The iLab Experience

a blended learning hands-on course concept

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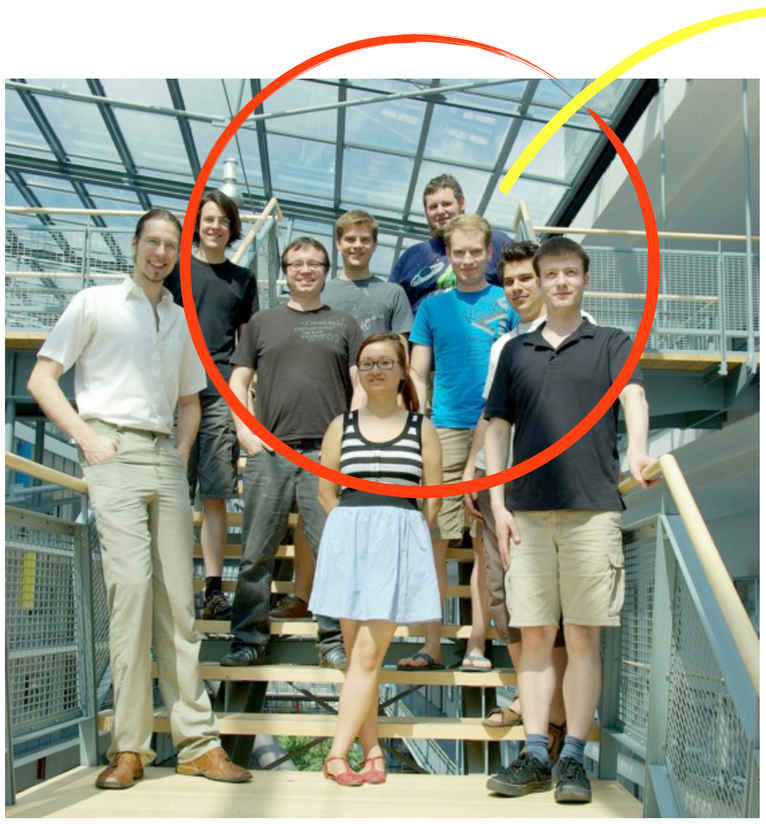
facts

- iLab (=Internet) & iLab^2 (=selected network architectures and services)
- Bachelor and Master Level hands-on lab
- 1 semester / 10 ECTS (~300h)
- over 1000 participants so far
- over 80 registrations for next semester

only possible as working with the eLearning platform scales

in short



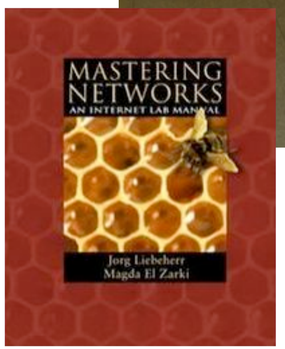
listen

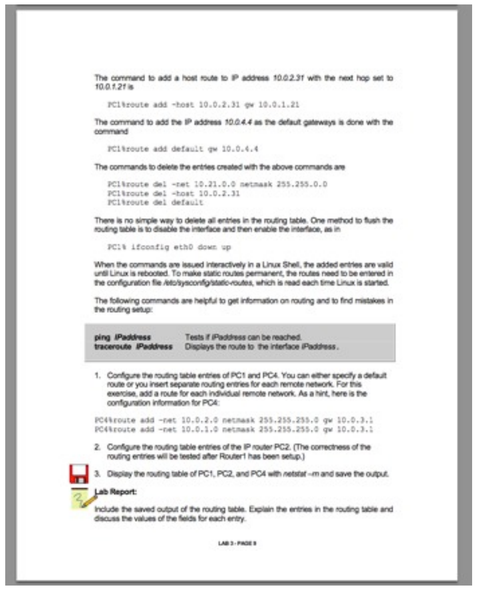
encourage

constantly improve

background

the beginning





The command to add a host route to IP address *10.0.2.31* with the next hop set to *10.0.1.21* is

```
PC1%route add -host 10.0.2.31 gw 10.0.1.21
```

The command to add the IP address *10.0.4.4* as the default gateways is done with the command

```
PC1%route add default gw 10.0.4.4
```

The commands to delete the entries created with the above commands are

```
PC1%route del -net 10.21.0.0 netmask 255.255.0.0
PC1%route del -host 10.0.2.31
PC1%route del default
```

There is no simple way to delete all entries in the routing table. One method to flush the routing table is to disable the interface and then enable the interface, as in

```
PC1% ifconfig eth0 down up
```

When the commands are issued interactively in a Linux Shell, the added entries are valid until Linux is rebooted. To make static routes permanent, the routes need to be entered in the configuration file */etc/sysconfig/static-routes*, which is read each time Linux is started.

The following commands are helpful to get information on routing and to find mistakes in the routing setup:

ping *IPaddress*	Tests if *IPaddress* can be reached.
traceroute *IPaddress*	Displays the route to the interface *IPaddress*.

