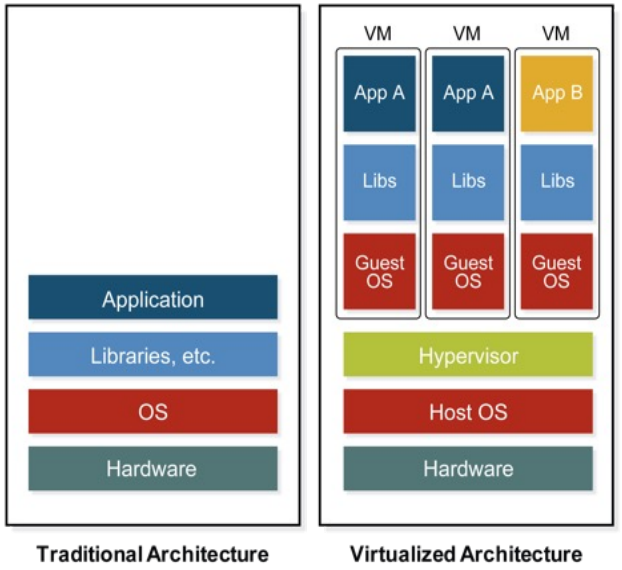
# Lab - 5

## Virtualization

# Virtualization

- **Virtualization** is the technique of running a **Guest** operating system on top of a **Host** operating system.
- Virtualization allowed developers to run multiple operating systems in different virtual machines all running on the same **host**.
- A **hypervisor**, also known as a virtual machine monitor or VMM, is **software that creates and runs virtual machines (VMs)**.
- A hypervisor allows one host computer to support multiple guest VMs by virtually sharing its **resources**, such as memory and **processing**.




Traditional vs. Virtualized Architecture

**Credit**: https://medium.com/edureka/docker-tutorial-9a6a6140d917

# Virtualization Cont..

**Pros**:

- Multiple operating systems can run on the same machine.
- Maintenance and Recovery were easy in case of failure conditions.
- Total cost of ownership was also less due to the reduced need for infrastructure.

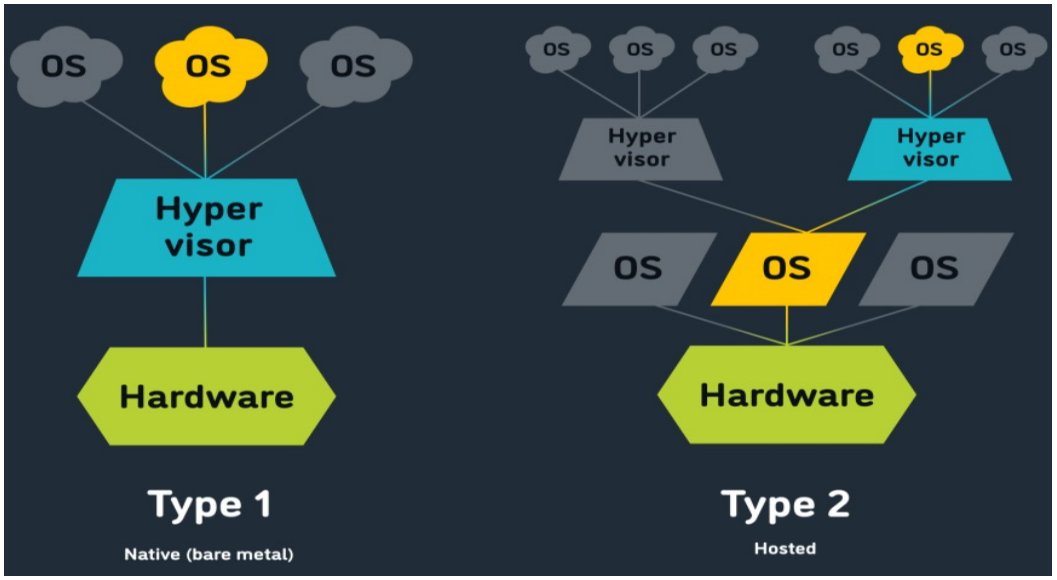
**Cons**:

- Running multiple Virtual Machines leads to unstable performance.
- Each VM has its own kernel and set of libraries and dependencies. This takes up a large chunk of system resources, i.e. hard disk, processor and especially RAM.
- Hypervisors are not as efficient as the host operating system.
- Boot up process is long and takes time.

**Credit**: https://medium.com/edureka/docker-tutorial-9a6a6140d917

# Hypervisor Types

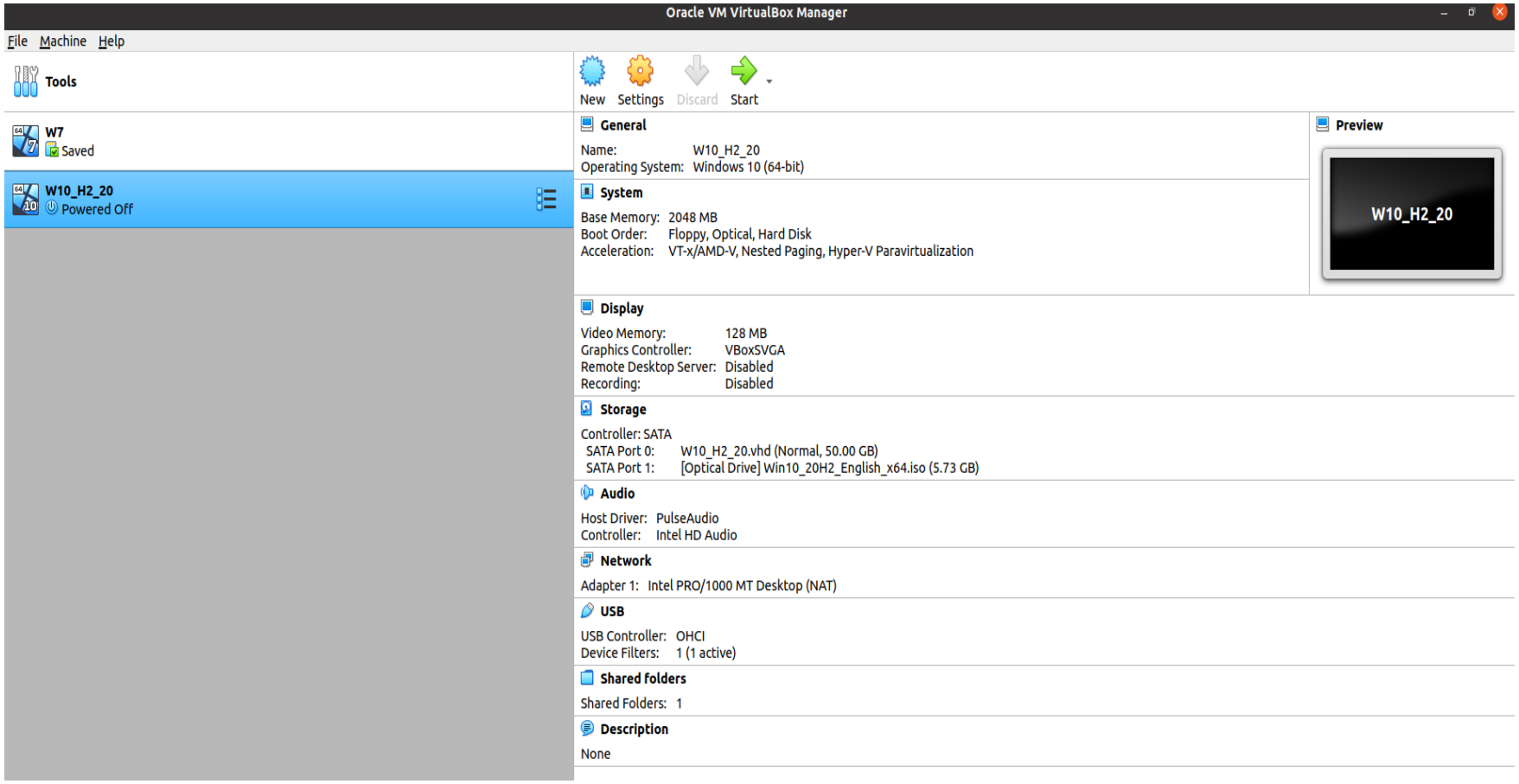
- **Type 1 (bare-metal)** A bare-metal hypervisor acts like a lightweight operating system and runs **directly on the host machine's hardware**.
  - These types of hypervisors are installed **directly on the hardware**, and they are located in between the hardware and the operating system.
  - perform better and more efficiently than other types of hypervisors.
  - Examples: Xen-Cirtix, VMWare(ESXI), Azure (Hyper-V)
- **Type 2 (hosted)** A hosted hypervisor runs **on top of the operating system of the host machine**.
  - communication between the hypervisor and the hardware must pass through an extra layer of the operating system, potentially leading to **higher levels of latency.**
  - A hacker compromising the host OS means that they could manipulate any guest OS running within the hypervisor.
  - Examples: Vmware-Workstation, Oracle VBox, MS Hyper-V




