. Do not close your browser while this is loading."

The screenshot shows the AWS EC2 Instances Launch an instance page. At the top, there are two tabs: "Launch an instance | EC2 | us-east-1" and "Launch an instance | EC2 | us-east-1". The URL in the address bar is "us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#LaunchInstances:". The page header includes the AWS logo, a search bar, and navigation links for "EC2", "Instances", and "Launch an instance". On the right side of the header are icons for "Finish update", "N. Virginia", and "Sanjeev Thapa". Below the header, a green success message box displays "Successfully initiated launch of instance (i-012d557c213a9f6c8)". Under the "Launch log" section, five steps are listed, all marked as "Succeeded": "Initializing requests", "Creating security groups", "Creating security group rules", "Launch initiation", and "Succeeded". A "Next Steps" section contains a search bar with the placeholder "What would you like to do next with this instance, for example "create alarm" or "create backup"" and a page navigation menu with links 1 through 6. At the bottom of the page, there are four buttons: "Create billing and free", "CloudShell", "Feedback", "Connect to your", "Connect an RDS", "Create EBS snapshot", "Privacy", "Terms", and "Cookie preferences". The footer contains the copyright notice "© 2024, Amazon Web Services, Inc. or its affiliates."

The screenshot shows the AWS EC2 'Launch an instance' page. At the top, there are two tabs: 'Launch an instance | EC2 | us-east-1' and 'Launch an instance | EC2 | us-east-1'. The main content area is titled 'Launch an instance' and includes the following sections:

- Create billing and free tier usage alerts**: To manage costs and avoid surprise bills, set up email notifications for billing and free tier usage thresholds. Includes a 'Create billing alerts' button.
- Connect to your instance**: Once your instance is running, log into it from your local computer. Includes a 'Connect to instance' button and a 'Learn more' link.
- Connect an RDS database**: Configure the connection between an EC2 instance and a database to allow traffic flow between them. Includes a 'Connect an RDS database' button and a 'Create a new RDS database' link.
- Create EBS snapshot policy**: Create a policy that automates the creation, retention, and deletion of EBS snapshots. Includes a 'Create EBS snapshot policy' button.
- Manage detailed monitoring**: Enable or disable detailed monitoring. Includes a 'CloudShell' and 'Feedback' link.
- Create Load Balancer**: Create a application, network gateway or classic Elastic Load balancer.
- Create AWS budget**: AWS Budgets allows you to create budgets, forecast.
- Manage CloudWatch alarms**: Create or update Amazon CloudWatch alarms.

At the bottom of the page, there are links for 'Privacy', 'Terms', and 'Cookie preferences'. The footer contains the copyright notice: '© 2024, Amazon Web Services, Inc. or its affiliates.'

Sessions | Launch an instance | EC2 | us-east-1 | Launch an instance | EC2 | us-east-1 | Connect to instance | EC2 | us-east-1 | +

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#ConnectToInstance:instance=i-012d557c213a9f6c8

aws | Search [Alt+S] | N. Virginia | Sanjeev Thapa

EC2 > Instances > i-012d557c213a9f6c8 > Connect to instance

## Connect to instance Info

Connect to your instance i-012d557c213a9f6c8 (my\_windows\_iaas) using any of these options

**Session Manager** **RDP client** **EC2 serial console**

**Instance ID**  
 i-012d557c213a9f6c8 (my\_windows\_iaas)

**Connection Type**

- Connect using RDP client  
Download a file to use with your RDP client and retrieve your password.
- Connect using Fleet Manager  
To connect to the instance using Fleet Manager Remote Desktop, the SSM Agent must be installed and running on the instance. For more information, see [Working with SSM Agent](#)

You can connect to your Windows instance using a remote desktop client of your choice, and by downloading and running the RDP shortcut file below:

[!\[\]\(c3fd5cf9e48414b79c1275a1d2aa3d84\_img.jpg\) Download remote desktop file](#)

When prompted, connect to your instance using the following username and password:

CloudShell Feedback Privacy Terms Cookie preferences

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EC2 > Instances > i-012d557c213a9f6c8 > Connect to instance

**Session Manager** **RDP client** **EC2 serial console**

**Instance ID**  
 i-012d557c213a9f6c8 (my\_windows\_iaas)

**Connection Type**

- Connect using RDP client  
Download a file to use with your RDP client and retrieve your password.
- Connect using Fleet Manager  
To connect to the instance using Fleet Manager Remote Des Agent must be installed and running on the instance. For mo see [Working with SSM Agent](#)

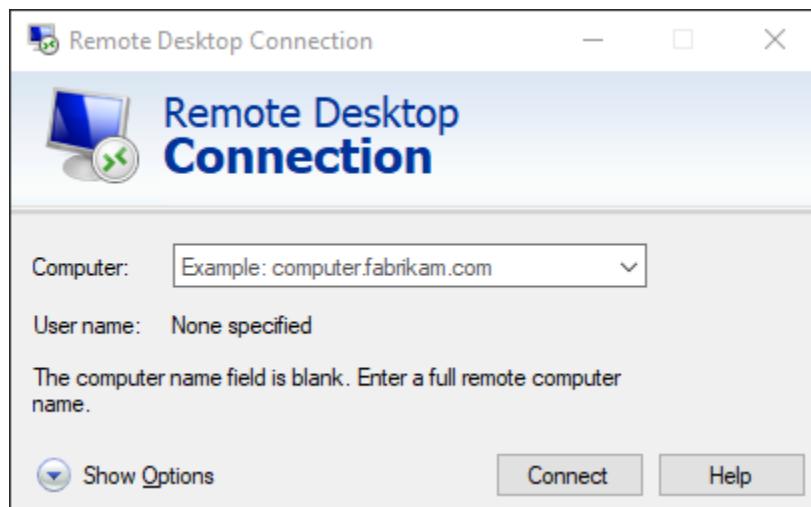
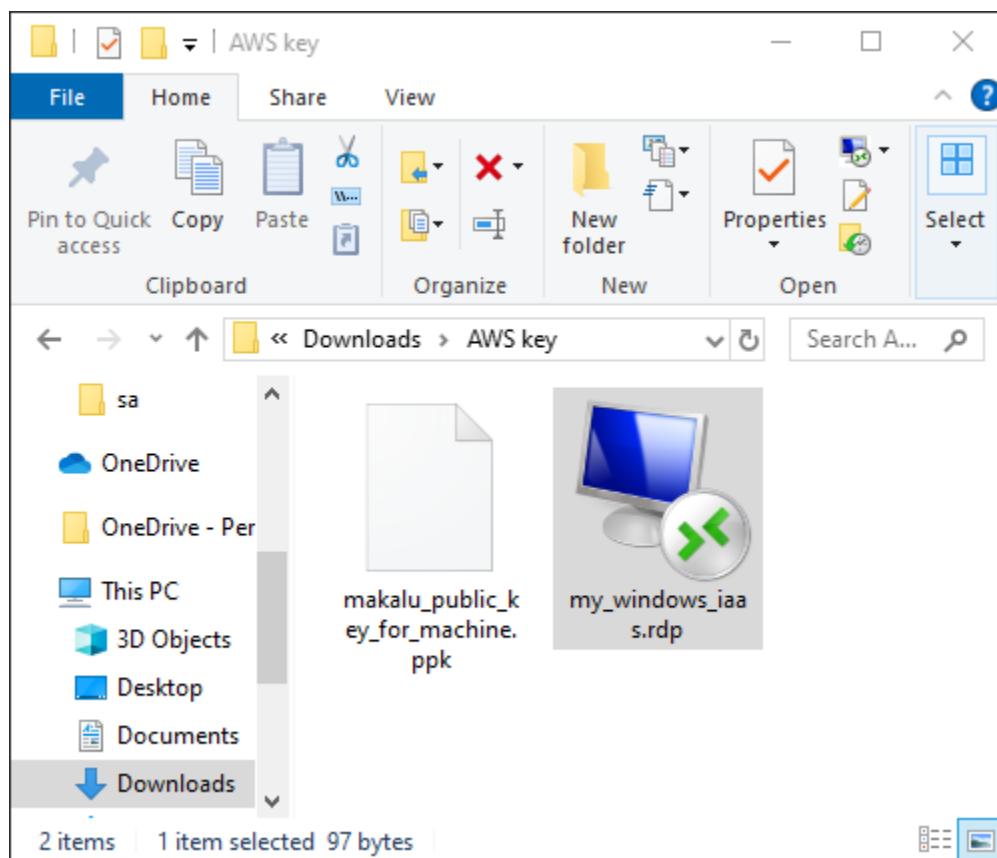
1 You can connect to your Windows instance using a remote desktop client of your choice, and by downloading and running the RDP shor

