COLLEGE OF ENGINEERING CHENGANNUR

FREE AND OPEN SOURCE SOFTWARE LAB REPORT

CS232

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Submitted by:

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S4-D 21

Certificate

Name :   Class :

Roll No :   Exam No :

This is certified to be the bonafide record of practical work done in Free and Open Source Software as per Syllabus of class .... in the Lab during the academic year 20   /20

....

Teacher In-charge   *Head of Dept.*

....

Examiner's Signature   *Principal*

Date : ....   *Institution Rubber Stamp*

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1. LINUX COMMANDS

Linux is a free open source operating system based on UNIX.

cd

cd is used to change the shell working directory. By default it directs to the home directory.

```
$ cd /          set directory to root,
$ cd ~          set directory to home,
$ cd ..         set previous directory.
```

ls

The ls command is used to get a list of files and directories. Options can be used to get additional information about the files.

```
$ ls [options] [paths]

$ ls -a          list of all files including
                 hidden files
```

mkdir

mkdir used to create directories (if they do not exist). This command can create multiple directories at once as well as set the permission for the directories.

```
$ mkdir [options...] [directories ...]
```

cat

Concatenate files and prints on standard output. cat command allows us to create single or multiple files view contain of file, concatenate files and redirect output in terminal or files.

```
$ cat [option]... [file]...

$ cat > filename          creates file (filename)

$ cat >> filename          appends to (filename)
```

alias

Create an alias, aliases allow a string to be substituted for a word when it is used as the first word of a simple command. If arguments are supplied, an alias is defined for each name whose value is given. If no value is given, alias will print the current value of the alias. unalias can be used to remove each name from the list of defined aliases.

```
$ alias [-p] [name[=value] ...]

$ unalias [-a] [name ... ]
```

sort

Sort command is used to sort lines of a text file, arranging the records in a particular order. By default, the sort command sorts file assuming the contents are ASCII. Using options in sort command, it can also be used to sort numerically.

```
$ sort [OPTION]... [FILE]...

$ sort [OPTION]... --files0-from=F
```

grep

grep searches the named input files (or standard input if no files are named). By default, grep prints the matching lines. In a file grep command searches for the matching word and print the line in the stdout if match found.

```
$ grep [OPTIONS] PATTERN [FILE...]

$ grep [OPTIONS] [-e PATTERN | -f FILE] [FILE...]
```

kill

kill is a built in command to terminate process by pid. kill command sends a signal to a process which terminates the process.

```
$ kill <pid>        terminates the process with
                    given pid.
```

useradd

useradd is used to create new user accounts. It also update default new user information.

```
$ useradd <username>       creates new user account

$ userdel [options] LOGIN  delete existing user
```

mount

mount is used to attach file systems and removable devices such as USBs at a particular mount point in the directory tree. The umount command detaches the mounted file system from the directory tree.

```
$ mount [OPTION...] <device_name> <directory>

$ unmount <device_name>
```

2. SHELL SCRIPTING

A task was assigned to calculate CGPA and SGPA of S1 and S2 D batch for the academic year 2017-18. For the execution of this task, S1 and S2 results of College of Engineering, Chengannur for the academic year 2017-18 has been downloaded from the KTU website. Also, s4d.txt has been downloaded from http://14.139.189.217.

The .pdf file downloaded from the KTU website has been converted into .txt file using command

```
$ pdftotext s1_result.pdf s1_result.txt
```

In the scripting part initially, each word with substring 'CHN17CS' has been selected from s4d.txt using command

```
$ grep –q 'CHN17CS' ;
```

The word thus found has been used to search for the exact same word in s1_results.txt using command

```
$ if echo "$j" | grep –q "$i" ;
```

(where **"$j"** is word from s1_result.txt and "$i" is the word with substring 'CHN17CS')

The next nine words correspond to the subjects studied and their grades in parenthesis. For example, MA101(O), CY100(O), BE110(O), BE10104(O), BE103(O), ME100(O), CY110(O), ME110(O), EC110(O)

The grades in the parenthesis have been converted into corresponding grade points. The sum of these grade points are calculated and divided by 9 to find SGPA.

An output file result1.txt with reg. no, name and SGPA is created in parallel.

```
$ echo –n '$i     ' >> result1.txt
$ echo –n '$sgpa' >> result1.txt
```

The same procedure has been repeated for s2_result.txt and an output file result2.txt is created.

