Cloud Computing:

cloud computing:

- It is the use of computing resources (hardware and software) that are delivered as a service over a network
- cloud services including the delivery of software, infrastructure and storage over internet.

characteristics:

1) On demand self service:
   - Users are able to provision cloud computing resources without requiring human interaction, mostly done through a web based self service portal

2) Broad network access:
   - Cloud computing resources are accessible over the network supporting heterogeneous client platforms such as mobile devices and workstations.

3) Resource pooling:
   - Provides service to multiple customers from same physical resources by securely separating the resources on logical level.

4) Rapid elasticity:
   - Resources are provisioned and released on demand.
   - This will make sure application will have exactly the capacity it needs at any point of time.

5) Measured service:
   - Resource usage are monitored, measured, and reported transparently based on utilization in short, pay for use.

Advantages:

1) Trade capital expense for variable expense:

- Instead of having to invest heavily in data centers and servers before knowing how it is going to be used, we can pay only when we consume computing resources and pay only for how much we consume.

2) Benefit from massive economics of scale.

- By using cloud computing, we can achieve a lower variable cost than we can get on our own.
- Because usage of hundreds of thousands of customers is aggregated in the cloud, providers such as AWS can achieve higher economics of scale, which translates into lower pay as-you-go prices.

3) Stop guessing capability:

Stop guessing on infrastructure capacity needs.

- It eliminates guessing on infrastructure capacity needs prior to deploying an application
- When capacity decision is made prior to deploying an application we often end up either sitting on expensive idle resources or dealing with limited capacity.
- With cc, these problems will go away.
- We can access as much as or as little capacity as we need and scale up and down as required with only few minute notice.

4) Increase speed and agility:

- In cc environment, new IT resources are only a click away which means it reduces time to make those resources available to developers from weeks to just minutes.
- This results in a dramatic increase in agility for the organization, since the cost and time it takes ~~the organization~~ to experiment and develop is significantly lower.

5) Stop spending money running and maintaining data center.

- It helps people focus on projects that differentiates business rather than infrastructure.
- cc lets people focus on their customers, rather than heavy lifting of racking, stacking and powering servers.

6) Go global in minutes.

- It helps to deploy application easily in multiple regions around world with just a few clicks.
- This means ~~people~~ provider can provide lower latency and a better experience for their customers at minimal cost.

⑧ Disadvantages:

1) Downtime: (Disaster recovery, availability of services)
- Downtime is biggest disadvantages of CC.
- CC is internet based so service outages are always an unfortunate possibility and can occur for any reason.
- Downtime can cause bad impact on business economically and no organization is immune, especially when critical business processes cannot afford to be interrupted.

2) Security (Security on every level, understand shared responsibility model of cloud ~~processes~~ providers)
- cloud hacking cases as recent as the past few months have shown that no all cloud providers are as secure as they claim to be.
- As a business, you can't afford to have sensitive info about the company or clients fall victim to hackers.
- Disadvantage → which cloud service providers to trust

3) Vulnerability to Attack (Security, security policies checked, access control)
- In CC, every component is online which exposes pontential vulnerability.
- Even best teams suffer severe attacks and security breaches time to time.
- Since CC is built as a public service, its easy to run before learning to walk.
- No cloud vendor checks administrative skills before granting accoun all it takes to get started is generally a valid credit card.

4) Costs
- Applying cloud soln.s on a small scale and for short term projects can be perceived as being expensive.
- The most significant benefit of CC is IT cost savings.
- Pay-as-you-go cloud service can provide more flexibility and lower hardware costs, but overall price tag can end up being higher.

Prevent:
- stop instances when not used
- scale down as well as up
- create alerts to track cloud spending.