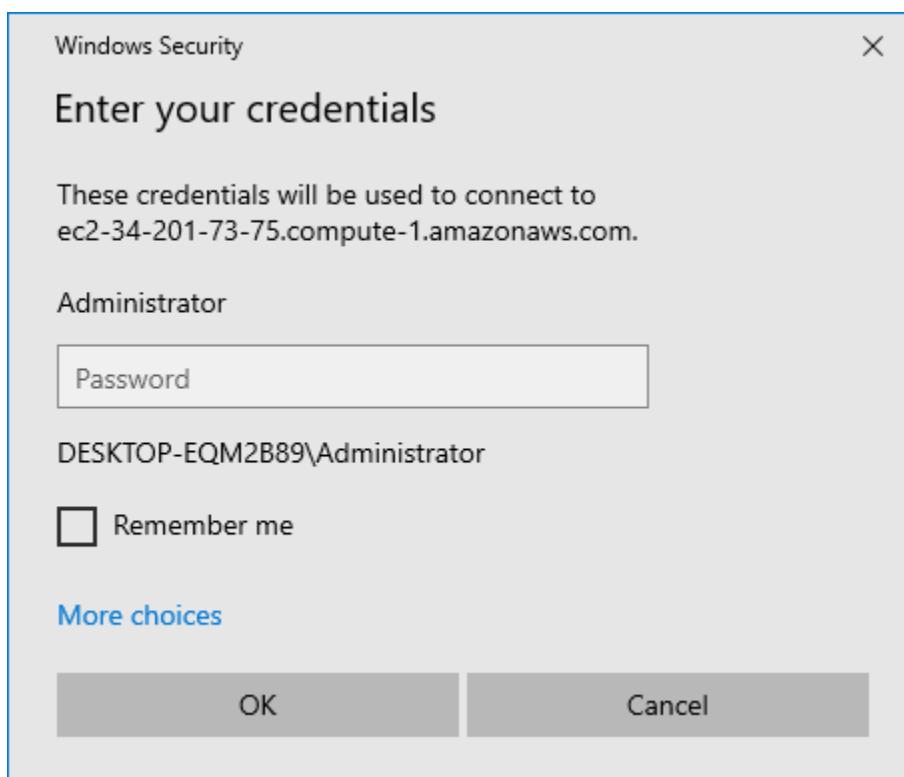
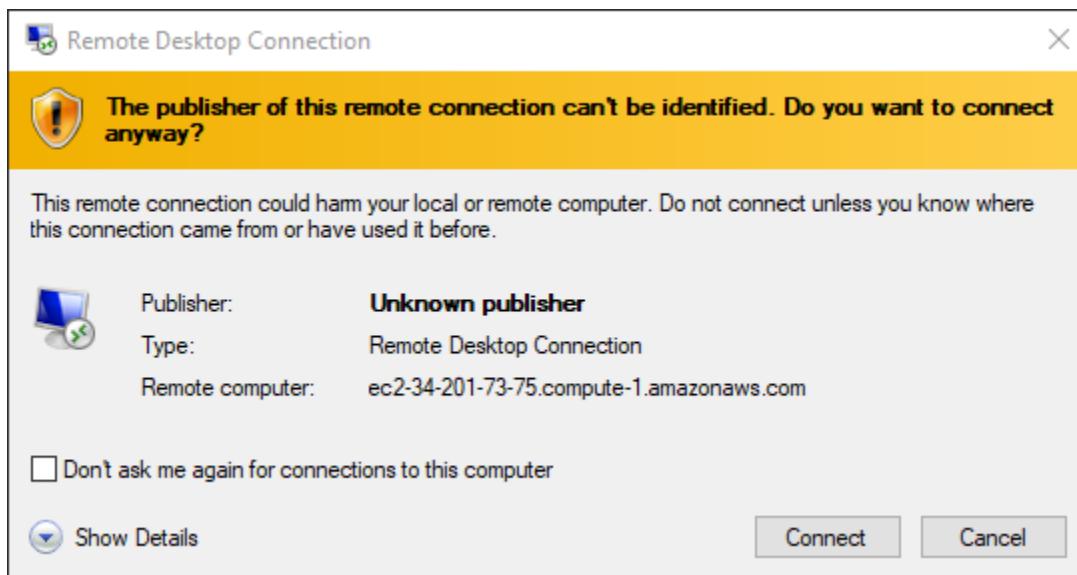
[!\[\]\(f0954db7a500118d074e2da7fda77094\_img.jpg\) Download remote desktop file](#)

When prompted, connect to your instance using the following username and password:

**Public DNS**  
 ec2-34-201-73-75.compute-1.amazonaws.com

2 **Username Info**  
 Administrator





**Connection Type**
 Connect using RDP client

Download a file to use with your RDP client and retrieve your password.

 Connect using Fleet Manager

To connect to the instance using Fleet Manager Remote Desktop, the SSM Agent must be installed and running on the instance. For more information, see [Working with SSM Agent](#)

You can connect to your Windows instance using a remote desktop client of your choice, and by downloading and running the RDP shortcut file below:

[!\[\]\(976ed27d450a1e7f12be023482e94461\_img.jpg\) Download remote desktop file](#)

When prompted, connect to your instance using the following username and password:

**Public DNS**

 ec2-34-201-73-75.compute-1.amazonaws.com

**Username Info**

 Administrator

**Password** [Get password](#)

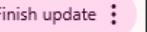
 If you've joined your instance to a directory, you can use your directory credentials to connect to your instance.

 CloudShell [Feedback](#)

[Privacy](#) [Terms](#) [Cookie preference](#)

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Launch an instance | EC2 | us-east-1 | Launch an instance | EC2 | us-east-1 | Get windows password | EC2 | us-east-1 | +

us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1#GetWindowsPassword:inst...     

aws | Search [Alt+S]     N. Virginia  Sanjeev Thapa 

EC2 > Instances > i-012d557c213a9f6c8 > Get Windows password  

## Get Windows password

Use your private key to retrieve and decrypt the initial Windows administrator password for this instance.

**Instance ID**  
 i-012d557c213a9f6c8 (my\_windows\_iaas)

**Key pair associated with this instance**  
 makalu\_public\_key\_for\_machine

**Private key**  
 Either upload your private key file or copy and paste its contents into the field below.

 [Upload private key file](#)

Private key contents - optional

Private key contents

 CloudShell [Feedback](#)

[Privacy](#) [Terms](#) [Cookie preferences](#)

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```
C:\>cd C:\Program Files\OpenSSL-Win64\bin
```

EC2 > Instances > i-012d557c213a9f6c8 > Get Windows password

makalu\_public\_key\_for\_machine

**Private key**  
Either upload your private key file or copy and paste its contents into the field below.

permConverted\_file.pem  
0KB

Private key contents - optional

