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UTU appliance guide
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Contents

Chapter 1

Introduction

1.1 Educational appliances of the University of Turku

The Department of Future Technologies provides pre-configured virtual machine and USB images that the students can run on a virtual machine monitor, or in the case of the USB images, burn to a USB drive to boot the machine from. The images contain a Linux operating system that comes with pre-installed software that has been deemed useful or mandatory for the course(s) the machine is used in.

The goal of these appliances is to reduce the amount of time taken by installation and configuration of software in the beginning of a course. They also provide a unified environment, which reduces the spectrum of different software issues, and ensures everyone has the same setup.

Chapter 2

VM setup

> Note: chapter 2 applies to the virtual machine only. Skip to chapter 3 if you are using the USB appliance.

2.1 Installing the hypervisor

The UTU virtual appliance is designed to run on VMware Workstation Pro/Player and Fusion or Oracle VirtualBox. You can get the license key needed for VMware hypervisors from your course manager. VirtualBox is open source.

2.1.1 VMware

Windows Download the installation executable for VMware Workstation Player[1] or VMware Workstation Pro[2]. Double-click the downloaded file to start the installation and click *Next* or *Ok* all the way through the installation wizard. After the installation, restart your computer when prompted.

MacOS Download the installation executable for VMware Fusion[3]. Open the downloaded .dmg file and double-click on the *Install* icon. Agree to the installation wizard's prompts. By default, Fusion is installed in the Applications folder. After the installation you are asked if you want to delete the installation file.

Linux Download the bundle file for VMware Workstation Player[1] or Workstation Pro[2]. In the download directory, run the bundle with the command

```
$ sudo sh VMware-Workstation-xxxx-xxxx.architecture.bundle
```

replacing the filename with that of your downloaded file. If you do not get a message announcing the installation succesful, proceed to the further instructions below.

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[1]https://www.vmware.com/products/workstation-player.html

[2]https://www.vmware.com/products/workstation-pro/workstation-pro-evaluation.html

[3]https://www.vmware.com/products/fusion/fusion-evaluation.html

Linux – in case of installation failure   The Linux kernel API has variance between distributions and is not always directly compatible with VMware modules, which can lead to hiccups especially with outdated or novel versions. In addition, especially rolling release distributions might have uncompatible versions of dependent software.

Patched kernel drivers[4] are available for use with new kernels. These instructions concern primaly downstream versions of the 4.x kernel tree or those transitioned to 5.x. Update as follows:

```
$ rm -fdr /tmp/vmware-patch
$ git clone https://github.com/mkubecek/vmware-host-modules /tmp/vmware-
    ↪ patch -b workstation-15.1.0  **
$ cd /tmp/vmware-patch
$ make
$ sudo make install
$ sudo rm /usr/lib/vmware/lib/libz.so.1/libz.so.1
$ sudo ln -s /lib/x86_64-linux-gnu/libz.so.1 /usr/lib/vmware/lib/libz.so
    ↪ .1/libz.so.1
$ sudo /etc/init.d/vmware restart
```

** replace with your downloaded version
The driver update has to be redone after every kernel update.

2.1.2   VirtualBox

Windows   Download the installation executive from the VirtualBox site[5]. Run the downloaded file and agree to the installation wizard's prompts. Finally, restart your computer.

MacOS   Download the installation executive from the VirtualBox site[5]. Open the downloaded .dmg file and double-click on the *Install* icon. Agree to the installation wizard's prompts. By default, VirtualBox is installed in the Applications folder. After the installation you are asked if you want to delete the installation file.

Linux   The preferable way to install VirtualBox on Linux distributions is through the distribution's packet manager. ItsFoss has a tutorial that covers several ways of installation. The next chain of commands installs VirtualBox on Debian and Debian-based distributions, such as Ubuntu.

```
$ sudo apt-get install wget
$ sudo apt-get install software-properties-common
$ wget -q https://www.virtualbox.org/download/oracle_vbox_2016.asc -O- |
    ↪  sudo apt-key add -
$ sudo add-apt-repository "deb [arch=amd64] http://download.virtualbox.
    ↪ org/virtualbox/debian $(lsb_release -cs) contrib"
$ sudo apt update && sudo apt install virtualbox-6.1
```

The VirtualBox site offers official packages and installation guides[6].