**Credit**: https://www.trentonsystems.com/blog/hypervisors

# Installing VirtualBox (Hosted Hypervisor)

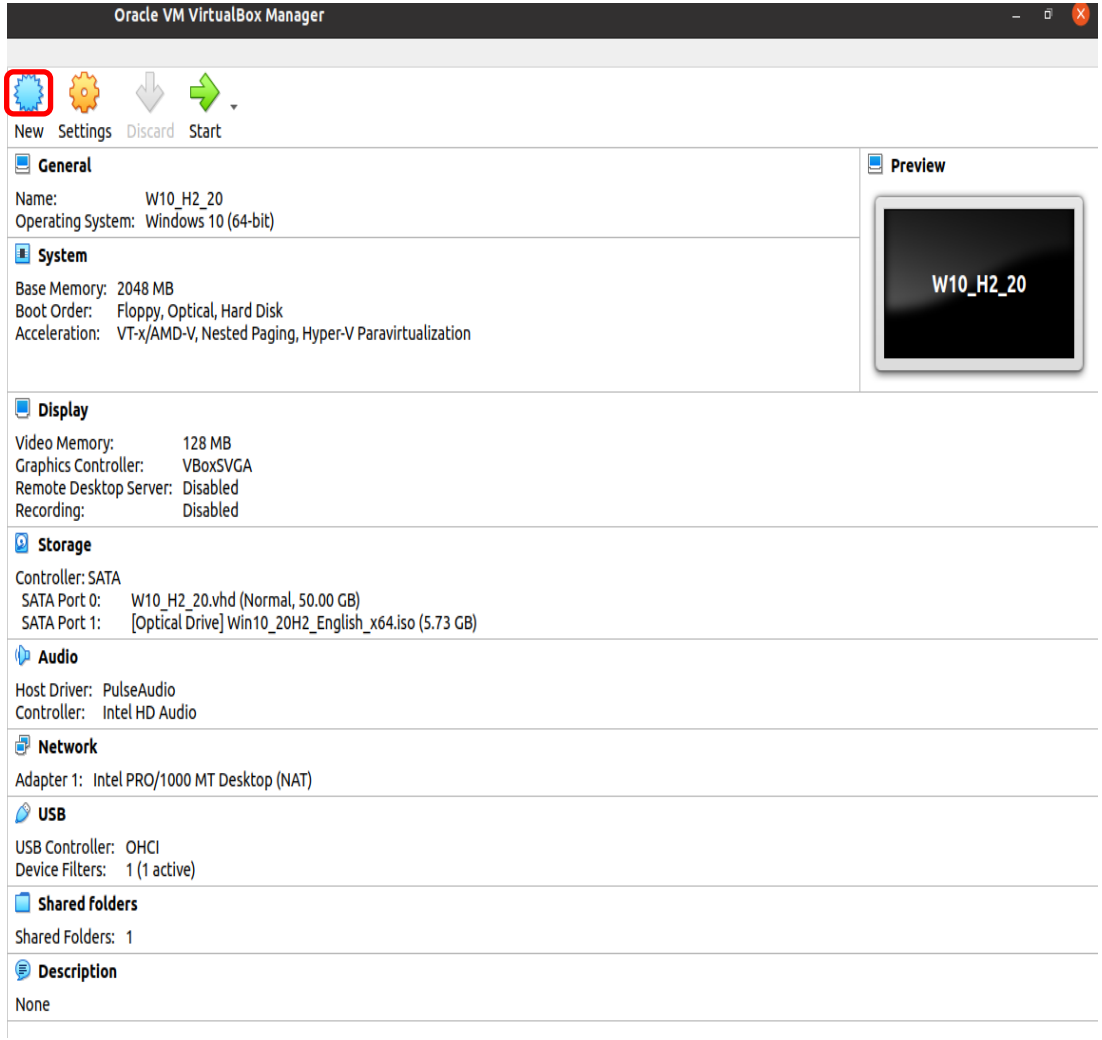
- Download VirtualBox.
- Follow Installation Steps.




**Credit**: https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_virtualbox.htm

# Create Virtual Machine

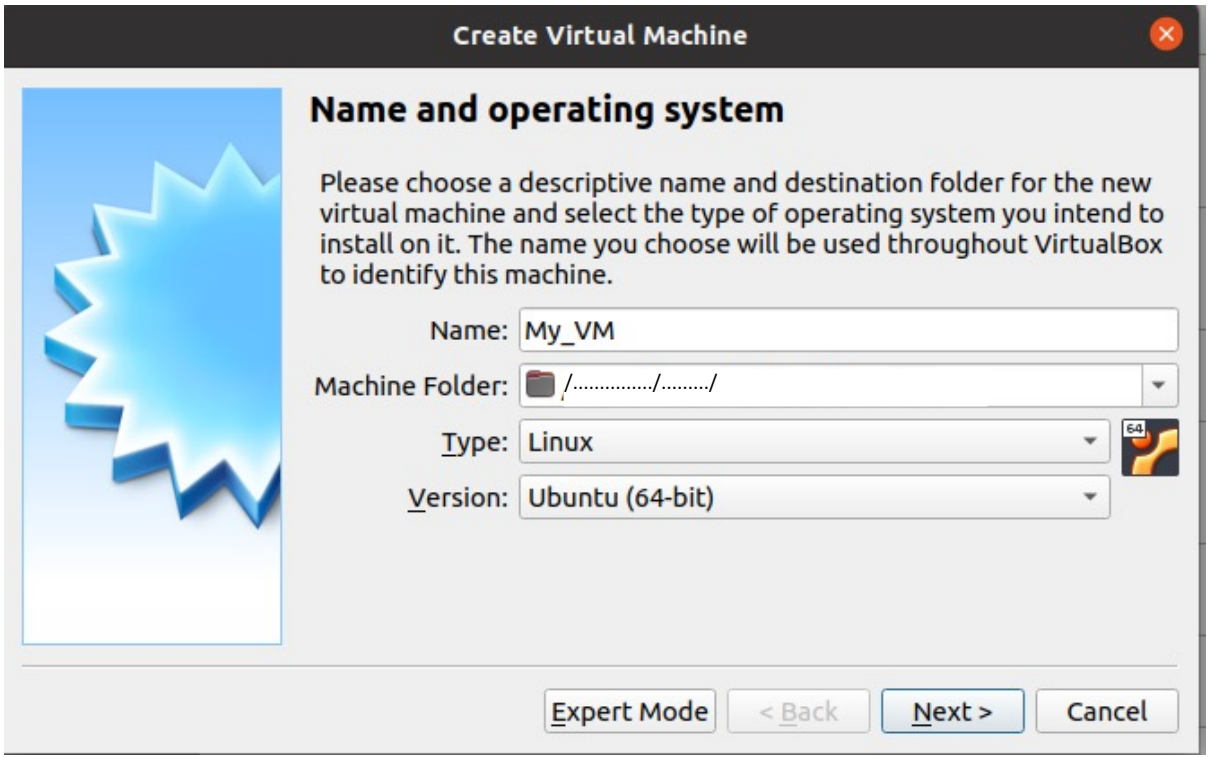
•**Step 1** – click on “New” button, which is in the top left hand side of the screen.




**Credit**: https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_virtualbox.htm

# Create Virtual Machine

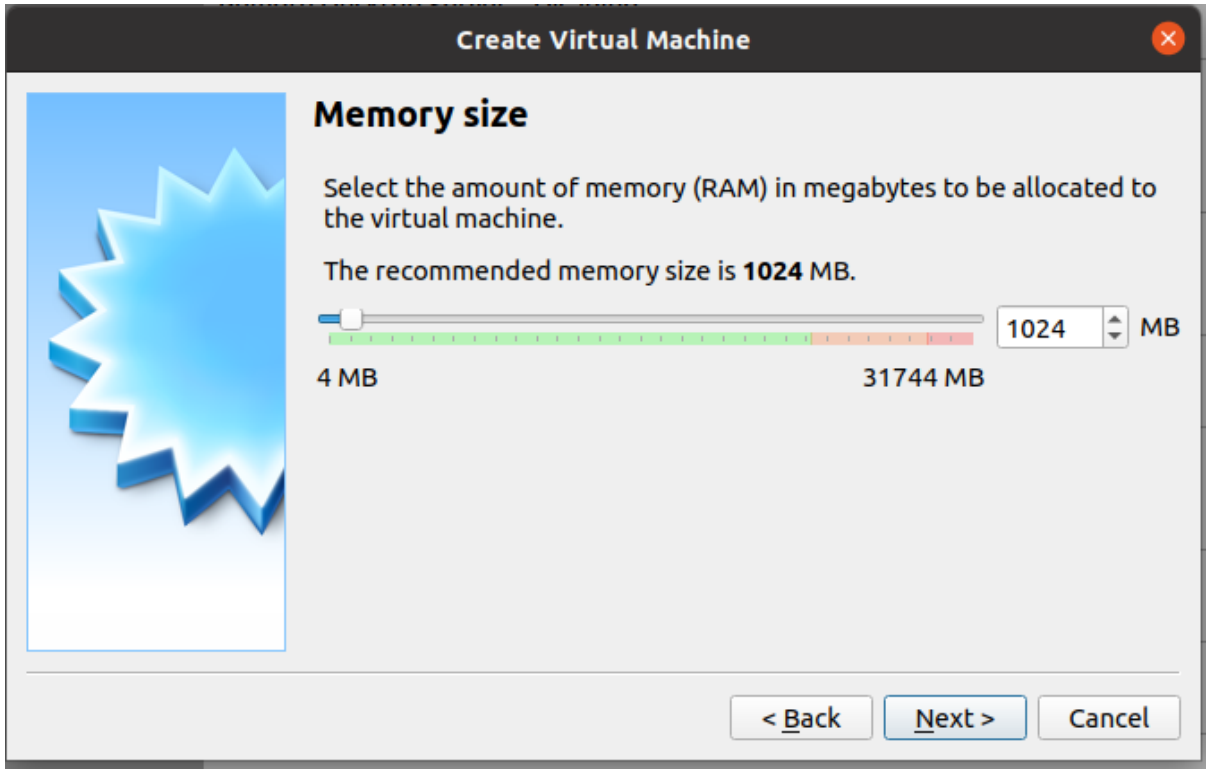
- **Step 2** –Set the parameters for the virtual machine.
  - **Name** – We have to put a friendly name for this Virtual Machine.
  - **Type** – Enter the OS that is going to be installed on it.
  - **Version** – Enter the specific version for that OS, which we have selected earlier.




