Distributed Systems and Cloud Computing
Module 6: Implementation of Cloud Computing Services

Aim: To explore and implement "Storage as a Service" using a cloud storage platform, such as Google Drive

Theory:

What is Cloud Computing?

Cloud Computing is the delivery of computing services over the internet, often referred to as "the cloud." These services include storage, processing power, databases, networking, software, and analytics, among others, allowing users to access and store data and run applications without the need for local hardware or infrastructure.

On-Demand Self-Service: Users can access computing resources like server time and network storage as needed, without requiring human interaction with each service provider.

Broad Network Access: Services are available over the network and accessed through standard mechanisms, enabling access from various devices like laptops, phones, and tablets.

Resource Pooling: Cloud providers pool resources to serve multiple users, with resources dynamically allocated according to demand.

Rapid Elasticity: Cloud services can scale up or down quickly, often automatically, depending on user needs.

Measured Service: Usage can be monitored, controlled, and reported, offering transparency for both provider and customer.

History of Cloud Computing

Cloud computing has developed over several decades, evolving from early concepts like **utility computing** in the 1960s, which envisioned computing as an accessible public resource, to the adoption of **virtualization** in the 1970s and **client-server architecture** in the 1980s. The rise of the **internet** in the 1990s enabled software to be delivered over networks, leading to early Software as a Service (SaaS) models. Amazon Web Services (AWS) launched in the early 2000s, popularizing **Infrastructure as a Service (IaaS)** and marking the commercialization of cloud

computing. Major players like Google and Microsoft followed, solidifying the cloud's role in business as a scalable, flexible alternative to traditional data centers.

By the 2010s, cloud computing had become mainstream, with organizations adopting **hybrid** and **multi-cloud strategies** for enhanced flexibility and security. Today, cloud computing is foundational in supporting digital transformation across industries, integrating emerging technologies like **Edge Computing, Artificial Intelligence (AI),** and **Machine Learning (ML)**. These advancements allow for real-time data processing, automation, and scalability, making cloud services central to modern infrastructure and business innovation.

Cloud Computing Service Models

Cloud computing offers various **service models** that provide different levels of control, flexibility, and management to users. These models define what services are provided and who manages each layer of the cloud infrastructure. Here are the primary cloud computing service models:

1. Infrastructure as a Service (IaaS)

- **Overview**: IaaS provides basic computing infrastructure, such as virtualized servers, storage, and networking, over the internet. It allows organizations to avoid the cost of purchasing and managing physical servers and data center infrastructure.
- **Who Manages What**: The cloud provider manages the infrastructure, including servers, storage, networking, and virtualization, while the customer controls the operating systems, applications, and data.
- **Use Cases**: Hosting websites, big data analytics, backup and recovery, and development and testing environments.
- **Examples**: Amazon Web Services (AWS EC2), Microsoft Azure Virtual Machines, Google Compute Engine.

2. Platform as a Service (PaaS)

- **Overview**: PaaS provides a platform allowing users to develop, run, and manage applications without dealing with the underlying infrastructure. It offers tools and

services to support the complete application lifecycle, including development, testing, deployment, and maintenance.

- **Who Manages What**: The provider manages infrastructure, operating systems, middleware, and runtime, while the customer controls applications and data.
- **Use Cases**: Developing web and mobile applications, database management, and automating software deployment.
- **Examples**: Google App Engine, Microsoft Azure App Service, Heroku.

3. Software as a Service (SaaS)

- **Overview**: SaaS delivers software applications over the internet on a subscription basis. Users access applications via a web browser, while the cloud provider handles all aspects of the application, including maintenance, updates, and security.
- **Who Manages What**: The provider manages everything, including infrastructure, platform, and software, while the customer only uses the application.
- **Use Cases**: Email services, customer relationship management (CRM), collaboration tools, and enterprise resource planning (ERP).
- **Examples**: Salesforce, Google Workspace (formerly G Suite), Microsoft 365, Dropbox.

4. Other Models (Emerging)

- **Function as a Service (FaaS)**: Also known as **Serverless Computing**, it allows developers to execute code in response to events without managing servers.
- **Examples**: AWS Lambda, Azure Functions, Google Cloud Functions.

Each model provides different levels of flexibility, control, and simplicity, allowing organizations to choose the right service model based on their specific needs, workloads, and budget.

Advantages of Cloud Computing

Cloud computing has transformed industries by allowing businesses to access advanced technologies without significant upfront costs, fostering innovation, flexibility, and efficiency.

1. **Cost Efficiency**: Reduces the capital expense of buying hardware and software.

2. **Scalability**: Resources can be adjusted to meet demand without over-investment in physical infrastructure.

3. **Disaster Recovery**: Data backup and recovery solutions are often built into cloud services.

4. **Access Anywhere**: Users can access data and applications from any device with internet access.

5. **Automatic Updates**: Many cloud services offer continuous software updates.

Disadvantages of Cloud Computing

While cloud computing offers numerous benefits, it also comes with several limitations that organizations must carefully consider:

1. **Downtime**: Cloud services can experience outages or downtime, which can disrupt business operations and lead to productivity loss if critical applications become unavailable.

