Data Center Networking Technology
Project 2

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Outline

- Project Info
- Descriptions and Objectives
- Project Content
- Step-by-Step Instructions
- Demo
- Reference

Project Info

Goal:

- In this project, student will learn how to use Mininet and a SDN controller (Ryu) to emulate a simple network system

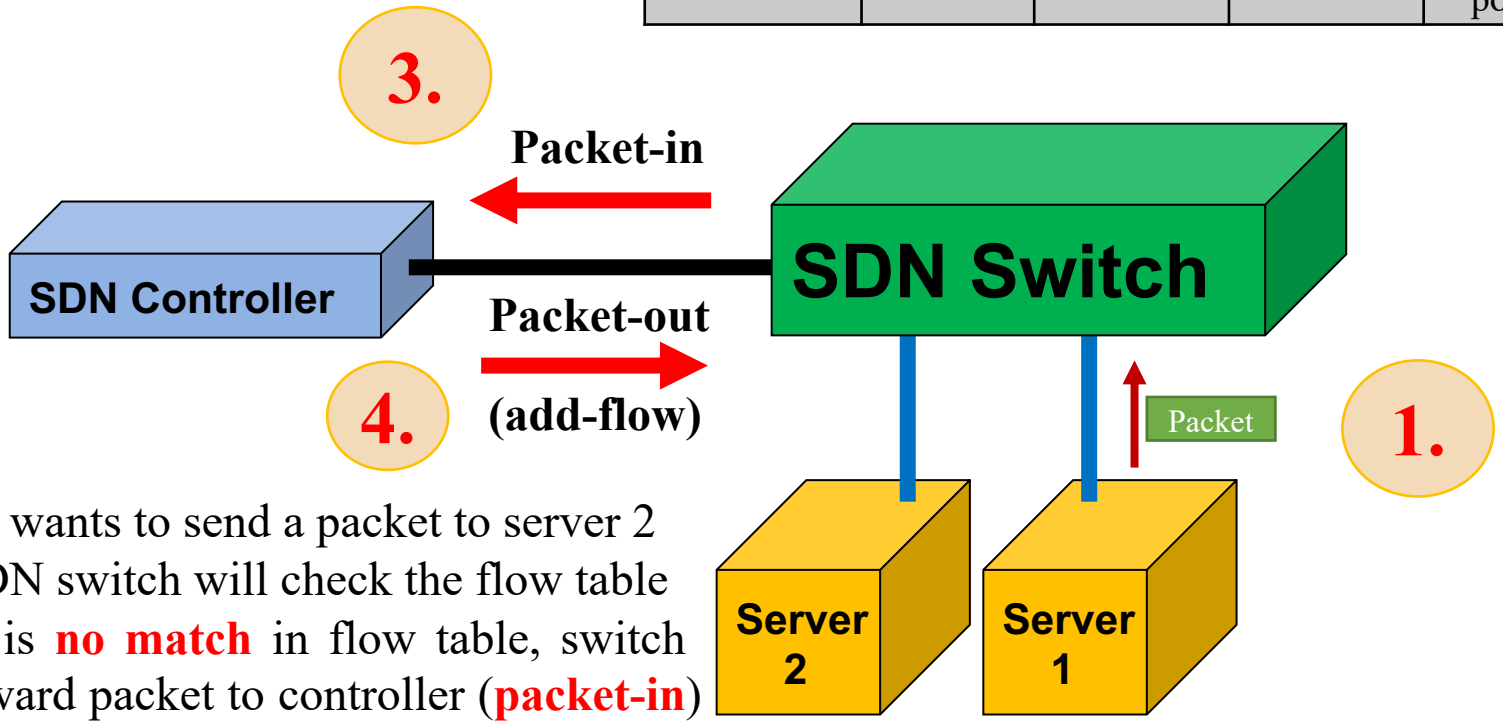
Project assigned: 03/16/2021
Project deadline: 03/30/2021

Descriptions and Objectives (1/3)

About SDN Switch:

Flow table in switch

Ingress Port	Ethec Src	Ether Dst	…	Action
Port 1	192.168.14.3	*		Output port=2

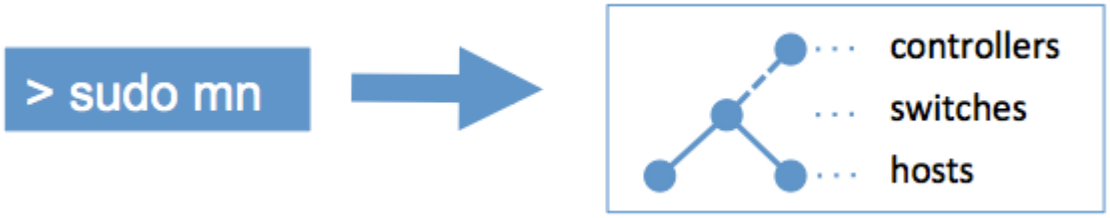


1. Server 1 wants to send a packet to server 2
2. First, SDN switch will check the flow table
3. If there is **no match** in flow table, switch will forward packet to controller (**packet-in**)
4. Controller will decide the **action** and send packet back to switch (**packet-out**), it can also add new flow entry in switch's flow table