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[4]https://github.com/mkubecek/vmware-host-modules
[5]https://www.virtualbox.org/
[6]https://www.VirtualBox.org/wiki/Linux_Downloads

2.2 Installing the virtual machine

To begin, you need to download the OVA image of the virtual machine from the site provided by your teacher. You can save it to the default location of Downloads to find it easily in the next step.

2.2.1 Importing the VM to the hypervisor

VMware Workstation and Player

Run the VMware software. In the start view, choose the option labeled *Open a Virtual Machine* (Figure 2.1) and navigate to the OVA file you previously downloaded. On Windows 10, you can also double-click the OVA file and it will open in the hypervisor.
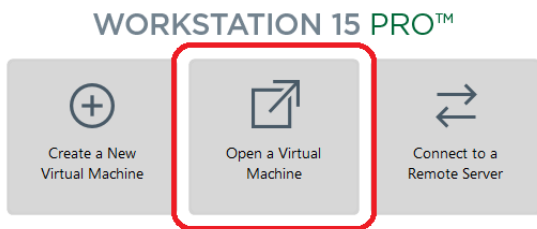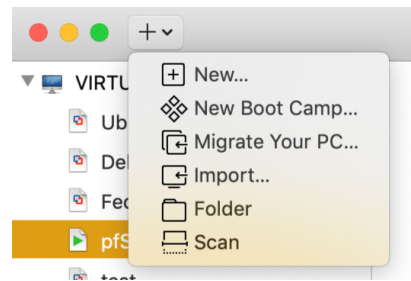

Figure 2.1: VMware workstation

Figure 2.2: VMware Fusion

VMware Fusion

Run VMware Fusion. In the upper right corner, press the + button to open a dropdown menu and choose the item labeled *Import* (Figure 2.2). A window opens, where you can browse to and open the previously downloaded OVA file. After confirming *Choose file*, you can submit a label for the imported virtual machine (Figures 2.3 and 2.4).
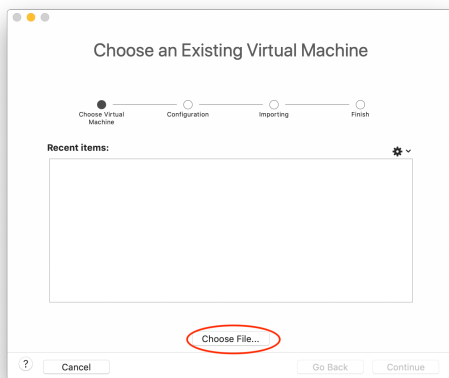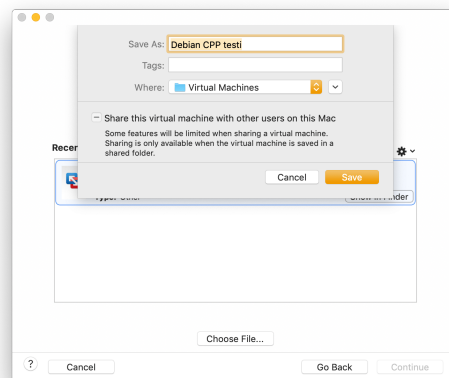

