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Dipartimento di Ingegneria
Computer Networks Research Group

Kathará

A container-based framework for experimenting computer networking

Version	1.0
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Description	an introduction to the architecture, setup, and usage of kathará – based on a similar presentation of netkit

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about computer networks

- computer networks are quite complex
  - several devices (computers, routers, etc.)
  - several interfaces
  - several protocols running
  - physical interconnections originate complex topologies

how to perform experiments?

- performing experiments may be unfeasible
- the currently used network cannot be exploited for experiments
  - it hosts services that are critical for the company
  - it would be necessary to coordinate different departments of the company
- network equipments are expensive
  - sometimes, even for performing simple experiments, several equipments should be available in the same test bed

simulation vs. emulation

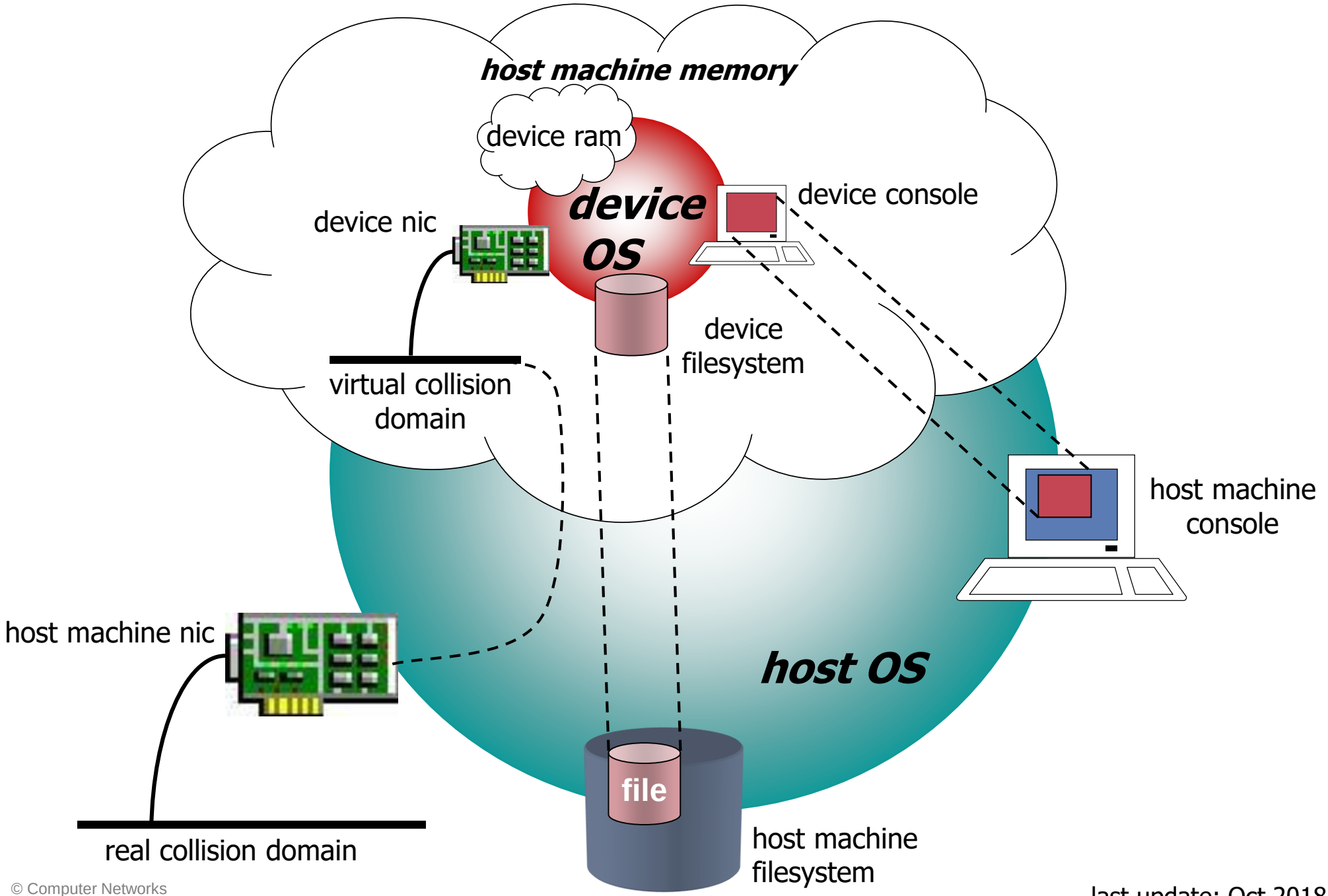
- emulation and simulation systems put at user's disposal a virtual environment that can be exploited for tests, experiments, measures
- simulation systems aim at reproducing the performance of a real-life system (latency time, packet loss, etc.)
  - e.g.: ns, real, …
- emulation systems aim at accurately reproducing the functionalities of a real-life system (configurations, architectures, protocols), with limited attention to performance

