UNIT NINE:

Virtualization and Cloud Computing

Data Backup and Disaster Recovery

UNIT EIGHT – VIRTUALIZATION AND CLOUD COMPUTING

DATA BACKUP AND DISASTER RECOVERY

This unit discusses concept of Virtualization and Cloud Computing. Virtualization translates to creating a virtual counterpart of an existing system such as a desktop, server, network resource or an operating system. Cloud computing means that instead of all the computer hardware and software you're using sitting on your desktop, or somewhere inside your company's network, it's provided for you *as a service* by another company and accessed over the Internet, usually in a completely seamless way. This also introduces backup and data recovery concepts and why it important to an organization.

Essential Questions:

- How do Virtualization and Cloud Computing work?
- What are the advantages and disadvantages of implementing the technology?
- Why do we need to implement an effective data backup and recovery system?

Intended Learning Outcomes:

- Understand the concept of virtualization and cloud computing.
- Implement and design an effective backup and disaster recovery plan.

Diagnostic Assessment Task:

Please answer the question by placing a check mark on the YES/NO column.

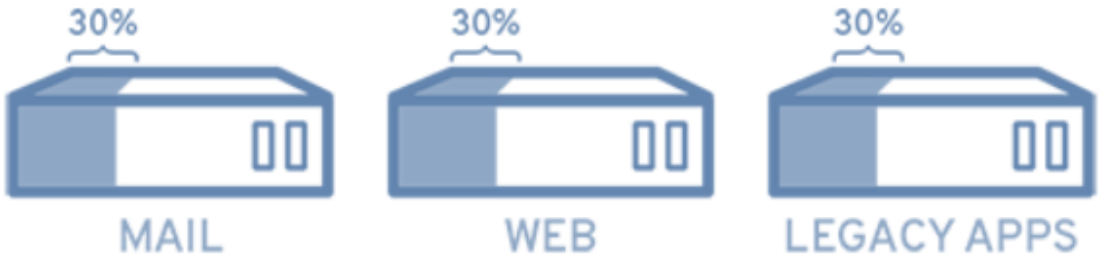
Question	YES	NO
Do you have knowledge on Virtualization?		
Have you used a desktop virtualization software?		
Do you have knowledge on Cloud Computing?		
Do you do regular backup of files on your computer/laptop?		
If yes, how do you do your backup?		

LESSON:

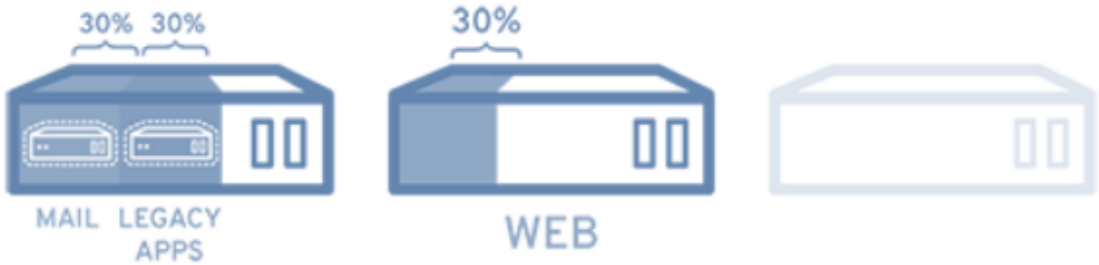
What is virtualization?

Virtualization is technology that lets you create useful IT services using resources that are traditionally bound to hardware. It allows you to use a physical machine's full capacity by distributing its capabilities among many users or environments.

In more practical terms, imagine you have 3 physical servers with individual dedicated purposes. One is a mail server, another is a web server, and the last one runs internal legacy applications. Each server is being used at about 30% capacity—just a fraction of their running potential. But since the legacy apps remain important to your internal operations, you have to keep them and the third server that hosts them, right?



Traditionally, yes. It was often easier and more reliable to run individual tasks on individual servers: 1 server, 1 operating system, 1 task. It wasn't easy to give 1 server multiple brains. But with virtualization, you can split the mail server into 2 unique ones that can handle independent tasks so the legacy apps can be migrated. It's the same hardware, you're just using more of it more efficiently.



Keeping security in mind, you could split the first server again so it could handle another task—increasing its use from 30%, to 60%, to 90%. Once you do that, the now empty servers could be reused for other tasks or retired altogether to reduce cooling and maintenance costs.

A brief history of virtualization

- While virtualization technology can be sourced back to the 1960s, it wasn't widely adopted until the early 2000s .

- The technologies that enabled virtualization—like hypervisors—were developed decades ago to give multiple users simultaneous access to computers that performed batch processing.
- But, over the next few decades, other solutions to the many users/single machine problem grew in popularity while virtualization didn't. One of those other solutions was time-sharing, which isolated users within operating systems—inadvertently leading to other operating systems like UNIX, which eventually gave way to Linux. All the while, virtualization remained a largely unadopted, niche technology.
- Fast forward to the the 1990s. Most enterprises had physical servers and single-vendor IT stacks, which didn't allow legacy apps to run on a different vendor's hardware. As companies updated their IT environments with less-expensive commodity servers, operating systems, and applications from a variety of vendors, they were bound to underused physical hardware—each server could only run 1 vendor-specific task.

How does virtualization work?

Software called hypervisors separate the physical resources from the virtual environments—the things that need those resources. Hypervisors can sit on top of an operating system (like on a laptop) or be installed directly onto hardware (like a server), which is how most enterprises virtualize. Hypervisors take your physical resources and divide them up so that virtual environments can use them.

Resources are partitioned as needed from the physical environment to the many virtual environments. Users interact with and run computations within the virtual environment (typically called a guest machine or virtual machine). The virtual machine functions as a single data file. And like any digital file, it can be moved from one computer to another, opened in either one, and be expected to work the same.

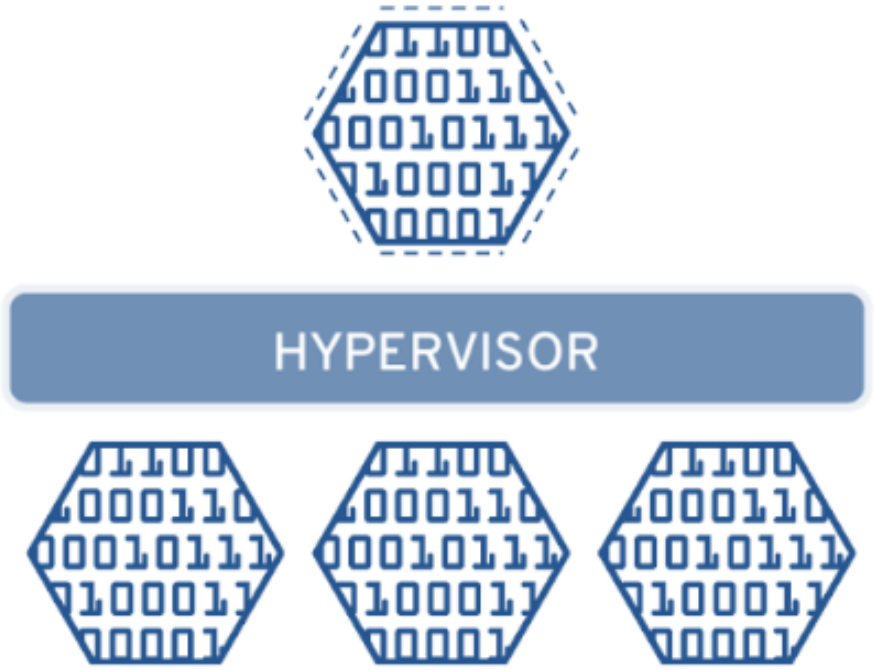
When the virtual environment is running and a user or program issues an instruction that requires additional resources from the physical environment, the hypervisor relays the request to the physical system and caches the changes—which all happens at close to native speed (particularly if the request is sent through an open source hypervisor based on KVM, the Kernel-based Virtual Machine).

Types of virtualization

- Data virtualization
- Desktop virtualization
- Operating System virtualization
- Network functions virtualization

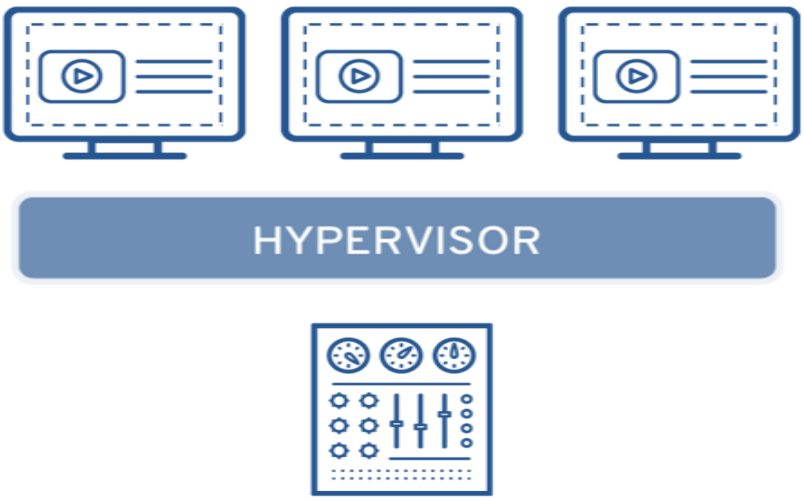
Data virtualization

Data that's spread all over can be consolidated into a single source. Data virtualization allows companies to treat data as a dynamic supply—providing processing capabilities that can bring together data from multiple sources, easily accommodate new data sources, and transform data according to user needs. Data virtualization tools sit in front of multiple data sources and allows them to be treated as single source, delivering the needed data—in the required form—at the right time to any application or user.