```
JJwMnsIQc9KzAAAAgQDQpfFOc2kei7pUgpm4qp/4B1v1AFMUV1idHz0kh6xbAHxa
wErbYenbPBE2gVoRDIWUkmjADudWTEyOep8Z95fmy69Lw13jyv+sH6FNcL37fVb
6r2TdykVlg6YzjR4JACondZ4NG3q1yhlB4D3wTLp+qR/ERiL0rlBv6EBLo3MfQAA
AIEAkfxzRuG3eMk9kVOPQywVEzyep7MArFbvQ0N9yydA08Y9HsasYrjSJ+Atrjx9
iRP9KYwrWiQZuGxsMvRZdaoeSLPJF3uotWMJnEkI1RRdi8F2JNeHKWdWR9NCORNR
gZKngydaO0CI5j/eGZlgwSvV0HxLSIZDVmokFuegL5oxleA=
Private-MAC: 7a5b32d56e4adbf7ce5a70d1f6725c5cfb9e56a3
```

[CloudShell](#) [Feedback](#) [Privacy](#) [Terms](#) [Cookie preferences](#)

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Launch an... | Launch an... | Connect t... | Playgroup | Convert P... | +

us-east-1.console.aws.amazon.com/ec2/home?region=us-e...

Finish update

aws N. Virginia Sanjeev Thapa

EC2 > Instances > i-012d557c213a9f6c8 > Connect to instance

You can connect to your Windows instance using a remote desktop client of your choice, and by downloading and running the RDP shortcut file below:

[Download remote desktop file](#)

When prompted, connect to your instance using the following username and password:

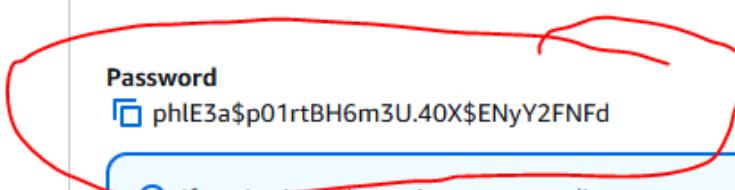
**Public DNS**  
 ec2-34-201-73-75.compute-1.amazonaws.com

**Username**  Administrator ▾

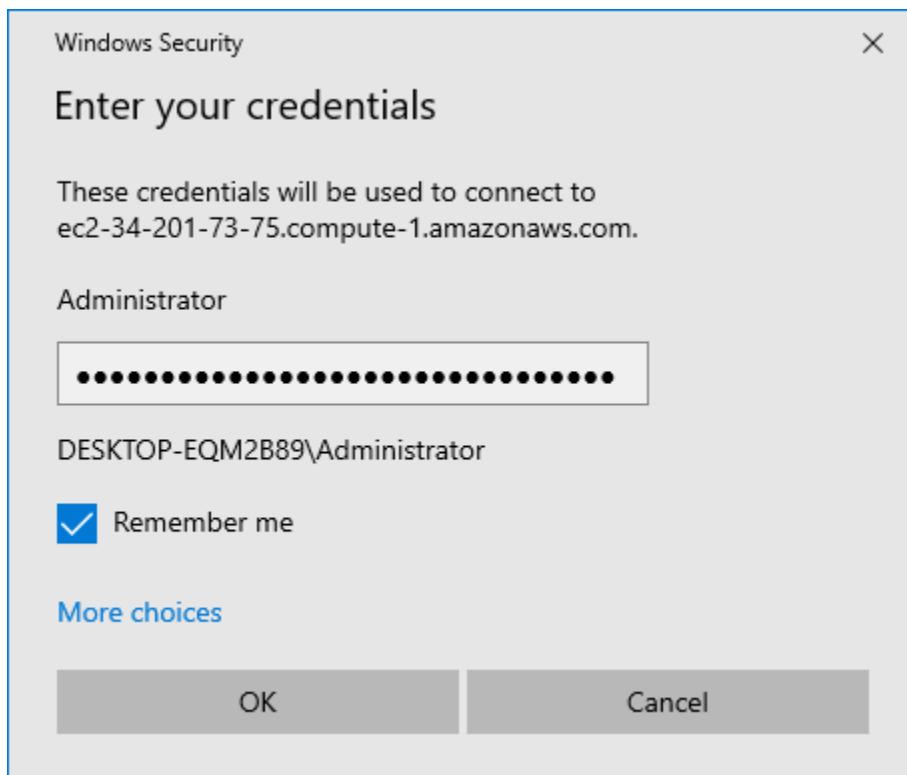
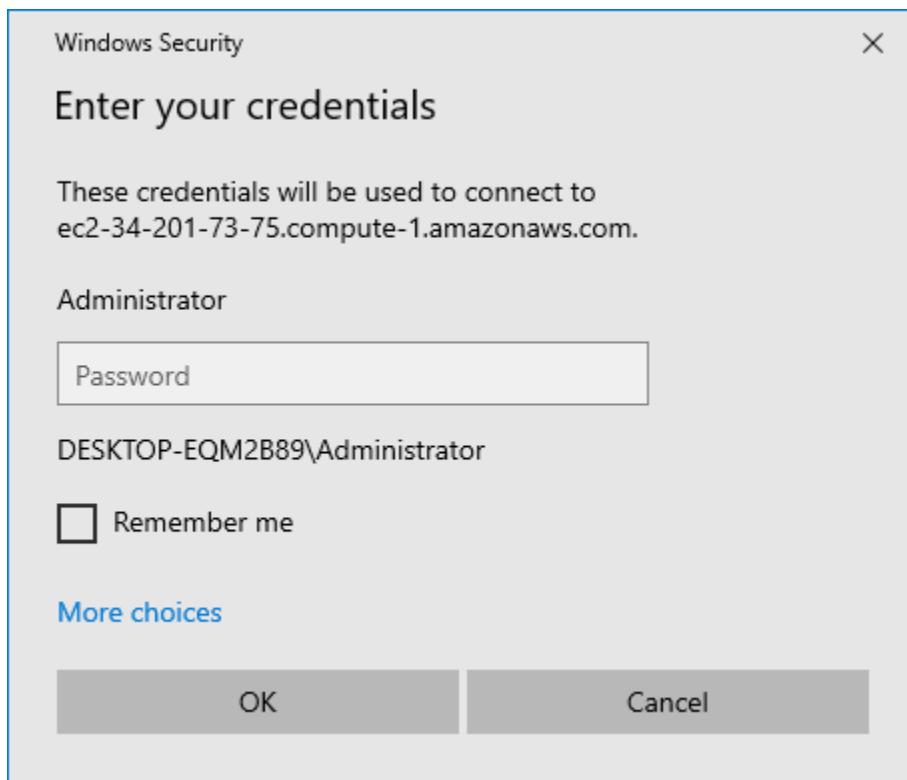
**Password**  
 phlE3a\$p01rtBH6m3U.40X\$ENyY2FNFd

If you've joined your instance to a directory, you can use your directory credentials to connect to your instance.

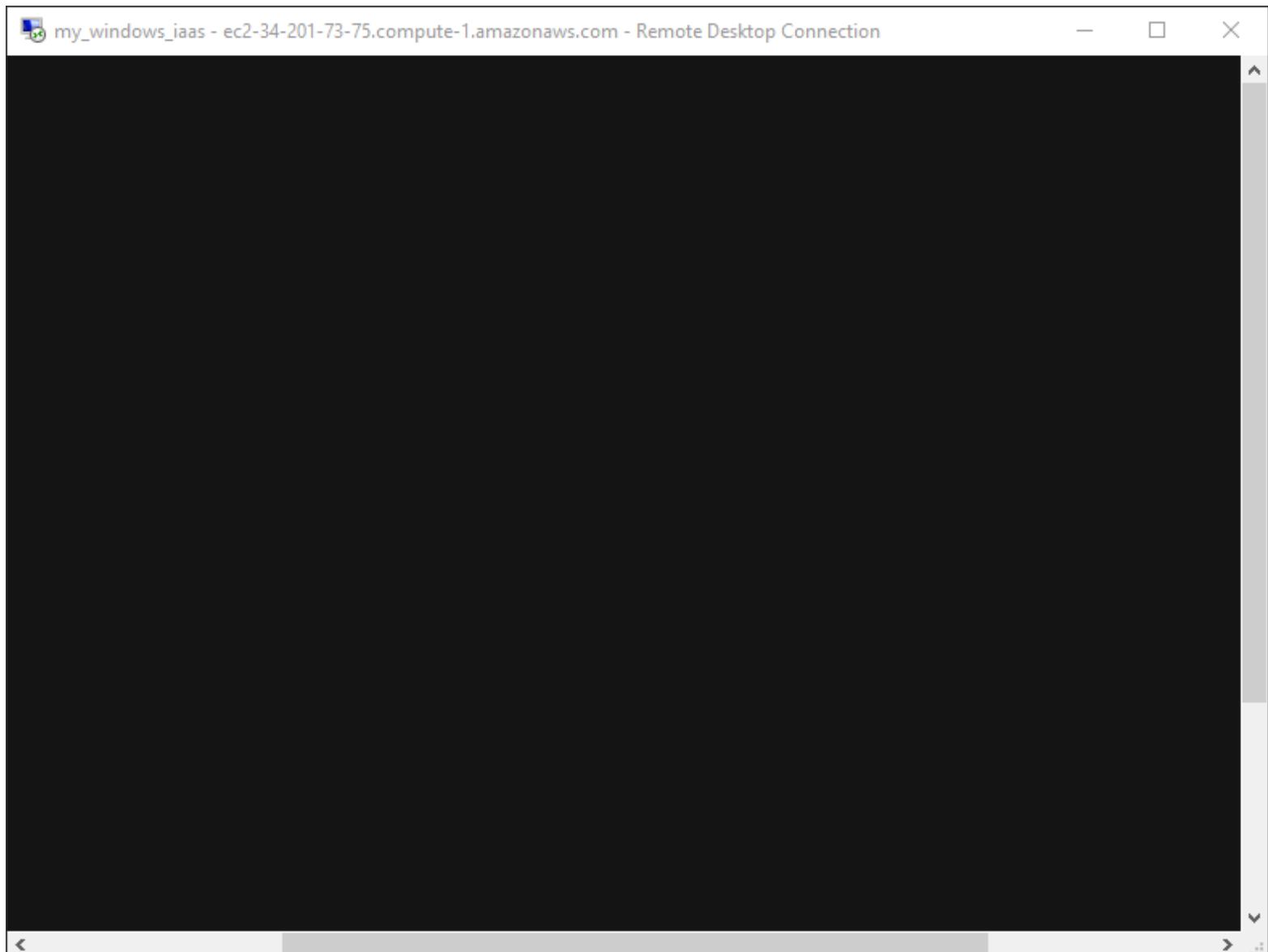
Cancel

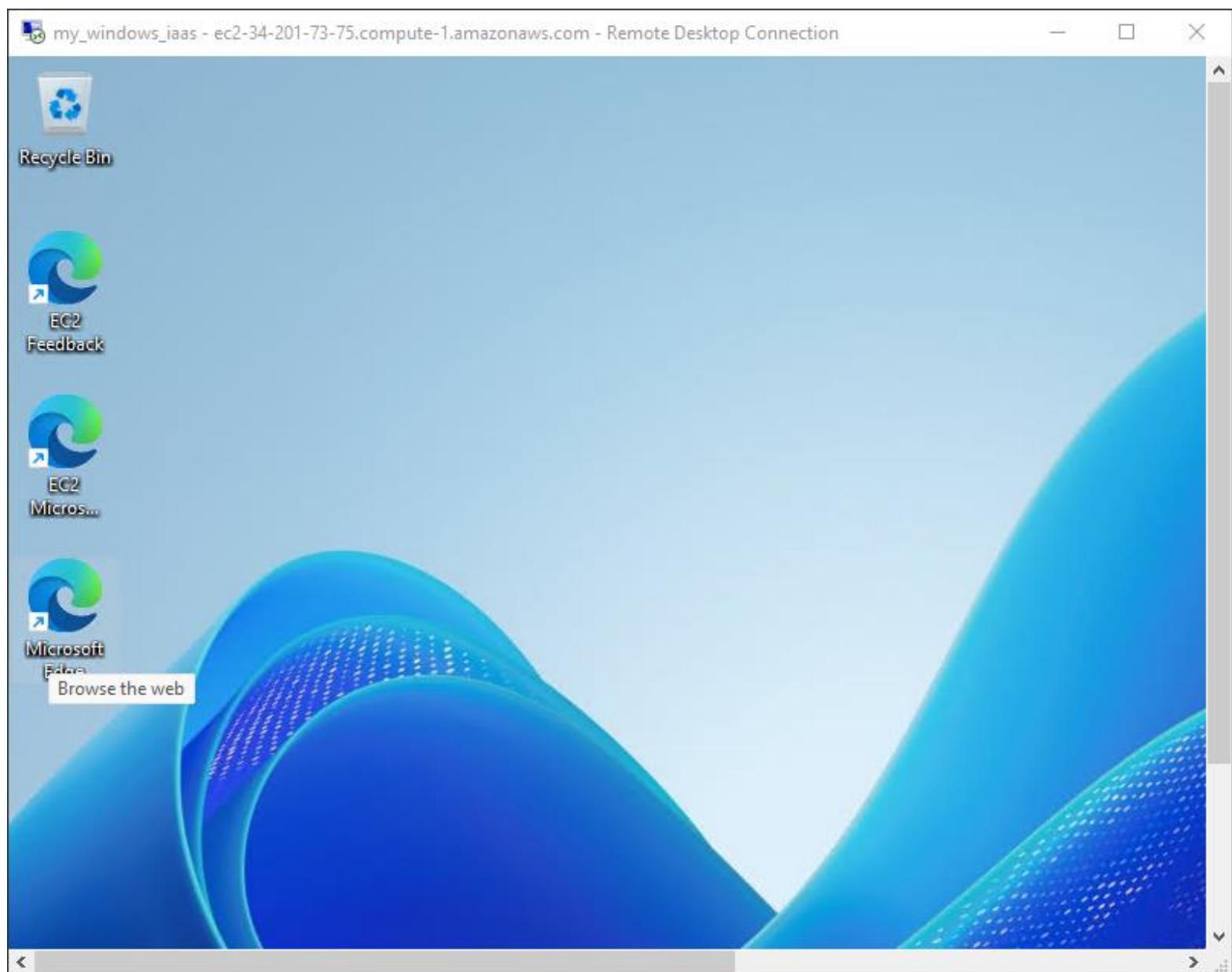


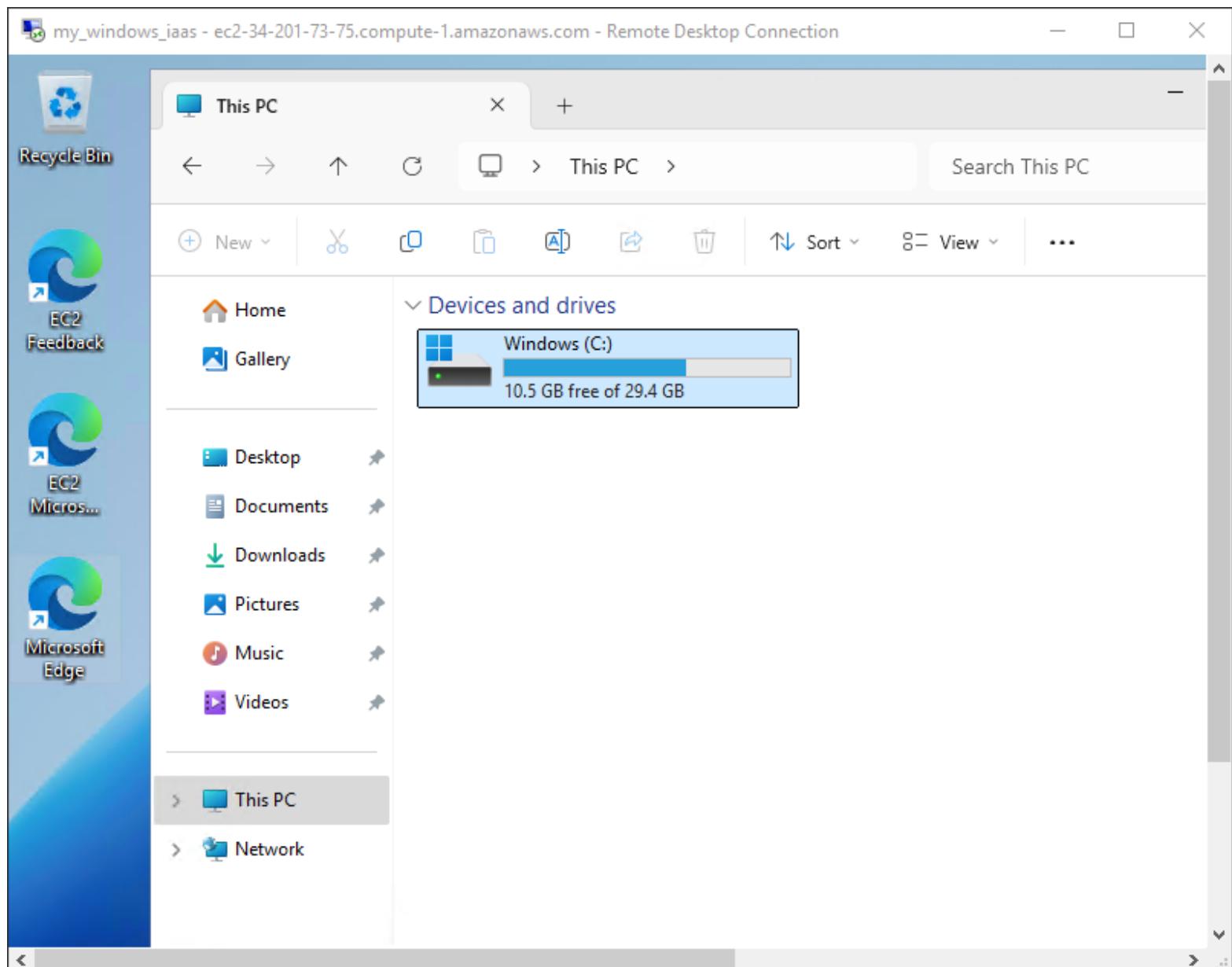
CloudShell Feedback Privacy Terms Cookie preferences

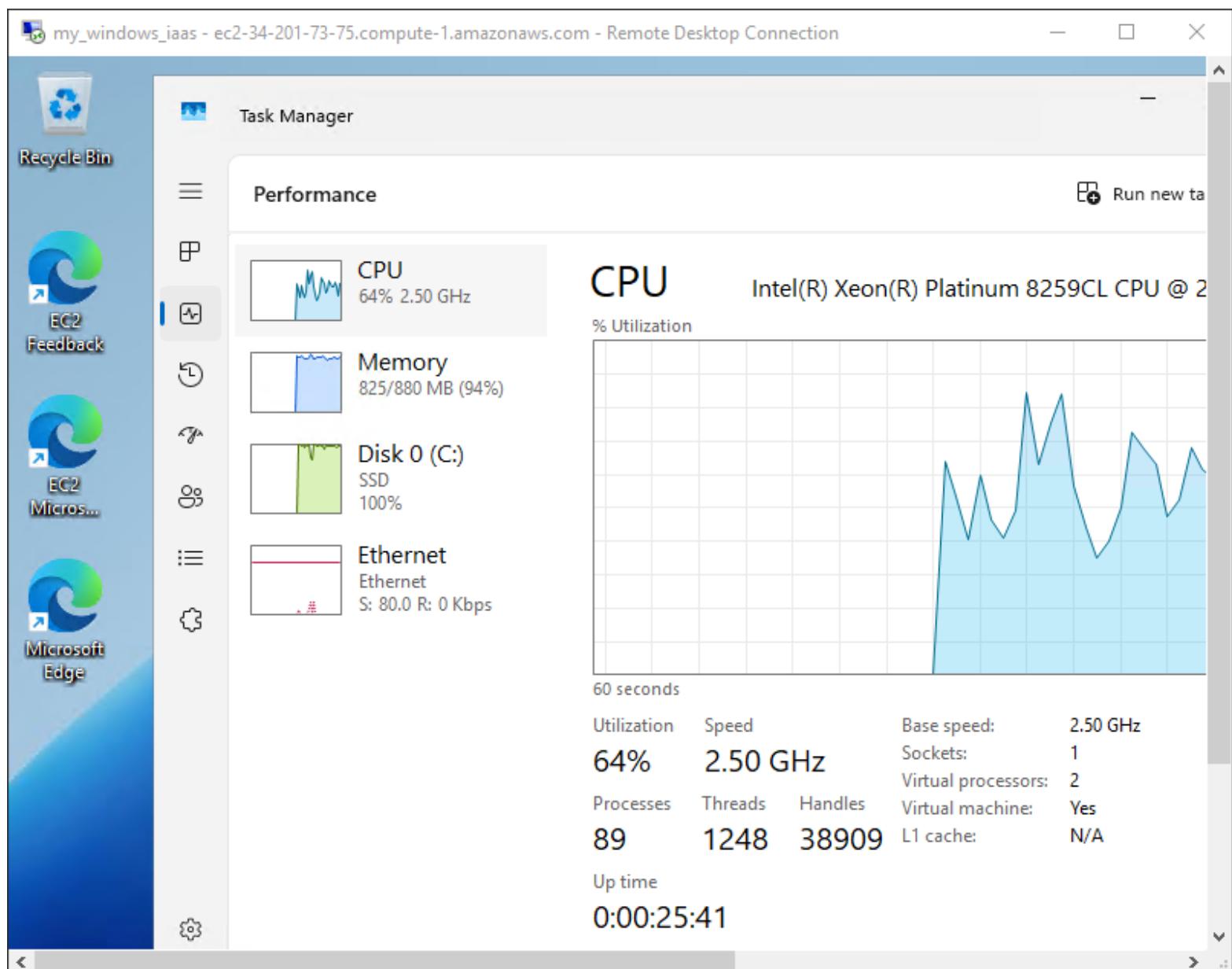


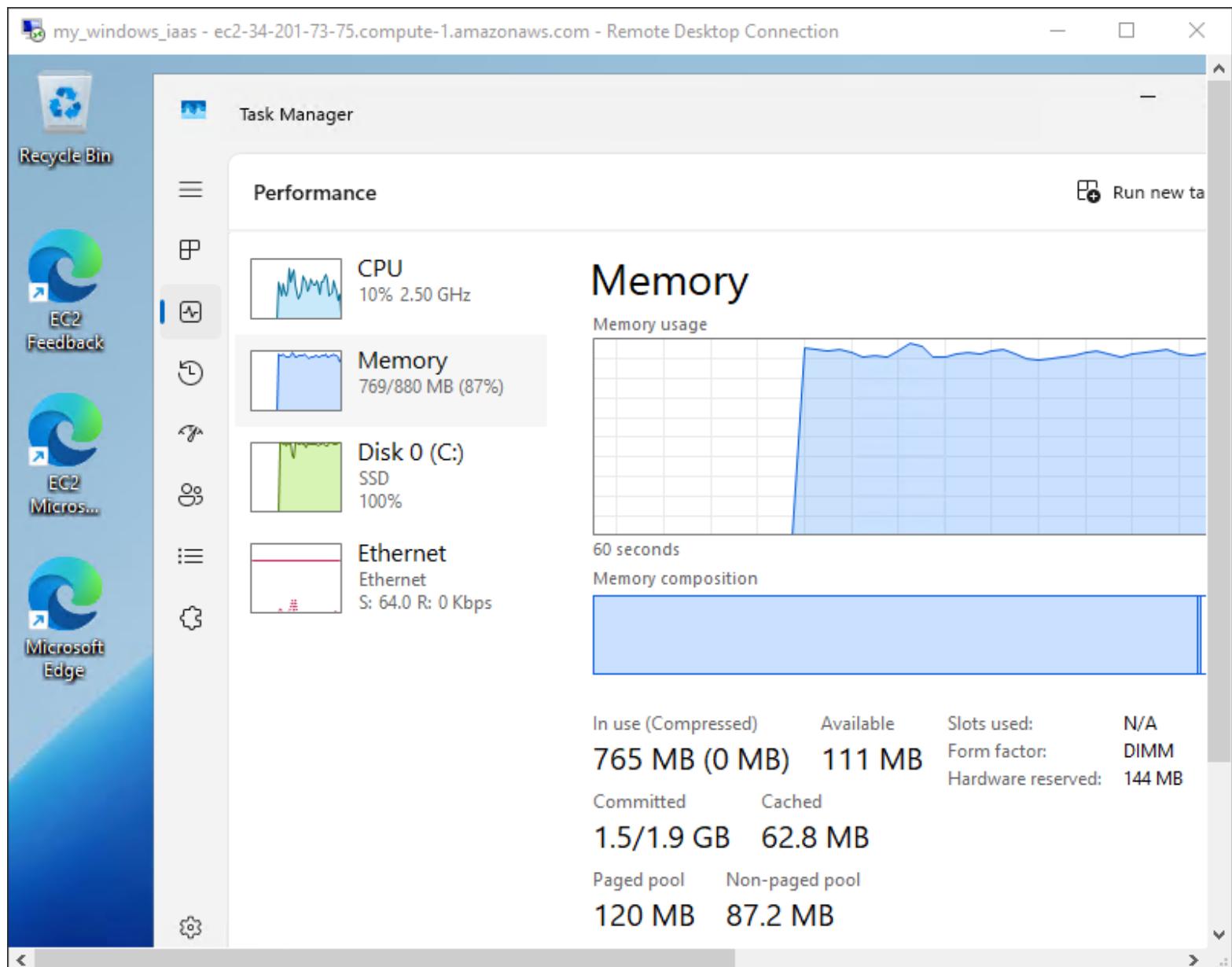


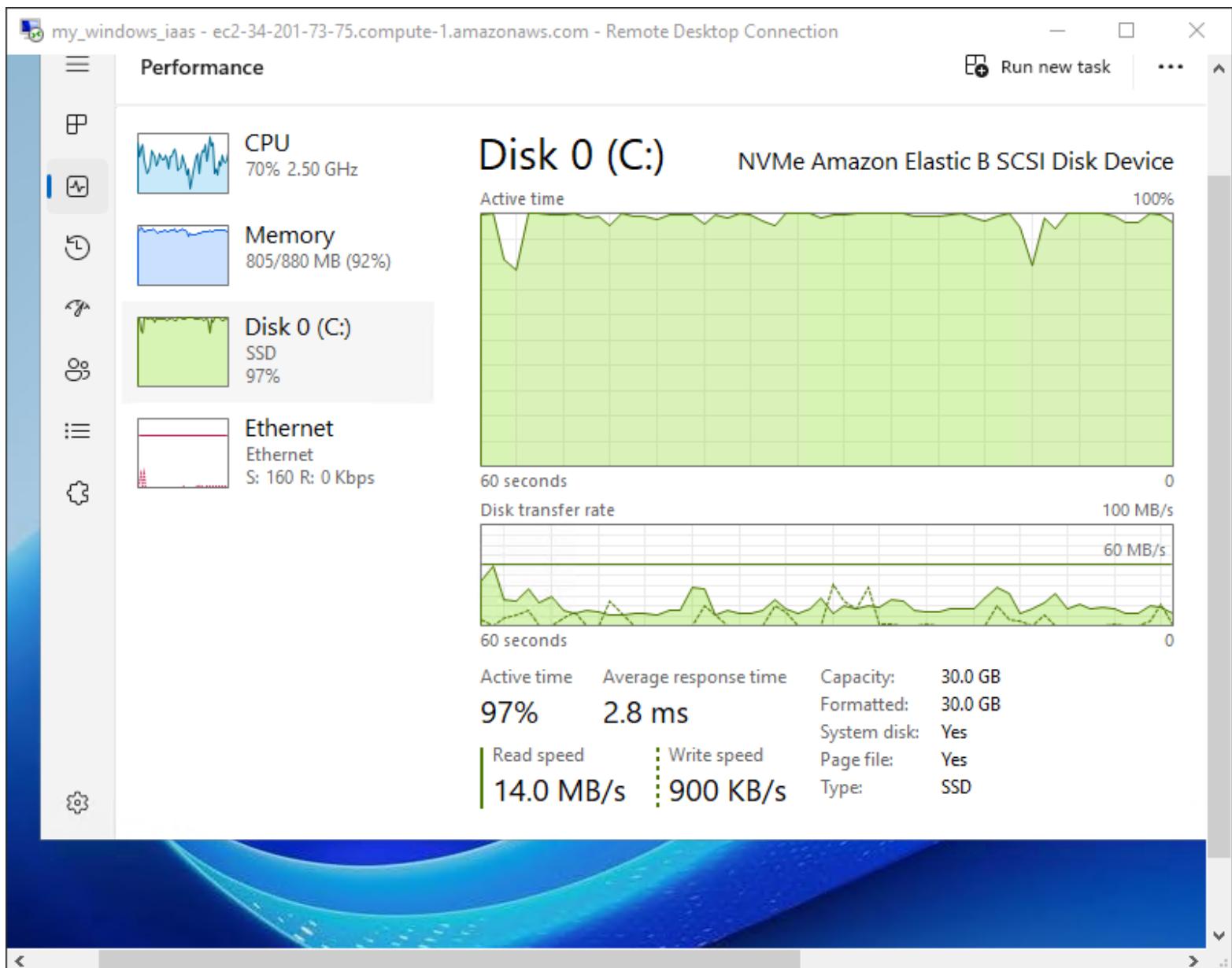


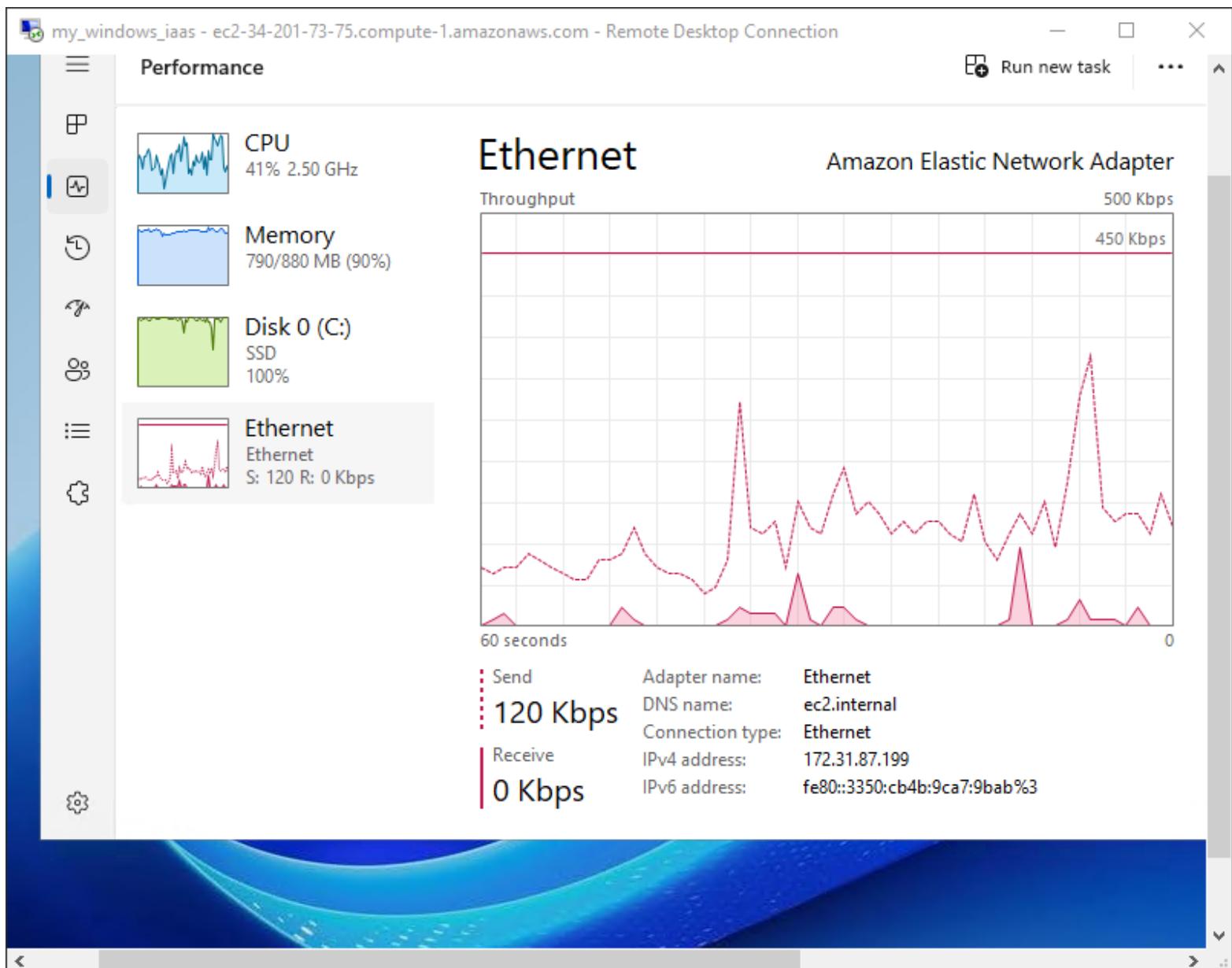








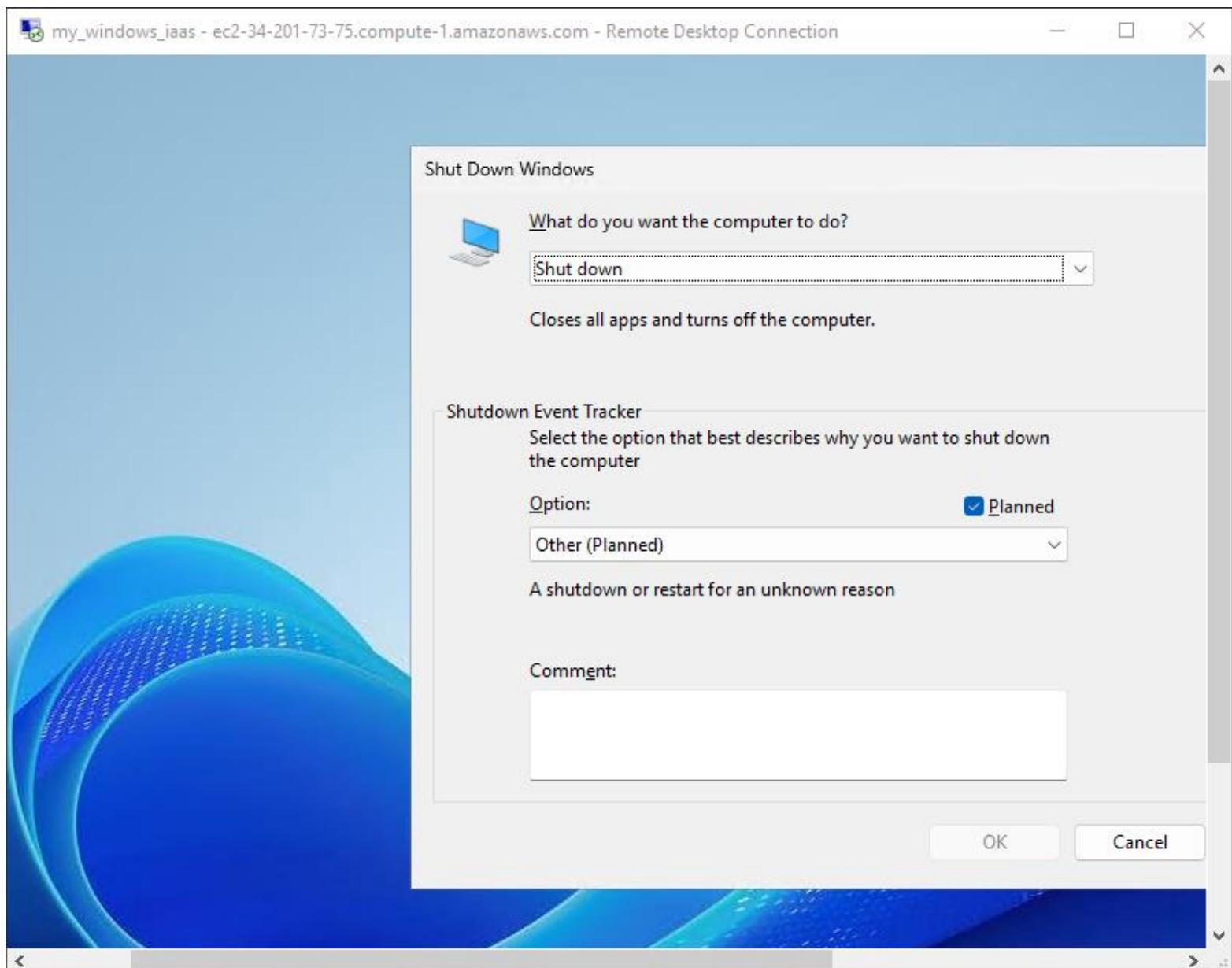


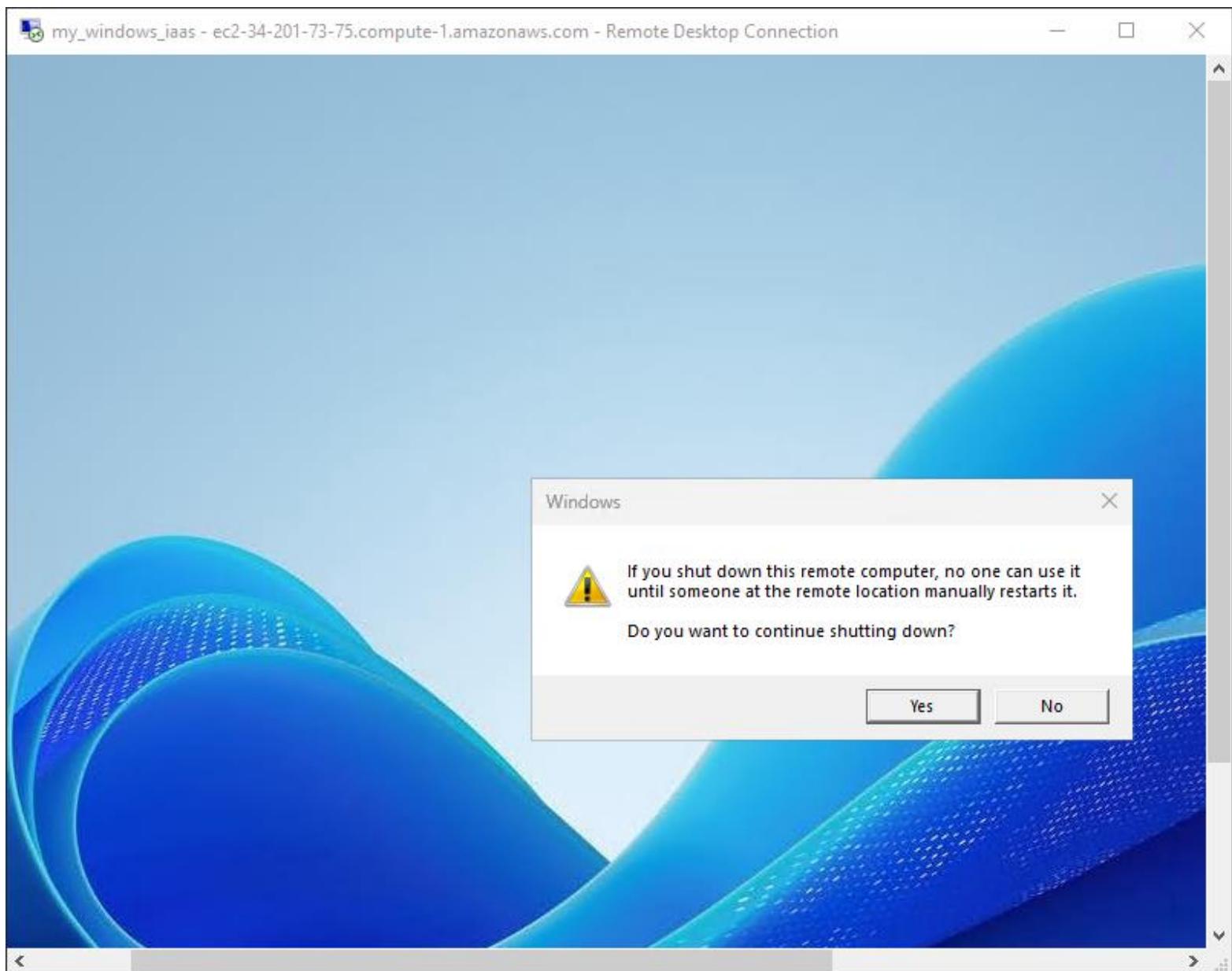


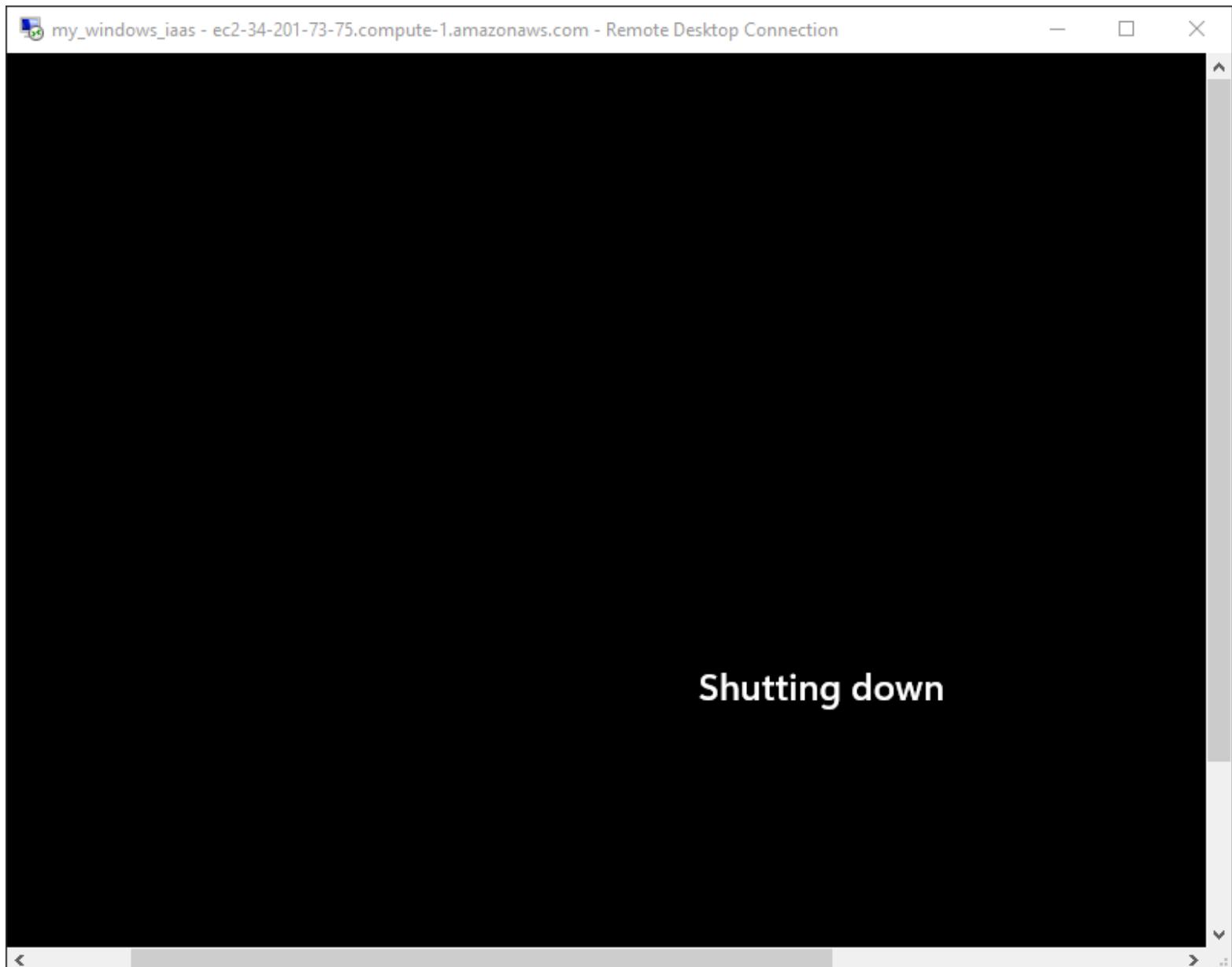
The screenshot shows the AWS EC2 Instances page with three instances listed:

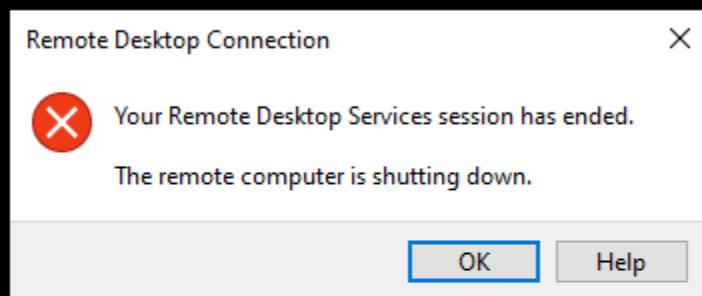
Name	Instance ID	Instance state	Instance type	Status check
prairesh_ubu	i-0a7d220db7d8f469e	Terminated	t2.micro	-
my_windows_...	i-012d557c213a9f6c8	Running	t3.micro	3/3 checks pass
my_demo_ub...	i-0ad5d0b5c677a5453	Terminated	t2.micro	-

At the bottom, there is a "Select an instance" section and a footer with links to CloudShell, Feedback, Privacy, Terms, and Cookie preferences.









The screenshot shows the AWS EC2 Instances page. At the top, there are tabs for Launch, Instances, Playgroup, and Convert. The Instances tab is selected. The URL in the address bar is [us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1](https://us-east-1.console.aws.amazon.com/ec2/home?region=us-east-1). The top navigation bar includes links for Launch an instance, Launch a group, Instances, Playgroup, Convert, and a Finish update button. On the left, there's a sidebar with a menu icon and user information for Sanjeev Thapa.

