

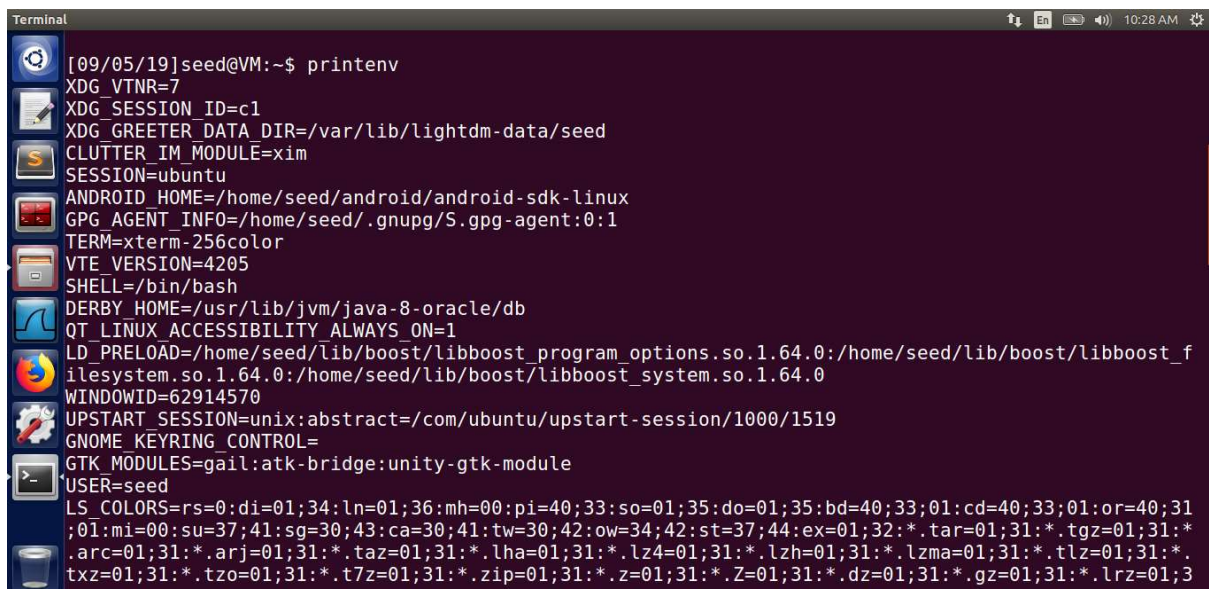
Assignment 1

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Task 1

Environment Variable

A terminal window titled "Terminal" with a dark purple background and a sidebar of application icons on the left. The terminal displays the output of the 'printenv' command, listing various environment variables. The variables include system settings like 'XDG_VTNR', user session information like 'XDG_SESSION_ID', and system paths like 'ANDROID_HOME'. It also shows window management variables like 'WINDOWID' and 'WINDOWID=62914570', and user-specific settings like 'USER=seed'. The list ends with 'LS_COLORS' which defines the color coding for file types in the ls command.

```
[09/05/19]seed@VM:~$ printenv
XDG_VTNR=7
XDG_SESSION_ID=c1
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
CLUTTER_IM_MODULE=xim
SESSION=ubuntu
ANDROID_HOME=/home/seed/android/android-sdk-linux
GPG_AGENT_INFO=/home/seed/.gnupg/S.gpg-agent:0:1
TERM=xterm-256color
VTE_VERSION=4205
SHELL=/bin/bash
DERBY_HOME=/usr/lib/jvm/java-8-oracle/db
QT_LINUX_ACCESSIBILITY_ALWAYS_ON=1
LD_PRELOAD=/home/seed/lib/boost/libboost_program_options.so.1.64.0:/home/seed/lib/boost/libboost_filesystem.so.1.64.0:/home/seed/lib/boost/libboost_system.so.1.64.0
WINDOWID=62914570
UPSTART_SESSION=unix:abstract=/com/ubuntu/upstart-session/1000/1519
GNOME_KEYRING_CONTROL=
GTK_MODULES=gail:atk-bridge:unity-gtk-module
USER=seed
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:*.tlz=01;31:*.txz=01;31:*.tzo=01;31:*.t7z=01;31:*.zip=01;31:*.z=01;31:*.Z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;3
```

```
Terminal
DESKTOP_SESSION=ubuntu
PATH=/home/seed/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:/usr/lib/jvm/java-8-oracle/bin:/usr/lib/jvm/java-8-oracle/db/bin:/usr/lib/jvm/java-8-oracle/jre/bin:/home/seed/android/android-sdk-linux/tools:/home/seed/android/android-sdk-linux/platform-tools:/home/seed/android/android-ndk/android-ndk-r8d:/home/seed/.local/bin
QT_IM_MODULE=ibus
QT_QPA_PLATFORMTHEME=appmenu-qt5
XDG_SESSION_TYPE=x11
PWD=/home/seed
JOB=unity-settings-daemon
XMODIFIERS=@im=ibus
JAVA_HOME=/usr/lib/jvm/java-8-oracle
GNOME_KEYRING_PID=
LANG=en_US.UTF-8
GDM_LANG=en_US
MANDATORY_PATH=/usr/share/gconf/ubuntu.mandatory.path
COMPIZ_CONFIG_PROFILE=ubuntu-lowgfx
IM_CONFIG_PHASE=1
GDMSESSION=ubuntu
SESSIONTYPE=gnome-session
GTK2_MODULES=overlay-scrollbar
SHLVL=1
HOME=/home/seed
XDG_SEAT=seat0
LANGUAGE=en_US
```

```
Terminal
UPSTART_EVENTS=xsession started
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=seed
COMPIZ_BIN_PATH=/usr/bin/
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-wAt2iWsivt
J2SDKDIR=/usr/lib/jvm/java-8-oracle
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
QT4_IM_MODULE=xim
LESSOPEN=| /usr/bin/lesspipe %s
INSTANCE=
UPSTART_JOB=unity7
XDG_RUNTIME_DIR=/run/user/1000
DISPLAY=:0
XDG_CURRENT_DESKTOP=Unity
GTK_IM_MODULE=ibus
J2REDIR=/usr/lib/jvm/java-8-oracle/jre
LESSCLOSE=/usr/bin/lesspipe %s %s
XAUTHORITY=/home/seed/.Xauthority
=/usr/bin/printenv
OLDPWD=/home/seed/rishi
[09/05/19]seed@VM:~$ printenv pwd
[09/05/19]seed@VM:~$ printenv PWD
/home/seed
[09/05/19]seed@VM:~$
```