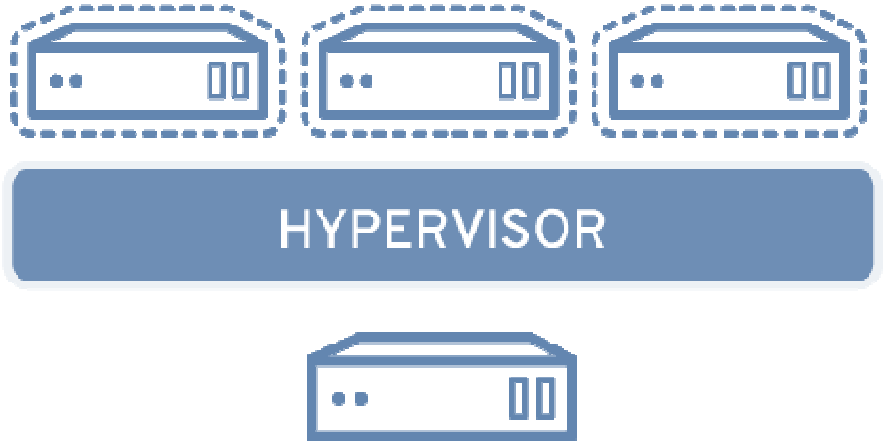
Desktop virtualization

Easily confused with operating system virtualization—which allows you to deploy multiple operating systems on a single machine—desktop virtualization allows a central administrator (or automated administration tool) to deploy simulated desktop environments to hundreds of physical machines at once. Unlike traditional desktop environments that are physically installed, configured, and updated on each machine, desktop virtualization allows admins to perform mass configurations, updates, and security checks on all virtual desktops.



Server virtualization

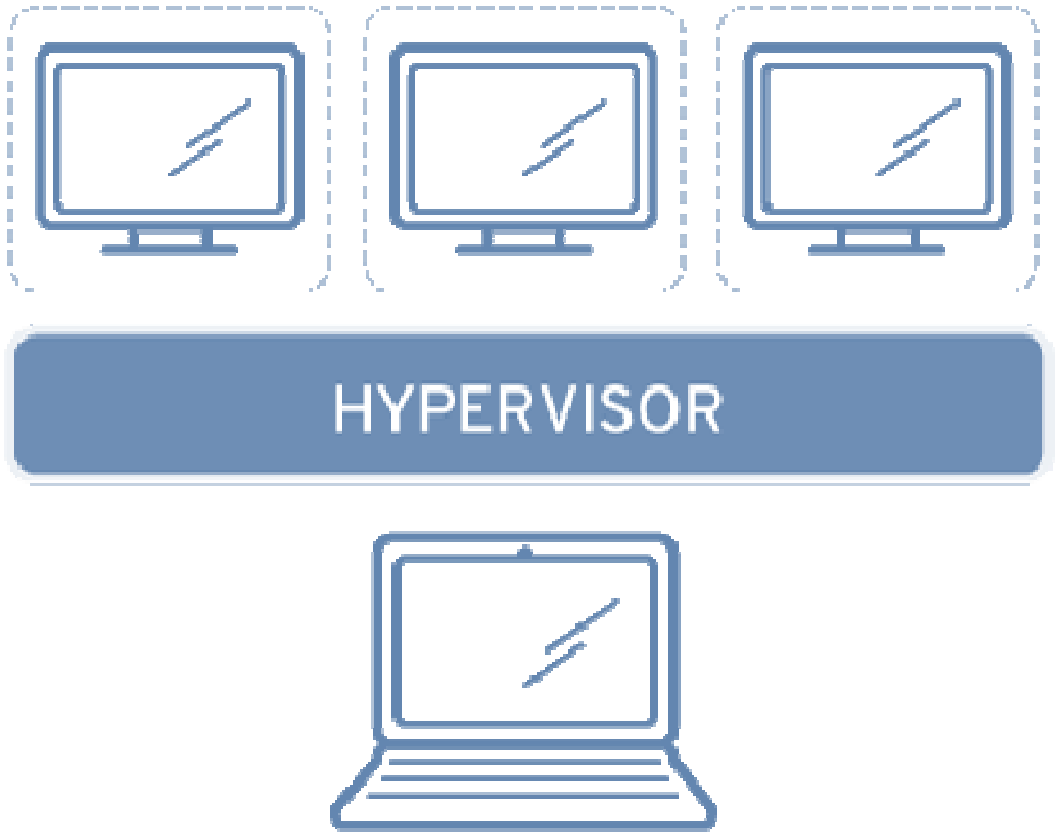
Servers are computers designed to process a high volume of specific tasks really well so other computers—like laptops and desktops—can do a variety of other tasks. Virtualizing a server lets it to do more of those specific functions and involves partitioning it so that the components can be used to serve multiple functions.



Operating system virtualization

Operating system virtualization happens at the kernel—the central task managers of operating systems. It's a useful way to run Linux and Windows environments side-by-side. Enterprises can also push virtual operating systems to computers, which:

- Reduces bulk hardware costs, since the computers don't require such high out-of-the-box capabilities.
- Increases security, since all virtual instances can be monitored and isolated.
- Limits time spent on IT services like software updates.


HYPERVISOR

CLOUD COMPUTING OVERVIEW

Cloud Computing provides us means of accessing the applications as utilities over the Internet. It allows us to create, configure, and customize the applications online.

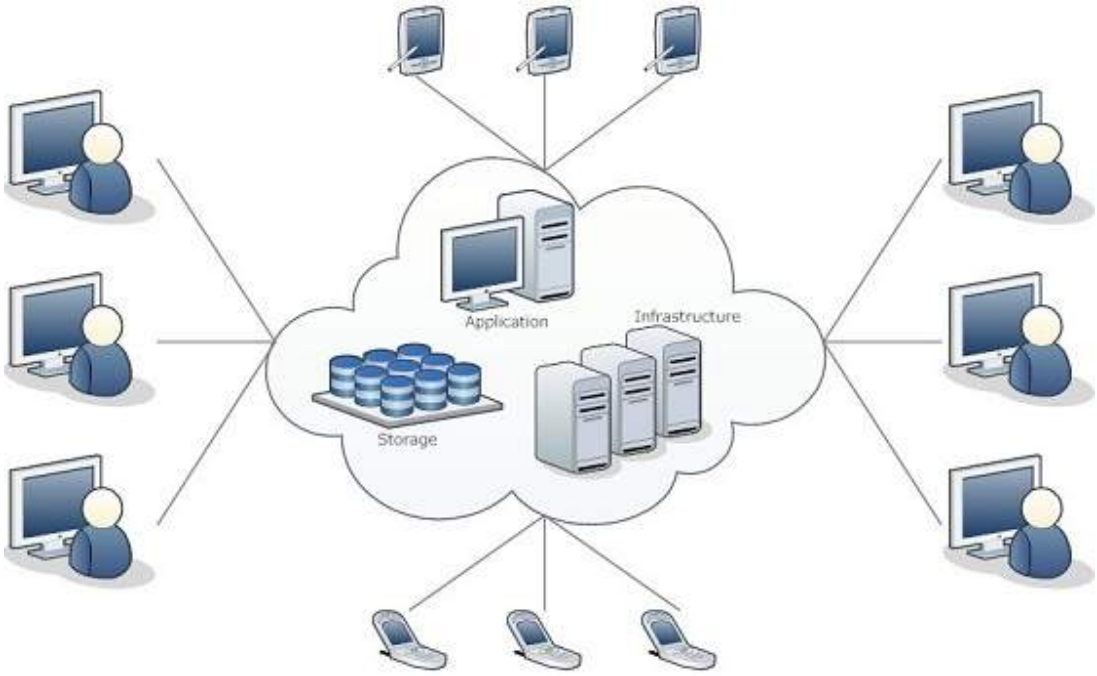
What is Cloud?

The term **Cloud** refers to a **Network** or **Internet.** In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over public and private networks, i.e., WAN, LAN or VPN.

Applications such as e-mail, web conferencing, customer relationship management (CRM) execute on cloud.

What is Cloud Computing?

Cloud Computing refers to **manipulating, configuring,** and **accessing** the hardware and software resources remotely. It offers online data storage, infrastructure, and application.



Cloud computing offers **platform independency,** as the software is not required to be installed locally on the PC. Hence, the Cloud Computing is making our business applications **mobile** and **collaborative.**