Descriptions and Objectives (2/3)

About Mininet:

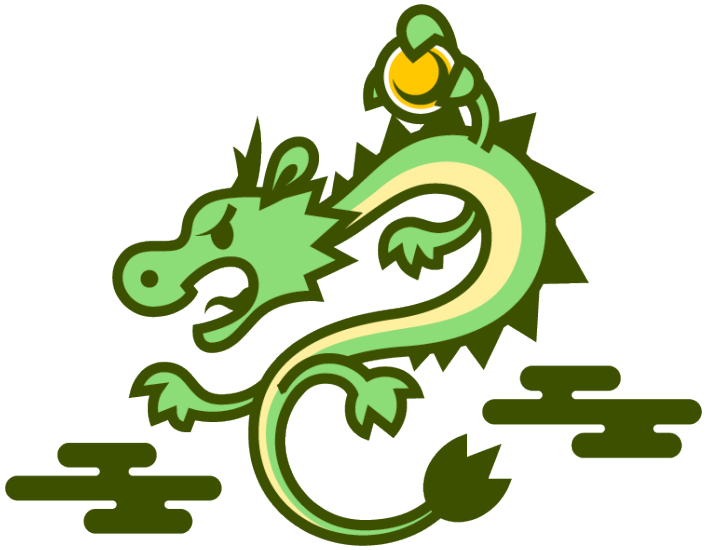
- Mininet creates a realistic **virtual network**, running real kernel, switch and application code
- It runs a collection of end-hosts, switches, routers, and links on a single Linux kernel
- The switches are OpenFlow-enabled



Descriptions and Objectives (3/3)

About SDN Controller Ryu:

- RYU supports the OpenFlow 1.0, 1.2, 1.3, 1.4 and 1.5
- RYU can work in conjunction with OpenStack for cloud computing
- Written in Python



Project Content

1. Create a VM which runs Ubuntu 16.04
2. Install Mininet
3. Install Ryu
4. Run Mininet and Ryu to emulate a simple SDN network system
5. Study SDN controller's sample code

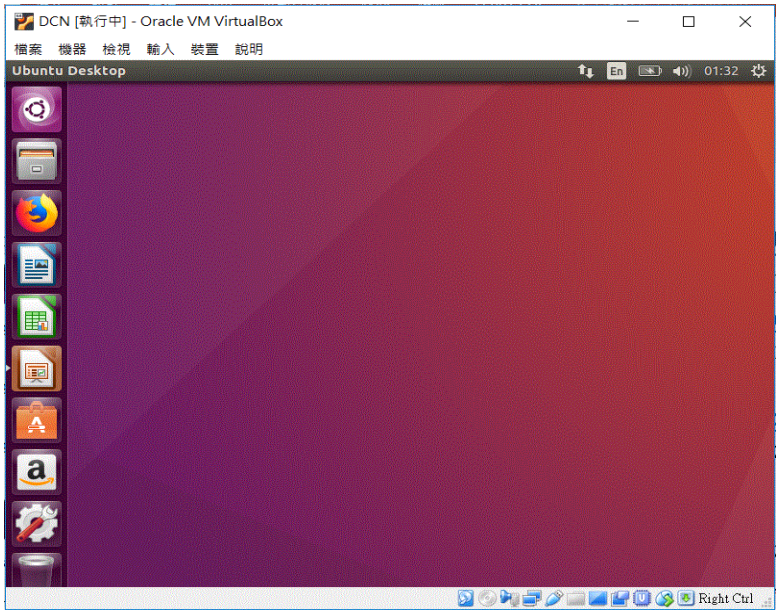
Step-by-Step Instructions (1/11)

Step 1: Create a VM running Ubuntu 16.04

1. Go to https://www.virtualbox.org/wiki/Downloads and download VirtualBox

2. Go to http://releases.ubuntu.com/16.04/ download the Ubuntu 16.04 desktop ISO file

3. Use Virtual Box to install Ubuntu ISO file



4. Following is the reference video https://www.youtube.com/watch?v=RBU1xMP-SGc

Step-by-Step Instructions (2/11)