5) vendor lock in (employ multi cloud strategy, build in flexibility designing app)

- another disadvantage.
- differences between vendor platforms may create difficulties in migrating from one cloud platform to another, which would equate to additional costs and configuration complexities
- Switching cloud services is something that hasn't yet completely evolved, organizations may find it difficult to migrate their services from one vendor to another

6) Limited control and flexibility (understand provider's responsibilities and your responsibilities (CSP basic level & support understand)

- Since cloud infrastructure is entirely owned, managed and monitored by service provider, it transfers minimal control over to customer
- Cloud users may find they have less control over the function and execution of services within cloud hosted infrastructure
- A cloud provider's end user license agreement (EULA) and management ~~pro~~ policies might & impose limits on what customers can do with their deployments

⊗ Risks:

1) Customers have reduced visibility and control.
- When transistroning assets to cloud, organization lose some visibility and control over those assets.
- When using external cloud services, responsibility for some of policies and infrastructure moves to CSP.

2) Data Deletion is incomplete:-
- Threat associated with data deletion exists because consumer has reduced visibility where data is physically stored in cloud and a reduced ability to verify secure deletion of their data.
- Risk is concerning because data is spread over number of different storage devices ~~of~~ with CSP's infrastructure.
- organization may not be able to verify their data was securely deleted which means remaining data can be available to attacker.

2) Credentials are lost.
- If attacker gains access to a user's credentials, attacker can have access to CSP's services to use additional resources as well as target organization's assent.
- An attacker who gains access to CSP's admin's cloud credential may use those credentials to access agency's system and data.

4) Insiden Abuse Authorized Access:
- Insiders such as staff and admins for both organizations and CSPs, who abuse their authorized access to organization's network, system and dates are uniquely positioned to cause damaged.

5) Stored Data is lost
- Data stored in cloud can be lost for reasons other than malicious attack
- Accidental detetion of data by CSP or from physical disaster, can ~~d~~ lead to permanent loss of customer's data
- Burden to avoiding data loss doesn't ~~a~~ fall solely on providers shoulder.
- Customer encrypts data before uploading to cloud but loses encryption key, data is lost.

6) Vendor lock in increases cost, time.

Q Service models:

1) Iaas (Infrastructure as a service)

- cloud computing offering in which a vendor provides users access to computing resources such as servers, storage and networking.

Features:

- Instead of purchasing hardware outright, users pay for Iaas on demand.
- Infrastructures is scalable depending on processing and storage needs.
- Saves enterprise the costs of buying and maintaining their own hardware.
- Because data is in cloud, there can be no single point of failure.
- Enables virtualization of administrative tasks, freeing up time for other work.

2) Paas (Platform As a Service)

- cloud~~ing~~ computing offering that provides user with a cloud environment in which they can develop, manage and deliver applications.

Features:

- provides platform with tools to test, develop and host application in same environment.
- Enables organization to focus on development without having to worry about underlying infrastructure.
- Providers manage OS, security, server s/w and backups.
- Facilitates collaborative work even if teams work remotely

3) Saas (Software as a Service)

- cloud computing offering that provides users with access to a vendor's cloud based software.

Features:

- Saas vendors provide user with s/w and app via subscription model.
- Users do not need to manage, install or upgrade s/w, saas manages
- Data is secure in cloud, equipment failure doesn't result in loss of data.
- Use of resources can be scaled depending on service needs.
- Applications are accessible from almost any internet connected devices

Total Cost of Ownership:

1) Recognize that total cost is comprised of a number of different cost streams:

- It is common for a cloud provider to change for amount of compute capacity, network traffic and storage.
- In addition, cloud providers offer additional services that also carry a charge.

2) Assess the mix of cloud services that application will likely to use:

- Some applications are compute intensive.
- Some are processin storage intensive.
- Understanding what services application uses to assign costs to different services will help to create clearer TCO picture.

3) Understand the role of application load:

- If load on application varies significantly, it probably will affect the number of compute instances that is being used.
- Eg. apps ~~with~~ that experience high load often scale horizontally; ie they deploy multiple instances of same functionality to reduce bottlenecks.
- Calculate TCO under a number of different app topologies to understand the cost under different loads.

4) Understand the role of load variation:

- It is likely app will experience load variation, which means at some time periods will have much larger loads than others.
- calculate TCO under different load patterns.

5) Look for accuracy, but not down to the penny and ~~defined~~ demand a significant cost advantage.

