

# Lab1: Bring up "Virtualized" x86 System

CSE4009: System Programming

# Overview

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- Download and Install VirtualBox
- Download Linux Server Image (Ubuntu 22.04)
- Create New Virtual Machine (VM) Instance
- Install Linux Server
- Setup Lab Environment
- Your VM as an x86 System

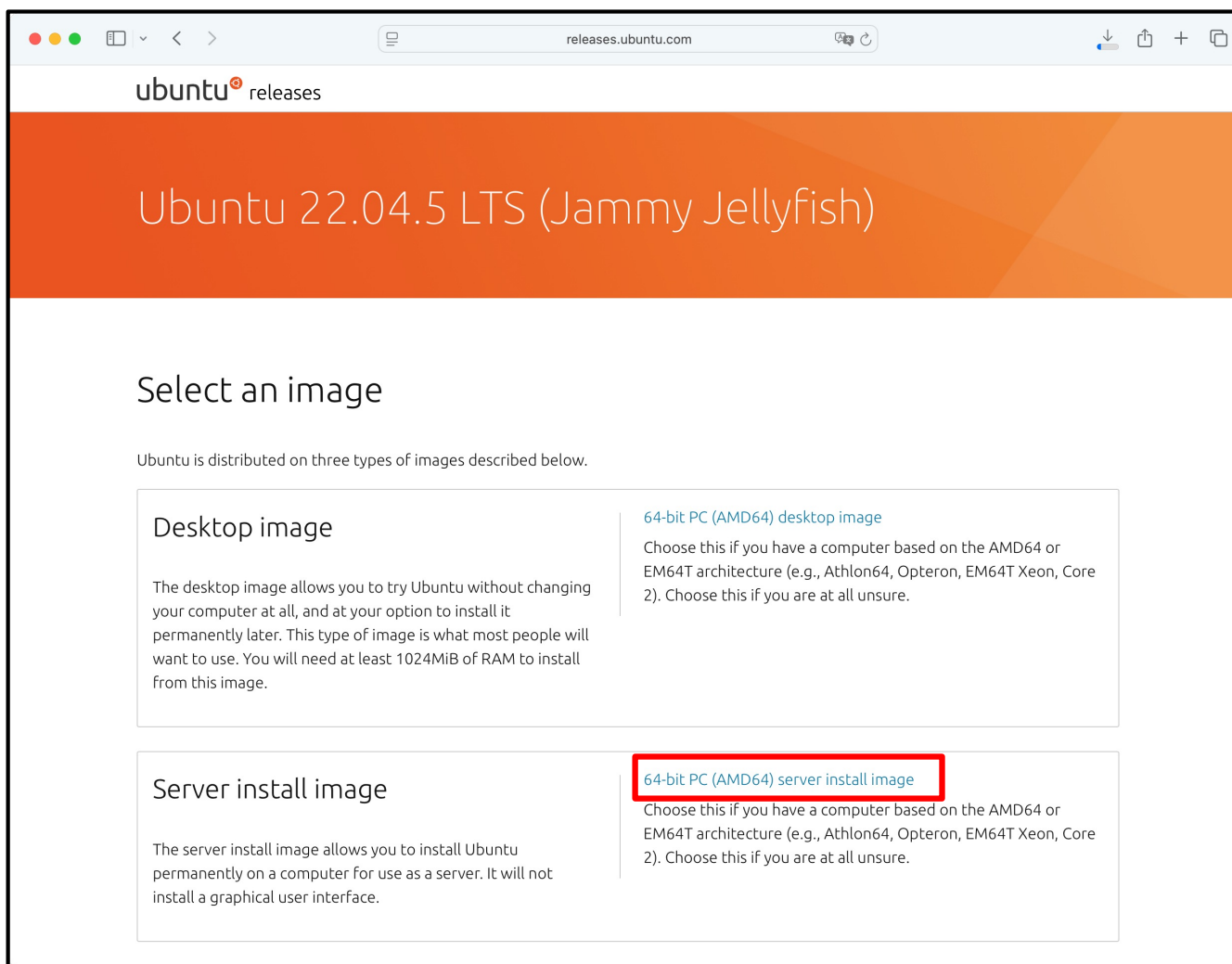
# Download and Install Virtual Box

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- **VirtualBox**
  - <https://www.virtualbox.org>
  - Oracle provides another download page
- **UTM** if you use Mx Apple Silicon (ARM)
  - <https://mac.getutm.app>
  - Make sure your VM is set in "emulate" mode (not virtualize mode)
    - The virtual machine (x86-64) on your computer (aarch64, ARM)

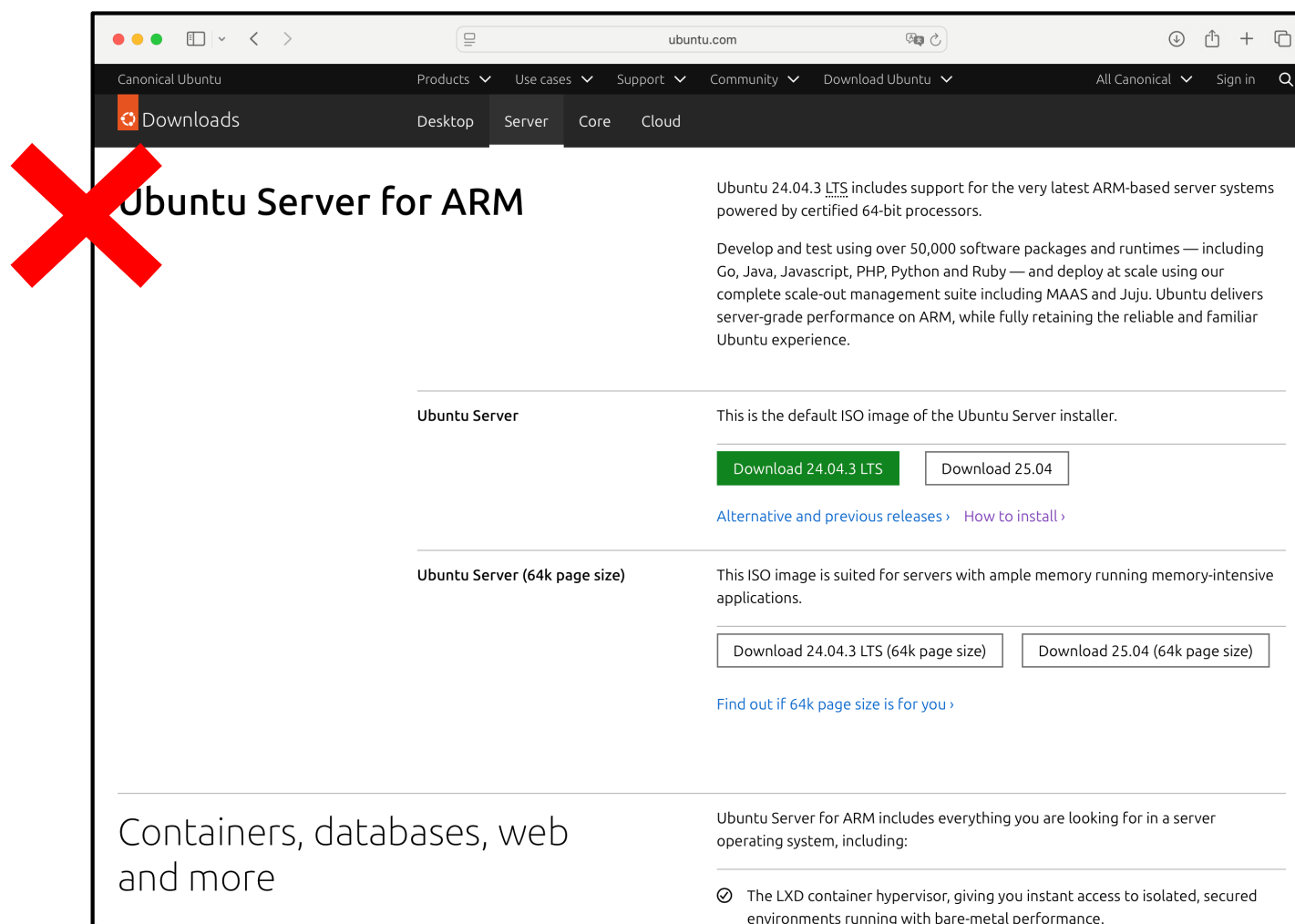
# Download Linux Image (Ubuntu 22.04 LTS)

