# Project 3 - Virtual Networks, SDNs, and Ethernet Learning

- Learn to work with virtual networks using Mininet
- Learn to manage networks with SDN Controllers by using POX or Floodlight
- Learn how L2 ethernet topology learning works by creating a self-learning algorithm
- These three major points will also encompass
  - Learning how to setup a virtual machine
  - Learning how to evaluate a network's performance capabilities
  - Learning how to access a node using SSH (if you haven't done so already)
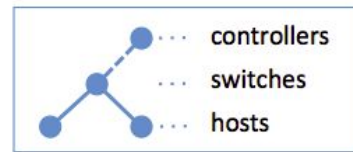
# Mininet

- What: A network simulator, which can simulate hosts, switches, controllers, and various other network infrastructure
  - Can be run via command line or python files
- Example: 3 hosts and a switch
  - CMD:  sudo mn --topo single,3
  - Python:

```
SimpleTopology(Topo):
def __init__(self, **opts):
        Topo.__init__(self, **opts)
         # define all the hosts
        h1 = self.addHost('h1')
        h2 = self.addHost('h2')
        h3 = self.addHost('h3')
        # define switch
        s1 = self.addSwitch('s1')
        # define links
        self.addLink(h1, s1)
        self.addLink(h2, s1)
        self.addLink(h3, s1)
```
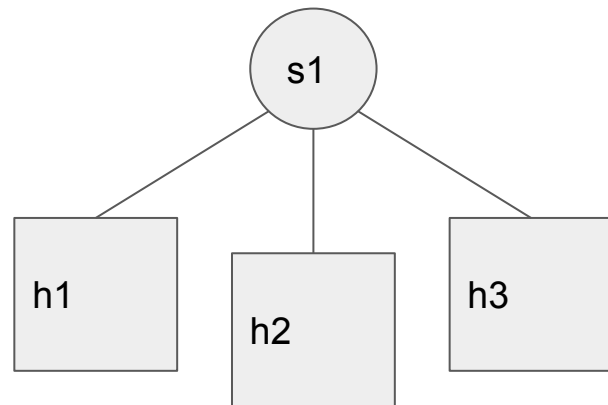
# Mininet Python

```python
SimpleTopology(Topo):
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```
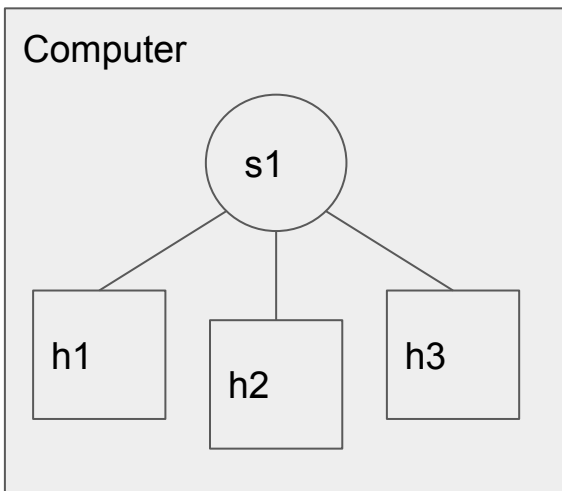
# Mininet

- The networks appear as separate network components on a host device (your computer) but you can think of each host/component as a "real" device
- Example, you can ping each component from the other connected components
  - Think of this as an advanced version of MahiMahi



```
mininet> h1 ping h2
PING 10.0.0.2 (10.0.0.2) 56(84) bytes of data.
64 bytes from 10.0.0.2: icmp_seq=1 ttl=64 time=0.065 ms
64 bytes from 10.0.0.2: icmp_seq=2 ttl=64 time=0.085 ms
```

```
mininet> h2 ping h3
PING 10.0.0.3 (10.0.0.3) 56(84) bytes of data.
64 bytes from 10.0.0.3: icmp_seq=1 ttl=64 time=0.776 ms
64 bytes from 10.0.0.3: icmp_seq=2 ttl=64 time=0.088 ms
```

```
mininet> h1 ping s1
PING 127.0.0.1 (127.0.0.1) 56(84) bytes of data.
64 bytes from 127.0.0.1: icmp_seq=1 ttl=64 time=0.044 ms
64 bytes from 127.0.0.1: icmp_seq=2 ttl=64 time=0.052 ms
```

# Mininet plus a Controller (SDN concepts)

- SDN controllers provide a logically central location to control and manage a network.
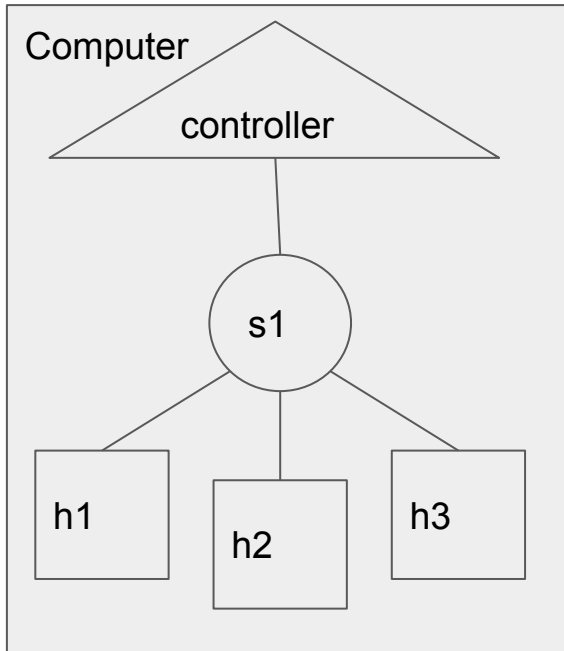


- Example:
  - Controlling entries for switches (s1) by having switches forward packets to the controller and asking for direction

# POX (Python) Example - telling switch to send a packet

- POX utilizes Python to run
- Some useful examples for the homework
- Sending a packet onto a specific port for a switch

```
# create a message that takes the packet coming in on inPort and attaches the
packet the switch sent to the controller to then forward
msg = of.ofp_packet_out(in_port = inPort, data = packet)

# attach an action, telling the switch to send the packet out on a defined outPort
msg.actions.append(of.ofp_action_output(port =outPort))

# send the command to the switch
event.connection.send(msg)
```

# POX (Python) Example - adding a flow to a switch

```
# create a message that will add a "flow" rule to a switch (eg: always send x to y)
msg = of.ofp_flow_mod()

# indicate in the message what messages will be subject to this rule (any packets
that come in on a defined inPort)
Msg.match.in_port = inPort

# append action indicating what port that packets will be sent on as part of the rule
msg.actions.append(of.ofp_action_output(port =outPort))

# send the command to the switch
event.connection.send(msg)
```

# Additional Resources

- On Canvas:
  - Video Recordings:
    - How to setup the VM
    - How to setup/run the POX controller
- Additional Materials in the assignment zip
  - Some getting started documents
    - With outside references too
  - Skeleton code provided

# Advice

- Start early, if you wait it increases the chances of losing points on small stuff
- There are many hurdles to this that may trip you up, ask about them early, and explore them early
  - Setting up the VM may be difficult for some
    - SSH and SCP may be a challenge
  - Running Mininet's CLI may be a challenge
  - Building and running the POX/Floodlight code may be difficult