1. Configure the routing table entries of PC1 and PC4. You can either specify a default route or you insert separate routing entries for each remote network. For this exercise, add a route for each individual remote network. As a hint, here is the configuration information for PC4:

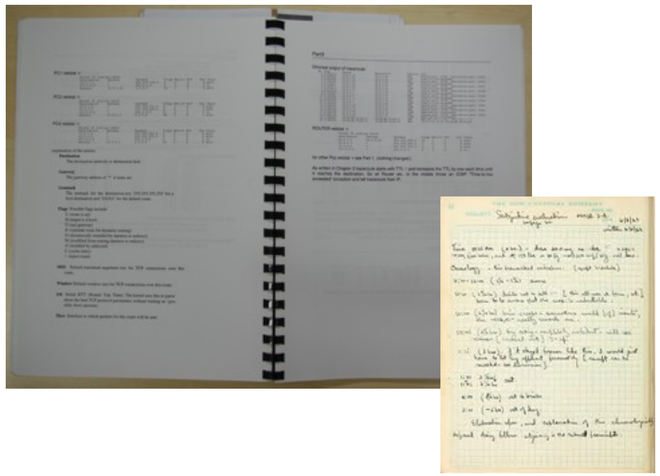
```
PC4%route add -net 10.0.2.0 netmask 255.255.255.0 gw 10.0.3.1
PC4%route add -net 10.0.1.0 netmask 255.255.255.0 gw 10.0.3.1
```

2. Configure the routing table entries of the IP router PC2. (The correctness of the routing entries will be tested after Router1 has been setup.)
3. Display the routing table of PC1, PC2, and PC4 with *netstat -rn* and save the output.

Lab Report:

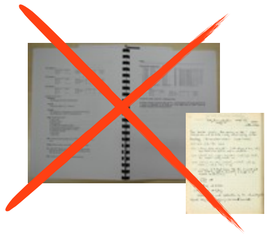
Include the saved output of the routing tables. Explain the entries in the routing table and discuss the values of the fields for each entry.

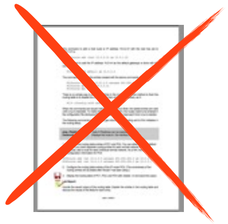
LAB 3 - PAGE 9



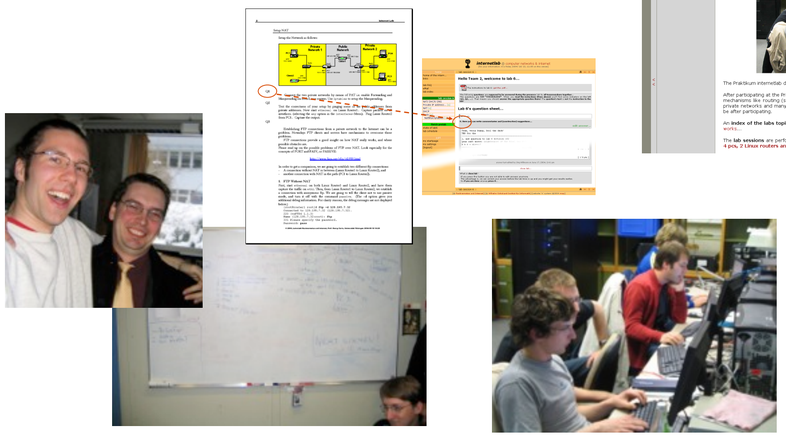
2003 Universität Tübingen: Internetpraktikum 2003