- <https://releases.ubuntu.com/22.04/>
  - You may need a **server** Image (not desktop)



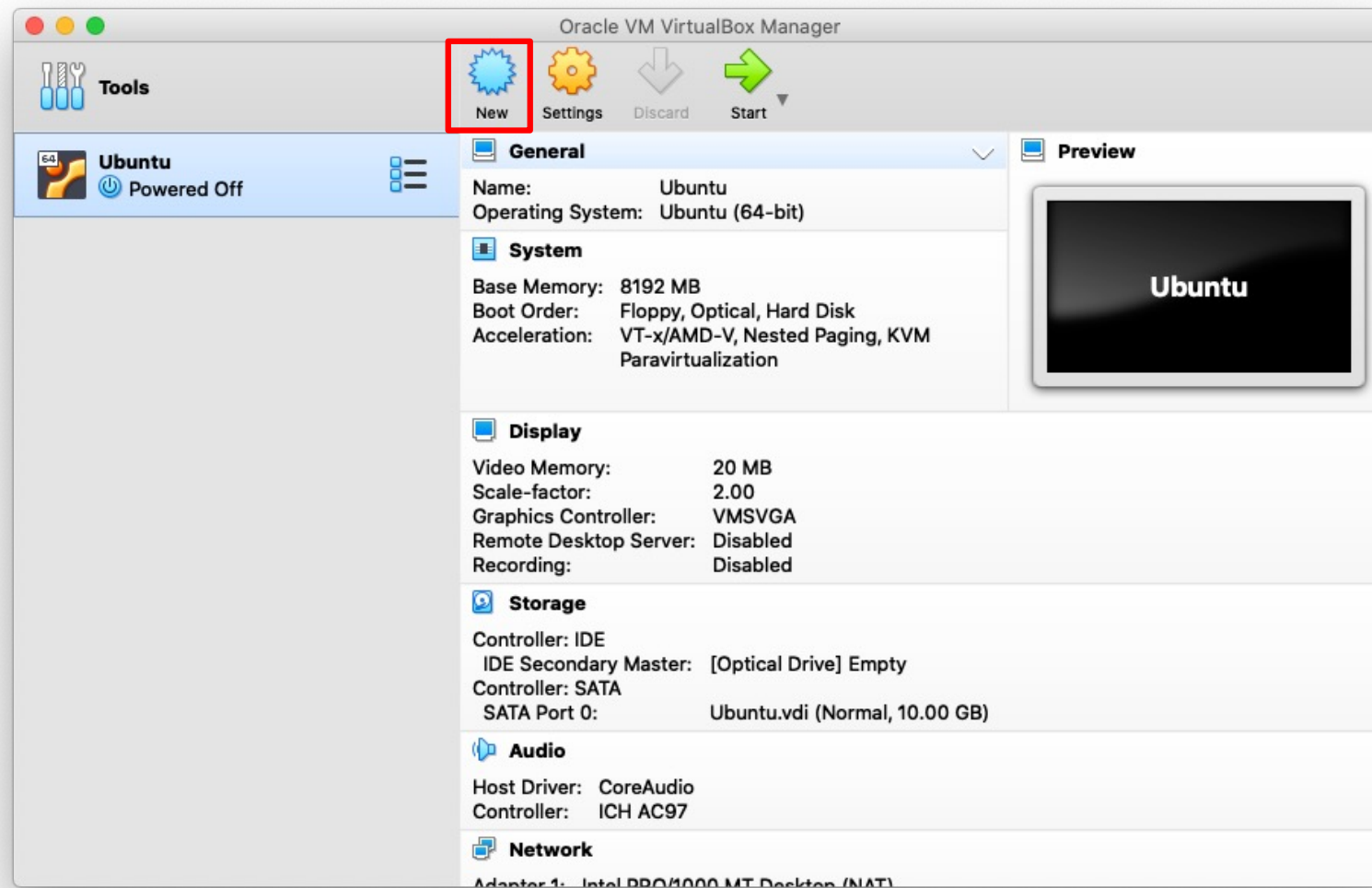
# Alternative: Ubuntu For Apple Silicon

- <https://releases.ubuntu.com/22.04/>
  - The installation image MUST be for x86, not Aarch64(ARM)