kathará: a system for emulating computer networks

- based on Docker
- each emulated network device (in what follows *device*) is a container
- note: several container images available, e.g.:
  - Quagga (standard routing and switching protocols) and Open vSwitch (Open Flow enabled switch)
  - Behavioral Model (software implementation of a P4 target switch)

emulated network devices

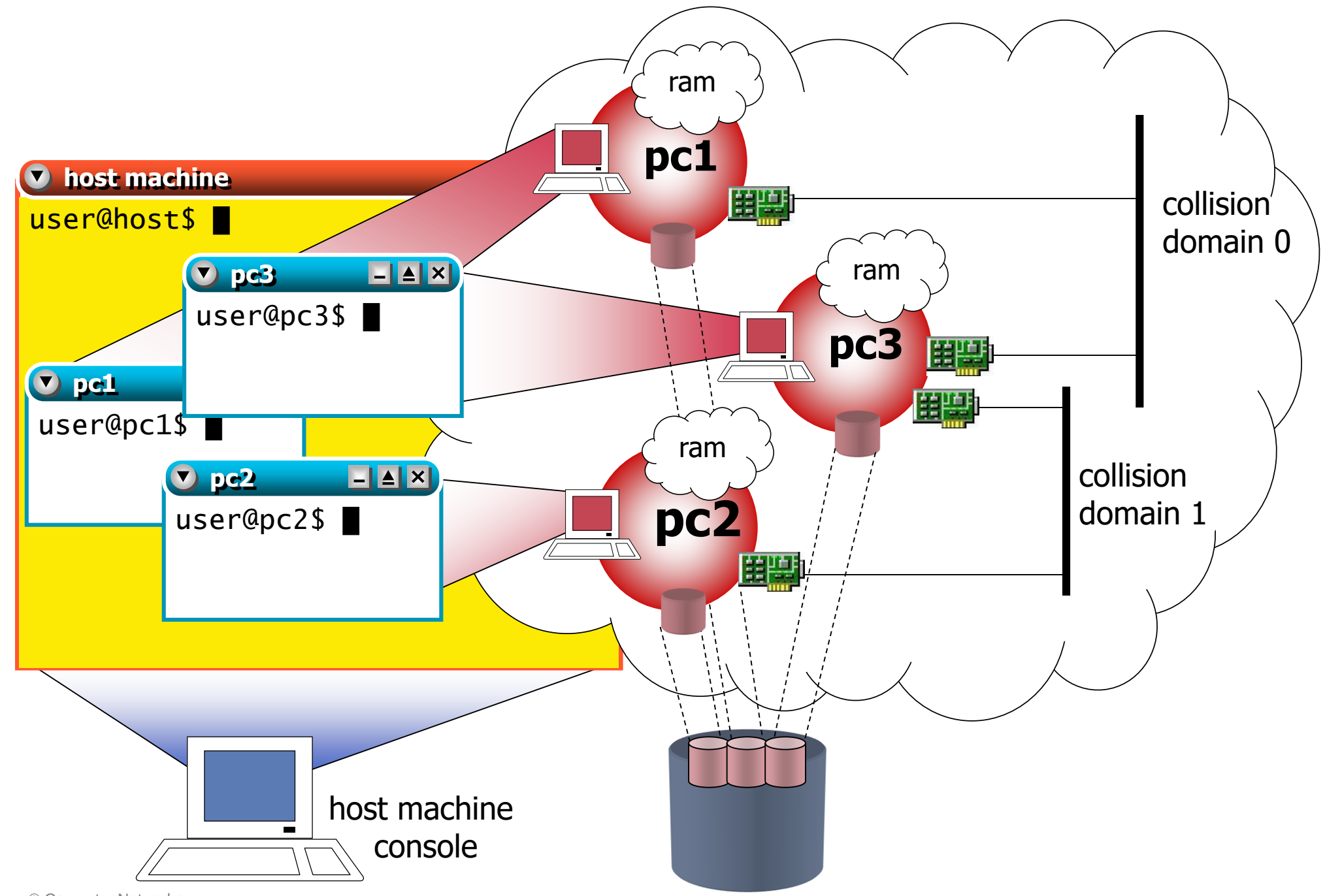
- each device has:
  - a console (a terminal window)
  - a memory
  - a filesystem
  - (one or more) network interfaces
- each network interface can be connected to a (virtual) collision domain
- each virtual collision domain can be connected to several interfaces