constant improvement





ilab2



ilab

internetpraktikum

part II - for master

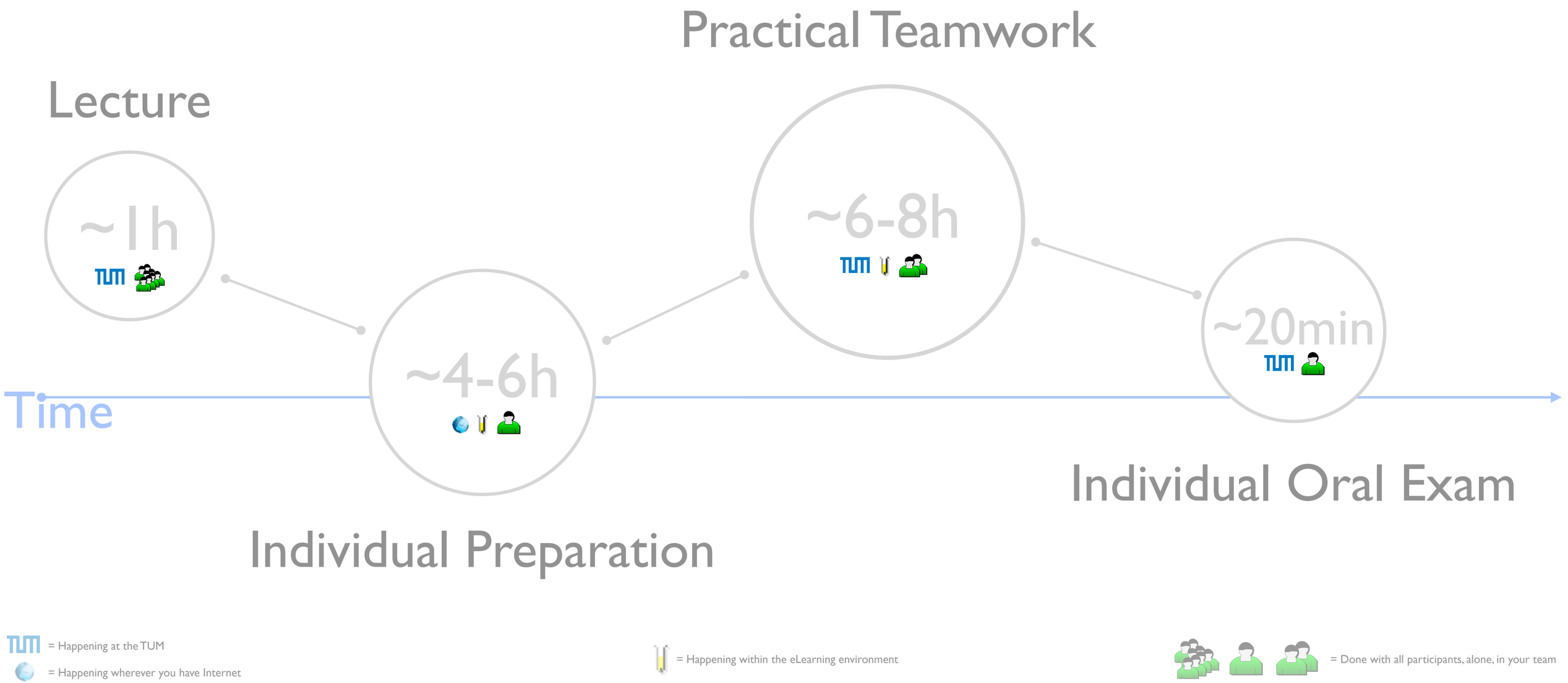
part I - for bachelor

EBERHARD KARLS
UNIVERSITÄT
TÜBINGEN

2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013

didactic concept

blended learning concept



= Happening at the TUM

= Happening wherever you have Internet

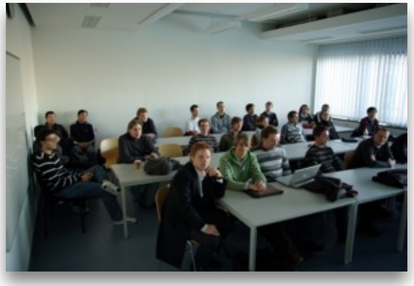
= Happening within the eLearning environment

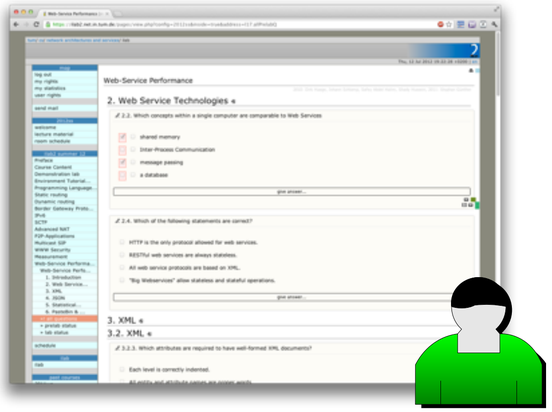
= Done with all participants, alone, in your team

eLearning support

Individual Preparation

Lecture

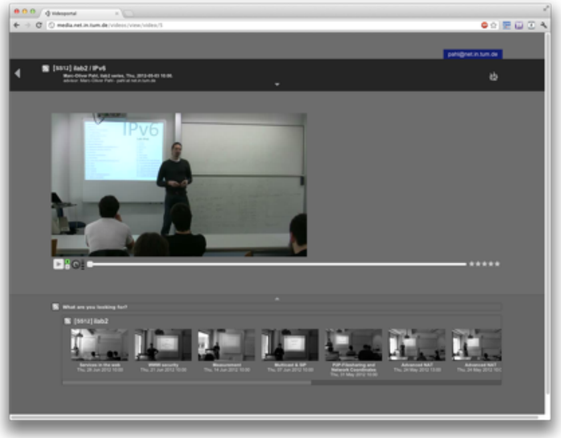




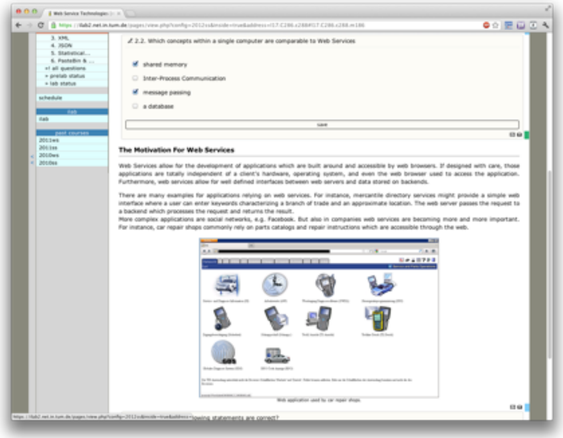
Practical Teamwork

eLearning prelab

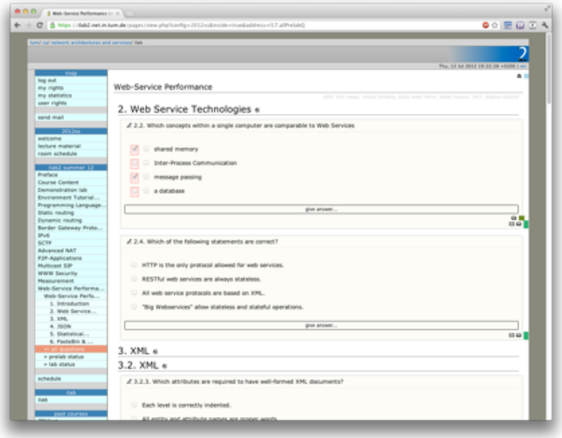
not taken into account for grading
(directly learn from errors)



