Week 7 IT Infrastructure Management

1. List the various uses of Hierarchical Storage Management.

Hierarchical storage management or HSM is a storage system that automatically moves data between tiered storage devices depending on performance requirements.

Faster storage devices such as hard disc drives are more expensive to utilize than slower devices such as SATA or magnetic tape drives.

HSM organizes storage by identifying inactive, rarely used, and frequently used data and filing it.

Accordingly, with the highest demand files being stored on faster devices and the least accessed files being archived on slower devices.

HSM provides businesses with a more economical storage system moving the bulk of data onto more affordable devices and prioritizing high-use data on hard drives, improving productivity, and device utilization.

There are many benefits of using HSM when you consider that requests from businesses for additional storage are the norm, but most of them are hosting numerous duplicate or rarely accessed files in their environment.

Here are a few ways businesses could benefit from HSM:

Free up resources:

Improving data storage across multiple devices makes the most of the resources the company already has without having to invest in new equipment.
This efficiency also frees up space on higher-speed devices so that the most vital data can be prioritized.

Save Money:
Moving the bulk of company data onto slower devices saves money on storage as this equipment is much cheaper per-byte than faster devices such as hard drives.

This is especially economical if businesses are managing large amount of data where costs can build up.

Save Time:

By simplifying data retrieval from lower level devices, time and resources can be saved when archiving and restoring information as HSM ensures these processes are automated.

Disaster Recovery:
Archiving backups on lower level devices can provide companies with a failback if data is lost or damaged on frequently used systems.

Performance optimization.

HSM frees up more expensive, high-performance storage for the workloads that need it the most.

Cost savings.
HSM systems keep as much data as possible on low-cost storage devices, saving money without sacrificing performance

Efficient resource use. The automation capabilities included in HSM systems make data retrieval faster. The tiered storage makes more efficient use of overall storage space.

Backup capabilities. HSM provides archiving capabilities on lower-level devices that can serve as data backups.

2. Explain about the space management techniques.

The system keeps tracks of the free disk blocks for allocating space to files when they are created.

Also, to reuse the space released from deleting the files, free space management becomes crucial.

The system maintains a free space list which keeps track of the disk blocks that are not allocated to some file or directory. The free space list can be implemented mainly as:

1. **Bitmap or Bit vector –**
   A Bitmap or Bit Vector is series or collection of bits where each bit corresponds to a disk block.
2. The bit can take two values: 0 and 1: *0 indicates that the block is allocated* and 1 indicates a free block.
   The given instance of disk blocks on the disk in *Figure 1* (where green blocks are allocated) can be represented by a bitmap of 16 bits as: **0000111000000110**.

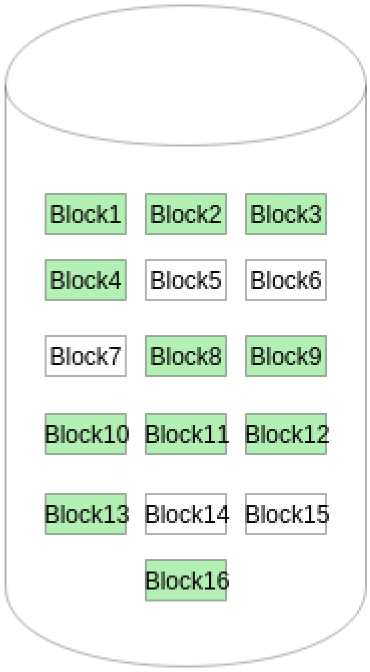


Figure - 1

Advantages –

- Simple to understand.
- Finding the first free block is efficient. It requires scanning the words (a group of 8 bits) in a bitmap for a non-zero word. (A 0-valued word has all bits 0). The first free block is then found by scanning for the first 1 bit in the non-zero word.

The block number can be calculated as:
*(number of bits per word) *(number of 0-values words) + offset of bit first bit 1 in the non-zero word* .
For the *Figure-1*, we scan the bitmap sequentially for the first non-zero word.
The first group of 8 bits (00001110) constitute a non-zero word since all bits are not 0. After the non-0 word is found, we look for the first 1 bit. This is the 5th bit of the non-zero word. So, offset = 5.
Therefore, the first free block number = 8*0+5 = 5.

3. **Linked List –**
In this approach, the free disk blocks are linked together i.e. a free block contains a pointer to the next free block. The block number of the very first disk block is stored at a separate location on disk and is also cached in memory.