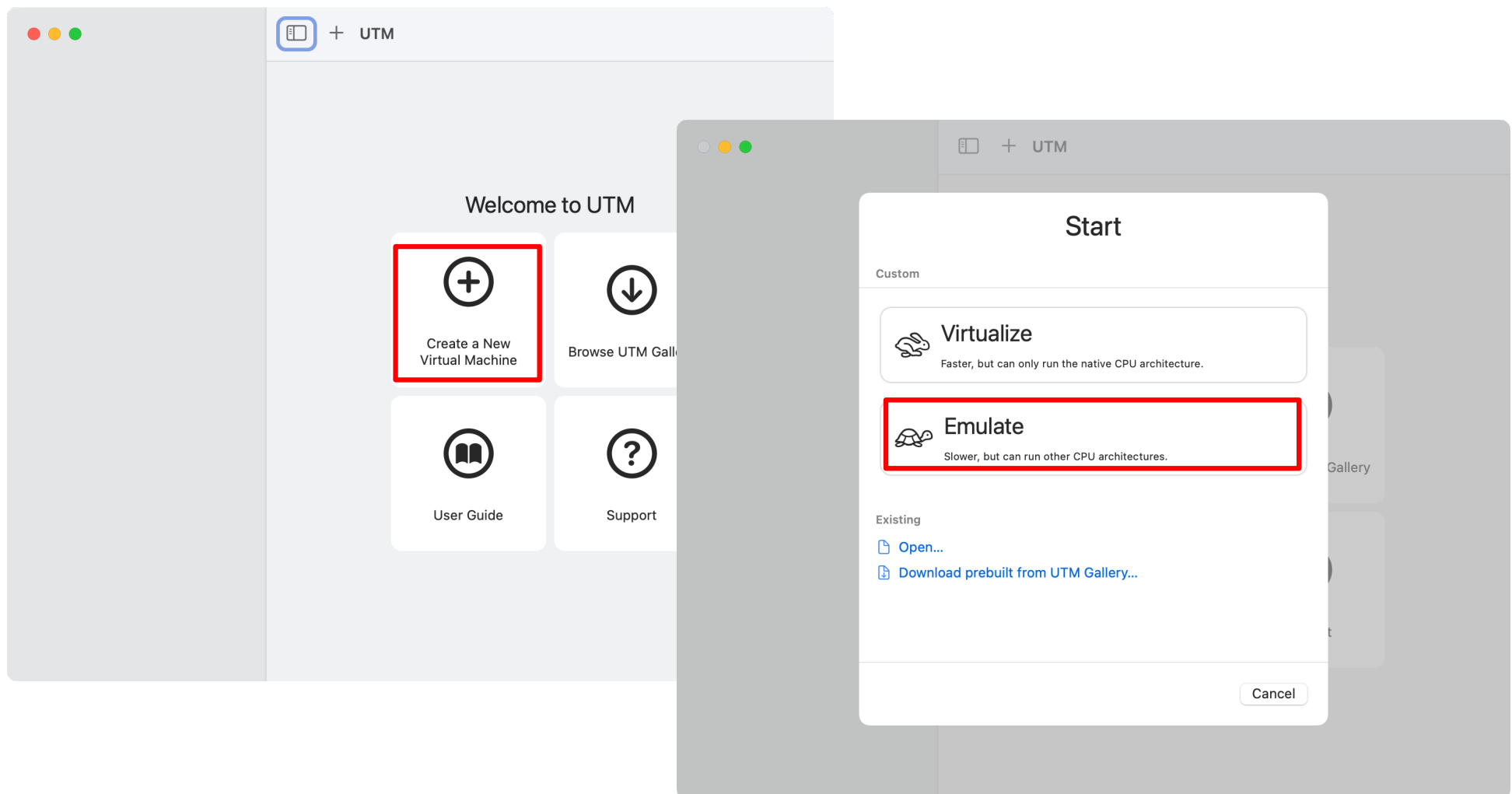
# Create Virtual Machine (VM) instance

- Press "New" Button
  - Make sure your VM is set to 64-bit



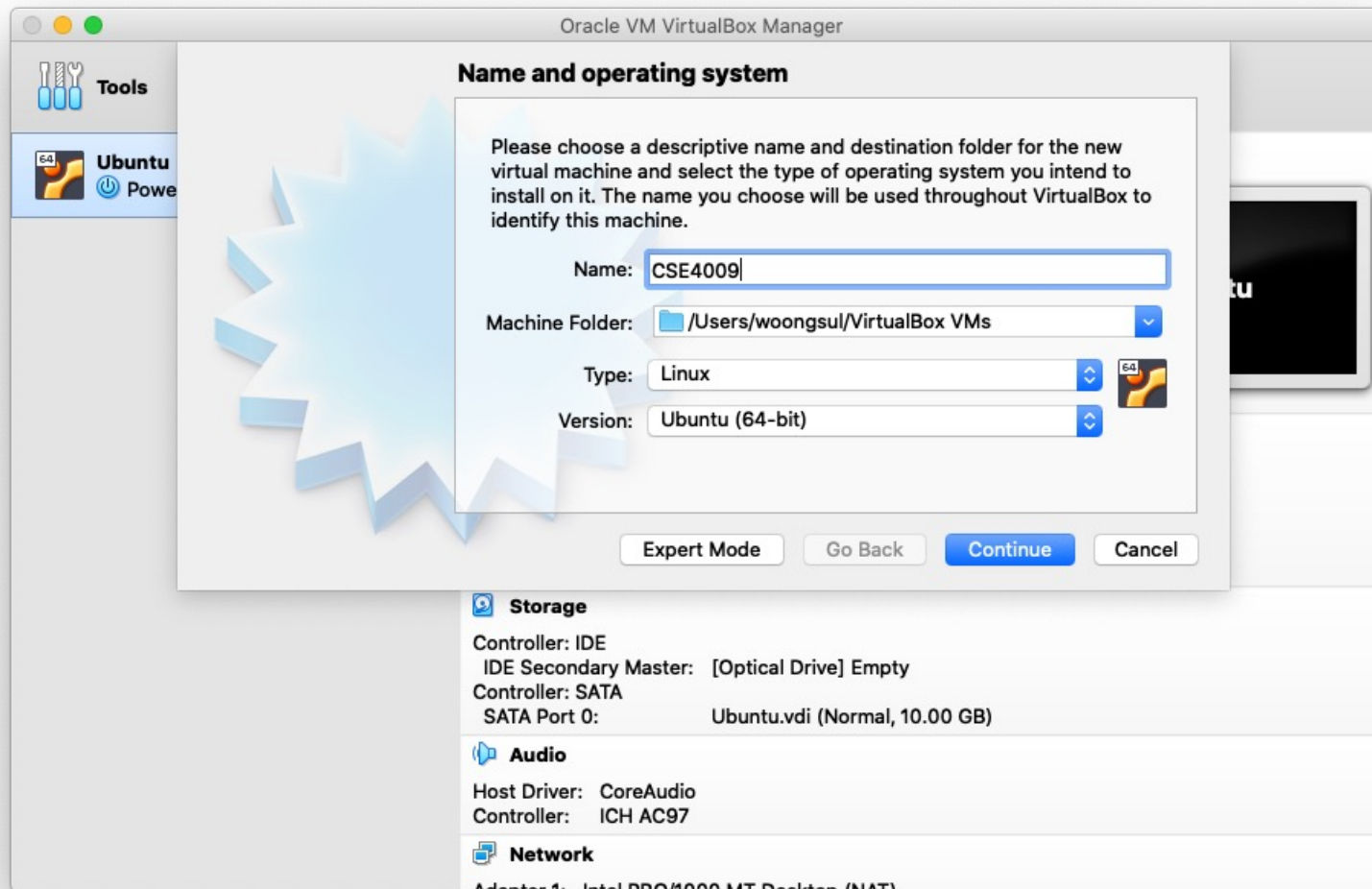
# Alternative: Create VM instance for UTM

- Press "New" Button
  - Make sure your VM is set in **emulate** mode (x86 system on ARM)