Step 2: Install Mininet

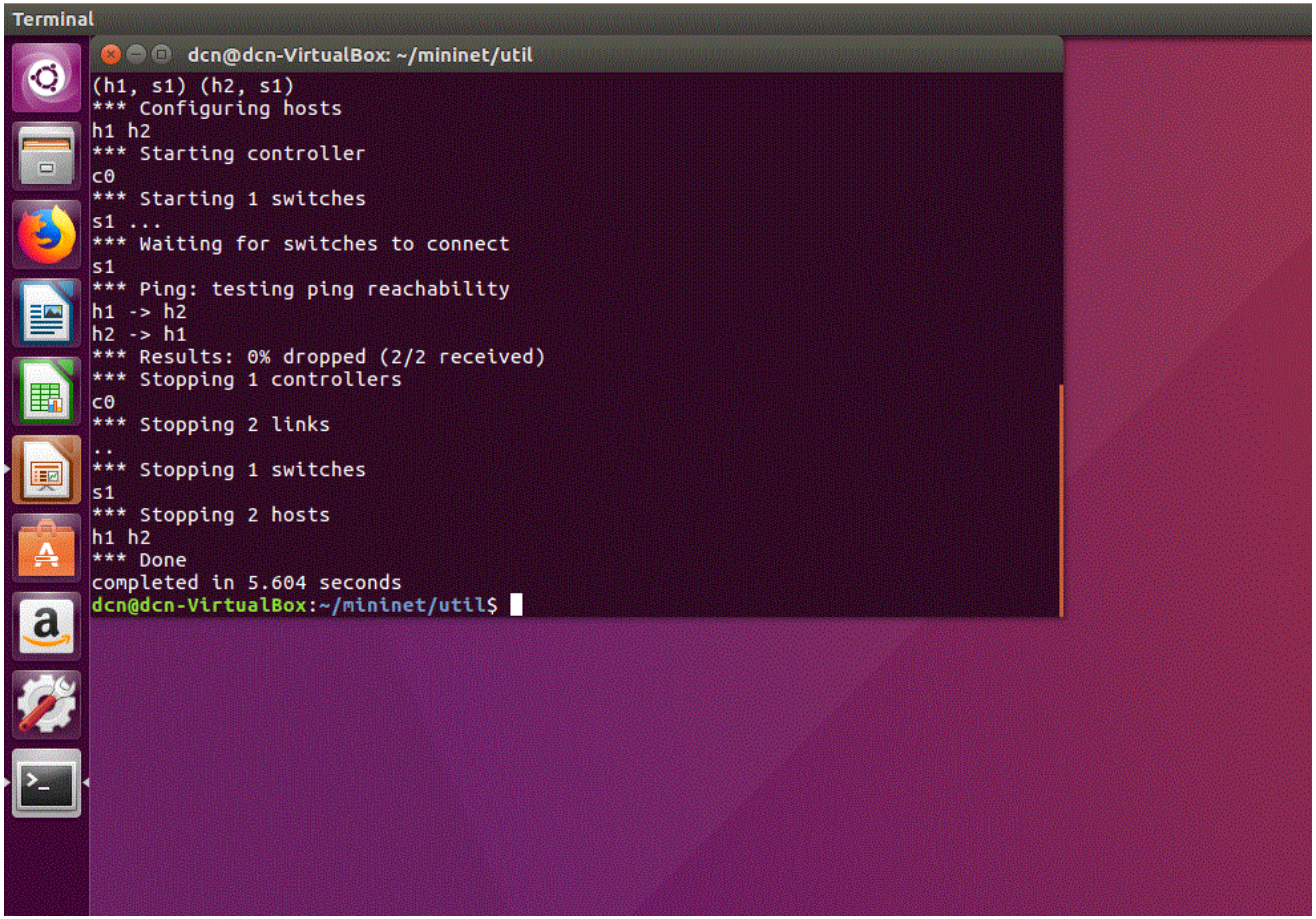
Open a new terminal and enter the following commands

1. **Install git**
   ```
   sudo apt-get install -y git
   ```
2. **Clone the mininet repository with git**
   ```
   git clone git://github.com/mininet/mininet
   ```
3. **Install mininet (takes 3-7 minutes)**
   ```
   cd mininet/util
   sudo ./install.sh -a
   ```
4. **Test the mininet installation and then close the terminal**
   ```
   sudo mn --test pingall
   ```

Step-by-Step Instructions (3/11)

Step 2: Install Mininet

- You should see the following screen for a successful install



Step-by-Step Instructions (4/11)

Step 3: Install Ryu

Open a new terminal and enter the following commands

1. Install required packages (5-10 minutes)

```
sudo apt-get install -y python-pip python-dev build-essential
sudo pip install --upgrade pip
sudo pip install --upgrade six
sudo apt-get install -y python-eventlet python-routes
sudo apt-get install -y python-webob python-paramiko
sudo pip install --upgrade setuptools
```