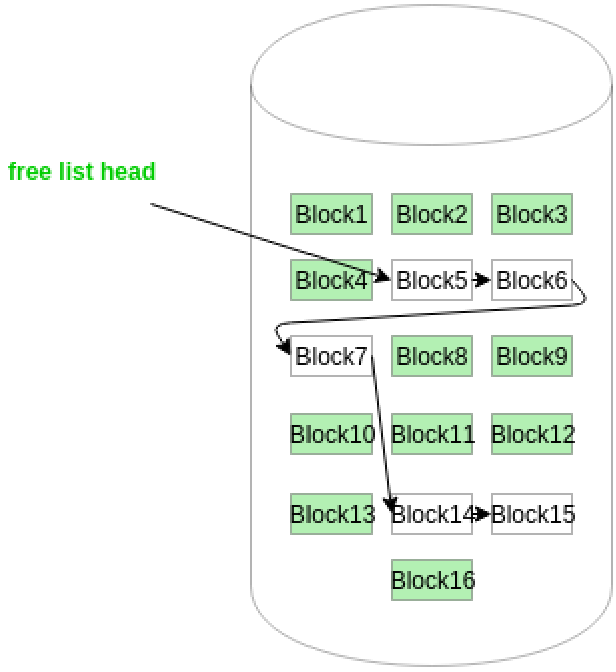


Figure - 2

In *Figure-2*, the free space list head points to Block 5 which points to Block 6, the next free block and so on. The last free block would contain a null pointer indicating the end of free list.
A drawback of this method is the I/O required for free space list traversal.

4. **Grouping –**
   This approach stores the address of the free blocks in the first free block. The first free block stores the address of some, say n free blocks. Out of these n blocks, the first n-1 blocks are actually free and the last block contains the address of next free n blocks.
   An **advantage** of this approach is that the addresses of a group of free disk blocks can be found easily.
5. **Counting –**
   This approach stores the address of the first free disk block and a number n of free contiguous disk blocks that follow the first block.
   Every entry in the list would contain:
   - Address of first free disk block
   - A number n
   -

3.Briefly explain about the hierarchy of different storage types.

A storage device hierarchy consists of a group of storage devices that have different costs for storing data, different amounts of data stored, and different speeds of accessing the data

Hierarchical storage management (HSM) is policy-based management of data files that uses storage media economically and without the user being aware of when files are retrieved from storage.

HSM automatically moves data among different storage tiers based on a defined policy.

It can be set up as a standalone system, but it is often used in distributed enterprise networks.

HSM consists of two or more types of storage media that make up the storage tiers.

At one end is a high-performance tier that is typically more expensive and accessed more frequently than the other tiers.

This tier includes storage class memory (SCM), enterprise-grade flash solid-state drives (SSDs) and high-performing hard disk drives (HDDs).

At the other end of the storage tier spectrum are slower, less expensive devices, such as optical disks and tape systems.

This tier is used for data archives and cold data. Other tiers fall in between these extremes, based on data requirements, supported workloads and how often users access the data.

hierarchical storage management work:

Each tier in the HSM hierarchy represents a different cost and performance pairing.

As a file ages and is accessed less often, the system moves it to slower and less expensive form of storage.

A file that has moved to a slower tier can be retrieved and moved back to a higher performing tier if it is needed for more critical workflows.

Administrators set data governance policies that manage how data moves among the tiers.

Once the policies are set, the HSM software manages the data itself.

HSM helps organizations make more efficient use of storage devices and lowers storage costs.

It is especially useful in large-scale environments that support massive data sets.