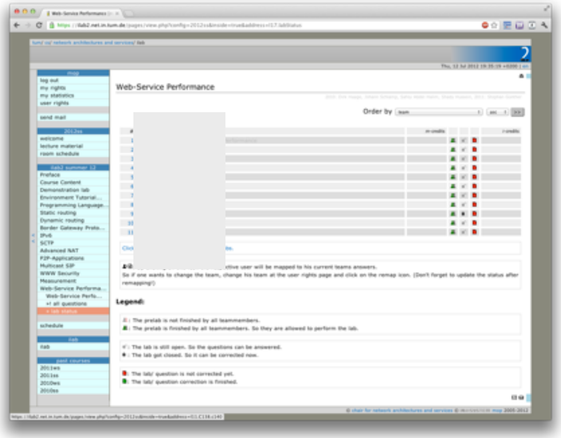
lecture recording



preparation texts



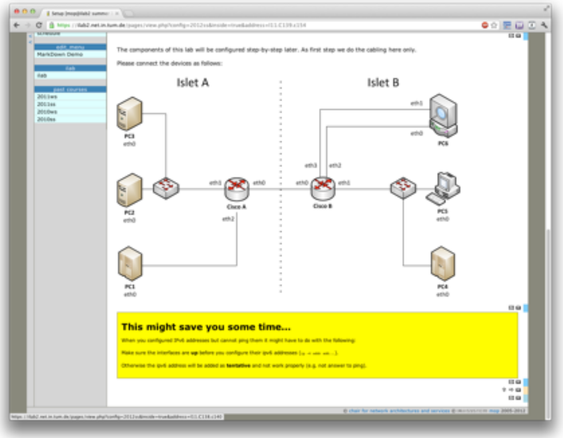
multiple-choice
motivation



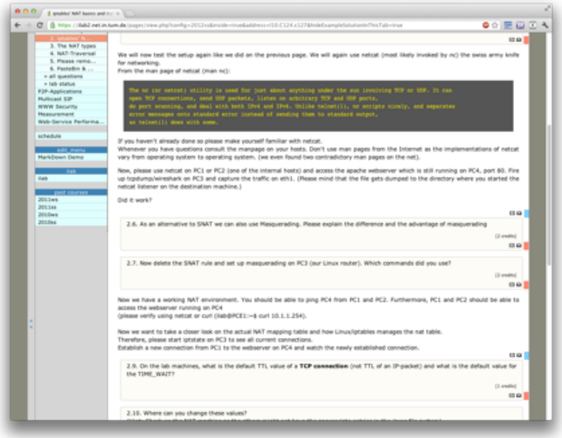
ranking +
who did not
finish?