last update: Oct 2018

emulating a computer network using kathará

- basic idea:
  - several containers are created inside a single host machine
  - containers are connected to virtual collision domains and thus can communicate with each other
- each container can be configured as a device that plays the role of a regular host, of a router, of a switch, ….



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setting up kathará

setting up kathará

- available for:
  - Windows 8 Pro, Windows 10 Pro
  - Linux
  - MacOS
- download at http://www.kathara.org/
- follow the wiki

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using kathará

kathará commands

- kathará provides users with two sets of commands
  - v-prefixed commands (v-commands)
  - l-prefixed commands (l-commands)
- v-commands act as low level tools for configuring and starting up devices
- l-commands provide an easier-to-use environment to set up complex labs consisting of several devices

kathará v-commands

- allow to startup devices with arbitrary configurations (network interfaces, etc.)
  - vstart: starts a new device
  - vlist: lists currently running devices
  - vconfig: attaches network interfaces to running device
  - vclean: gracefully halts a device cleaning the device disk

kathará l-commands

- ease setting up complex labs consisting of several virtual machines
  - lstart: starts a kathará lab
  - lclean: gracefully halts all the devices of a lab cleaning the device disks
  - lwipe: gracefully halts all the devices OF KATHARÁ cleaning the device disks
  - linfo: provides information about a lab without starting it
  - ltest: allows to run tests to check that the lab is working properly

accessing the "external world" from a device

the directory **`/hosthome`** inside a device directly points to the home directory of the current user on the real host

- read/write access is allowed

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preparing a kathará lab

kathará lab

- a kathará lab is a set of preconfigured devices that can be started and halted together
- a standard kathará lab is a directory tree containing:
  - a lab.conf file describing the network topology
  - a set of subdirectories that contain the configuration settings for each device
  - .startup and .shutdown files that describe actions performed by virtual machines when they are started or halted

lab.conf

- this file describes
  - the settings of the vms that make up a lab
  - the topology of the network that interconnects the vms of the lab
- list of **`machine[arg]=value`** assignments
  - **`machine`** is the name of the vm (e.g., **`pc1`**)
  - if **`arg`** is an integral number (say ***`i`***), then **`value`** is the name of the collision domain to which interface **`eth`*`i`*** should be attached
  - if **`arg`** is a string, then it must be the name of a **`vstart`** option and **`value`** is the argument (if any) to that option