**Instances (2)** [Info](#)

Last updated less than a minute ago

[Connect](#) [Instance state](#) [Actions](#) [Launch instances](#)

Find Instance by attribute or tag (case-sensitive) [All states](#)

<input type="checkbox"/>	Name <a href="#">Edit</a>	Instance ID	Instance state	Instance type	Status check
<input type="checkbox"/>	my_windows_...	i-012d557c213a9f6c8	<a href="#">Stopped</a> <a href="#">+ Details</a> <a href="#">Edit</a>	t3.micro	-
<input type="checkbox"/>	my_demo_ub...	i-0ad5d0b5c677a5453	<a href="#">Terminated</a> <a href="#">+ Details</a> <a href="#">Edit</a>	t2.micro	-

Select an instance

CloudShell Feedback Privacy Terms Cookie preferences

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The screenshot shows the AWS Instances page with two instances listed: **my\_windows\_iaas** (selected) and **my\_demo\_ub...**. The Actions menu is open over the selected instance, showing options: Stop instance, Start instance, Reboot instance, Hibernate instance, and **Terminate (delete) instance**. A sub-menu for Instance type is also visible, listing **t3.micro** and **t2.micro**.

**Instances (1/2)** [Info](#)

Last updated less than a minute ago [Connect](#)

**Actions** ▾ [Launch instances](#) ▾

Stop instance  
Start instance  
Reboot instance  
Hibernate instance  
**Terminate (delete) instance**

All states ▾

Instance type ▾ Status check

t3.micro  
t2.micro

**i-012d557c213a9f6c8 (my\_windows\_iaas)**

Details Status and alarms Monitoring Security Networking Storage

▼ Instance summary [Info](#)

CloudShell Feedback Privacy Terms Cookie preferences

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The screenshot shows the AWS EC2 Instances page with the following details:

- Instances (2) Info**: Shows 2 instances.
- Last updated**: less than a minute ago.
- Actions**: Connect, Instance state, Actions, Launch instances.
- Search bar**: Find Instance by attribute or tag (case-sensitive).
- Filter**: All states.
- Table Headers**: Name, Instance ID, Instance state, Instance type, Status check.
- Table Data**:
  - my\_windows\_... (Instance ID: i-012d557c213a9f6c8) - Terminated, t3.micro
  - my\_demo\_ub... (Instance ID: i-0ad5d0b5c677a5453) - Terminated, t2.micro
- Select an instance**: A dropdown menu where "my\_windows..." is selected.
- Page Bottom**: CloudShell, Feedback, Privacy, Terms, Cookie preferences, © 2024, Amazon Web Services, Inc. or its affiliates.

Criterion	Definition	Goal	Formula/Key Consideration
CPU Utilization	Measures how effectively the CPU is being used.	Maximize CPU usage.	Typically expressed as a percentage (%).
Throughput	Number of processes completed per unit time.	Maximize the number of completed tasks.	Higher throughput indicates better efficiency.