2. **Security Concerns**: Storing sensitive data off-premises increases the risk of cyber threats, such as data breaches and unauthorized access, especially if security controls are not robust.

3. **Limited Control**: Cloud users have less control over infrastructure settings, configurations, and customizations, which may not fully align with specific business needs or regulatory requirements.

4. **Cost Overruns**: While cloud services can be cost-effective, unexpected increases in resource usage, such as traffic surges or scaling needs, can lead to unexpectedly high costs.

5. **Vendor Lock-In**: Moving data and applications from one cloud provider to another can be challenging and costly due to compatibility issues, making organizations dependent on a single vendor's platform and services.

Cloud Computing Deployment Methods

Cloud computing can be deployed in various ways, each method offering unique benefits tailored to different organizational needs and security requirements.

1. **Public Cloud:** Services are available to the general public and shared among multiple organizations. This model offers high scalability and cost efficiency but may raise security concerns for sensitive data.

- **Examples:** AWS, Google Cloud Platform, Microsoft Azure.

2. Private Cloud: Dedicated infrastructure is used exclusively by one organization, providing greater control, security, and customization. It is suitable for businesses with strict regulatory requirements or sensitive data.

- **Examples:** VMware, OpenStack, Microsoft Private Cloud.

3. **Hybrid Cloud:** Combines public and private clouds, allowing data and applications to be shared between them. This model provides flexibility and more deployment options, enabling organizations to leverage the benefits of both environments.

- **Examples:** AWS Outposts, Microsoft Azure Arc.

4. **Community Cloud:** Infrastructure is shared among several organizations with common interests (e.g., compliance requirements). It offers a collaborative environment while ensuring specific security and privacy needs are met.

- **Examples:** Cloud services tailored for healthcare or government sectors.

Implementation of Storage as a Service using Google Drive

Implementing Storage as a Service (STaaS) using Google Drive can be an effective way to store, manage, and share files over the cloud. Here's a step-by-step guide on how to set up Google Drive as a storage solution.

1. Setting Up Google Drive

- **Create a Google Account**: If you don't have a Google account, create one, as Google Drive requires an account to store data.
- **Access Google Drive**: Once signed in, navigate to Google Drive to access your storage dashboard.

2. Organizing Storage in Google Drive

- **Folder Structure**: Create a well-organized folder structure to categorize files and manage permissions efficiently.
- **Permissions**: Google Drive allows specific permissions for each file or folder (e.g., view, comment, or edit). Customize access settings for collaboration or secure storage.

3. Using Google Drive API for Automation

- **Google Cloud Console Setup**:
  1. Visit Google Cloud Console.
  2. Create a new project and enable the **Google Drive API**.
  3. Generate OAuth credentials (Client ID and Client Secret) or an API key for app integration.
- **Integration with Applications**: You can use programming languages like Python, JavaScript, or Java to connect applications with Google Drive, enabling features like file upload, download, and metadata management.

Introduction to Google Docs

Google Docs is a versatile, web-based word processor that allows users to create and edit documents online. Unlike traditional word processors, Google Docs is entirely cloud-based, which means files are saved in real-time and accessible from anywhere with internet connectivity. It enables users to share documents with others, grant permissions for editing or viewing, and collaborate without the hassle of managing multiple file versions. By integrating seamlessly with Google Drive, Google Docs supports productivity and team collaboration in both educational and professional settings.

Features of Google Docs

Google Docs offers a range of features designed to optimize productivity and streamline collaboration. Key features include:

- **Real-Time Editing:** Multiple users can work on the same document simultaneously, with changes visible instantly.

- **Commenting and Suggestions:** Users can add comments and suggest edits, making it easy to discuss and improve content collectively.

- **Version History:** A detailed version history allows users to view and revert to previous versions, ensuring that no work is lost.

- **Accessibility and Offline Mode:** Google Docs can be accessed on any device with internet connectivity, and users can also enable offline access for times without internet.

- **Integration with Google Drive:** Documents created in Google Docs are automatically stored in Google Drive, making them easy to organize, share, and access within the broader Google Workspace ecosystem.

Practical 1:

a. Create a Google Doc.

Steps:

- Open Google Drive, click New > Google Docs, and start creating your document.