Types of cloud computing

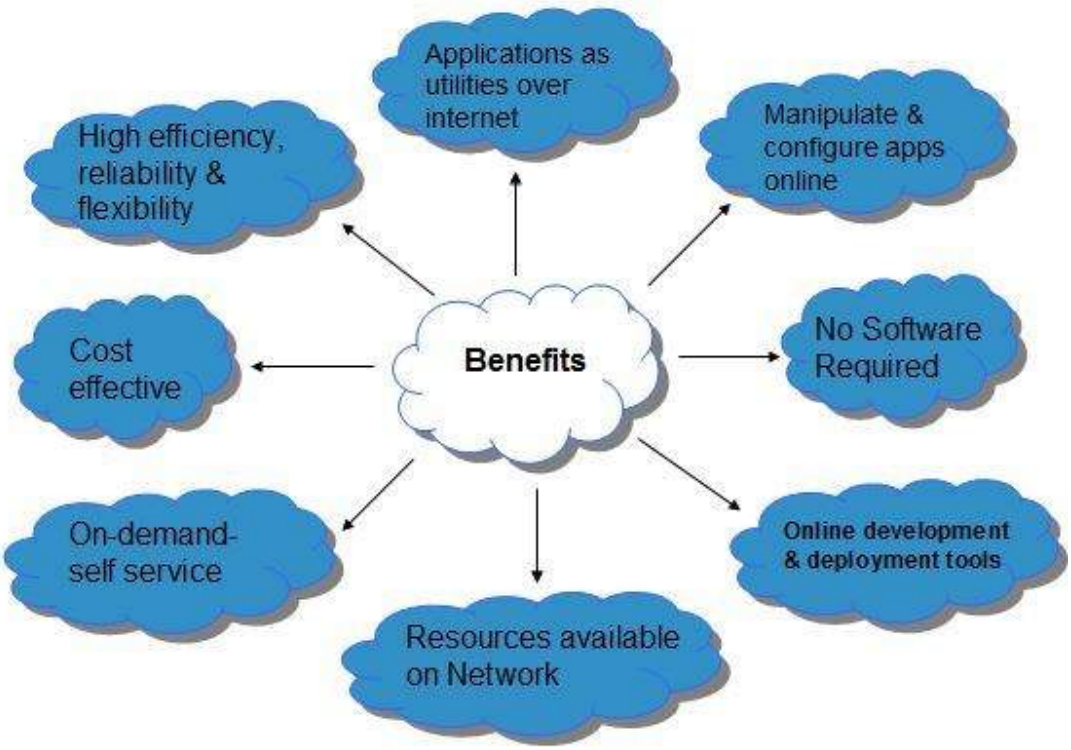
IT people talk about three different kinds of cloud computing, where different services are being provided for you. Note that there's a certain amount of vagueness about how these things are defined and some overlap between them.

- **Infrastructure as a Service (IaaS)** means you're buying access to raw computing hardware over the Net, such as servers or storage. Since you buy what you need and pay-as-you-go, this is often referred to as utility computing. Ordinary web hosting is a simple example of IaaS: you pay a monthly subscription or a per-megabyte/gigabyte fee to have a hosting company serve up files for your website from their servers.
- **Software as a Service (SaaS)** means you use a complete application running on someone else's system. Web-based email and Google Documents are perhaps the best-known examples. Zoho is another well-known SaaS provider offering a variety of office applications online.
- **Platform as a Service (PaaS)** means you develop applications using Web-based tools so they run on systems software and hardware provided by another company. So, for example, you might develop your own ecommerce website but have the whole thing, including the shopping cart, checkout, and payment mechanism running on a merchant's server. App Cloud (from salesforce.com) and the Google App Engine are examples of PaaS.

Benefits

Cloud Computing has numerous advantages. Some of them are listed below -

- One can access applications as utilities, over the Internet.
- One can manipulate and configure the applications online at any time.
- It does not require to install a software to access or manipulate cloud application.
- Cloud Computing offers online development and deployment tools, programming runtime environment through PaaS model.
- Cloud resources are available over the network in a manner that provide platform independent access to any type of clients.
- Cloud Computing offers on-demand self-service. The resources can be used without interaction with cloud service provider.
- Cloud Computing is highly cost effective because it operates at high efficiency with optimum utilization. It just requires an Internet connection
- Cloud Computing offers load balancing that makes it more reliable.



Risks related to Cloud Computing

Although cloud Computing is a promising innovation with various benefits in the world of computing, it comes with risks. Some of them are discussed below:

Security and Privacy

It is the biggest concern about cloud computing. Since data management and infrastructure management in cloud is provided by third-party, it is always a risk to handover the sensitive information to cloud service providers.

Although the cloud computing vendors ensure highly secured password protected accounts, any sign of security breach may result in loss of customers and businesses.

Lock In

It is very difficult for the customers to switch from one Cloud Service Provider (CSP) to another. It results in dependency on a particular CSP for service.

Isolation Failure

This risk involves the failure of isolation mechanism that separates storage, memory, and routing between the different tenants.

Management Interface Compromise

In case of public cloud provider, the customer management interfaces are accessible through the Internet.

Insecure or Incomplete Data Deletion

It is possible that the data requested for deletion may not get deleted. It happens because either of the following reasons

- Extra copies of data are stored but are not available at the time of deletion
- Disk that stores data of multiple tenants is destroyed.

BACKUP AND DISASTER RECOVERY

The threats to computers and communications systems…

- Errors and Accidents
- Natural and Other Hazards
- Crimes Against Information Technology
- Crimes Using Information Technology
- Virus

Errors and Accidents

In general, errors and accidents in computer systems may be classified as People Errors, Procedural Errors, Software Errors, Electromechanical Problems, and "Dirty Data" problems.

People Errors

Recall that one part of computer system is the people who manage it or run it.

Procedural Errors

Some spectacular computer failures have occurred because someone didn't follow procedures.

Software Errors

We are forever hearing about "Software Glitches" or software bugs. A Software Bug is an error in a program that causes it to malfunction.

Electromechanical Problems

Absence of Electricity or power failure causing the system not to work

Importance of System Backups

- **Which Files Should Be Backed Up?**
  - OS Binaries?
  - Applications?
  - Configuration Files?

- User files?
- Log files?
    - Generally, full backups of everything are easiest to manage, but backup of system files is creating extra work for yourself.
        - Possibly full dump when installed, then again after patches/upgrades.
    - Backup of just user files is not enough.
    - Should dump the log files, and configuration information.

Backup Procedure

- To prevent against data loss, computer users should have backup procedures
- A backup is a copy of information stored on a computer.
- Additional resources or duplicate copies of data on different storage media for emergency purposes.
- Backup procedures specify a regular plan of copying and storing key data and programs files

Backup Devices

- **Backup devices must exhibit the following traits:**
    - User ability to write data to the device.
    - Media capable of storing the data for long periods.
    - Support of standard system interconnects.
    - Support of reasonable input/output throughput.

Backup Devices

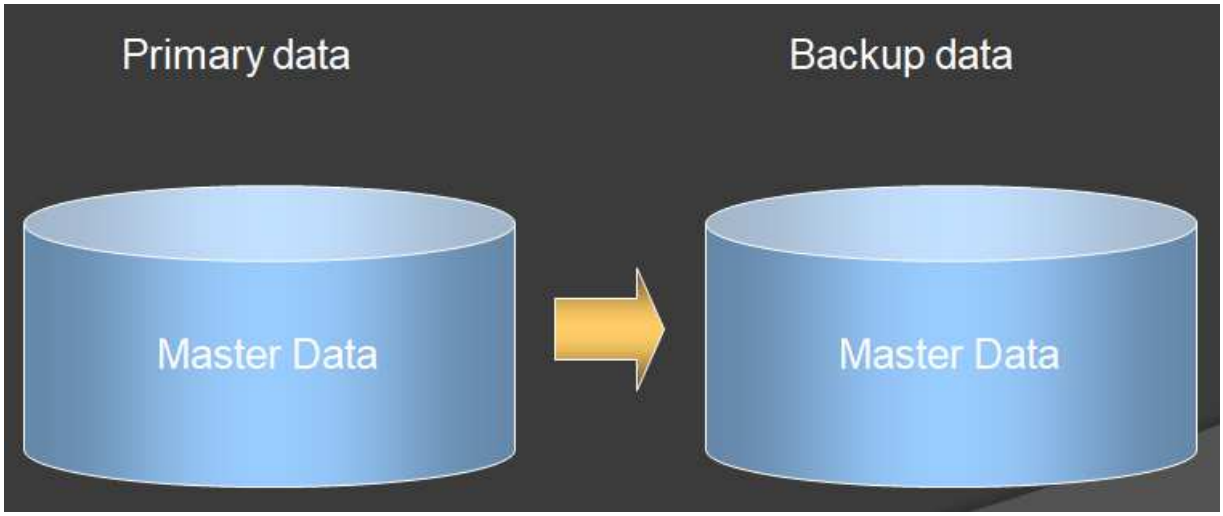
- Tape Backup Devices
    - Cartridge Tape Drive
    - 8-mm Tape Drive
    - Digital Audio Tape Drive
    - Linear Tape Open
    - Digital Linear Tape
- Optical Backup Devices
- Disk Systems As Backup Devices
    - RAID Disk Arrays
    - Problems with Disks As Backup Devices
    - High-Density Removable Media Backups

Backup types

- Full backup
- Differential backup
- Incremental backup

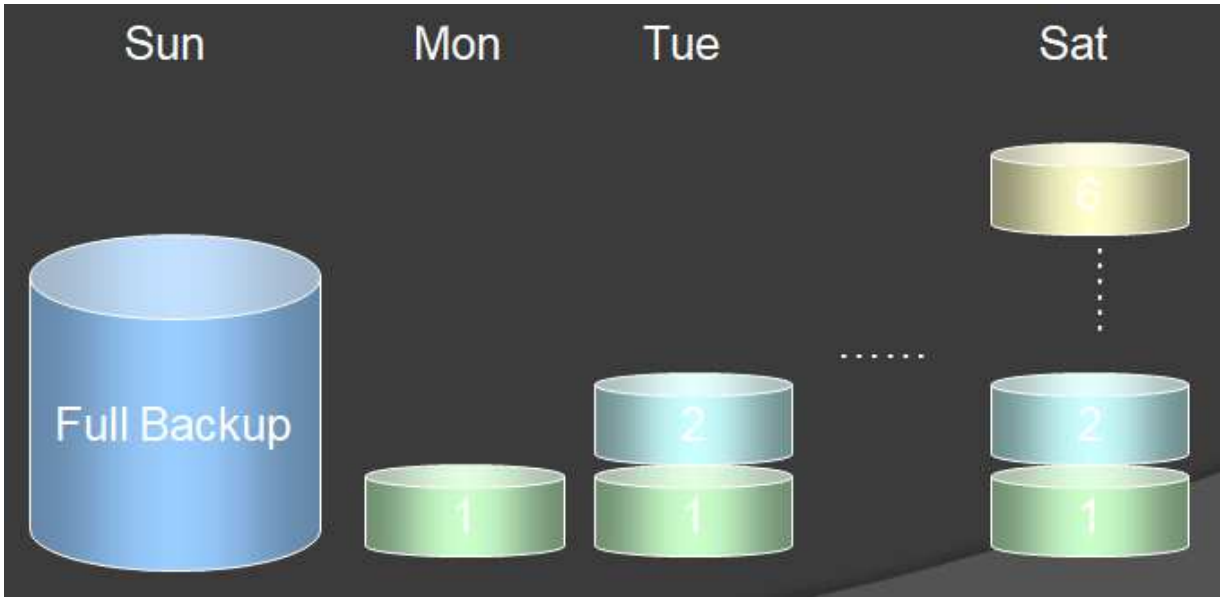
Full backup

- Backs up all selected files.