Turnaround Time	Total time taken from process submission to completion.	Minimize turnaround time.	Turnaround Time = Completion Time – Arrival Time
Waiting Time	Total time a process spends waiting in the ready queue.	Minimize waiting time.	Waiting Time = Turnaround Time – Burst Time
Response Time	Time between process arrival and the first CPU execution.	Minimize response time.	Depends on process arrival and scheduling.
Fairness	Ensures that all processes get a fair share of CPU time.	Avoid starvation; maintain fairness.	Prioritize processes equitably.
Context Switching Overhead	Time/resources spent in switching CPU from one process to another.	Minimize context switching. ↓	Affects overall CPU efficiency.

Component	Impact of Configuration	Potential Difference with Your System
RAM (4 GB)	<ul style="list-style-type: none"> <li>- Limits multitasking and running heavy applications.</li> <li>- Suitable for lightweight tasks like web browsing or document editing.</li> </ul>	Adding more RAM (e.g., 8 GB or 16 GB) would allow smoother multitasking and better handling of memory-intensive applications like video editing or gaming.
CPU (Intel i3, 8 cores)	<ul style="list-style-type: none"> <li>- Multicore CPU can handle multiple threads efficiently.</li> <li>- Limited by clock speed and i3's architecture, which is designed for entry-level performance.</li> </ul>	Upgrading to a higher-tier processor (e.g., i5 or i7) would improve single-thread performance and better handle heavy computation workloads.
Number of Cores (8)	<ul style="list-style-type: none"> <li>- Good for multitasking and parallel processing tasks.</li> <li>- Software must be optimized to use multiple cores effectively.</li> </ul>	Similar core count in a higher-performing CPU (e.g., Ryzen 5 or i5) would improve overall processing power.
Disk Type (Assume HDD)	<ul style="list-style-type: none"> <li>- If paired with HDD, system speed is bottlenecked during file I/O operations (e.g., boot times, loading applications).</li> </ul>	Switching to an SSD would drastically improve system responsiveness, reducing boot and application load times.
Graphics (Integrated)	<ul style="list-style-type: none"> <li>- Integrated graphics may struggle with graphical workloads like gaming or 3D rendering.</li> </ul>	Adding a dedicated GPU would significantly enhance graphical performance for tasks like gaming, video editing, or rendering.

## So far now IaaS machine

**Recents**    **Quick Start**

---

Amazon Linux 	macOS 	Ubuntu 	Windows 	Red Hat 	SUSE Linux 	Debian 
---	--	---	--	--	---	---

      [Browse more AMIs](#)  
 Including AMIs from AWS, Marketplace and the Community

---

Console Home | Console    Instances | EC2 | us-east-...    Playground | Killer Shell C | +

us-east-1.console.aws.amazon.com/console/home?region=...

aws    N. Virginia    Sanjeev Thapa

**Console Home** Info    [Reset to default layout](#)    [+ Add widgets](#)

**Recently visited** Info

-  [EC2](#)
-  [CloudShell](#)
