Task1

[09/02/20]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
XDG_MENU_PREFIX=gnome-
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=60817418
UPSTART_SESSION=unix:abstract=/com/ubuntu/upstart-session/1000/1510
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;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:*.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:*.jpg=01;35:*.jpeg=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:*.flv=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:*.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:
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
SESSION_MANAGER=local/VM:@/tmp/.ICE-unix/1815,unix/VM:/tmp/.ICE-unix/1815
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
JOB=dbus
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
IM_CONFIG_PHASE=1
GDMSESSION=ubuntu
SESSIONTYPE=gnome-session
GTK2_MODULES=overlay-scrollbar
SHLVL=1
HOME=/home/seed
XDG_SEAT=seat0
LANGUAGE=en_US
LIBGL_ALWAYS_SOFTWARE=1
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=seed
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-ncSWIB8xY9
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=
XDG_RUNTIME_DIR=/run/user/1000
DISPLAY=:0

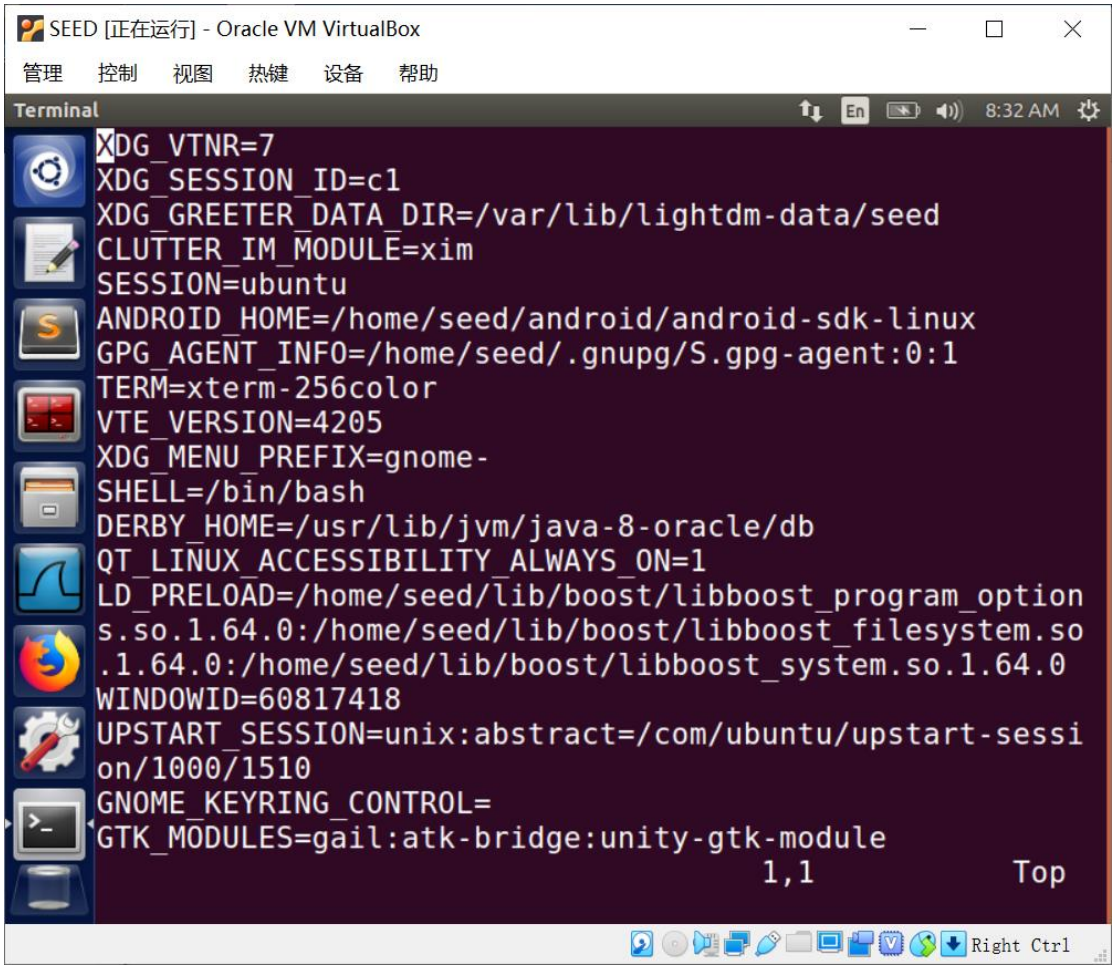
XDG_CURRENT_DESKTOP=Unity
GTK_IM_MODULE=ibus
J2REDIR=/usr/lib/jvm/java-8-oracle/jre
LESSCLOSE=/usr/bin/lesspipe %s %s
XAUTHORITY=/home/seed/.Xauthority
_=/usr/bin/printenv

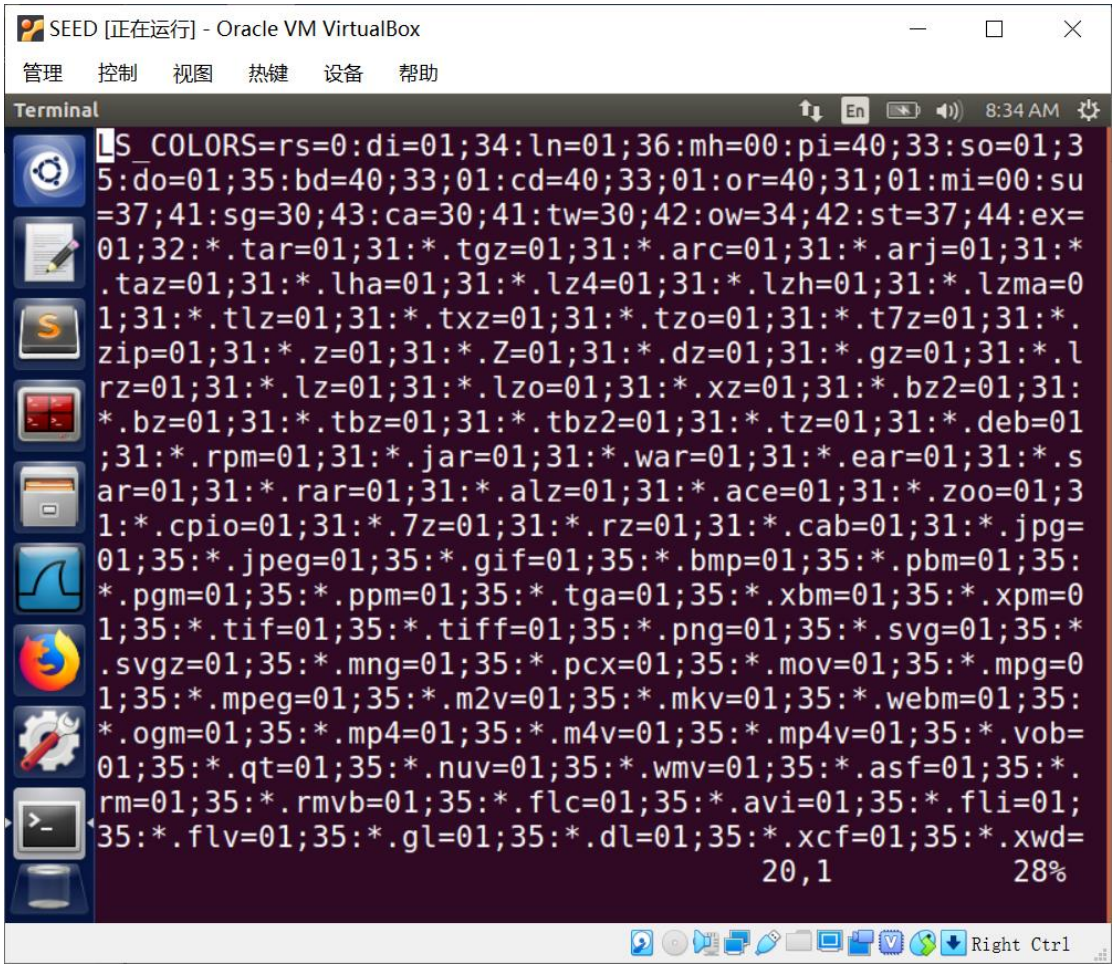
[09/02/20]seed@VM:~$ printenv PWD
/home/seed

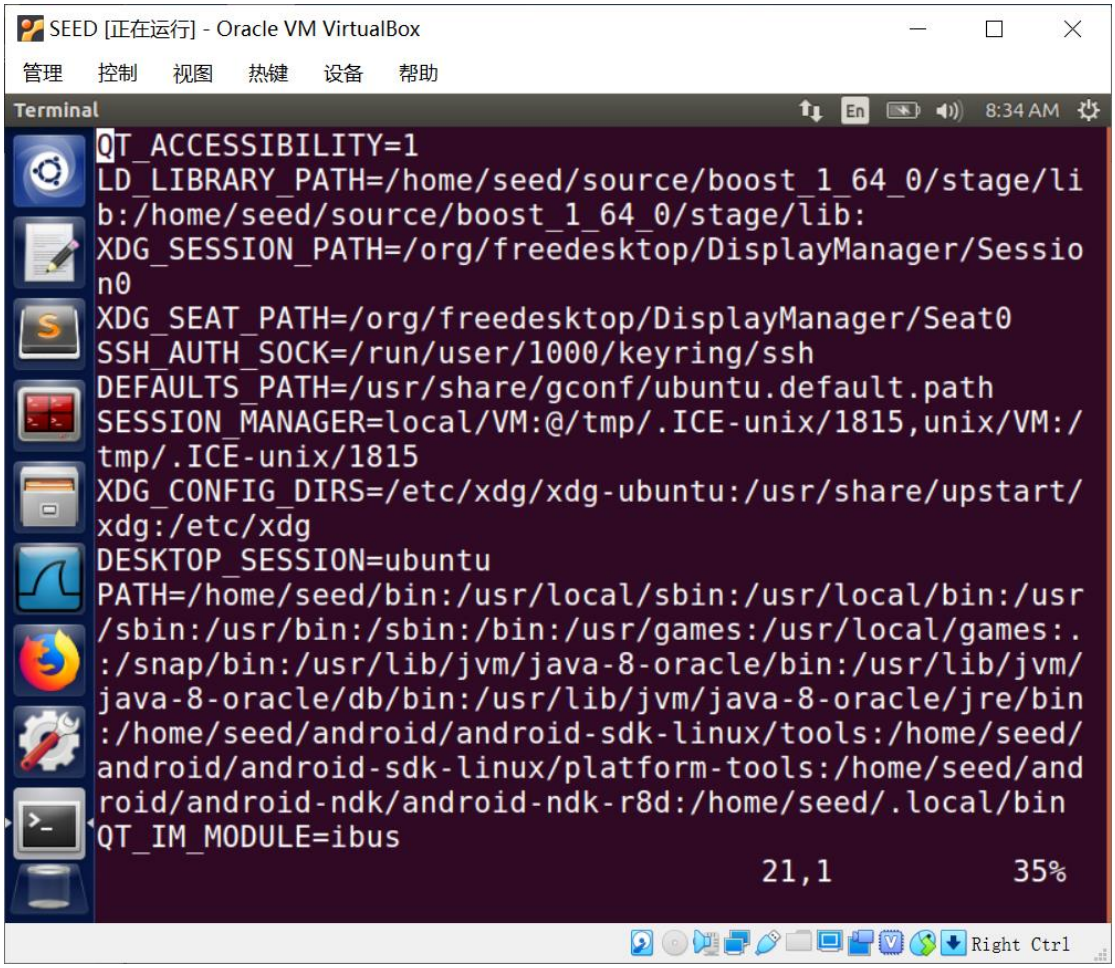
[09/02/20]seed@VM:~$ export jinhui=111111
[09/02/20]seed@VM:~$ printenv jinhui
111111
[09/02/20]seed@VM:~$ unset jinhui
[09/02/20]seed@VM:~$ printenv jinhui

