

The EPFL logo, consisting of the letters 'EPFL' in a stylized, bold, black font.

ÉCOLE POLYTECHNIQUE
FÉDÉRALE DE LAUSANNE

TCP/IP Networking

Jean-Yves Le Boudec
2018

Understanding what's behind TCP/IP

A computer terminal screen with a black background and green text. The text reads 'TO START' on the first line and 'PRESS ANY KEY' on the second line. The terminal is part of a larger computer system with a keyboard and a mouse visible below it.

Your Team

Lecturer: J.-Y. Le Boudec

Teaching Assistants

Roman Rudnik (head TA and webmaster)

Ehsan Mohammadpour (cameraman and quizmaster)

Dr. Arpan Mukhopadhyay

Dr. Eleni Stai

Dr. Jagdish Achara

Cong Wang

Marguerite Delcourt

Whom is this course for ?

Master students in electricity, communication systems and computer science, all branches of engineering

Requirements

Experience with using one programming language

No prior knowledge of TCP/IP is required

We will practice with computers in a virtual environment – expect to spend time on your computer

The RAKE philosophy

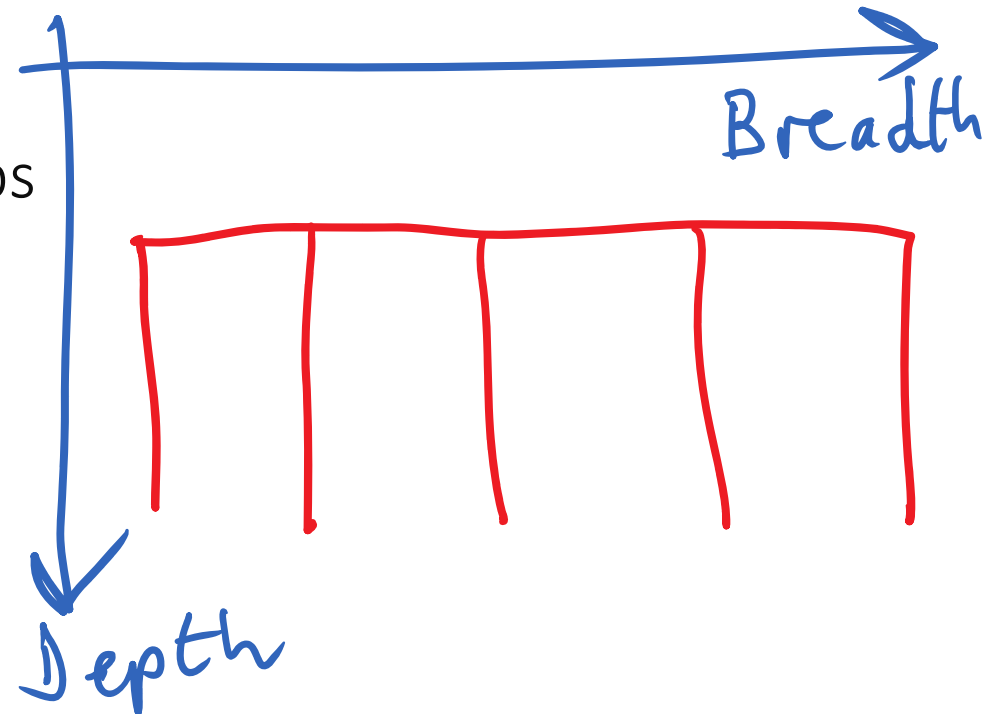


Viewpoint 1 :« I want this course to teach me all the details of all networking protocols »

Viewpoint 2: « TCP/IP is a mountain of details, I will learn when and if the need arises »

We will use the RAKE philosophy

- Depth by a few carefully selected labs
- Breadth by systematic concepts



What, Why, How

I will try and teach you to always ask first

Why was this stuff invented, what problem is it solving ?

What is it doing?

before asking:

How does it do its job ?

The why and what are short.

The how is long but can often be guessed once you understand the why and what.

Wikipedia is good at how, often less good at what and why

Organization of the course

Lecture
Every week
12:15-14:00
CM 2

Test (quiz) on
weeks 2,4,6,8,10,12,14
11:15-11:30 INF 1

Final exam
Winter exam
session

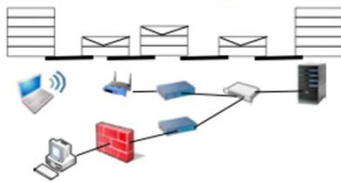
Lab
Every week
Friday
11:15-13:00 INF1

or
(extra session)
Tuesday
16:00-18:00 INF019

Courseware

“Computer Networking : Principles, Protocols and Practice”
version 1 or 2, by O. Bonaventure, open source textbook,
<http://inl.info.ucl.ac.be/CNP3>

Computer Networking
Principles
Protocols
and
Practice



Rate adaptation, Congestion Control and Fairness: A Tutorial

JEAN-YVES LE BOUDEC
Ecole Polytechnique Fédérale de Lausanne (EPFL)

Module 2: “Rate adaptation, Congestion Control and
Fairness: A Tutorial” by JY Le Boudec, on moodle and on the
web http://ica1www.epfl.ch/PS_files/LEB3132.pdf

On Moodle

Enrolment automatic after course registration
slides, lab and research exercise

TCP/IP LABS

ROMAN RUDNIK

Labs

A total of 7 labs (lab 0 to lab 6)

Labs are mandatory and graded

Main slot for labs is on **Fridays from 11:15 to 13:00**

Extra lab slot on **Tuesdays 16h-18h in INF019** – Internet Engineering Workshop

Bring your own PC

You work **in groups of 2**

One written report per group

Fill in the answers **directly** in the assignment PDF file

(Use Adobe Reader XI, not all PDF readers support saving forms)

Upload it on Moodle

Deadline for uploading the lab report:

Given on Moodle, but typically is the week after the last session of the lab, **at 23:55, Wednesday** the day before the lecture on Thursday.