# Configure Virtual Machine (VM) instance

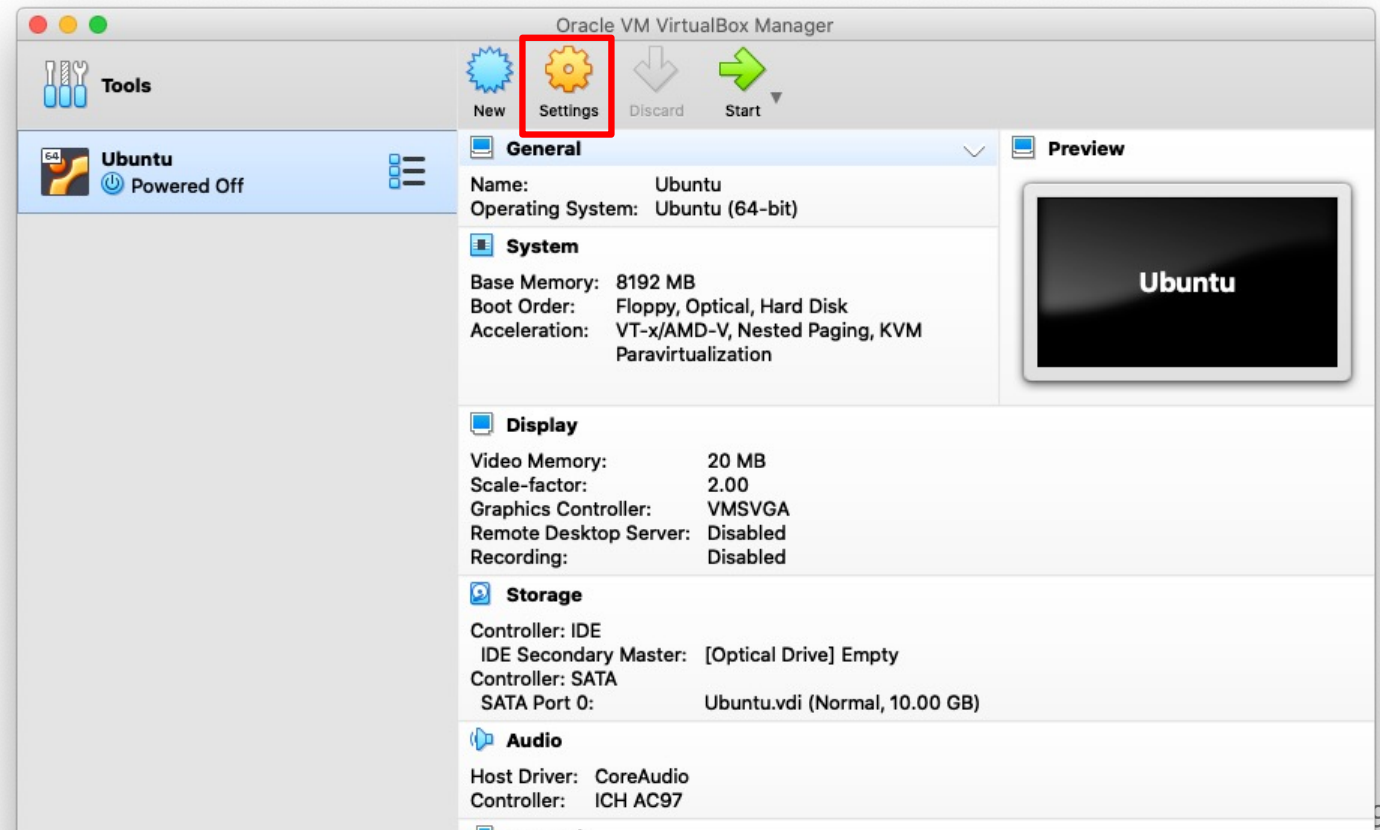
- Select Linux – Ubuntu (64-bit)





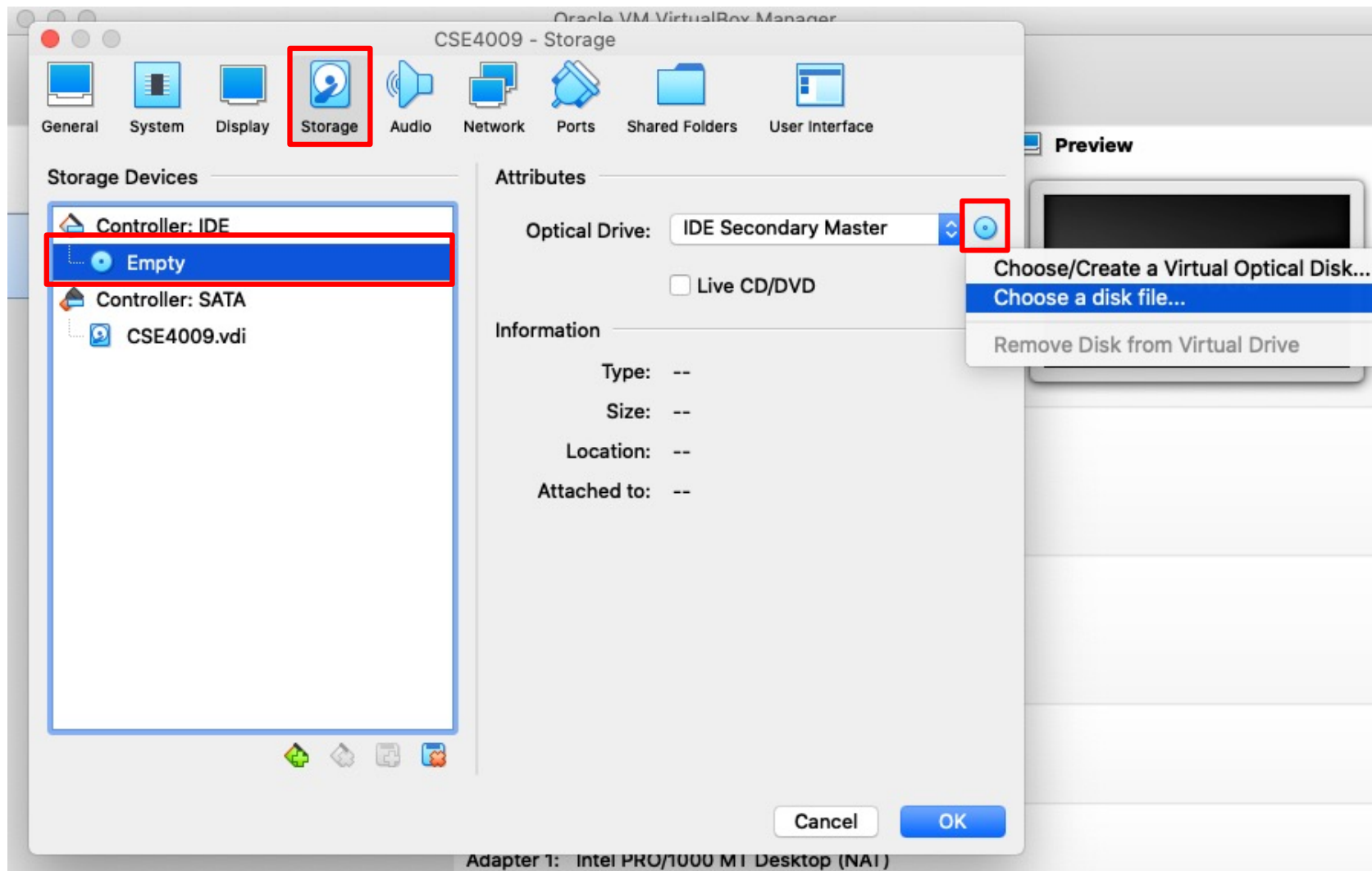
# Configure Virtual Machine (VM) instance

- You can adjust memory size and processor count at "Settings"
- My example
  - Processor: 6 out of 12 cores
  - Memory: 8192 MiB out of 16 GiB
  - Storage: 20 GiB