Differential backup

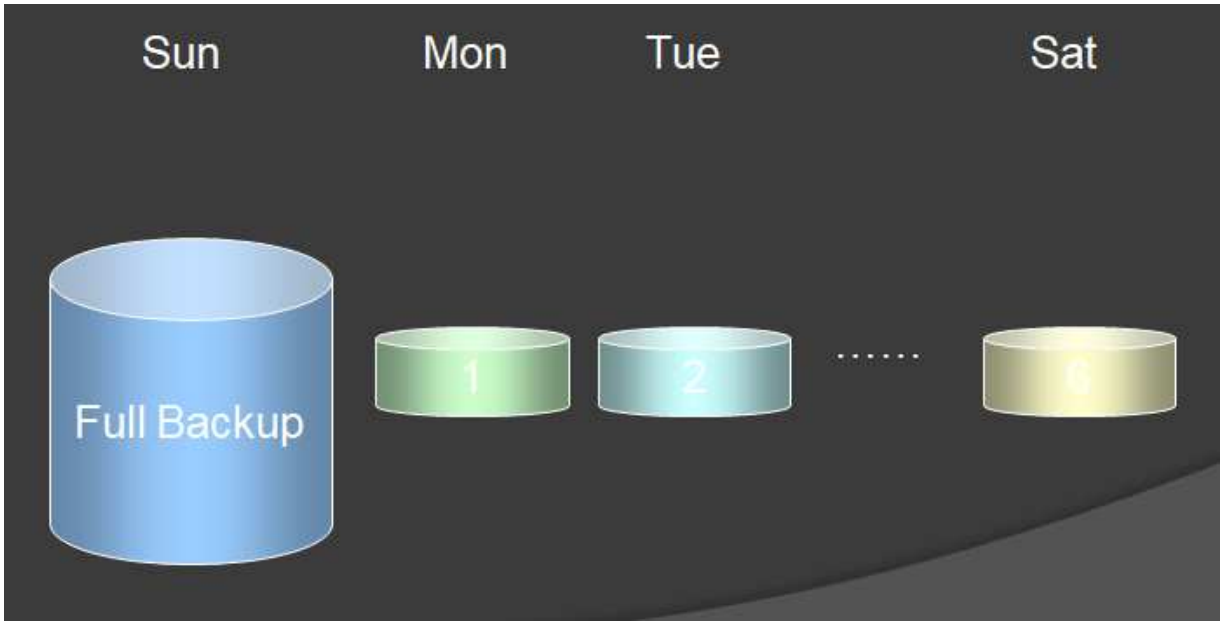
- Backs up selected files that have been changed. This is used when only the latest version of a file is required.



- Only full backup (Sun) and the latest differential backup (Sat) are required to restore the files
- More space required than incremental backup strategy
- Backup operation is slower than incremental backup
- Faster restore
- Keep only the latest differential backup between 2 full backups

Incremental backup

- Save space
- Faster backup
- Must keep all incremental backups between 2 full backups
- Restore/recovery operation is slower
- The full backup and all incremental backups are required to restore the files



Disaster Recovery Planning Process

- Defines resources, actions, and data required to reinstate critical business processes that have been damaged or disabled because of a disaster
- Potential threats
    - Human-induced accidents
    - Natural
    - Internal
    - Armed conflict
    - External
    - Backing up all mission-critical data so personnel can restore files and application software to continue business as though nothing happened
    - Essential part of a disaster recovery plan

Effective Backup Strategy Issues

- Frequency of backups
- Backup medium
- Time of day
- Manual or automated
- How verified
- Length of storage
- Location of storage
- Primary and fallback person responsible
- Need for off-site storage

Types of Off-Site Backup Facilities

- Hot site
- Warm site
- Cold site

Hot Site

- Fully configured and ready to operate within a few hours of a disaster
- Can support a short- or long-term outage
- Flexible in its configuration and options
- Advantages
    - Ready within hours for operations
    - High availability
    - Flexible configurations
    - Annual testing available
    - Exclusive use
- Disadvantages
    - Very expensive (can more than double data center costs)

Warm Site

- Partially configured with some equipment
- Essentially provide the facility and some peripheral devices, but not a full configuration like a hot site
- Advantages
    - Less expensive
    - Usually exclusive use
    - Available for long time frames
- Disadvantages
    - Not immediately available
    - Operational testing usually not available

Cold Site

- Supplies basic computing environments including wiring, ventilation, plumbing, and flooring
- Advantages
    - Relatively low cost
- Disadvantages
    - No hardware infrastructure

- Not immediately available
  Operational testing not available

STEPS IN THE DISASTER RECOVERY PLANNING PROCESS

- Evaluate and determine potential sources of the outage
- Assess business impact
- Document the server in concise language

Policies and Procedures

- Security policy
- Human resources policy
- Incident response policy

LABORATORY

Objectives

Backup user data.

PART 1: USE A LOCAL EXTERNAL DISK TO BACKUP DATA

Objective

It is important to establish a backup strategy that includes data recovery of personal files. You will be using the Microsoft Backup Utility to perform backup using an external local disk drive.

Step 1: Getting Started With Backup Tools in Windows

Computer usage and organizational requirements determine how often data must be backed up and the type of backup to perform. It can take a long time to run a backup. If the backup strategy is followed carefully, it is not necessary to back up all files every time. Only the files that have changed since the last backup need to be backed up.

Microsoft Windows includes backup tools that can be used to backup files. In versions earlier than Windows 8/10, you could use Backup and Restore to backup your files. Windows 8.1/10 ships with File History which can be used to back up the files in the Documents, Music, Pictures, Videos, and Desktop folders. Over time, File History builds a history of your files, allowing you to go back and recover specific versions of a file. This is a helpful feature if there are damaged or lost files.

Windows 7 and Vista ship with a different backup tool called **Backup and Restore**. When an external drive is selected, Windows 7 will offer the chance to use the new drive a backup device. Use Backup and Restore to manage backups.

To access the Backup and Restore utility in Windows 7, follow the steps below:

a. Connect an external drive.
b. Execute the Backup and Restore by using the following path:

Start > Control Panel > Backup and Restore

To get started with File History in Windows 8.1/10, follow the steps below:

a. Connect an external drive.
b. Turn on File History by using the following path:
c.

Control Panel > File History > click Turn on

Note: Other operating systems also have backup tools available.

Step 2: Backing up the Documents and Pictures folders

Now that the external disk is connected and you know how to find the backup tool, set it up to back up the Documents and Pictures folders every day, at 3 a.m.

a. Open **Backup and Restore** (Windows 7) or **File History** (Windows 8.x/10).
b. Select the external disk you want to use to receive the backup.
c. Specify what you want to be backed up to the disk. For this lab, choose the **Documents** and **Pictures** folders.
d. Set up a backup schedule. For this lab, use daily at 3 a.m.
   Why would you choose to perform backups at 3 a.m.?_____
   _____
   _____
e. Start the backup by clicking the **Save settings and run backup**.

PART 2: BACKING UP TO A REMOTE DISK

Step 1: Getting Familiar With Cloud-Based Backup Services

Another option for a backup destination is a remote disk. This might be a complete cloud service, or simply a NAS connected to the network, remote backups are also very common.

Step 2: Using Backup and Restore to Back Up Data to the Cloud

Choose a service that fits your needs and backup your copy of your Documents folder to the cloud. Notice that Dropbox and OneDrive allow you to create a folder on your computer that

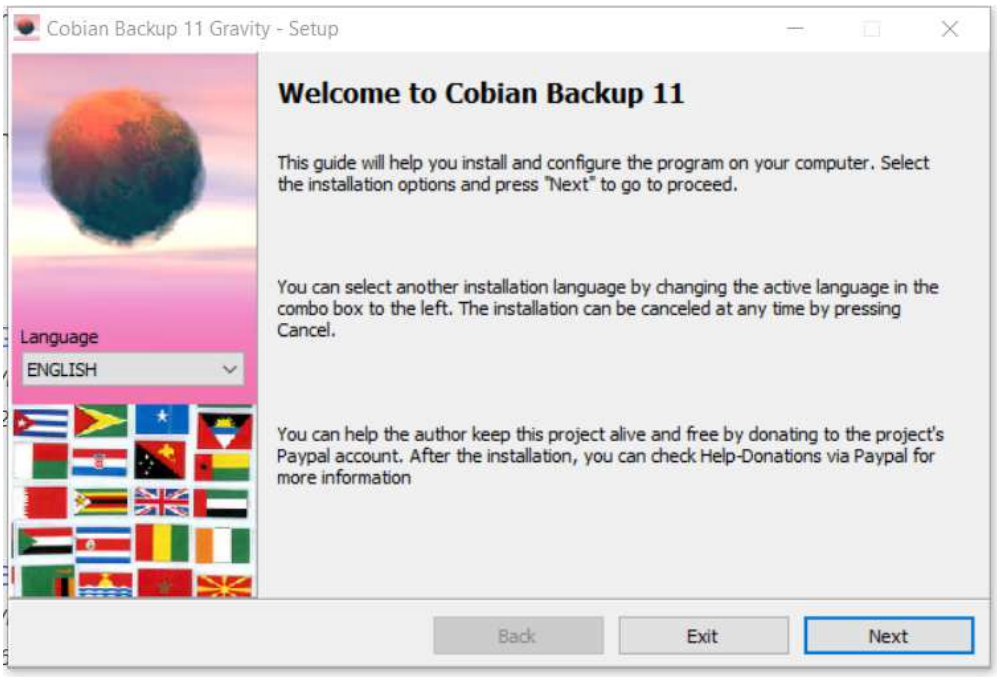
acts as a link to the cloud drive. Once created, files copied to that folder are automatically uploaded to the cloud by the cloud-service client that is always running. This setup is very convenient because you can use any backup tools of your choice to schedule cloud backups. To use Windows Backup and Restore to back up your files to Dropbox, follow the steps below:

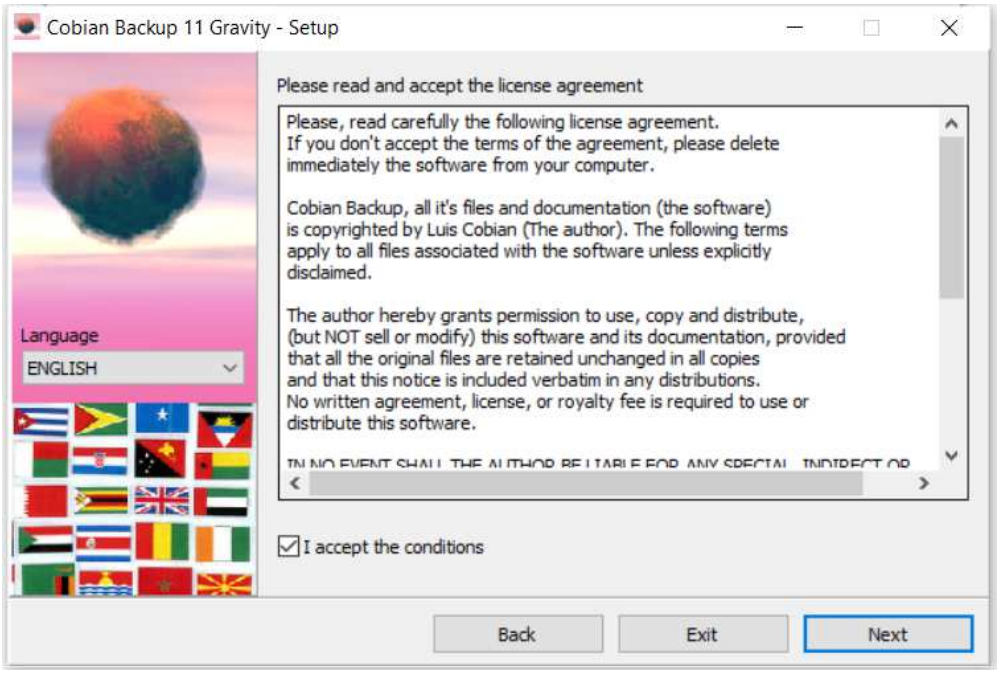
a. Visit http://dropbox.com and sign up for a free Dropbox account.
b. When the account is created, Dropbox will display all the files stored in your account. Click **your name** and click **Install** to download and install the appropriate Dropbox client for your operating system.
c. Open the downloaded program to install the client.
d. After the installation is complete, the Dropbox client will create a folder named Dropbox inside your Home folder. Notice that any files copied into the newly created folder will be automatically copied to Dropbox's cloud-hosted servers.
e. Open **Windows Backup and Restore** and configure it to use the new Dropbox folder as a backup destination.

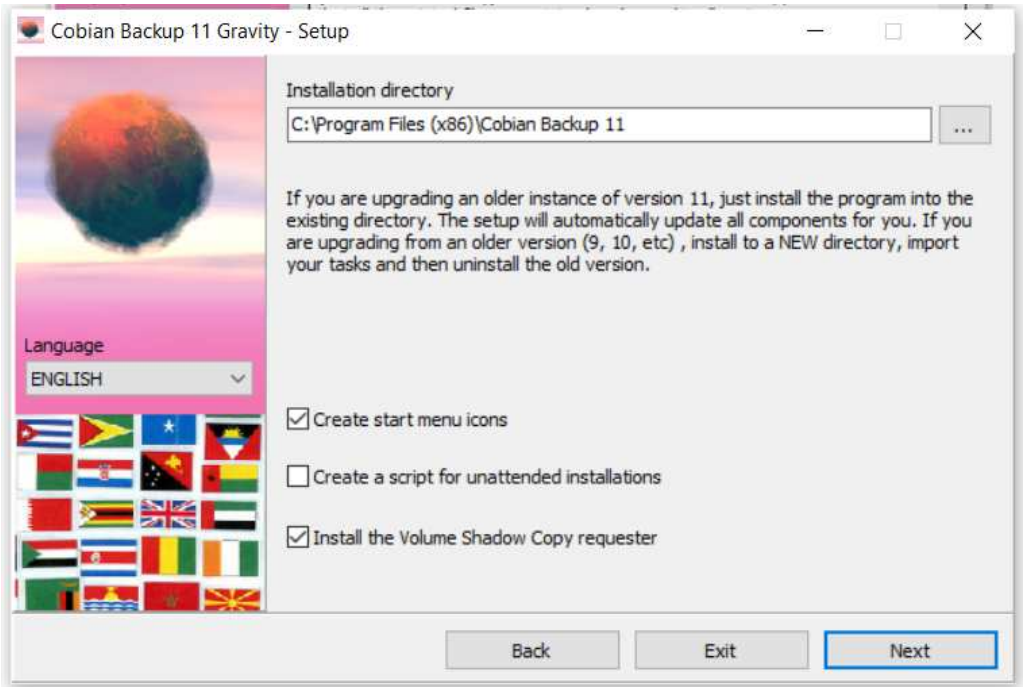
PART 3: BACKING UP USING AN OPEN SOURCE BACKUP APPLICATION (COBIAN)

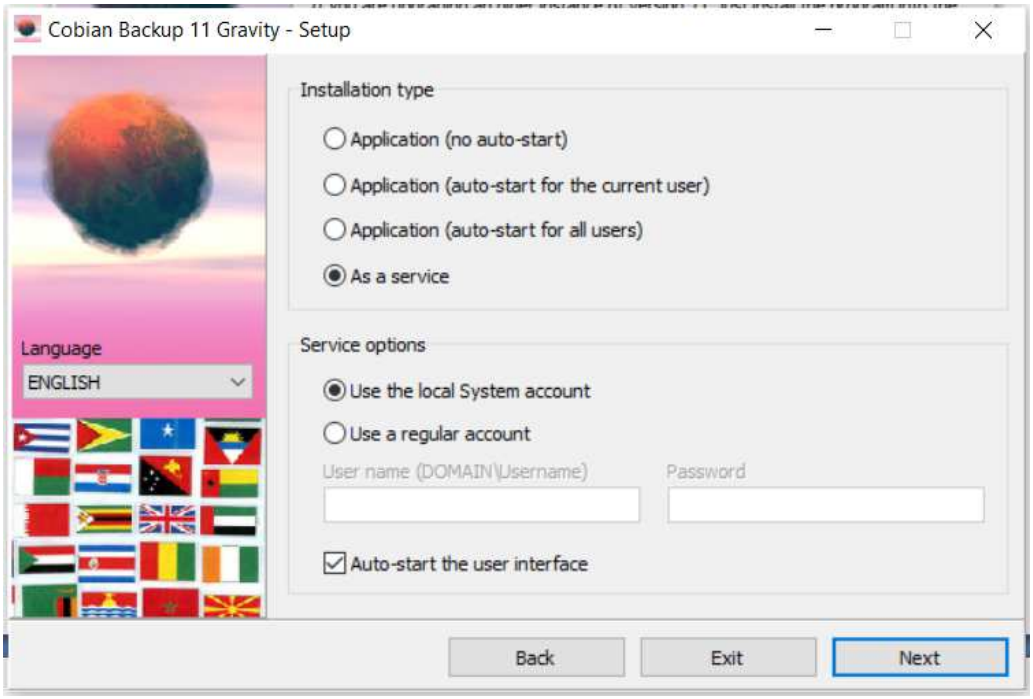
Step 1: Download the COBIAN Bakup Application from the website https://www.cobiansoft.com .