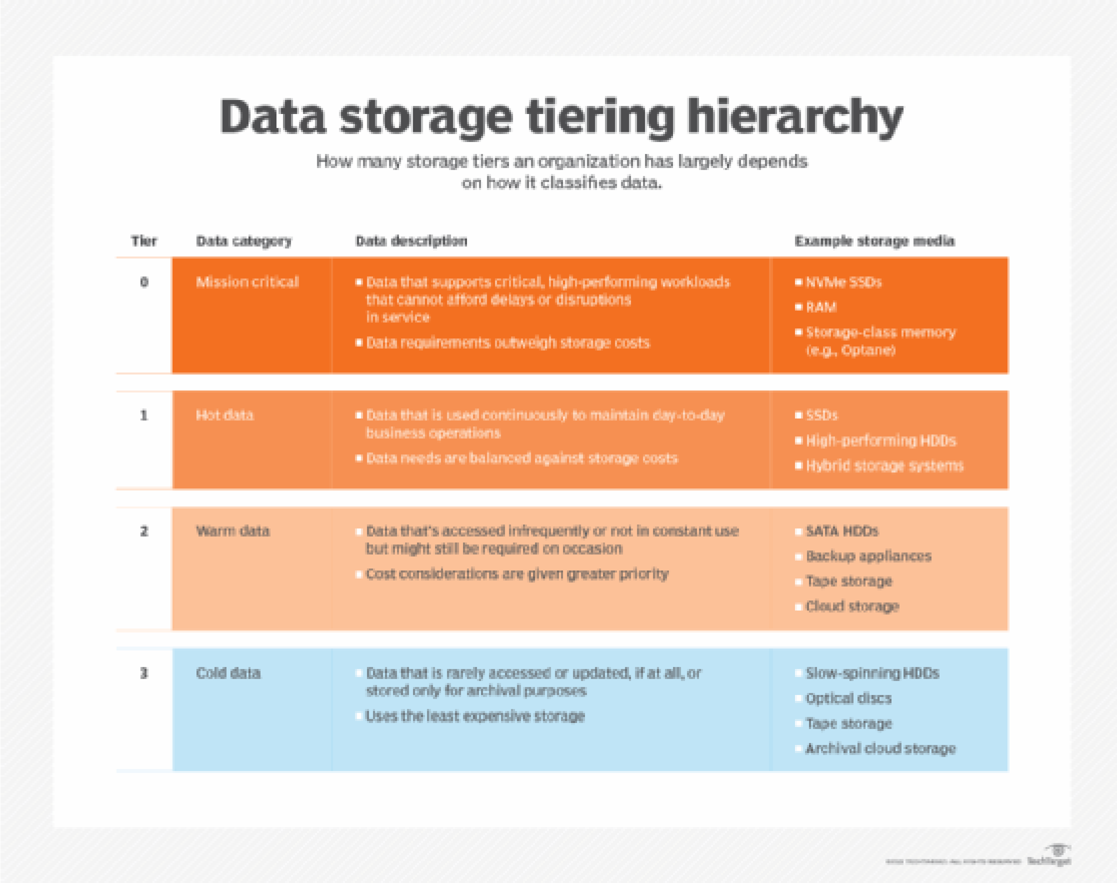
Older files can be moved to less expensive storage yet still appear to be immediately accessible. When a user tries to access the files, the HSM software restores them automatically and transparently from the lower data tier to a higher performing tier.

HSM software often uses stub files -- abbreviated representations of the original files -- to point to the real location of the files in secondary storage.

Some HSM software enables administrators to set high and low thresholds for disk capacity.

With this approach, the software determines when to move older or less-frequently accessed files to another storage medium.

In addition, administrators can usually exclude certain file types, such as executable files, from being automatically moved.



Data storage tiering hierarchy

How many storage tiers an organization has largely depends on how it classifies data.

Tier	Data category	Data description	Example storage media
0	Mission critical	■ Data that supports critical, high-performing workloads that cannot afford delays or disruptions in service ■ Data requirements outweigh storage costs	■ NVMe SSDs ■ RAM ■ Storage-class memory (e.g., Optane)
1	Hot data	■ Data that is used continuously to maintain day-to-day business operations ■ Data needs are balanced against storage costs	■ SSDs ■ High-performing HDDs ■ Hybrid storage systems
2	Warm data	■ Data that's accessed infrequently or not in constant use but might still be required on occasion ■ Cost considerations are given greater priority	■ SATA HDDs ■ Backup appliances ■ Tape storage ■ Cloud storage
3	Cold data	■ Data that is rarely accessed or updated, if at all, or stored only for archival purposes ■ Uses the least expensive storage	■ Slow-spinning HDDs ■ Optical discs ■ Tape storage ■ Archival cloud storage

4.Mention the different types of disaster? And also write about the disaster recovery management.

The most common disasters result from meteorological (weather-related) and geological events and can affect any area of the U.S.

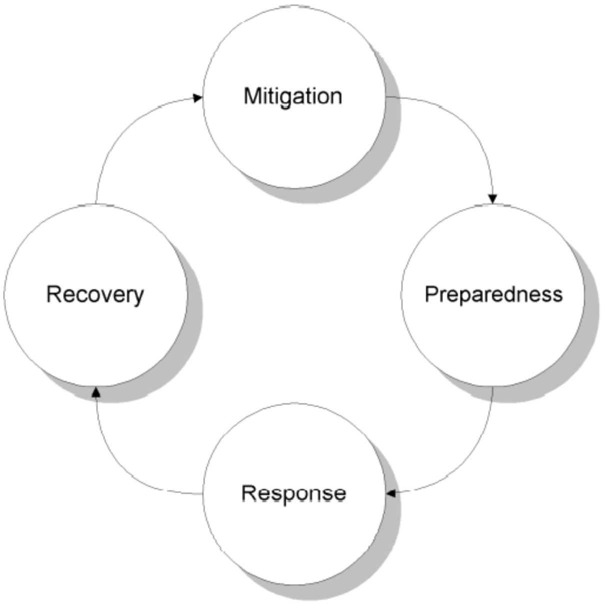
Their impact can be localized or widespread, predictable or unpredictable. Damage can range from minimal to major.