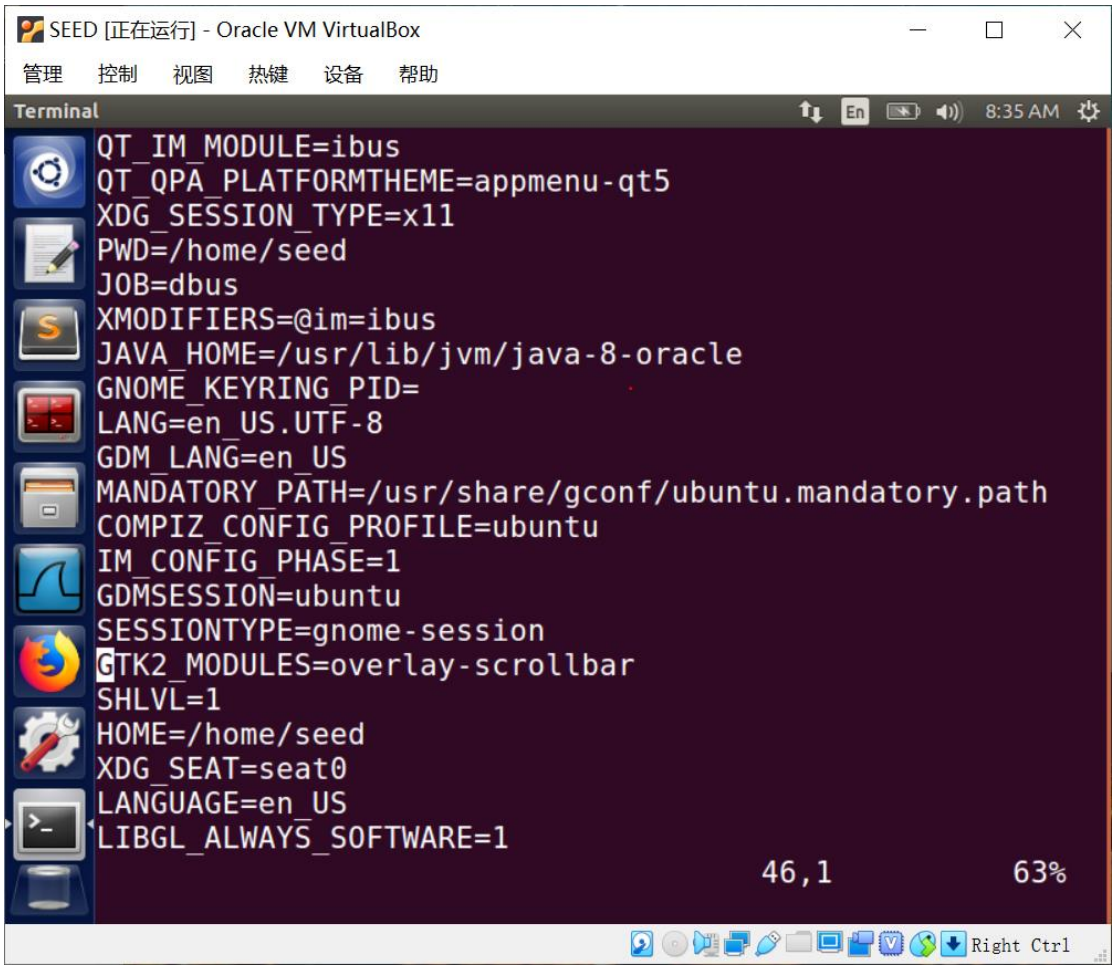
Task2

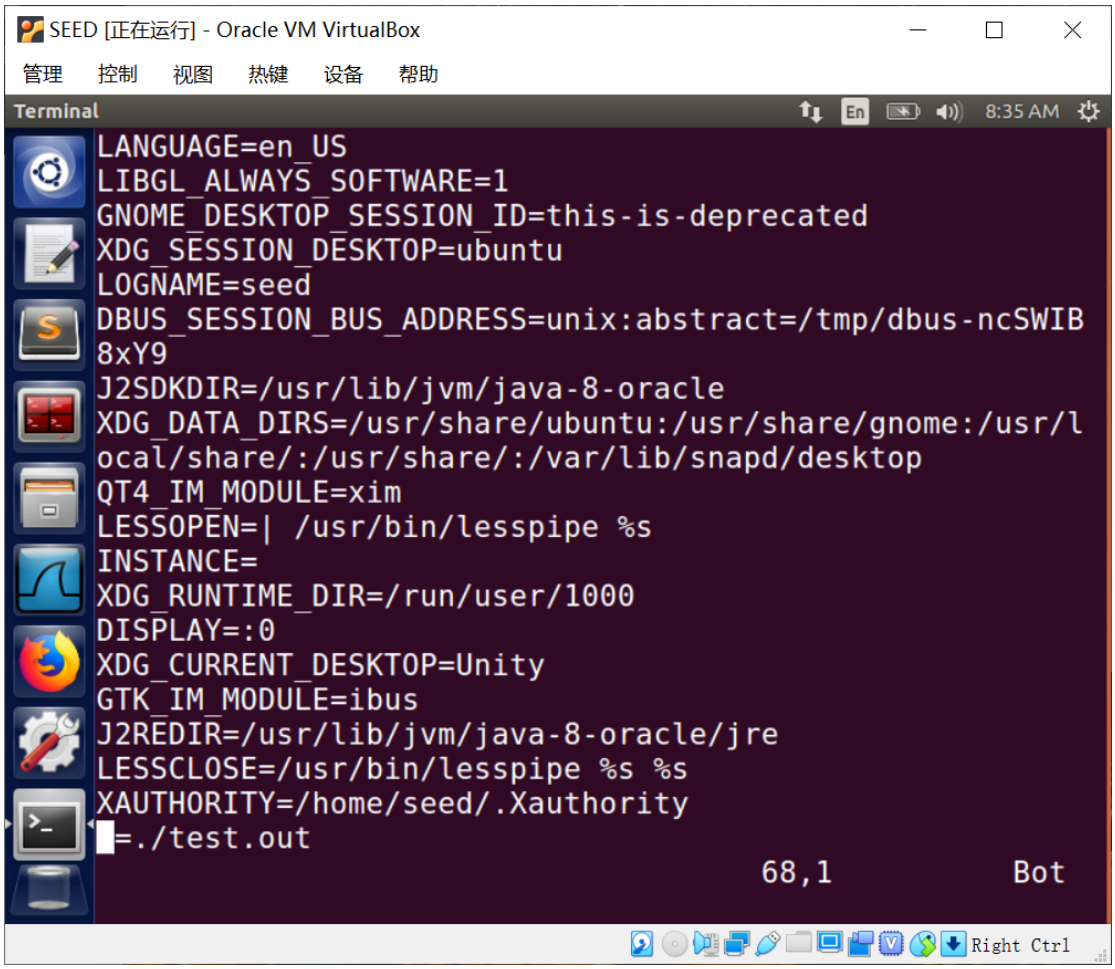
Step1:



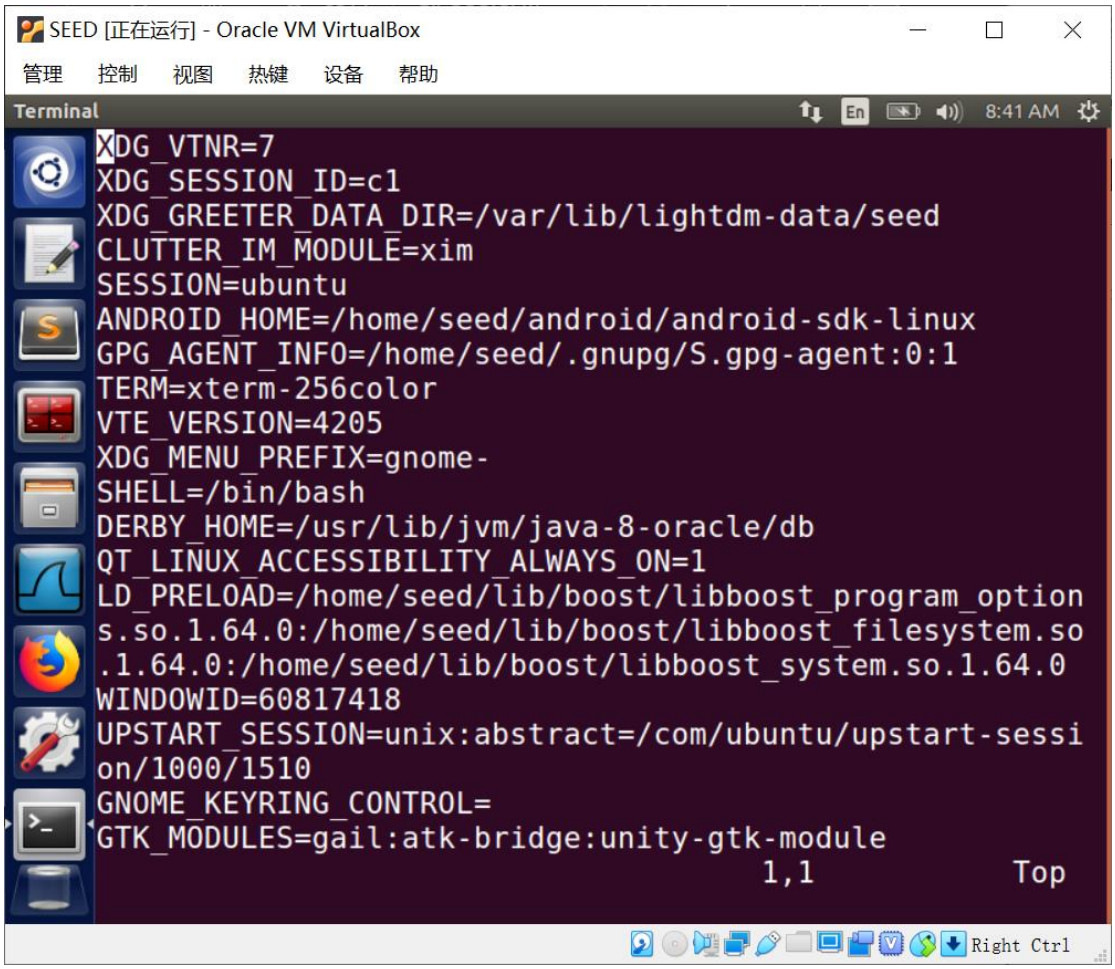

SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
8:34 AM
LS_COLORS=rs=0:di=01;34:ln=01;36:mh=00:pi=40;33:so=01;35:do=01;35:bd=40;33;01:cd=40;33;01:or=40;31;01:mi=00:su=37;41:sg=30;43:ca=30;41:tw=30;42:ow=34;42:st=37;44:ex=01;32:*.tar=01;31:*.tgz=01;31:*.arc=01;31:*.arj=01;31:*.taz=01;31:*.lha=01;31:*.lz4=01;31:*.lzh=01;31:*.lzma=01;31:*.tlz=01;31:*.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;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:*.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:*.jpg=01;35:*.jpeg=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:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=
20,1 28%
Right Ctrl