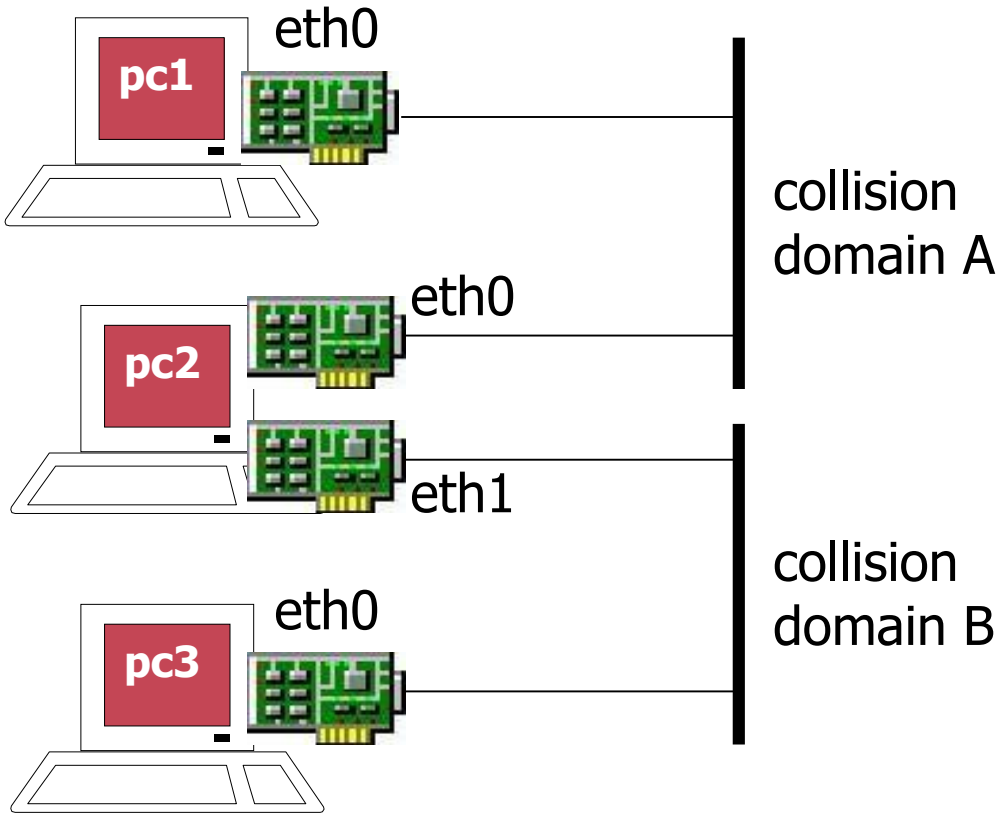
lab.conf

- example

```
pc1[0]=A

pc2[0]=A
pc2[1]=B

pc3[0]=B
```



lab subdirectories

- kathará starts a device for device specified in lab.conf
- the contents of subdirectory **`vm`** are mapped (=copied) into the root (**`/`**) of **`vm`**'s filesystem
  - for example, **`vm/foo/file.txt`** is copied to **`/foo/file.txt`** inside virtual machine **`vm`**

startup files

- shell scripts that tell virtual machines what to do when starting up
- they are executed inside virtual machines
- a typical usage of a **`.startup`** file is to configure network interfaces and/or start network services

```
ifconfig eth0 10.0.0.1 up
/etc/init.d/zebra start
```

- sample of **`vm_name.startup`**

launching/stopping a lab

- enter the lab directory (**`cd lab_directory`**)
- ***`lcommand`***
  - where ***`lcommand`*** can be one of the following:
    - **`lstart`**, to start the lab
    - **`lclean`**, to stop the lab

more information

- further information can be found…
  - …on GitHub's kathará wiki
  - …on the web site http://www.kathara.org/