Screenshot:
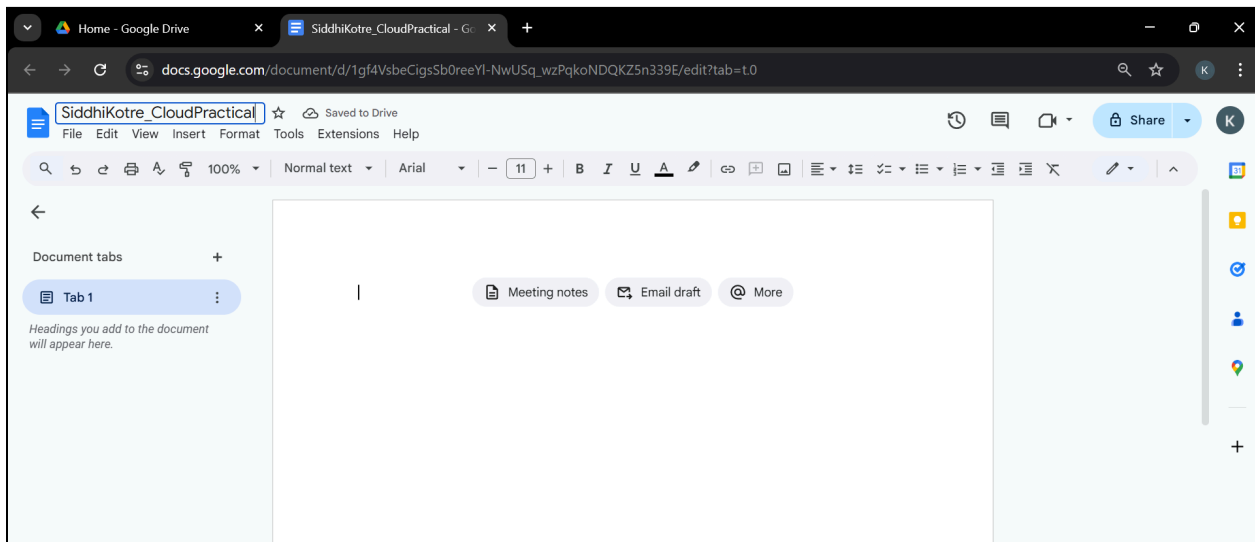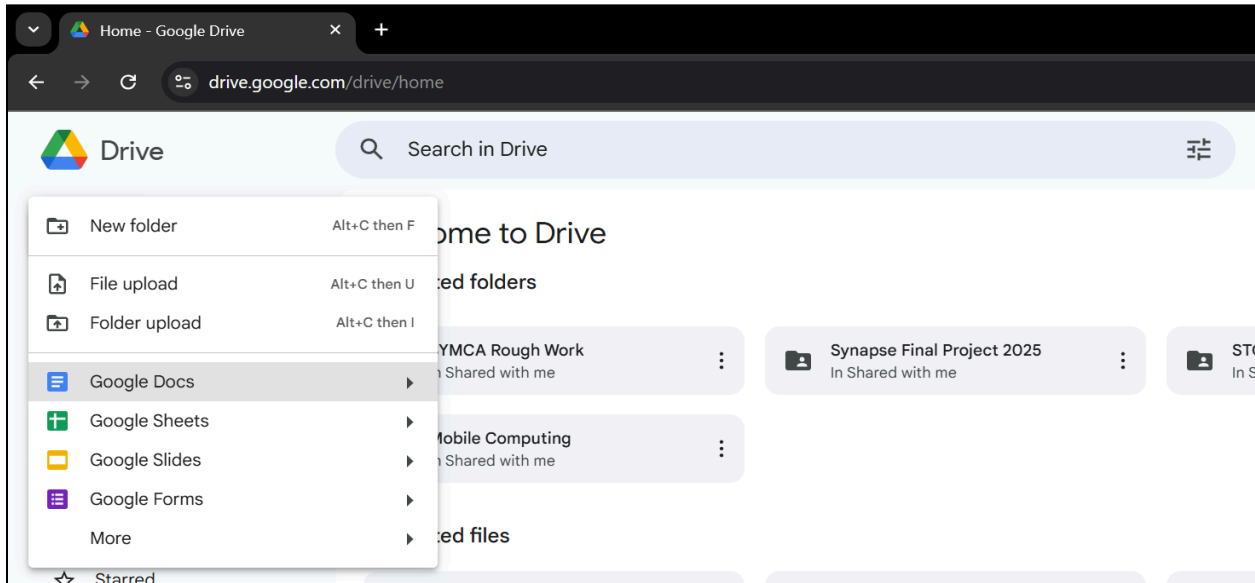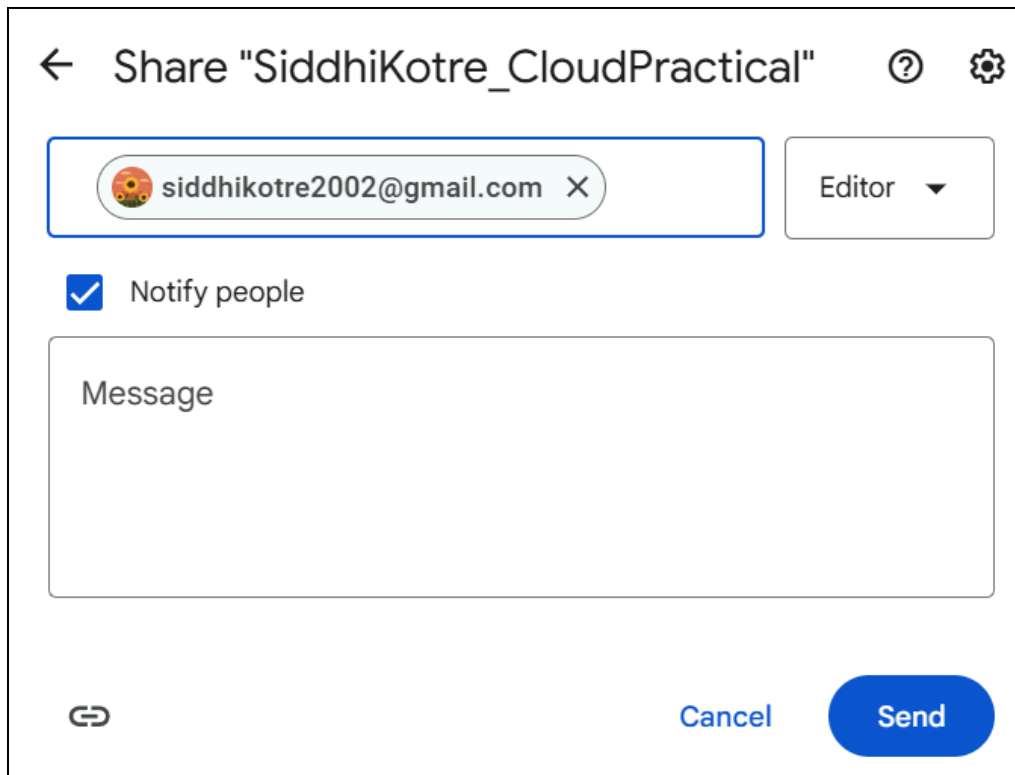
b. Configure sharing settings in Google Docs.