2. Download and install ryu

```
git clone git://github.com/osrg/ryu.git
cd ryu
sudo pip install .
```

3. Test (the result is on next page)

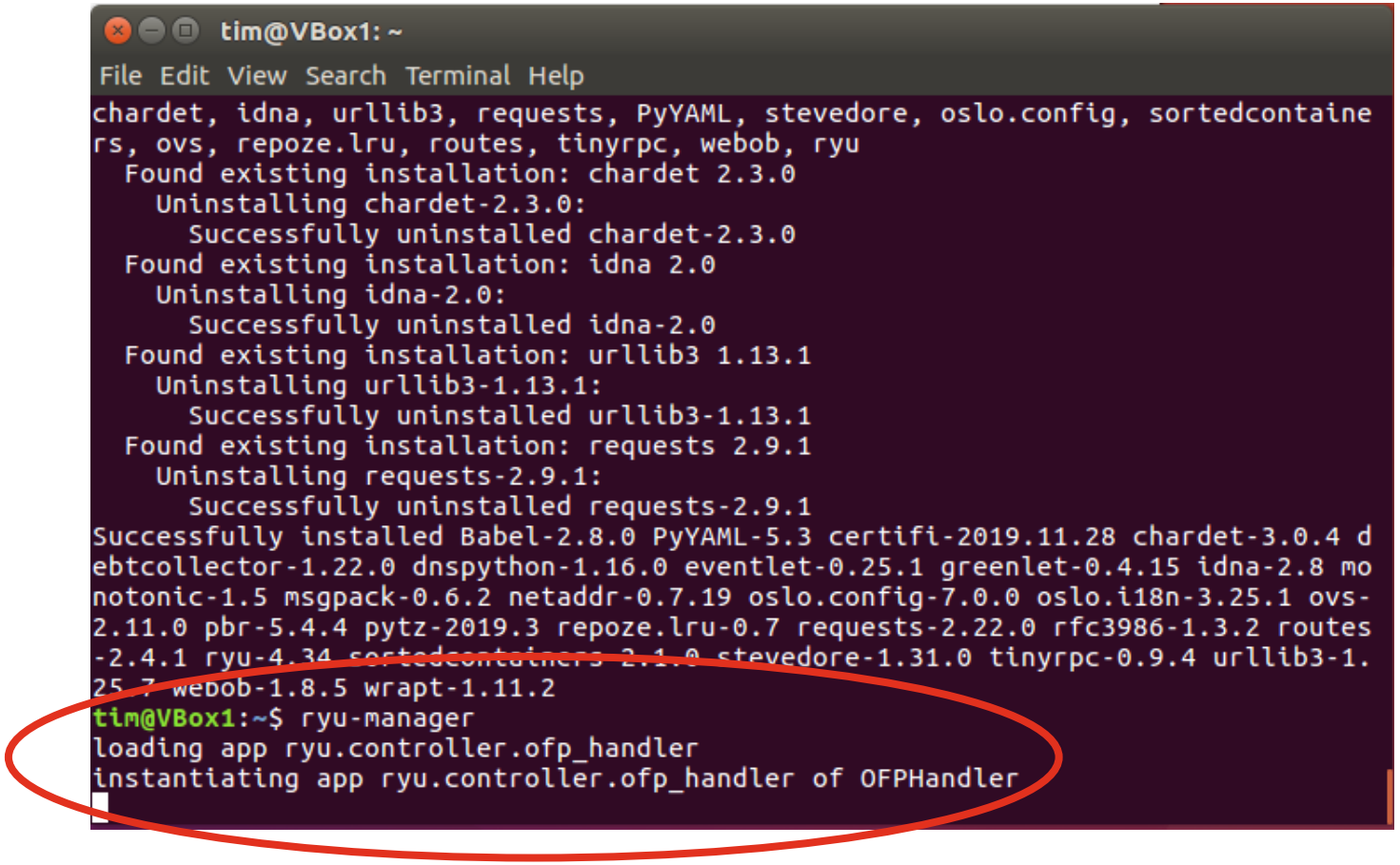
```
ryu-manager
```

4. Press "Ctrl+C" to leave ryu-manger and then close the terminal

Step-by-Step Instructions (5/11)

Step 3: Install Ryu

- If you can see this output, then Ryu is installed
- Quit **`ryu-manager`** by pressing "Ctrl+C" and close the terminal afterwards