SET AND UNSET

```
Terminal
[09/05/19]seed@VM:~$ env | grep myvar
[09/05/19]seed@VM:~$ var=42
[09/05/19]seed@VM:~$ var1="Rishi's here"
[09/05/19]seed@VM:~$ env | grep var
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
[09/05/19]seed@VM:~$ export var
[09/05/19]seed@VM:~$ export var1
[09/05/19]seed@VM:~$ env | grep var
var1=Rishi's here
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
var=42
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
[09/05/19]seed@VM:~$ unset var
[09/05/19]seed@VM:~$ env | grep var
var1=Rishi's here
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
[09/05/19]seed@VM:~$
```

VARIABLE EXPORT

```
Terminal
[09/05/19]seed@VM:~$ env | grep myvar
[09/05/19]seed@VM:~$ var=42
[09/05/19]seed@VM:~$ var1="Rishi's here"
[09/05/19]seed@VM:~$ env | grep var
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
[09/05/19]seed@VM:~$ export var
[09/05/19]seed@VM:~$ export var1
[09/05/19]seed@VM:~$ env | grep var
var1=Rishi's here
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
var=42
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
[09/05/19]seed@VM:~$
```

Task 2

CODE SNIPPET

-Inheriting Environment Variable from parent

```
#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:
            printenv();
            exit(0);
        default:
            exit(0);
    }
}
```

CHILD ENV


```
Terminal
Open [?]
#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);
    }
}

Terminal
[09/05/19]seed@VM:~/Desktop$ gcc Child.c -o Child
[09/05/19]seed@VM:~/Desktop$ ./Child
XDG_VTNR=7
XDG_SESSION_ID=c1
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
CLUTTER_IM_MODULE=xim
SESSION=ubuntu
ANDROID_HOME=/home/seed/android/android-sdk-linux
GPG_AGENT_INFO=/home/seed/.gnupg/S.gpg-agent:0:1
TERM=xterm-256color
VTE_VERSION=4205
SHELL=/bin/bash
DERBY_HOME=/usr/lib/jvm/java-8-oracle/db
QT_LINUX_ACCESSIBILITY_ALWAYS_ON=1
LD_PRELOAD=/home/seed/lib/boost/libboost_program_options.so.1.64.0:/home/seed/lib/boost/libboost_filesystem.so.1.64.0:/home/seed/lib/boost/libboost_system.so.1.64.0
WINDOWID=62914570
UPSTART_SESSION=unix:abstract=/com/ubuntu/upstart-session/1000/1519
GNOME_KEYRING_CONTROL=
GTK_MODULES=gail:atk-bridge:unity-gtk-module
USER=seed
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;40;36:*.oga=00;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
QT_ACCESSIBILITY=1
LD_LIBRARY_PATH=/home/seed/source/boost_1_64_0/stage/lib:/home/seed/source/boost_1_64_0/stage/lib:
XDG_SESSION_PATH=/org/freedesktop/DisplayManager/Session0
XDG_SEAT_PATH=/org/freedesktop/DisplayManager/Seat0
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
DEFAULTS_PATH=/usr/share/gconf/ubuntu.default.path
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/usr/share/upstart/xdg:/etc/xdg
DESKTOP_SESSION=ubuntu
PATH=/home/seed/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:./snap/bin:/usr/lib/jvm/java-8-oracle/bin:/usr/lib/jvm/java-8-oracle/db/bin:/usr/lib/jvm/java-8-oracle/jre/bin:/home/seed/android/android-sdk-linux/tools:/home/seed/android/android-sdk-linux/platform-tools:/home/seed/android/android-ndk/android-ndk-r8d:/home/seed/.local/bin
QT_IM_MODULE=ibus
QT_QPA_PLATFORMTHEME=appmenu-qt5
XDG_SESSION_TYPE=x11
PWD=/home/seed/Desktop
JOB=unity-settings-daemon
XMODIFIERS=@im=ibus
JAVA_HOME=/usr/lib/jvm/java-8-oracle
GNOME_KEYRING_PID=
LANG=en_US.UTF-8
```

```
Terminal
Open [?]
#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);
    }
}

Terminal
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
UPSTART_INSTANCE=
UPSTART_EVENTS=xsession started
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=seed
COMPIZ_BIN_PATH=/usr/bin/
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-wAt2iWsiVt
J2SDKDIR=/usr/lib/jvm/java-8-oracle
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desktop
QT4_IM_MODULE=xim
LESSOPEN=| /usr/bin/lesspipe %s
INSTANCE=
UPSTART_JOB=unity7
XDG_RUNTIME_DIR=/run/user/1000
DISPLAY=:0
XDG_CURRENT_DESKTOP=Unity
GTK_IM_MODULE=ibus
J2REDIR=/usr/lib/jvm/java-8-oracle/jre
LESSCLOSE=/usr/bin/lesspipe %s %s
XAUTHORITY=/home/seed/.Xauthority
OLDPWD=/home/seed
= ./Child
[09/05/19]seed@VM:~/Desktop$
```