Steps:

- Click **Share** in Google Docs, enter email addresses, set permissions (Viewer, Commenter, or Editor), and click **Send** to share the document.

Screenshot:

← Share "SiddhiKotre_CloudPractical"

siddhikotre2002@gmail.com ✕   Editor ▾

☑ Notify people

Message

🔗   Cancel   **Send**

c. Upload a document to Google Drive (create a folder, then upload a document into the created folder).

Steps:

- In Google Drive, click **New** > **Folder**, name it, open the folder, then click **New** > **File upload** to add a document from your computer.
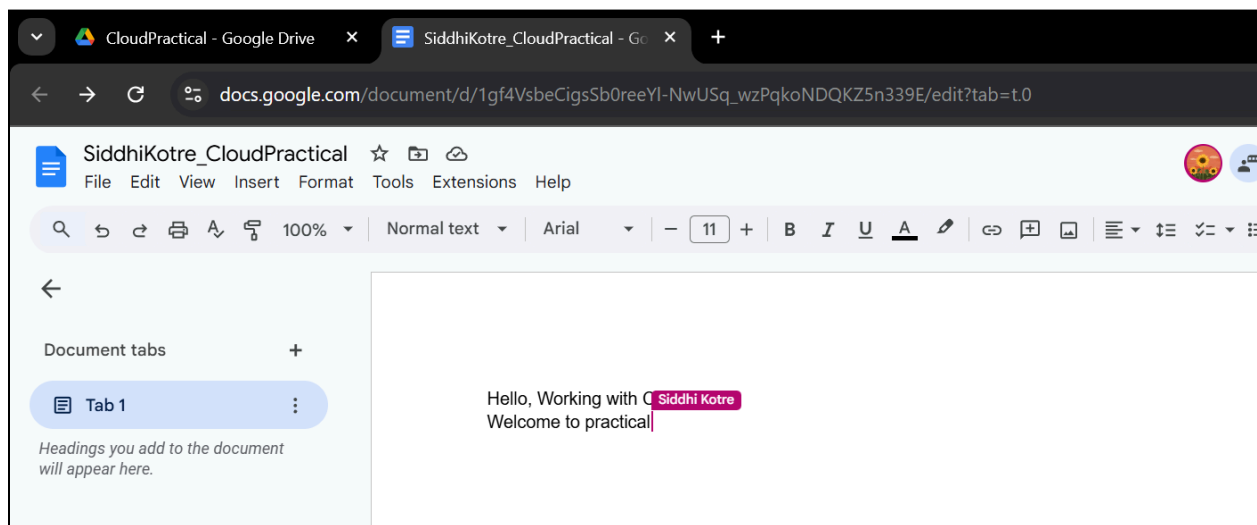
Screenshot:
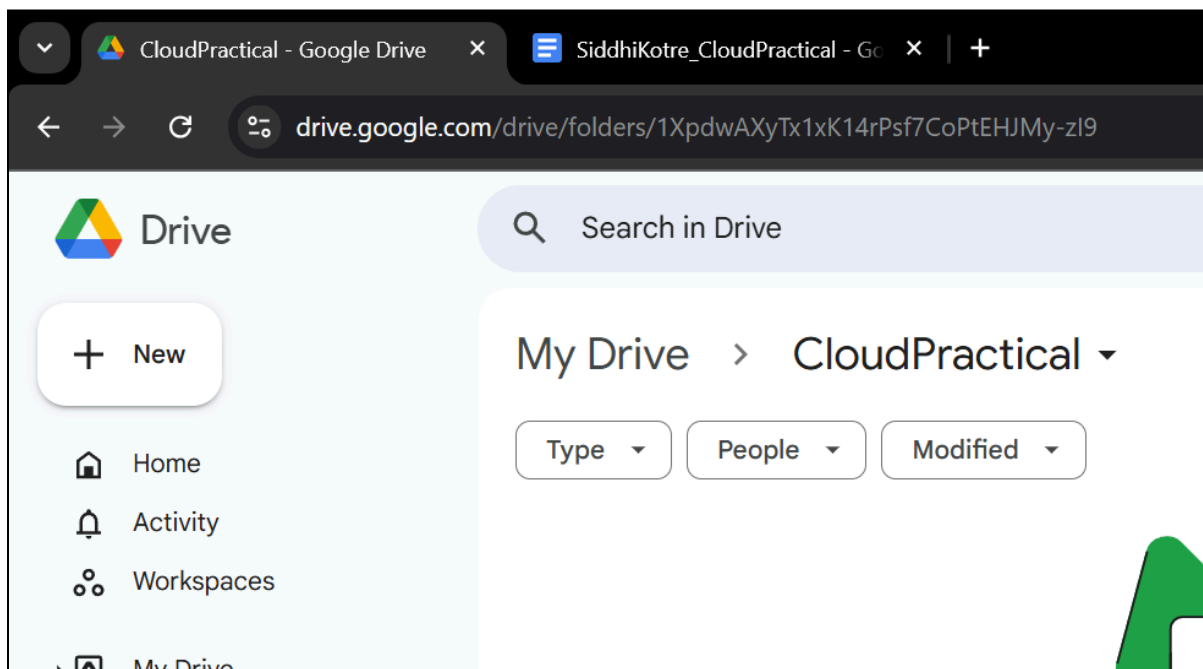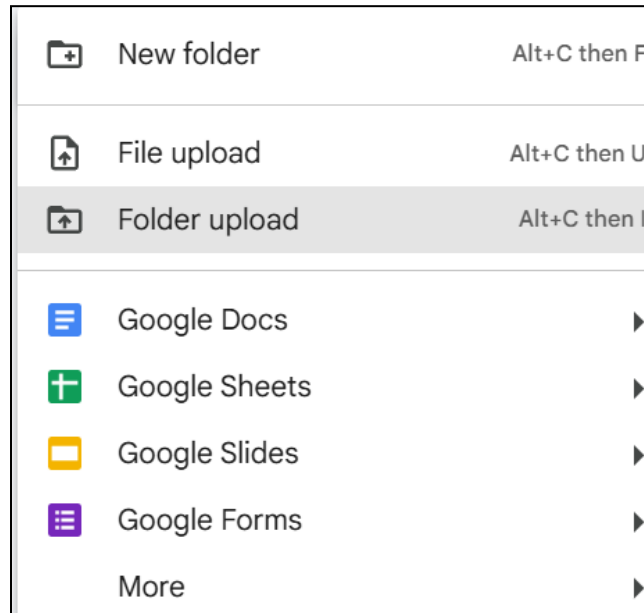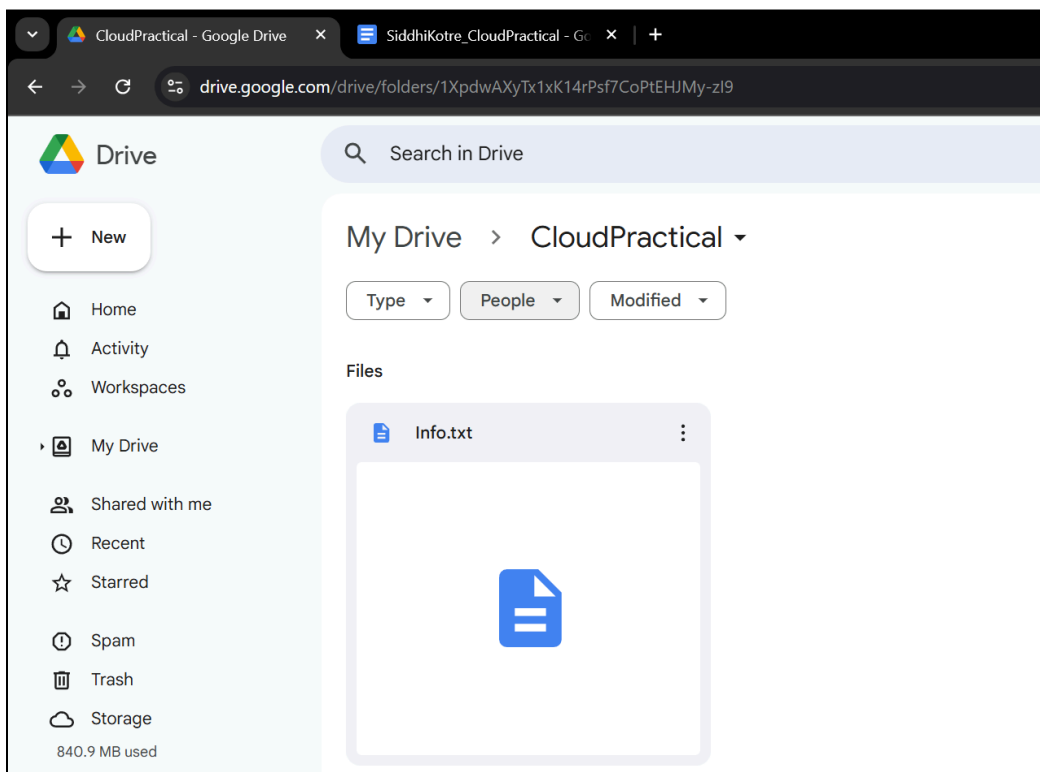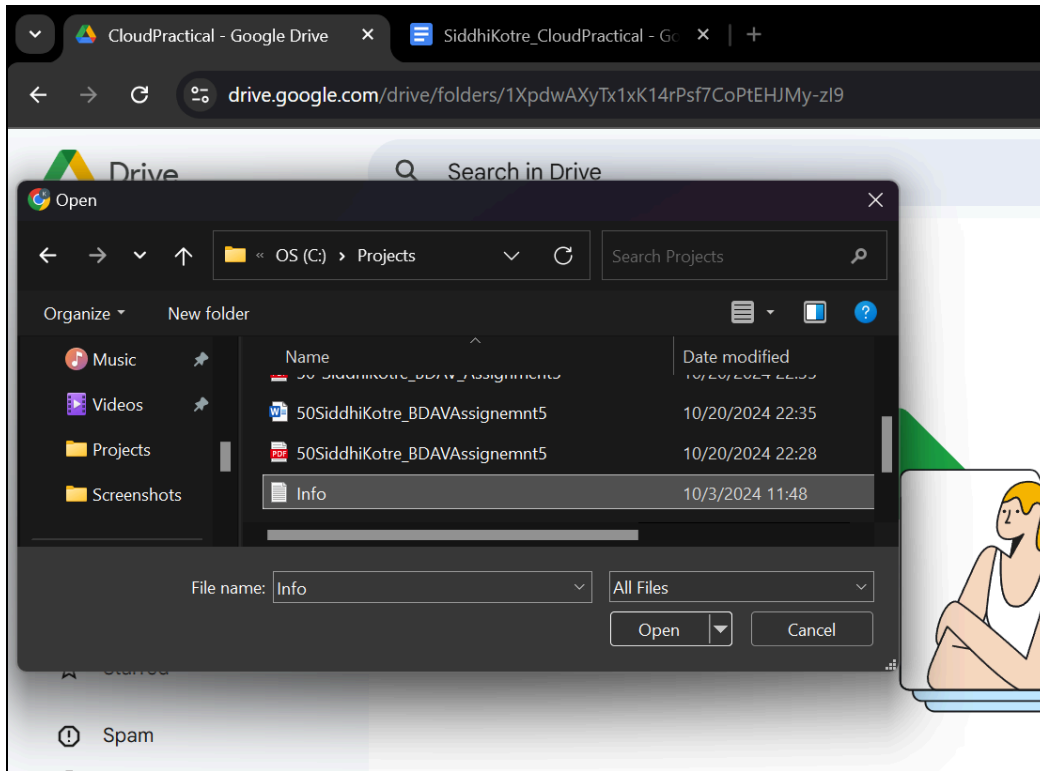
Practical 2:

a. Use real-time editing.

Steps:

- Share your Google Docs document with a collaborator, giving them Editor access, then both open the document to edit together and observe real-time updates and each other's cursors.
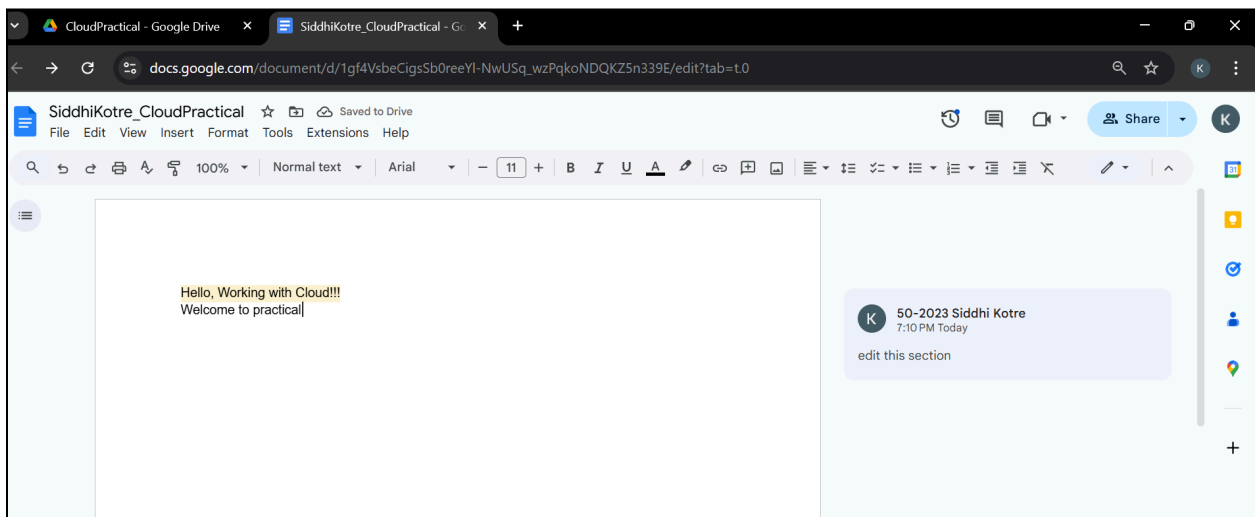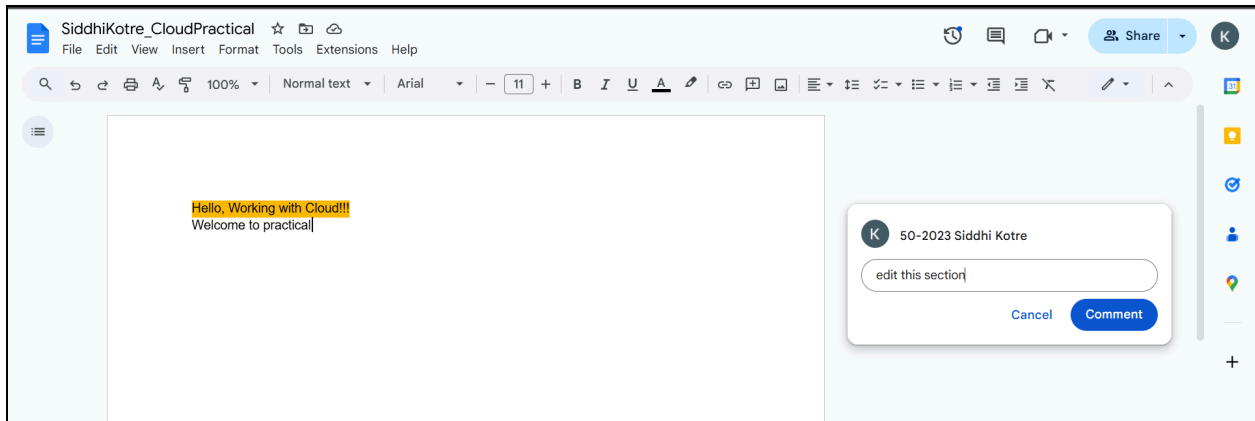