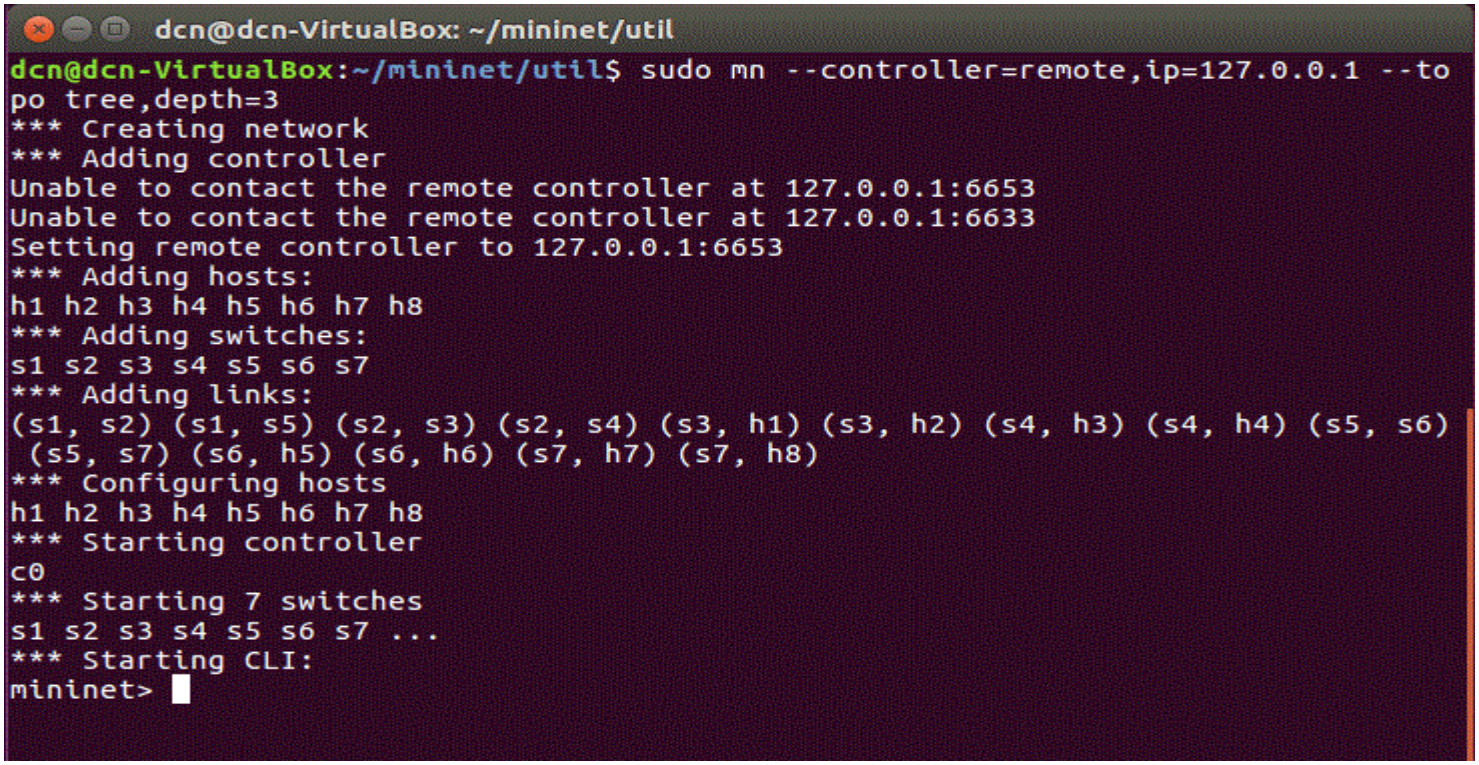


Step-by-Step Instructions (6/11)