The SGPAs corresponding to same reg. no are selected from both result1.txt and result2.txt. These SGPAs are summed and divided by 2 to calculate the CGPA.

An output file result.txt with reg. no, name, SGPA1, SGPA2, CGPA is created in parallel.

3. NETWORKING

Computer network is the interconnection of multiple devices for sending or receiving data.

- **ifconfig**

  Ifconfig is used to configure the kernel-resident network interfaces. It is used at boot time to set up interfaces as necessary. After that, it is usually only needed when debugging or when system tuning is needed. By default it displays the network interfaces currently in operation.

  ```
  $ ifconfig [interface]      display details about
                              the given [interface]
  $ ifconfig [interface] [ip] assigns an ip for the
  $ ifconfig [interface] up/down
                              enables or disables
                              [interface]
  ```

- **iwconfig**

  Iwconfig is dedicated to the wireless interfaces. It is used to set the parameters of the network interface which are specific to the wireless operation (for example : the frequency).

  ```
  $ iwconfig [interface] [options]
  $ iwconfig [Interface] nwid on/off
                              enables or disables
                                  network id
  ```

- **route**

  Route manipulates the kernel's IP routing tables. Its primary use is to set up static routes to specific hosts or networks via an interface after it has been configured with the ifconfig program.

  ```
  route                      displays route table
  route add default gw <ip>  adds a default gateway
  route delete default gw <ip>
                             removes default gateway
                             from route table
  ```

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4. SSH, RSYNC, SCP

4.1 SSH

Secure Shell is a cryptographic network protocol and interface to operate network services securely over an unsecured network. It includes remote login and remote command executions. It is designed to establish a secure channel in a client - server architecture.

The connection established using the command:

```
ssh <user>@<server>
```

Commands like ls, cat, mkdir, cd, touch, rm, cp, mv, grep, du, nano work in the SSH shell)

4.2 RSYNC

Remote SYNC is a utility for efficiently transferring and synchronizing files between a computer and an external hard drive and across networked computers by comparing the modification times and sizes of files.

`-a` archive combining into a single file

`-v` verbose gives a brief summary about the transferring data

`-z` compress data files during transfer

`-h` human-readable format

`-a` preserves the date and time and permission of the files

`--progress` show the progress while transferring the data

Sending a file (test.txt) to the server:

```
rsync -avz test.txt <user>@<server>:/home/cs17d21
```

Receiving a file (index.html) from the server using SSH protocol:

```
rsync –avzhe ssh <user>@<server>:/remote/directory/
index.html /local/directory
```

4.3 SCP

The Secure Copy command is used to transfer files between two hosts. It uses the same authentication and security as the Secure Shell (SSH) protocol. It is a command line utility. Since it uses SSH the transferred data will be encrypted and transferred through a secure channel.

-r copy entire directories recursively

Sending a file (test.txt) to the server:

```
$ scp test.txt <user>@<server>:/remote/directory
```

Receiving a file (test.txt) from the server:

```
$ scp <user>@<server>:/remote/directory/test.txt
/home/georgi/Desktop
```

Sending a directory (sample) to the server:

```
$ scp -r sample <user>@<server>:/remote/directory
```

5. FTP USAGE

Ftp is the user interface to the Internet standard File Transfer Protocol. The program allows a user to transfer files to and from a remote network site.

Connection established using command:

```
$ sftp <user>@<server>
```

Changing directory on remote server:

```
$ cd <directory>
```

Changing directory on local device:

```
$ lcd <directory>
```

Show current directory on remote server:

```
$ pwd
```

Show current directory on local device:

```
$ lpwd
```

Fetch file from the server:

```
$ get <filename>
```

Upload file to the server:

```
$ put <filename>
```

6. LINUX INSTALLATION

Linux is a free open source operating system. Due to the GNU General Public License under which Linux is distributed, no one can sell a license for the software. Able to use Linux at no charge and are encouraged to make it available to others.

Any Linux distribution can be installed via bootable USB or DVD. iso file can be downloaded from the official website of various linux distributions, and can be installed completely or alongside with windows (dual boot). Different partitions (/ , /home, /swap) has to be created in ext4 format and set to logical memory allocation. If the system uses UEFI then a separate partition formatted as FAT32 is required for ESP which contains boot managers and boot information for the UEFI.

