



Linnaeus University

1DV512 - Operating System Group Assignment 1 FreeBSD Operating System (Group 10)

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1. Introduction

FreeBSD is a version of the UNIX operating system which is derived from BSD that is developed at the University of California, Berkeley [1]. The advantages of FreeBSD include speed, stability, and a variety of features [1]. So far, FreeBSD has a life span of 28 years and has developed thirteen versions by April 2021 [2]. In this assignment, we will explore the FreeBSD operating system and implement the related tasks according to the course requirements. First of all, system environments and the selected virtual machine software will be described. Next, the detailed information and procedures regarding the selected FreeBSD, virtual machine configurations as well as FreeBSD installation will be discussed separately. Moreover, each step of manipulating the FreeBSD operating system according to assignment instructions will be presented. Last but not least, the developed Java program related to each step of task 4 will be presented and reviewed.

2. Task 1

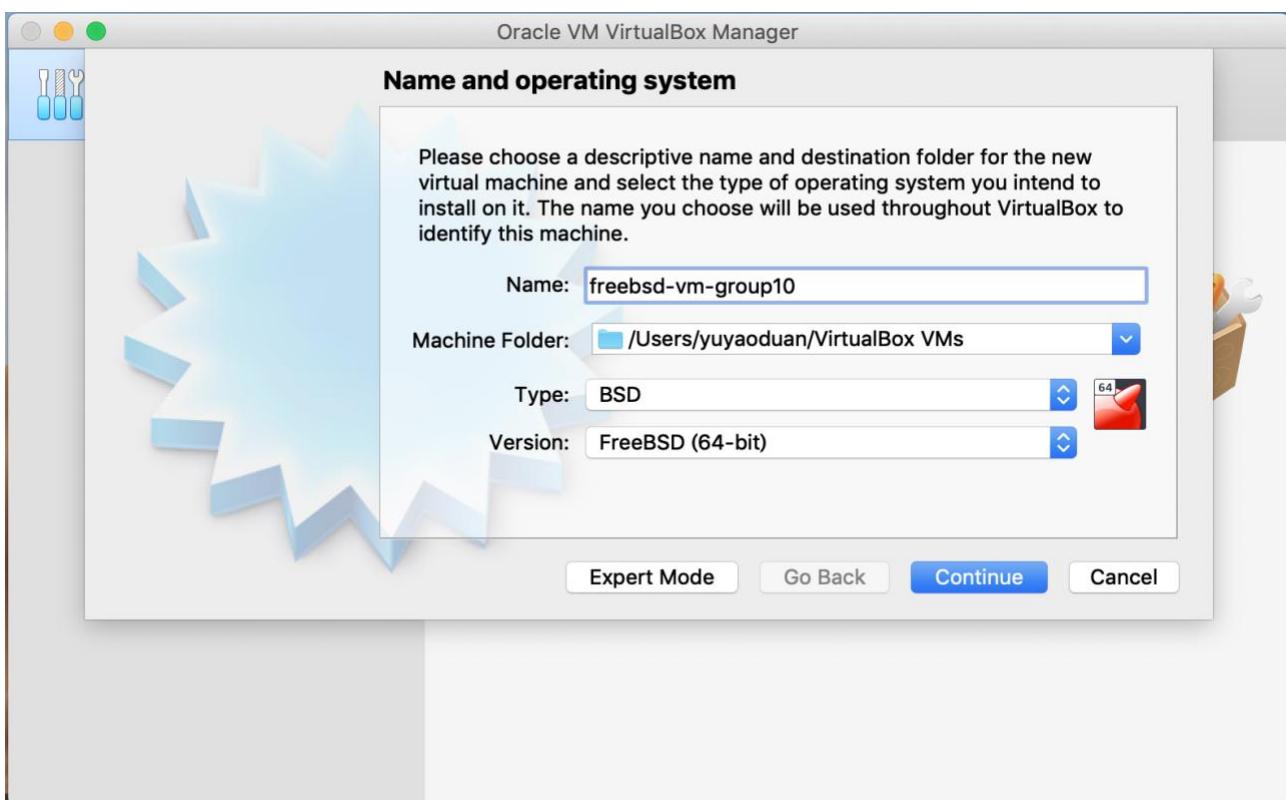
In this group, two operating systems are used for host OS systems – Windows 10 and MacOS Mojave. This is due to different user habits among the students in this group. The two Windows and the Mac are all X64 architecture, and all the system systems in 64 bits. We followed the suggestion of the course instructions and utilized the latest version of Oracle VirtualBox (v 6.1) as our virtual machine software in this assignment.

3. Task 2

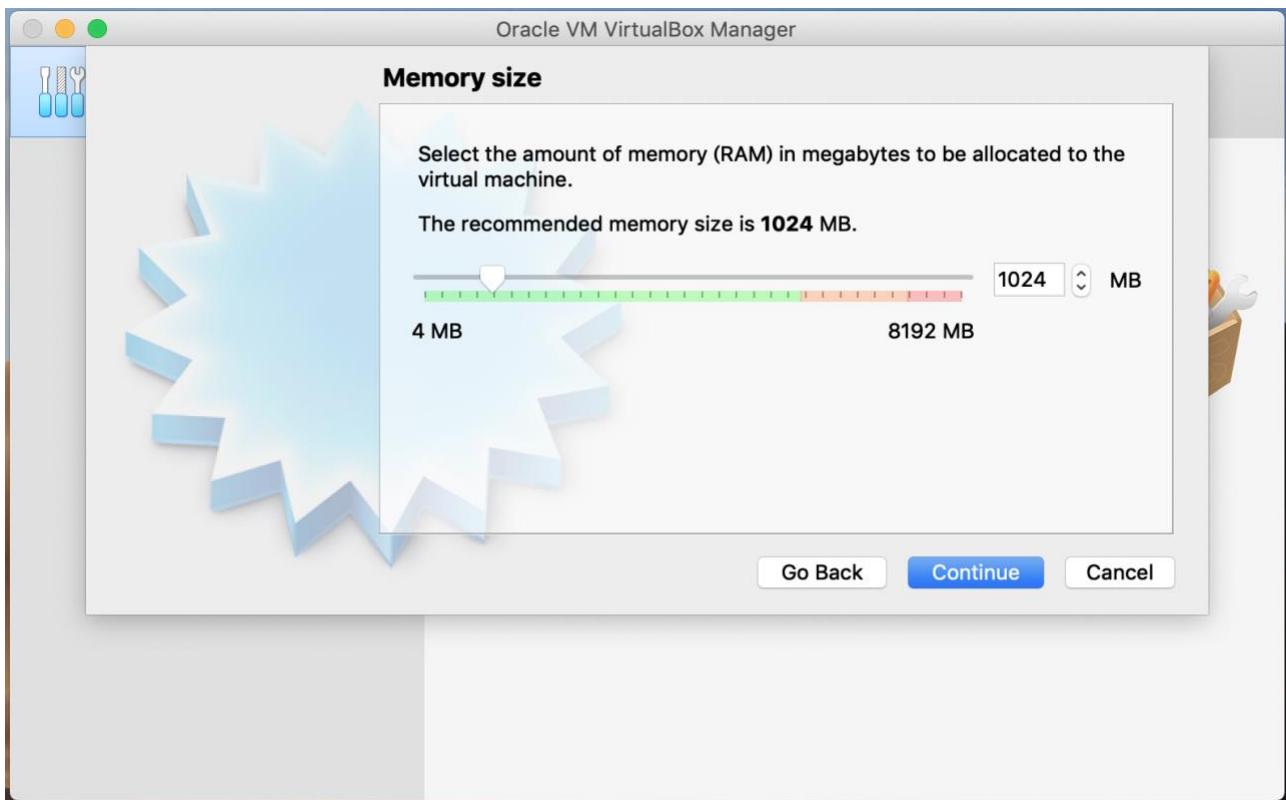
In order to keep the system image consistent, the FreeBSD system is installed and set up by one person which will be used by other team members in the later tasks. The built-up FreeBSD image is shared and distributed via LNU Google Drive.

3.1 Virtual machine installation and configurations

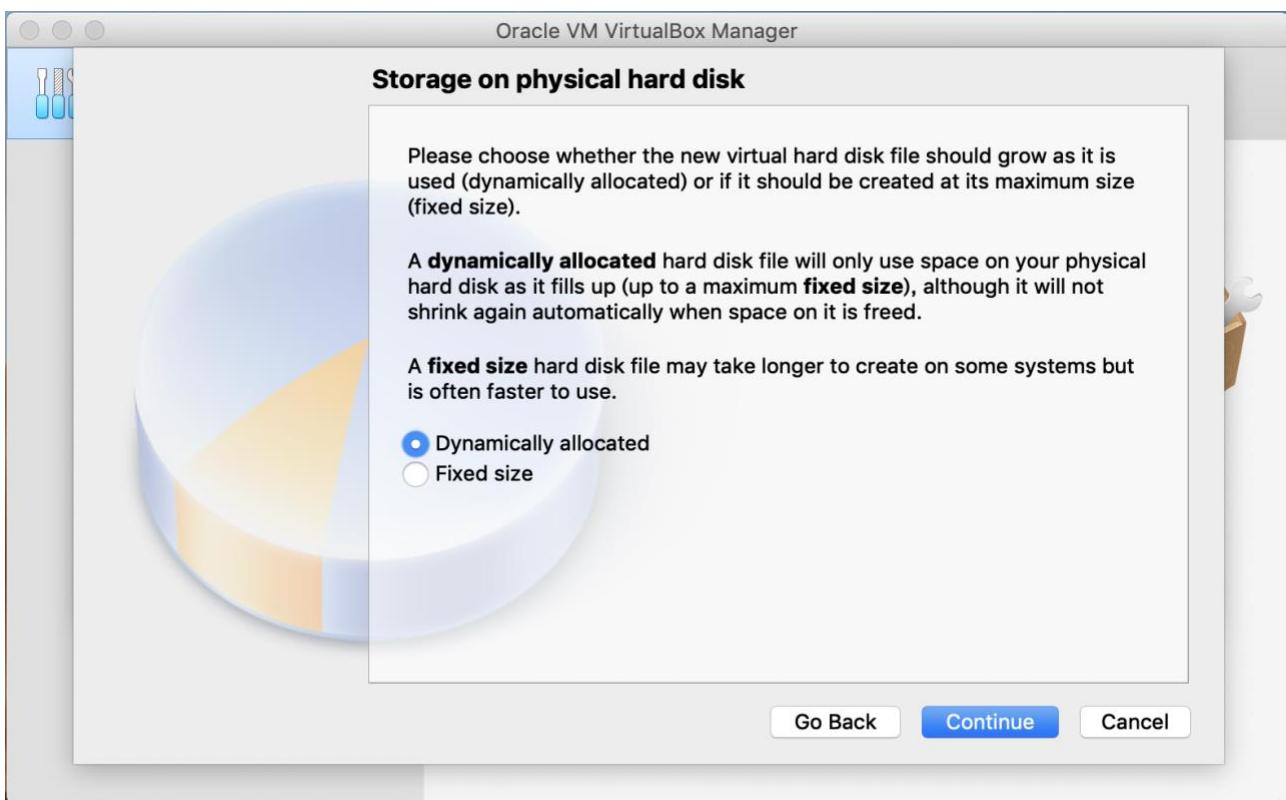
3.1.1 Oracle VM VirtualBox installation and environment configurations



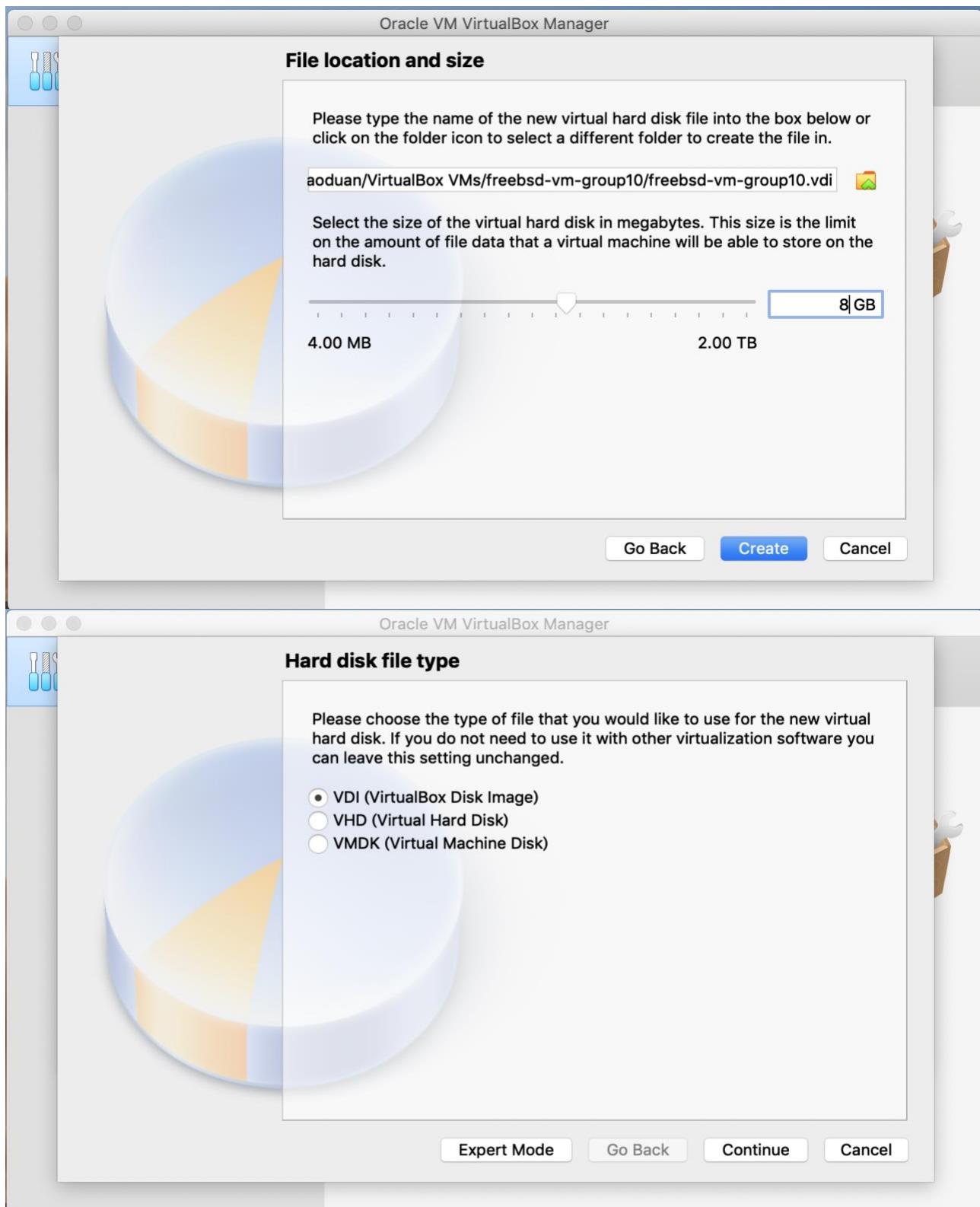
After downloading and installing Oracle VM VirtualBox, we need to set up the name of the operating system's image. In our case, we name it "freebsd-vm-group10" and the version is 64-bit.