PARENT ENV

```
Terminal
Open [?]
#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);
    }
}

Terminal
[09/05/19]seed@VM:~/Desktop$ gcc Parent.c -o Parent
[09/05/19]seed@VM:~/Desktop$ ./Parent
XDG_VTNR=7
XDG_SESSION_ID=c1
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
CLUTTER_IM_MODULE=xim
SESSION=ubuntu
ANDROID_HOME=/home/seed/android/android-sdk-linux
GPG_AGENT_INFO=/home/seed/.gnupg/S.gpg-agent:0:1
TERM=xterm-256color
VTE_VERSION=4205
SHELL=/bin/bash
DERBY_HOME=/usr/lib/jvm/java-8-oracle/db
QT_LINUX_ACCESSIBILITY_ALWAYS_ON=1
LD_PRELOAD=/home/seed/lib/boost/libboost_program_options.so.1.64.0:/home/seed/lib/boost/libboost_filesystem.so.1.64.0:/home/seed/lib/boost/libboost_system.so.1.64.0
WINDOWID=62914570
UPSTART_SESSION=unix:abstract=/com/ubuntu/upstart-session/1000/1519
GNOME_KEYRING_CONTROL=
GTK_MODULES=gail:atk-bridge:unity-gtk-module
USER=seed
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;4
```



```
Terminal
Open [?]
#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);
    }
}

1 64 0/stage/lib:
XDG_SESSION_PATH=/org/freedesktop/DisplayManager/Session0
XDG_SEAT_PATH=/org/freedesktop/DisplayManager/Seat0
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
DEFAULTS_PATH=/usr/share/gconf/ubuntu.default.path
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/usr/share/upstart/xdg:/etc/xdg
DESKTOP_SESSION=ubuntu
PATH=/home/seed/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin
:/usr/games:/usr/local/games:./snap/bin:/usr/lib/jvm/java-8-oracle/bin:/usr/lib
/jvm/java-8-oracle/db/bin:/usr/lib/jvm/java-8-oracle/jre/bin:/home/seed/android/
android-sdk-linux/tools:/home/seed/android/android-sdk-linux/platform-tools:/hom
e/seed/android/android-ndk/android-ndk-r8d:/home/seed/.local/bin
QT_IM_MODULE=ibus
QT_QPA_PLATFORMTHEME=appmenu-qt5
XDG_SESSION_TYPE=x11
PWD=/home/seed/Desktop
JOB=unity-settings-daemon
XMODIFIERS=@im=ibus
JAVA_HOME=/usr/lib/jvm/java-8-oracle
GNOME_KEYRING_PID=
LANG=en_US.UTF-8
GDM_LANG=en_US
MANDATORY_PATH=/usr/share/gconf/ubuntu.mandatory.path
COMPIZ_CONFIG_PROFILE=ubuntu-lowgfx
```

```
Terminal
Open [?]
#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);
    }
}

GNOME_DESKTOP_SESSION_ID=this-is-deprecated
UPSTART_INSTANCE=
UPSTART_EVENTS=xsession started
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=seed
COMPIZ_BIN_PATH=/usr/bin/
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-wAt2iWsivt
J2SDKDIR=/usr/lib/jvm/java-8-oracle
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share:/usr/share:/
var/lib/snapd/desktop
QT4_IM_MODULE=xim
LESSOPEN=| /usr/bin/lesspipe %s
INSTANCE=
UPSTART_JOB=unity7
XDG_RUNTIME_DIR=/run/user/1000
DISPLAY=:0
XDG_CURRENT_DESKTOP=Unity
GTK_IM_MODULE=ibus
J2REDIR=/usr/lib/jvm/java-8-oracle/jre
LESSCLOSE=/usr/bin/lesspipe %s %s
XAUTHORITY=/home/seed/.Xauthority
OLDPWD=/home/seed
= ./Parent
[09/05/19]seed@VM:~/Desktop$
```

DIFFERENCE BETWEEN PARENT AND CHILD ENV

[illegible]


```
Terminal
[09/07/19]seed@VM:~/Desktop$ ./File
XDG_VTNR=7
XDG_SESSION_ID=c1
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
CLUTTER_IM_MODULE=xim
SESSION=ubuntu
ANDROID_HOME=/home/seed/android/android-sdk-linux
GPG_AGENT_INFO=/home/seed/.gnupg/S.gpg-agent:0:1
TERM=xterm-256color
VTE_VERSION=4205
SHELL=/bin/bash
DERBY_HOME=/usr/lib/jvm/java-8-oracle/db
QT_LINUX_ACCESSIBILITY_ALWAYS_ON=1
LD_PRELOAD=/home/seed/lib/boost/libboost_program_options.so.1.64.0:/home/seed/lib/boost/libboost_f
ilesystem.so.1.64.0:/home/seed/lib/boost/libboost_system.so.1.64.0
WINDOWID=65011722
UPSTART_SESSION=unix:abstract=/com/ubuntu/upstart-session/1000/1519
GNOME_KEYRING_CONTROL=
GTK_MODULES=gail:atk-bridge:unity-gtk-module
USER=seed
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:*.tlz=01;31:*.
txz=01;31:*.tzo=01;31:*.t7z=01;31:*.zip=01;31:*.z=01;31:*.Z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;3
```

```
Terminal
LIBGL_ALWAYS_SOFTWARE=1
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
UPSTART_INSTANCE=
UPSTART_EVENTS=xsession started
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=seed
COMPIZ_BIN_PATH=/usr/bin/
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-wAt2iWsivt
J2SDKDIR=/usr/lib/jvm/java-8-oracle
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share:/usr/share:/var/lib/snapd/desk
top
QT4_IM_MODULE=xim
LESSOPEN=| /usr/bin/lesspipe %s
INSTANCE=
UPSTART_JOB=unity7
XDG_RUNTIME_DIR=/run/user/1000
DISPLAY=:0
XDG_CURRENT_DESKTOP=Unity
GTK_IM_MODULE=ibus
J2REDIR=/usr/lib/jvm/java-8-oracle/jre
LESSCLOSE=/usr/bin/lesspipe %s %s
XAUTHORITY=/home/seed/.Xauthority
./File
OLDPWD=/home/seed
[09/07/19]seed@VM:~/Desktop$ ./File
```

NULL ARGUMENT

```
Terminal
[09/07/19]seed@VM:~/Desktop$ gcc File1.c -o File1
[09/07/19]seed@VM:~/Desktop$ ./File1
[09/07/19]seed@VM:~/Desktop$
```