Figure 2.3: VMware Fusion
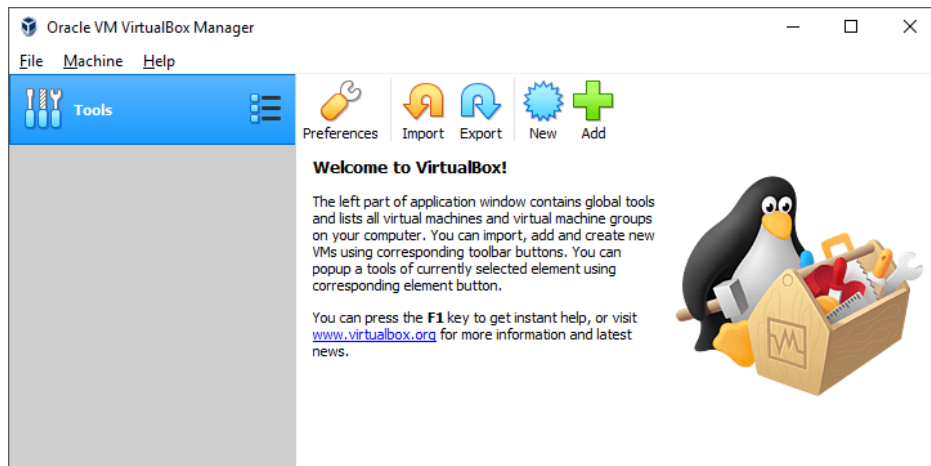

Figure 2.4: VMware Fusion

Figure 2.5: VirtualBox

VirtualBox

Double-click on your downloaded OVA file to open it in VirtualBox. In the opening dialog, click the *Import* button to complete the import. Your virtual machine can be seen in the list on the left in the VirtualBox window.

Recommended VirtualBox settings   Open *Settings → Display* and check that the chosen graphics controller is VMSVGA. You can also adjust the resolution according to your display size. In the *Audio* tab, choose an appropriate driver – Intel HD Audio in most cases. Make sure that *Enable Audio Output* and *Enable Audio Input* are checked. Finally, in the *General* tab, in the *Advanced* subtab, set *Shared Clipboard* and *Drag'n'Drop* to bidirectional.

2.2.2   Using the appliance in the university computer labs

The virtual appliances can easily be ran in the university lab computers. Sign in with your university account as usual, and download the VM OVA. When asked if you want to save the file or open it in an application, choose to open in application and select VMware Workstation Player from the application list. The virtual machine is imported to VMware and the necessary files are copied to your network disk, so that the VM is now available on all university machines when you sign in with your university account.

Chapter 3

The USB appliance

> Note: chapter 3 applies to the USB appliance only. See chapter 2 if you are using the virtual appliance.

3.1 The USB Disk Image

The USB versions of the appliances are provided as Raw Disk Images. They cannot be simply moved to the USB drive, but must be copied byte by byte to make an exact copy of the image in case. In Linux systems this can be done with the dd (Data Duplicator) tool or by the GUI application Gnome Disk Util. In MacOS and Windows systems, beginner-friendly graphical applications are used.

3.2 Formatting the USB drive

3.2.1 Formatting the drive in Windows

There are many applications for device formatting. USB Image Tool[1] is a free, well-functioning application that is able to perform the required byte-by-byte duplication. Choose the drive you intend to format from the pane in the left (figure 3.1). The *Restore* button opens a dialog where you can browse to and choose the image you want to burn to the drive and starts the burning process, after which the drive is ready for use.

3.2.2 Formatting on Linux/Unix

On Linux systems, formatting the drive can be done via command line using the dd (Data Duplicator) tool. For advanced users, a guide can be found at oueta.com[2]. Another approach is to use gnome disk utility.