eLearning lab

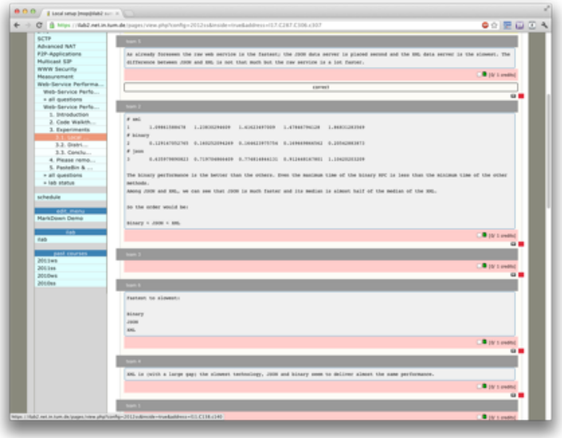
credits for grading



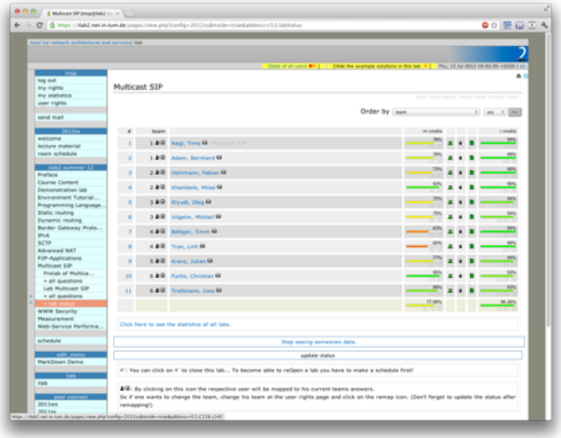
all instructions online



free text inputs inline



cross correction



course management

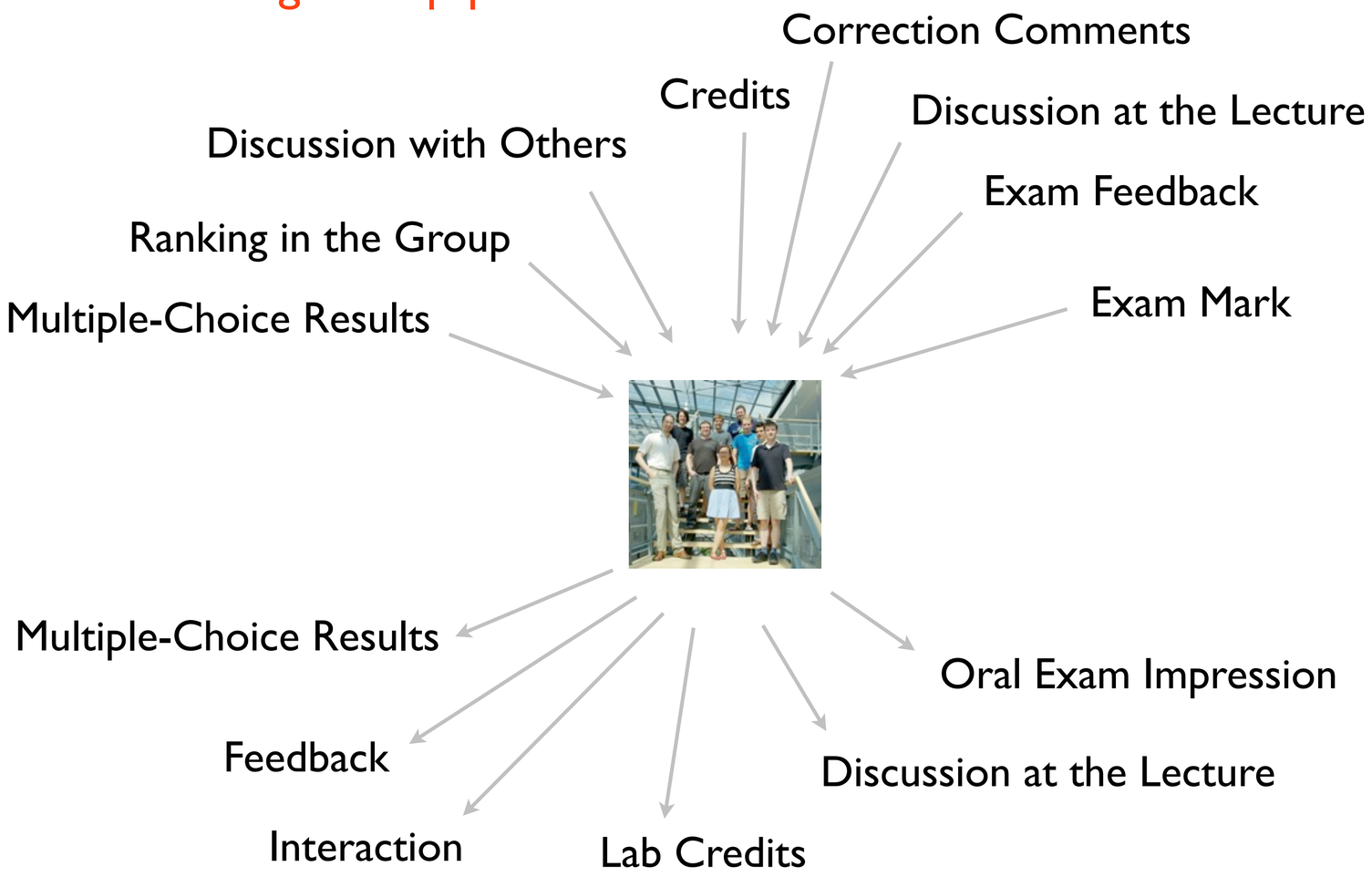
no additional reports

fast feedback

important success factors

interactivity

Self-Learning Support



Feedback is important to encourage the learners to continue learning. It is a main mean for motivation. Feedback is important for the teachers as well as it helps them to adapt to the needs of the current student group. The student feedback is continuously used to improve the exercises.

Feedback to the Teachers

frequent change

variation

in learning methods and modes

iLab

= online + live

instructions, self-correcting multiple-choice questions, free text inputs, course management, mail support, chat