**Credit**: https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_virtualbox.htm

# Create Virtual Machine

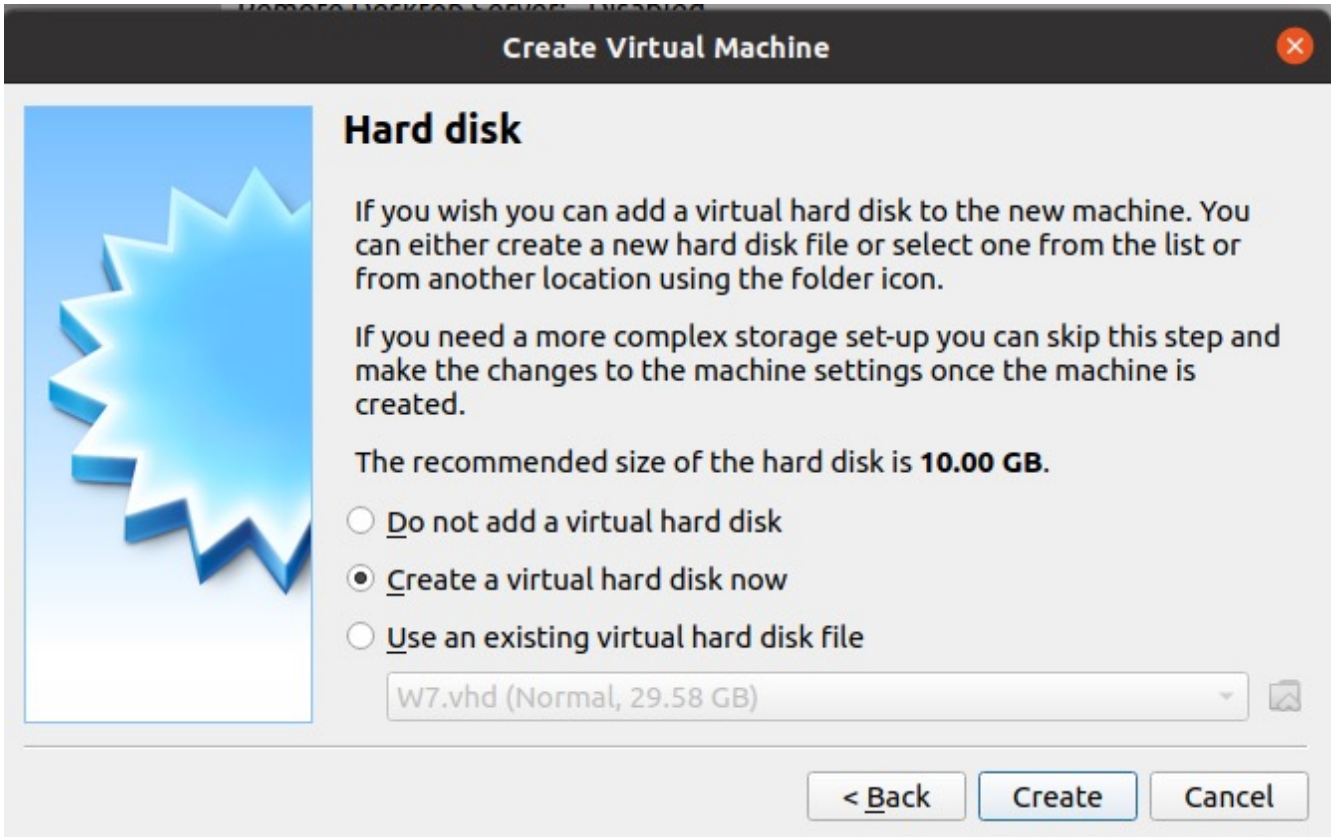
•**Step 3** – Select the amount of memory that you need to allocate in this VM → Click on "Next".




**Credit**: https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_virtualbox.htm

# Create Virtual Machine

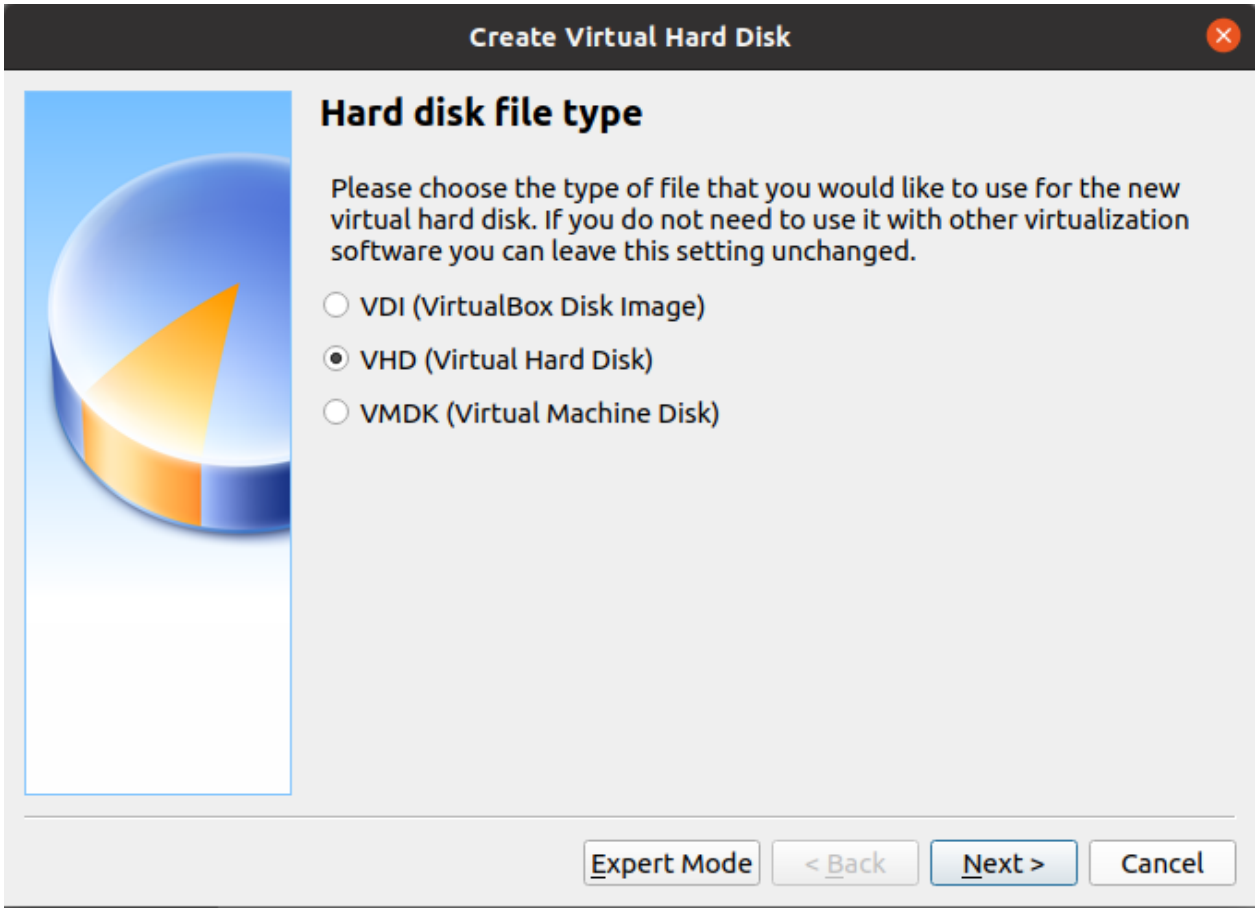
•**Step 4** – Check one of the three options for the HDD and click on “Create”.




**Credit**: https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_virtualbox.htm

# Create Virtual Machine

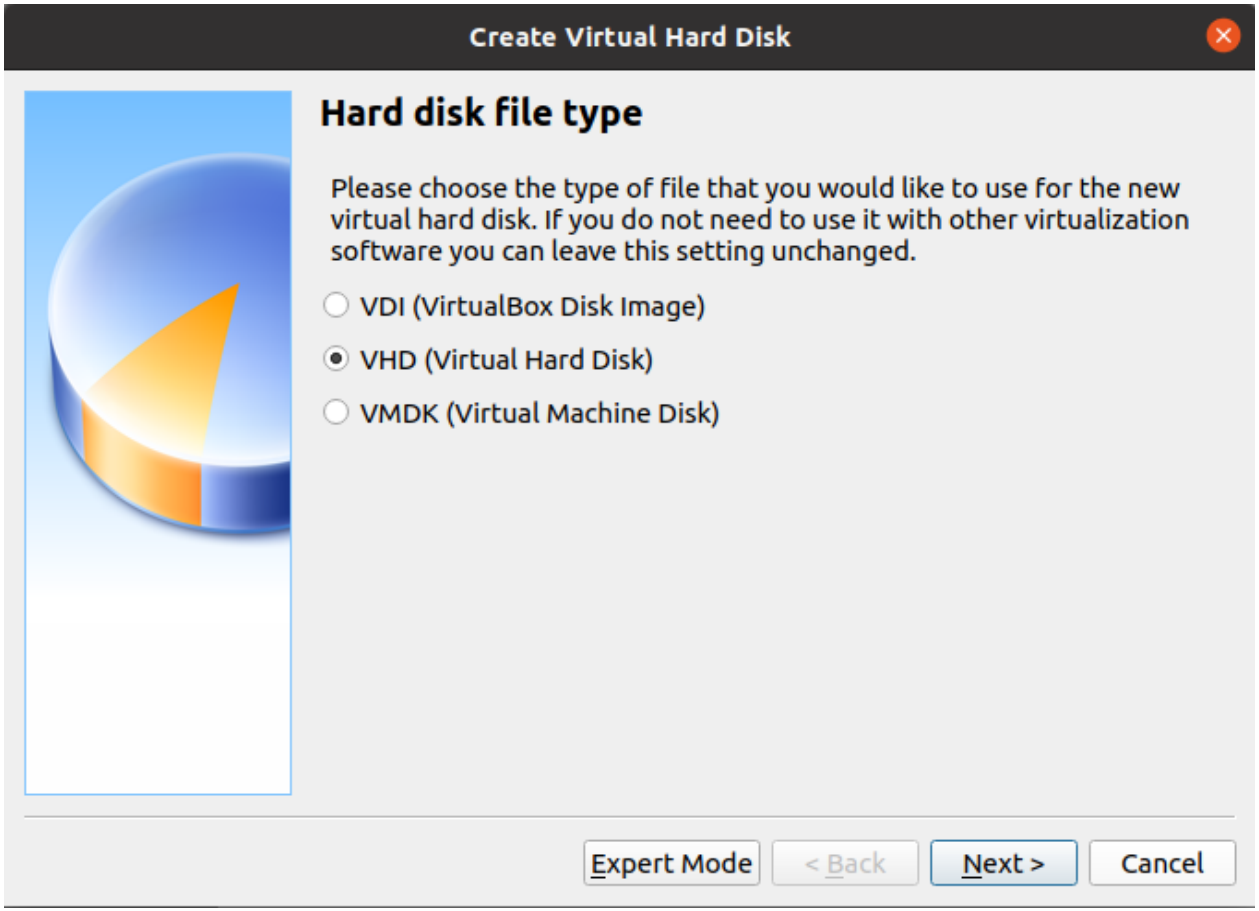
•**Step 5** – Select a file extension for your virtual HDD (It is recommended to use a common file extension that **most of the hypervisors** use like VHD) → click on “Next”.