-  [Lambda](#)
-  [Red Hat OpenShift Service on AWS](#)
-  [VPC](#)
-  [Systems Manager](#)
-  [EC2 Global View](#)
-  [Elastic Kubernetes Service](#)

-  [CloudWatch](#)
-  [IAM](#)
-  [S3](#)
-  [RDS](#)

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## AWS free tier feature on

**IaaS    SaaS    PaaS**

[https://aws.amazon.com/free/?gclid=Cj0KCQiAvP-6BhDyARIsAJ3uv7YIcltoTWHbtmt07skgQUpB0DcntsdR6LECVd9HMvES\\_UqDeb9tkZ4aAkkfEALw\\_wcB&trk=14a4002d-4936-4343-8211-b5a150ca592b&sc\\_channel=ps&ef\\_id=Cj0KCQiAvP-6BhDyARIsAJ3uv7YIcltoTWHbtmt07skgQUpB0DcntsdR6LECVd9HMvES\\_UqDeb9tkZ4aAkkfEALw\\_wcB:G:s&s\\_kwcid=AL!4422!3!453325184782!e!!g!!aws!10712784856!111477279771&all-free-tier.sort-by=item.additionalFields.SortRank&all-free-tier.sort-order=asc&awsf.Free%20Tier%20Types=\\*all&awsf.Free%20Tier%20Categories=\\*all](https://aws.amazon.com/free/?gclid=Cj0KCQiAvP-6BhDyARIsAJ3uv7YIcltoTWHbtmt07skgQUpB0DcntsdR6LECVd9HMvES_UqDeb9tkZ4aAkkfEALw_wcB&trk=14a4002d-4936-4343-8211-b5a150ca592b&sc_channel=ps&ef_id=Cj0KCQiAvP-6BhDyARIsAJ3uv7YIcltoTWHbtmt07skgQUpB0DcntsdR6LECVd9HMvES_UqDeb9tkZ4aAkkfEALw_wcB:G:s&s_kwcid=AL!4422!3!453325184782!e!!g!!aws!10712784856!111477279771&all-free-tier.sort-by=item.additionalFields.SortRank&all-free-tier.sort-order=asc&awsf.Free%20Tier%20Types=*all&awsf.Free%20Tier%20Categories=*all)

The screenshot shows a web browser window with the title "Free Cloud Computing Services". The URL in the address bar is [https://aws.amazon.com/free/?gclid=Cj0KCQiAvP-6BhDyARIsAJ3uv7YIcltoTWHbtmt07skgQUpB0DcntsdR6LECVd9HMvES\\_UqDeb9tkZ4aAkkfEALw\\_wcB&trk=14a4002d-4936-4343-8211-b5a150ca592b&sc\\_channel=ps&ef\\_id=Cj0KCQiAvP-6BhDyARIsAJ3uv7YIcltoTWHbtmt07skgQUpB0DcntsdR6LECVd9HMvES\\_UqDeb9tkZ4aAkkfEALw\\_wcB:G:s&s\\_kwcid=AL!4422!3!453325184782!e!!g!!aws!10712784856!111477279771&all-free-tier.sort-by=item.additionalFields.SortRank&all-free-tier.sort-order=asc&awsf.Free%20Tier%20Types=\\*all&awsf.Free%20Tier%20Categories=\\*all](https://aws.amazon.com/free/?gclid=Cj0KCQiAvP-6BhDyARIsAJ3uv7YIcltoTWHbtmt07skgQUpB0DcntsdR6LECVd9HMvES_UqDeb9tkZ4aAkkfEALw_wcB&trk=14a4002d-4936-4343-8211-b5a150ca592b&sc_channel=ps&ef_id=Cj0KCQiAvP-6BhDyARIsAJ3uv7YIcltoTWHbtmt07skgQUpB0DcntsdR6LECVd9HMvES_UqDeb9tkZ4aAkkfEALw_wcB:G:s&s_kwcid=AL!4422!3!453325184782!e!!g!!aws!10712784856!111477279771&all-free-tier.sort-by=item.additionalFields.SortRank&all-free-tier.sort-order=asc&awsf.Free%20Tier%20Types=*all&awsf.Free%20Tier%20Categories=*all).

**Three Types of Offers**

More than 100 AWS products are available on AWS Free Tier today. Three different types of free offers are available depending on the product used. Click an icon below to explore our offers.

<b>Free Trials</b>  <a href="#">Click to Learn More</a>	<b>12 months free</b>  <a href="#">Click to Learn More</a>	<b>Always free</b>  <a href="#">Click to Learn More</a>
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**Free Tier details**