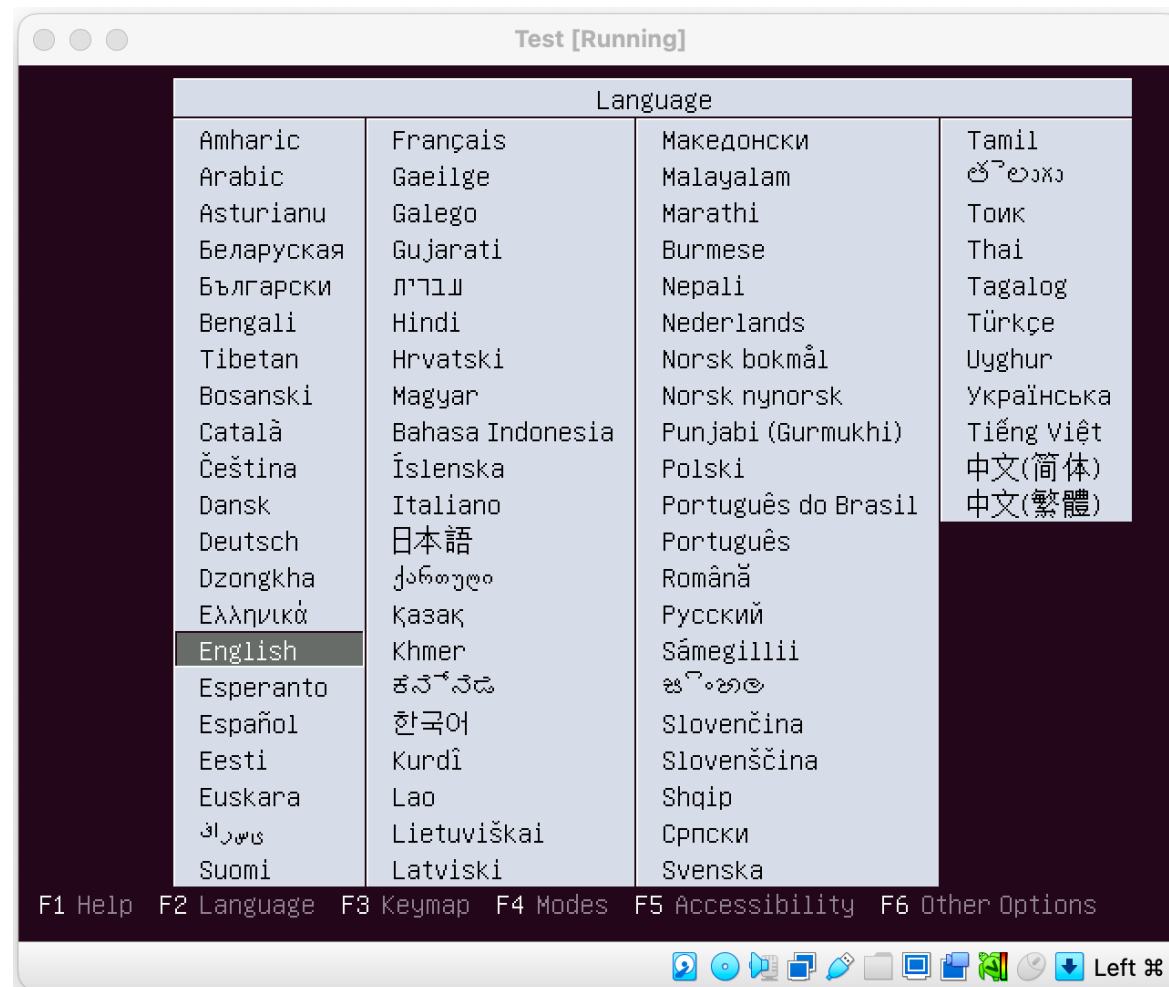
# Install ubuntu Server

- Start VM instance with Linux Server Image



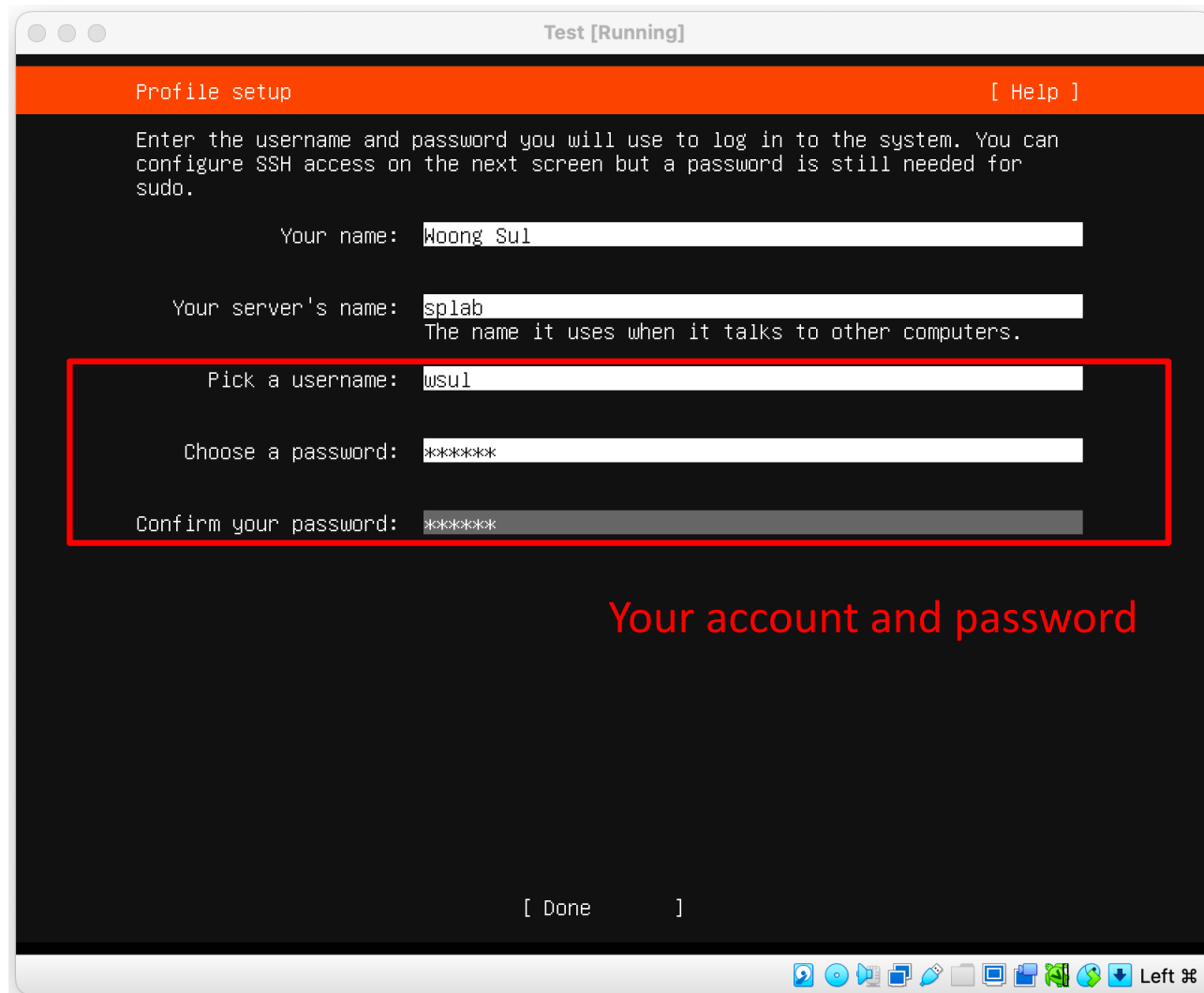
# Install ubuntu Server

- Start your VM with the downloaded install image
  - Except for the next slides, skip most of it or use the default options



# Install ubuntu Server

- Setup your account



Test [Running]

Profile setup [ Help ]

Enter the username and password you will use to log in to the system. You can configure SSH access on the next screen but a password is still needed for sudo.