Step 4: Run Mininet and Ryu to emulate a simple SDN network system

1. Open a new terminal and run mininet

```
sudo mn --controller=remote,ip=127.0.0.1 --topo tree,depth=3
```

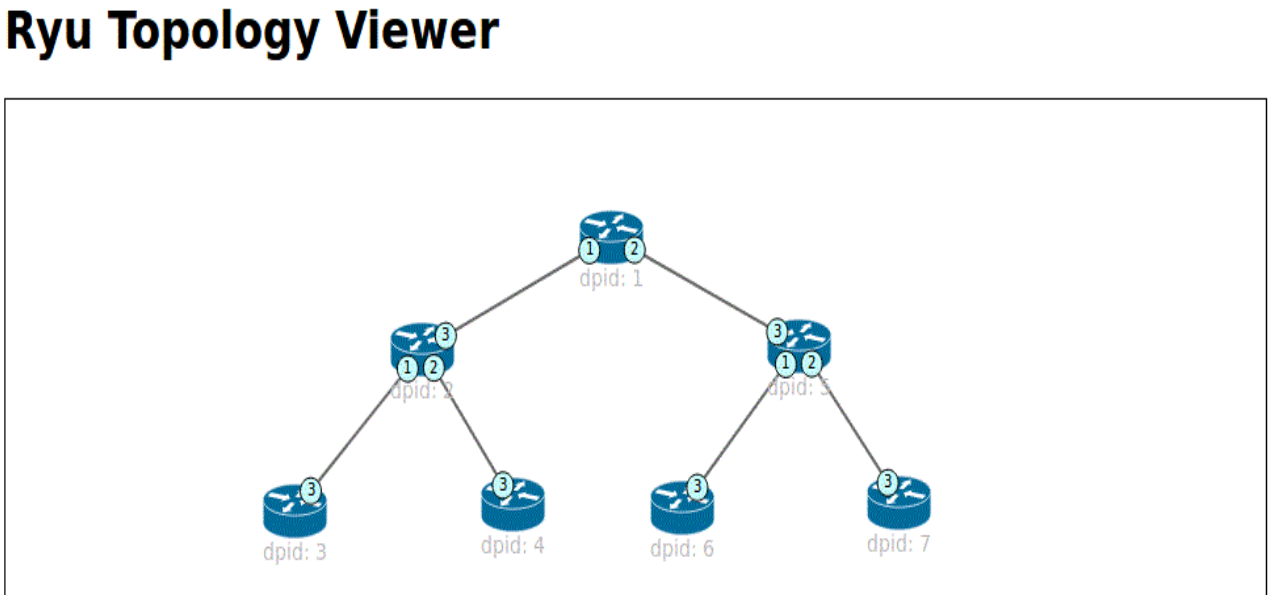


Step-by-Step Instructions (7/11)

Step 4: Run Mininet and Ryu to emulate a simple SDN network system

```
sudo mn --controller=remote,ip=127.0.0.1 --topo tree,depth=3
```

- The command above will create the tree topology below



Step-by-Step Instructions (8/11)

Step 4: Run Mininet and Ryu to emulate a simple SDN network system

2. Open another new terminal and go to Ryu installation folder

- Get the Ryu installation directory:
  `pip show ryu`
- Go to the specified directory, **e.g.**:
  `cd /usr/local/lib/python2.7/dist-packages`

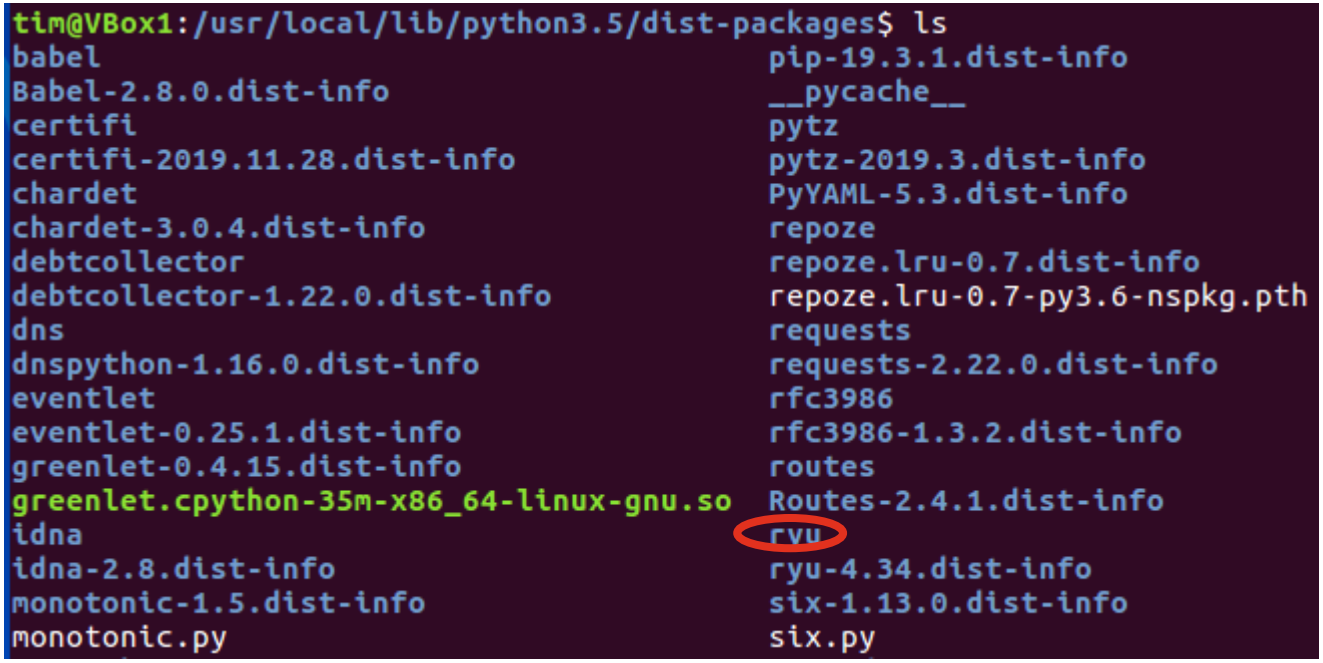
```
root@localhost:~# pip show ryu
DEPRECATION: Python 2.7 reached the end of its life on January 1st, 2020. Please upg
n January 2021. More details about Python 2 support in pip can be found at https://p
 this functionality.
Name: ryu
Version: 4.34
Summary: Component-based Software-defined Networking Framework
Home-page: https://ryu-sdn.org
Author: Ryu project team
Author-email: ryu-devel@lists.sourceforge.net
License: Apache License 2.0
Location: /usr/local/lib/python2.7/dist-packages
Requires: webob, ovs, tinyrpc, routes, six, netaddr, msgpack, eventlet, oslo.config
Required-by:
root@localhost:~#
```