DIFFERENCE BETWEEN NULL AND ENVIRONMENT VARIABLE

```
Terminal
[09/07/19]seed@VM:~/Desktop$ gcc File1.c -o File1
[09/07/19]seed@VM:~/Desktop$ ./File1
[09/07/19]seed@VM:~/Desktop$ diff File1 File
Binary files File1 and File differ
[09/07/19]seed@VM:~/Desktop$ diff File1.c File.c
10c10
<     execve("/usr/bin/env" , argv, NULL);
---
>     execve("/usr/bin/env" , argv, environ);
[09/07/19]seed@VM:~/Desktop$
```

CODE SNIPPET

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

extern char **environ;

int main()
{
    char *argv[2];
```

```

argv[0] = "/usr/bin/env";
argv[1] = NULL;

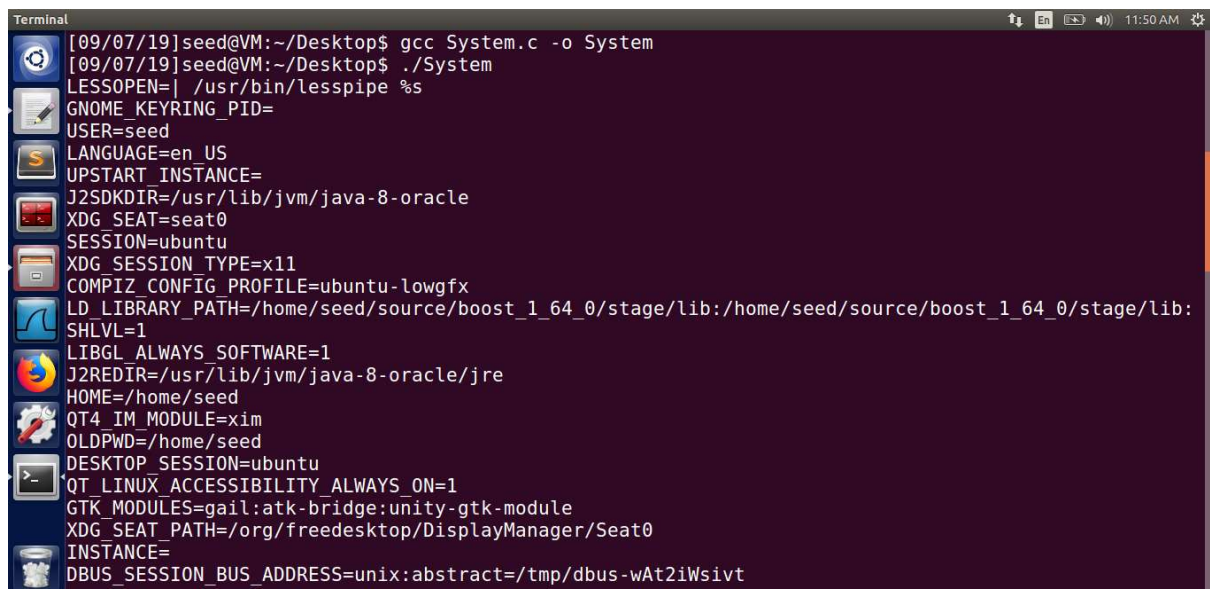
execve("/usr/bin/env", argv, NULL);

return 0;
}

```

Task 4

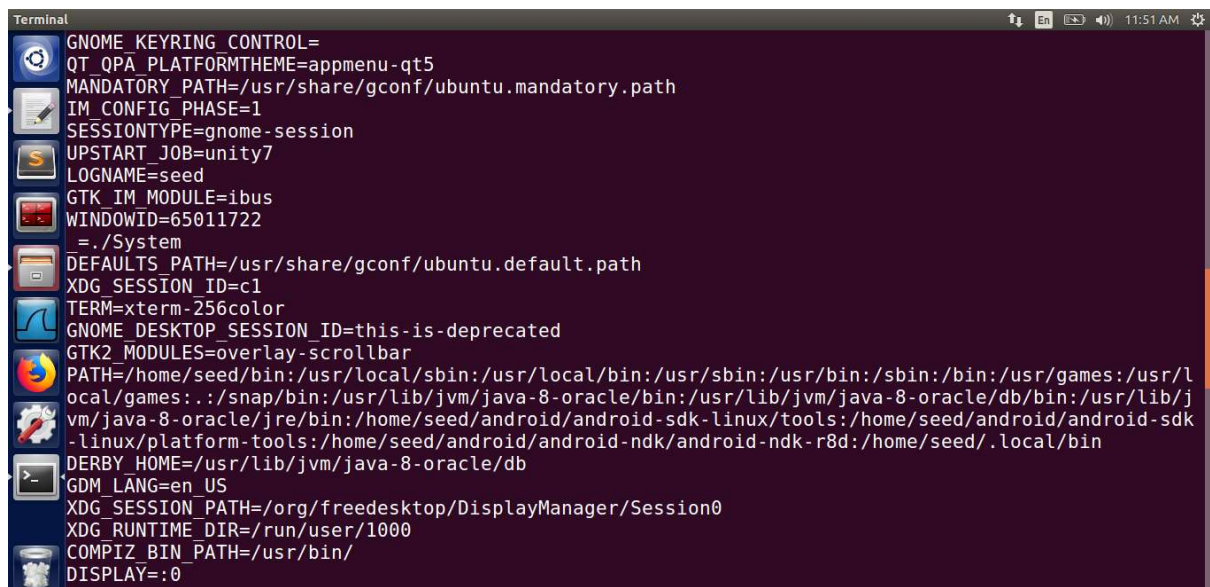
Environment Variable and System