**Credit**: https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_virtualbox.htm

# Create Virtual Machine

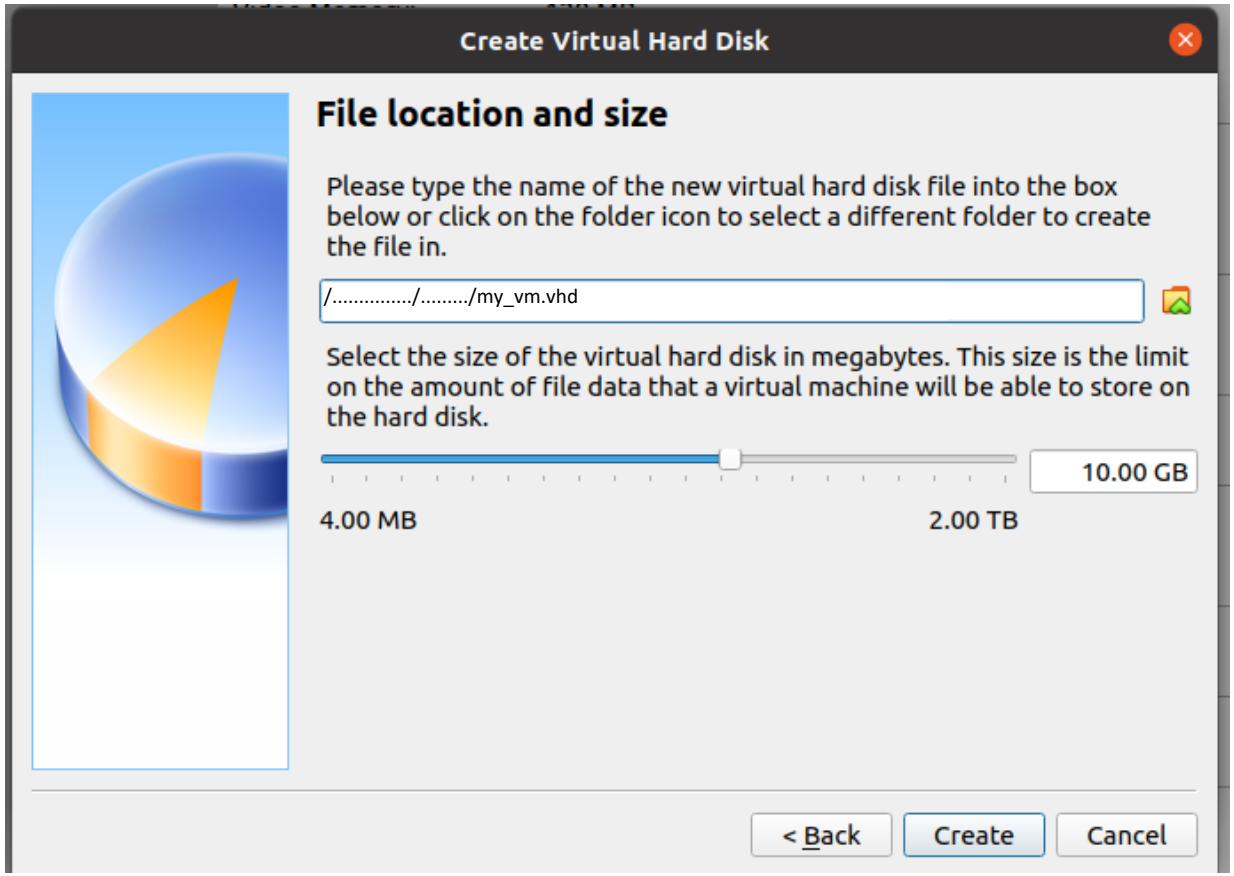
•**Step 6** – Choose whether you want the Virtual HDD as dynamic or fixed. This is based on your needs → Click on “Next”.




**Credit**: https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_virtualbox.htm

# Create Virtual Machine

•**Step 7** – Put a name for your virtual HDD file and select the disk size for your VM → Click on “Create”.  Now VM Settings are Done.

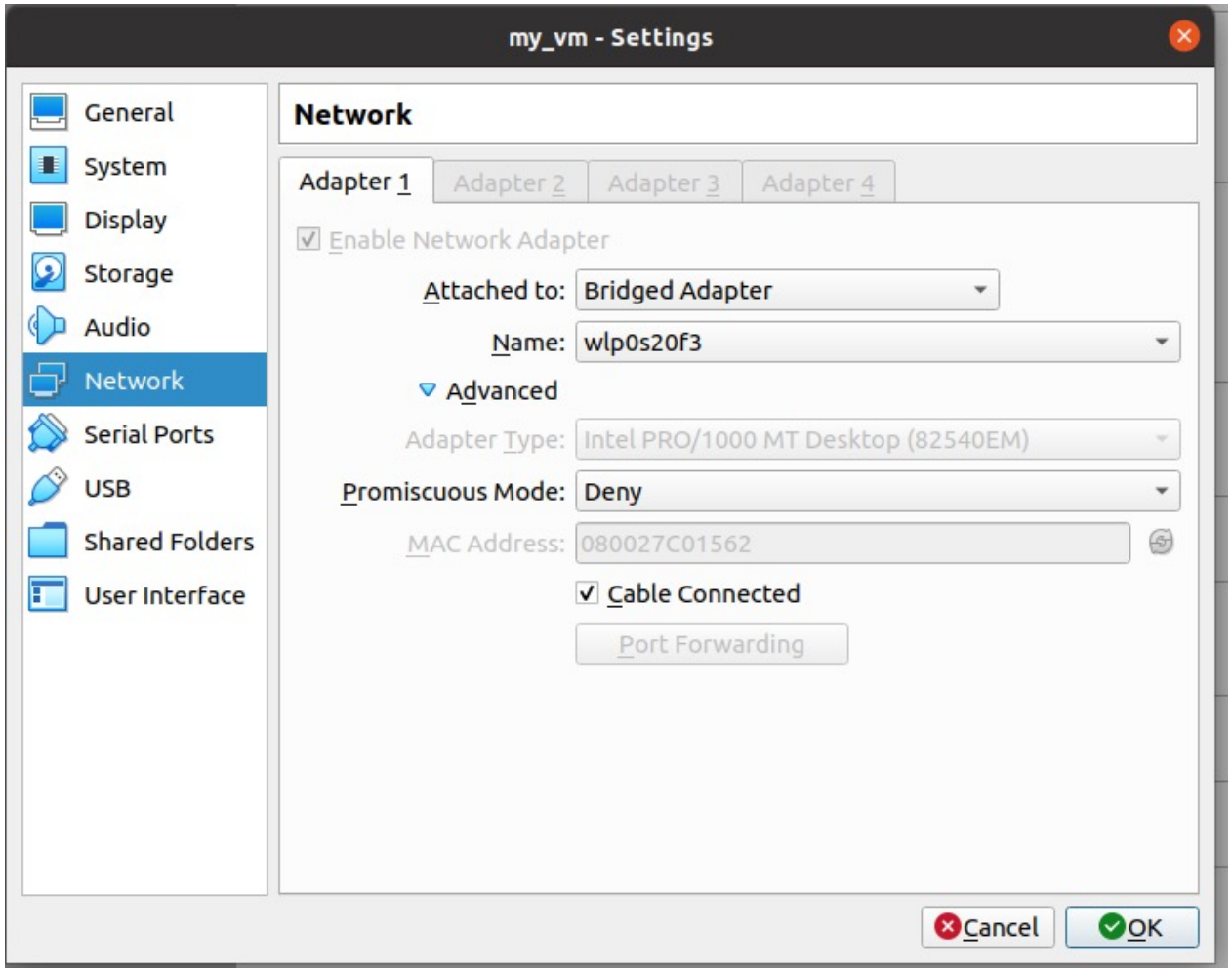



**Credit**: https://www.tutorialspoint.com/virtualization2.0/virtualization2.0_virtualbox.htm

# Setting up Networking

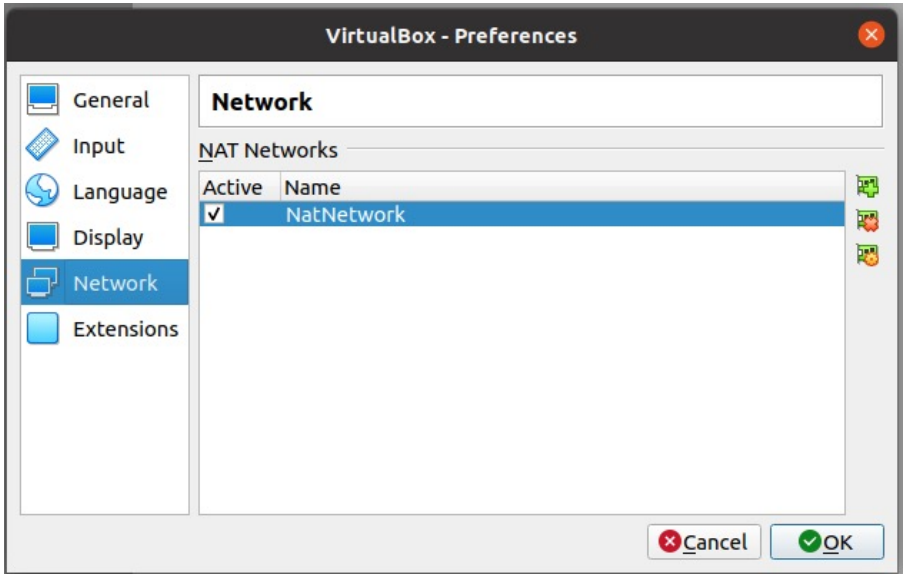
**Configure VM Adapter Network:**
There are multiple types of networking modes such as:

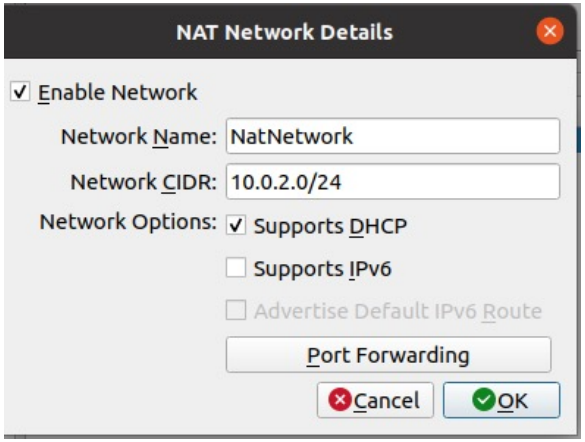
- NAT  Networks.
- Host-only Networks.
- **Bridged**



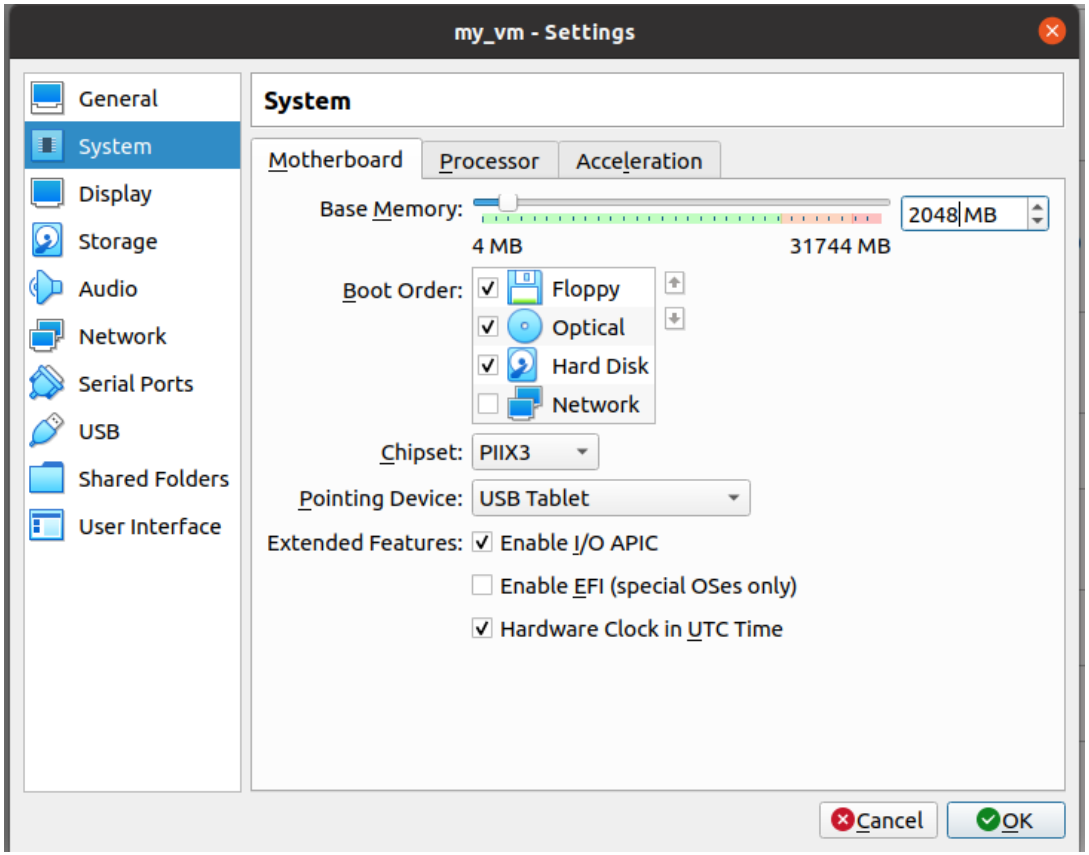
# Setting up Networking

Configure Virtual Box NAT Network

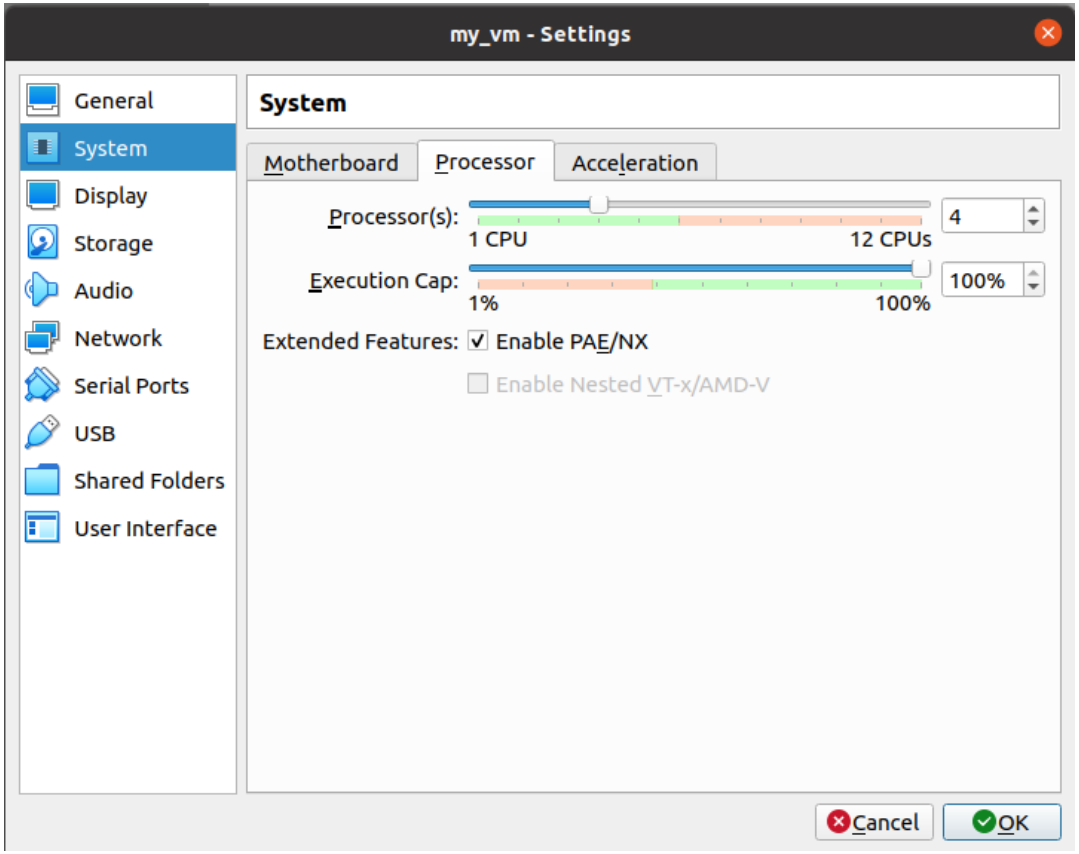


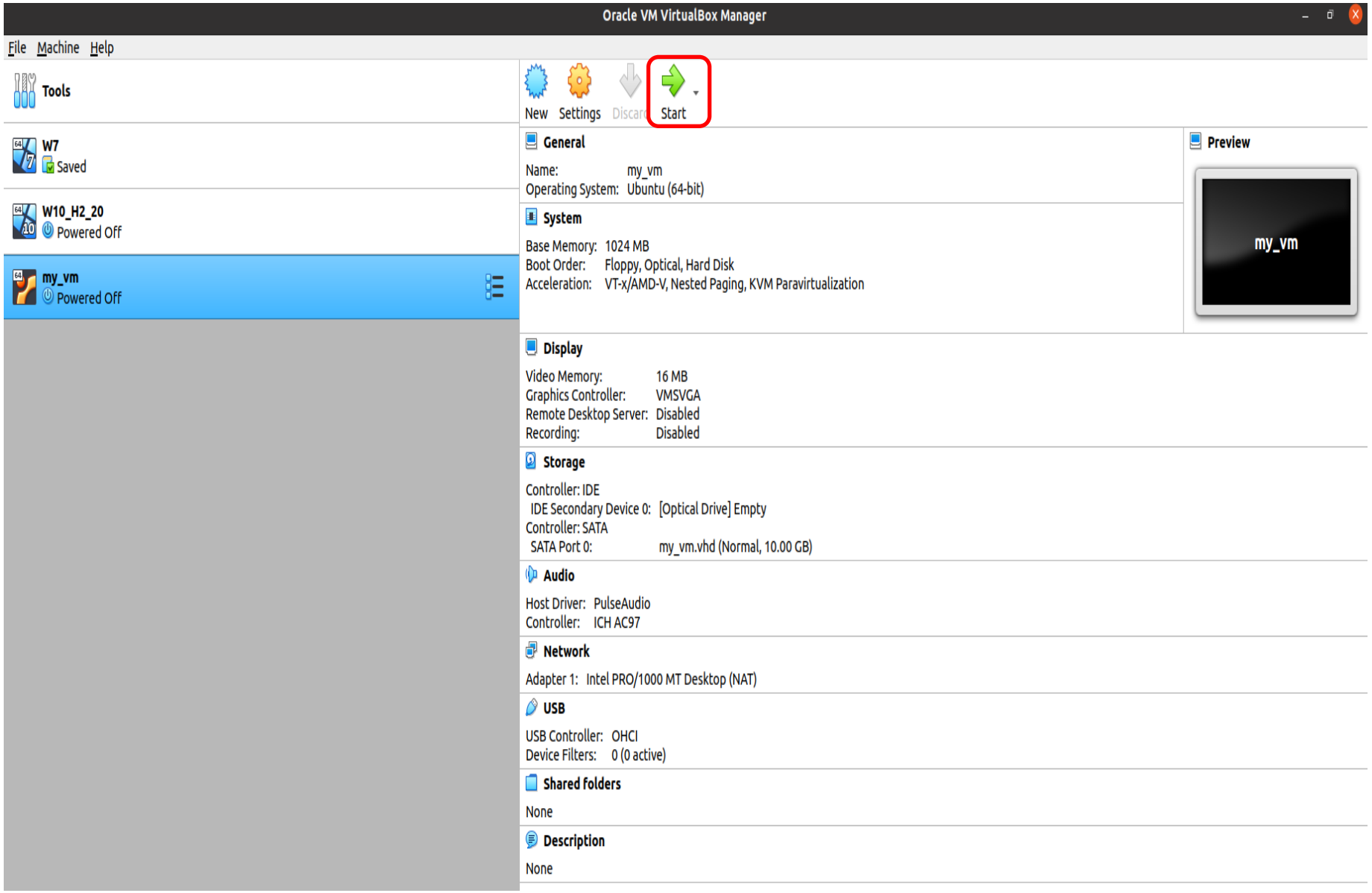