Your name: Woong Sul

Your server's name: splab  
The name it uses when it talks to other computers.

Pick a username: wsul

Choose a password: \*\*\*\*

Confirm your password: \*\*\*\*

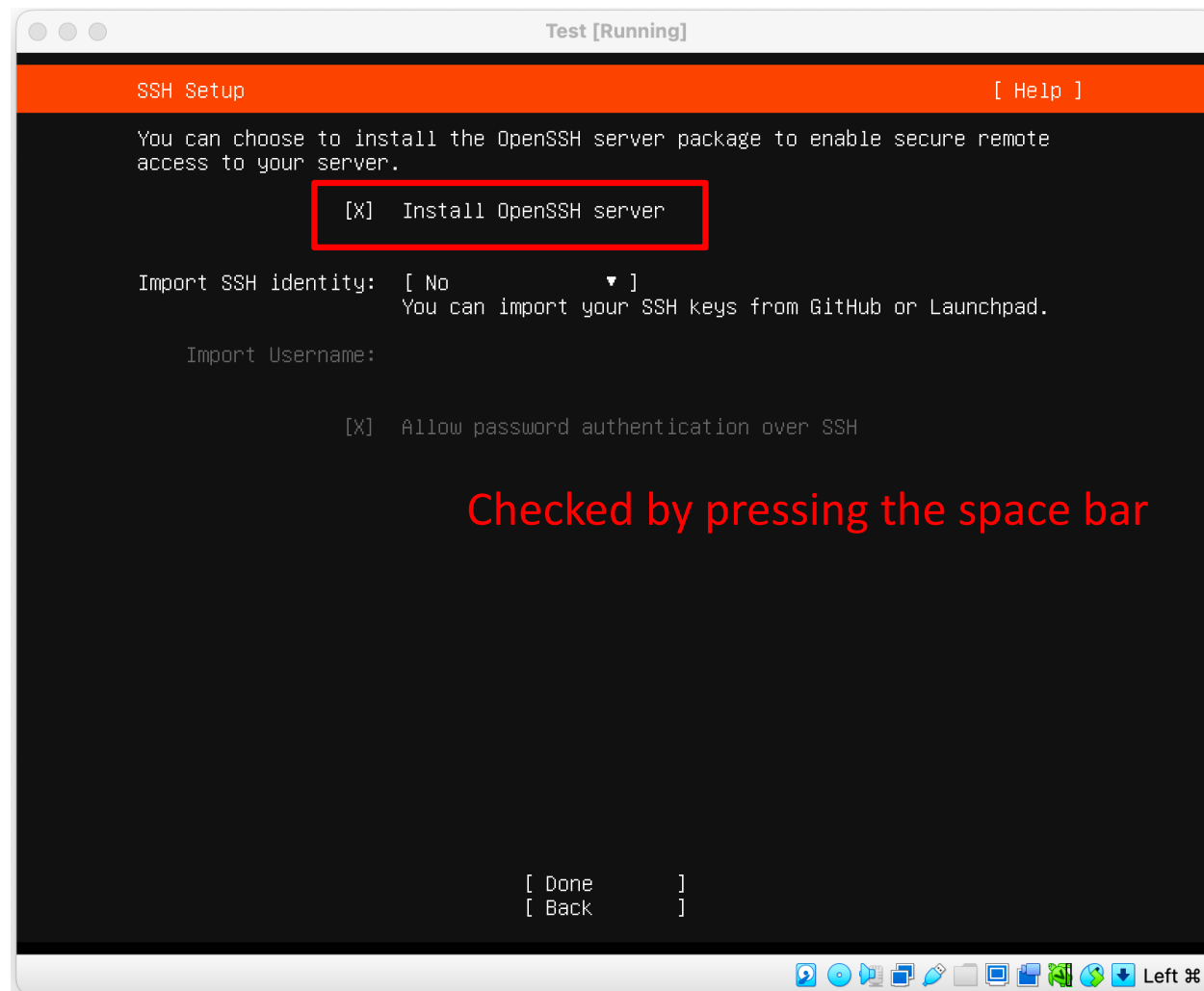
Your account and password

[ Done ]

