

# CS168 Routing Simulator Guide (Fall 2014)

## 1 File Layout

The simulator is organized thusly:

`run.py` - Starts up the simulator.

`sim/core.py` - Inner workings of the simulator. Keep out.

`sim/api.py` - Parts of the simulator that you'll need to use (such as the `Entity` class). See `help(api)`.

`sim/basics.py` - Basic simulator pieces built with the API. See `help(basics)`.

`sim/topo.py` - You can use this to create your own topologies/scenarios. See `help(topo)`.

`scenarios/*.py` - Test topologies and scenarios for you to use. See `help(scenarios)`.

`tests/*.py` - Test scripts for you to use. Your submitted implementation must pass the compatibility test.

## 2 Running the Simulator

To start the simulator, run `run.py` to interact with the simulated network:

```
$ python run.py
```

This spouts some informational text, and gives you a Python interpreter in the terminal. From the interpreter in the terminal, you can run arbitrary Python code, can inspect and manipulate the simulation, and can get help on many aspects of the simulator.

As `run.py` comes, it simply creates a test scenario (mostly this just means a topology) and starts the simulator. You may wish to modify it to load a different scenario (including a custom one). In particular, you can modify the scenario on [line 22](#), and the switches used in the network on [line 15](#). By default, the simulator will load a 'linear' scenario (two hosts connected by a single hub) with a Hub switch that just forwards between the two.

To change the scenario and switches imported by the simulator, find the lines that define "`switch`" and "`scenario`" and edit them, e.g.,

```
#from hub import Hub as switch
from dv_router import DVRouter as switch
#import scenarios.linear as scenario
import scenarios.candy as scenario
```

This essentially switches the default Hub switch to your DVRouter, and switches the linear topology into a candy topology. You can see the source code for the Hub switch in `hub.py`, and the source code for the scenario in the `scenarios/` directory.

The scenarios in the scenario directory each contain a `create()` method. You might want to look at these. They create the topology that goes with the scenario. The included ones can be run with an arbitrary switch class, so you can easily set them up using a hub, a leaning switch, your distance vector switch, etc.

From the simulator's commandline, you have access to all the `Entities` created in your scenario, and you can interact with these. For example:

```
>>> start() ← make sure you don't forget this.
>>> h1.ping(h2)
```

To get started, we suggest you play around with the default scenario and default switches and make sure you understand how to send pings between hosts, add `DEBUG` messages to the log, and understand the `DEBUG` messages printed by default to the log viewer.

## 3 The Log Viewer

Log messages are generally sent to the terminal from which the simulator is run. If you are using the interactive interpreter for debugging or experimentation, this can be somewhat irritating. You can disable these by editing `run.py` – towards the top, there is a line: `#_DISABLE_CONSOLE_LOG = True`.

If you uncomment this line (by removing the '#'), you will no longer see log messages on the terminal. Of course, those log messages can be really quite helpful, and you might want to see them. To rectify this, there is a standalone log viewer – `logviewer.py`. Run this along with the simulator as:

```
$ python logviewer.py & python run.py
```

Executing this program should opens a new window where you'll see `DEBUG` messages output by the hosts and switches in the simulated network.

## 4 Implementing Entities

Objects that exist in the simulator are subclasses of the `Entity` superclass (in `api.py`). These have a handful of utility functions, as well as some empty functions that are called when various events occur. You probably want to handle at least some of these events! For more help try `help(api.Entity)` within the simulator. You might also want to peek at `hub.py`, which is a simple `Entity` to get you started.

### 4.1 Sending Packets

Entities can send and receive packets. In the simulator, this means a subclass of `Packet`. See `basics.Ping` for one such example, and see `basics.BasicHost` to see an example of how it is used. In the default simulation (a linear topology with a hub), try `h1.ping(h2)` to start.

## 5 Building Your Own Scenarios

To check the correctness of your router implementation, we strongly recommend you to build scenarios that are talked about in the lectures and sections. You might also want to build additional scenarios to cover test cases that are not covered. In a customized scenario, you can use your own topologies, and test your own events (such as nodes joining and leaving the network) within those topologies. The simulator should come with some (in the scenarios directory) to get you started.