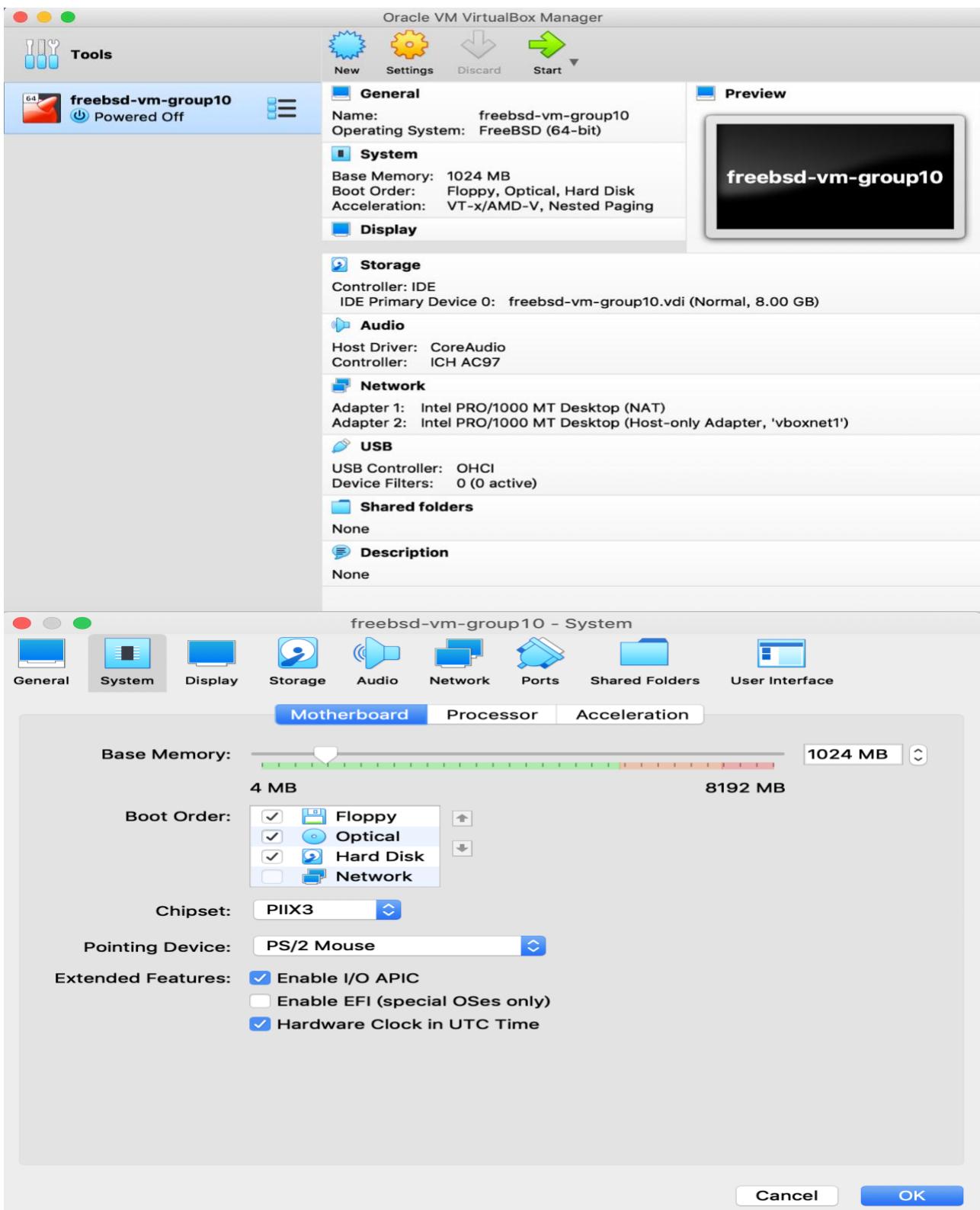
We set up our virtual machine's RAM with 1024 MB according to the FreeBSD video tutorial.



The settings of the hard disk are configured as dynamically allocated; therefore, it will save the resources of the system and will not occupy the whole amount of the space in the beginning.

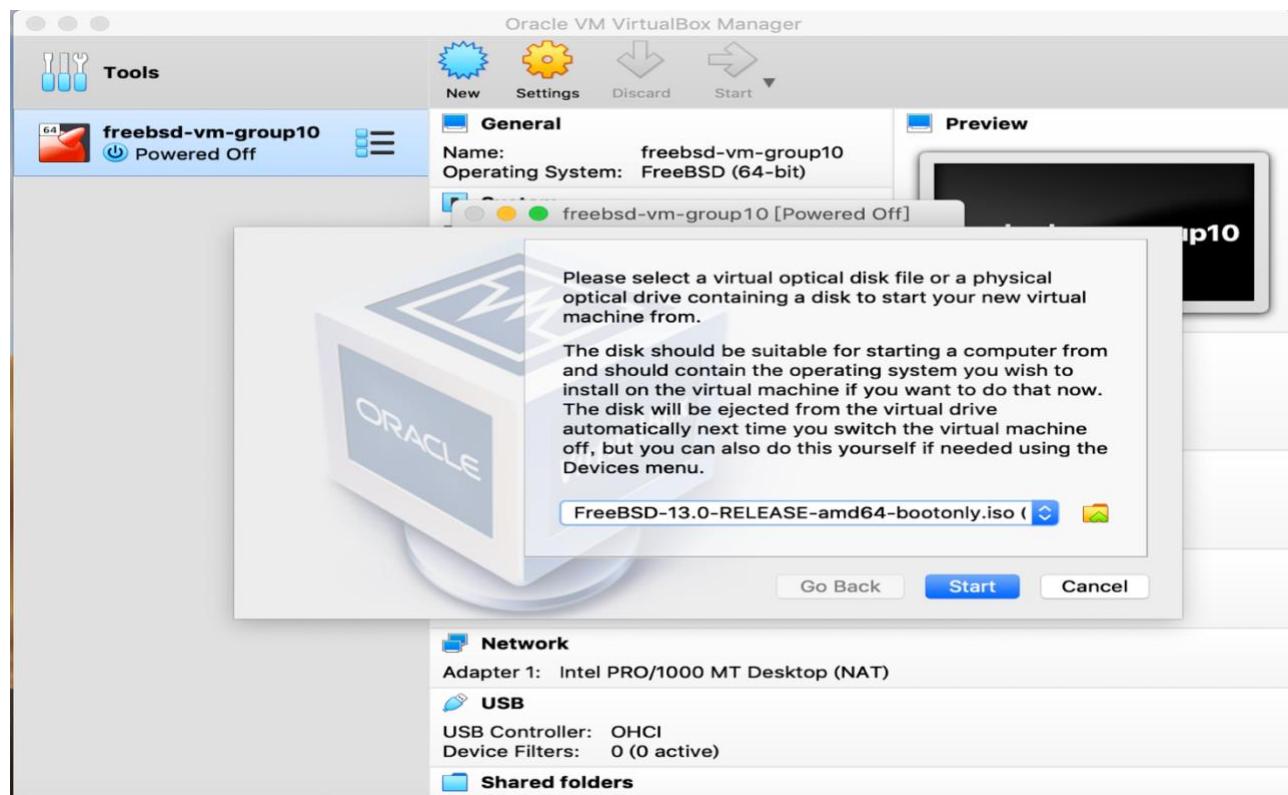


The size of the hard disk is adjusted to 8 GB according to the assignment instruction. The file format is selected as VDI (VirtualBox Disk Image).

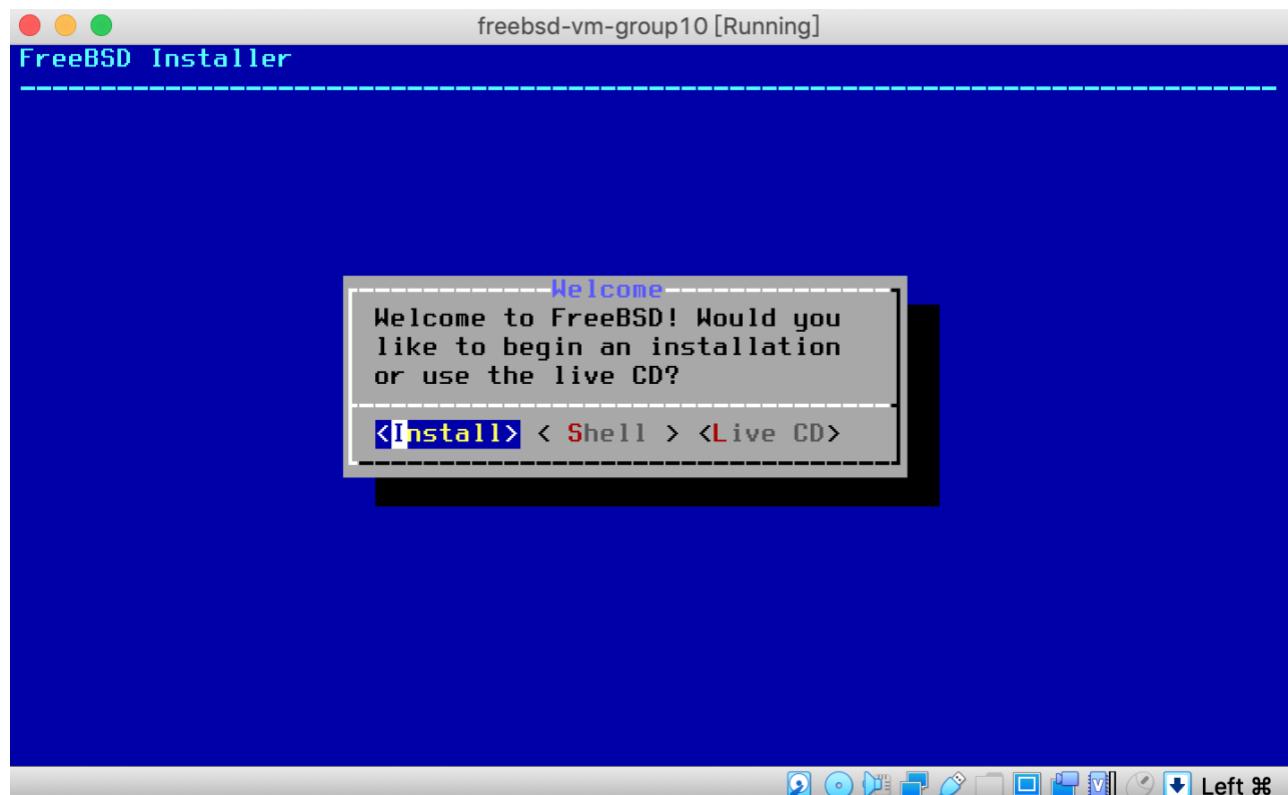


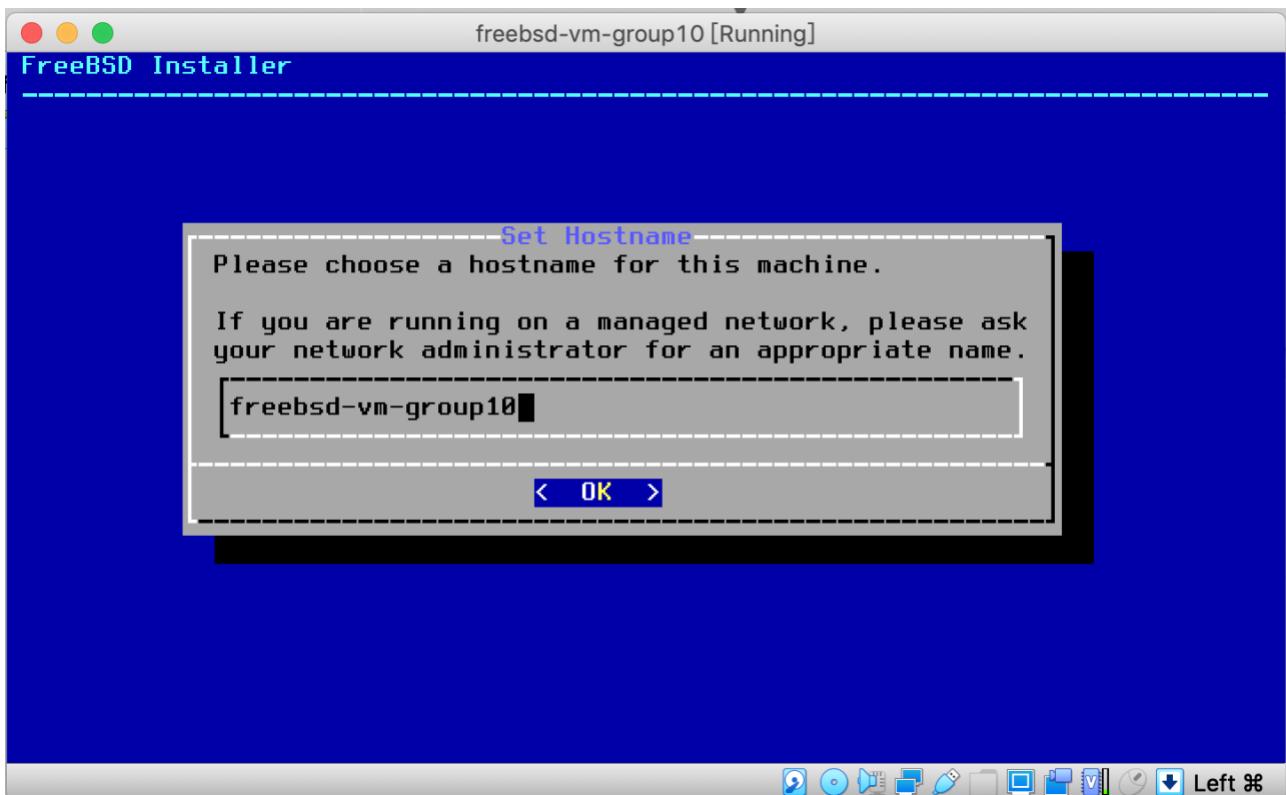
After the previous procedures, we can get an overview of VirtualBox environment configurations.