lecture, hands-on, discussion

iLab

= group + individual + team

lecture

self-preparation

hands-on

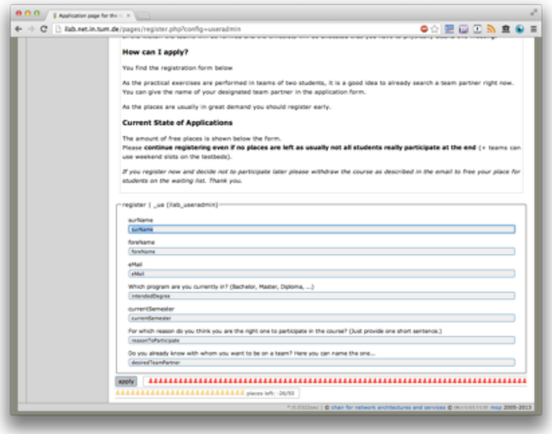
teamwork

you are not alone

learning from and supporting the team mate

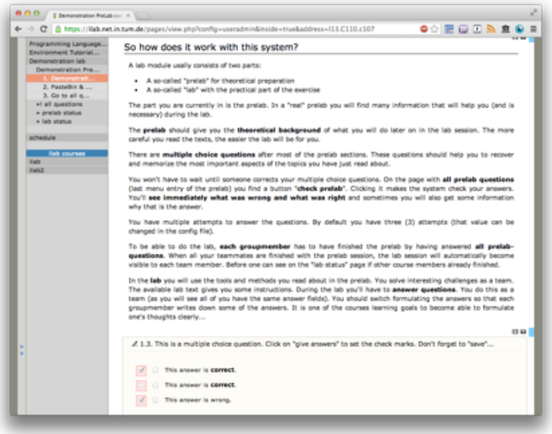
further encouragement

eLearning registration

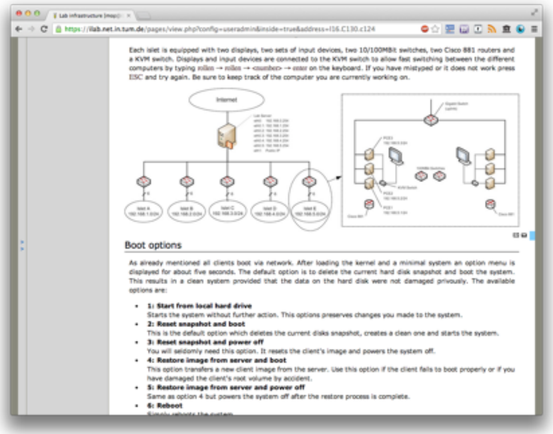


registration

immediate access



tutorials web-based labsystem



tutorials environment / basic tools

feel at home

topics

a **Demonstration lab** - This lab module makes you familiar with the web-based learning system and the didactical principles behind the course.
b **Cisco IOS Tutorials** - This tutorial give an introduction into the programming languages used in iLab2 (C, Java, Python). It also introduces the basics of Cisco IOS.
c **Environment Tutorial Lab Room** - This tutorial introduces the lab room environment.

0 **The basics** - Our main concern in the first lab exercise is to get familiar with the basic tools we are using. You'll have a look at Linux' network capabilities experimenting on Layer 2 and 3 of the ISO-model.

1 **Static routing** - Continuing on Layer 3 we have a deeper look into IP-Routing.

2 **Dynamic routing** - On our journey towards the "real Internet" we learn how automatic routing works inside the different domains of the net.

3 **TCP/ UDP** - After looking at IP fragmentation, we climb up one Layer to Layer 4: The end-to-end-communication is of our interest now.

4 **DNS** - Most of the time we address machines using names instead of (IP-)numbers... but how does the Domain Name System work? After this lab you should know exactly what happens, when you type http://ilab.net.in.tum.de into your browsers url-field...

5 **NAT/ DHCP/ IPv6** - Coming closer to our home setup we look inside Network Address Translation as technique to use one external address to allow multiple intern machines to access the Internet. NAT is especially important today since we are getting out of Ipv4 addresses. Besides ist usefulness NAT causes some trouble as we will see. Another important mechanism is Dynamic Host Control Protocol allowing computers to be partly automatically configured. As the migration towards Ipv6 is ongoing and since the new protocol provides intersting mechanisms we have a look at it here.

6 **Security I** - In this lab we get to know how Firewalls help to secure our network-nodes. As example we use a webserver using TLS.

7 **Security II** - How can we establish secure connections over insecure networks?

8 **Wireless LAN** - Often used but how is it really working? We address physical aspects as well as protocol aspects before we come to security. We will explore how fast we can crack a WEP-Key and more important why. We will look at WPA and Radius for a more secure wireless infrastructure.

a **Environment Tutorial Lab Room** - This tutorial introduces the lab room environment.
b **Programming Language and Cisco IOS Tutorials** - This tutorial give an introduction into the programming languages used in iLab2 (C, Java, Python). It also introduces the basics of Cisco IOS.
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0 **Dynamic routing** - On our journey towards the "real Internet" we learn how automatic routing works inside the different domains of the net.

1 **Border Gateway Protocol** - This lab is about the Border Gateway Protocol (BGP) that is used for routing between Autonomous Systems (AS). You will learn about the power of the system and the risks of configuration errors...

2 **IPv6** - In this lab different features of IPv6 are examined: Autoconfiguration, DHCPv6, NAT64, Fragmentation, and Dual Stack implementation. Additionally a DNS Server running with IPv6 and IPv4 addresses and automatic Zone transfer is configured.

3 **SCTP** - You will get to know the features of SCTP realizing a video streaming example.

4 **Advanced NAT** - You will explore advanced NAT traversal techniques in this exercise.

5 **WWW Security** - In this lab, you are going to investigate some of the most important security challenges on the WWW. You will hack a Web server using a number of attack techniques, working your way through SQL Injection, Cross-Site Scripting and Remote Code Execution until you gain shell access to the server and can manipulate the file system.