After the creation of partitions set timezone, keyboard layout, language, etc through the installation interface. Then create a user account and set password for the root user.

Packages for driver installation comes alongside with the image file in most of the linux distributions. If additional driver packages are required it can be installed after the installation of OS.

7. SERVER SETUP

7.1 FTP

An FTP server is a computer which has a file transfer protocol address and is dedicated to receiving an FTP connection. It requires TCP/IP network for functioning and is dependent on usage of dedicated servers with one or more FTP clients. Here VSFTPD (Very Secure FTP Daemon) have been used to create FTP server.

For setting up FTP server, vsftpd has been installed using apt (Advanced Package Tool) and opening ports using UFw (Uncomplicated Firewall) for incoming connections through (20/tcp, 21/tcp, 990/tcp, 40000:50000/tcp).

```
$ sudo ufw allow <port>
```

Then a new user account has been created for FTP access. VSFTPD accomplishes this with chroot jails. When chroot is enabled for local users, they are restricted to their home directory by default.

Clients are able to access using

```
$ ftp <username>@<ip>
```

7.2 HTTP

HTTP or web server is computer which uses Hyper Text Tranfer Protocol to serve files to the clients in response to their requests. Apache is one of the most popular server software to host an HTTP server. It is designed to create web servers that have the ability to host one or more HTTP-based websites. It includes the ability to support multiple programming languages, server-side scripting, an authentication mechanism and database support.

- Installation using apt
  ```
  $ apt install apache2
  ```

- Adjusting firewall (ufw)
  ```
  $ sudo ufw allow 'Apache Full'
  ```

- Start Apache server
  ```
  $ sudo systemctl start apache2
  ```

- Stop Apache server
  ```
  $ sudo systemctl stop apache2
  ```

- Restart Apache server
  ```
  $ sudo systemctl restart apache2
  ```

- Reload Apache server
  ```
  $ sudo systemctl reload apache2
  ```

- Enable Apache server
  ```
  $ sudo systemctl enable apache2
  ```

- Disable Apache server
  ```
  $ sudo systemctl disable apache2
  ```

8. FURTHER TASKS

8.1 Package Management

A package-management system is a collection of software tools that automates the process of installing, upgrading, configuring, and removing computer programs for a computer's operating system in a consistent manner. Operating system like Debian, Ubuntu uses apt, apt-get which comes pre-installed to the OS. Further package management tools like pip, npm, anaconda can be installed through apt. Packages which are not available in there libraries can be manually installed from the source.

- Update package database
  ```
  $ apt update
  ```

- Upgrade installed packages
  ```
  $apt upgade
  ```

- Install new packages
  ```
  $ sudo apt install <package_name>
  ```

- Remove installed packages
  ```
  $ sudo apt remove <package_name>
  ```

- Search for packages
  ```
  $ apt search <package_name>
  ```

- Display content of a package
  ```
  $ apt show <package_name>
  ```

- List upgradable packages
  ```
  $ apt list –upgradeable
  ```

- List installed packages
  ```
  $ apt list --installed
  ```

8.2 Perl

Perl is a family of two high-level, general-purpose, interpreted, dynamic programming languages. It is a general-purpose programming language originally developed for text manipulation and now used for a wide range of tasks including system administration, web development, network programming, GUI development, and more.
Perl is a stable, cross platform programming language. It takes the best features from other languages, such as C, awk, sed, sh, and BASIC, among others. Its database integration interface DBI supports third-party databases including Oracle, Sybase, Postgres, MySQL and others. Perl works with HTML, XML, and other mark-up languages.

Perl program to swap to numbers

```
$a = 10;
$b = 20;
print "initial value of a: $a \n";
print "initial value of b: $b \n";
$a = $a + $b;
$b = $a - $b;
$a = $a - $b;
print "Value of a: $a\n";
print "Value of b: $b\n";
```

8.3 LAMP stack

The LAMP (Linux Apache MySQL PHP) stack is the foundation for Linux hosted websites. It consist of four software layers which supports each other. Websites and web applications run on top of this underlying stack. Integration between these four layers makes it the best platform to host websites.

Linux: The operating system makes up the first layer. It sets the foundation for the stack model. All other layers run on top of this layer.