    Gnome disk utility is found in most of the common linux package managers by the name gnome-disk-util or gnome-disk-utility. It can then be run from the terminal

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[1]https://www.alexpage.de/usb-image-tool/

[2]https://www.oueta.com/linux/create-linux-and-unix-bootable-usb-flash-drive-in-linux-with-command-line/
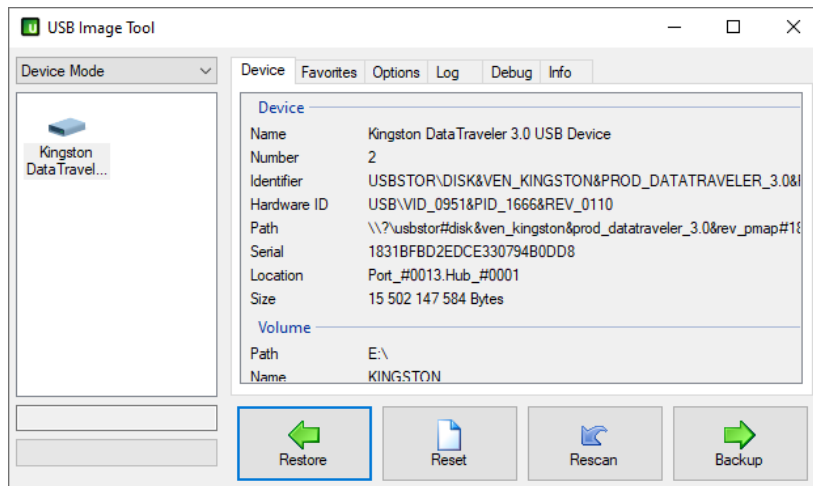
Figure 3.1: USBIT

via the command `gnome-disks`. The main view is as seen in figure **??**. All connected storages are listed in the leftmost pane, and the USB drive intended to be used should be also seen in this list.

Choose your USB drive from the mentioned list. The view on the right should display the contents of the drive. You should see a section labelled *Volumes* (Labelled *Taltiot* in figure **??**) displaying the partitions on the drive. Double-check that you have chosen the right drive and use the minus button beneath *Volumes* to delete all existing partitions from the disk. You should end up with a drive with no partitions.

After removing all of the existing partitions from your USB drive, press the button with three horizontal lines in the top right of the window and choose *Restore disk image* (labelled *palauta levykuva* in figure **??**. A dialog opens where you can browse to and choose the image you want to burn on the drive and start the process.

During the burning of the image, Gnome disk utility displays a progress bar (Figure 3.3). After 100 % is reached, the drive is ready. Press on the same button with three horizontal lines as earlier, and choose *Standby now* to switch of the drive so it can be removed safely.
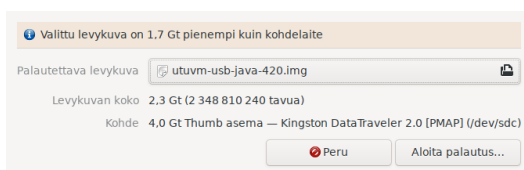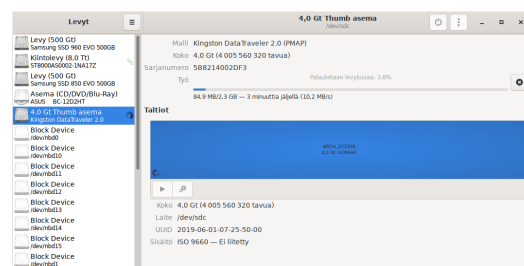

Figure 3.2: Image dialog

Figure 3.3: Burning progress

3.2.3 Formatting the drive in MacOS

In MacOS, first format the drive with the built-in partition manager, Disk Utility (figure 3.4). Choose the drive you intend to use from the list on the left and choose *MS-*

DOS(FAT) as the format from the drop-down menu in the center of the view and *GUID Partition Map* as the Scheme below.