```

Terminal
[09/07/19]seed@VM:~/Desktop$ gcc System.c -o System
[09/07/19]seed@VM:~/Desktop$ ./System
LESSOPEN=| /usr/bin/lesspipe %s
GNOME_KEYRING_PID=
USER=seed
LANGUAGE=en_US
UPSTART_INSTANCE=
J2SDKDIR=/usr/lib/jvm/java-8-oracle
XDG_SEAT=seat0
SESSION=ubuntu
XDG_SESSION_TYPE=x11
COMPIZ_CONFIG_PROFILE=ubuntu-lowgfx
LD_LIBRARY_PATH=/home/seed/source/boost_1_64_0/stage/lib:/home/seed/source/boost_1_64_0/stage/lib:
SHLVL=1
LIBGL_ALWAYS_SOFTWARE=1
J2REDIR=/usr/lib/jvm/java-8-oracle/jre
HOME=/home/seed
QT4_IM_MODULE=xim
OLDPWD=/home/seed
DESKTOP_SESSION=ubuntu
QT_LINUX_ACCESSIBILITY_ALWAYS_ON=1
GTK_MODULES=gail:atk-bridge:unity-gtk-module
XDG_SEAT_PATH=/org/freedesktop/DisplayManager/Seat0
INSTANCE=
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-wAt2iWsivt

```



```

Terminal
GNOME_KEYRING_CONTROL=
QT_QPA_PLATFORMTHEME=appmenu-qt5
MANDATORY_PATH=/usr/share/gconf/ubuntu.mandatory.path
IM_CONFIG_PHASE=1
SESSIONTYPE=gnome-session
UPSTART_JOB=unity7
LOGNAME=seed
GTK_IM_MODULE=ibus
WINDOWID=65011722
./System
DEFAULTS_PATH=/usr/share/gconf/ubuntu.default.path
XDG_SESSION_ID=c1
TERM=xterm-256color
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
GTK2_MODULES=overlay-scrollbar
PATH=/home/seed/bin:/usr/local/sbin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin:/usr/lib/jvm/java-8-oracle/bin:/usr/lib/jvm/java-8-oracle/db/bin:/usr/lib/jvm/java-8-oracle/jre/bin:/home/seed/android/android-sdk-linux/tools:/home/seed/android/android-sdk-linux/platform-tools:/home/seed/android/android-ndk/android-ndk-r8d:/home/seed/.local/bin
DERBY_HOME=/usr/lib/jvm/java-8-oracle/db
GDM_LANG=en_US
XDG_SESSION_PATH=/org/freedesktop/DisplayManager/Session0
XDG_RUNTIME_DIR=/run/user/1000
COMPIZ_BIN_PATH=/usr/bin/
DISPLAY=:0

```

```
Terminal
;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:*.tlz=01;31:*.
txz=01;31:*.tzo=01;31:*.t7z=01;31:*.zip=01;31:*.z=01;31:*.Z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;3
1:*.lz=01;31:*.lzo=01;31:*.xz=01;31:*.bz2=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.tz=01;31:*.d
eb=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:*.jpg=01;35:*.jpeg=01;35:*.gif=0
1;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:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=01;35:*.yuv=01;35:*.c
gm=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:*.midi=00;36:*.mka=00;36:*.mp3=00;36:*.mpc=00;36:*.ogg=00;36:*.ra=00;36:*.wav=00;36:*.oga=0
0;36:*.opus=00;36:*.spx=00;36:*.xspf=00;36:
XMODIFIERS=@im=ibus
XDG_SESSION_DESKTOP=ubuntu
XAUTHORITY=/home/seed/.Xauthority
XDG_GREETER_DATA_DIR=/var/lib/lightdm-data/seed
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
SHELL=/bin/bash
QT_ACCESSIBILITY=1
GDMSESSION=ubuntu
LESSCLOSE=/usr/bin/lesspipe %s %s
UPSTART_EVENTS=xsession started
GPG_AGENT_INFO=/home/seed/.gnupg/S.gpg-agent:0:1
```

CODE SNIPPET

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

int main()
{
system("/usr/bin/env");

return 0;
}
```

Task 5

-Environment and Set UID

CODE SNIPPET


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

extern char **environ;

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

```
root@VM: /home/seed
root@VM:/home/seed# vim task5.c
root@VM:/home/seed# gcc -o task5 task5.c
root@VM:/home/seed# chmod u+s task5
root@VM:/home/seed# exit
logout
[09/08/19]seed@VM:/home$ cd ..
[09/08/19]seed@VM:/ $ cd ..
[09/08/19]seed@VM:/ $ ls
bin      dev      initrd.img  media  proc  sbin  sys  var
boot     etc      lib         mnt    root  snap  tmp  vmlinuz
cdrom    home    lost+found  opt     run   srv   usr
[09/08/19]seed@VM:/ $ cd ..
[09/08/19]seed@VM:/ $ cd ~
[09/08/19]seed@VM:/ $ export MY_Env="task5"
[09/08/19]seed@VM:/ $ export PATH="task5":$PATH
[09/08/19]seed@VM:/ $ ./task5 | grep "task5"
PATH=task5:foo.c:foo:my env:/home/seed/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:./snap/bin:/usr/lib/jvm/java-8-oracle/bin:/usr/lib/jvm/java-8-oracle/db/bin:/usr/lib/jvm/java-8-oracle/jre/bin:/home/seed/android/android-sdk-linux/tools:/home/seed/android/android-sdk-linux/platform-tools:/home/seed/android/android-ndk/android-ndk-r8d:/home/seed/.local/bin
MY_Env=task5
=./task5
[09/08/19]seed@VM:/ $
```