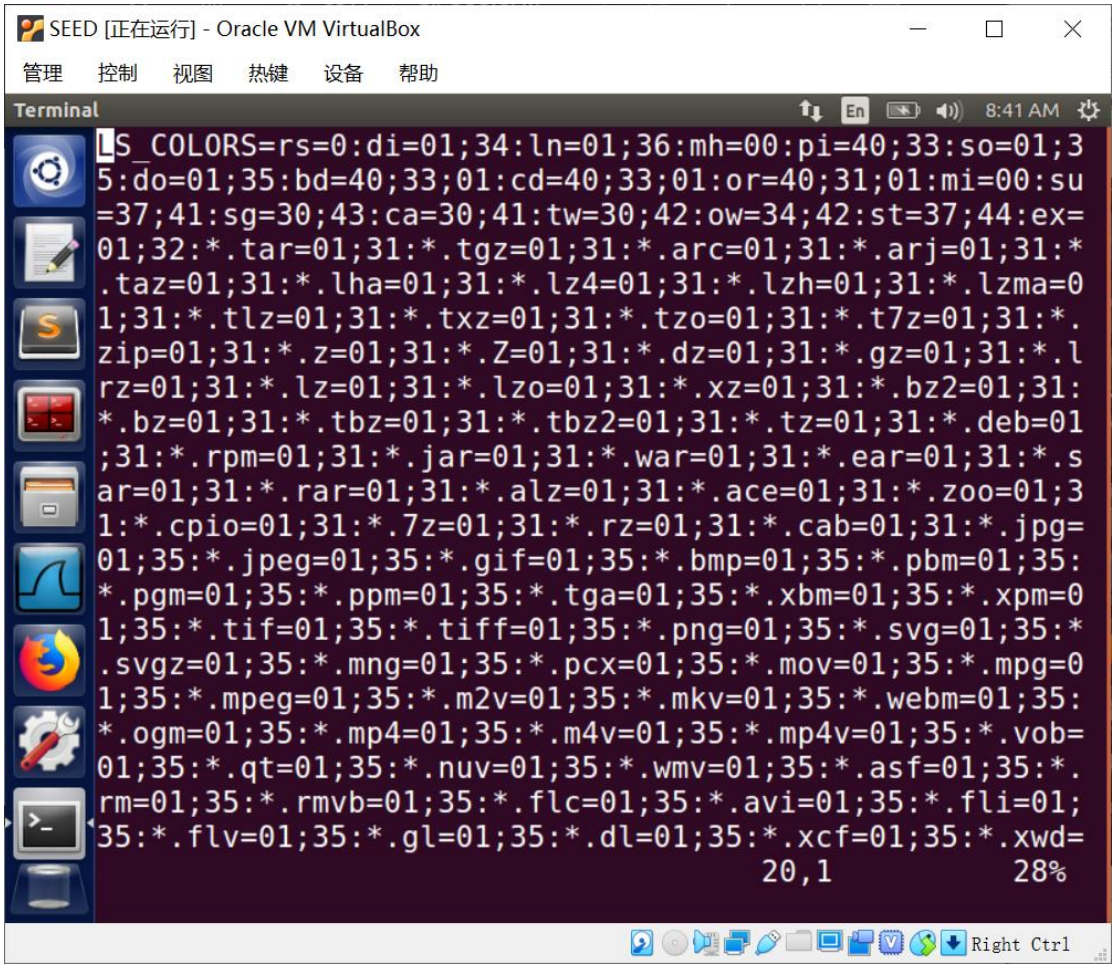

SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
8:34 AM
QT_ACCESSIBILITY=1
LD_LIBRARY_PATH=/home/seed/source/boost_1_64_0/stage/lib:/home/seed/source/boost_1_64_0/stage/lib:
XDG_SESSION_PATH=/org/freedesktop/DisplayManager/Session0
XDG_SEAT_PATH=/org/freedesktop/DisplayManager/Seat0
SSH_AUTH_SOCK=/run/user/1000/keyring/ssh
DEFAULTS_PATH=/usr/share/gconf/ubuntu.default.path
SESSION_MANAGER=local/VM:@/tmp/.ICE-unix/1815,unix/VM:/tmp/.ICE-unix/1815
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
21,1 35%
Right Ctrl

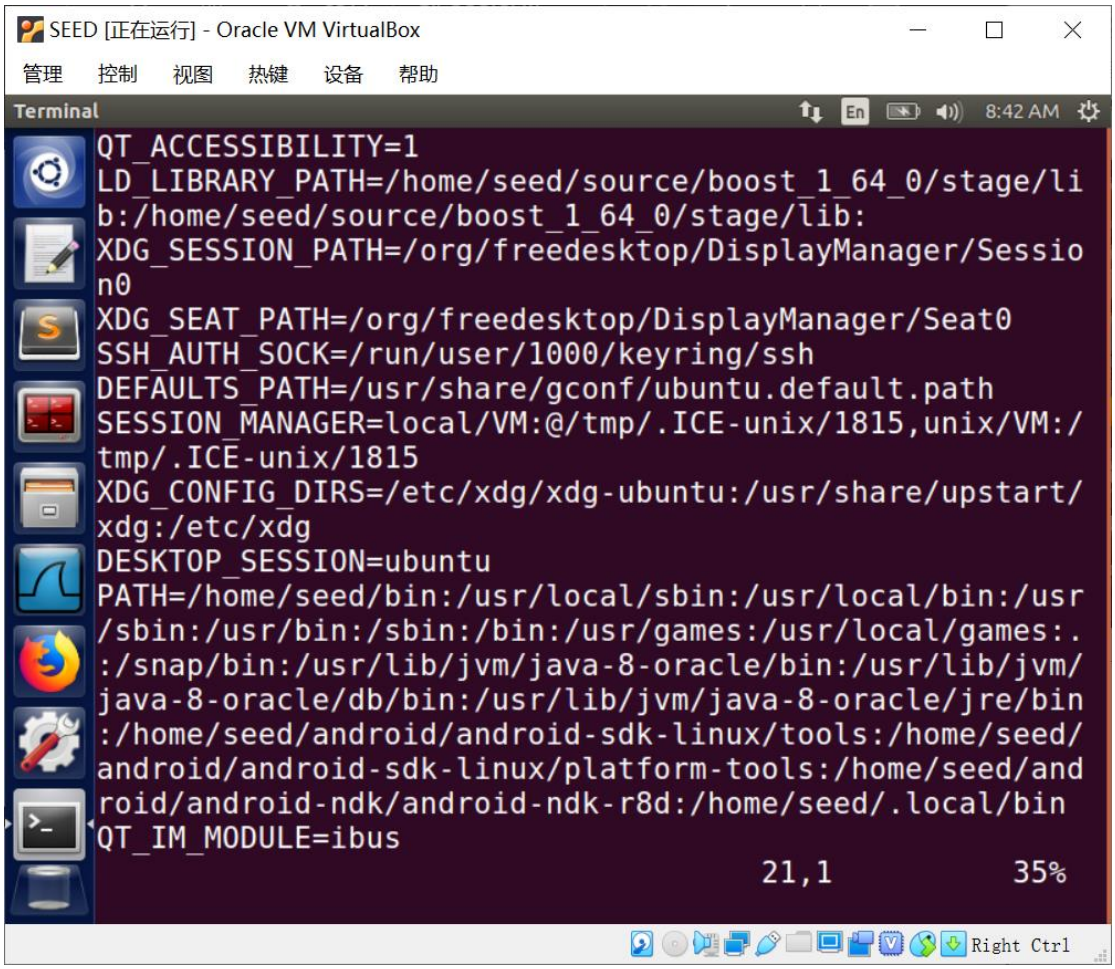

SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
8:35 AM
QT_IM_MODULE=ibus
QT_QPA_PLATFORMTHEME=appmenu-qt5
XDG_SESSION_TYPE=x11
PWD=/home/seed
JOB=dbus
XMODIFIERS=@im=ibus
JAVA_HOME=/usr/lib/jvm/java-8-oracle
GNOME_KEYRING_PID=
LANG=en_US.UTF-8
GDM_LANG=en_US
MANDATORY_PATH=/usr/share/gconf/ubuntu.mandatory.path
COMPIZ_CONFIG_PROFILE=ubuntu
IM_CONFIG_PHASE=1
GDMSESSION=ubuntu
SESSIONTYPE=gnome-session
GTK2_MODULES=overlay-scrollbar
SHLVL=1
HOME=/home/seed
XDG_SEAT=seat0
LANGUAGE=en_US
LIBGL_ALWAYS_SOFTWARE=1
46,1 63%
Right Ctrl

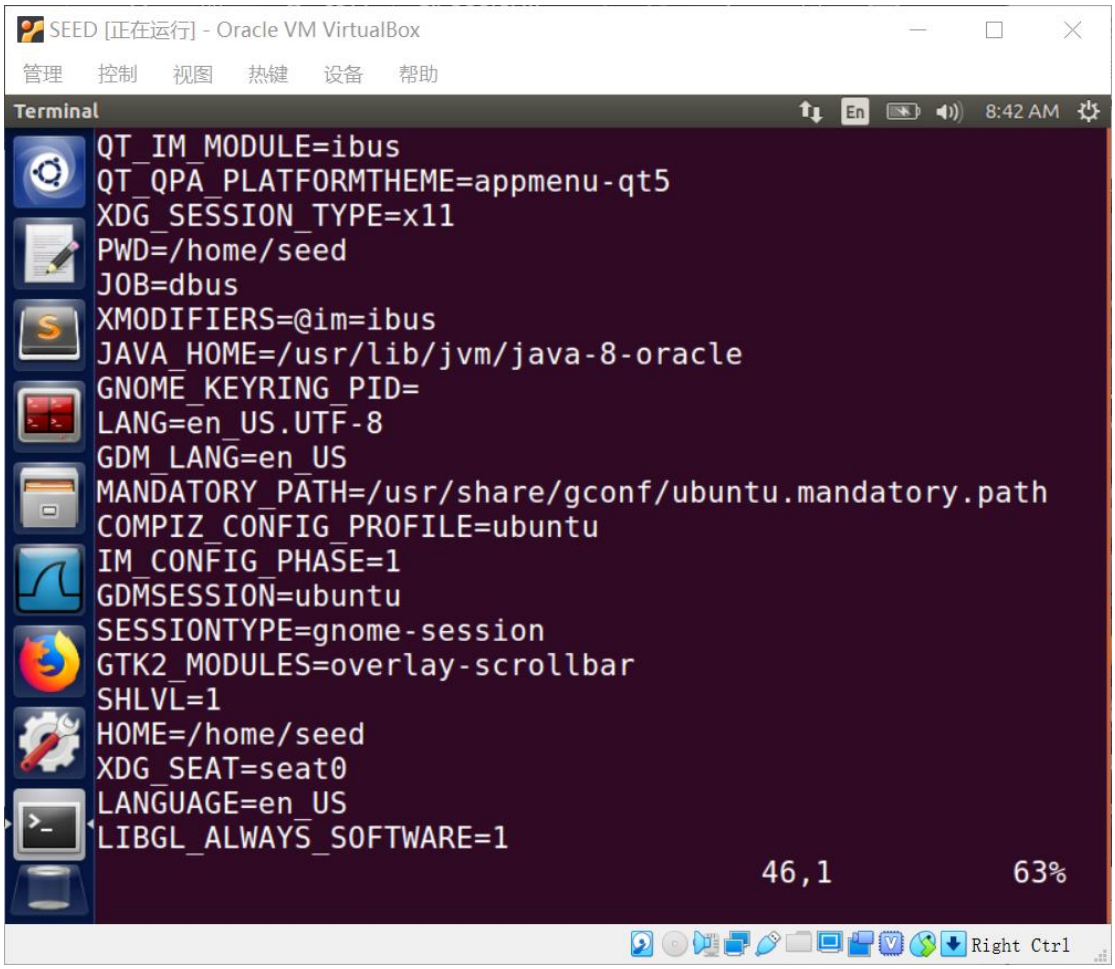

SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
8:35 AM
LANGUAGE=en_US
LIBGL_ALWAYS_SOFTWARE=1
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
XDG_SESSION_DESKTOP=ubuntu
LOGNAME=seed
DBUS_SESSION_BUS_ADDRESS=unix:abstract=/tmp/dbus-ncSWIB
8xY9
J2SDKDIR=/usr/lib/jvm/java-8-oracle
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/share/gnome:/usr/l
ocal/share/:/usr/share/:/var/lib/snapd/desktop
QT4_IM_MODULE=xim
LESSOPEN=| /usr/bin/lesspipe %s
INSTANCE=
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
=./test.out
68,1 Bot
Right Ctrl