3.1.2 Installing FreeBSD

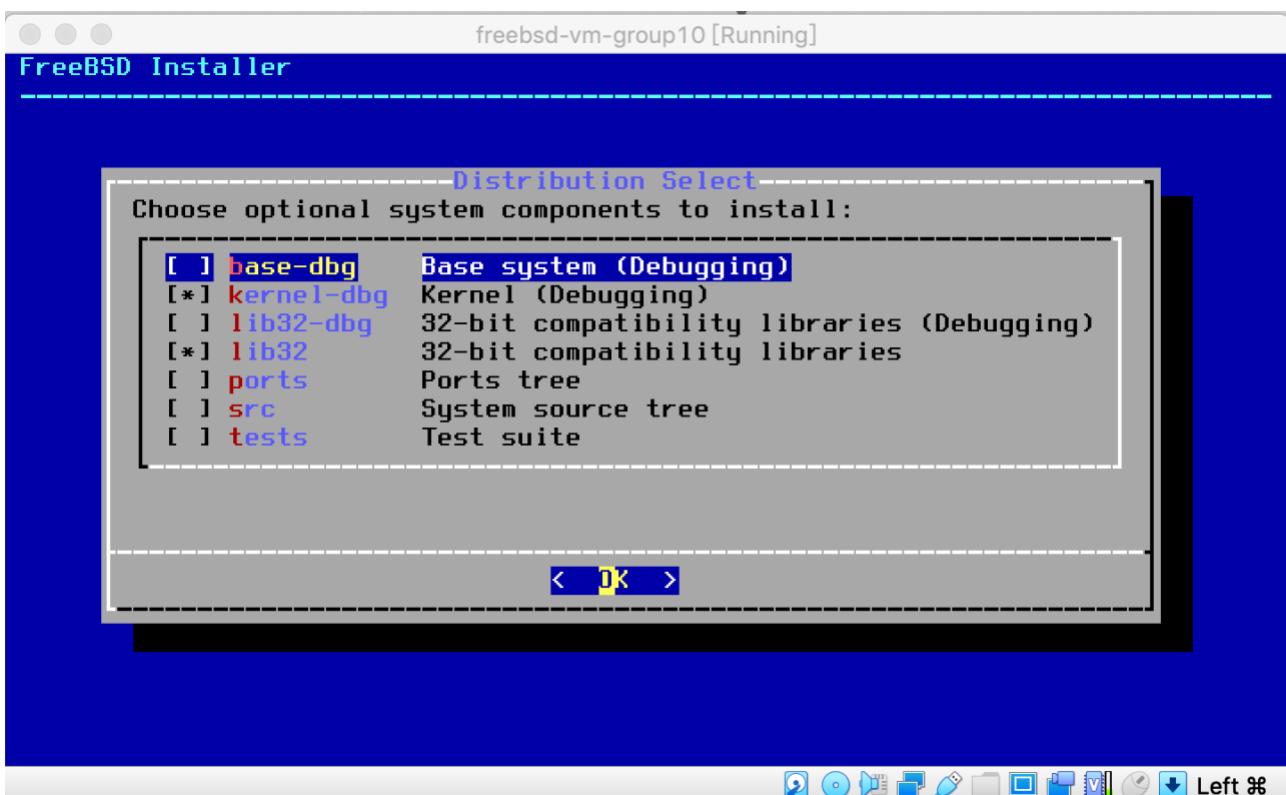


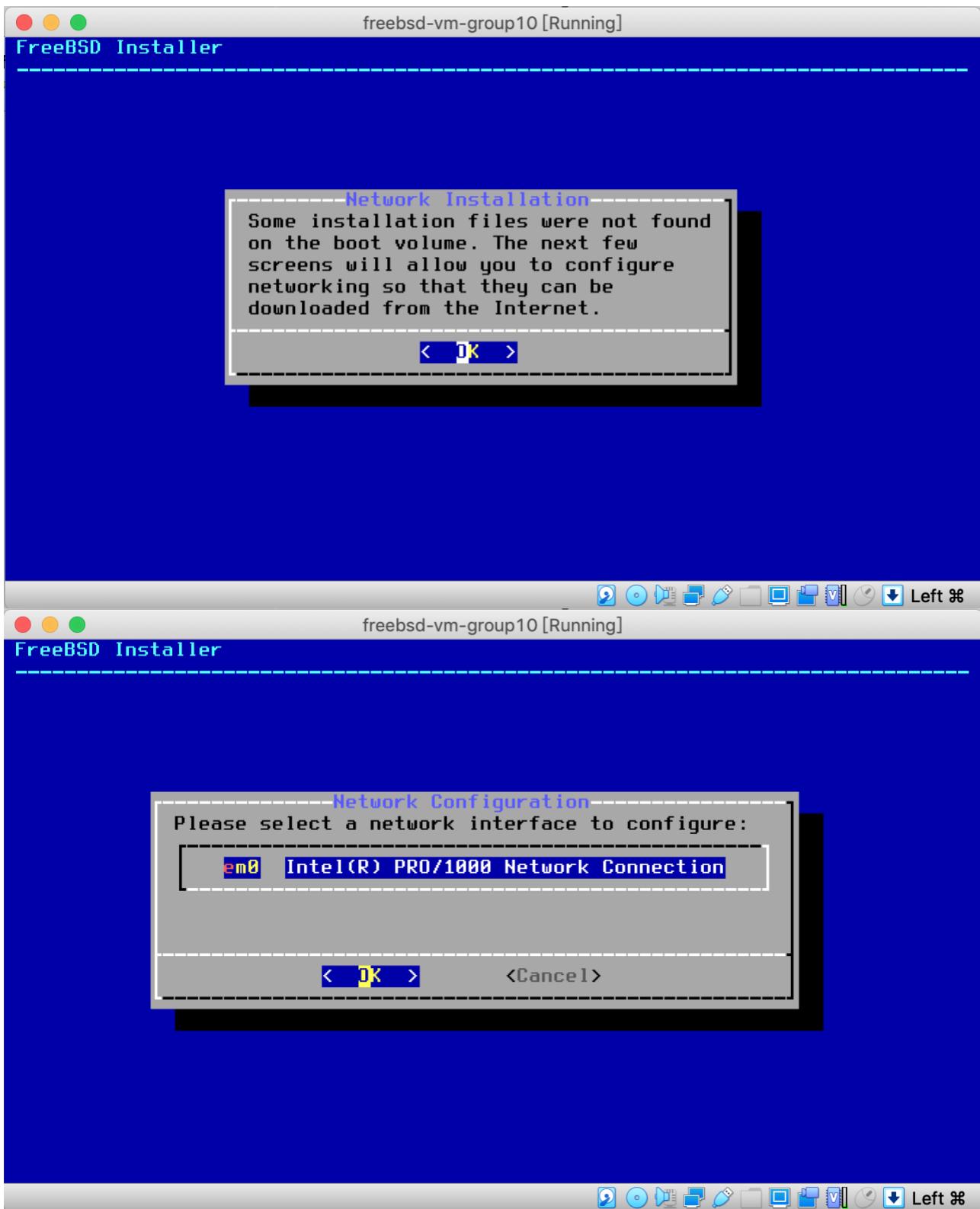
By clicking on the start button, VirtualBox will start the installation process. We followed the instructions and used the latest “bootonly” version of amd64 architecture. The following screenshots will describe the installation processes in detail.

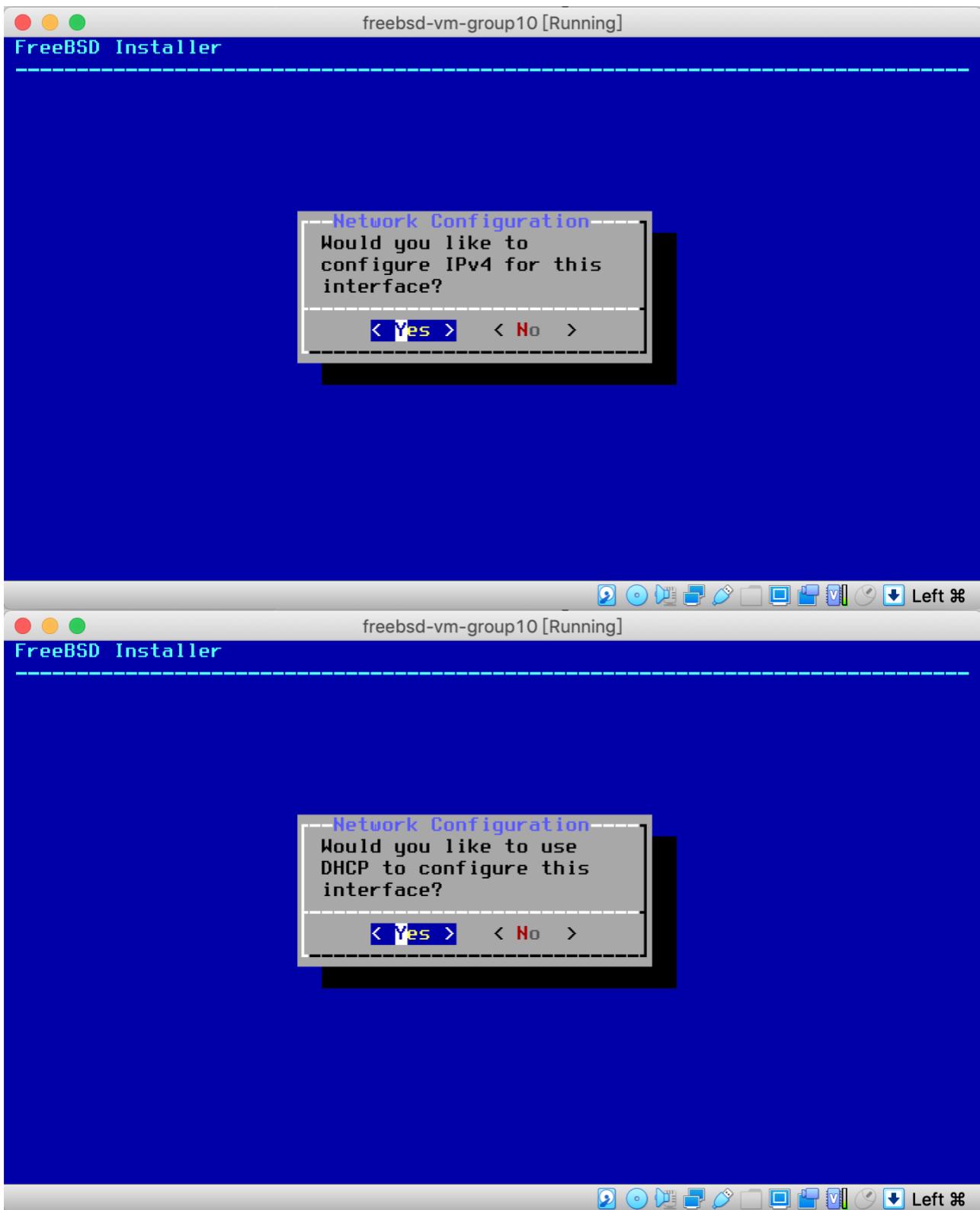


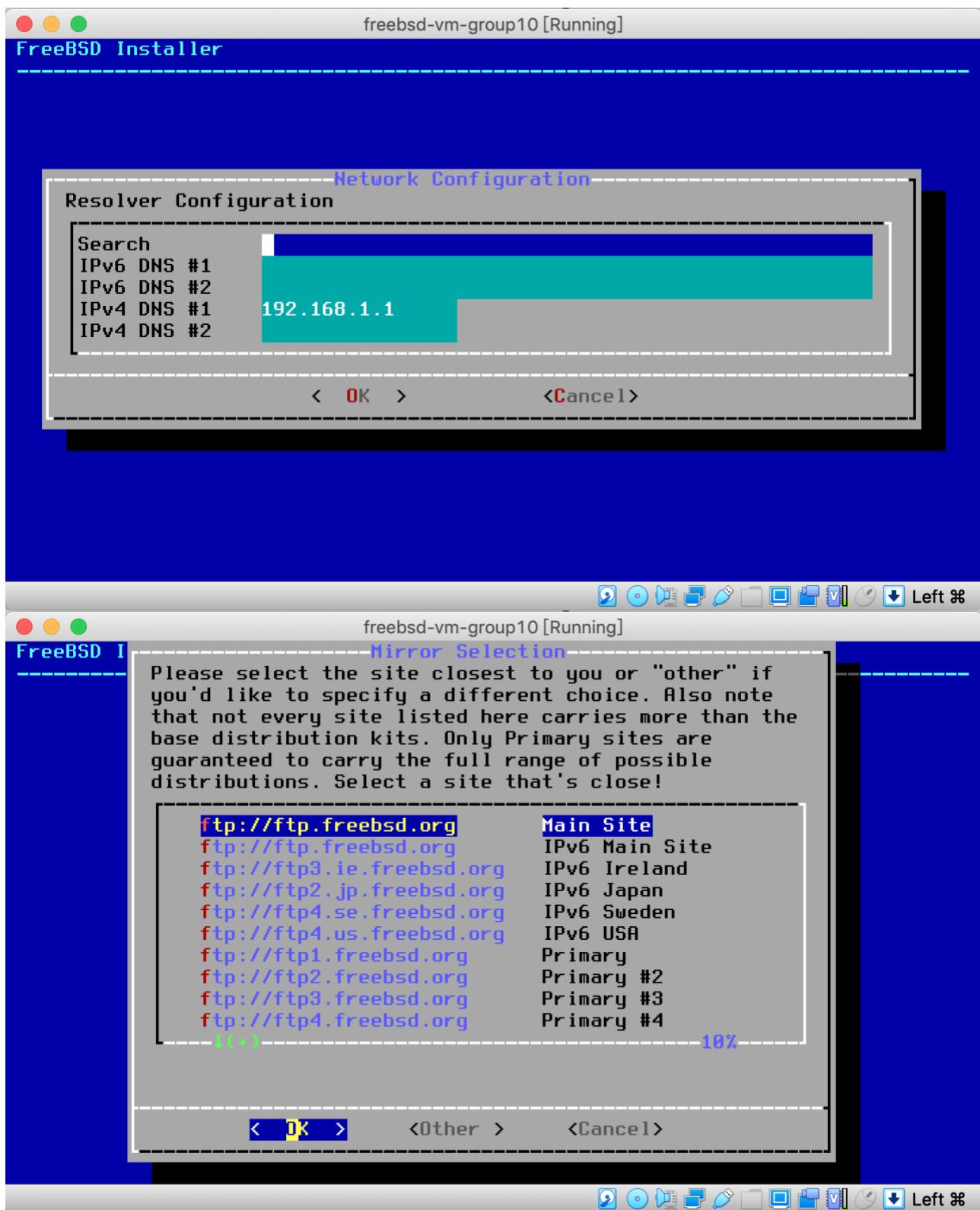


In this step, we set up the hostname as our group name “freebsd-vm-group10”. The following steps are all based on the default settings.