Task6

-The Path Environment Variable and Set-UID

CODE SNIPPET

```
int main()
{
    system("ls");
    return 0;
}
```

```
root@VM: /home/seed
root@VM:/home/seed# vim task6.c
root@VM:/home/seed# gcc -o task6 task6.c
root@VM:/home/seed# chmod u+s task6
root@VM:/home/seed# exit
logout
[09/08/19]seed@VM:~$ ./task6
android      Desktop    examples.desktop  Music    source  Templates
bin           Documents  get-pip.py        Pictures task6    typescript
Customization Downloads  lib               Public   task6.c  Videos
[09/08/19]seed@VM:~$
```

```
root@VM: /home/seed
root@VM:/home/seed# vim task6.c
root@VM:/home/seed# gcc -o task6 task6.c
root@VM:/home/seed# chmod u+s task6
root@VM:/home/seed# exit
logout
[09/08/19]seed@VM:~$ ./task6
android      Desktop    examples.desktop  Music    source  Templates
bin           Documents  get-pip.py        Pictures task6    typescript
Customization Downloads  lib               Public   task6.c  Videos
[09/08/19]seed@VM:~$
```

```
root@VM: /home/seed/Desktop
root@VM:/home/seed/Desktop# gcc -o task6 task6.c
root@VM:/home/seed/Desktop# chmod u+s task6
root@VM:/home/seed/Desktop# exit
exit
[09/13/19]seed@VM:~/Desktop$ cp /bin/sh /tmp/ls
[09/13/19]seed@VM:~/Desktop$ ./task6
libmylib.so.1.0.1 mylib.o sml1 t9.c task6.c task8.c test.txt
mylib.c out.txt t9 task6 task8 task9.c
[09/13/19]seed@VM:~/Desktop$
```

```
root@VM: /home/seed/Desktop
root@VM:/home/seed/Desktop# gcc -o task6 task6.c
root@VM:/home/seed/Desktop# chmod u+s task6
root@VM:/home/seed/Desktop# exit
exit
[09/13/19]seed@VM:~/Desktop$ cp /bin/sh /tmp/ls
[09/13/19]seed@VM:~/Desktop$ ./task6
libmylib.so.1.0.1 mylib.o sml1 t9.c task6.c task8.c test.txt
mylib.c out.txt t9 task6 task8 task9.c
[09/13/19]seed@VM:~/Desktop$ id
uid=1000(seed) gid=1000(seed) groups=1000(seed),4(adm),24(cdrom),27(sudo),30(dip),46(plugdev),113(lpadmin),128(sambashare)
[09/13/19]seed@VM:~/Desktop$
```

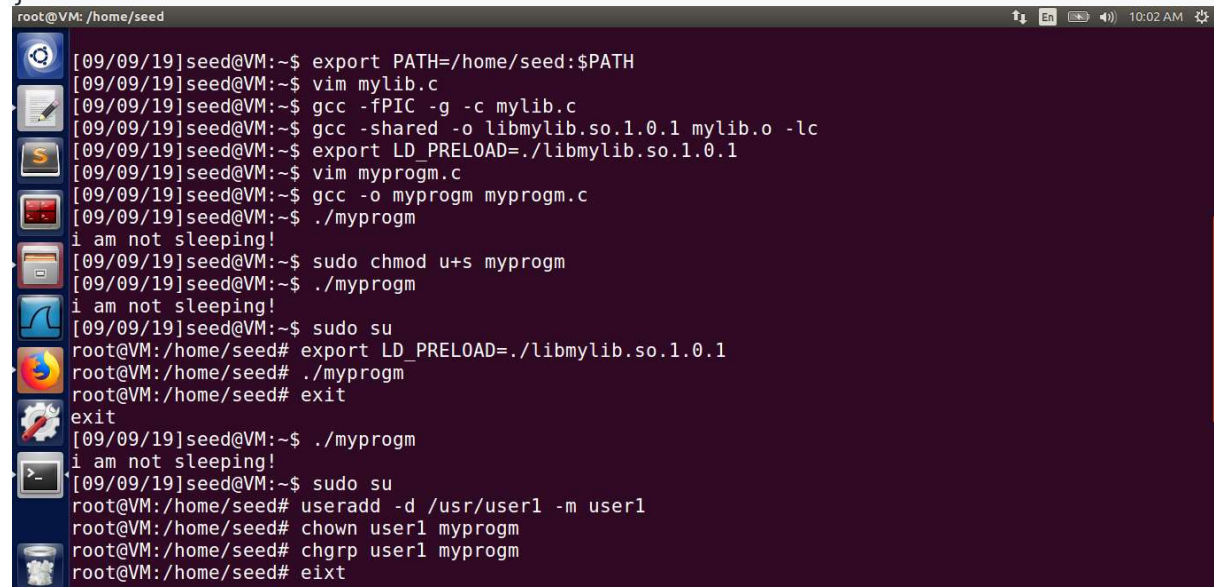
Observation

It can have root privilege, copy /bin/sh to /tmp/ls. Then compile and run system program and we will get root privilege.

Task7

CODE SNIPPET

```
#include<stdio.h>
void sleep(int s)
{
printf("I am not sleeping!\n");
}
```



A terminal window titled 'root@VM: /home/seed' showing a series of commands and their outputs. The user sets the PATH to include the current directory, compiles a custom sleep function into a shared library (libmylib.so.1.0.1), and then runs a program (myprog.c) that uses this library. The program prints 'i am not sleeping!' and then sleeps for 1 second. The user then switches to root and adds a new user (user1) to the system, setting permissions for the program.

```
root@VM: /home/seed
[09/09/19]seed@VM:~$ export PATH=/home/seed:$PATH
[09/09/19]seed@VM:~$ vim mylib.c
[09/09/19]seed@VM:~$ gcc -fPIC -g -c mylib.c
[09/09/19]seed@VM:~$ gcc -shared -o libmylib.so.1.0.1 mylib.o -lc
[09/09/19]seed@VM:~$ export LD_PRELOAD=./libmylib.so.1.0.1
[09/09/19]seed@VM:~$ vim myprog.c
[09/09/19]seed@VM:~$ gcc -o myprog myprog.c
[09/09/19]seed@VM:~$ ./myprog
i am not sleeping!
[09/09/19]seed@VM:~$ sudo chmod u+s myprog
[09/09/19]seed@VM:~$ ./myprog
i am not sleeping!
[09/09/19]seed@VM:~$ sudo su
root@VM:/home/seed# export LD_PRELOAD=./libmylib.so.1.0.1
root@VM:/home/seed# ./myprog
root@VM:/home/seed# exit
exit
[09/09/19]seed@VM:~$ ./myprog
i am not sleeping!
[09/09/19]seed@VM:~$ sudo su
root@VM:/home/seed# useradd -d /usr/user1 -m user1
root@VM:/home/seed# chown user1 myprog
root@VM:/home/seed# chgrp user1 myprog
root@VM:/home/seed# eixt
```

```
//myprog.c
int main()
{
sleep(1);
return 0;
}
```



```
root@VM: /home/seed# useradd -d /usr/user1 -m user1
root@VM: /home/seed# chown user1 myprog
root@VM: /home/seed# chgrp user1 myprog
root@VM: /home/seed# eixt
eixt: command not found
root@VM: /home/seed#
root@VM: /home/seed#
root@VM: /home/seed#
root@VM: /home/seed#
root@VM: /home/seed#
root@VM: /home/seed#
root@VM: /home/seed#
root@VM: /home/seed# exit
exit
[09/09/19]seed@VM:~$ export LD_PRELOAD=./libmylib.so.1.0.1
[09/09/19]seed@VM:~$ ./myprog
i am not sleeping!
[09/09/19]seed@VM:~$
```