Apache: The second layer consists of HTTP server software. This layer resides on top of the Linux layer. It waits for the HTTP request from the clients and server the appropriate files (webpages) as per the request. It is also the most popular HTTP server side software.

MySQL: MySQL stores details that can be queried by scripting to construct a website. It usually sits on top of the Linux layer alongside Apache. In high end configurations, MySQL can be off loaded to a separate host server.

PHP: Sitting on top of them all is our fourth and final layer. The scripting layer consists of PHP or other similar web programming languages. Websites and web applications run within this layer.

PHP program to add two numbers

```php
<?php

    $x = 3;

    $y = 5;

    $sum = $x + $y;

    echo "Sum is " . $sum;

?>
```

8.4 Kernel Compilation

Linux provides user with the ability to modify/ update Linux kernel. Every version of Linux kernel are available in their official website https://kernel.org/.
The process includes downloading the source file, extraction, verification, compilation, installation of compiled kernel and updating boot loader (grub) to recognise the new kernel.

Downloading kernel source files:

```
$ wget https://cdn.kernel.org/pub/linux/kernel/
v4.x/linux4.20.12.tar.xz
```

Extraction:
```
$ unxz -v linux-4.20.12.tar.xz
```

Verification of Linux kernel tartball with pgp:
```
$ wget https://cdn.kernel.org/pub/linux/kernel/v4.x/
linux-4.20.12.tar.sign

$ gpg --recv-keys <RSA_key>

$ gpg --verify linux-4.20.12.tar.sign
```

Installing required compiling tools:
```
$ sudo apt-get install build-essential libncurses-dev
bison flex libssl-dev libelf-dev
```

Configuring the kernel
```
$ make menuconfig
```

Compiling Linux Kernel
```
$ make
```

Installing Linux kernel modules
```
$ sudo make modules_install
```

Installing Linux kernel
```
$ sudo make install
```

Updating GRUB
```
$ sudo update-initramfs -c -k 4.20.12
$ sudo update-grub
```

9. OWN WEBPAGE

An nginx server (14.139.189.217) is configured in such a way that it directs the URL http://14.139.189.217/cs17d/cs17dxx to the corresponding home directory of user account (cs17dxx) in search of index.html as the source file.

An index.html file with experiment details and hyperlinks to the github repository is created locally. Then transferred to the home directory of student in the server using scp.

```
$ scp index.html <user>@<server>:/home/directory
```

10. EXPERIMENT 5

Shell script to show various system configurations.

```sh
#!/bin/sh

lsb_release -a
uname -r
cat /etc/shells
cat /proc/cpuinfo
cat /proc/meminfo
sudo hdparm -I /dev/sda
lscpu | grep cache
sudo fsck
lsb_release
```

10.1   OS, version, release number

`$ lsb_release –a`

LSB – Linux Standard Base – is a joint project by a number of Linux vendors to standardize the OS environment. LSB participating Linux distributions share few commands. lsb_release is one of them, and it allows you to find out all the LSB information about your Linux distribution.

-v	--version	displays version
-r	--release	displays release number
-a	--all	displays all information

Result:

```
No LSB modules are available.

Distributor ID:        Ubuntu

Description:  Ubuntu 18.10

Release:       18.10

Codename:      cosmic
```

10.2   Kernel version

```
$ uname -r
```

uname command is one of the most useful commands when it comes to gathering basic information about your Unix/Linux system.

-a	--all	print all information
-r	--kernel-release	print the kernel release
-v	--kernel-version	print the kernel version

Result:

```
4.20.12
```

10.3   List of all available shells

```
$ cat /etc/shells
```

The **/etc/shells** is a Linux / UNIX text file which contains the full pathnames of valid login shells. This file is used by various commands including chsh command.

Result:

```
# /etc/shells: valid login shells

/bin/sh

/bin/bash

/bin/rbash

/bin/dash

/usr/bin/rc

/usr/bin/tcsh
```

10.4   Show CPU info

```
cat /proc/cpuinfo
```

/**proc/cpuinfo** is a virtual file identifies the type of processor used by your system. It includes information about include, number of cores, availability of hyper threading, architecture, cache size etc.