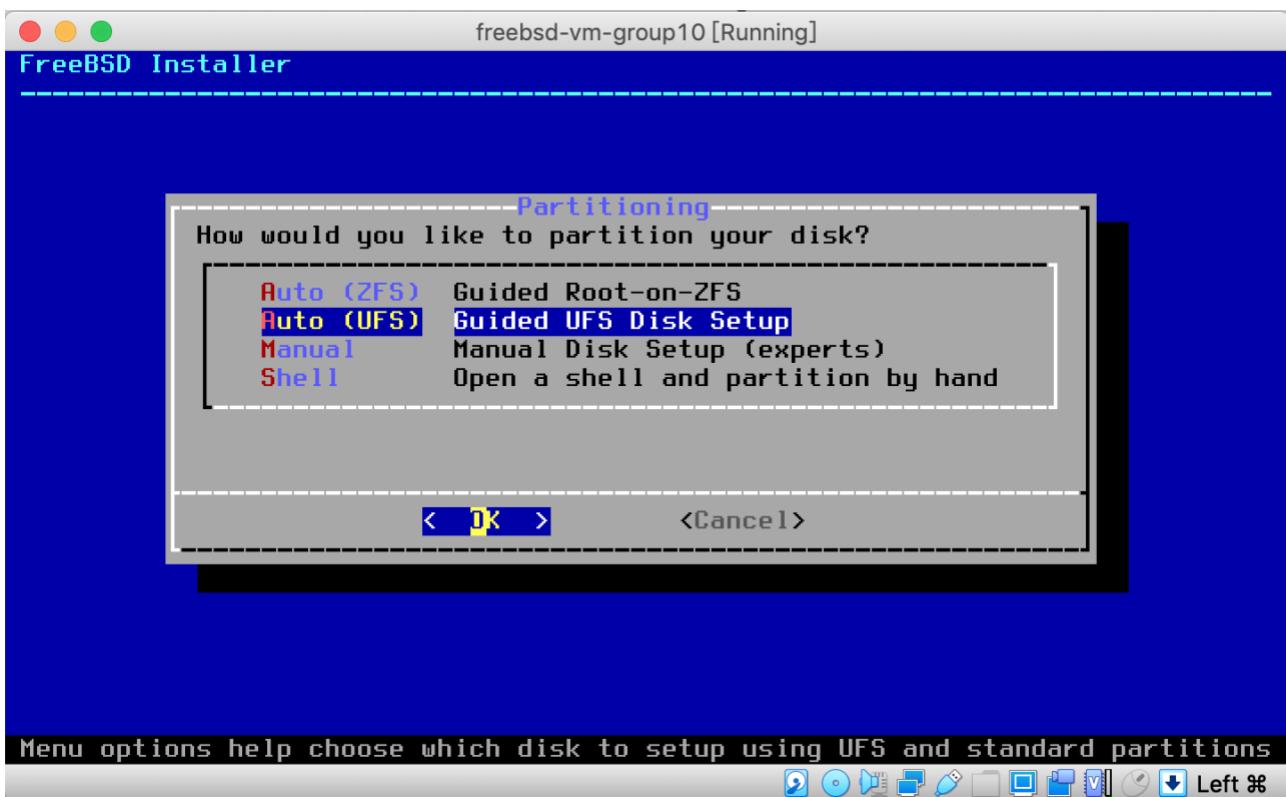




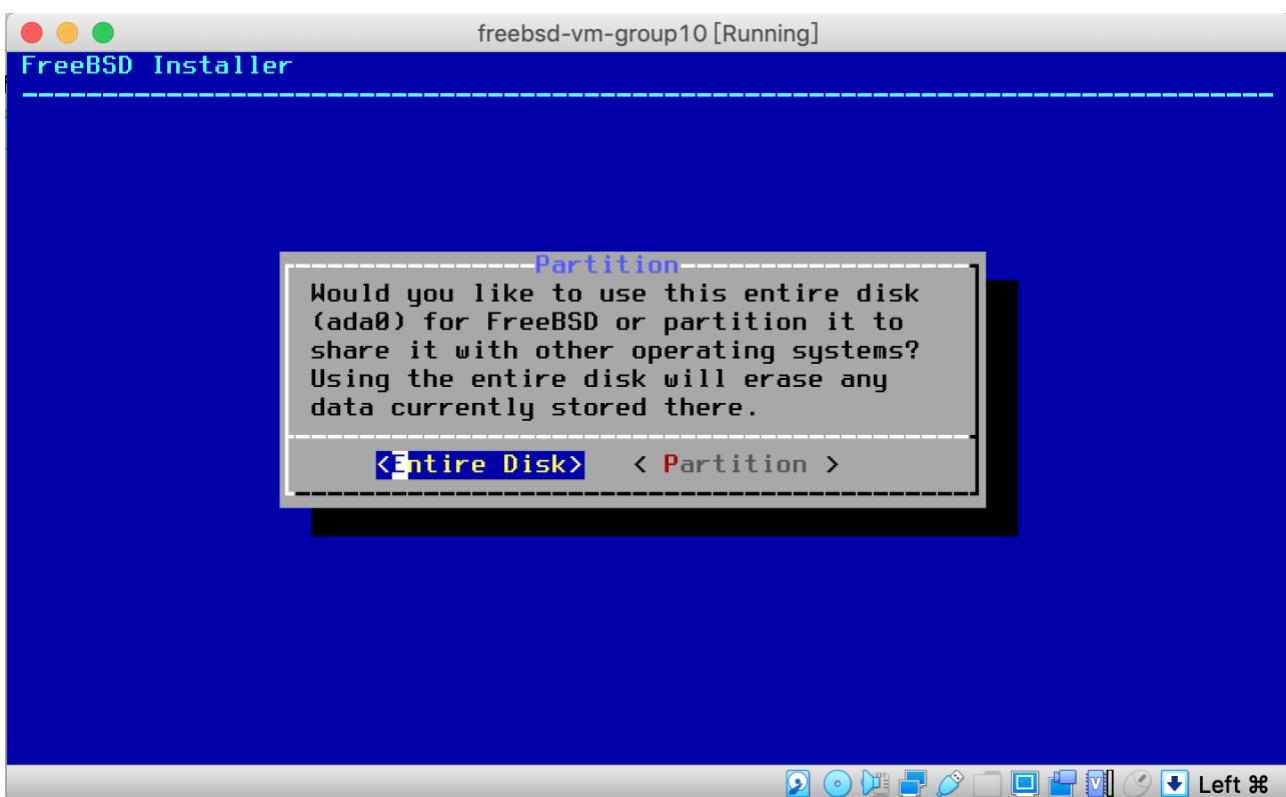


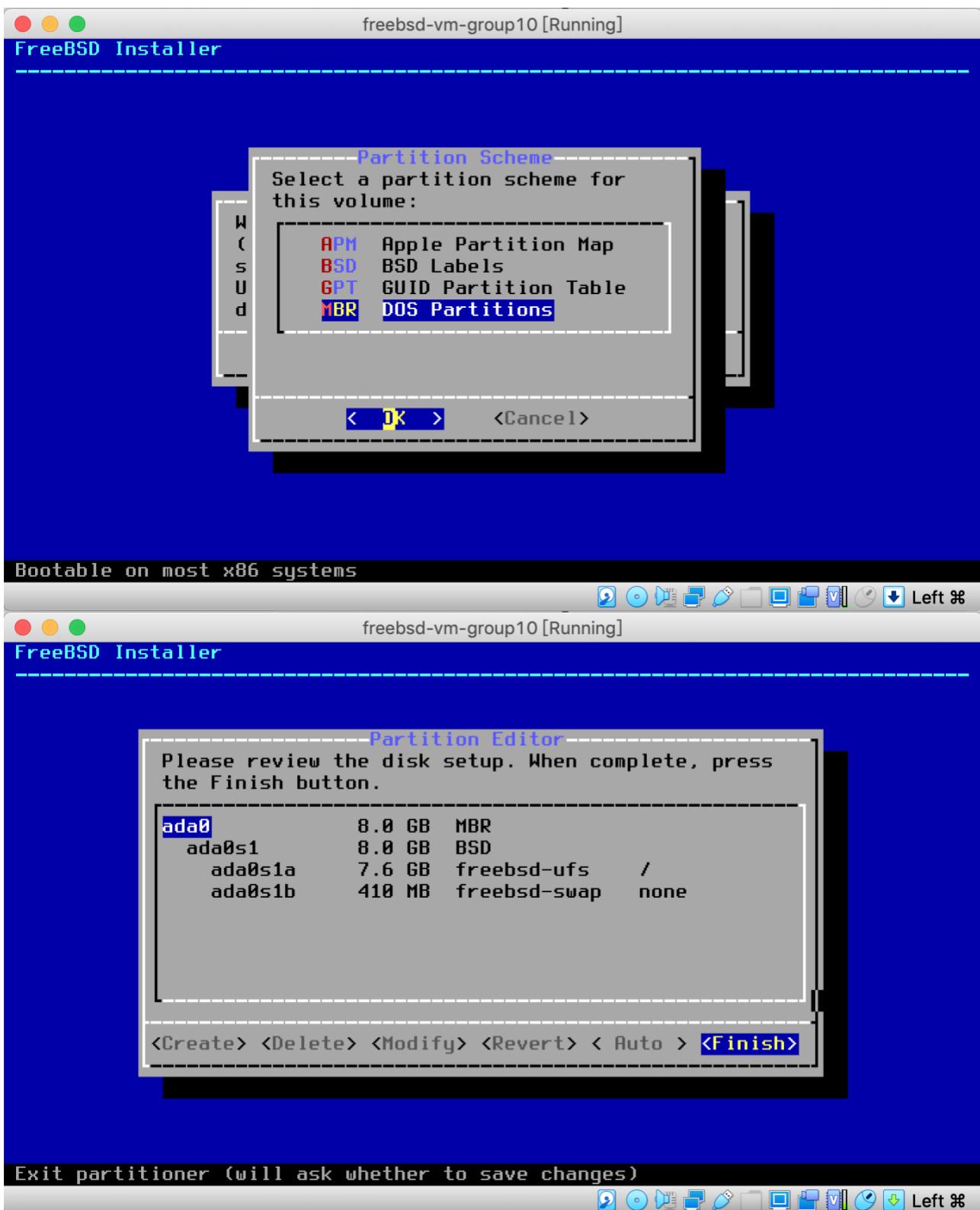


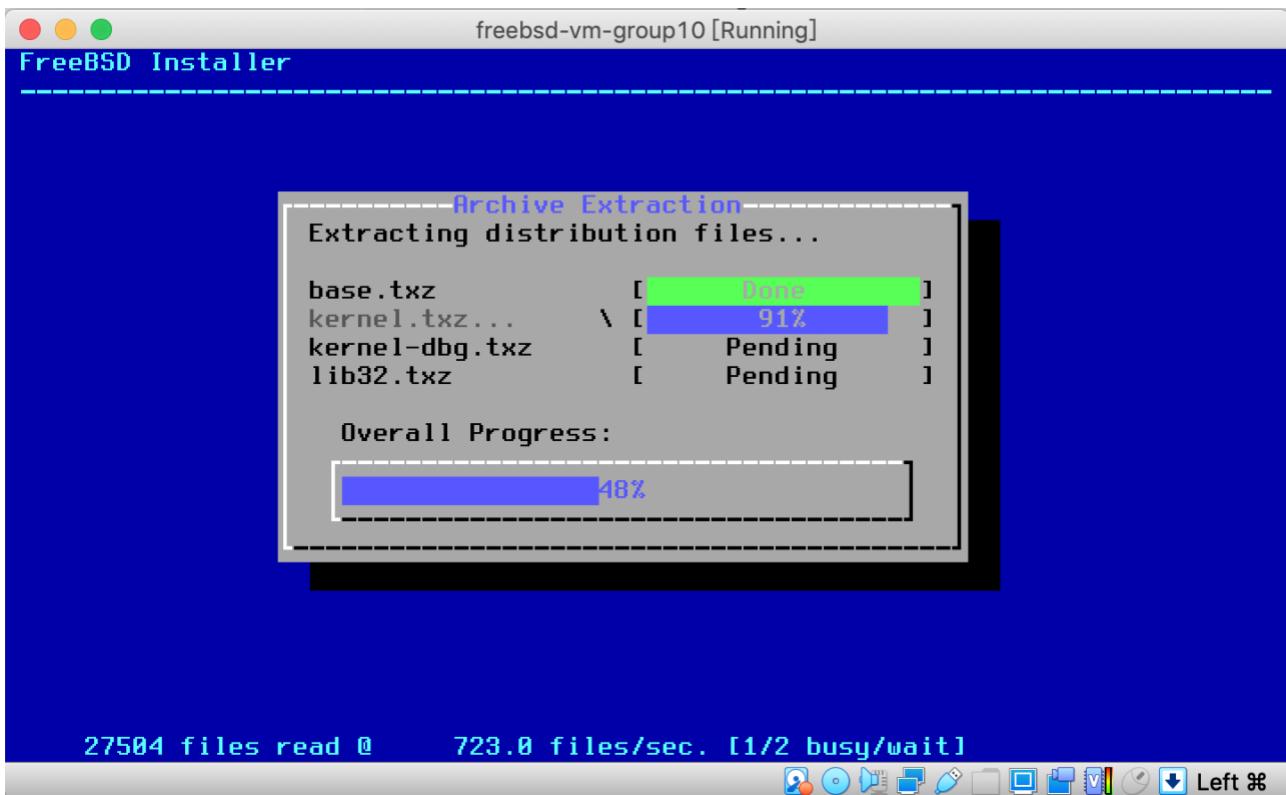
After this step, the additional packages will be downloaded from the internet, and the partitioning step will be initiated.



According to the instructions, we should select UFS for disk setup.

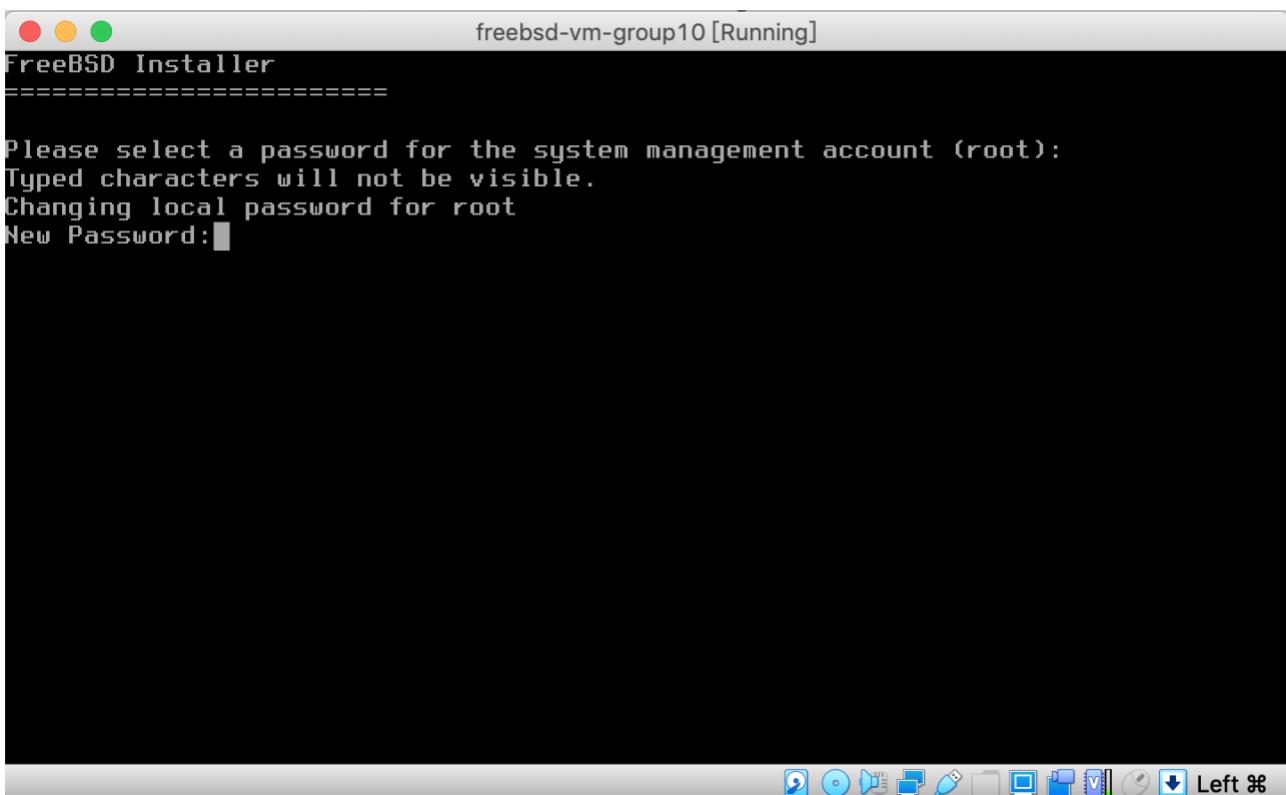


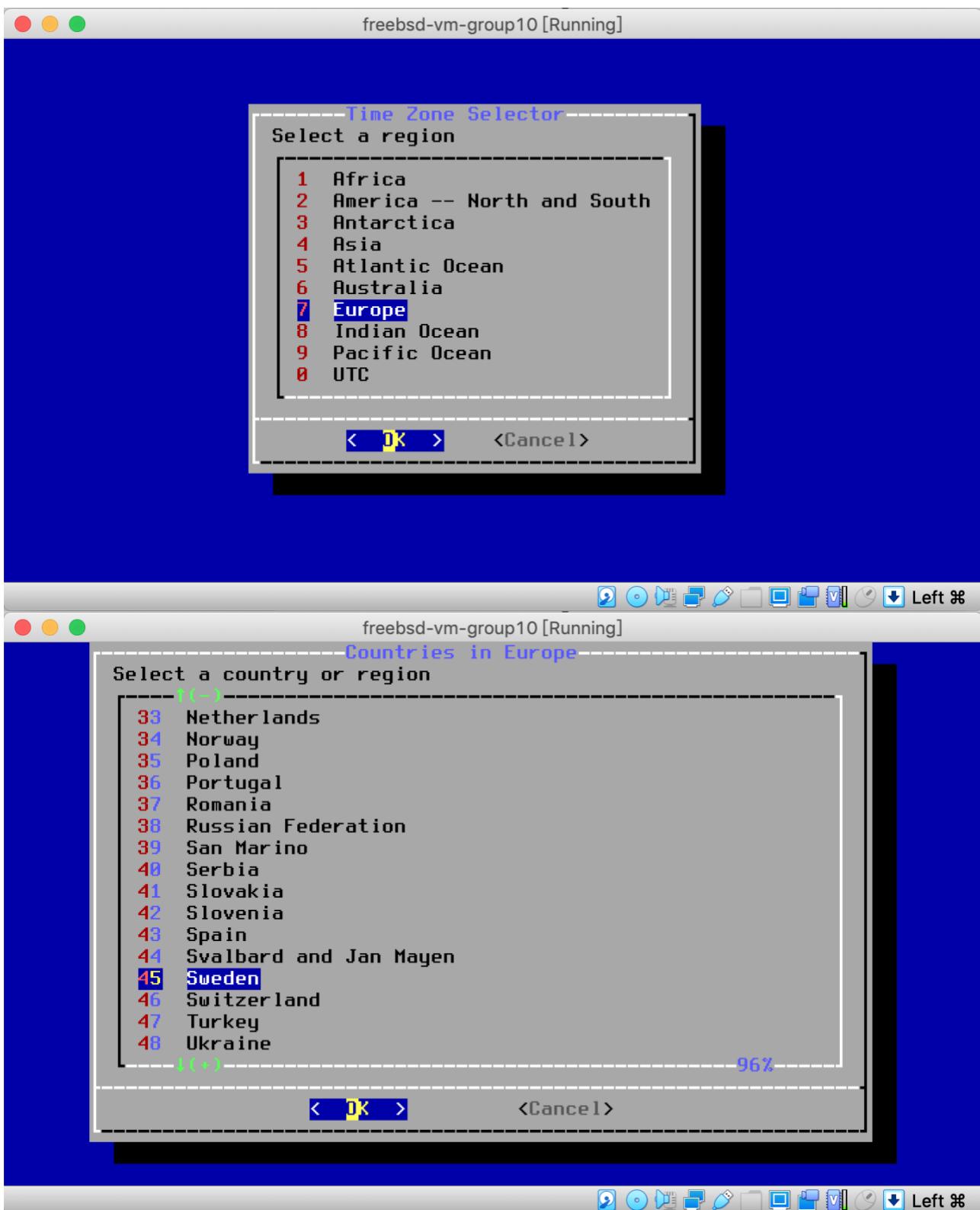




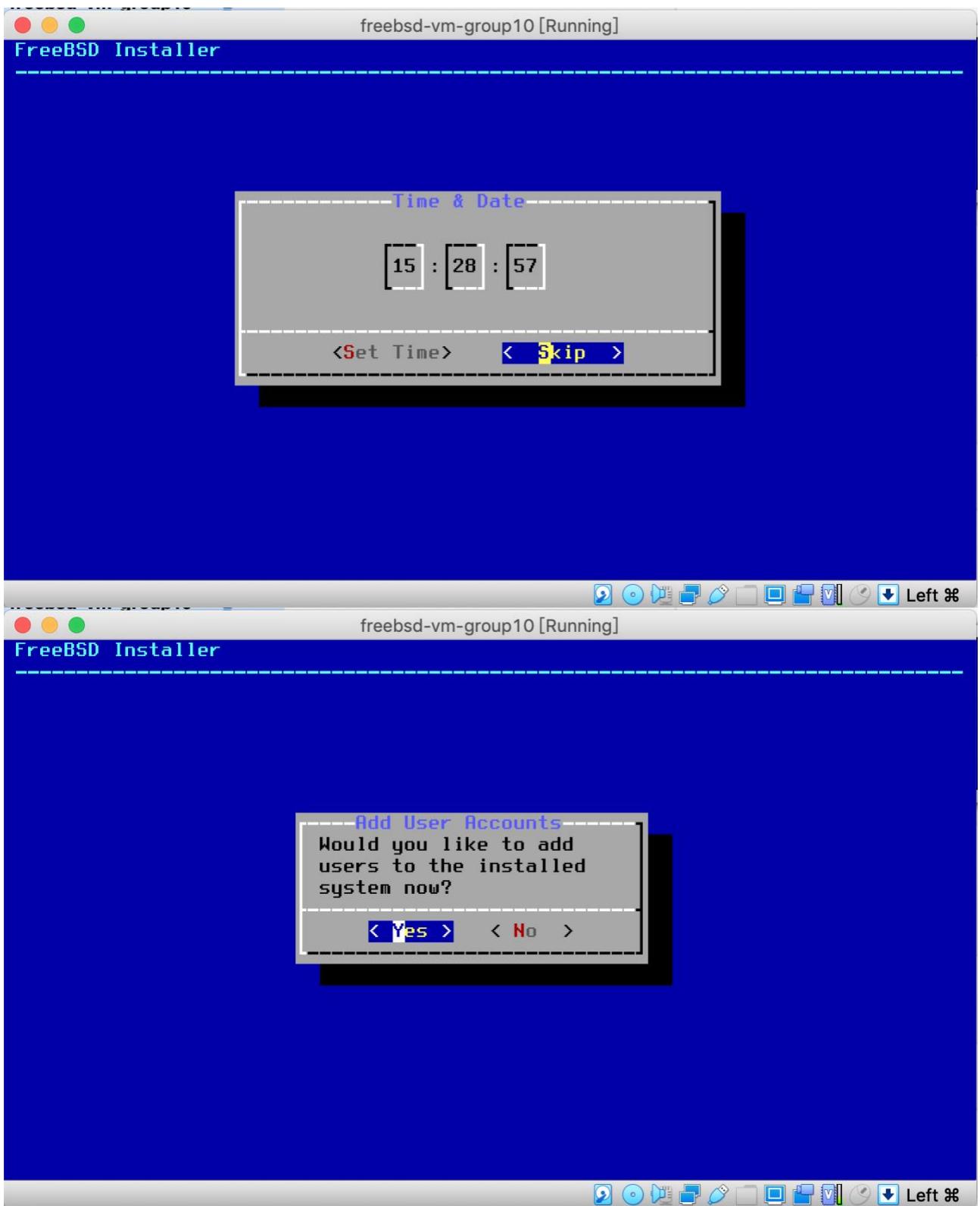
3.1.3 System configuration

After finishing the above processes, we will reach the following step to configure the system management account (root). In our system, we set “root” as the password.