Observation

From the four conditions, we know that only a user run the program created by himself, LD_PRELOAD environment variable can be used and sleep () function can be override.

Task 8

CODE SNIPPET

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

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

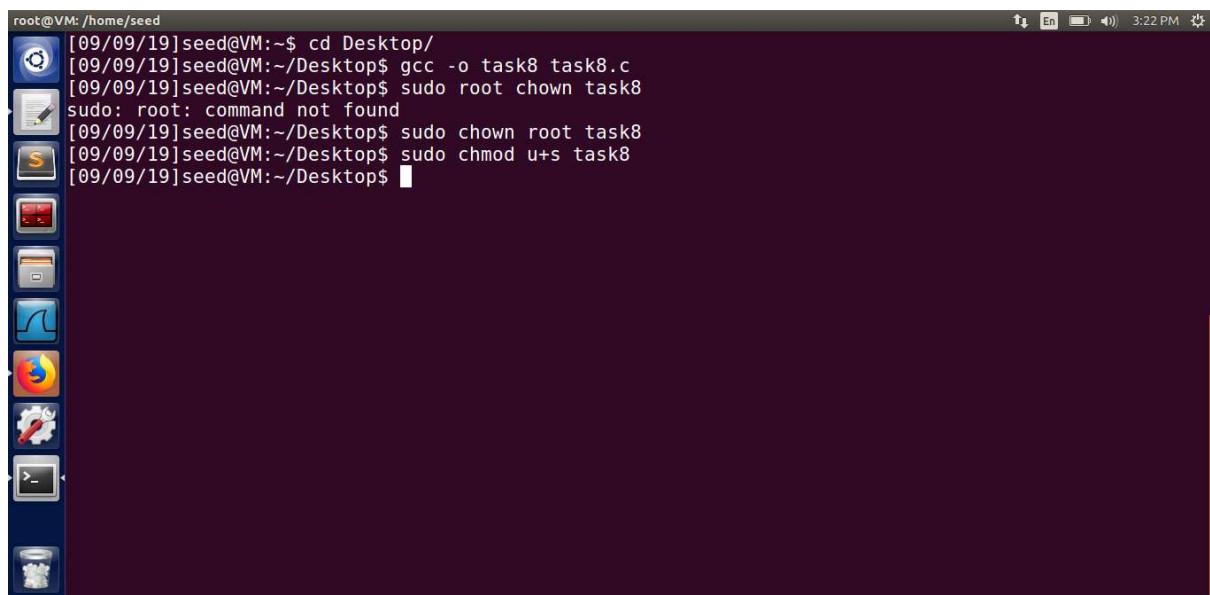
    if(argc < 2) {
        printf("Please type a file name.\n");
        return 1;
    }
}
```

```
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]);

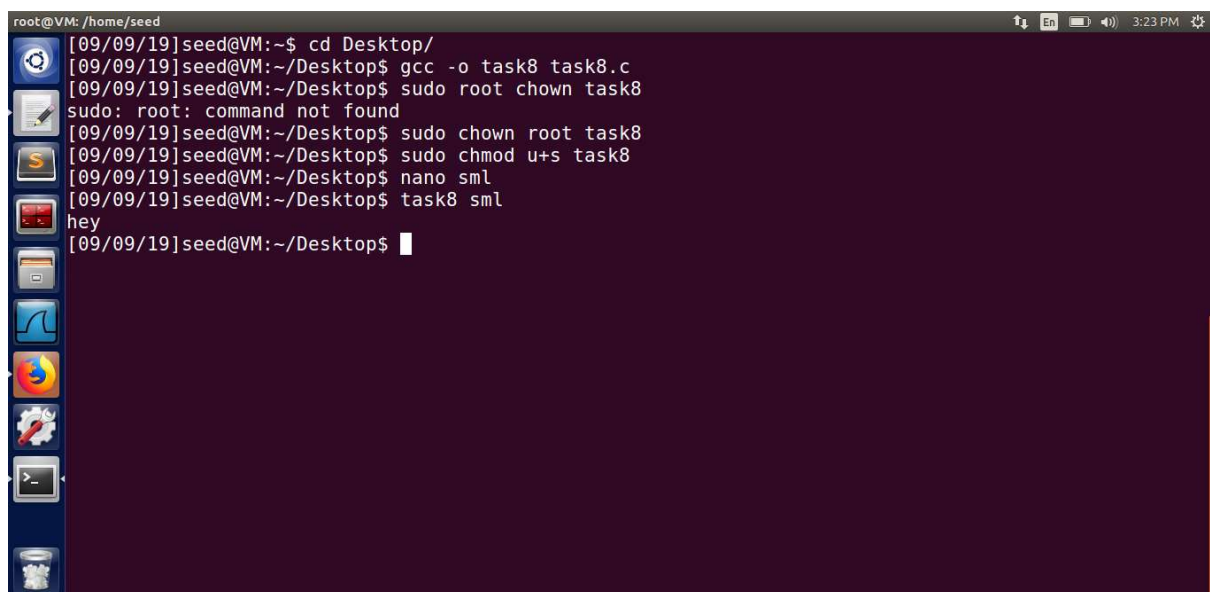
// Use only one of the followings.
system(command);
// execve(v[0], v, NULL);

return 0;
}
```



A terminal window titled 'root@VM: /home/seed' showing the following commands and output:

```
[09/09/19]seed@VM:~$ cd Desktop/
[09/09/19]seed@VM:~/Desktop$ gcc -o task8 task8.c
[09/09/19]seed@VM:~/Desktop$ sudo root chown task8
sudo: root: command not found
[09/09/19]seed@VM:~/Desktop$ sudo chown root task8
[09/09/19]seed@VM:~/Desktop$ sudo chmod u+s task8
[09/09/19]seed@VM:~/Desktop$
```



A terminal window titled 'root@VM: /home/seed' showing the following commands and output:

```
[09/09/19]seed@VM:~$ cd Desktop/
[09/09/19]seed@VM:~/Desktop$ gcc -o task8 task8.c
[09/09/19]seed@VM:~/Desktop$ sudo root chown task8
sudo: root: command not found
[09/09/19]seed@VM:~/Desktop$ sudo chown root task8
[09/09/19]seed@VM:~/Desktop$ sudo chmod u+s task8
[09/09/19]seed@VM:~/Desktop$ nano sml
[09/09/19]seed@VM:~/Desktop$ task8 sml
hey
[09/09/19]seed@VM:~/Desktop$
```

```
root@VM: /home/seed
[09/09/19]seed@VM:~$ cd Desktop/
[09/09/19]seed@VM:~/Desktop$ gcc -o task8 task8.c
[09/09/19]seed@VM:~/Desktop$ sudo root chown task8
sudo: root: command not found
[09/09/19]seed@VM:~/Desktop$ sudo chown root task8
[09/09/19]seed@VM:~/Desktop$ sudo chmod u+s task8
[09/09/19]seed@VM:~/Desktop$ nano sml
hey
[09/09/19]seed@VM:~/Desktop$ rm sml
[09/09/19]seed@VM:~/Desktop$ nano sl
[09/09/19]seed@VM:~/Desktop$ task8 sml
/bin/cat: sml: No such file or directory
[09/09/19]seed@VM:~/Desktop$ task8 sl
hey
[09/09/19]seed@VM:~/Desktop$ task8 "sl;rm sl"
hey
[09/09/19]seed@VM:~/Desktop$ ls
libmylib.so.1.0.1 mylib.c mylib.o task8 task8.c
[09/09/19]seed@VM:~/Desktop$
```

```
root@VM: /home/seed
hey
[09/09/19]seed@VM:~/Desktop$ ls
libmylib.so.1.0.1 mylib.c mylib.o task8 task8.c
[09/09/19]seed@VM:~/Desktop$ nano task8.c
[09/09/19]seed@VM:~/Desktop$ gcc -o task8 task8.c
task8.c: In function 'main':
task8.c:20:2: warning: implicit declaration of function 'execve' [-Wimplicit-function-declaration]
  execve(v[0], v, NULL);
  ^
[09/09/19]seed@VM:~/Desktop$ nano task8.c
[09/09/19]seed@VM:~/Desktop$ gcc -o task8 task8.c
[09/09/19]seed@VM:~/Desktop$ ./task8
Please type a file name.
[09/09/19]seed@VM:~/Desktop$ nano sml
[09/09/19]seed@VM:~/Desktop$ ./task8
Please type a file name.
[09/09/19]seed@VM:~/Desktop$ ./task8
Please type a file name.
[09/09/19]seed@VM:~/Desktop$ ./task8 sml
hello
[09/09/19]seed@VM:~/Desktop$ task8 "sml;rm sml"
/bin/cat: 'sml;rm sml': No such file or directory
[09/09/19]seed@VM:~/Desktop$ ls
libmylib.so.1.0.1 mylib.c mylib.o sml task8 task8.c
[09/09/19]seed@VM:~/Desktop$
```

Observation

The task8 file is not safe, Bob can read, write or move files which only root user can run.

Task 9

CODE SNIPPET

```
#include <stdio.h>
#include <stdlib.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>
#include <unistd.h>
void main()
{
    int fd;
    // Assume that /etc/zxx is an important system file,
    // and it is owned by root with permission 0644.
    // Before running this program, you should creat
    // the file /etc/zxx first.
    fd = open("/etc/zxx", O_RDWR | O_APPEND);
    if(fd == -1) {
        printf("Cannot open /etc/zxx\n");
        exit(0);
    }
    // Simulate the tasks conducted by the program
    sleep(1);
    // After the task, the root privileges are no longer needed,
    // it's time to relinquish the root privileges permanently.
    setuid(getuid()); // getuid() returns the real uid
    if(fork()) { // In the parent process
        close(fd);
        exit(0);
    } else { // in the child process
        //Now, assume that the child process is compromised, malicious
        //attackers have injected the following statements
        //into this process
        write(fd, "Malicious Data", 14);
        close(fd);
    }
}
```



```
Terminal
[09/13/19]seed@VM:/etc$ sudo gcc -o Task9 TASK9.C
[09/13/19]seed@VM:/etc$ chmod u+s TASK9
chmod: changing permissions of 'TASK9': Operation not permitted
[09/13/19]seed@VM:/etc$ sudo chmod u+s TASSK9
chmod: cannot access 'TASSK9': No such file or directory
[09/13/19]seed@VM:/etc$ sudo chmod u+s TASK9
[09/13/19]seed@VM:/etc$ exit
exit
There are stopped jobs.
[09/13/19]seed@VM:/etc$ sudo ls -al zzz TASK9
-rwsr-xr-x 1 root root 7640 Sep 13 20:13 TASK9
-rw-r--r-- 1 root root 17 Sep 13 19:51 zzz
[09/13/19]seed@VM:/etc$ ./TASK9
[09/13/19]seed@VM:/etc$ sudo cat zzz
hey zzz file !!!
Malicious Data[09/13/19]seed@VM:/etc$
```

As we can see, the file has been modified, the reason is file zzz is opened before set uid. To avoid this problem, we can move `setuid (getuid ())` to the front of `open()` function.