The screenshot shows the AWS Free Cloud Computing Services landing page. At the top, there's a navigation bar with the AWS logo, a search icon, a filter icon, and a user profile icon. Below the header, there are two main sections: 'COMPUTE' on the left and 'STORAGE' on the right. Both sections feature a large 'Free Tier' badge with '12 MONTHS FREE'. The 'COMPUTE' section highlights 'Amazon EC2' and '750 Hours per month' of resizable compute capacity. It also mentions '750 hours per month of Linux, RHEL, or SLES t2.micro or t3.micro\* instance dependent on region'. The 'STORAGE' section highlights 'Amazon S3' and '5 GB of standard storage' of secure, durable, and scalable object storage infrastructure.

Free Cloud Computing Services

aws.amazon.com/free/?gclid=Cj0KCQiAv...

Get Started for Free

Contact Us

Filter

Search free tier products

COMPUTE

Free Tier 12 MONTHS FREE

Amazon EC2

**750 Hours**

per month

Resizable compute capacity in the Cloud.

750 hours per month of Linux, RHEL, or SLES t2.micro or t3.micro\* instance dependent on region

STORAGE

Free Tier 12 MONTHS FREE

Amazon S3

**5 GB**

of standard storage

Secure, durable, and scalable object storage infrastructure.

5 GB of Standard Storage

The screenshot shows the AWS Free Cloud Computing Services landing page. At the top, there's a navigation bar with a back arrow, forward arrow, refresh icon, and a search bar containing the URL "aws.amazon.com/free/?gclid=Cj0KCQiAv...". To the right of the search bar are icons for a shield, a folder, a person, and a three-dot menu, along with a pink button labeled "Finish update". Below the navigation is the AWS logo and a search bar with a magnifying glass icon.

**Get Started for Free** **Contact Us**

**DATABASE**

Free Tier	12 MONTHS FREE
<b>Amazon RDS</b>	
<b>750 Hours</b>	
per month of database usage (applicable DB engines)	
Managed Relational Database Service for MySQL, PostgreSQL, MariaDB, or SQL Server.	
750 Hours of Amazon RDS Single-AZ db.t3.micro and	

**DATABASE**

Free Tier	ALWAYS FREE
<b>Amazon DynamoDB</b>	
<b>25 GB</b>	
of storage	
Serverless, NoSQL, fully managed database with single-digit millisecond performance at any scale.	

**MACHINE LEARNING** **NEW**

Free Tier	FREE TRIAL
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**COMPUTE**

Free Tier	ALWAYS FREE
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Free Cloud Computing Services X +

aws.amazon.com/free/?gclid=Cj0KCQiAv... ☆ Finish update :

aws Get Started for Free Contact Us

**MACHINE LEARNING** NEW

Free Tier FREE TRIAL

**Amazon SageMaker**

# 2 Months

free trial

Machine learning for every data scientist and developer.

250 hours per month of ml.t3.medium on Studio notebooks OR 250 hours per month of ml.t2.medium or ml.t3.medium on on-demand notebook instances

25 hours per month on ml.m5.4xlarge on SageMaker Data Wrangler