To start building your own scenario:

```
>>> import sim.topo as topo
```

The first step is simply creating some `Entities` so that the simulator can use them. You shouldn't create the nodes yourself, but rather let the `create()` function in `core` do it for you, something along the lines of:

```
>>> MyNodeType.create('myNewNode', MyNodeType, arg1, arg2)
```

That is, you **don't** want to use normal Python object creation like:

```
>>> x = MyNodeType(arg1, arg2) # Don't do this
```

`create()` returns the new entity, and all entities that you create are added to the `sim` package. So you can do:

```
>>> import sim
>>> x = MyNodeType.create('myNewNode', arg1, arg2)
>>> print sim.myNewNode, x
```

which will show the new `Entity` twice.

To link this to some other Entity:

```
>>> topo.link(sim.myNewNode, sim.someOtherNode)
```

You can also unlink it, or disconnect it from everything:

```
>>> topo.disconnect(sim.myNewNode)
```

To see the connections on a given Entity:

```
>>> topo.show_ports(sim.someNode)
```

this shows how the ports on some node are connected to other nodes and their ports.

## 5.1 Build you own tests

Test script is a way to automate the testing process, and some people might like it better than interactive debugging. We do provide some examples under `tests/`. To run a test, simply execute it from the project home folder. For example, to run the compatibility test:

```
$ python tests/compatibility_test.py
```

The other test we provide simulates a big network with multiple failures. You can take parts of the source code and construct your own tests.

## 6 Your Components

As discussed in the problem statement, you will be responsible for implementing two subclasses of the `Entity` superclass. Some important functions from `Entity` are as follows (feel free to poke around in the source, but knowing these should be sufficient to implement your subclass):

```
class Entity(__builtin__.object)
    handle_rx(self, packet, port)
        Called by the framework when the Entity self receives a packet.
        packet - a Packet (or subclass).
        port - port number it arrived on.
        You definitely want to override this function.

    send(self, packet, port=None, flood=False)
        Sends the packet out of a specific port or ports. If the packet's
        src is None, it will be set automatically to the Entity self.
        packet - a Packet (or subclass).
        port - a numeric port number, or a list of port numbers.
        flood - If True, the meaning of port is reversed - packets will
        be sent from all ports EXCEPT those listed.
        Do not override this function.

    get_port_count(self)
        Returns the number of ports this Entity has.
        Do not override this function.

    set_debug(self, *args)
        Turns all arguments into a debug message for this Entity.
```

`args` - Arguments for the debug message.  
*Do not override this function.*

The `Packet` class contains four fields and a function that you should know:

```
class Packet(object)
    self.src
    The origin of the packet.

    self.dst
    The destination of the packet.

    self.ttl
    The time to live value of the packet.
    Automatically decremented for each Entity it goes.

    self.trace
    A list of every Entity that has handled the packet previously. This is
    here to help you debug.
```

## 7 Visualization

Finally, the simulator includes a graphical user interface. **THIS IS MOSTLY UNSUPPORTED.** But if you want to play with it, check it out: NetVis is a visualization tool for the network simulator. It is written using Processing, which is basically framework for writing visualization tools in Java (with some nice shortcuts).

You should have received NetVis executables for Linux, Mac OS, and Windows. Provided you have Java installed (which should always be the case on Macs, but not necessarily on the other two), these will hopefully all just run.

If you have trouble running the GUI, the most likely explanation is that you don't have Java installed. You might try installing it. Alternately, you could install Processing (a straightforward download from [processing.org](http://processing.org)) and copy the NetVis workbook folder into your Processing projects folder.

Entities, links, and packets in your simulator should show up automatically in NetVis. Generally these try to position themselves automatically. You can also "pin" them in place, by clicking the attached bubble. You can zoom in and out, as well as altering some of the layout forces using options in the "adjustments" panel (click on it to open it).