- The goal of evaluation is to develop a good understanding of cloud application TCO, but not to obsess down to last penny.
- And moving app to cloud environment imposes charge, it makes sense to demand a minimum advantage for cloud deployment to mitigate work required for cloud deployment. (20% cost ad)

⊗ Benefits of cloud computing:

1) Cost savings:
- organization doesn't need to maintain and run their data center and server
- They can use resource on demand.
- saves money.

2) Security:
- It monitor security which is better and more efficient than conventional inhouse system.
- high percentage of data theft occur internally and done by employee.
- so, it is much safer to keep data offsite.

3) Flexibility:
- It provides more flexibility overall vs. hosting on a local server
- ~~If~~ cloud based service can meet demand instantly. rather undergoing a complex and ~~so~~ expensive to update IT infrastructure.

4) Mobility:
- It allows mobile access to data via smartphones and devices.

5) Collaboration:
It facilitates collaboration of work even if team work remotely.

6) Automatic software updates and upgrade
- Users don't need to install software, apps are automatically update themselves.

7) Loss prevention:
- ~~do~~ If cc isnot used, data resides in office computer.
- If hardware experience problem, data is lost.
- If data is on cloud, loss q data is prevented & it is easily accessible.

8) set some preferences in designing interaction betn. app in private cloud and saas.

④ How do you achieve cloud Interoperability
- using integration hub for cloud. uses mature q tugo pattern ~~too~~ & EPL.
- ability q cloud to exchange and make use q info.

1) Avoid synchronous communication between cloud.
- avoid as much as possible.
- engage an acquire store resend model.
- we pay for performance penalties but avoid binding life cycles of app with life cycle q Saas.
- goal is to achieve loose coupling between clouds.

2) Monitor the connections:
- Monitor connections in integration hub at all available levels.
- Reserve a mechanism for an automated acquiring q lost q connection.

3) Pay attention to the interactions:
- Put maxm attention on semantics and ontologies q operations q data involved in interaction between q clouds.
- Info "translation" in cloud integration hub is must-have feature

4) Minimize interactions:
- keep number q interactions between clouds to minm. but use coarse-grained interfaces.

5) REST is best:
- It provides interoperability on internet.
- uses standards (HTTP, XML)
- supports all HTTP methods.
- It allows to minimize data volumes moved between clouds ~~and~~ ~~ton~~

6) Do it yourself with security.
- Donot rely on saas providers ~~on~~ regarding security.
- Protect channel to SaaS from integration hub with all security means corporate policies specify.

@ Best practices for cloud security.

1) Perform Due Diligence:

- Consumers must fully understand their networks and applications to determine how to provide functionalities, reslience and security for cloud based apps & systems.
- It must be performed across life cycle of app being deployed to cloud including planning, development and deployment, operations and decommissioning.