10M write units, 10 M, read units, 25 GB storage per month on SageMaker Feature Store

50 hours per month of m4.xlarge or m5.xlarge instances on Training

**COMPUTE**

Free Tier ALWAYS FREE

**AWS Lambda**

# 1 Million

free requests per month

Run code without thinking about servers or clusters

1,000,000 free requests per month

**ANALYTICS**

Free Tier 12 MONTHS FREE

This screenshot shows the AWS Free Cloud Computing Services page. It features a sidebar on the left with sections for Machine Learning (Amazon SageMaker), Compute (AWS Lambda), and Analytics. Each section highlights specific free tiers and trials. The Machine Learning section offers 2 months of free trial for SageMaker Data Wrangler and 12 months of free tier for AWS Lambda. The Compute section offers 250 hours per month of ml.t3.medium on Studio notebooks or ml.t2.medium or ml.t3.medium on on-demand notebook instances. The Analytics section offers 1,000,000 free requests per month for AWS Lambda. The page also includes a search bar, a contact us button, and a 'Finish update' button.

The screenshot shows a web browser window for the AWS Free Cloud Computing Services page. The URL in the address bar is [aws.amazon.com/free/?gclid=Cj0KCQiAv...](https://aws.amazon.com/free/?gclid=Cj0KCQiAv...). The page features a dark header with the AWS logo, a search icon, and a user profile icon. Below the header are two main sections: "ARTIFICIAL INTELLIGENCE" and "ANALYTICS".

**ARTIFICIAL INTELLIGENCE** (NEW)

ALWAYS FREE

**Amazon CodeWhisperer**  
**Unlimited**

code suggestions for Individual Tier

Your AI-powered productivity tool for the IDE and command line

Free for individual use:

Unlimited code suggestions

Includes Amazon Q chat in the IDE (Preview)

50 security scans per user per month

Reference tracking

Command line integration

Authenticate with AWS Builder ID

**ANALYTICS** (NEW)

Free Tier 12 MONTHS FREE

**Amazon OpenSearch Service**  
**750 Hours**

per month of a single-AZ t2.small.search or t3.small.search instance

Managed service that makes it easy to perform interactive log analytics, real-time application monitoring, website search, and more.

A large blue button with a white speech bubble icon is located on the right side of the page.

The screenshot shows a web browser window for 'Free Cloud Computing Services' on the AWS website. The URL is [aws.amazon.com/free/?gclid=Cj0KCQiAv...](https://aws.amazon.com/free/?gclid=Cj0KCQiAv...). The page features the AWS logo and navigation icons. A large callout box highlights 'Amazon SNS' with the text '1 Million publishes'. Below this, it says 'Fast, flexible, fully managed push messaging service.' and lists metrics: '1,000,000 Publishes', '100,000 HTTP/S Deliveries', and '1,000 Email Deliveries'. There are also navigation arrows and a message icon.

Walla More on  
AWS.....  
And  
Same as on  
Azure , GCP , digital ocean, Alibaba etc