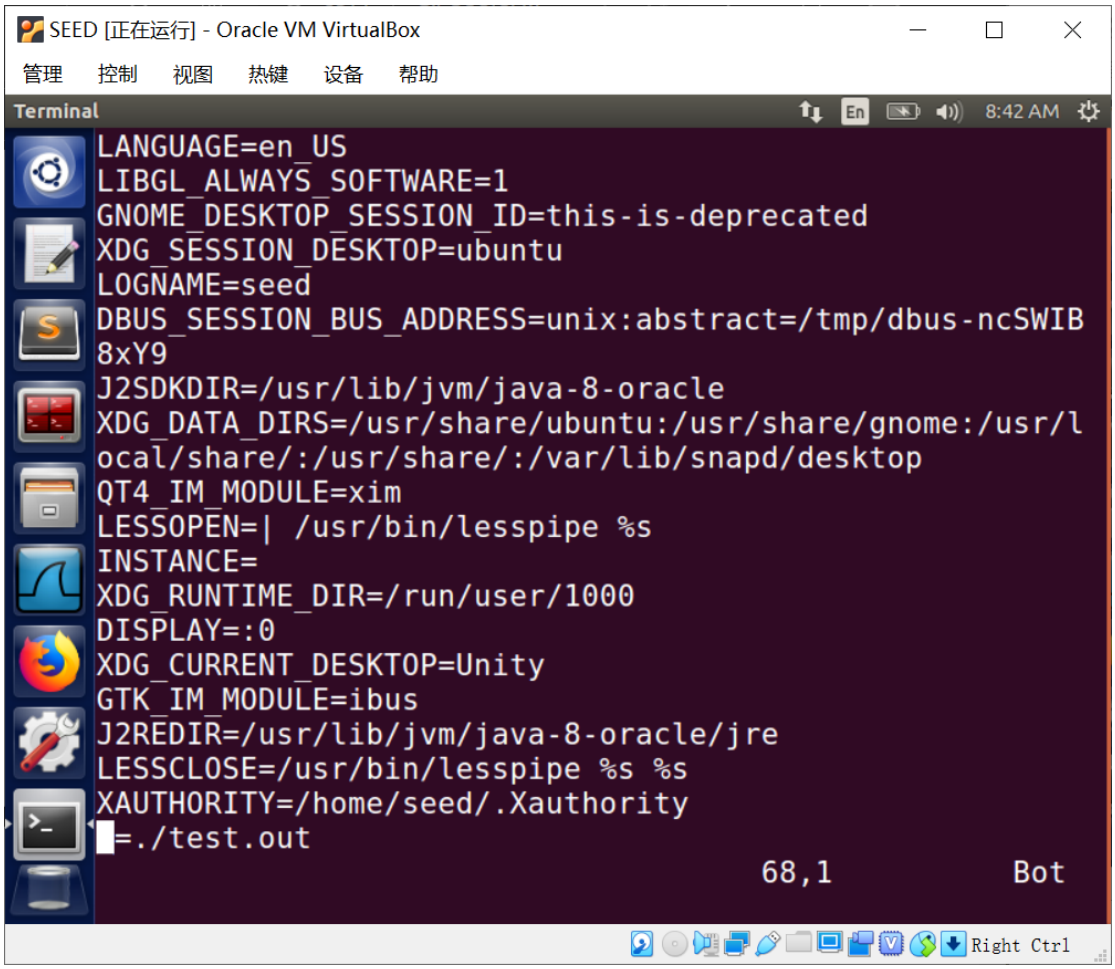
Step2:


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
8:41 AM
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
XDG_MENU_PREFIX=gnome-
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_option
s.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=60817418
UPSTART_SESSION=unix:abstract=/com/ubuntu/upstart-sessi
on/1000/1510
GNOME_KEYRING_CONTROL=
GTK_MODULES=gail:atk-bridge:unity-gtk-module
1,1 Top
Right Ctrl


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
8:41 AM
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;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:*.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:*.jpg=01;35:*.jpeg=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:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=
20,1 28%
Right Ctrl


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
8:42 AM
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
SESSION_MANAGER=local/VM:@/tmp/.ICE-unix/1815,unix/VM:/tmp/.ICE-unix/1815
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
21,1 35%
Right Ctrl


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
8:42 AM
QT_IM_MODULE=ibus
QT_QPA_PLATFORMTHEME=appmenu-qt5
XDG_SESSION_TYPE=x11
PWD=/home/seed
JOB=dbus
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
IM_CONFIG_PHASE=1
GDMSESSION=ubuntu
SESSIONTYPE=gnome-session
GTK2_MODULES=overlay-scrollbar
SHLVL=1
HOME=/home/seed
XDG_SEAT=seat0
LANGUAGE=en_US
LIBGL_ALWAYS_SOFTWARE=1
46,1 63%
Right Ctrl



Step3:

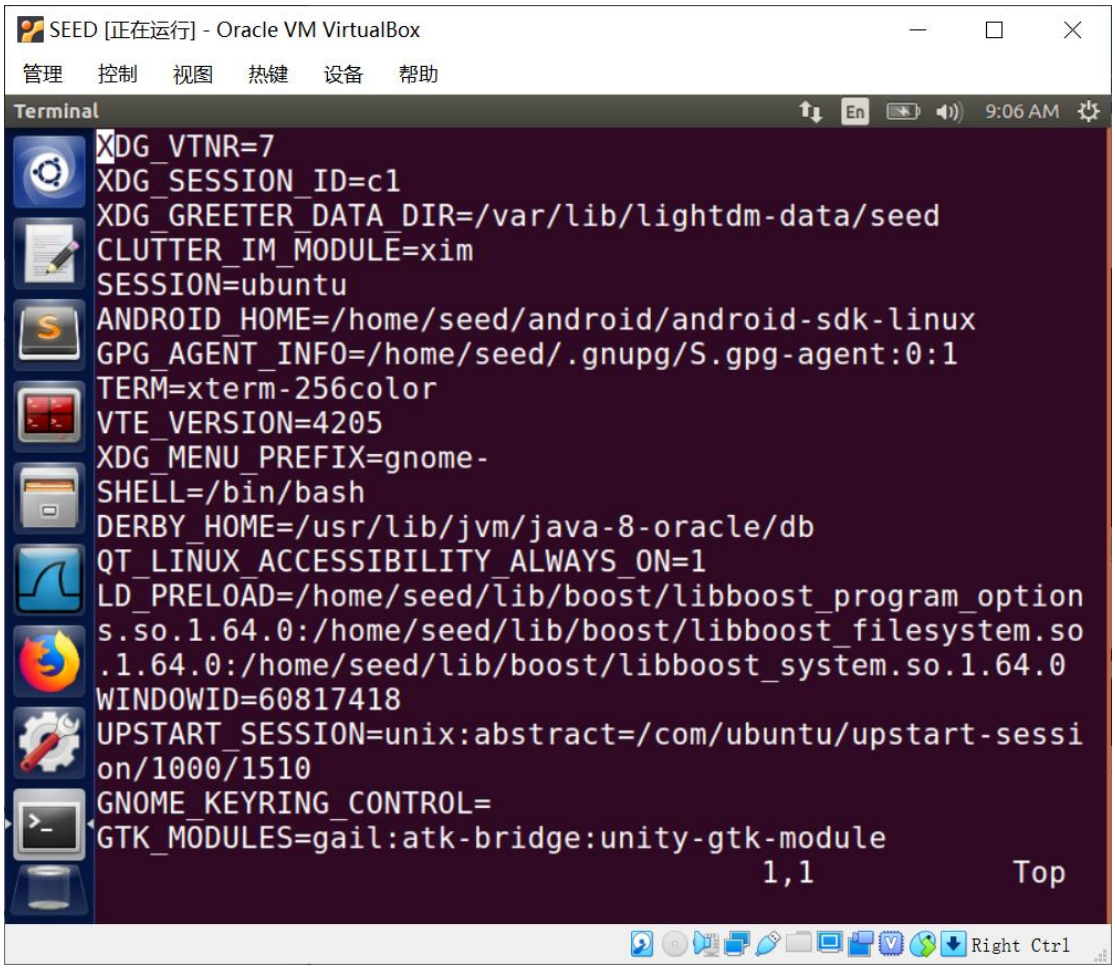
```
[09/02/20]seed@VM:~$ diff output1 output
[09/02/20]seed@VM:~$
```

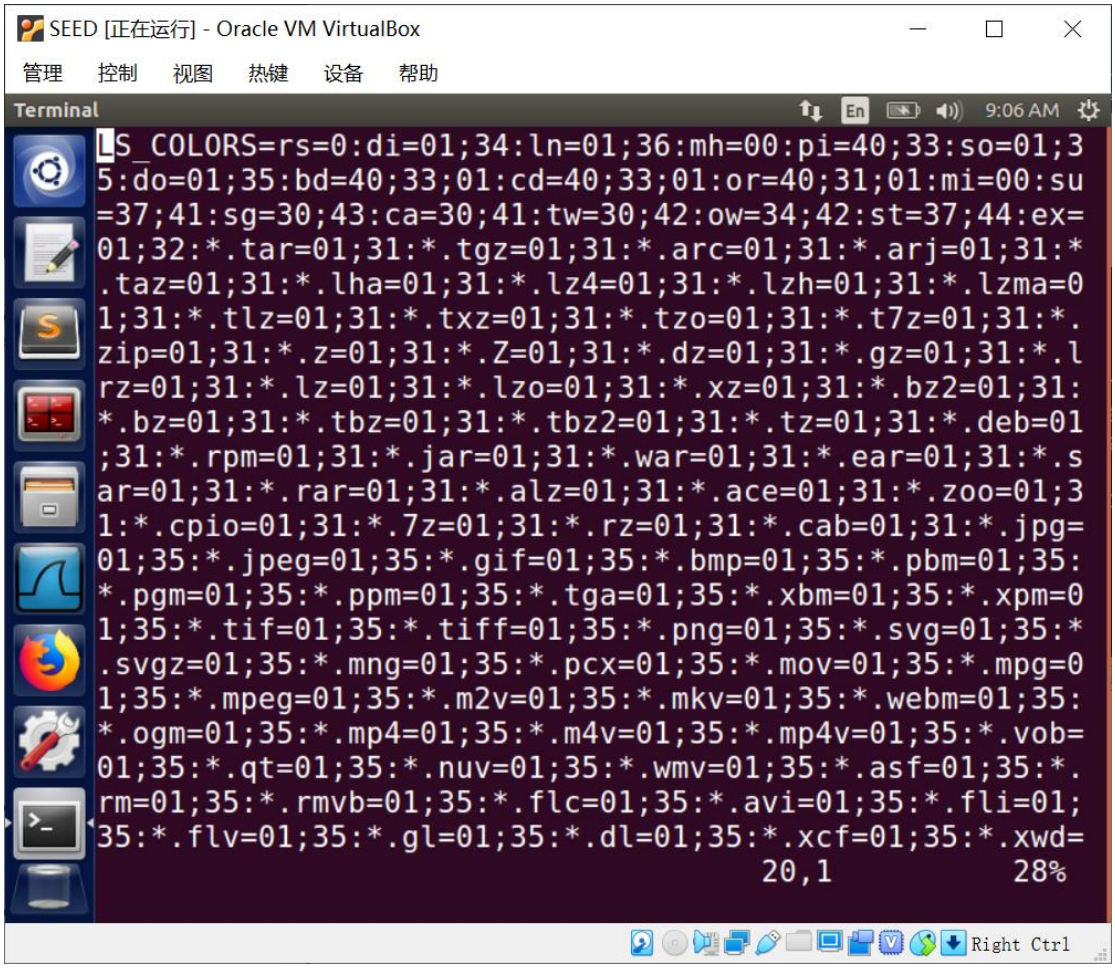
通过 diff 命令比较得两个文件完全相同，可以得到结论：继承父进程的子进程会继承父进程的所有环境变量。