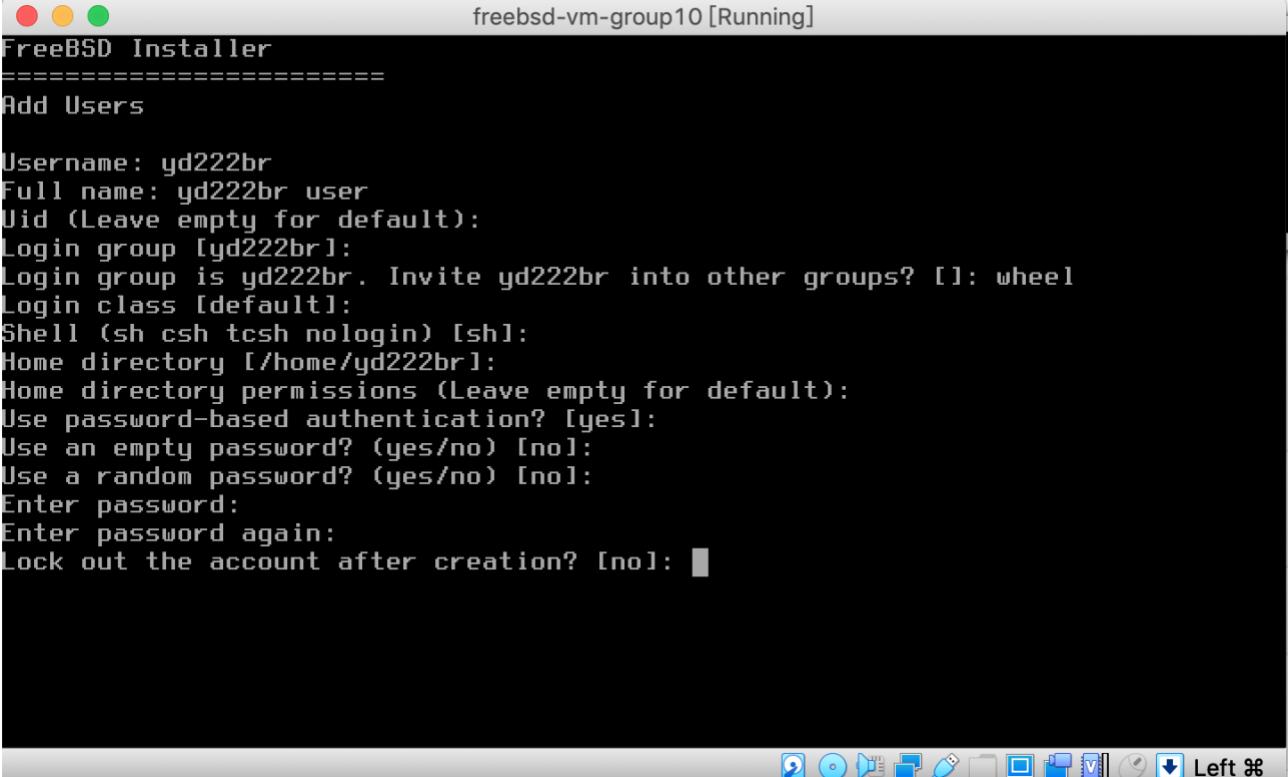




We selected Europe and Sweden, and after this, all the settings are default.

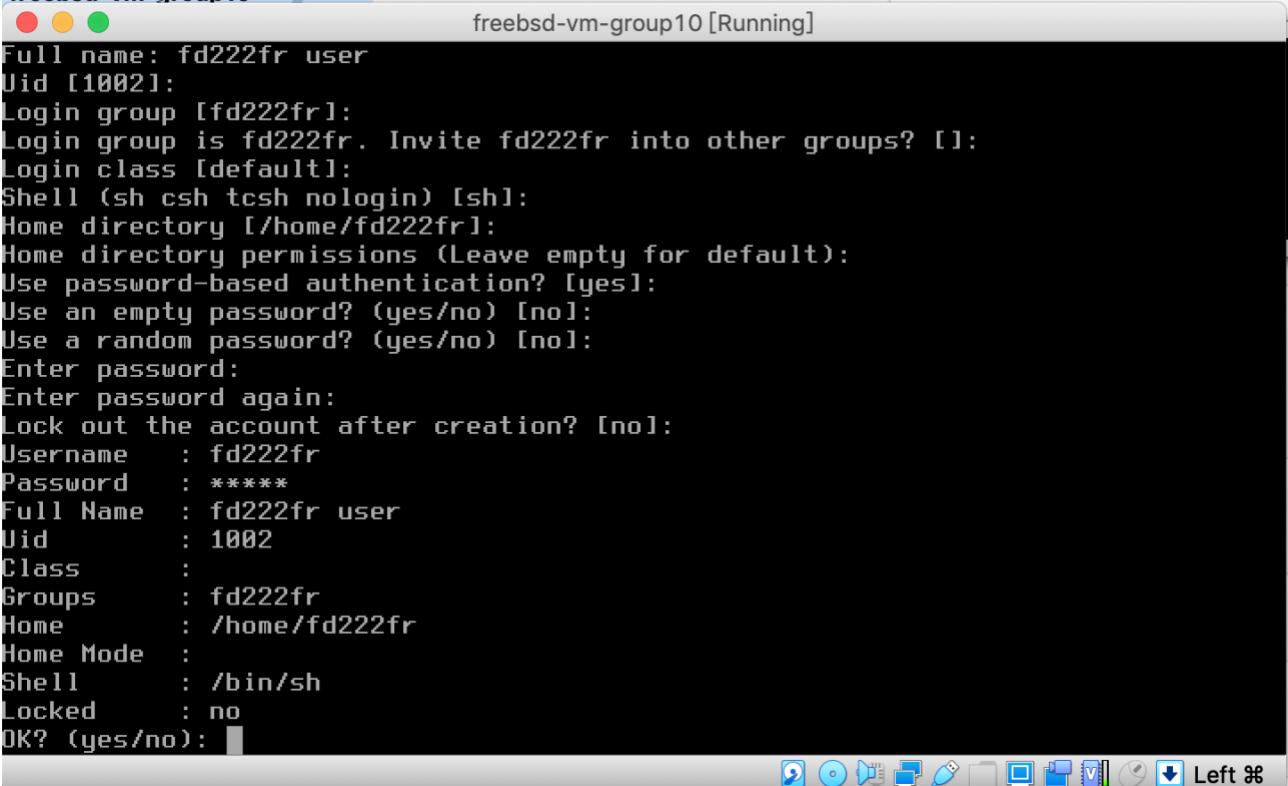


3.2 Adding users to FreeBSD



The screenshot shows the FreeBSD Installer interface with the title "freebsd-vm-group10 [Running]". The main window displays the "Add Users" configuration screen. The user is prompted to enter a "Username" (yd222br), "Full name" (yd222br user), and "Uid" (Leave empty for default). The "Login group" is set to "yd222br". A question "Login group is yd222br. Invite yd222br into other groups? []: wheel" is present. The "Login class" is set to "default". The "Shell" option is set to "sh csh tcsh nologin [sh]". The "Home directory" is set to "/home/yd222br". The "Home directory permissions" are set to "Leave empty for default". Questions about password authentication ("Use password-based authentication? [yes]"), empty password ("Use an empty password? (yes/no) [no]"), and random password ("Use a random password? (yes/no) [no]") are shown. The user is prompted to "Enter password" and "Enter password again". Finally, a question "Lock out the account after creation? [no]: █" is displayed.

We added user “yd222br” to “wheel” while “fd222fr” as well as “fe222pa” were set up with default settings. In our case, the password is same as the username.

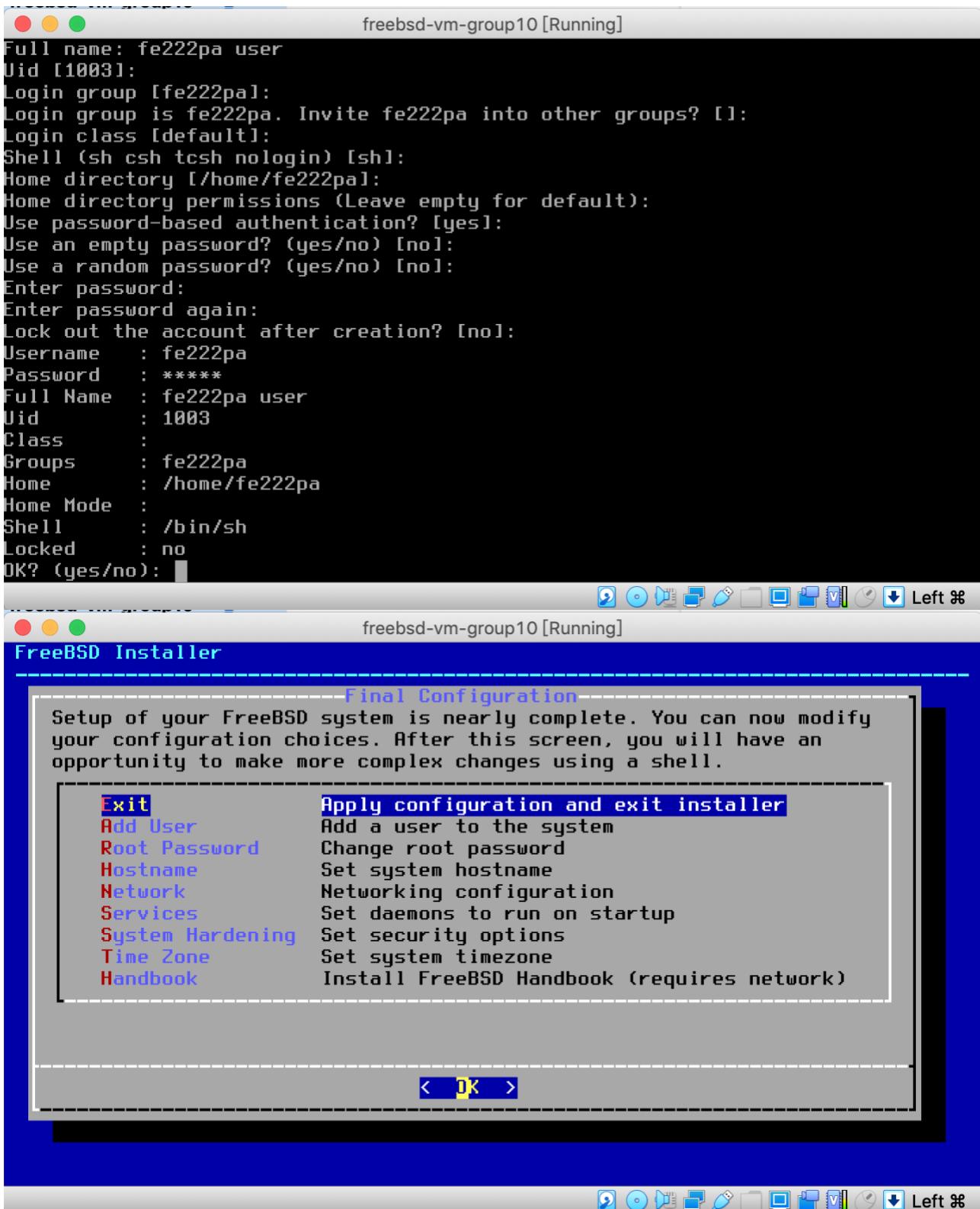


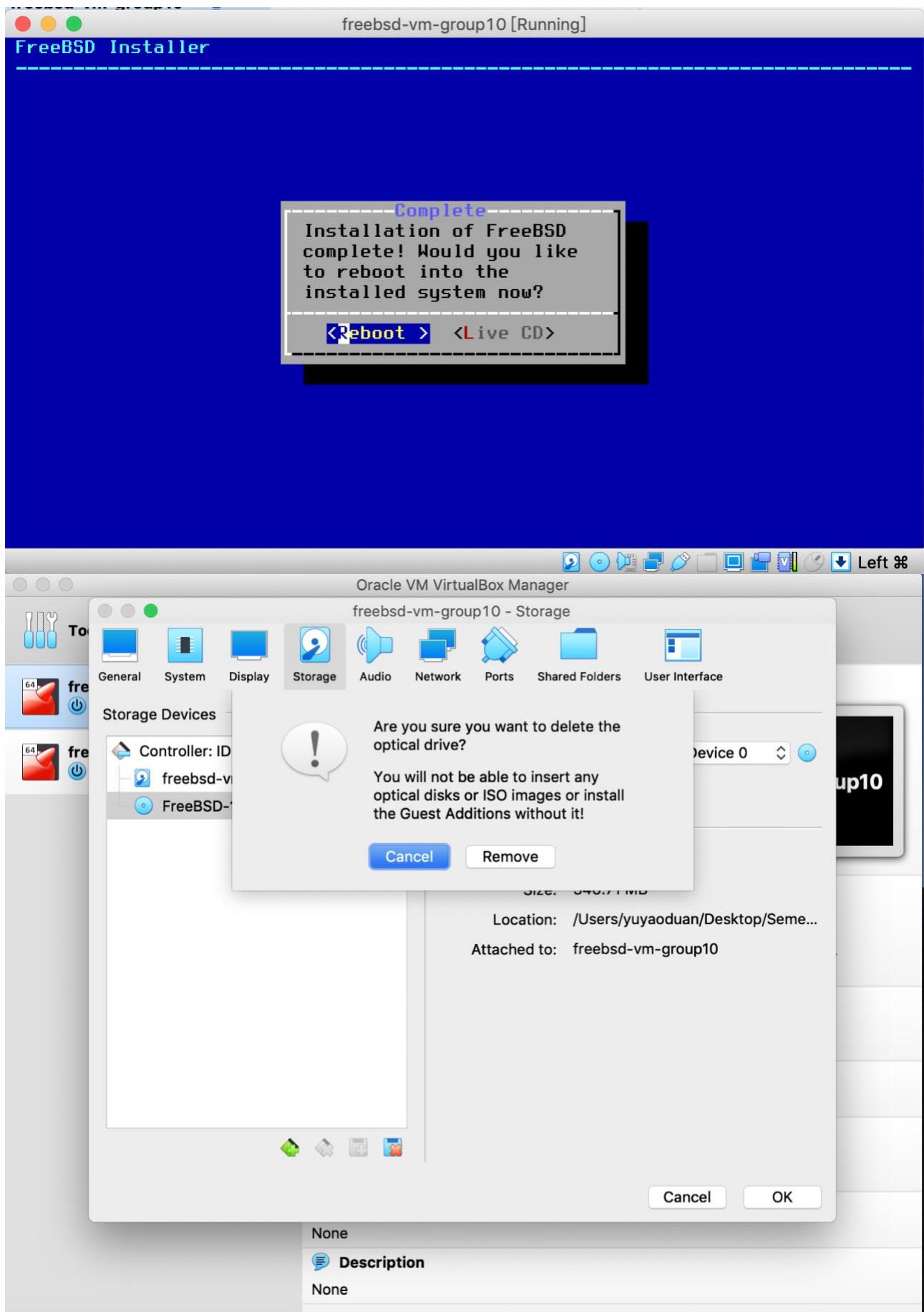
The screenshot shows the FreeBSD Installer interface with the title "freebsd-vm-group10 [Running]". The main window displays the "Add Users" configuration screen. The user has entered a "Full name" (fd222fr user), "Uid" (1002), and "Login group" (fd222fr). The "Login group is fd222fr. Invite fd222fr into other groups? []:" question is present. The "Login class" is set to "default". The "Shell" option is set to "sh csh tcsh nologin [sh]". The "Home directory" is set to "/home/fd222fr". The "Home directory permissions" are set to "Leave empty for default". Questions about password authentication ("Use password-based authentication? [yes]"), empty password ("Use an empty password? (yes/no) [no]"), and random password ("Use a random password? (yes/no) [no]") are shown. The user has entered a password ("Enter password") and confirmed it ("Enter password again"). The "Lock out the account after creation? [no]: █" question is present. Below the configuration, a summary of the user's settings is shown:

```

Username      : fd222fr
Password      : *****
Full Name    : fd222fr user
Uid          : 1002
Class         :
Groups        : fd222fr
Home          : /home/fd222fr
Home Mode     :
Shell          : /bin/sh
Locked        : no
OK? (yes/no): █

```





After this stage, we can boot the newly installed FreeBSD operating system.