Left ⌘

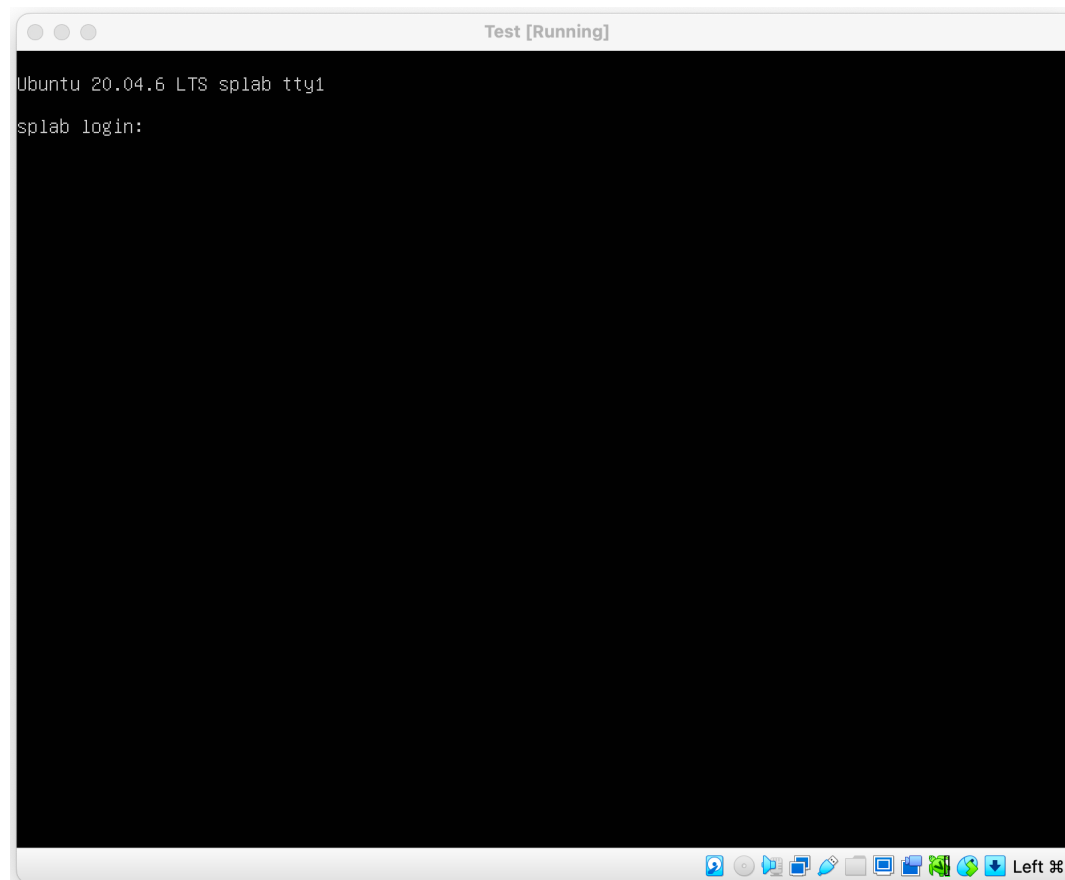
# Install ubuntu Server

- Check OpenSSH server
  - Or you can install it later with ***apt-get***



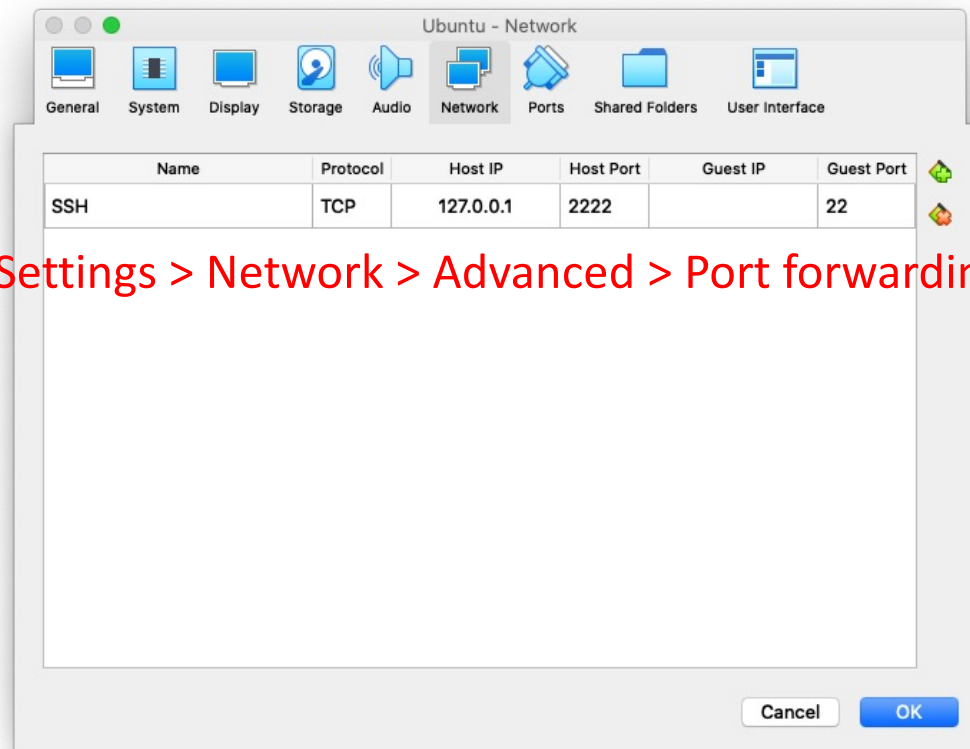
# Install System Software

- After rebooting you can log in with your account
  - `sudo apt-get -y install build-essential gdb`
  - `sudo apt-get -y install openssh-server`
  - `sudo apt-get -y install gcc-multilib g++-multilib`



# Network Setup

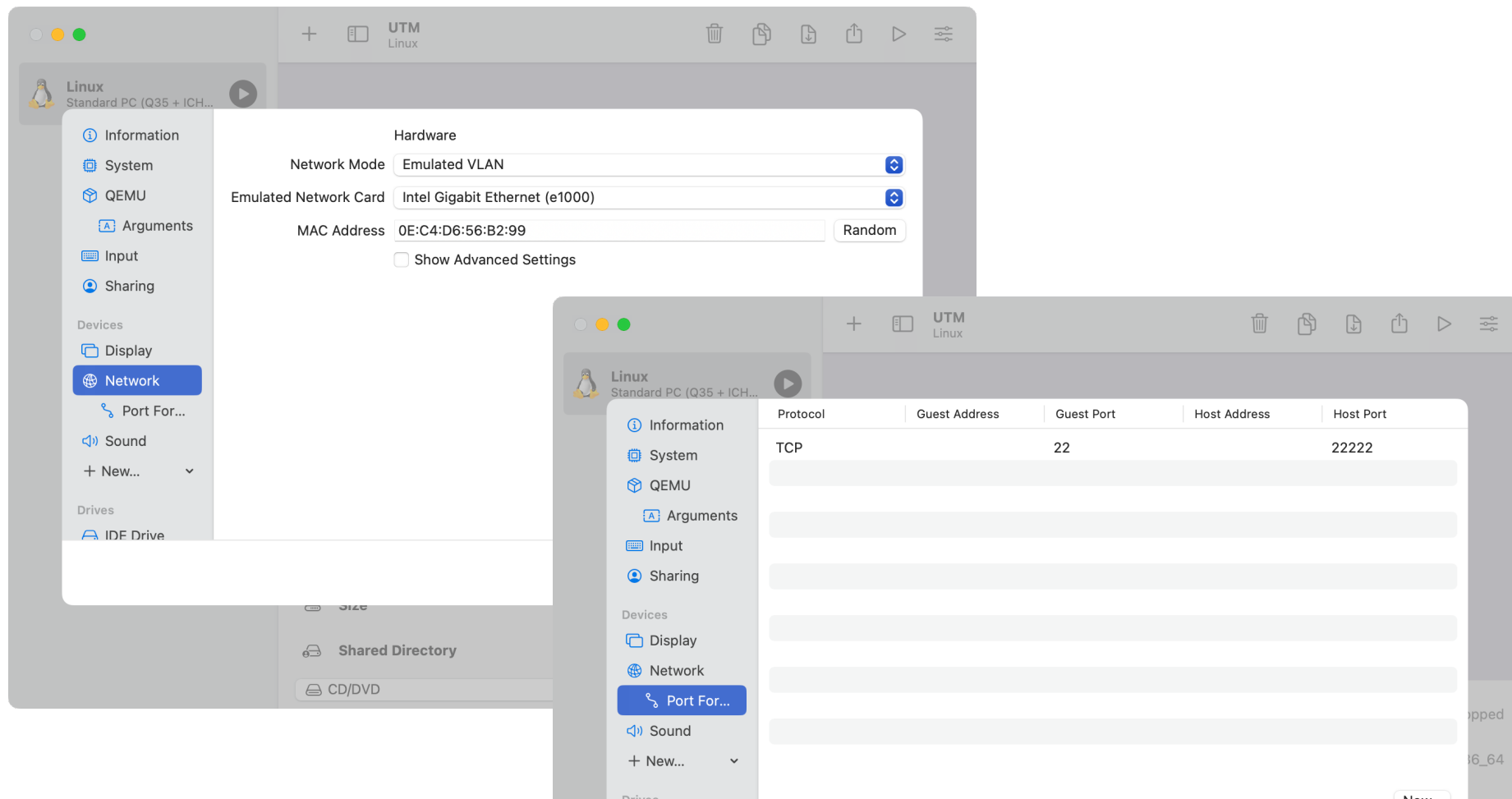
- Instead of typing commands directly to the VM instance
- You can use a terminal connected to the VM
  - Port forwarding: real computer at 2222 to VM at 22(ssh)  
`ssh -p 2222 {account}@localhost`