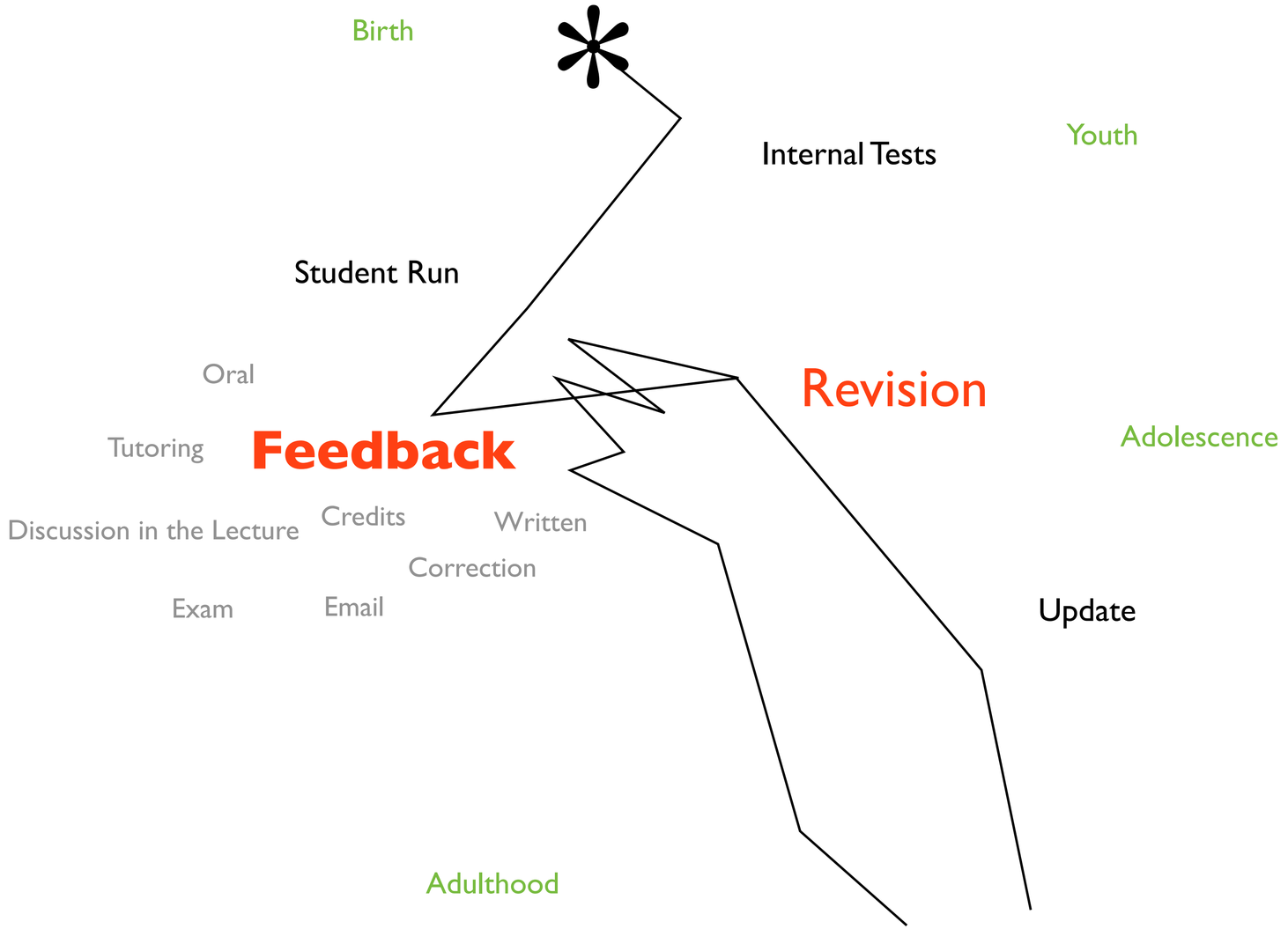
6 **Multicast SIP** - In the first part of this PreLab you will learn about IP Multicast and the protocols used by it, IGMP and PIM. The second part is about SIP, the Session Initialisation Protocol, and how it is used, both in voice over IP and other applications.

7 **Measurement** - This lab is about passive traffic measurements and the export of measurement data from a monitoring probe to a remote traffic analyzer using the IPFIX protocol.

8 **Advanced Wireless LAN** - Defend my wireless territory - Do you have problems with overcrowded frequency bands for WLAN? The ilab2 can help you!
This lab will address multiple aspects of WLAN, focusing on the protocol, especially on management and its flaws.

9 **Smart Space Orchestration** - Physical spaces that are enriched with networked sensors and actuators are called smart spaces. In this exercise you will build your own smart device, write a protocol for communicating with it, write a driver that connects your device with the ds2os middleware, and create user application services that orchestrate your space using your device.