# Edit VM Memory and Boot Order



# Edit VM CPU-Cores

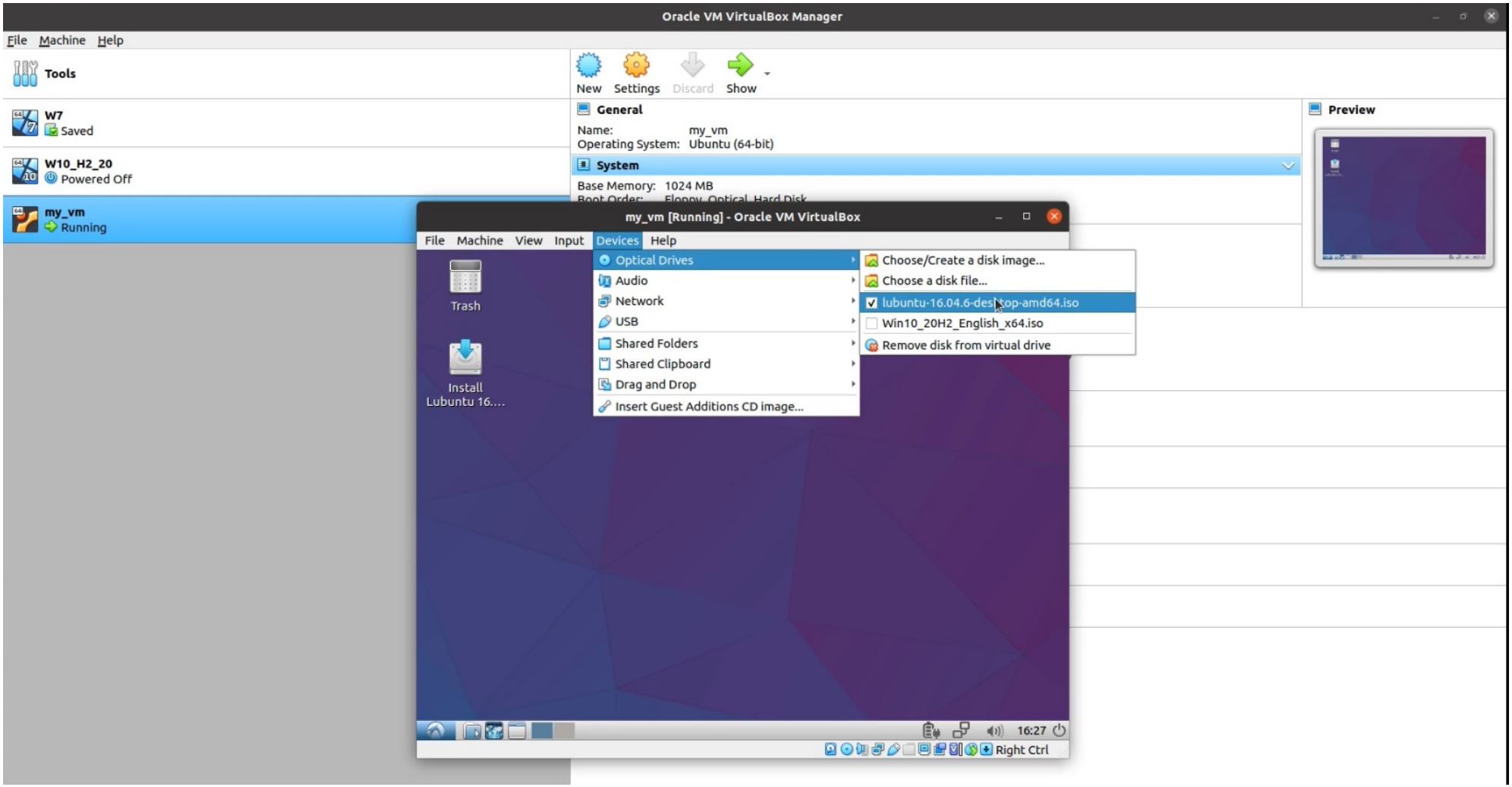


# Start Virtual Machine



# Start Virtual Machine

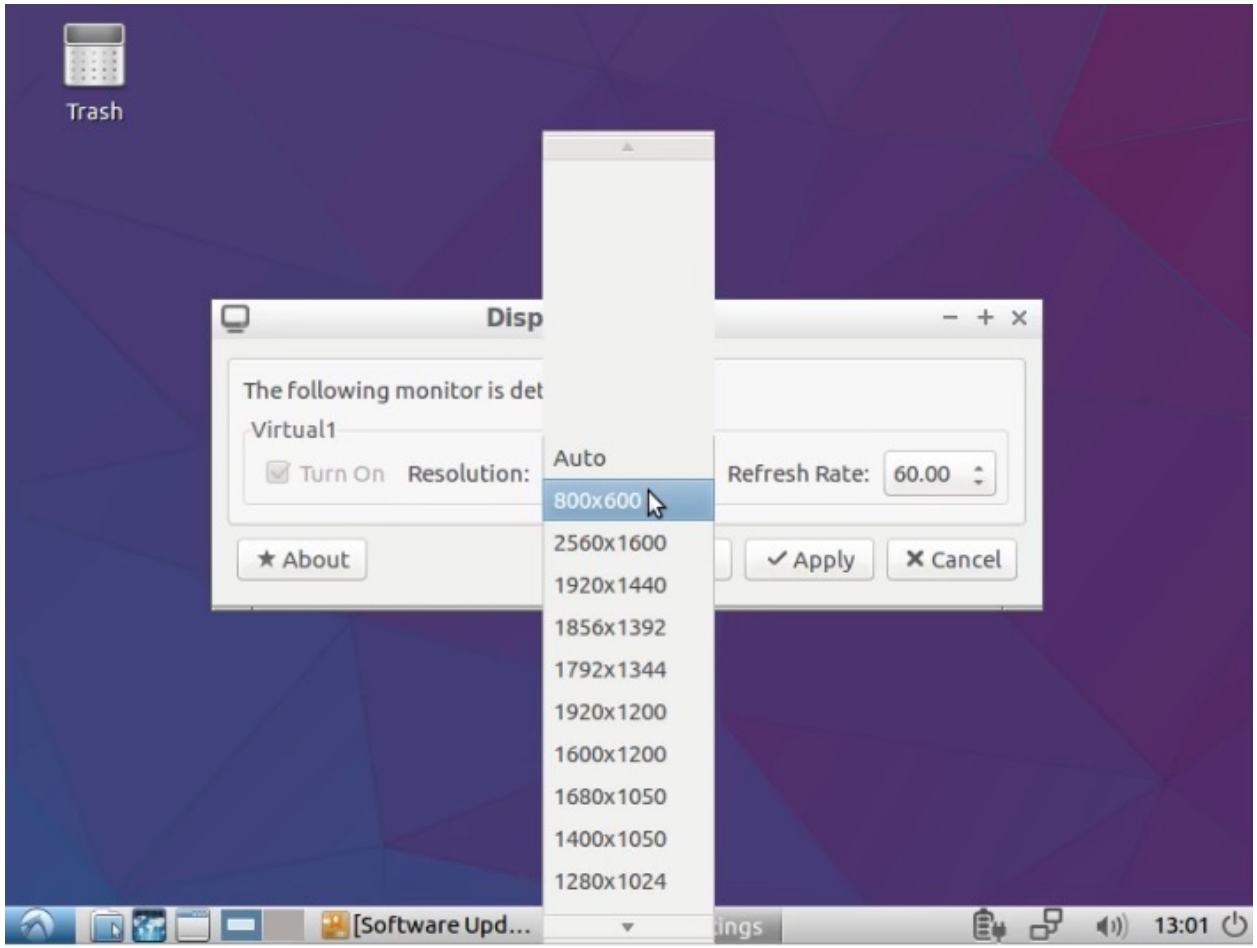
**Select Boot Device and Install your OS.**
**Use Lubuntu Light Version** [16.04.6-desktop]