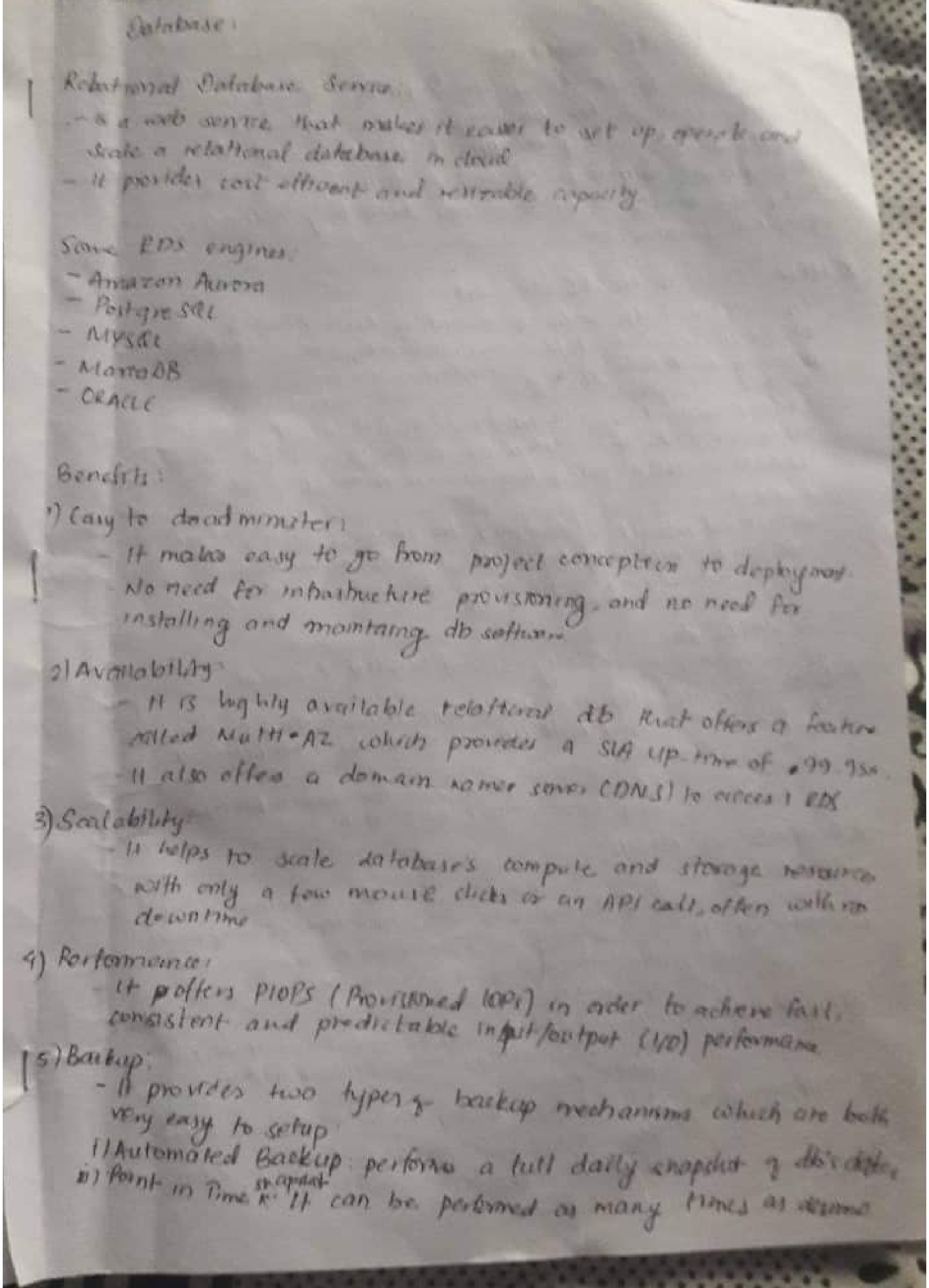
2) Managing access:

- It requires three capabilities: ability to identify and authenticate users, the ability to assign users access rights, and ability to create and enforce access control policies for resources
  - Use multifactor authentication to reduce risk of credent compromise.
  - Plan roles ~~of responsibilities~~ for ~~both all~~ both shared and consumer specific responsibilities.
    Eg: Individual developers and system managers should not have uncontrolled access to resources.
  - Each services must ~~be~~ have unique access policy

3) Protect data:

- It involves: protecting data from unauthorized access, ensuring continued access to critical data in event of errors and failures, and preventing accidental disclosure of data that was supposedly deleted.
  - Encrypt data to protect from unauthorized access.
  - Ensure Availability of critical data: backup & recovery
  - Prevent Disclosure of deleted data: data deleted securely verify.

4) Monitor and Defend: → csp monitor infrastructure & resource.
  - Monitor cloud Deployed Resources; monitor info of ~~to~~ to detect unauthorized acc
  - Analyze both cloud and on premises monitoring
  · Coordinate with CSP as csp can detect event that affect consumer's app and inform consumer.