Depending on the severity of the incident, they can have a long-term impact on the infrastructure (roads, bridges, and utilities) of any location.

Four Phases of Emergency Management Emergency managers think of disasters as recurring events with four phases:

Mitigation, Preparedness, Response, and Recovery.

The following diagram illustrates the relationship of the four phases of emergency management.



The significance of the emergency management cycle is that all communities are in at least one phase of emergency management at any time.

Mitigation :

This phase includes actions taken to prevent or reduce the cause, impact, and consequences of disasters. Examples of hazard mitigation include:

- Tying down homes or barns with ground anchors to withstand wind damage
- Digging water channels to redirect water and planting vegetation to absorb water
- Constructing levees or permanent barriers to control flooding
- Reinforcing fencing to prevent animal escapes
- Buying insurance policies

Preparedness :

- This phase includes planning, training, and educational activities for events that cannot be mitigated. Examples include:
- Developing disaster preparedness plans for what to do, where to go, or who to call for help in a disaster
- Exercising plans through drills, tabletop exercises, and full-scale exercises

- Creating a supply list of items that are useful in a disaster
- Walking around a farm and identifying possible vulnerabilities to high winds

Response:

- The response phase occurs in the immediate aftermath of a disaster.
- During the response phase, business and other operations do not function normally. Personal safety and wellbeing in an emergency and the duration of the response phase depend on the level of preparedness.
- Examples of response activities include:
- Implementing disaster response plans
- Conducting search and rescue missions
- Taking actions to protect yourself, your family, your animals, and others
- Addressing public perceptions about food safety

Recovery :

- During the recovery period, restoration efforts occur concurrently with regular operations and activities. The recovery period from a disaster can be prolonged. Examples of recovery activities include:
- Preventing or reducing stress-related illnesses and excessive financial burdens
- Rebuilding damaged structures based on advanced knowledge obtained from the preceding disaster Reducing vulnerability to future disasters

5. Identify various storage devices and compare them based on their access speed and cost.

1. Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS)

Infrastructure-as-a-Service (IaaS) delivers fundamental compute, network and storage resources to consumers on-demand, over the Internet and on a pay-as-you-go basis.

Using cloud infrastructure on a pay-per-use scheme enables companies to save on the costs of acquiring, managing and maintaining their own IT infrastructure.

Plus, the cloud is easily accessible. Most major cloud service providers — including Amazon Web Services (AWS), Google Cloud, IBM Cloud and Microsoft Azure — offer IaaS with their cloud computing services.

Platform-as-a-Service (PaaS) provides customers a complete cloud platform — hardware, software and infrastructure — for developing, running and managing applications without the cost, complexity and inflexibility of building and maintaining that platform on-premises.

Organizations may turn to PaaS for the same reasons they look to IaaS; they want to increase the speed of development on a ready-to-use platform and deploy applications with a predictable and cost-effective pricing model.

2. Software-as-a-Service (SaaS)

While Software-as-a-Service (SaaS) is similar to the IaaS and PaaS uses described above, it actually deserves its own mention for the undeniable change this model has brought about in the way companies use software. SaaS offers software access online via a subscription, rather than IT teams having to buy and install it on individual systems.

SaaS providers, like Salesforce, enable software access anywhere, anytime, as long as there's an Internet connection.

These tools have opened access to more advanced tools and capabilities, like automation, optimized workflows and collaboration in real-time in various locations.

3. Hybrid cloud and multicloud

Hybrid cloud is a computing environment that connects a company's on-premises private cloud services and third-party public cloud services into a single, flexible infrastructure for running critical applications and workloads.

This unique mix of public and private cloud resources makes it easier to select the optimal cloud for each application or workload and then move the workloads freely between the two clouds as circumstances change.

With a hybrid cloud infrastructure, technical and business objectives are fulfilled more effectively and cost-efficiently than could be achieved with a public or private cloud alone.

Multicloud takes things a step further and allows organizations to use two or more clouds from different cloud providers. This type of cloud computing can include any mix of IaaS, PaaS or SaaS resources. With multicloud, workloads can be run in different cloud environments to match unique needs. This also means that companies can avoid vendor lock-in.

3. Test and development

One of the best use cases for the cloud is a software development environment.