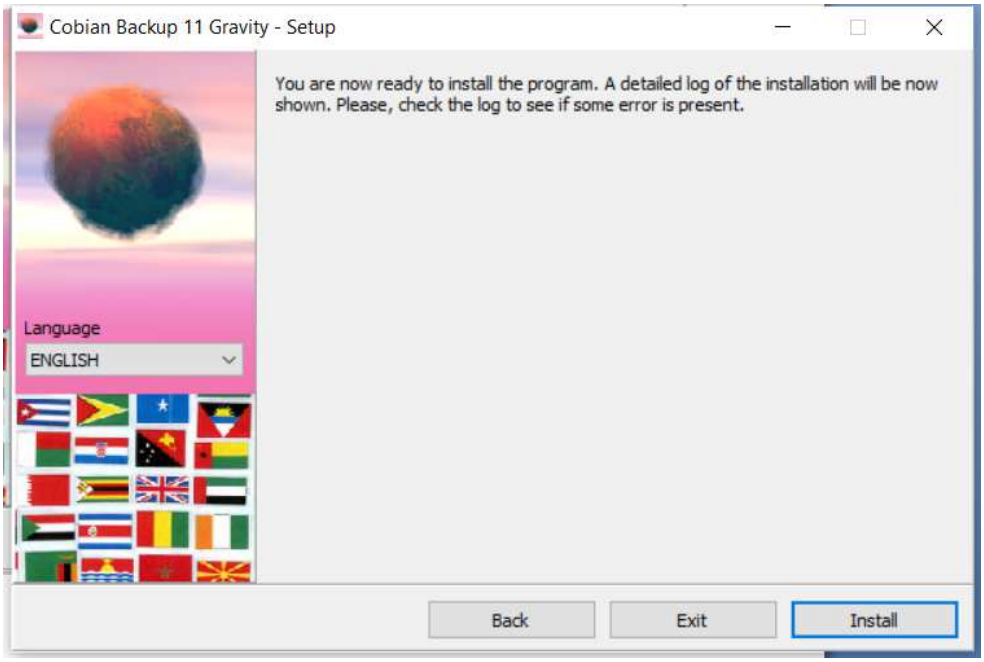
Step 2: Install and Run the Application.



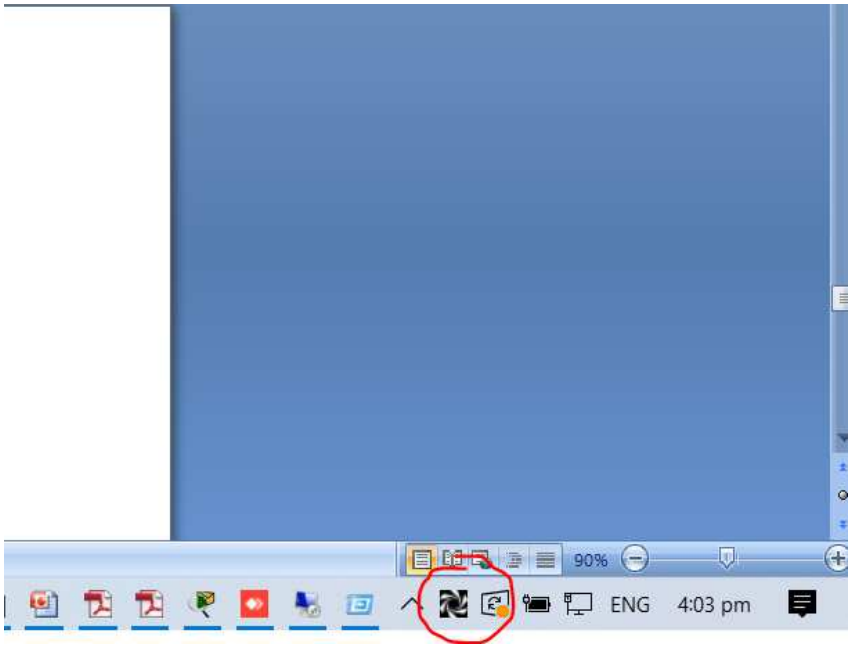

Cobian Backup 11 Gravity - Setup
Please read and accept the license agreement
Please, read carefully the following license agreement.
If you don't accept the terms of the agreement, please delete immediately the software from your computer.
Cobian Backup, all it's files and documentation (the software) is copyrighted by Luis Cobian (The author). The following terms apply to all files associated with the software unless explicitly disclaimed.
The author hereby grants permission to use, copy and distribute, (but NOT sell or modify) this software and its documentation, provided that all the original files are retained unchanged in all copies and that this notice is included verbatim in any distributions.
No written agreement, license, or royalty fee is required to use or distribute this software.
Language
ENGLISH
I accept the conditions
Back
Exit
Next


Cobian Backup 11 Gravity - Setup
Installation directory
C:\Program Files (x86)\Cobian Backup 11
...
If you are upgrading an older instance of version 11, just install the program into the existing directory. The setup will automatically update all components for you. If you are upgrading from an older version (9, 10, etc) , install to a NEW directory, import your tasks and then uninstall the old version.
Language
ENGLISH
Create start menu icons
Create a script for unattended installations
Install the Volume Shadow Copy requester
Back
Exit
Next

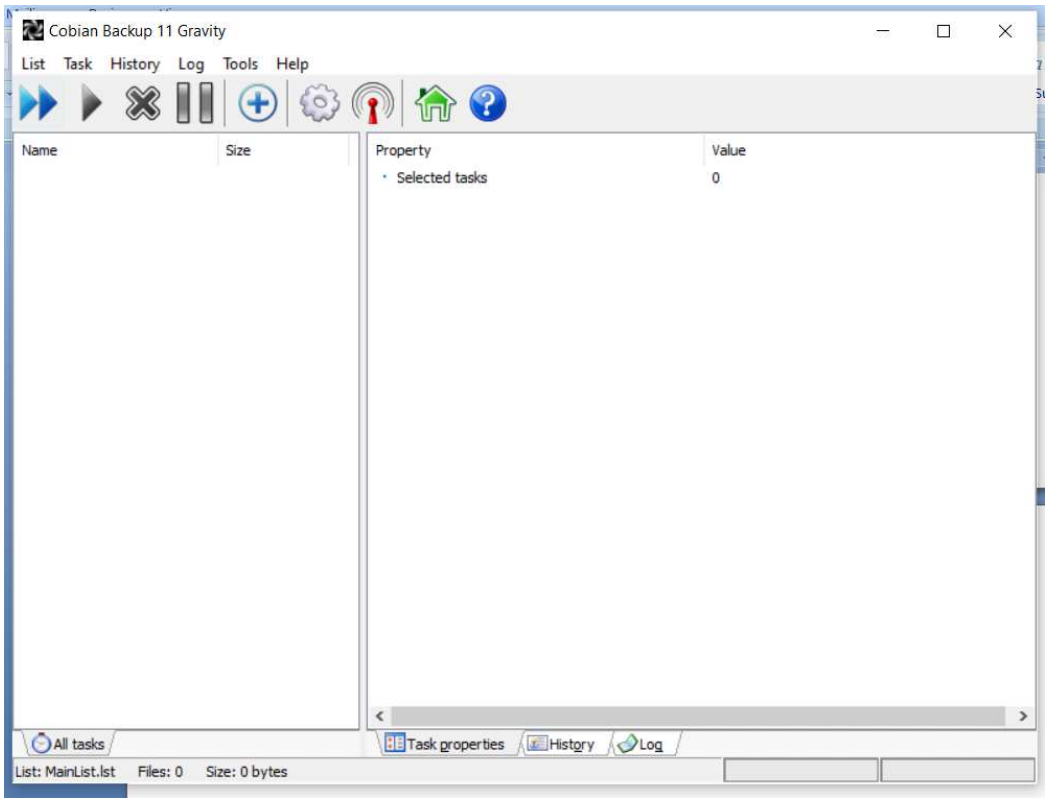




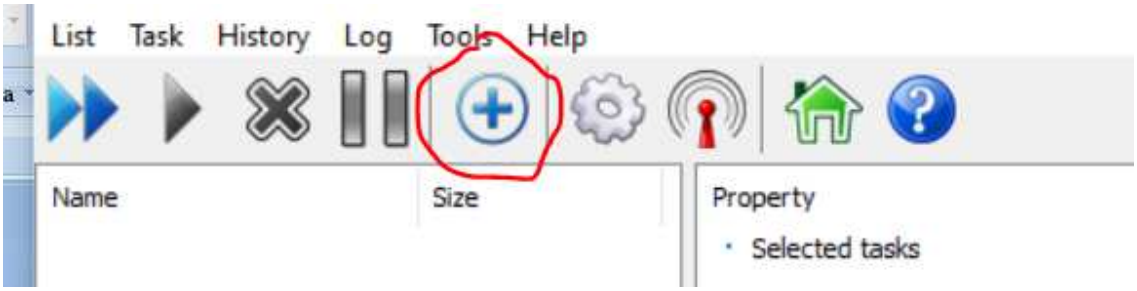
Once installed, you can now see the icon on the system tray below.



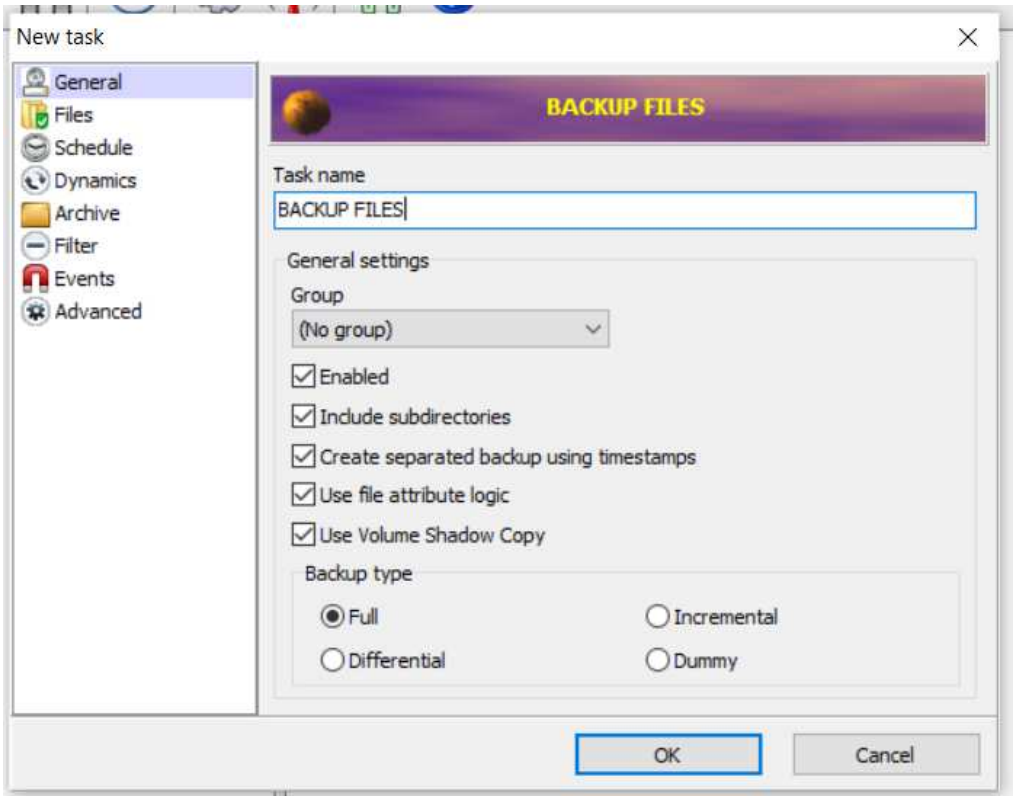
Double-Click on the icon to Open the Application.