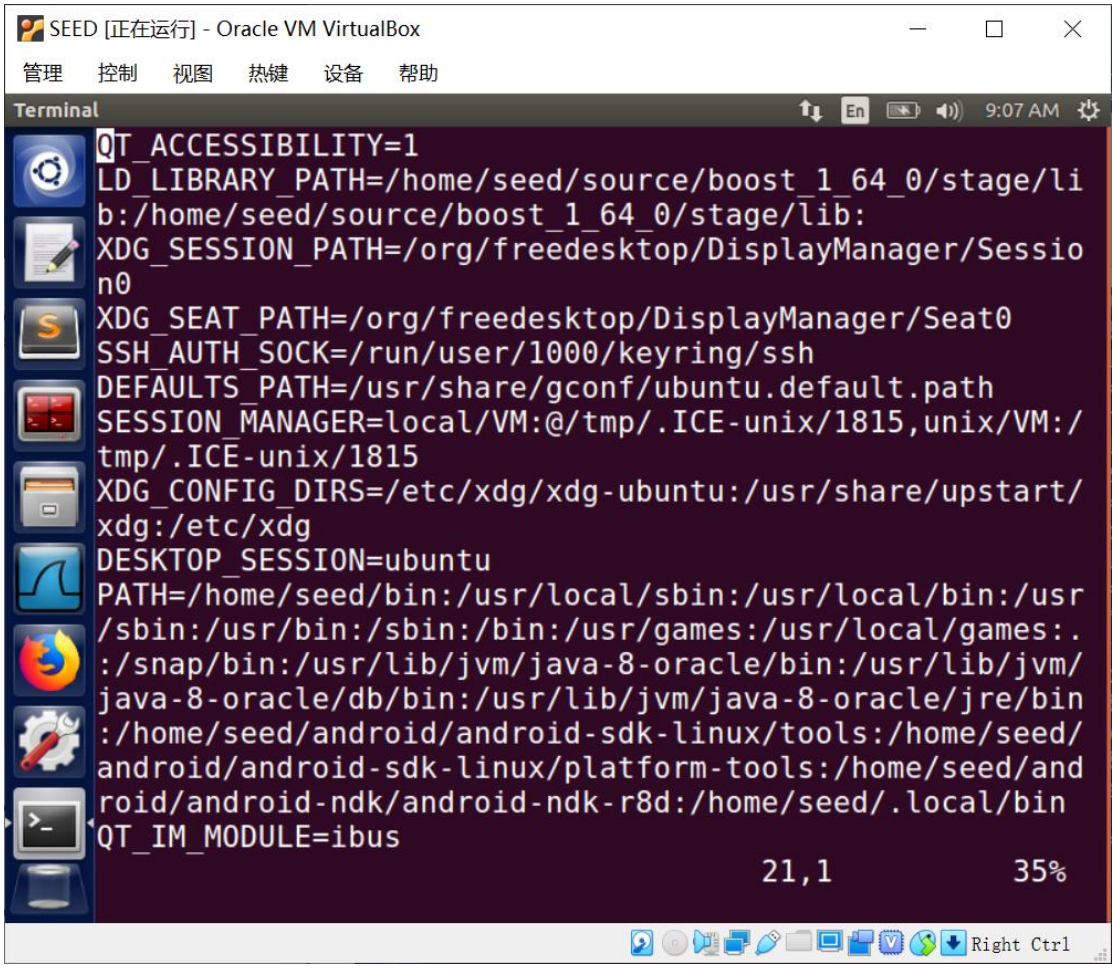
Task3

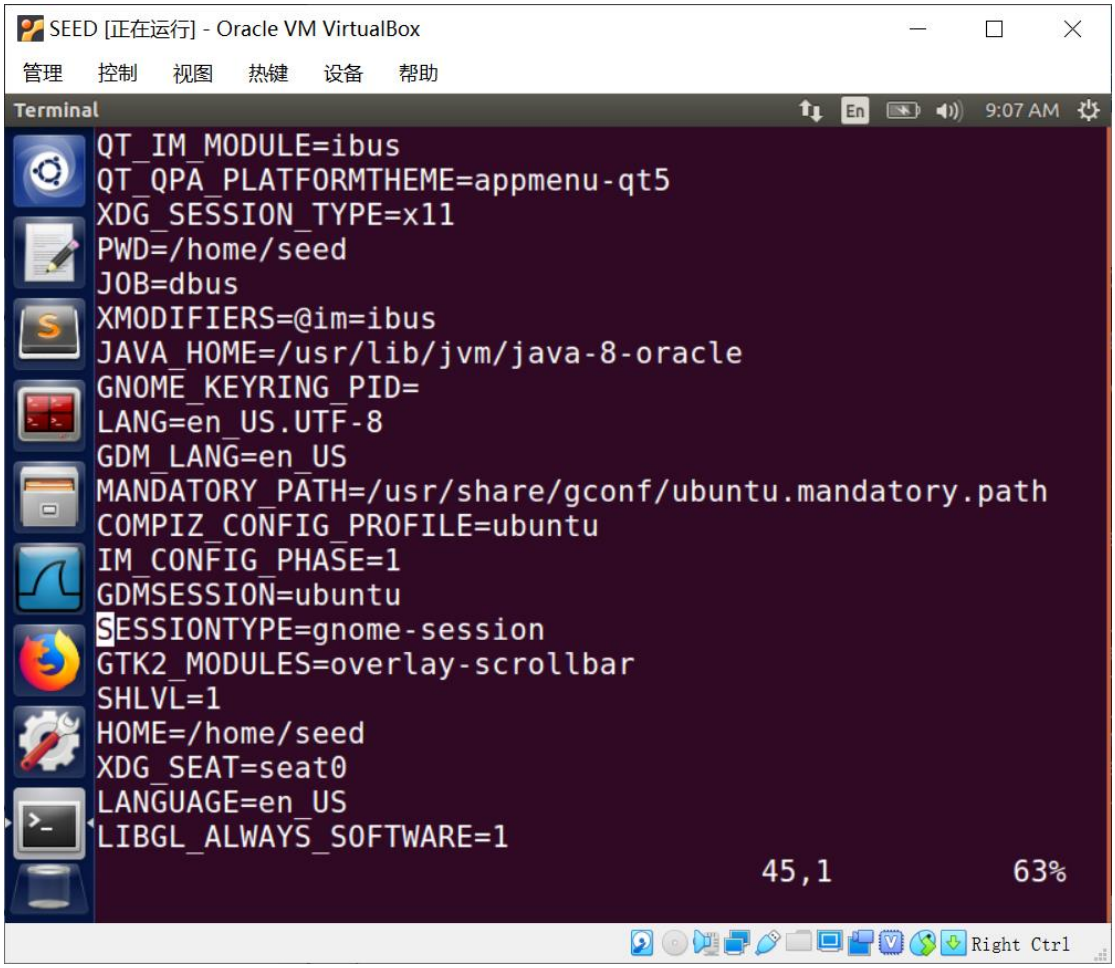
Step1:程序运行结果表示当前环境变量为空

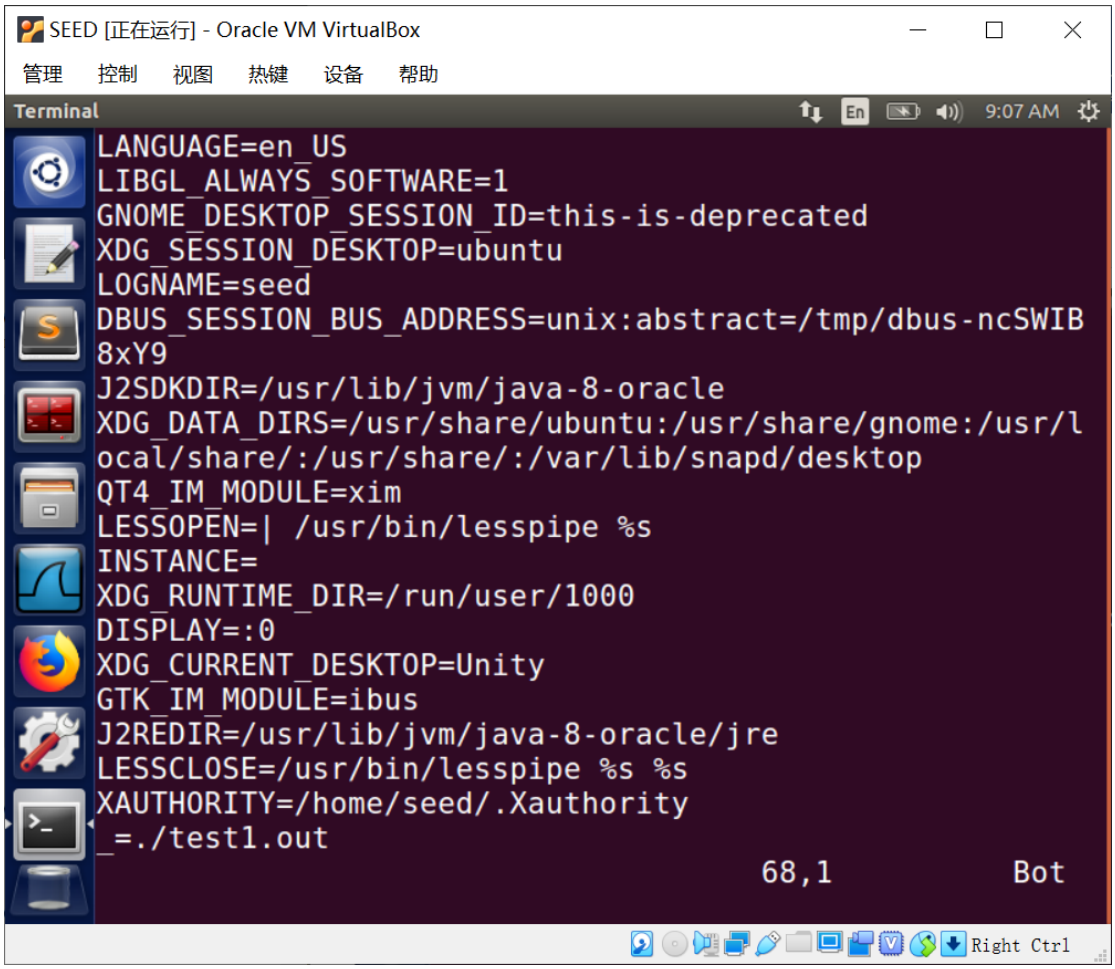
Step2:


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
9:06 AM
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
XDG_MENU_PREFIX=gnome-
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_option
s.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=60817418
UPSTART_SESSION=unix:abstract=/com/ubuntu/upstart-sessi
on/1000/1510
GNOME_KEYRING_CONTROL=
GTK_MODULES=gail:atk-bridge:unity-gtk-module
1,1 Top
Right Ctrl


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
9:06 AM
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;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:*.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:*.jpg=01;35:*.jpeg=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:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=
20,1 28%
Right Ctrl


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
9:07 AM
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
SESSION_MANAGER=local/VM:@/tmp/.ICE-unix/1815,unix/VM:/tmp/.ICE-unix/1815
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
21,1 35%
Right Ctrl