Next, navigate to https://www.tweaking4all.com/downloads/raspberrypi/ApplePi-Baker-1.9.9.dmg to download ApplePiBaker 1.9.9 (note that newer versions up from 2.0 are not able to burn the drive properly). Run ApplePiBaker (you need administrator permissions for this). Choose your drive from the pane on the left as seen in figure 3.5. Press the button with three dots next to *IMG file* to open a dialog for choosing the image you intend to burn on the drive. Start burning by pressing the *Restore Backup* button and wait for the burning process to run.
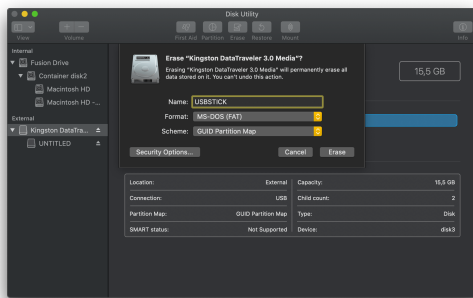

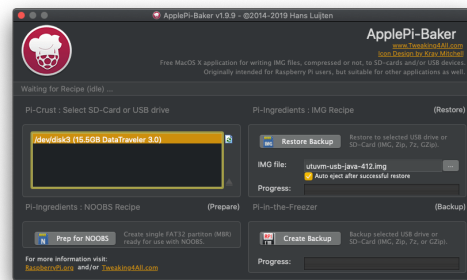Figure 3.4: MacOS' Disk Utility

Figure 3.5: ApplePiBaker 1.9.9

3.3 Booting from the USB drive

On **Apple computers**, booting from the USB drive is managed by pressing the option (alt) key when the Apple logo appears during startup. On **other machines**, USB boot settings are usually managed in BIOS or EFI settings. They can be accessed by pressing a certain key or key combination during startup. The keys vary by manufacturer and model. The key or combination is often displayed briefly during startup, or it can be found by searching the web.

In **Windows 10** you can also access BIOS by pressing the shift key while selecting restart from the *Start* menu. During the restart, a menu opens. Choose the options *Troubleshoot → Advanced options → UEFI Firmware settings → Reboot*.

While in the bios menu, look for a BOOT tab and reorder the boot priorities so that your USB device is at the top. Save and exit to restart.

3.4   Connecting to Eduroam

If your device does not connect to Eduroam, you have to either configure the network from the system settings or install the Eduroam Configuration Assistant Tool (CAT). To download the tool, you need to temporarily connect to another network, ie. to UTU Visitor or to a mobile hotspot. Thean head to http://cat.eduroam.org and press the button labeled *Click here to download your eduroam installer*. You are then prompted to choose your organization, which is University of Turku (figure 3.6).
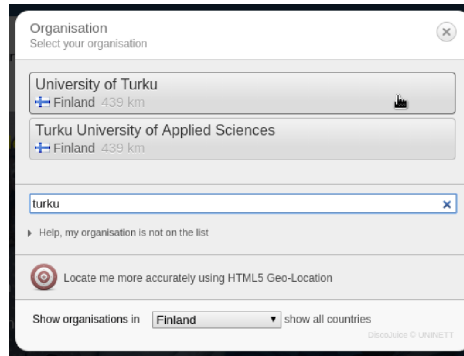

Figure 3.6: Choose University of Turku as your organization.

After the download has finished, open the terminal, navigate to downloads by `cd ~/Downloads` and run the command `python eduroam-linux-UoT-eduroam.py`

Figure 3.7: Terminal

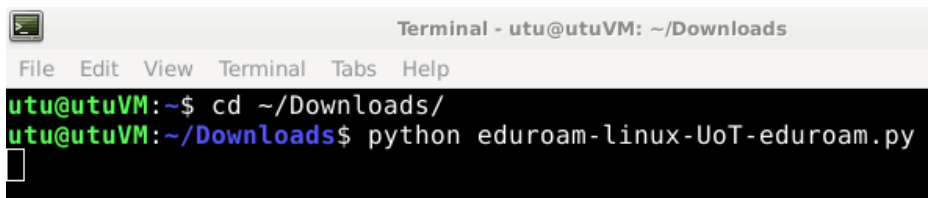The installer opens an information dialog and thereafter another dialog to confirm that the user is from the University of Turku (figures 3.8 and 3.9).
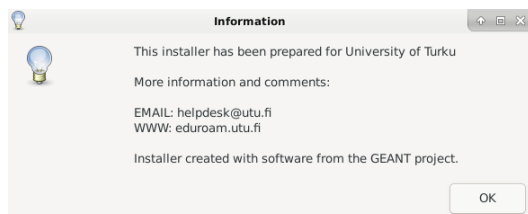