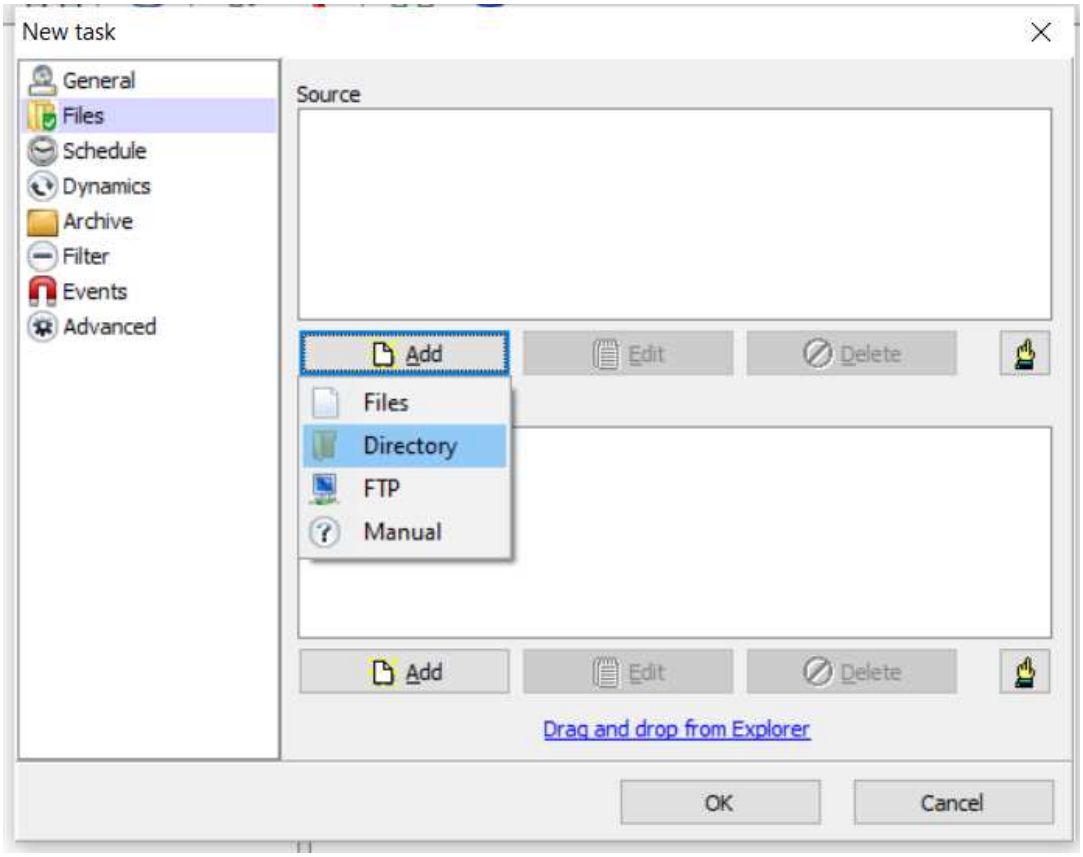


Click on the New Task Icon.

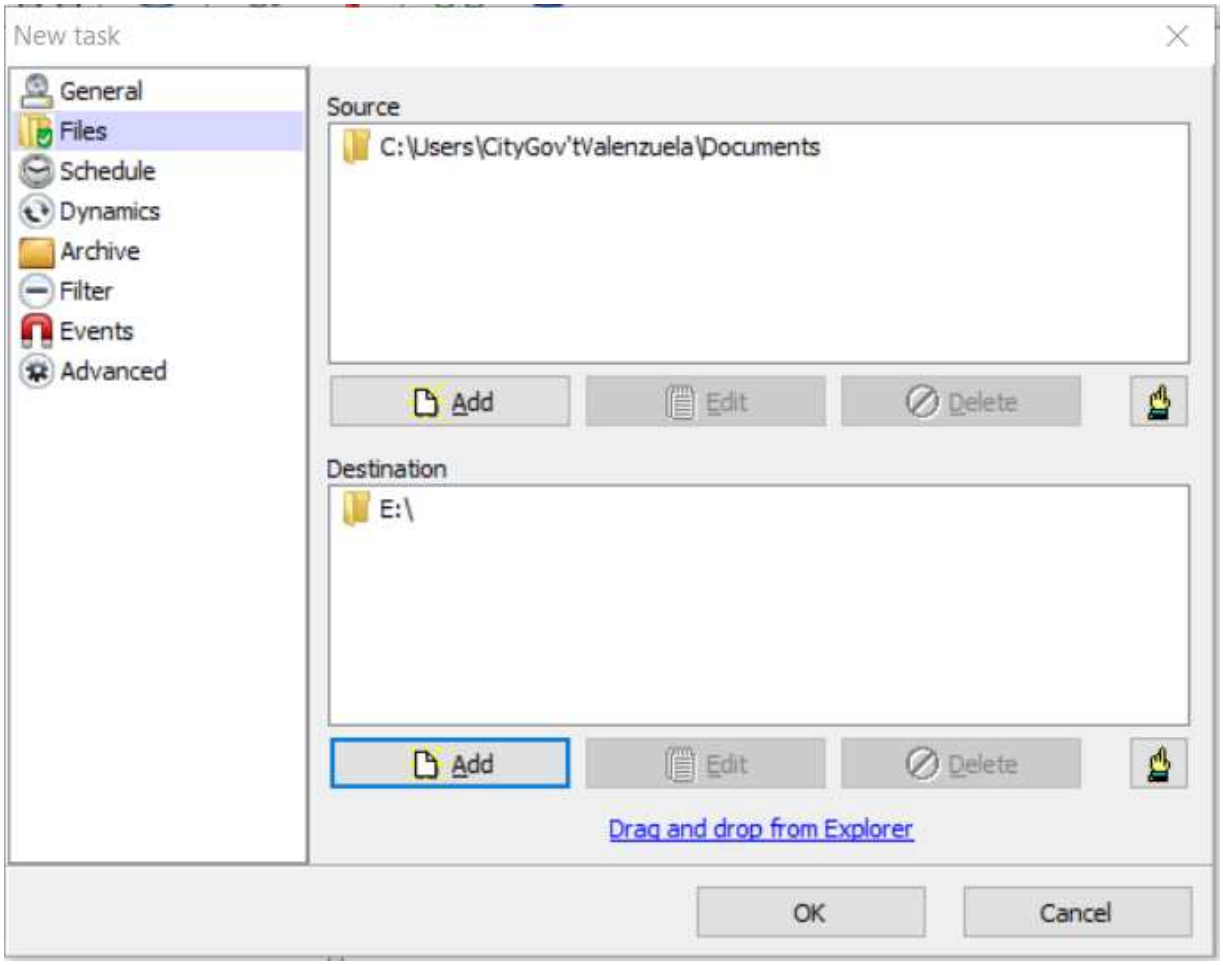


Type “BACKUP FILES” on the field for the task name. Leave the FULL Backup Type selected.