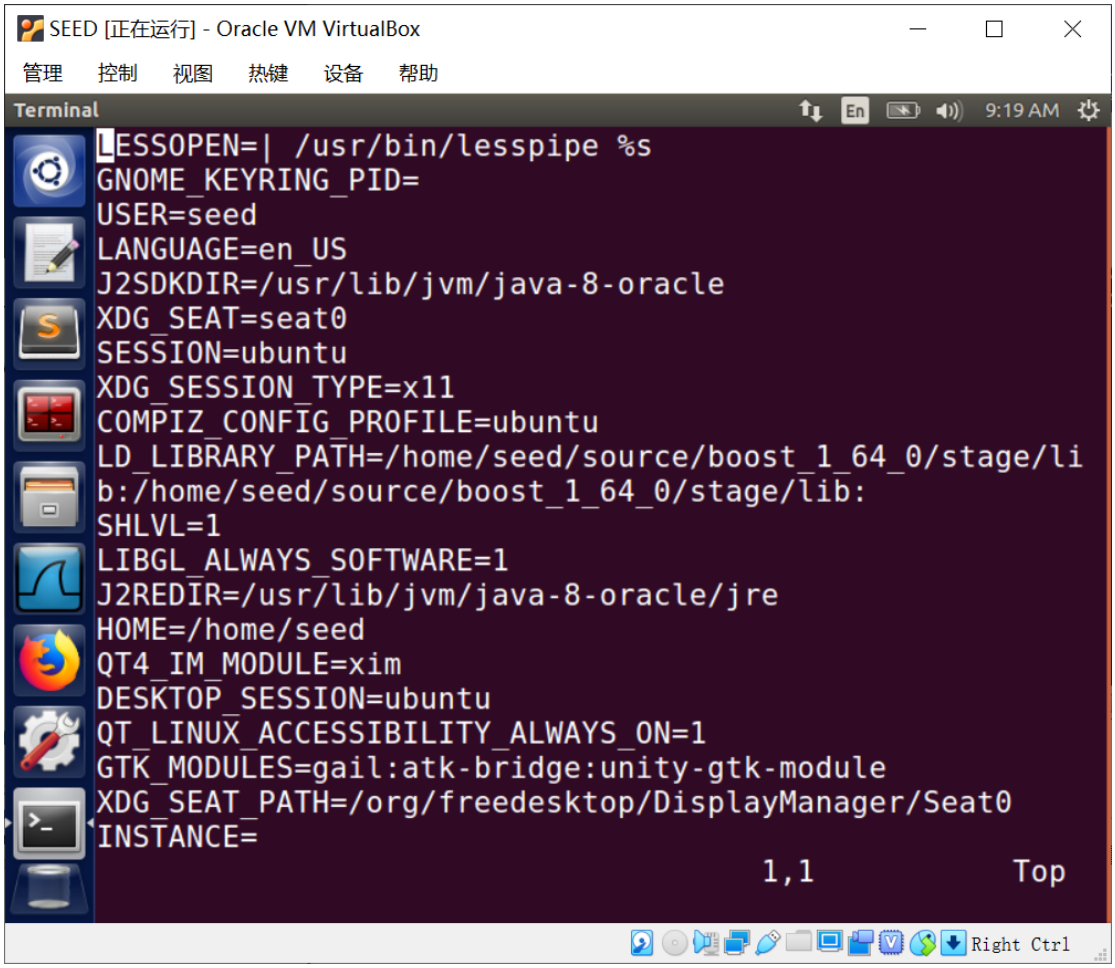

SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
9:07 AM
QT_IM_MODULE=ibus
QT_QPA_PLATFORMTHEME=appmenu-qt5
XDG_SESSION_TYPE=x11
PWD=/home/seed
JOB=dbus
XMODIFIERS=@im=ibus
JAVA_HOME=/usr/lib/jvm/java-8-oracle
GNOME_KEYRING_PID=
LANG=en_US.UTF-8
GDM_LANG=en_US
MANDATORY_PATH=/usr/share/gconf/ubuntu.mandatory.path
COMPIZ_CONFIG_PROFILE=ubuntu
IM_CONFIG_PHASE=1
GDMSESSION=ubuntu
SESSIONTYPE=gnome-session
GTK2_MODULES=overlay-scrollbar
SHLVL=1
HOME=/home/seed
XDG_SEAT=seat0
LANGUAGE=en_US
LIBGL_ALWAYS_SOFTWARE=1
45,1 63%
Right Ctrl