3.3 Running FreeBSD

When running the operating system for the first time, we need to set up a few configurations according to the tutorial. In our case, we enabled “vbox_guest” and “vbox_service” as mentioned in the video.

```
freebsd-vm-group10 [Running]
Release Notes, Errata: https://www.FreeBSD.org/releases/
Security Advisories: https://www.FreeBSD.org/security/
FreeBSD Handbook: https://www.FreeBSD.org/handbook/
FreeBSD FAQ: https://www.FreeBSD.org/faq/
Questions List: https://lists.FreeBSD.org/mailman/listinfo/freebsd-questions/
FreeBSD Forums: https://forums.FreeBSD.org/

Documents installed with the system are in the /usr/local/share/doc/freebsd/
directory, or can be installed later with: pkg install en-freebsd-doc
For other languages, replace "en" with a language code like de or fr.

Show the version of FreeBSD installed: freebsd-version ; uname -a
Please include that output and any error messages when posting questions.
Introduction to manual pages: man man
FreeBSD directory layout: man hier

To change this login announcement, see motd(5).
If you have a CD-ROM drive in your machine, you can make the CD-ROM that is
presently inserted available by typing 'mount /cdrom' as root. The CD-ROM
will be available under /cdrom/. Remember to do 'umount /cdrom' before
removing the CD-ROM (it will usually not be possible to remove the CD-ROM
without doing this.)

Note: This tip may not work in all configurations.
yd222br@freebsd-vm-group10:~ $ █

freebsd-vm-group10 [Running]
Documents installed with the system are in the /usr/local/share/doc/freebsd/
directory, or can be installed later with: pkg install en-freebsd-doc
For other languages, replace "en" with a language code like de or fr.

Show the version of FreeBSD installed: freebsd-version ; uname -a
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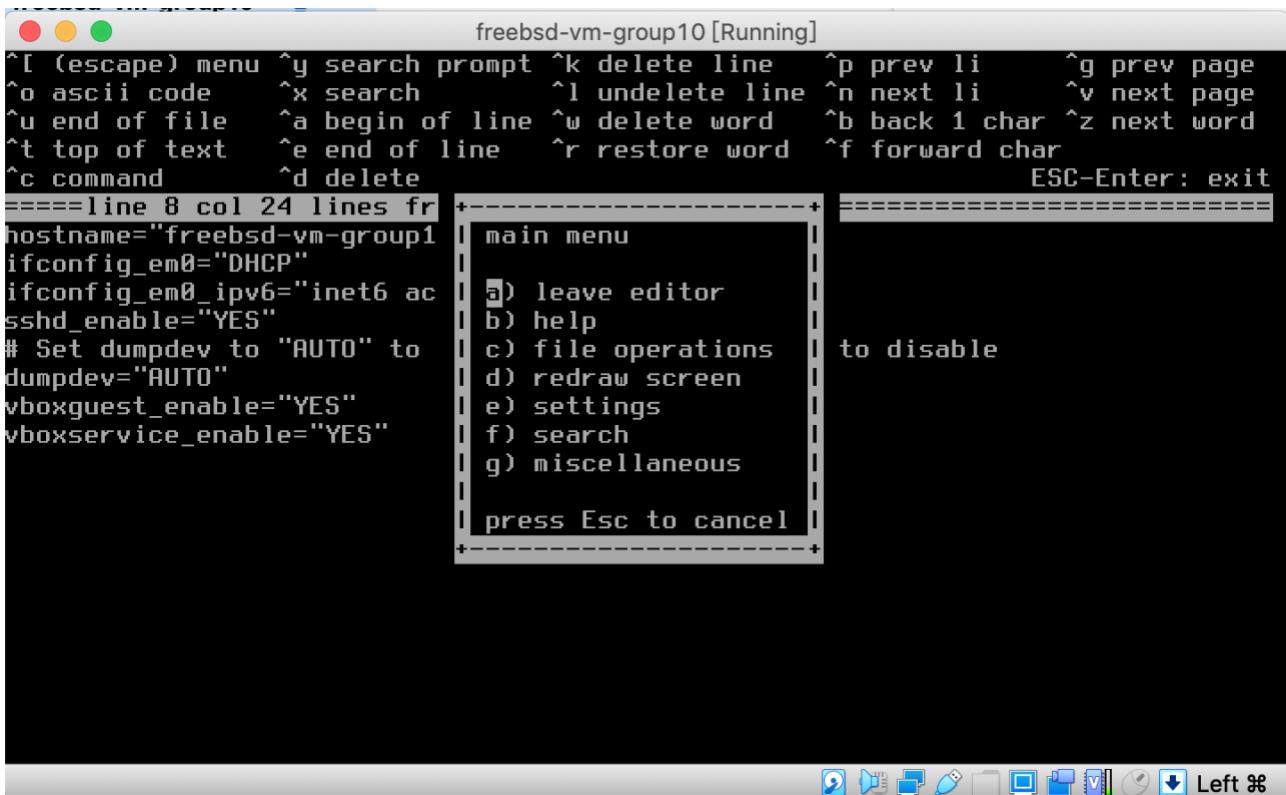
To change this login announcement, see motd(5).
If you have a CD-ROM drive in your machine, you can make the CD-ROM that is
presently inserted available by typing 'mount /cdrom' as root. The CD-ROM
will be available under /cdrom/. Remember to do 'umount /cdrom' before
removing the CD-ROM (it will usually not be possible to remove the CD-ROM
without doing this.)

Note: This tip may not work in all configurations.
yd222br@freebsd-vm-group10:~ $ su
Password:
Nov 24 16:47:38 freebsd-vm-group10 su[849]: yd222br to root on /dev/ttys0
root@freebsd-vm-group10:/home/yd222br # pkg install emulators/virtualbox-ose-additions
The package management tool is not yet installed on your system.
Do you want to fetch and install it now? [y/N]: y █
```

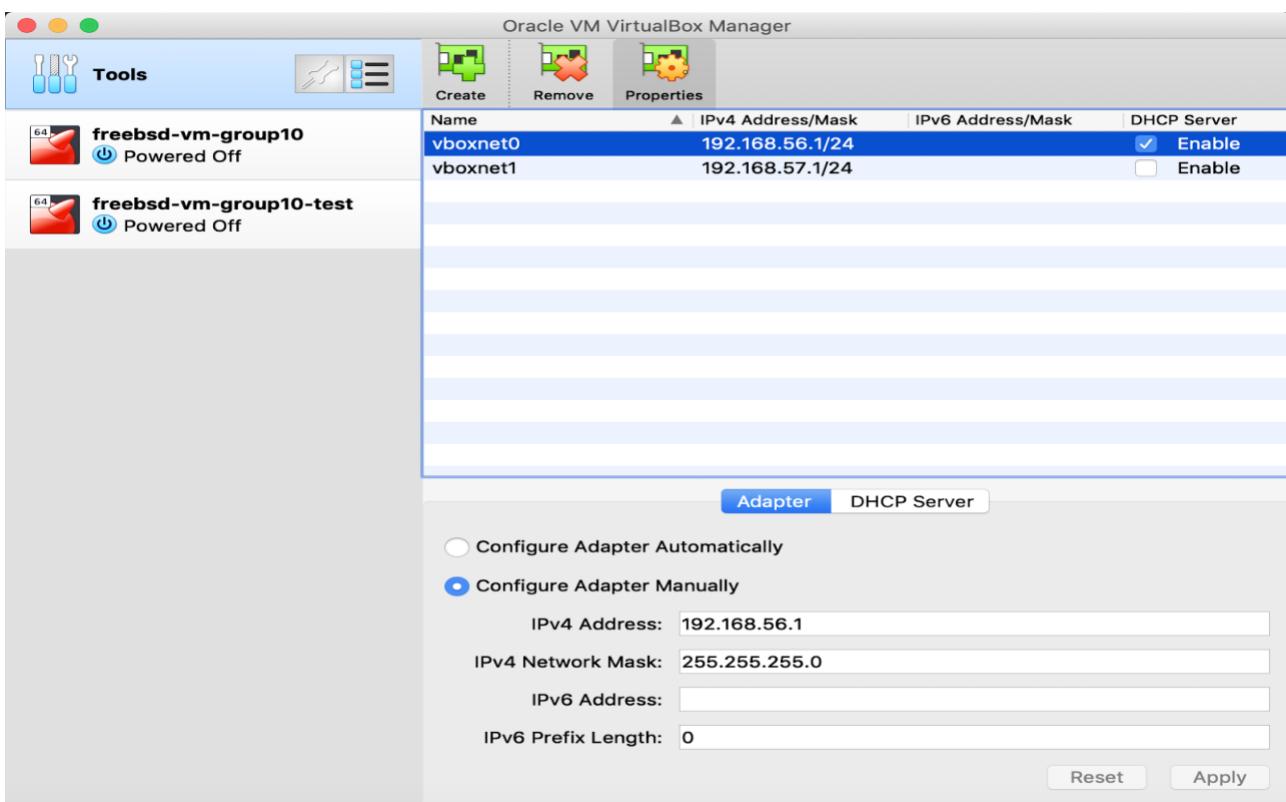
The image shows two terminal windows side-by-side, both titled "freebsd-vm-group10 [Running]". The top window displays the beginning of the /etc/rc.conf file, specifically lines 1 through 6. The bottom window displays the entire /etc/rc.conf file from line 1 to line 8. Both windows show the same keybinding information at the top and a toolbar with various icons at the bottom.

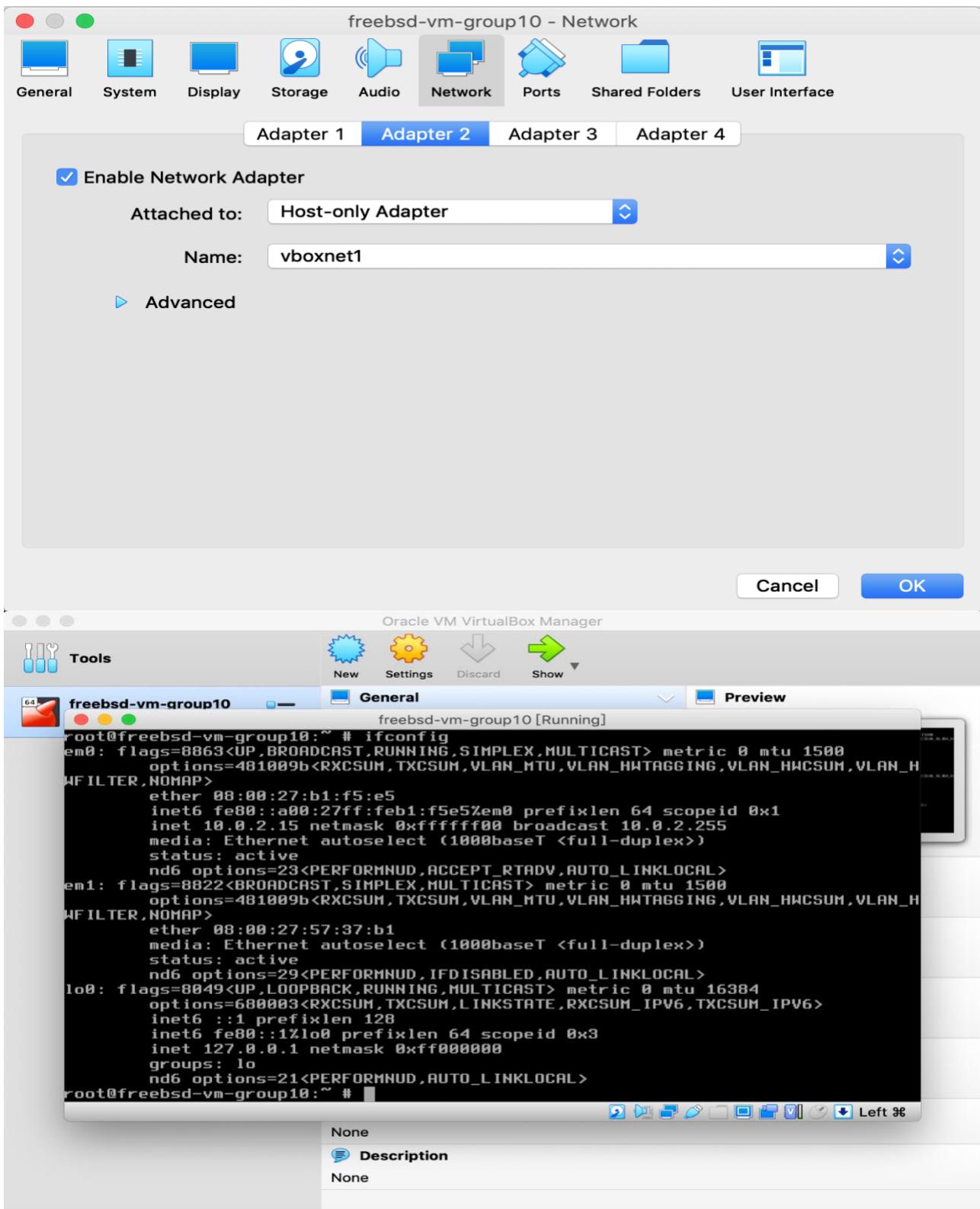
```
file "/etc/rc.conf", 6 lines
freebsd-vm-group10 [Running]
^I (escape) menu ^y search prompt ^k delete line ^p prev li      ^g prev page
^o ascii code   ^x search      ^l undelete line ^n next li      ^v next page
^u end of file  ^a begin of line ^w delete word ^b back 1 char ^z next word
^t top of text  ^e end of line  ^r restore word ^f forward char
^c command     ^d delete char  ^j undelete char           ESC-Enter: exit
=====line 1 col 0 lines from top 1 =====
hostname="freebsd-vm-group10"
ifconfig_em0="DHCP"
ifconfig_em0_ipv6="inet6 accept_rtadv"
sshd_enable="YES"
# Set dumpdev to "AUTO" to enable crash dumps, "NO" to disable
dumpdev="AUTO"

file "/etc/rc.conf", 8 lines
freebsd-vm-group10 [Running]
^I (escape) menu ^y search prompt ^k delete line ^p prev li      ^g prev page
^o ascii code   ^x search      ^l undelete line ^n next li      ^v next page
^u end of file  ^a begin of line ^w delete word ^b back 1 char ^z next word
^t top of text  ^e end of line  ^r restore word ^f forward char
^c command     ^d delete char  ^j undelete char           ESC-Enter: exit
=====line 8 col 24 lines from top 8 =====
hostname="freebsd-vm-group10"
ifconfig_em0="DHCP"
ifconfig_em0_ipv6="inet6 accept_rtadv"
sshd_enable="YES"
# Set dumpdev to "AUTO" to enable crash dumps, "NO" to disable
dumpdev="AUTO"
vboxguest_enable="YES"
vboxservice_enable="YES"■
```



3.4 Setting up network interface





After this step, task 2 has been done.