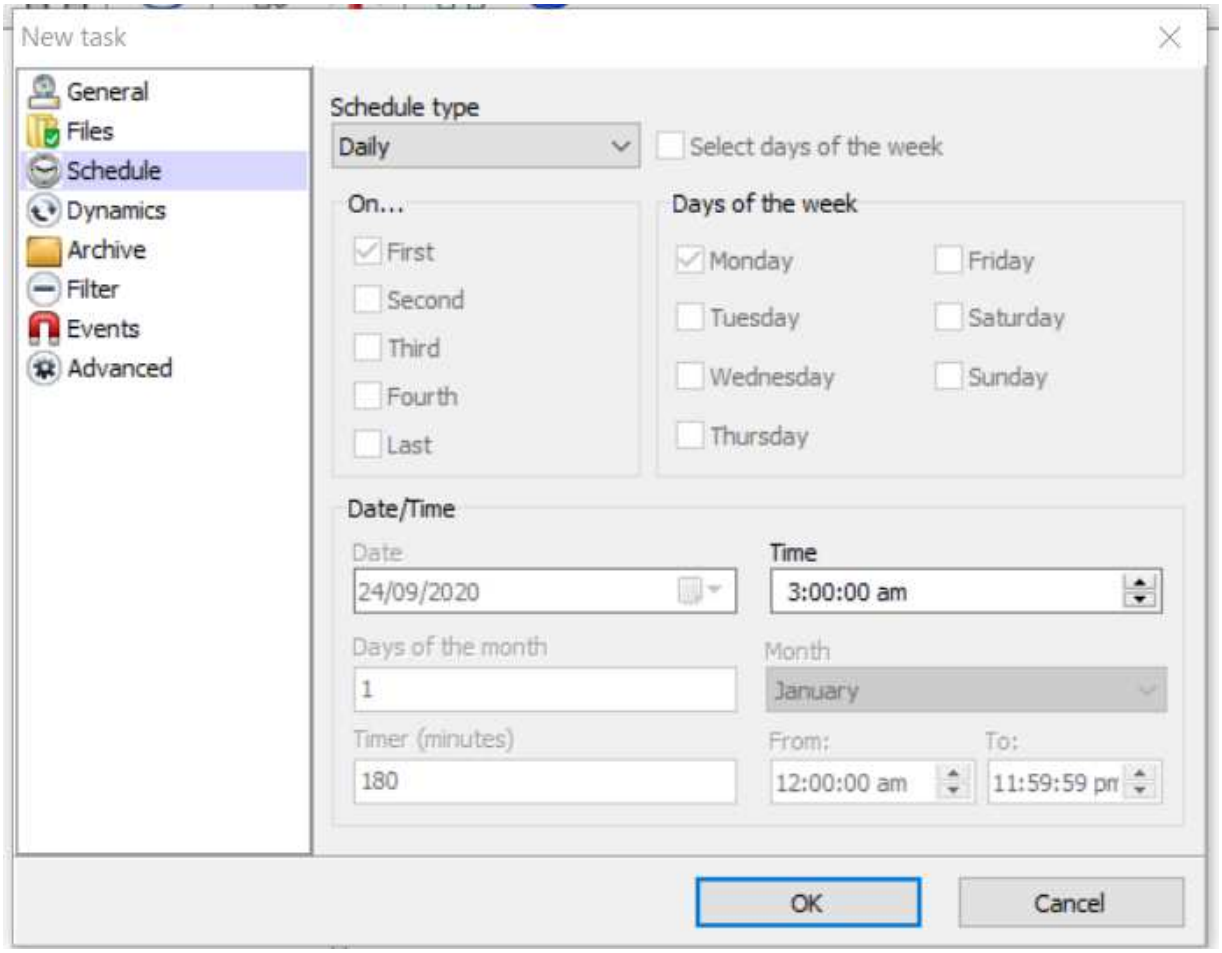




Select the Directory for the Source folder that you want to backup. In our example, we will going to backup the **Documents** folder on computer and save the backup to the destination folder/path which is the External Drive.

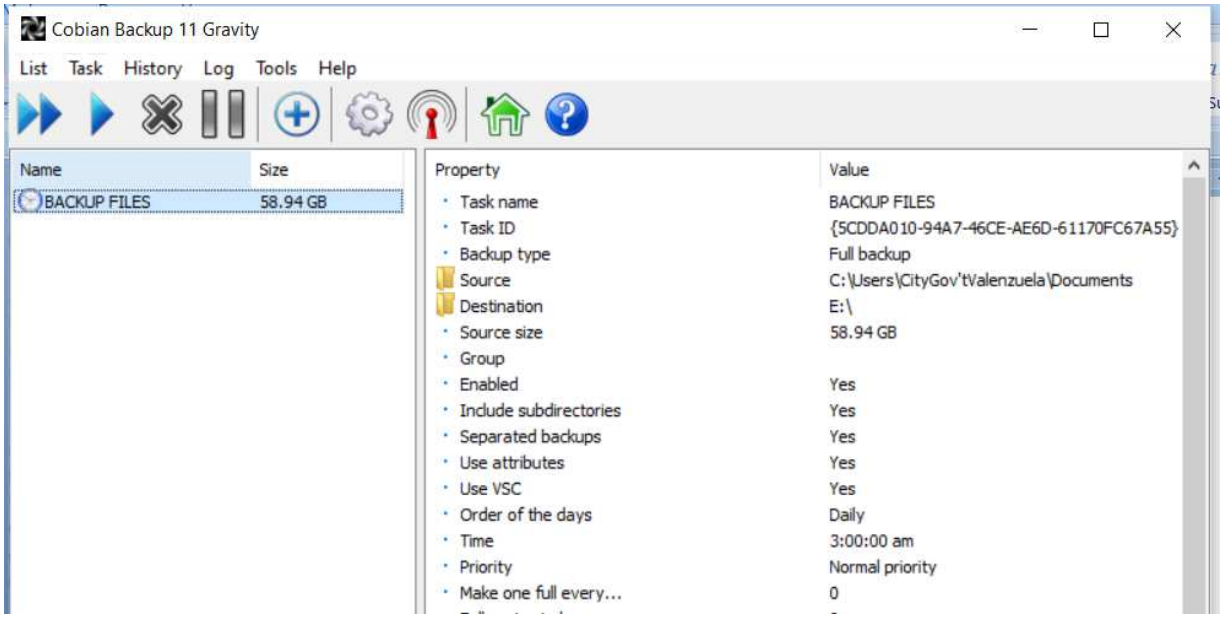


Select **SCHEDULE** to schedule the backup process. In our example, we will set the backup to 3:00 am which runs on a daily basis.

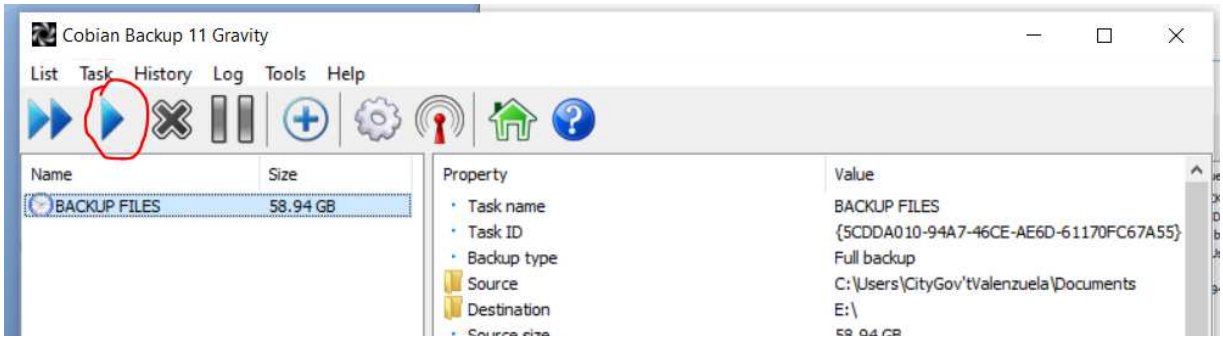


Then Click OK.

The backup task is already created.



To test the backup up process and force to run it, Click the “Run the Selected Task Now” icon.



Check if the backup has been executed. Check the external drive and write down the file/folder created.

File/Folder Created by the Cobian Backup Task: _____.

Formative Task

1. How do you backup your files and data on your computer?
2. What do you think are the advantages and disadvantages of having cloud or virtualized environment?

ASSESSMENT TASK

I. Multiple Choice

1. Threat to Computers and Communications Systems: Errors and accidents which pertains to the absence of electricity or power failure causing the system not to work.
   a. Electrostatic Problem
   b. Electromechanical Problem
   c. Electromagnetic Problem
   d. Electrochemical Problem
2. Threat to Computers and Communications Systems: Errors and accidents which pertain to the Data is incomplete, outdated or otherwise inaccurate that causes errors in the computer system.
   a. People Error b. Dirty Data
   c. Procedural Errord. Software Error
3. Threat to Computers and Communications Systems: Errors and accidents which pertain to some spectacular computer failures have occurred because someone didn't follow procedures.
   a. Procedural Error b. Dirty Data
   c. People Error d. Software Error
4. Threat to Computers and Communications Systems: Errors and accidents which pertain to "Recall that one part of computer system is the people who manage it or run it…"
   a. Software Error b. Dirty Data
   c. People Error d. Procedural Error
5. Backs up type where it backs-up selected files that have been changed, and carries over previous changes together with the present change in the file backup.
   a. Full Backup b. RAID
   c. Incremental Backup d. Differential Backup
6. Backs up type where it back-up selected files that have been changed only. This is used when only the latest version of a file is required.
   a. Warm Site b. Incremental Backup
   c. Differential Backup d. Cold Site
7. DoS Stands/acronym for:
   a. Denial-of-Service b. Distribution-of-Service
   c. Distribution-of-System d. Denial-of-System
8. It is a type of backup that copies only data that was changed since the previous backup.
   a. Full b. Incremental c. Differential
9. It is a type of backup which is a total copy of your organization's entire data assets, which backs up all of your files into a single version.
   a. Full b. Incremental c. Differential

10. It is a type of backup which is a cumulative backup of all files changed since the last backup.
    a. Full b. Incremental c. Differential
11. _____ is also known as a virtual machine monitor or VMM, is software that creates and runs virtual machines (VMs). A hypervisor allows one host computer to support multiple guest VMs by virtually sharing its resources, such as memory and processing.
    a. HyperVirtual b. Hyper Terminal
    c. Hypervisor d. Virtual OS
12. In virtualization, KVM stands/acronym for:
    a. Kerrnel-Video Machine b. Keyboard-Based Virtual Machine
    c. Kernel-based Virtual Machine d. Kernel-based Virtual Memory

II. Enumeration

1. What are the three (3) types of Offsite Backup Facilities.?
2. Four (4) Cost of Unprotected Environment?
3. Three (3) Policies and Procedures on Disaster Recovery Planning?
4. What are the three (3) types of Cloud Computing?

III. Answer the following questions.

1. What are the benefits of backing up data to a local external disk?_____
   _____
   _____
2. What are the drawbacks of backing up data to a local external disk?_____
   _____
   _____
3. What are the benefits of backing up data to a cloud-based disk?_____
   _____
   _____
4. What are the drawbacks of backing up data to a cloud-based disk?_____
   _____
   _____

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