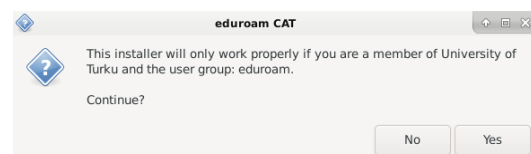Figure 3.9: Information dialog

Figure 3.8: Information dialog

Finally, a dialog opens where you are prompted to enter your UTU username (in the username@utu.fi format) and your UTU password. After providing the credentials you can connect to Eduroam.

Chapter 4

Using the appliance

4.1 Running the virtual machine

Note: section 4.1 applies to the virtual machine only. Skip to section 4.2 if you are using the USB appliance.

Run the virtual machine by pressing the arrow button in your hypervisor.
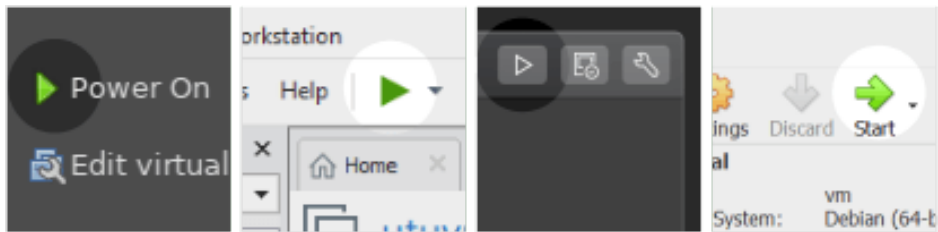
Figure 4.1: Running the virtual machine. From left to right: VMware Player, VMware workstation, WMware Fusion, VirtualBox.

4.2 First-run setup

When running the appliance for the first time, you are prompted to set the following:

1. The user interface language.
2. The keyboard layout.
3. A desktop theme.
4. Your name, email address and a passphrase (min. 5 characters) for an automatically generated SSH key.
5. Your time zone.

All of these can be reset and changed by using the UTU VM configurator application, or manually.

Note: The SSH key applet runs a script generating the key and updating your local Git configuration file with the given information. The input is not used for any other purposes. See section 4.3 if you want to create a SSH key manually.

4.3 Creating and using an SSH key

The SSH key pair is used for GitLab authentication. When a public key is added to a GitLab account, the private counterpart is used for identification and logging in instead of your GitLab username and password. You can check for existing SSH keys by entering `ls -al ~/.ssh` in the terminal.

4.3.1 Creating an SSH key

If you did not create a key during the first-run setup or want to re-create it, follow the next steps:

1. Open the terminal.
2. Create the key by entering
   `ssh-keygen -t rsa -b 4096 -C ''<your email>''`
   (eg. `ssh-keygen -t rsa -b 4096 -C ''student@utu.fi''`).
3. Press enter to confirm the default location (~/.ssh).
4. You are prompted to choose a passphrase which functions similarly to a password when connecting to GitLab. No-one will be able to use the phrase without the private key stored in your local .ssh folder, so it doesn't need to be too complicated.
5. After a succesful creation the general information of the key is printed.

4.3.2 Adding the SSH key to your GitLab account

1. View the public key by double-clicking the SSH key icon on the appliance's desktop and copy it to your clipboard.
2. Paste the key to the field at `https://gitlab.utu.fi/profile/keys` and press *Add key*.
3. The key should appear in the *Your SSH keys* list.

4.4 Connecting your Seadrive account

If you have a University of Turku account, you can use the university SeaDrive[1] for cloud storage. You can find the SeaDrive client from the *Applications* menu under *Internet*. To log in, enter the UTU seadrive server address https://seafile.utu.fi and fill in your UTU username and password.