Screenshot:

b. Add comments (Insert > Comment).

Steps:

- Highlight the text, right-click and select **Comment** (or go to **Insert** > **Comment**), type your comment, and click **Comment** to post it.
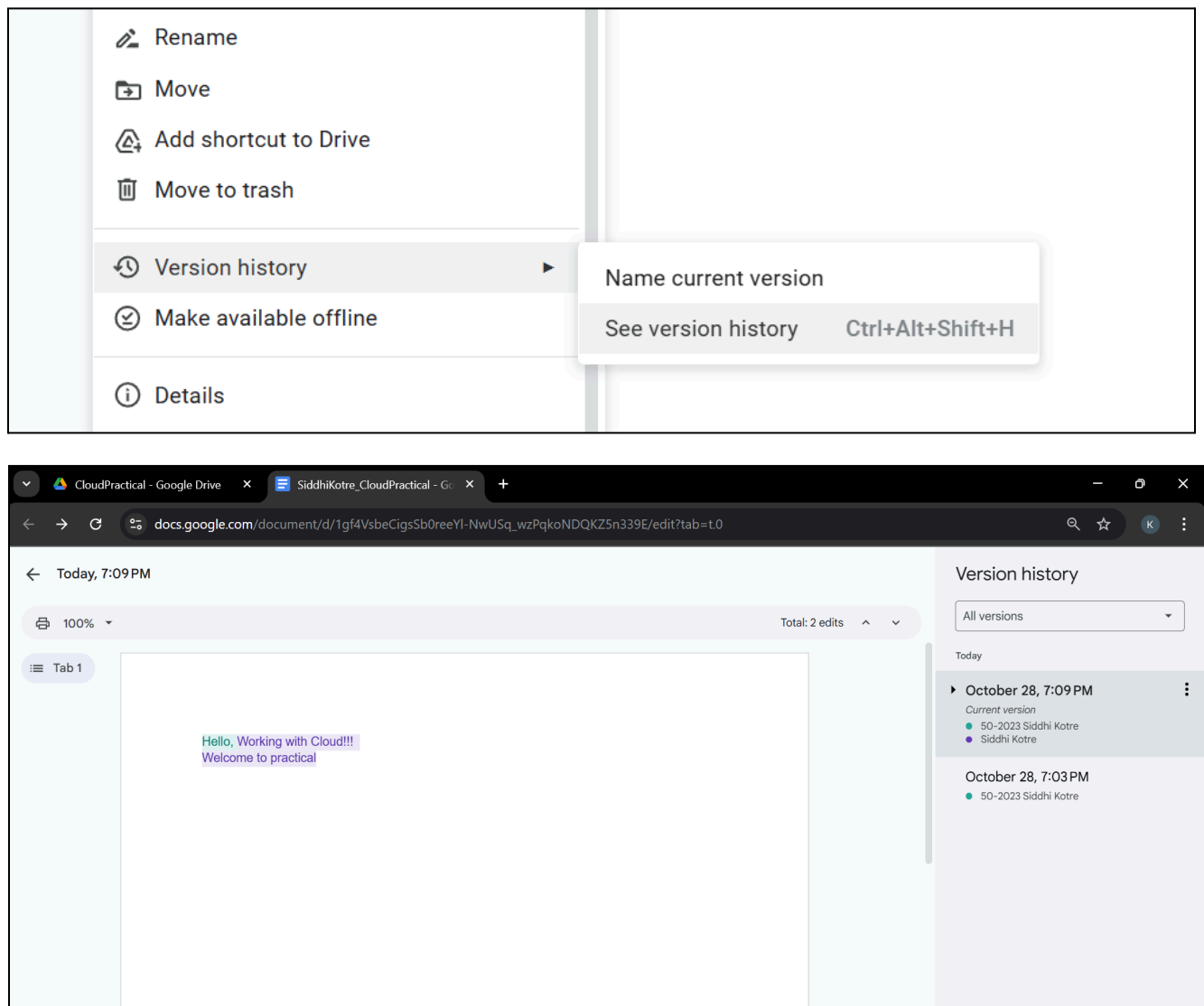
Screenshot:

c. View revision history (File > Version history > See version history, which opens a panel on the right of your document).

Steps:

- In Google Docs, go to **File** > **Version history** > **See version history** to view a panel with document versions, editor names, and timestamps, and click any version to see its changes.

Screenshot:

d. Search: Use filters in the Google Drive app to find files more easily. On your Android phone or tablet, open the Google Drive app, tap "Search Drive" at the top, select options like file types (documents, images, PDFs), enter a word or phrase in the search box, and tap "Search" on your keyboard.

Steps:

- On your Android device, open the Google Drive app, tap **Search Drive**, use the filter icon to select filters (like file type or date modified), enter a word or phrase in the search box, and tap **Search**.

Screenshot:
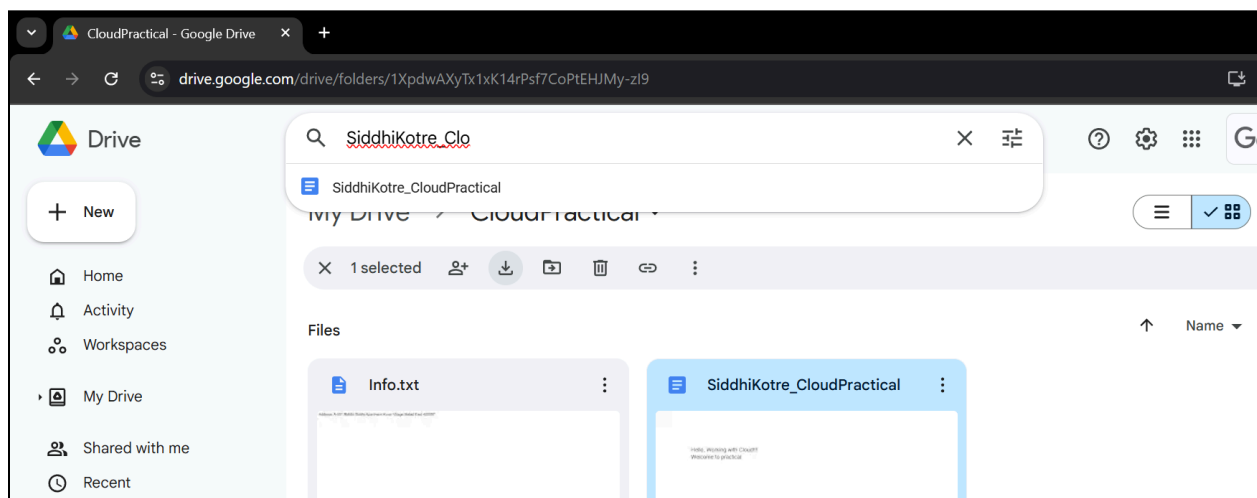
Type	PDFs ▾	✕
Owner	Anyone ▾	
Has the words	SiddhiKotre_Clo	
Item name	Enter a term that matches part of the file name	
Location	Anywhere ▾	

☐ In trash   ☐ Starred   ☐ Encrypted

Learn more   Reset   **Search**

Conclusion:

In conclusion, Google Drive provides a versatile platform for cloud storage, collaboration, and document management. Its user-friendly interface allows individuals and teams to create, share, and edit documents in real-time, enhancing productivity and communication. With features such as version history, commenting, and advanced search filters, Google Drive caters to a variety of needs, from personal projects to professional workflows. By leveraging these tools, users can streamline their work processes, ensuring efficient access to files and effective collaboration across different devices.