Step-by-Step Instructions (9/11)

Step 4: Run Mininet and Ryu to emulate a simple SDN network system

3. Check for Ryu installation folder existance

- You can see the Ryu folder (using '`ls`' command)

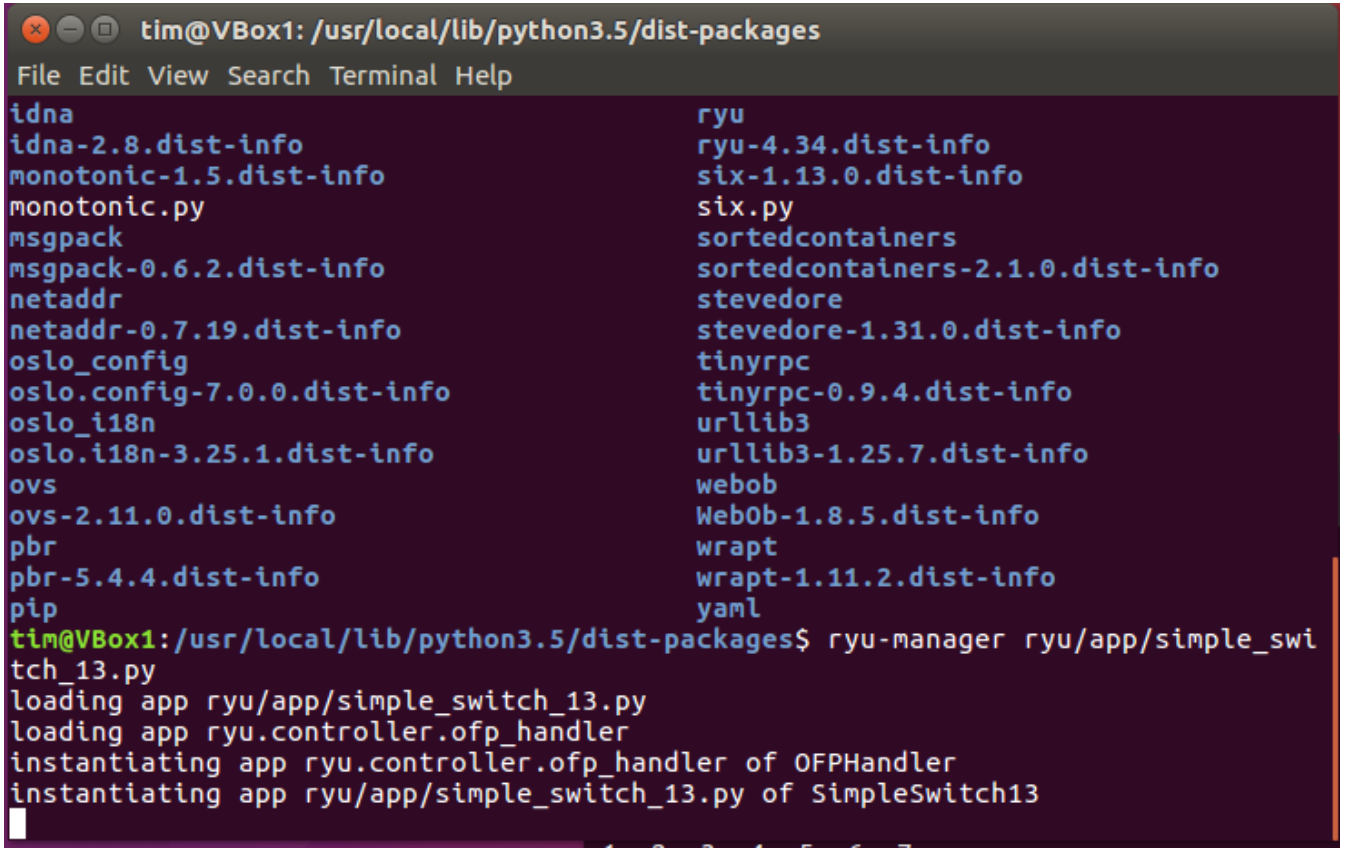


Step-by-Step Instructions (10/11)