# Install OS

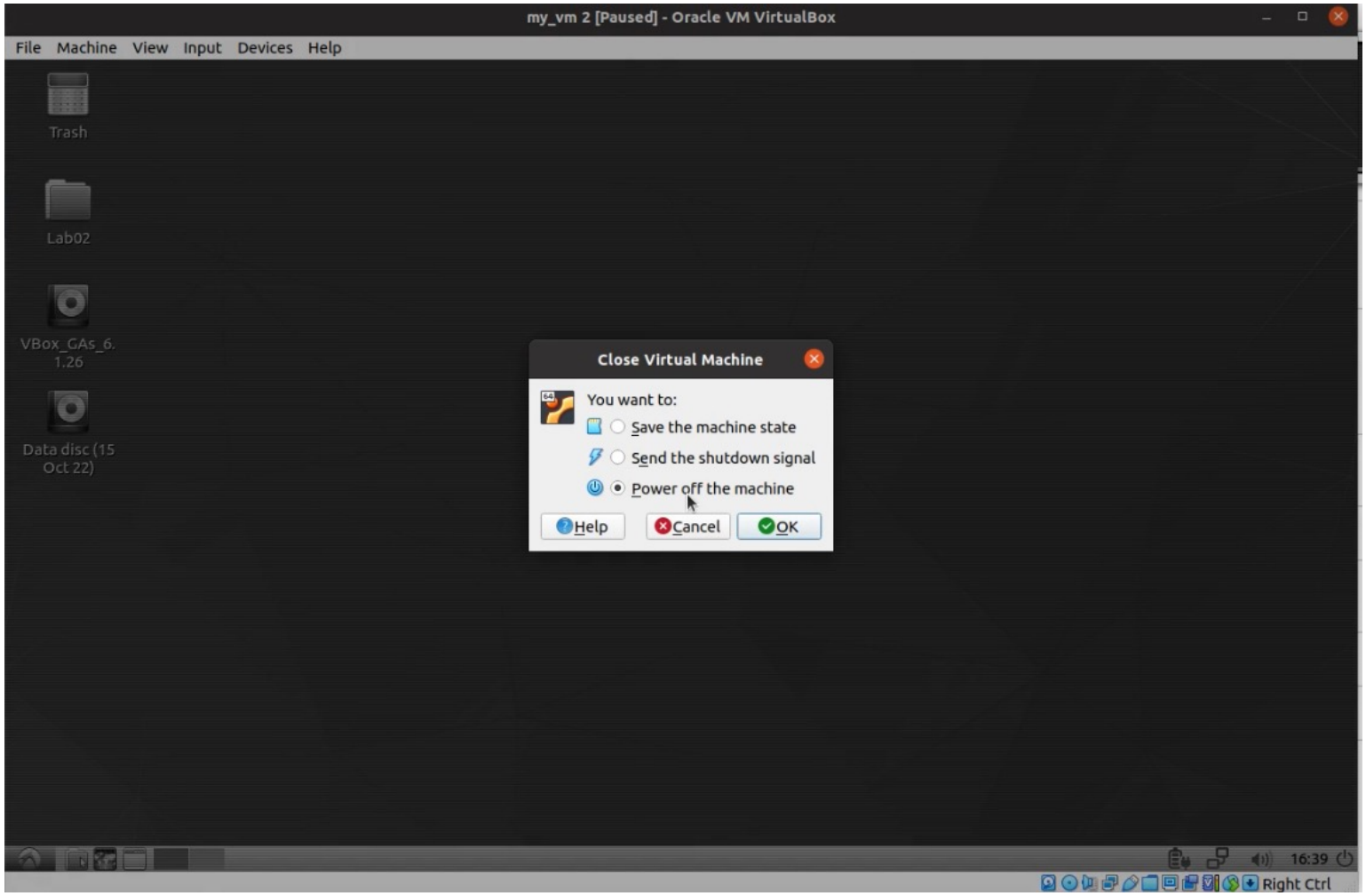

lubuntu
Try Lubuntu without installing
Install Lubuntu
Check disc for defects
Test memory
Boot from first hard disk
F1 Help F2 Language F3 Keymap F4 Modes F5 Accessibility F6 Other Options

# Change Desktop Resolution



# Close VM

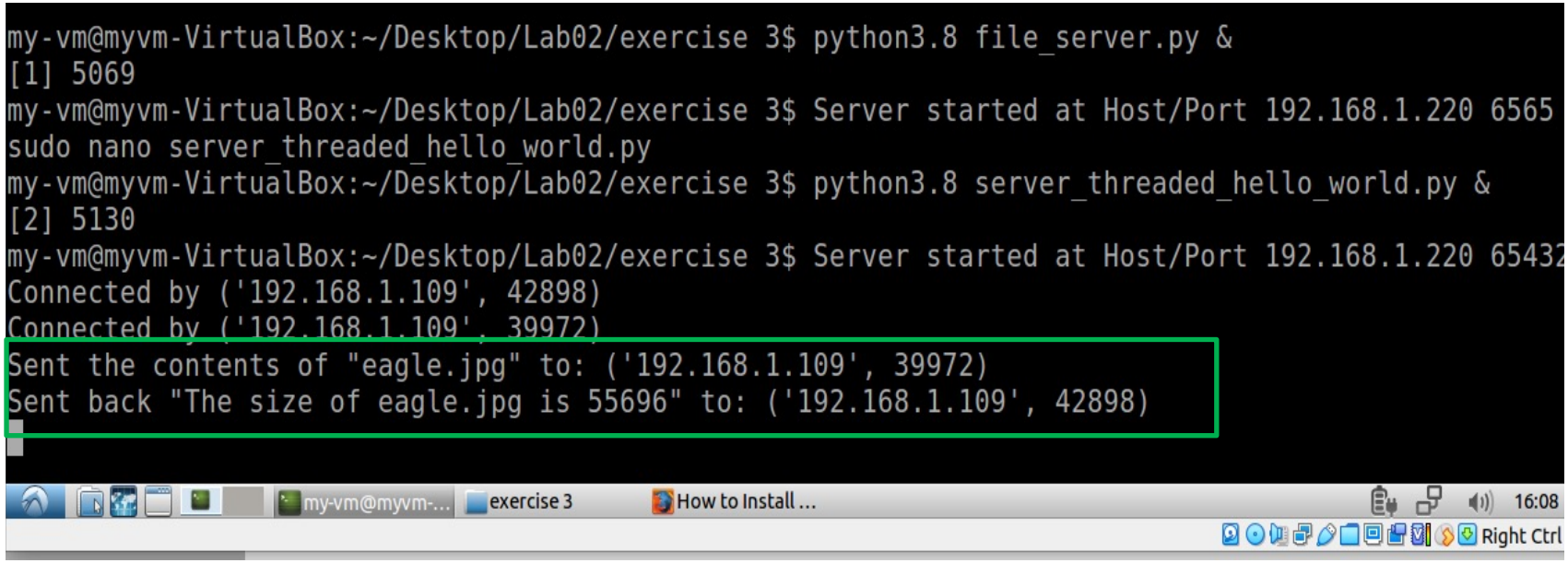
- You can either shutdown or save state your VM



# Exercises 1

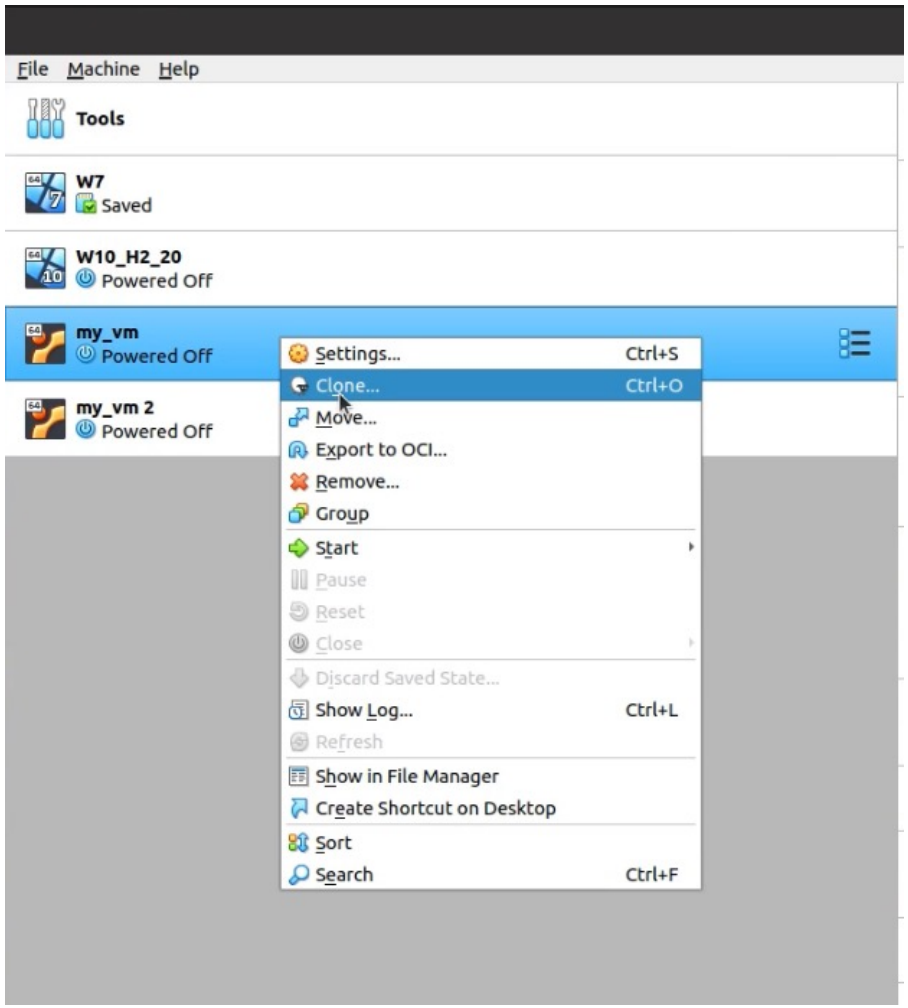
Run Lab02 Exercise 03 Servers  Under The VM:

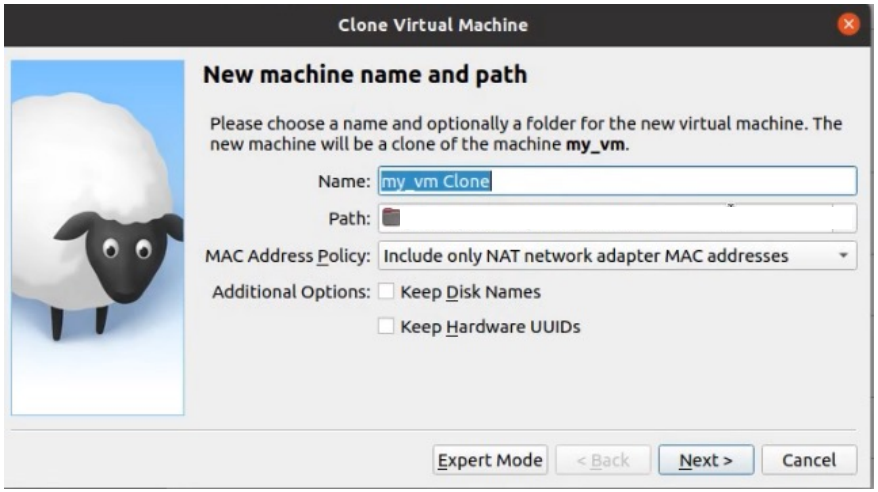
- Copy your Lab files inside the VM (download the files or copy  them through a shared folder)
- Install Python **3.8+**
- Get you VM Ip using **ifconfig** command
- Check your machine is reachable using **ping** command
- Edit your **file_server.py**, **server_threaded_hello_world.py** , set Server IP to your VM IP.
- Run the Servers inside the VM.
- Run the client from your **host machine** and check the server output:



# Clone Virtual Machine

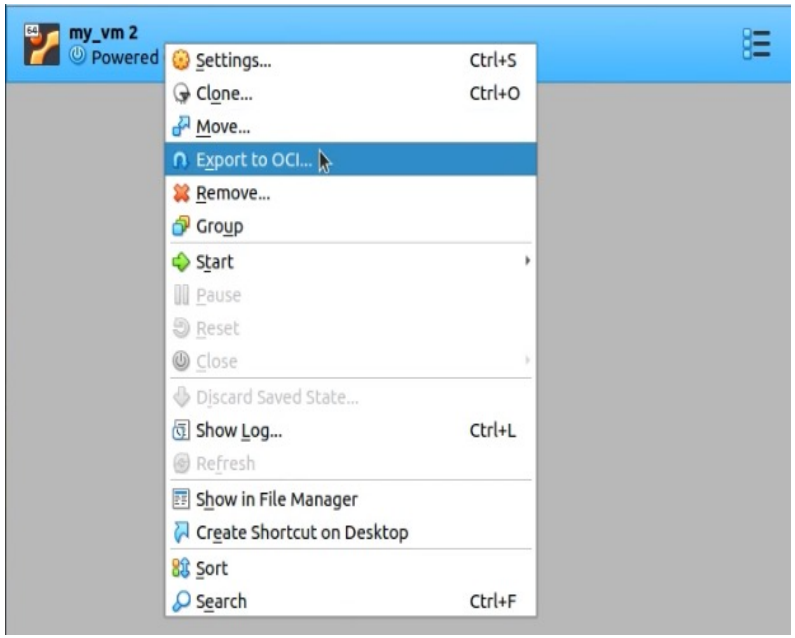
- Create a copy of your VM

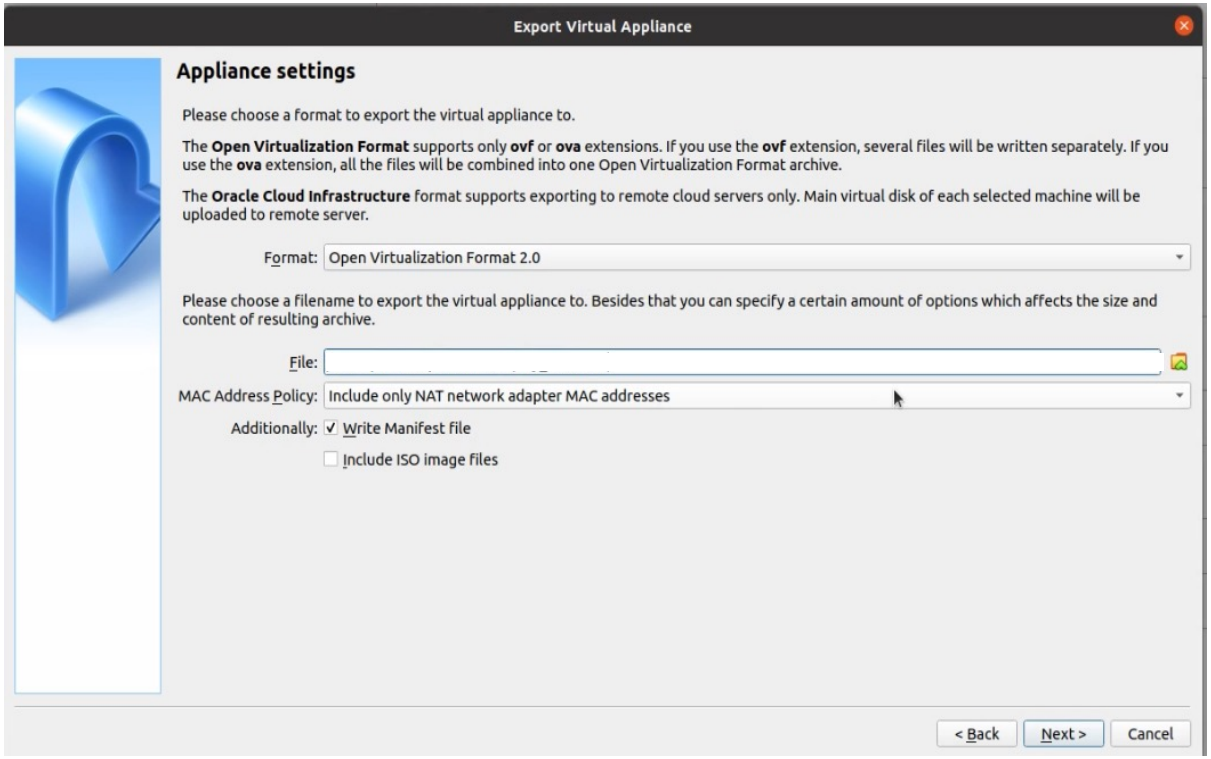


# Export Virtual Machine Appliance (OVA)

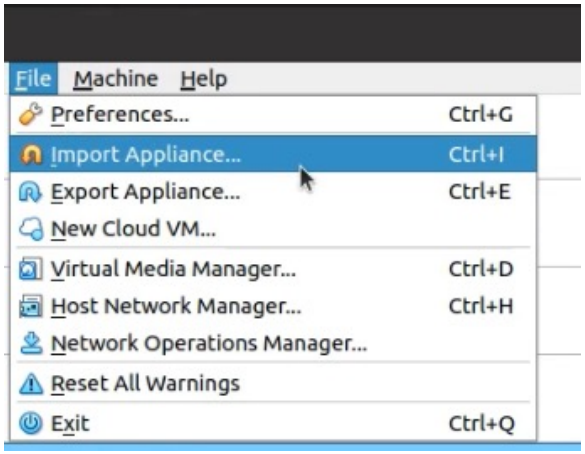
- Create a copy of your VM as an appliance file that can be imported by other hypervisors

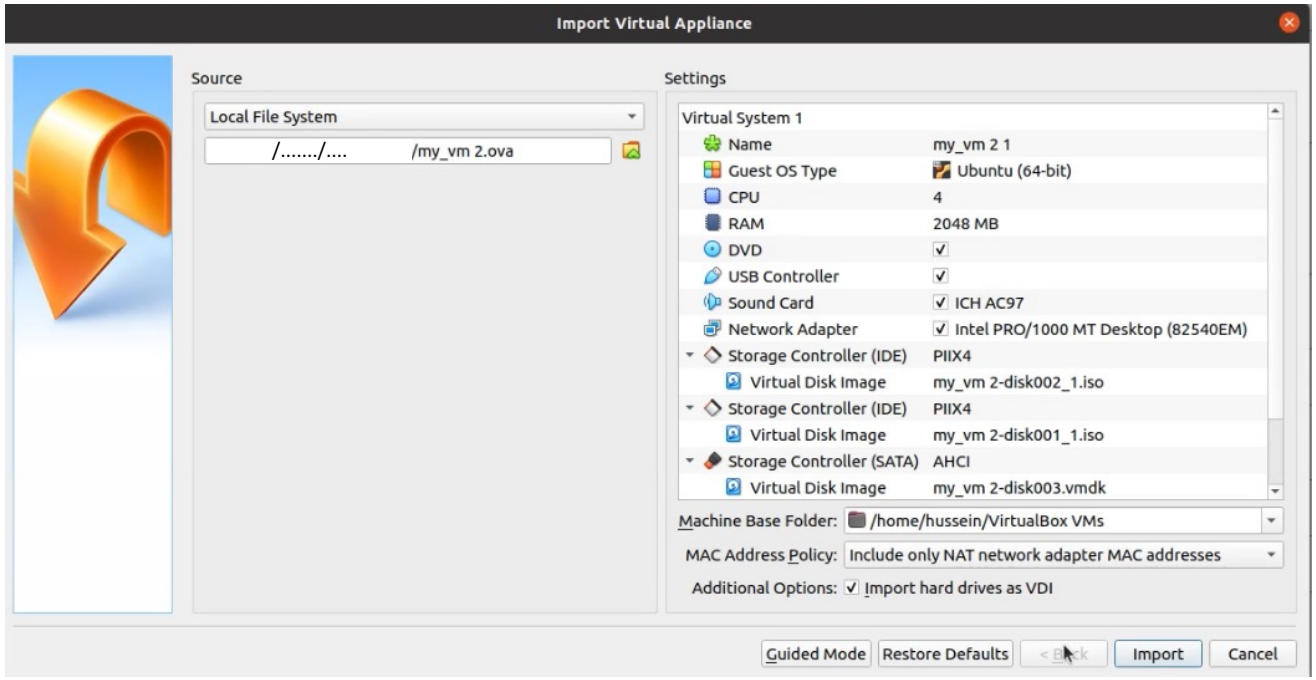


# Import Virtual Machine Appliance (OVA)

- Import VM appliance into your hypervisor.



# Exercise 2

- **Run** Lab02 Exercise 03 on **2 VMs**
  - Clone your VM
  - Check whether your server machine is reachable from the client machine using **ping** command.
  - Edit the **client.py** , set Server IP.
  - Run the Servers inside the original VM.
  - Run the client from the new VM and check the client output:

```
my-vm@myvm-VirtualBox://home/my-vm/Desktop/Lab02/exercise 3$ python3.8 client.py

Connected to hello world server at: 192.168.1.220 65432
Enter file name to fetch from file server: eagle.jpg
Connected to file server at: 192.168.1.220 6565
Got file: eagle.jpg from file server, size: 55696
Response from Hello World Server: I got "The size of eagle.jpg is 55696" from yo
u and I am sending it back.
my-vm@myvm-VirtualBox://home/my-vm/Desktop/Lab02/exercise 3$
```

# Extra-Exercise

- **Run Matrix Multiplication using Client server Architecture on a cluster of 3 VMs**
  - Run the Multiprocessing matrix multiprocessor example on a cluster of 3 VMs (1 Server and 2 Clients) on three machines. (group-based exercise)
  - Compare the speed up gain with a single machine.