4. Task 3

4.1 Running simple commands and redirecting outputs

For this task, it was asked to run the “id” command in one of the accounts. For this, the account fd222fr has been chosen. After running the command, the following result was:

```
Welcome to FreeBSD!

Release Notes, Errata: https://www.FreeBSD.org/releases/
Security Advisories: https://www.FreeBSD.org/security/
FreeBSD Handbook: https://www.FreeBSD.org/handbook/
FreeBSD FAQ: https://www.FreeBSD.org/faq/
Questions List: https://lists.FreeBSD.org/mailman/listinfo/freebsd-questions/
FreeBSD Forums: https://forums.FreeBSD.org/

Documents installed with the system are in the /usr/local/share/doc/freebsd/
directory, or can be installed later with: pkg install en-freebsd-doc
For other languages, replace "en" with a language code like de or fr.

Show the version of FreeBSD installed: freebsd-version ; uname -a
Please include that output and any error messages when posting questions.
Introduction to manual pages: man man
FreeBSD directory layout: man hier

To change this login announcement, see motd(5).
Want colour in your directory listings? Use "ls -G". "ls -F" is also useful,
and they can be combined as "ls -FG".
fd222fr@freebsd-vm-group10:~ $ id
uid=1002(fd222fr) gid=1002(fd222fr) groups=1002(fd222fr)
fd222fr@freebsd-vm-group10:~ $ █
```

Next was to list the complete contents of the home directory for the account chosen (including the hidden files and the permissions). In order to achieve this, the command “ls -la /home/fd222fr/” was used where it essentially means to list directory contents, use a long listing format and not ignore entries that start with a dot. The results were:

```
fd222fr@freebsd-vm-group10:/home/fd222fr$ ls -la /home/fd222fr
total 116
drwx----- 2 fd222fr fd222fr 512 Nov 22 16:52 .
drwxr-xr-x  5 root   wheel   512 Nov 13 19:35 ..
-rw-r--r--  1 fd222fr fd222fr 962 Nov 13 19:33 .cshrc
-rw-r--r--  1 fd222fr fd222fr 323 Nov 13 19:33 .login
-rw-r--r--  1 fd222fr fd222fr  91 Nov 13 19:33 .login_conf
-rw-----  1 fd222fr fd222fr 301 Nov 13 19:33 .mail_aliases
-rw-r--r--  1 fd222fr fd222fr 267 Nov 13 19:33 .mailrc
-rw-r--r--  1 fd222fr fd222fr 978 Nov 13 19:33 .profile
-rw-r--r--  1 fd222fr fd222fr 695 Nov 13 19:33 .shrc
-rw-r--r--  1 fd222fr fd222fr 47838 Nov 17 19:13 .zcompdump
-rw-----  1 fd222fr fd222fr 3698 Nov 22 15:44 .zhistory
-rw-r--r--  1 fd222fr fd222fr 731 Nov 17 20:03 .zshrc
-rw-r--r--  1 fd222fr fd222fr  60 Nov 15 22:26 Group
-rw-r--r--  1 fd222fr fd222fr    8 Nov 20 18:51 Group10Test.txt
```

Then the instructions stated that the same should be done for the file system *root* directory. After running the command “ls -la /root”, the results were:

```
fd222fr@freebsd-vm-group10:/home/fd222fr$ ls -la /root
total 0
ls: /root: Permission denied
fd222fr@freebsd-vm-group10:/home/fd222fr$ █
```

The final part was to create a file named “*Group 10*” in the home directory of the account chosen (in this case fd222fr) and then attempt to copy said file to a different account of the group (for this example, fe222pa has been chosen). A burner file was created by using the following command “ls -

la /home > Group10.txt” which redirects the output to the “*Group 10*” file. Attempting to copy this file from fd222fr to fe222pa resulted in the error below:

```
fd222fr@freebsd-vm-group10:~ $ cp /home/fd222fr/Group10.txt /home/fe222pa/Group10Copy.txt
cp: /home/fe222pa/Group10Copy.txt: Permission denied
fd222fr@freebsd-vm-group10:~ $
```

Which from the discussion within the group is due to as the name implies, the user fd222fr does not have writing permissions to the home directory of user fe222pa however by utilizing the root account and modifying the permissions for the directories → giving fd222fr writing permissions to the home directory of fe222pa and giving fe222pa reading permissions of the home directory of fd222fr and running the command from fe222pa resulted in a successful copying of the file which can be seen from the results below:

```
fe222pa@freebsd-vm-group10:~ $ ls -la
total 44
drwxr-xr-x  2 fe222pa  fe222pa  512 Nov 16 23:14 .
drwxr-xr-x  5 root     wheel    512 Nov 13 19:35 ..
-rw-r--r--  1 fe222pa  fe222pa  962 Nov 13 19:35 .cshrc
-rw-r--r--  1 fe222pa  fe222pa  323 Nov 13 19:35 .login
-rw-r--r--  1 fe222pa  fe222pa   91 Nov 13 19:35 .login_conf
-rw-----  1 fe222pa  fe222pa  301 Nov 13 19:35 .mail_aliases
-rw-r--r--  1 fe222pa  fe222pa  267 Nov 13 19:35 .mailrc
-rw-r--r--  1 fe222pa  fe222pa  978 Nov 13 19:35 .profile
-rw-r--r--  1 fe222pa  fe222pa  695 Nov 13 19:35 .shrc
-rw-r--r--  1 fe222pa  fe222pa   60 Nov 15 22:26 Group10Copy.txt
-rw-r--r--  1 fd222fr  fd222fr   60 Nov 15 22:26 Group10Sudo.txt
fe222pa@freebsd-vm-group10:~ $
```

4.2 Installing sudo and creating a group for the users

For this part, it is required that the root user is to be utilized in order to install the sudo package and create a group named “*sudoers*” for the other users and allow them to take advantage of the sudo command. The package sudo is installed using the command “pkg install sudo”.

```
Updating database digests format: 100%
The following 3 package(s) will be affected (of 0 checked):

New packages to be INSTALLED:
  gettext-runtime: 0.21
  indexinfo: 0.3.1
  sudo: 1.9.8p2

Number of packages to be installed: 3

The process will require 7 MiB more space.
2 MiB to be downloaded.

Proceed with this action? [y/N]: y
[1/3] Fetching sudo-1.9.8p2.pkg: 100%    1 MiB   1.5MB/s   00:01
[2/3] Fetching gettext-runtime-0.21.pkg: 100%  166 KiB 169.9kB/s   00:01
[3/3] Fetching indexinfo-0.3.1.pkg: 100%    6 KiB   5.7kB/s   00:01
Checking integrity... done (0 conflicting)
[1/3] Installing indexinfo-0.3.1...
[1/3] Extracting indexinfo-0.3.1: 100%
[2/3] Installing gettext-runtime-0.21...
[2/3] Extracting gettext-runtime-0.21: 100%
[3/3] Installing sudo-1.9.8p2...
[3/3] Extracting sudo-1.9.8p2: 100%
root@freebsd-vm-group10:/home/yd222br #
```

The group sudoers was then created.

```
To change this login announcement, see motd(5).
root@freebsd-vm-group10:~ # pw groupshow sudoers
sudoers:*:1004:
root@freebsd-vm-group10:~ #
```

After the group was created, all of the group members were added to it.

```
root@freebsd-vm-group10:~ # pw groupmod mod sudoers -m fd222fr,yd222br,fe222pa
root@freebsd-vm-group10:~ # pw groupshow sudoers
sudoers:*:1004:yd222br,fd222fr,fe222pa
root@freebsd-vm-group10:~ #
```

After the members were added to the group, the next step was to edit the configuration file for sudo to allow the group members to run any programs and that is done by simply adding the name of the group and a few additional lines which will be displayed below:

```
=====line 100 col 0 lines from top 102 =====
## Uncomment to allow members of group wheel to execute any command
# %wheel ALL=(ALL) ALL

## Same thing without a password
# %wheel ALL=(ALL) NOPASSWD: ALL

## Uncomment to allow members of group sudo to execute any command
%sudo ALL=(ALL) ALL

%sudoers ALL=(ALL) ALL

## Uncomment to allow any user to run sudo if they know the password
## of the user they are running the command as (root by default).
Defaults targetpw # Ask for the password of the target user
# ALL ALL=(ALL) ALL # WARNING: only use this together with 'Defaults targetpw'

## Uncomment to show on password prompt which users' password is being expected
```

This was done by using the ee editor and the changes were saved. After doing so, logged out of root and then logged in as instructed.

4.3 Working with hexadecimal dumps

For this part, the instructions stated that one of the group members' accounts should be used as a sample in order to run the following commands: "hexdump -n 32 /dev/ada0" and "sudo hexdump -n 32 /dev/ada0". Running the first command with the user account fd222fr gave the following result:

```
fd222fr@freebsd-vm-group10:/home/fd222fr$ hexdump -n 32 /dev/ada0
hexdump: /dev/ada0: Permission denied
fd222fr@freebsd-vm-group10:/home/fd222fr$
```

However, running the second command proved fruitful and gave the following results:

```
fd222fr@freebsd-vm-group10:~ $ sudo hexdump -n 32 /dev/ada0
Password:
00000000 31fc 8ec0 8ec0 8ed8 bcd0 7c00 1abe bf7c
00000010 061a e6b9 f301 e9a4 8a00 f631 bebb b107
00000020
fd222fr@freebsd-vm-group10:~ $
```

The command itself provides a hexadecimal dump, a view of the data of 32 bytes in length of the data found on the disk drive. Running the sudo command allowed for the command to be executed and overrule the permission denial beforehand.

4.4 Repeating a command with sudo

Repeating the command from 3.1 from user fd222fr and creating a different file named “Group10Sudo” gave the following results:

```
fe222pa@freebsd-vm-group10:~ $ ls -la
total 44
drwxr-xr-x  2 fe222pa  fe222pa  512 Nov 16 23:14 .
drwxr-xr-x  5 root      wheel     512 Nov 13 19:35 ..
-rw-r--r--  1 fe222pa  fe222pa  962 Nov 13 19:35 .cshrc
-rw-r--r--  1 fe222pa  fe222pa  323 Nov 13 19:35 .login
-rw-r--r--  1 fe222pa  fe222pa   91 Nov 13 19:35 .login_conf
-rw-------  1 fe222pa  fe222pa  301 Nov 13 19:35 .mail_aliases
-rw-r--r--  1 fe222pa  fe222pa  267 Nov 13 19:35 .mailrc
-rw-r--r--  1 fe222pa  fe222pa  978 Nov 13 19:35 .profile
-rw-r--r--  1 fe222pa  fe222pa  695 Nov 13 19:35 .shrc
-rw-r--r--  1 fe222pa  fe222pa   60 Nov 15 22:26 Group10Copy.txt
-rw-r--r--  1 fd222fr  fd222fr   60 Nov 15 22:26 Group10Sudo.txt
fe222pa@freebsd-vm-group10:~ $
```

which proves that it worked without the need to log into root to change any sort of permissions.

4.5 Changing the resolution and investigating vidcontrol

For this part, the instructions state that the current mode should be checked with the command “vidcontrol -i adapter” and running said command gave the result:

```
fd222fr@freebsd-vm-group10:~ $ vidcontrol -i adapter
vidcontrol: obtaining adapter information: Inappropriate ioctl for device
```

To make sure that the syscons drivers are used for the console and that is done by saving the command “kern.vty=sc” in the loader configuration file [3]. After doing so and checking the compatible resolutions or modes, the resolution was set the following way [4]:

```
!l (escape) menu ^y search prompt ^k delete line ^p prev li    ^g prev page
!o ascii code ^x search ^l undelete line ^n next li    ^v next page
!u end of file ^a begin of line ^w delete word ^b back 1 char ^z next word
!t top of text ^e end of line ^r restore word ^f forward char
!c command ^d delete char ^j undelete char           ESC-Enter: exit
====line 7 col 27 lines from top 7 ====
hostname="freebsd-vm-group10"
ifconfig_em0="DHCP"
ifconfig_em0_ipv6="inet6 accept_rtadv"
sshd_enable="YES"
# Set dumpdev to "AUTO" to enable crash dumps, "NO" to disable
dumpdev="AUTO"
allscreens_flags="MODE_283"
```

Finally, to print the set of standard supported colours using the command “vidcontrol show” gave this output:

```
fd222fr@freebsd-vm-group10:/home/fd222fr$ vidcontrol show

 0      8  grey      0  BACKGROUND    8  BACKGROUND
 1  blue   9  lightblue  1  BACKGROUND    9  BACKGROUND
 2  green  10 lightgreen  2  BACKGROUND   10 BACKGROUND
 3  cyan   11 lightcyan  3  BACKGROUND   11 BACKGROUND
 4  red    12 lightred   4  BACKGROUND   12 BACKGROUND
 5  magenta 13 lightmagenta  5  BACKGROUND  13 BACKGROUND
 6  brown  14 yellow    6  BACKGROUND   14 BACKGROUND
 7  white  15 lightwhite  7  BACKGROUND   15 BACKGROUND
```

4.6 Changing the shell and customizing it

For the next task, it was required that the default shell be changed to zsh instead. To begin, the zsh was installed first by using the command “pkg install zsh”. After doing so, using root account, the configuration file for zsh was edited so that it follows the pattern: “{account name}@{full host name}:{current path} {%, or #, depending on the current account permissions}”, keeps track of history and is able to scroll up and down through it which was in the courtesy of a few websites and individuals [5] [6].

```
"/home/fe222pa/.zshrc" 3 lines, 31 characters
freebsd-vm-group18% login
login: fd222fr
Password:
Last login: Wed Nov 17 28:06:46 on ttv0
FreeBSD 13.0-RELEASE (GENERIC) #0 releng/13.0-n244733-ea31abc261f: Fri Apr 9 04:24:09 UTC 2021

Welcome to FreeBSD!

Release Notes, Errata: https://www.FreeBSD.org/releases/
Security Advisories: https://www.FreeBSD.org/security/
FreeBSD Handbook: https://www.FreeBSD.org/handbook/
FreeBSD FAQ: https://www.FreeBSD.org/faq/
Questions List: https://lists.FreeBSD.org/mailman/listinfo/freebsd-questions/
FreeBSD Forums: https://forums.FreeBSD.org/

Documents installed with the system are in the /usr/local/share/doc/freebsd/
directory, or can be installed later with: pkg install en-freebsd-doc
For other languages, replace "en" with a language code like de or fr.

Show the version of FreeBSD installed: freebsd-version ; uname -a
Please include that output and any error messages when posting questions.
Introduction to manual pages: man man
FreeBSD directory layout: man hier

To change this login announcement, see motd(5).
fd222fr@freebsd-vm-group10:/home/fd222fr$ echo $0
-zsh
fd222fr@freebsd-vm-group10:/home/fd222fr$ cat ~/.zshrc
# Lines configured by zsh-newuser-install
HISTFILE=~/.zhistory
HISTSIZE=1000000
SAVEHIST=1000000
setopt appendhistory
bindkey -e

# Lines to be used when scrolling up or down in history
autoload -U up-line-or-beginning-search
autoload -U down-line-or-beginning-search
zle -N up-line-or-beginning-search
zle -N down-line-or-beginning-search
bindkey '^[[A' up-line-or-beginning-search
bindkey '^[[B' down-line-or-beginning-search

PROMPT="%n@%m:%d%(!#.%) " #put # for root and $ for other users of the system

# End of lines configured by zsh-newuser-install
# The following lines were added by compinstall
zstyle :compinstall filename '/home/fd222fr/.zshrc'

autoload -Uz compinit
compinit
# End of lines added by compinstall
fd222fr@freebsd-vm-group10:/home/fd222fr$
```

After editing the zsh configuration file, using the root account and the “chsh -s /bin/zsh” command, zsh was set to be the default shell for each of the group members’ accounts.

After setting up zsh, for the root user it looks so:

```
root@freebsd-vm-group10:/root#
```

And for any other users, it will display a \$ sign:

```
fd222fr@freebsd-vm-group10:/home/fd222fr$
```

4.7 Setting the network interfaces

For this task it was required that a second network interface within the virtual machine (VM) should have been set up and assigned a proper static IP however one of the members had no success in setting it up successfully and resorted to use the first network interface attached to a bridge adapter which is not optimal since it exposes the VM to the network and is not portable [7]. For the members that managed to set it up correctly, the instructions were followed regarding having two separate network interfaces with one of them being configured with a static IP address and connected to host-only network. Afterwards, depending on the default gateway the members had, they had to “keep track” of said default address so if the host system has 192.168.56.1 as its default address the second network interface of the VM should have 192.168.56.2 as its address. The speculation as to why the issue had persisted could either be the OS’s firewall being a barricade to the connection itself or perhaps an error was made during the setup therefore hindering progress. After consulting with one of the supervisors, an approval was received and an exception was made for the use of the bridge adapter. Awareness of the disadvantages of it were kept in mind.