SeaDrive creates a local drive that is automatically synchronized and uploaded to the cloud storage, so that the files remain even if the virtual or USB appliance is destroyed.

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[1]https://seafile.utu.fi

Chapter 5

Troubleshooting

5.1 Hardware and firmware

5.1.1 Virtualization is not enabled

Many consumer PCs come with virtualization disabled in UEFI/BIOS settings by default. This results in an error similar to those seen in figures 5.1 and 5.2. Virtualization must be enabled for virtual machines to function.
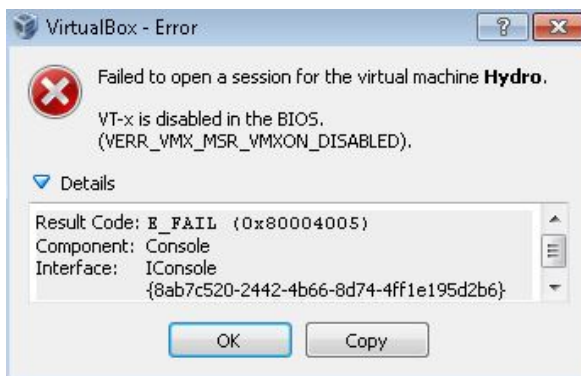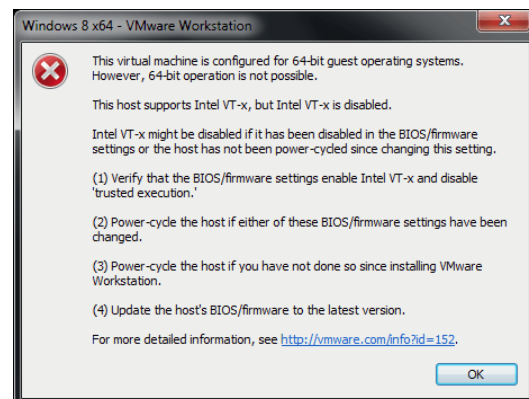

Figure 5.1: VirtualBox error.

Figure 5.2: VMware error.

To access BIOS you need to restart your computer and press a designated key on the keyboard during startup. The key varies by manufacturer and model, and it is often displayed by the bootloader right after the computer powers up. Common options include F1, F2, F9, F11, F12 and Delete, and helpful videos can be found by searching youtube for the computer model and "BIOS".

In **Windows 10** you can also access BIOS by pressing the shift key while selecting restart from the *Start* menu. During the restart, a menu opens. Choose the options *Troubleshoot → Advanced options → UEFI Firmware settings → Reboot*.

You have successfully entered BIOS when you see an old-fashioned interface with typically a very limited color palette. An exemplar is seen in figure 5.3. Menu navigation is usually managed with the arrow keys.
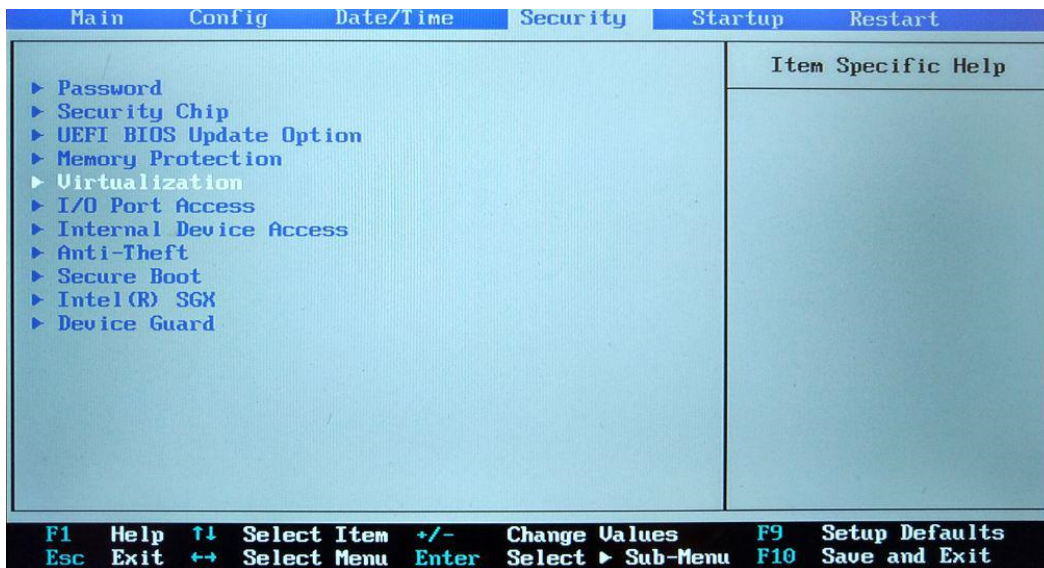
Figure 5.3: A BIOS screen exemplar.