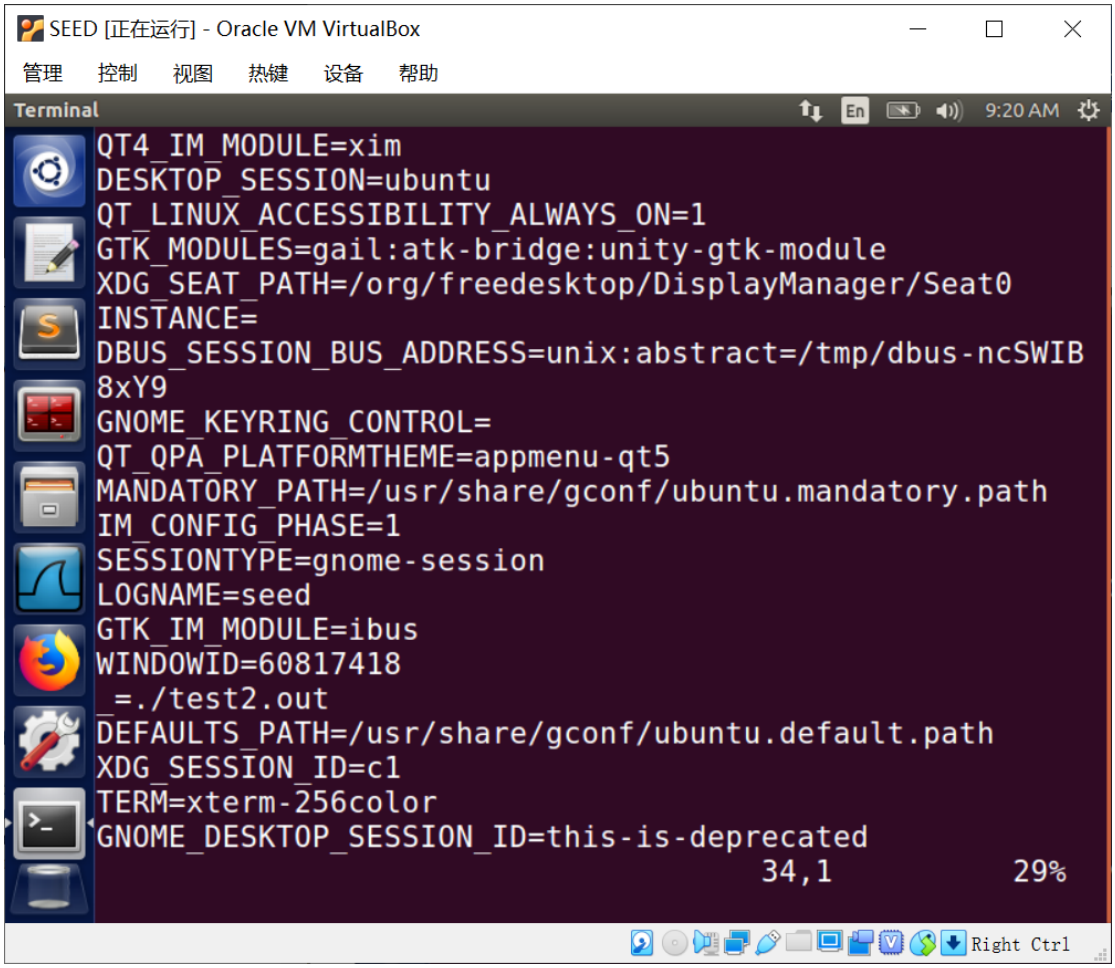


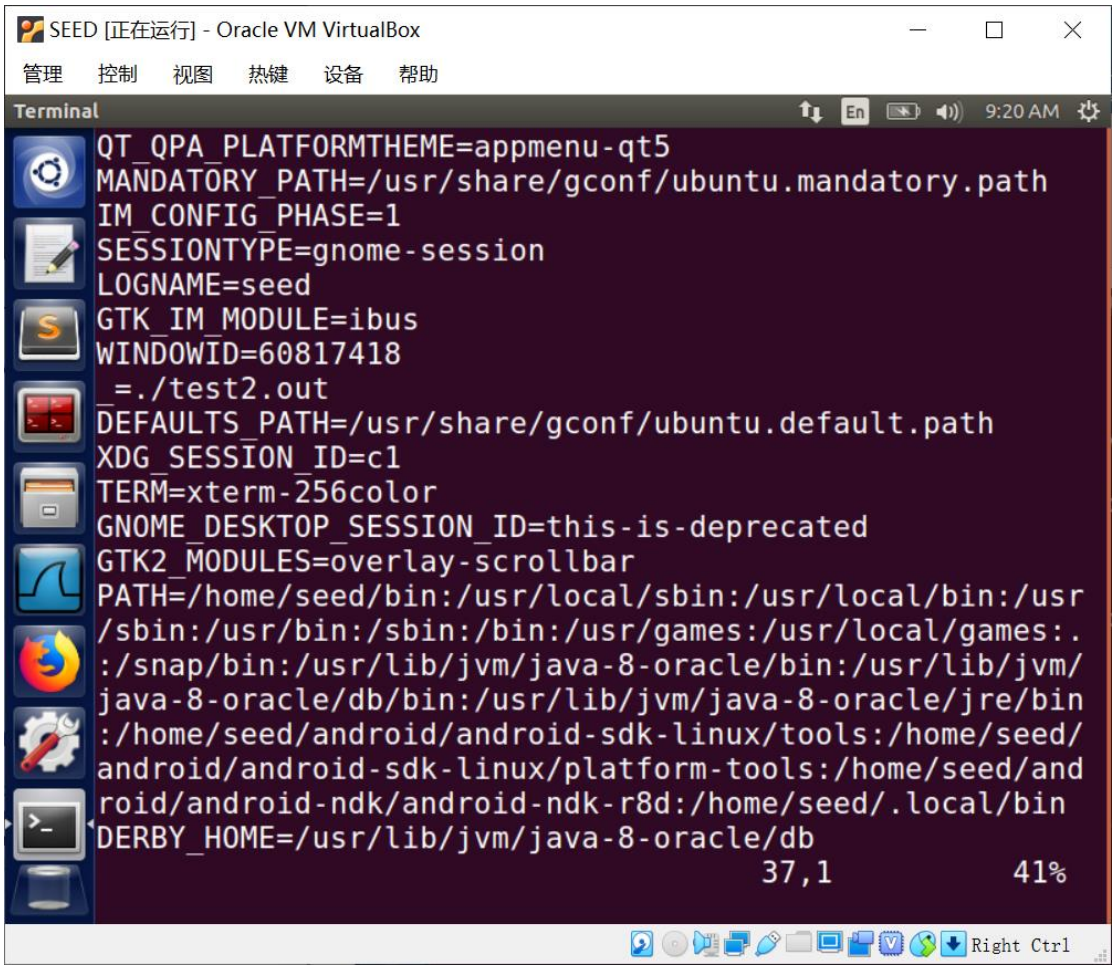
此时拥有了环境变量

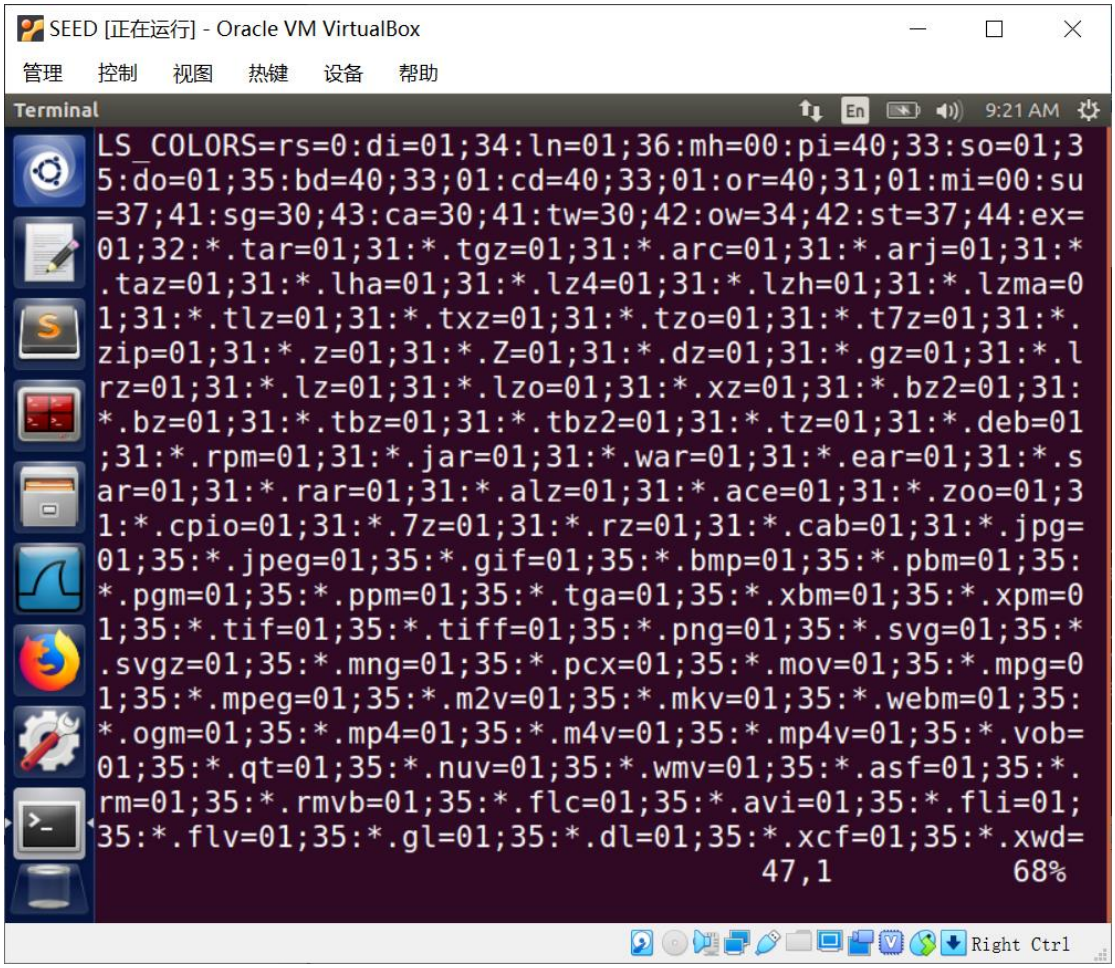
Step3：由以上实验可知使用 execve 命令创建出新的进程时，可用通过控制命令的第三个参数决定是传递空的环境变量还是传递原本的环境变量或者是定制化环境变量。

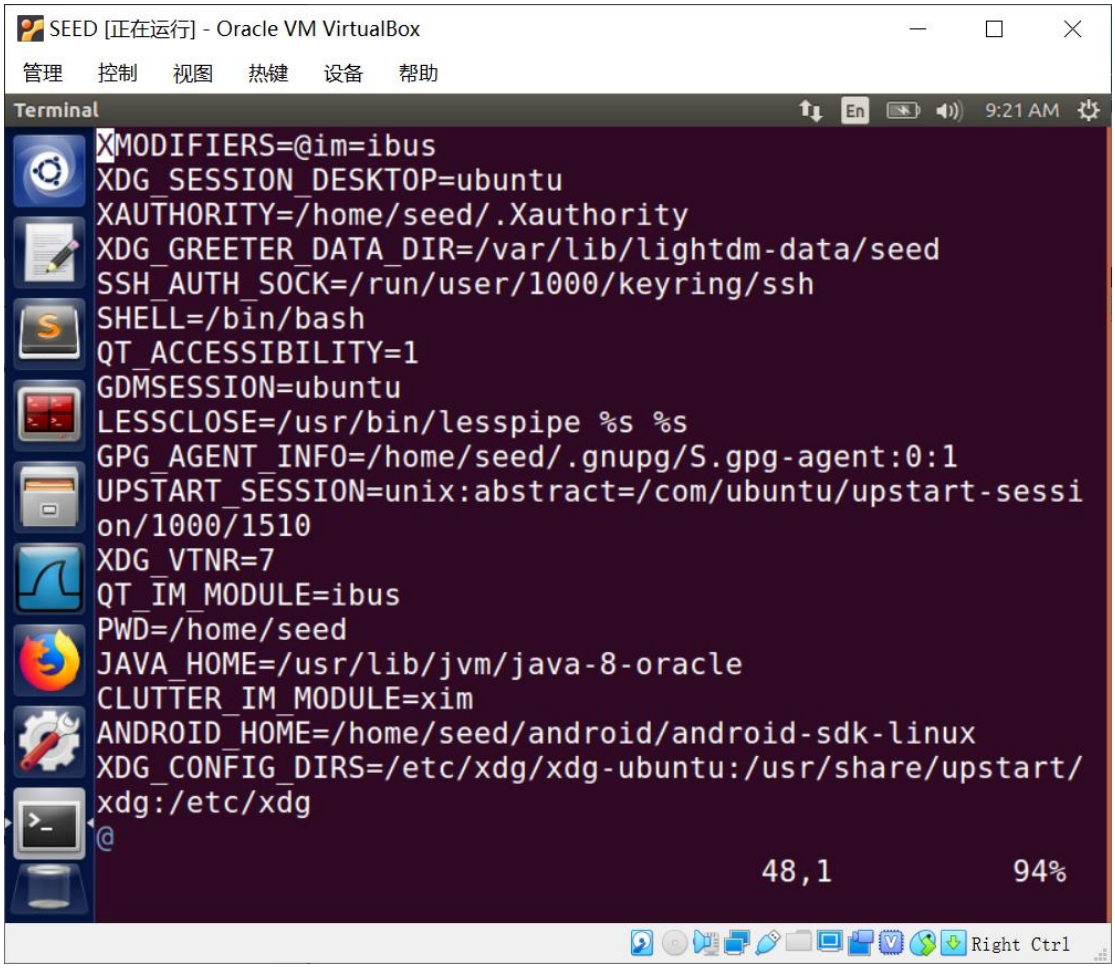
Task4

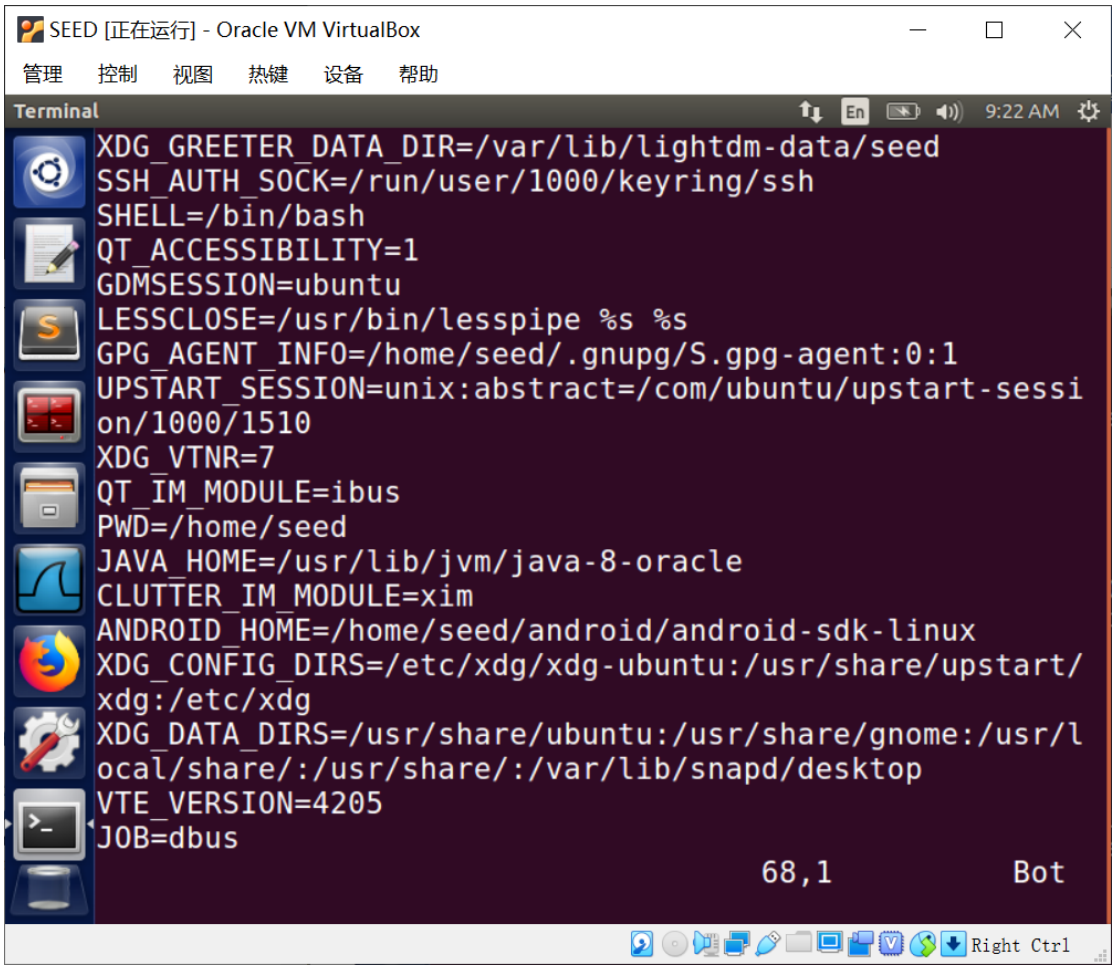

SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
9:19 AM
LESSOPEN=| /usr/bin/lesspipe %s
GNOME_KEYRING_PID=
USER=seed
LANGUAGE=en_US
J2SDKDIR=/usr/lib/jvm/java-8-oracle
XDG_SEAT=seat0
SESSION=ubuntu
XDG_SESSION_TYPE=x11
COMPIZ_CONFIG_PROFILE=ubuntu
LD_LIBRARY_PATH=/home/seed/source/boost_1_64_0/stage/lib:/home/seed/source/boost_1_64_0/stage/lib:
SHLVL=1
LIBGL_ALWAYS_SOFTWARE=1
J2REDIR=/usr/lib/jvm/java-8-oracle/jre
HOME=/home/seed
QT4_IM_MODULE=xim
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=
1,1 Top
Right Ctrl


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
9:20 AM
QT4_IM_MODULE=xim
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-ncSWIB
8xY9
GNOME_KEYRING_CONTROL=
QT_QPA_PLATFORMTHEME=appmenu-qt5
MANDATORY_PATH=/usr/share/gconf/ubuntu.mandatory.path
IM_CONFIG_PHASE=1
SESSIONTYPE=gnome-session
LOGNAME=seed
GTK_IM_MODULE=ibus
WINDOWID=60817418
_=./test2.out
DEFAULTS_PATH=/usr/share/gconf/ubuntu.default.path
XDG_SESSION_ID=c1
TERM=xterm-256color
GNOME_DESKTOP_SESSION_ID=this-is-deprecated
34,1 29%
Right Ctrl


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
9:20 AM
QT_QPA_PLATFORMTHEME=appmenu-qt5
MANDATORY_PATH=/usr/share/gconf/ubuntu.mandatory.path
IM_CONFIG_PHASE=1
SESSIONTYPE=gnome-session
LOGNAME=seed
GTK_IM_MODULE=ibus
WINDOWID=60817418
_=./test2.out
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/and
roid/android-ndk/android-ndk-r8d:/home/seed/.local/bin
DERBY_HOME=/usr/lib/jvm/java-8-oracle/db
37,1 41%
Right Ctrl