Settings > Network > Advanced > Port forwarding

# Alternative: Network Setup for UTM

- Set Network Mode to ***Emulated VLAN*** to activate the ***Port forwarding*** submenu
  - Add the same rule to the previous slide





# Almost Done!!

- You can connect to your VM like a remote server

The image shows two terminal windows. The left window is titled 'CSE4009 [Running]' and shows a login session on 'Ubuntu 20.04.5 LTS splab2022012345 tty1'. The user 'wsul' logs in and sees system information, including system load, memory usage, and update notifications. The right window is titled 'woongsul — wsul@splab2022012345: ~ — ssh -p 2222 wsul@localhost — 93x35' and shows an SSH session from a Mac to the same VM. The user 'woongsul' runs 'ssh -p 2222 wsul@localhost' and sees the same system information as the left window.

```

CSE4009 [Running]
Ubuntu 20.04.5 LTS splab2022012345 tty1
splab2022012345 login: wsul
Password:
Welcome to Ubuntu 20.04.5 LTS (GNU/Linux 5.4.0-155-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

System information as of Tue 05 Sep 2023 07:36:46 AM UTC

System load:  0.19           Processes:
Usage of /:   41.5% of 29.42GB Users logged in:
Memory usage: 15%           IPv4 address for enp0s3: 10.0.2.15
Swap usage:   0%

 * Strictly confined Kubernetes makes edge and IoT secure.
   just raised the bar for easy, resilient and secure K8s cluster deployment.

https://ubuntu.com/engage/secure-kubernetes-at-the-edge

66 updates can be applied immediately.
To see these additional updates run: apt list --upgradable

The list of available updates is more than a week old.
To check for new updates run: sudo apt update
New release '22.04.3 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Last login: Tue Sep  5 07:35:13 UTC 2023 on tty1
wsul@splab2022012345:~$

woongsul — wsul@splab2022012345: ~ — ssh -p 2222 wsul@localhost — 93x35
~ — wsul@splab2022012345: ~ — ssh -p 2222 wsul@localhost
woongsul@Woongs-MacBook-Pro:~$ ssh -p 2222 wsul@localhost
wsul@localhost's password:
Welcome to Ubuntu 20.04.5 LTS (GNU/Linux 5.4.0-155-generic x86_64)

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 * Management:    https://landscape.canonical.com
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System information as of Tue 05 Sep 2023 07:35:07 AM UTC

System load:  0.3           Processes:           113
Usage of /:   41.5% of 29.42GB Users logged in:           0
Memory usage: 15%           IPv4 address for enp0s3: 10.0.2.15
Swap usage:   0%

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Last login: Tue Sep  5 07:28:24 2023
wsul@splab2022012345:~$
  
```

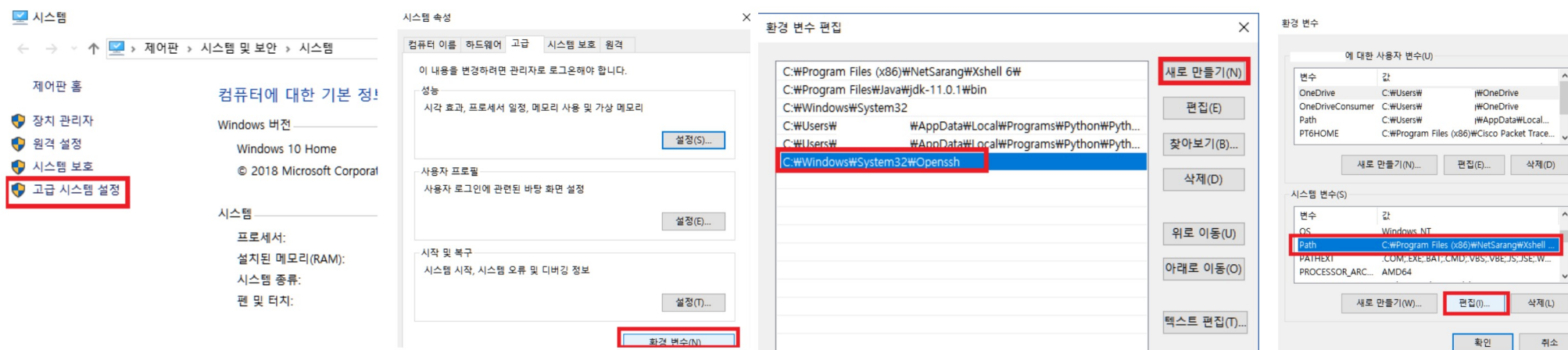
# Remote Access to Your VM

```
ssh -p {port} {account}@localhost
```

- **Terminal.app** for MacOS users
- **PowerShell** or **gitbash** for Windows users
  - You may need env setup

Control panel > System and Security > Advanced > Environment Variables

Add {OpenSSH directory path} on "Path"



# Almost Done!!

- You can connect to your VM like another remote server

```

CSE4009 [Running]
Ubuntu 20.04.5 LTS splab2022012345 tty1
splab2022012345 login: wsul
Password:
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woongsul — wsul@splab2022012345: ~ — ssh -p 2222 wsul@localhost — 93x35
~ — wsul@splab2022012345: ~ — ssh -p 2222 wsul@localhost
woongsul@Woongs-MacBook-Pro:~$ ssh -p 2222 wsul@localhost
wsul@localhost's password:
Welcome to Ubuntu 20.04.5 LTS (GNU/Linux 5.4.0-155-generic x86_64)

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New release '22.04.3 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Last login: Tue Sep  5 07:28:24 2023
wsul@splab2022012345:~$

```

# Finally Done!!

- Make sure that your VM appears as an x86 system

```
woongsul — wsul@splab2022012345: ~/Projects/test — ssh -p 2222 wsul@localhost — 93x35
~ — wsul@splab2022012345: ~/Projects/test — ssh -p 2222 wsul@localhost +

1200:      48 83 c4 08      add    $0x8,%rsp
1204:      c3                retq
wsul@splab2022012345:~/Projects/test$ cat hello.c
#include <stdio.h>

int main(void) {

    int id = 2023123456;
    printf("Hello %d!\n", id);
    return 0;
}
wsul@splab2022012345:~/Projects/test$ !vi
vi hello.c
wsul@splab2022012345:~/Projects/test$
wsul@splab2022012345:~/Projects/test$ cat hello.c
#include <stdio.h>

int main(void) {
    printf("Hello World!\n");
    return 0;
}
wsul@splab2022012345:~/Projects/test$ gcc hello.c -o hello
wsul@splab2022012345:~/Projects/test$ objdump -d hello | head

hello:      file format elf64-x86-64

Disassembly of section .init:

0000000000001000 <_init>:
   1000:      f3 0f 1e fa      endbr64
   1004:      48 83 ec 08      sub    $0x8,%rsp
   1008:      48 8b 05 d9 2f 00 00  mov    0x2fd9(%rip),%rax      # 3fe8 <__gmon_start_
->
wsul@splab2022012345:~/Projects/test$
```