Result:

```
processor : 0

vendor_id : GenuineIntel

cpu family       : 6

model            : 78

model name       : Intel(R) Core(TM) i3-6006U CPU @
2.00GHz

stepping  : 3

microcode : 0xc6

cpu MHz          : 2000.007

cache size       : 3072 KB

physical id      : 0

siblings  : 4

core id          : 0

cpu cores : 2

apicid           : 0
```

10.5   Show memory info

```
cat /proc/meminfo
```

/proc/meminfo virtual file that stores information about the RAM and swap of a device. Much of the information in /proc/meminfo is used by the free, top, and ps commands.

Result:

```
MemTotal:        8054144 kB

MemFree:         3430548 kB

MemAvailable:    5464980 kB

Buffers:          200016 kB

Cached:          2147824 kB

SwapCached:            0 kB

Active:          2533980 kB

Inactive:        1670068 kB

Active(anon):    1625312 kB

Inactive(anon):   387448 kB

Active(file):     908668 kB

Inactive(file):  1282620 kB

Unevictable:          88 kB

Mlocked:              88 kB

SwapTotal:       3999740 kB

SwapFree:        3999740 kB

Dirty:                12 kB
```

```
Writeback:           0 kB

AnonPages:     1854044 kB

Mapped:         541260 kB

Shmem:          394544 kB

KReclaimable:   137140 kB

Slab:           253576 kB

SReclaimable:   137140 kB

SUnreclaim:     116436 kB

KernelStack:     13708 kB

PageTables:      31616 kB

NFS_Unstable:        0 kB

Bounce:              0 kB

WritebackTmp:        0 kB

CommitLimit:   8026812 kB

Committed_AS:  7403520 kB

VmallocTotal: 34359738367 kB

VmallocUsed:         0 kB

VmallocChunk:        0 kB

Percpu:           2384 kB

HardwareCorrupted:   0 kB

AnonHugePages:       0 kB

ShmemHugePages:      0 kB

ShmemPmdMapped:      0 kB

CmaTotal:            0 kB
```

10.6   Show harddisk info

```
sudo hdparm -I /dev/sda
```

hdparm provides a command line interface to various kernel interfaces supported by the Linux SATA/PATA/SAS "libata" subsystem and the older IDE driver subsystem. It can set parameters such as drive caches, sleep mode, power management, acoustic management, and DMA settings.

```
hdparm [options] [device ...]
```

-I   Request identification info directly from the drive

/dev/sda is the first hard drive. The disk names in Linux are alphabetical, /dev/sdb corresponds to second harddrive. The numbers refer to partitions, so /dev/sda1 is the first partition of the first drive.

Result:

```
ATA device, with non-removable media

     Model Number:       ST1000LM035-1RK172

     Serial Number:      WDE5FYBD

     Firmware Revision:  RSM4

     Transport:          Serial, ATA8-AST, SATA 1.0a, SATA II
Extensions, SATA Rev 2.5, SATA Rev 2.6, SATA Rev 3.0

Standards:

     Used: unknown (minor revision code 0x001f)

     Supported: 10 9 8 7 6 5

     Likely used: 10

Configuration:

     Logical         max     current

     cylinders       16383   16383

     heads           16      16
```

```
     sectors/track  63      63

     --

     CHS current addressable sectors:    16514064

     LBA    user addressable sectors:    268435455

     LBA48  user addressable sectors:  1953525168

     Logical  Sector size:                    512 bytes

     Physical Sector size:                   4096 bytes

     Logical Sector-0 offset:                   0 bytes

     device size with M = 1024*1024:      953869 MBytes

     device size with M = 1000*1000:     1000204 MBytes (1000GB)

     cache/buffer size  = unknown

     Form Factor: 2.5 inch

     Nominal Media Rotation Rate: 5400
```

10.7   Show cache info

```
lscpu | grep cache
```

lscpu gathers CPU architecture information from sysfs and /proc/cpuinfo. The command output can be optimized for parsing or for easy readability by humans. **grep** is used to separate cache info from entire cpuinfo.

Result:

```
L1d cache:             32K

L1i cache:             32K

L2 cache:              256K

L3 cache:              3072K
```

10.8   Show mounted filesystem

```
sudo fsck
```

fsck is used to check and optionally repair one or more Linux file systems. The fsck program will try to handle filesystems on different physical disk drives in parallel to reduce the total amount of time needed to check all of the filesystems.

Result:

```
fsck from util-linux 2.32

e2fsck 1.44.4 (18-Aug-2018)

/dev/sda9 is mounted.

e2fsck: Cannot continue, aborting.
```