4.8 Enabling SSH

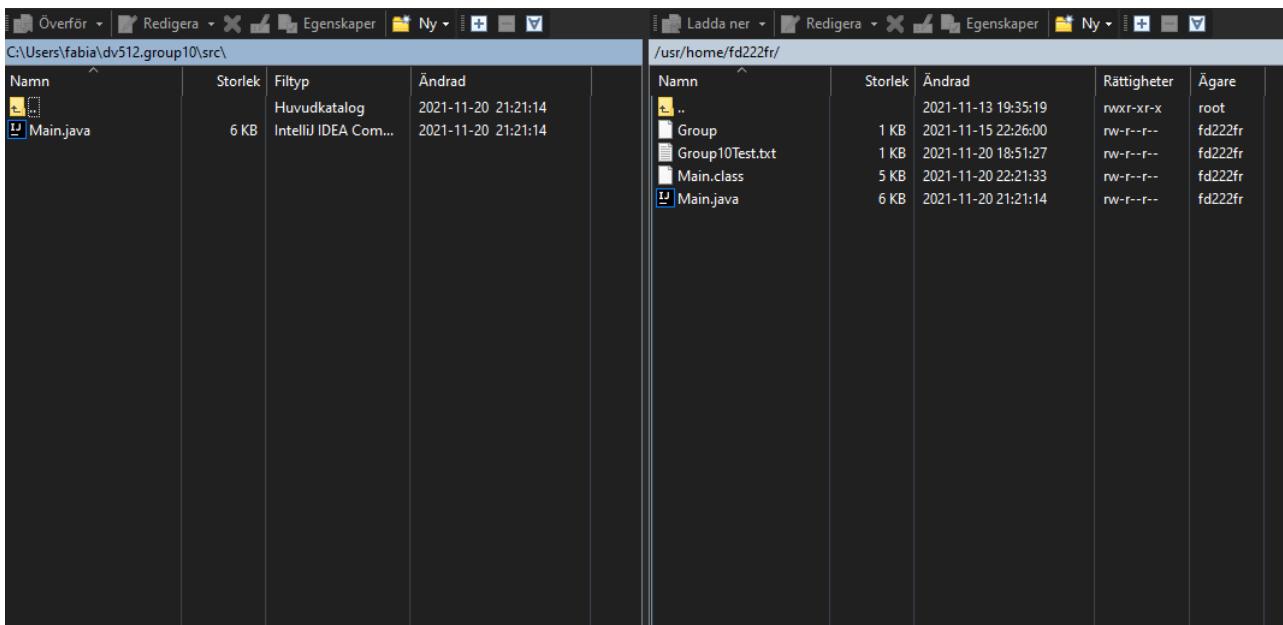
Using the command shell from the host, it is required that we use the following command: “`ssh [username]@the static that was used`” to set up an SSH connection to the VM.

```
Tue Nov 23 18:31:38 CET 2021
FreeBSD/amd64 (freebsd-vm-group10) (ttyv8)
login: fd222fr
Password:
Last login: Mon Nov 22 19:51:49 on ttys0
FreeBSD 13.0-RELEASE (GENERIC) #0 releng/13.0-n244733-ea31abc261f: Fri Apr 9 04:24:09 UTC 2021
Welcome to FreeBSD!
Welcome to FreeBSD!
Release Notes, Errata: https://www.FreeBSD.org/releases/
Security Advisories: https://www.FreeBSD.org/security/
FreeBSD Handbook: https://www.FreeBSD.org/handbook/
FreeBSD FAQ: https://www.FreeBSD.org/faq/
Questions List: https://lists.FreeBSD.org/mailman/listinfo/freebsd-questions/
FreeBSD Forums: https://forums.FreeBSD.org/
Documents installed with the system are in the /usr/local/share/doc/freebsd/
directory, or can be installed later with: pkg install en-freebsd-doc
For other languages, replace "en" with a language code like de or fr.
Show the version of FreeBSD installed: freebsd-version ; uname -a
Please include that output and any error messages when posting questions.
Introduction to manual pages: man man
FreeBSD directory layout: man hier
To change this login announcement, see motd(5).
fd222fr@freebsd-vm-group10:/home/fd222fr$
```

It was a success for all members of the group.

4.9 Connecting with rsync or WinSCP

Regarding this task, it was required that either rsync or WinSCP are to be utilized in order to transfer files from the host system to VM and for the sake of simplicity, only the WinSCP example is going to be shown. The application itself was quite intuitive since all a user needs to do is provide the address and the username along with the password if there is one in order to establish a connection.



Briefly said, as it can be seen in the figure provided above, the connection was used to transfer the application file to the VM. Further elaboration will be provided in the next section of the report.

5. Task 4

5.1 Installing OpenJDK

This task requires to install OpenJDK in the VM in order to run a java program with the command `pkg install openjdk`. The installation can be confirmed with the command “`java --version`”.

```
fd222fr@freebsd-vm-group10:/home/fd222fr$ java --version
openjdk 11.0.12 2021-07-20
OpenJDK Runtime Environment (build 11.0.12+7-1)
OpenJDK 64-Bit Server VM (build 11.0.12+7-1, mixed mode)
fd222fr@freebsd-vm-group10:/home/fd222fr$
```

Above screenshot shows that the installation has been successful.

5.2 Implementing a program in Java for FreeBSD

In this task it is required to implement a program in Java for FreeBSD and the program should be able to:

- Invoke the command “`id`”.
- Switch to the working directory “`/etc`” and run the following command: “`find . -name 'rc*'`”

Invoke the command “`hostname freebsd-vm-group10-up`” in the group 10’s case.

The program was designed so that when it is started, the user is greeted with a main menu and with the aforementioned options and an additional option to exit the program. For the commands themselves, ProcessBuilder was used which is a class used to create operating system processes along with Process which is an abstract class used to run the command itself (process).

```

private void userCommand(String command) {
    ProcessBuilder processBuilder = new ProcessBuilder().command(command);
    String result = "";

    try {
        Process proBuild = processBuilder.start();

        InputStreamReader inputStreamReader = new InputStreamReader(proBuild.getInputStream());
        BufferedReader bufferedReader = new BufferedReader(inputStreamReader);
        String output = "";

        while ((output = bufferedReader.readLine()) != null) {
            result += output;
        }

        int exitCode = proBuild.waitFor();
        System.out.println("The result is: " + result);
        System.out.println("The exit code is: " + exitCode);

        bufferedReader.close();
        proBuild.destroy();
    } catch (IOException | InterruptedException e) {
        e.printStackTrace();
    }
}
}

```

This was the code for the first method used in order to invoke the first command and below is the result of it:

```

WELCOME TO JAVA + FREEBSD app

-----Please choose one of the options below-----
1. Invoke id
2. Switch to /etc/ and find . -name 'rc*'
3. Run hostname freebsd-vm-group10-upd
0. Exit

Please choose the desired action!:
1
Invoking id...
The result is: uid=1002(fd222fr) gid=1002(fd222fr) groups=1002(fd222fr),1004(sudoers)
The exit code is: 0

```

For the second task, the code for its method was:

```

private void secondPart() {
    List<String> commands = new ArrayList<>();
    commands.add("find");
    commands.add(".");
    commands.add("-name");
    commands.add("rc*");
    List<String> resultOfRc = new ArrayList<>();
    System.out.println("Switch to /etc...");
    ProcessBuilder pb = new ProcessBuilder();
    pb.directory(new File(pathname: "/etc/"));
    System.out.println("Running find . -name rc*");
    pb.command(commands);

    try {
        Process proBuild = pb.start();

        InputStreamReader inputStreamReader = new InputStreamReader(proBuild.getInputStream());
        BufferedReader bufferedReader = new BufferedReader(inputStreamReader);
        BufferedReader error = new BufferedReader(new InputStreamReader(proBuild.getErrorStream()));

        String output = "";
        String errorOutput = "";

        while ((output = bufferedReader.readLine()) != null) {
            resultOfRc.add(output);
        }

        int exitCode = proBuild.waitFor();

        System.out.println("Result is: ");
        for (String s : resultOfRc) {
            System.out.println(s);
        }
        System.out.println("The exit code is: " + exitCode);

        if (exitCode == 1) {
            while ((errorOutput = error.readLine()) != null) {
                System.out.println("Error occurred: " + errorOutput);
            }
        }
    }

    bufferedReader.close();
    proBuild.destroy();
}

} catch (IOException | InterruptedException e) {
    e.printStackTrace();
}
}

```

where it can be noted that considering the length of the command an ArrayList was used instead since the ProcessBuilder can only take a word at a time.

The result of running the second command is:

```

WELCOME TO JAVA + FREEBSD app
-----Please choose one of the options below-----
1. Invoke id
2. Switch to /etc/ and find . -name 'rc*'
3. Run hostname freebsd-vm-group10-upd
0. Exit

Please choose the desired action!:
2
Switching to /etc/ and finding . -name 'rc*'...
Switch to /etc...
Running find . -name rc*
Result is:
./rc.initdiskless
./rc.sendmail
./rc.firewall
./rc.d
./rc.d/rct1
./rc
./rc.suspend
./rc.bsdextended
./rc.conf.d
./rc.shutdown
./rc.subr
./defaults/rc.conf
./rc.resume
./rc.conf
The exit code is: 1
Error occurred: find: ./ntp: Permission denied

```

For the third and final requirement of the program, the code used for its method was which the same thing can be noted here as for the second task, since it's a compound sentence, the command was stored in the ArrayList and then processed through the ProcessBuilder:

```

private void thirdPart() {
    List<String> commands = new ArrayList<>();
    commands.add("hostname");
    commands.add("freebsd-vm-group10-upd");
    ProcessBuilder pb = new ProcessBuilder();
    List<String> resultCommands = new ArrayList<>();
    pb.command(commands);
    try {
        Process proBuild = pb.start();
        InputStreamReader inputStreamReader = new InputStreamReader(proBuild.getInputStream());
        BufferedReader bufferedReader = new BufferedReader(inputStreamReader);
        BufferedReader error = new BufferedReader(new InputStreamReader(proBuild.getErrorStream()));
        String output = "";
        String errorOutput = "";

        while ((output = bufferedReader.readLine()) != null) {
            resultCommands.add(output);
        }

        int exitCode = proBuild.waitFor();
        System.out.println("The exit code is: " + exitCode);

        if (exitCode == 0) {
            System.out.println("The result is: ");
            for (String s : resultCommands) {
                System.out.println(s);
            }
        } else {
            while ((errorOutput = error.readLine()) != null) {
                System.out.println("Error occurred: " + errorOutput);
            }
        }
        bufferedReader.close();
        proBuild.destroy();
    } catch (IOException | InterruptedException e) {
        e.printStackTrace();
    }
}

```

And the result of running the following command gave:

```
Please choose the desired action!:
3
3. Running hostname freebsd-vm-group10-upd...
The exit code is: 1
Error occurred: hostname: sethostname: Operation not permitted
```

5.3 Transferring the program to the VM and program compilation

The file was transferred by using WinSCP and once the connection was established it was a matter of dragging and dropping the file to the home directory of user fd222fr. After the file was transferred to the VM, it was then compiled by using the command “javac Main.java” as instructed. Proof can be found below:

```
To change this login announcement, see motd(5).
fd222fr@freebsd-vm-group10:/home/fd222fr$ javac Main.java
fd222fr@freebsd-vm-group10:/home/fd222fr$ ls -la
total 116
drwx----- 2 fd222fr fd222fr 512 Nov 27 12:24 .
drwxr-xr-x 5 root wheel 512 Nov 13 19:35 ..
-rw-r--r-- 1 fd222fr fd222fr 962 Nov 13 19:33 .cshrc
-rw-r--r-- 1 fd222fr fd222fr 323 Nov 13 19:33 .login
-rw-r--r-- 1 fd222fr fd222fr 91 Nov 13 19:33 .login_conf
-rw----- 1 fd222fr fd222fr 301 Nov 13 19:33 .mail_aliases
-rw-r--r-- 1 fd222fr fd222fr 267 Nov 13 19:33 .mailrc
-rw-r--r-- 1 fd222fr fd222fr 978 Nov 13 19:33 .profile
-rw-r--r-- 1 fd222fr fd222fr 695 Nov 13 19:33 .shrc
-rw-r--r-- 1 fd222fr fd222fr 47838 Nov 17 19:13 .zcompdump
-rw----- 1 fd222fr fd222fr 3606 Nov 24 19:32 .zhistory
-rw-r--r-- 1 fd222fr fd222fr 731 Nov 17 20:03 .zshrc
-rw-r--r-- 1 fd222fr fd222fr 60 Nov 15 22:26 Group
-rw-r--r-- 1 fd222fr fd222fr 8 Nov 20 18:51 Group10Test.txt
-rw-r--r-- 1 fd222fr fd222fr 4995 Nov 27 12:24 Main.class
-rw-r--r-- 1 fd222fr fd222fr 5490 Nov 20 21:21 Main.java
fd222fr@freebsd-vm-group10:/home/fd222fr$
```

5.4 Running the program and running a command as sudo

After running the command “java Main”, the following result was:

```
fd222fr@freebsd-vm-group10:/home/fd222fr$ java Main
WELCOME TO JAVA + FREEBSD app
-----Please choose one of the options below-----
1. Invoke id
2. Switch to /etc/ and find . -name 'rc*'
3. Run hostname freebsd-vm-group10-upd
0. Exit

Please choose the desired action!:
```

This indicates that the program is functioning as intended. As seen in the figures above, running the program works however two errors can be noted, running the second and third command. In both of them, the exit code results in 1 and in both cases access or operation is denied hence the exit code. In comparison to running the program with superuser privileges or sudo in other words, the exit code for both commands is 0 instead as it can be seen below:

```
fd222fr@freebsd-vm-group10:/home/fd222fr$ sudo java Main  
Password:  
  
WELCOME TO JAVA + FREEBSD app  
  
-----Please choose one of the options below-----  
1. Invoke id  
2. Switch to /etc/ and find . -name 'rc*'  
3. Run hostname freebsd-vm-group10-upd  
0. Exit  
  
Please choose the desired action!:  
2  
Switching to /etc/ and finding . -name 'rc*'...  
Switch to /etc...  
Running find . -name rc*  
Result is:  
.rc.initdiskless  
.rc.sendmail  
.rc.firewall  
.rc.d  
.rc.d/rctl  
.rc  
.rc.suspend  
.rc.bsdextended  
.rc.conf.d  
.rc.shutdown  
.rc.subr  
.defaults/rc.conf  
.rc.resume  
.rc.conf  
The exit code is: 0
```

```
WELCOME TO JAVA + FREEBSD app
```

```
-----Please choose one of the options below-----
1. Invoke id
2. Switch to /etc/ and find . -name 'rc*'
3. Run hostname freebsd-vm-group10-upd
0. Exit
```

```
Please choose the desired action!:
```

```
3
```

```
3. Running hostname freebsd-vm-group10-upd...
```

```
The exit code is: 0
```

```
The result is:
```

Sudo provided the user the necessary permissions (as stated before superuser privileges) in order to run the following commands and hence the difference of results between the two runs.

6. Reflection

In this assignment, we systematically studied utilizing UNIX system on virtual machine, running system commands, and deploying Java program on UNIX system which simulated the real process of deploying software on UNIX-based server that will benefit our capability in the real industry. There are several points that we believe which are important to mention and summarize in this report. First of all, the virtual machine installing process between Windows system and MacOS system are slightly different in terms of internet connection configuration. To set up vboxnet0 and vboxnet1, MacOS system-based VirtualBox need to be configured in “Tools” options. Furthermore, in task3, we realized that the importance of checking firewall settings in case to set up connection from host to VM since it may lead to connection failure. Setting up SSH demands installing such as OpenSSH on Windows and users need to make sure it runs through service manager. In cases of configuring files or similar manipulations, it is quite important that a reboot, logout and login or a simple restart should be done for the changes to take place. Moreover, we realized that ProcessBuilder cannot take compound sentences as arguments therefore it is necessary to create a list that stores each of the words individually which are then processed. For the commands, Quotation marks have drastic effects on the result of a command which was apparent in the case of "rc" and "rc" which respective commands gave two different outputs. Quotation marks have drastic effects on the result of a command which was apparent in the case of "rc" and "rc" which respective commands gave two different outputs. While the program is running, “exit code 1” does not necessarily mean that the output failed. In a few cases such as when running the command of subtask 4.2.2 where it returned an exit code 1 which results in a termination or a minor problem in the program which in this case was that permission was denied to one of the files because of its properties. The last but not least, we want to mention that overall we did good cooperation among different group members: Yuyao Duan was responsible for task1, task2, document editing, and general stuff; Fabian Dacic was responsible for task 3; Fredric Eriksson was responsible for task4. From the beginning to the end, we utilized Discord group to keep in touch with others in order to achieve mutual help learning manner.

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