Database:

Relational Database Service:

- Is a web service that makes it easier to set up, operate and scale a relational database in cloud
- It provides cost efficient and resizable capacity

Some RDS engines:

- Amazon Aurora
- PostgreSQL
- MySQL
- MariaDB
- ORACLE

Benefits:

1) Easy to administer:
   - It makes easy to go from project conception to deployment.
   - No need for infrastructure provisioning, and no need for installing and maintaing db software

2) Availability:
   - It is highly available relational db that offers a feature called Multi-AZ which provides a SLA up-time of .99.95%.
   - It also offers a domain name server (DNS) to access RDS

3) Scalability:
   - It helps to scale database's compute and storage resource with only a few mouse clicks or an API call, often with no downtime

4) Performance:
   - It offers PIOPS (Provisioned IOPs) in order to achieve fast, consistent and predictable input/output (I/O) performance

5) Backup:
   - It provides two types of backup mechanisms which are both very easy to setup

   i) Automated Backup: performs a full daily snapshot of db's data,

   ii) Point in Time snapshot: It can be performed as many times as desired

Ⓠ What are NoSQL databases?

- are purpose, built for specific data models and have flexible schemas for building modern application
- NoSQL db are widely recognized for their ease of development, functionality and performance at scale.
- They use variety of data models including document, graph, key-value, etc.

Ⓠ HOW does a NoSQL db work?

- In relational db, a book record is normalized & stored in separate tables and relationships are defined by primary and foreign key constraints.
- In this example,
  ↳ Book table has column for ISBN, Title & edition no.
  ↳ Author table has column for AuthorID and Author Name.
  ↳ Author - ISBN table has column AuthorID & ISBN.

~~→ Relati~~

- Relational model is designed to enable db to enforce referential integrity betn tables in db, normalized to reduce redundancy & generally optimized for storage.

- IN NOSQL db,
  ↳ Book record is usually stored in JSON document.
  ↳ For each book, the item, ISBN, Book Title, Edition Number, Author Name and AuthorID are stored as attributes in a single document
  ↳ In this model, data is optimized for dev intuitive development and horizontal scalability

Ⓠ Benefits of NoSQL:

1) Flexibility - It generally provides flexible schemas that enable faster and more iterative development.
2) Scalability - It is designed to scale out by using distributed clusters of hardware instead of scaling up by adding expensive servers.
3) High performance: It is optimized for specific data models and access patterns that enable to higher performance
4) Highly functional: It provides highly functioned APIs & data types that are purpose built for each of their respective data models.

SQL vs Non SQL db

SQL	NOSQL
1) Relational db	1) non-relational
2) table based db	2) document based, key-valued pairs or graph db
3) have predefined schemas	3) have dynamic schema for unstructured data.
4) are vertically scalable	4) are horizontally scalable.
5) uses structure query language (SQL) for defining & manipulating data.	5) uses query are focused on collection of documents.
6) SQL db are good fit for complex query intensive env	6) It is not good fit for complex queries.
7) are not best fit for ~~dt~~ hierarchical data storage.	7) better
8 Eg: MySQL, oracle, etc	Eg: MongoDB, BigTable, etc.

Gandaki College of Engineering and Science

Level: Bachelor — Final Assessment — Year : 2019

Program: BE — Time: 3 hrs. — Full Marks: 100

Course: Elective – I (Cloud Computing)

Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks.

Attempt all the questions.

1. a) What do you understand by Cloud Computing? List out some characteristics of Cloud Computing. 6BRRM — 8

   b) Describe with an architecture diagram how the end users and cloud operators design and develop the cloud platform. — 7

2. a) How do you achieve cloud interoperability? — 7

   b) Describe IAAS, SAAS, and PAAS with relevant examples. — 8

3. a) What are the things to be considered to evaluate the total cost of ownership (TCO) of a cloud computing application? — 7

   b) What are the advantages of serving your application on cloud-based servers over on premise data center? — 8

4. a) Differentiate between Object Storage and Block Storage Services. — 8

   b) How can Cloud Object Storage Service be helpful for the startups? — 7

5. a) What is Relational Database Service? What are the benefits of using an RDS instead of hosting the DB in a web server? — 8

   b) Describe NoSQL DB with an example. How does it fit for many modern applications such as mobile, web, and gaming? — 7

6. a) What is serverless architecture? How ~~can~~ cloud infrastructures can be used to run an application in a serverless environment? Give an example. — 8

   b) Mention key benefits of going serverless. — 7

7. Write short notes on (any two): — 2x5

   a) Risks of cloud computing

   b) RDS Engines

   c) Web Server