If the initial BIOS screen displayed mentions *Virtualization*, *VT-x* or *AMD-V*, set it to *Enabled* and choose the *Save and Exit* option (F10 in Figure 5.3, but this may vary). In other cases, virtualization might be managed under a tab labeled *Advanced*, *System Configuration* or *Security*. Navigate through the tabs using the instructions displayed on the BIOS screen and set virtualization to *Enabled* when you have reached the setting. Save and Exit to continue the startup.

If the problem persists, the hypervisor might not have registered the change in virtualization settings. Reinstalling VMware or VirtualBox solves the issue.

5.1.2   Issues with sound, webcam, WLAN, Bluetooth or ethernet

Check first if the issue is also present in the host operating system. In some cases, devices might be disabled in BIOS settings (see section 5.1.1) and enabling them fixes the issue. Some are managed by the hypervisor. When adjusting the virtual machine settings in the hypervisor, see that the VM is powered off, not hibernated or suspended.

Sound card doesn't activate when the VM is imported to Fusion.   The sound card can be added manually while the virtual machine is powered off. In the VM settings, choose *Add Device* and select your sound card.

WLAN and Bluetooth   are in some cases, in addition to BIOS and system settings, managed by designated buttons on a laptop or by key combinations like Fn-F2 or Fn-F12. The button or key is usually marked with a WLAN symbol depicting a dot and curved lines.

Mac device uses Bluetooth mouse and keyboard which the appliance is not paired with. While using the USB appliance, Bluetooth devices paired with the usual OS are not

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automatically paired with the USB system. Temporarily connect wired devices to your computer to pair the Bluetooth devices.

The webcam is not working. See first if the webcam is working in the host system without virtualization. Use any application that uses the webcam or eg. the `http://webcamera.io` site. On **MacOS** devices, check that USB 3.0 is enabled in the virtual machine settings and the FaceTime camera is chosen. In **Linux** environments, make sure the user belongs to the *video* group.

External USB devices

If anything else fails, every aforementioned device can be implemented with external USB devices.

5.2 Operating System and Hypervisor

5.2.1 Virtualization is not supported

The more inexpensive Home or Starter versions of Windows do not support virtualization. There are alternate solutions to this:

- Using the USB version of the appliance and thus bypassing the installed OS.
- Using the classroom computers.
- Upgrading to a Windows version that supports virtualization.

32-bit systems are not supported. Using the virtual appliance requires a 64-bit host operating system and hardware.

5.3 Software

A simple solution to malfunctioning virtual machines is to remove the faulty VM instance and to install a new one. Make sure to upload your personal files or work to Seadrive, GitLab or similar external storage or to transfer them to the host machine, since everyhing on the virtual machine that is not saved otherwhere will be lost.

If the problem lies not with the VM but with the IDE or other software used on the course, consult the person in charge of the course materials.

5.3.1 Problems connecting to GitLab via SSH

The GitLab service of the University of Turku require a RSA-type key for SSH connections. Check that there is a `id_rsa.pub` key in your ssd directory. **ED25519 type keys are not compatible with UTU GitLab.**