DevOps teams can quickly spin up development, testing and production environments tailored for specific needs. This can include, but is not limited to, automated provisioning of physical and virtual machines.

To perform testing and development in-house, organizations must secure a budget and set up the testing environment with physical assets. Then comes the installation and configuration of development platform.

All this can often extend the time it takes for a project to be completed and stretch out the milestones. Cloud computing speeds up this process with cloud-based development tools that make creating apps and software faster, easier and more cost-effective.
One of the top benefits of cloud computing is how it facilitates the DevOps process, CI/CD pipelines, and cloud-native advancements (e.g., microservices, serverless and containerization).

These technologies have led to rapid acceleration and innovation, but also require a self-sustaining cloud infrastructure to support the hundreds of services.

has always been a complex and time-consuming operation. Cloud-based backup, while not being the panacea, is certainly a far cry from what it used to be. Organizations can now automatically dispatch data to any location with the assurance that neither security, availability, nor capacity are issues.

While these top seven uses of cloud computing are not exhaustive, it shows the clear incentives for using the cloud to increase IT infrastructure flexibility, while also making the most of big data analytics, mobile computing and emerging technologies.

1. Big data analytics

By leveraging the computing power of cloud computing, companies can gain powerful insights and optimize business processes through big data analytics.
There is a massive amount of data collected each day from corporate endpoints, cloud applications and the users who interact with them.

Cloud computing allows organizations to tap into vast quantities of both structured and unstructured data available to harness the benefit of extracting business value.

Retailers and suppliers are now extracting information derived from consumers' buying patterns to target their advertising and marketing campaigns to a particular segment of the population.

Social networking platforms are providing the basis for analytics on behavioral patterns that organizations are using to derive meaningful information.

Businesses like these and more are also able to harness deeper insights through machine learning (ML) and artificial intelligence (AI), two capabilities made possible with cloud computing.

6. Cloud storage

Cloud data storage enables files to be automatically saved to the cloud, and then they can be accessed, stored and retrieved from any device with an Internet connection.

Rather than maintaining their own data centers for storage, organizations can only pay for the amount of cloud storage they are actually consuming and do so without the worries of overseeing the daily maintenance of the storage infrastructure. The

result is higher availability, speed, scalability and security for the data storage environment.

In situations where regulations and concerns about sensitive data are at play, organizations can store data either on- or off-premises, in a private or hybrid cloud model, for added security.

6. List any four natural disaster and suggest some ideas on how to overcome those effects when you setup an IT based office.
Any 3.

Disaster recovery and data backup:

Yet another benefit derived from using cloud is the cost-effectiveness of a disaster recovery (DR) solution that provides for faster recovery from a mesh of different physical locations at a much lower cost than a traditional DR site.

Building a DR site and testing a business continuity plan can be an extremely expensive and time-consuming task with fixed assets. When built in the cloud, however, organizations can replicate their production site and constantly replicate data and configuration settings, saving considerable time and resources.

· Natural disaster
Smog, flood, hurricane, fire, earthquake
· Manmade disaster
Virus, walkouts, accidents, intrusion, burglary
Disaster Recovery Planning
Also referred as
· Business Process Contingency Plan (BPCP)
· Disaster Recovery Plan (DRP)
Describes strategies
fight against potential disaster and deals with analysis of business processes and
continuity.

Includes
• Planning for recommendation of data, hardware, application, communication andreputation protection
• Planning for non-IT related aspects such as facilities, key personnel and reputation,protection

• Execution of DRP –Minimizes the effect of a disaster

Testing Disaster Recovery Plan
Walk-Through
Members of the key business units meet to trace through the steps of the plan

Find all or some omissions and inaccuracies

Simulation

Mimicking the response to a true emergency as closely as possible

Includes meeting of critical personnel to perform ‘dry run ‘of the emergency Checklist

Check critical task for which they are responsible and estimate the accuracy of the
checklist – this is the first step towards comprehensive test.

Parallel testing

Backup processing occurs in parallel with production service – never stops
Run in parallel with the existing system until the new system proves to be stable
Example
Installation of new payroll system by a company until new system is ready

Full interruption

Production system are stopped to see the performance of the backup services

Space Management

identifies and moves low-activity and inactive files to the hierarchy of storage.

Storage manager uses Hierarchical Storage Management (HSM) techniques
To migrate automatically and transparently -unused or infrequently accessed data files from local online storage to offline storage managed by a server

This migration help administrators and users from time-consuming manual file-pruning tasks, stretch the usability of a given amount of online storage space for a longer period reduce the overall cost of retaining large numbers of (easily retrievable) data files for long periods