Step 4: Run Mininet and Ryu to emulate a simple SDN network system

4. Run controller sample code : simple_switch_13.py

```
ryu-manager ryu/app/simple_switch_13.py
```

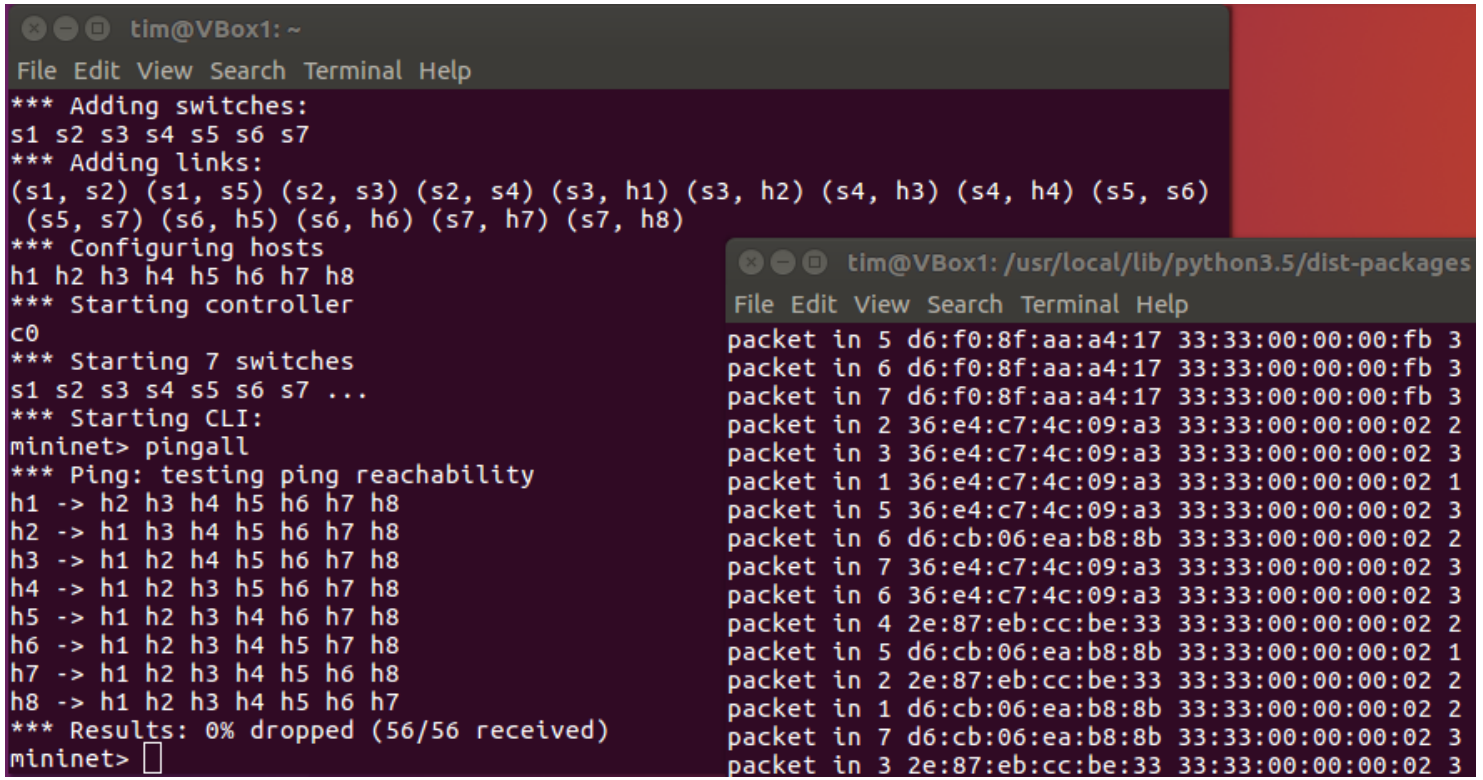


Step-by-Step Instructions (11/11)

Step 4: Run Mininet and Ryu to emulate a simple SDN network system

5. In the mininet terminal use 'pingall' command to test

- Every host should successfully ping to each other
- You should also see 'packet in' command in the ryu-manager



DEMO

- We will have DEMO on **04/01 Thursday**
  - Please go to **this link** and choose the time that you prefer
  - Demo location will be written there too

- TA will ask questions about controller sample code (simple_switch_13.py)
  - This is to make sure you understand the controller program
  - You will need to learn and review the logic of the code

- **03/23 Tues** at ED302 13:20 – 14:10 we have help session
  - Students who have problems or questions can attend

- Email TA, if you have any questions

Reference:

- Mininet: http://mininet.org/
- Ryu: http://osrg.github.io/ryu/
- Ryu book http://osrg.github.io/ryu-book/en/Ryubook.pdf

(There is detailed explanations for sample code in chap. 2)