Network Emulation

We will mostly use **Mininet** to emulate the communication network in a single computer

We will give you a virtual machine with Mininet installed

- Single virtual machine for all labs.

- Python-based scripting

To play a bit with real (small) network, we let you manipulate a small network we setup for you in INF 019 in Lab 2

Some labs require a public IPv6 address for your computer

- If you don't have one at home, you can use the **Ica2-tcpip-labs** WiFi AP (in or around INF 019) that provides **both IPv4 and IPv6 addresses** via DHCP(6)

You will need access to INF 019 **Access to INF019 (IEW)**

Lab2 will require access to do some network manipulation

You can access any time of the day and of the week (exception: maintenance periods)

What you need to do:

Go to Moodle and fill in the “Lab Rules Agreement”

You should do it before next Thursday (September 27).

We will then give you access to INF 019.

In particular:

Keep all lab material in good state and put them back after using

Watch out for mysterious activities when you are in the lab (you are responsible for lab activities during the time you are in the lab)

Respect the EPFL network rules

Lab 0 – introductory (Half-lab) **Labs 0 and 1**

Network tools on your PC

IPv4 / IPv6

Recommendation: Finish it ASAP to leave more time for lab 1

Deadline: Wed, September 26, 23h55 (in one week!)

Lab 1 – virtual environment – important for next labs!

The main objective: getting used to VirtualBox & **Mininet**

Other objectives: static network address configuration, iptables

Do it as soon as possible, things can go wrong...

Students, with no or little background in computer networks, may need to work harder to get up to the speed with others

Provision of extra slot on Tuesdays

No need to do the **optional** research exercise question in Lab 0

Organizational stuff

TAs are here to help – ask questions!

Also, Google, stackoverflow, etc. are your friend

There is a different TA in charge of each lab

... and of grading it!

Give **brief but complete** answers in the report

They should convince the grader that you really understand, without being too boring

No cheating

There have been cases in the past – just don't do it, it's embarrassing!

Labs are not very difficult, they just require some time

Slack channels

This year we are using **SLACK** to communicate

We will create **1 slack channel per lab + 1 channel for the questions about the course**

You will receive invitation on your EPFL email address

Write your question about the lab in the corresponding channel

You can also answer the questions of other students (start a thread)

Please, check if someone **already asked** question that you have

Add reaction on answer if it was useful for you (“Thumb up”)

On every lab slack channel, we will count reactions for answers, the 2 most active and helpful students will get bonus for this lab +0.25

Enjoy!



Tests

7 Tests (short quizzes)

INF1 on Fridays of even weeks 11:15-11:30 sharp

Program of test is: everything up to and including the lecture of the day before the test

Best 5 tests used for grading

No replacement if sick or other excuse

All tests are written, closed book, no electronic equipment
only one pen/pencil allowed on table



Please go to speakup.info or start
speakup app

Join room number written on board
and say in which case you are



- A. Computer Science
- B. Communication Systems
- C. Data Science
- D. Electrical Engineering, Smart Grid
- E. Electrical Engineering, other orientation
- F. Mechanical Engineering
- G. Maths
- H. Other Section

Please use speakup **ethically**
– don't abuse anonymity



Final Exam

One final exam in exam session

See last year's exams on moodle

All tests/exams are written, closed book, no electronic equipment

The "exam booklet" is allowed



Grading

$$\text{Theory Grade } T = \max(0.4 C + 0.6 F, F)$$

where C = test grade (average of best 5 tests)

F = final exam



Lab grade

$$L_i = \min(6, \text{raw lab grade} + \text{social influence bonus } (0.25))$$

$$L_{avg} = \frac{0.5L_0 + L_1 + \dots + L_6}{6.5} \quad (\text{lab0 counts as } \frac{1}{2} \text{ lab})$$

$$RE_{avg} = \frac{RE_0 + RE_1 + RE_3 + RE_4 + RE_5 + RE_6}{12}$$

where $RE_i \in [0,1]$ is the bonus at lab i (max bonus = 0.5 on scale 1-6)

$$L = \min(6, L_{avg} + RE_{avg})$$

Final grade G_1 = harmonic mean of T and L (where T and L are in scale 1-6, not rounded)

Final grade $G = \text{round}(G_1)$ where round is to the nearest quarter-integer.

All grades except G are non-rounded.

Roadmap

Module 1
Network Layer
Basics Labs
0 and 1

Module 2
Network Layer,
(advanced)
MAC layer Lab
2

Module 3
Transport layer
Socket programming Lab 3

Module 4
Single Domain
Routing, SDN Lab 4

Module 5
Traffic Control Lab 5

Module 6
Internet Routing Lab 6

Module 7
Appli, QUIC, 6-4,
Distance Vector