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
9:21 AM
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;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:*.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:*.jpg=01;35:*.jpeg=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:*.flv=01;35:*.gl=01;35:*.dl=01;35:*.xcf=01;35:*.xwd=
47,1 68%
Right Ctrl


SEED [正在运行] - Oracle VM VirtualBox
管理 控制 视图 热键 设备 帮助
Terminal
En
9:21 AM
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
GPG_AGENT_INFO=/home/seed/.gnupg/S.gpg-agent:0:1
UPSTART_SESSION=unix:abstract=/com/ubuntu/upstart-session/1000/1510
XDG_VTNR=7
QT_IM_MODULE=ibus
PWD=/home/seed
JAVA_HOME=/usr/lib/jvm/java-8-oracle
CLUTTER_IM_MODULE=xim
ANDROID_HOME=/home/seed/android/android-sdk-linux
XDG_CONFIG_DIRS=/etc/xdg/xdg-ubuntu:/usr/share/upstart/xdg:/etc/xdg
@
48,1 94%
Right Ctrl



Task5

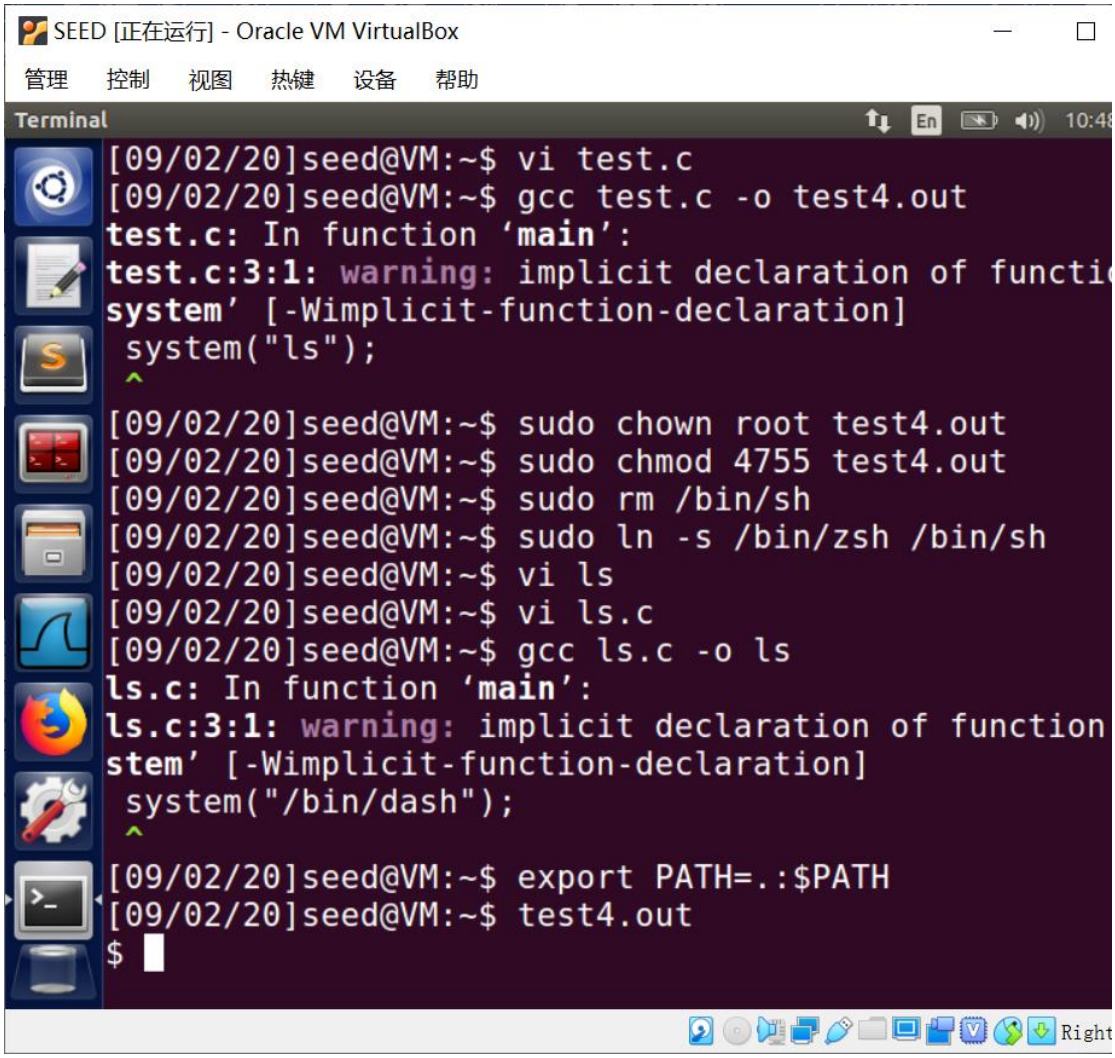
添加环境变量：

```
[09/02/20]seed@VM:~$ gcc test.c -o test3.out
[09/02/20]seed@VM:~$ sudo chown root test3.out
[09/02/20]seed@VM:~$ sudo chmod 4755 test3.out
[09/02/20]seed@VM:~$ export LD_LIBRARY_PATH
[09/02/20]seed@VM:~$ export jinhui_PATH
```

结果表示所添加的环境变量并未加入到 Set-UID 子进程中，我推测 Set-UID 子进程的环境变量由该进程的 owner 处继承，而非从 user 进程处继承。

Task6

通过在当前路径下创建并编译得到新的命令 ls，并且改变环境变量 PATH 优先查找当前目录，使得在执行 Set-UID 权限的 test4.out（即题目所给代码额可执行程序），成功将该程序原本的 ls 功能改变成了打开新的 shell 的功能。同时，由于 test4.out 是 Set-UID 程序，所以在执行过程中是使用 root 权限执行，因此我的 ls 代码在执行过程中也是有 root 权限的。



Task7

在普通用户权限下运行普通权限的 myprog，发现 sleep 函数调用被改为自己设置的：

```
[09/03/20]seed@VM:~$ gcc myprog.c -o test5.out
myprog.c: In function 'main':
myprog.c:3:1: warning: implicit declaration of function
 'sleep' [-Wimplicit-function-declaration]
 sleep(1);
 ^
[09/03/20]seed@VM:~$ test5.out
I am not sleeping!
```

在普通用户权限下运行 Set-UID 权限的 myprog，发现还是调用的系统的 sleep 函数：

```
[09/03/20]seed@VM:~$ sudo chown root test5.out
[09/03/20]seed@VM:~$ sudo chmod 4755 test5.out
[09/03/20]seed@VM:~$ test5.out
[09/03/20]seed@VM:~$
```

在 root 权限下添加 LD_PRELOAD 后再次运行 Set-UID 权限的 myprog，发现 sleep 函数再次变为自己定义的：

```
[09/03/20]seed@VM:~$ su
Password:
root@VM:/home/seed# export LD_PRELOAD=./libmylib.so.1.0
.1
root@VM:/home/seed# test5.out
I am not sleeping!
root@VM:/home/seed#
```

将 myprog 改为 user1 的 Set-UID 程序，并且在 seed 账户下执行，发现 sleep 函数仍然为系统函数：

```
root@VM:/home/seed# useradd user1 -p 123
root@VM:/home/seed# su user1
user1@VM:/home/seed$ su seed
Password:
[09/03/20]seed@VM:~$ sudo chown user1 test5.out
[09/03/20]seed@VM:~$ sudo chmod 4755 test5.out
[09/03/20]seed@VM:~$ export LD_PRELOAD=./linmylib.so.1.
0.1
ERROR: ld.so: object './linmylib.so.1.0.1' from LD_PREL
OAD cannot be preloaded (cannot open shared object file
): ignored.
[09/03/20]seed@VM:~$ export LD_PRELOAD=./libmylib.so.1.
0.1
[09/03/20]seed@VM:~$ test5.out
[09/03/20]seed@VM:~$
```

综上实验结果可以发现，环境变量决定了调用哪一个 sleep 函数。myprog 在执行时环境变量是继承其 owner 的，在第一种情况中 myprog 函数是普通权限，因此其环境变量就是当前的环境变量，而当前环境变量设置了 LD_PROLOAD 为自定义的.so 文件，因此 sleep 是自定义的 sleep，但是在第二种情况中将 myprog 改为了 Set-UID，在执行时 myprog 是继承 root 的环境变量，而 root 环境变量没有改变 LD_PROLOAD，因此此时还是执行系统 sleep 函数。同理第三种情况在 root 下设置了 LD_PROLOAD，因此 sleep 是自定义 sleep。第四种情况在 seed 用户下执行时 myprog 是继承 user1 用户的环境变量，因此还是系统的 sleep。

Task8

Step1：如果我是 Bob，我完全可以更改无权限的文件，如下，在输入需要读取的文件时，我输入“test5.c;/bin/sh”，此时 system 执行的 command 为“/bin/cat test5.c;/bin/sh”，即先打印 test5.c 的内容，然后执行下一条语句/bin/sh 打开一个 shell，此时在 shell 中可以执行想要的任何操作。

```
[09/03/20]seed@VM:~$ vi test5.c
[09/03/20]seed@VM:~$ gcc test5.c -o test6.out
[09/03/20]seed@VM:~$ sudo chown root test6.out
[09/03/20]seed@VM:~$ sudo chmod 4755 test6.out
[09/03/20]seed@VM:~$ test6.out
```

```
Please type a file name.
[09/03/20]seed@VM:~$ test6.out “test5.c;/bin/sh”
#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 ;
}

#
```

Step2：当把 system 换成 execve，刚才的攻击便不奏效了，因为使用 system 它会将传入的参数也当成命令执行。而 execve 只会执行第一个参数的“/bin/cat”命令，传入的参数只会被当做参数解释，因此会显示找不到此文件的提示。

```
[09/03/20]seed@VM:~$ test6.out "test5.c;/bin/sh"
/bin/cat: 'test5.c;/bin/sh': No such file or directory
```

Task9

可以观察到最后/etc/zzz 文件还是被修改了，因为 Set-UID 程序开始有 root 权限的时候打开了/zzz 文件的句柄 fd，但是在后来使用 setuid 进行降级时没有释放 fd，因此即使失去了 root 权限，仍然可以通过句柄 fd 对该文件进行修改。

```
[09/03/20]seed@VM:~$ gcc test6.c -o test7.out
test6.c: In function ‘main’:
test6.c:16:1: warning: implicit declaration of function ‘sleep’ [-Wimplicit-function-declaration]
 sleep(1);
 ^
test6.c:19:1: warning: implicit declaration of function ‘setuid’ [-Wimplicit-function-declaration]
 setuid(getuid()); /* getuid() returns the real uid */
 ^
test6.c:19:8: warning: implicit declaration of function ‘getuid’ [-Wimplicit-function-
```

```
declaration]
  setuid(getuid()); /* getuid() returns the real uid */
             ^
test6.c:20:5: warning: implicit declaration of function ‘fork’ [-Wimplicit-function-declaration]
  if (fork()) { /* In the parent process */
        ^
test6.c:21:1: warning: implicit declaration of function ‘close’ [-Wimplicit-function-declaration]
  close (fd);
  ^
test6.c:27:1: warning: implicit declaration of function ‘write’ [-Wimplicit-function-declaration]
  write (fd, "Malicious Data\n", 15);
  ^
[09/03/20]seed@VM:~$ sudo chown root test7.out
[09/03/20]seed@VM:~$ sudo chmod 4755 test7.out
[09/03/20]seed@VM:~$ test7.out
[09/03/20]seed@VM:~$ cat /etc/zzz

Malicious Data
```