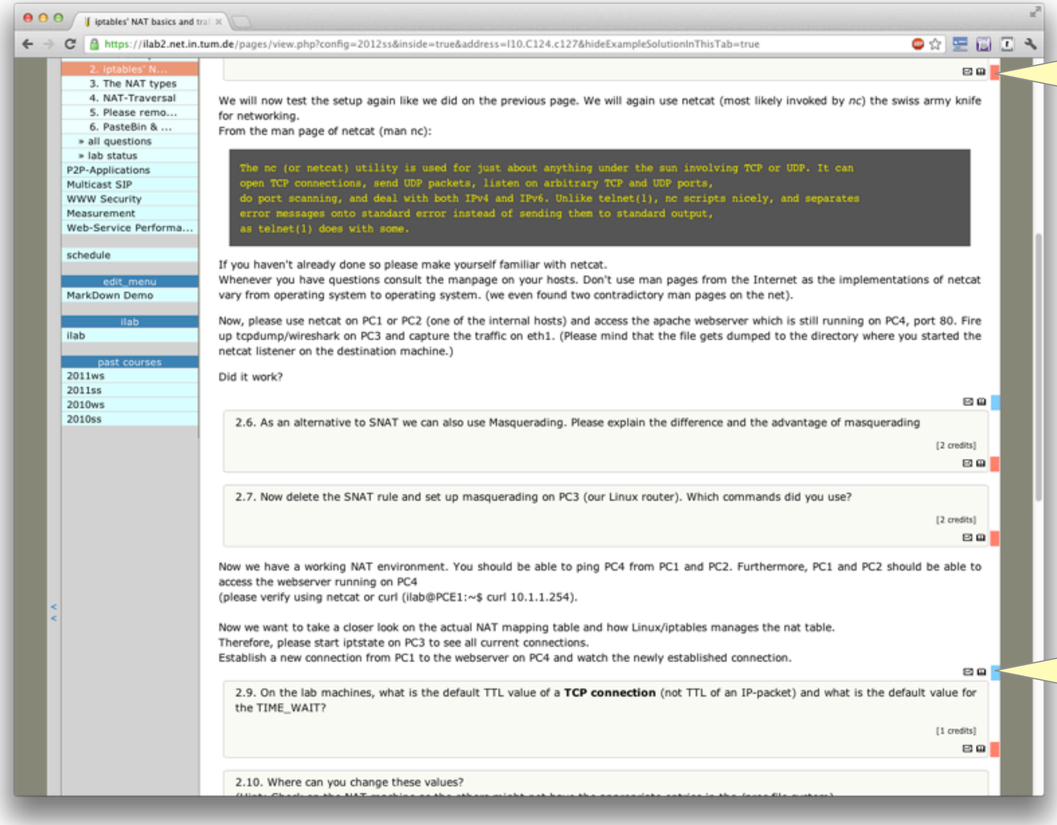
continuous evolution



iLab exercises grow from continuous exchange. Exchange within the group of learners and between the students and the professors. The iLab encourages to exchange wherever possible. It is an important element of the success of the concept.

outlook

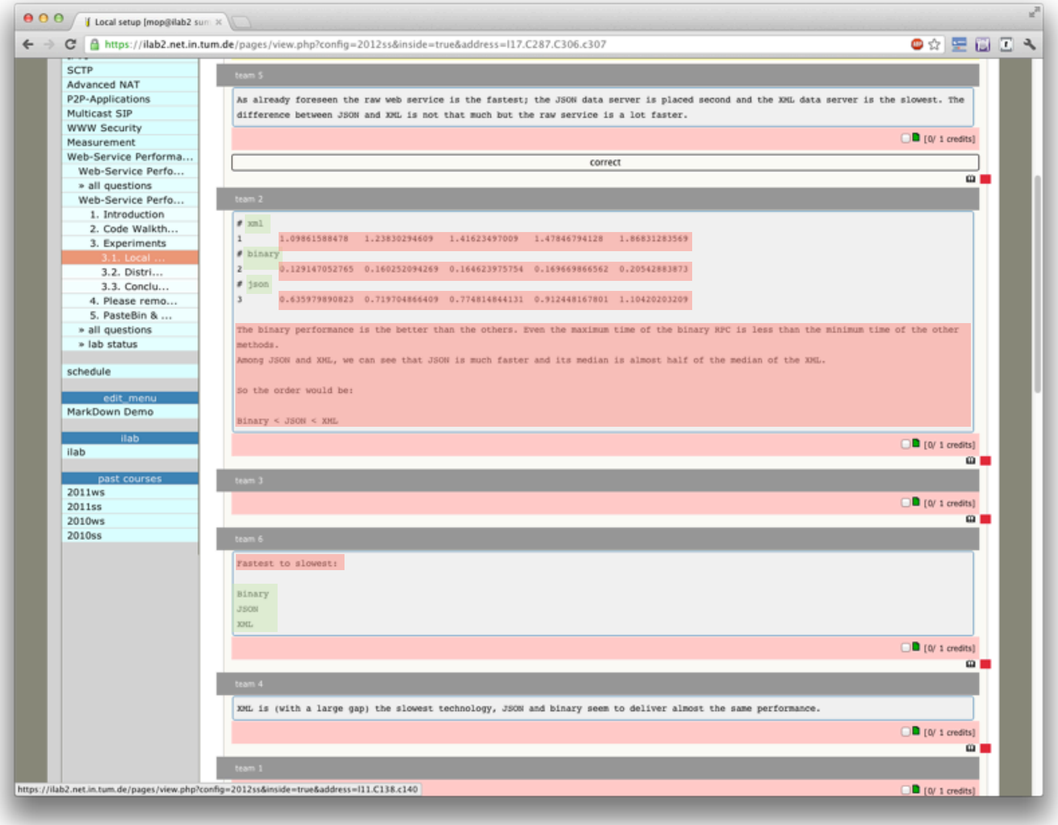
context related chat



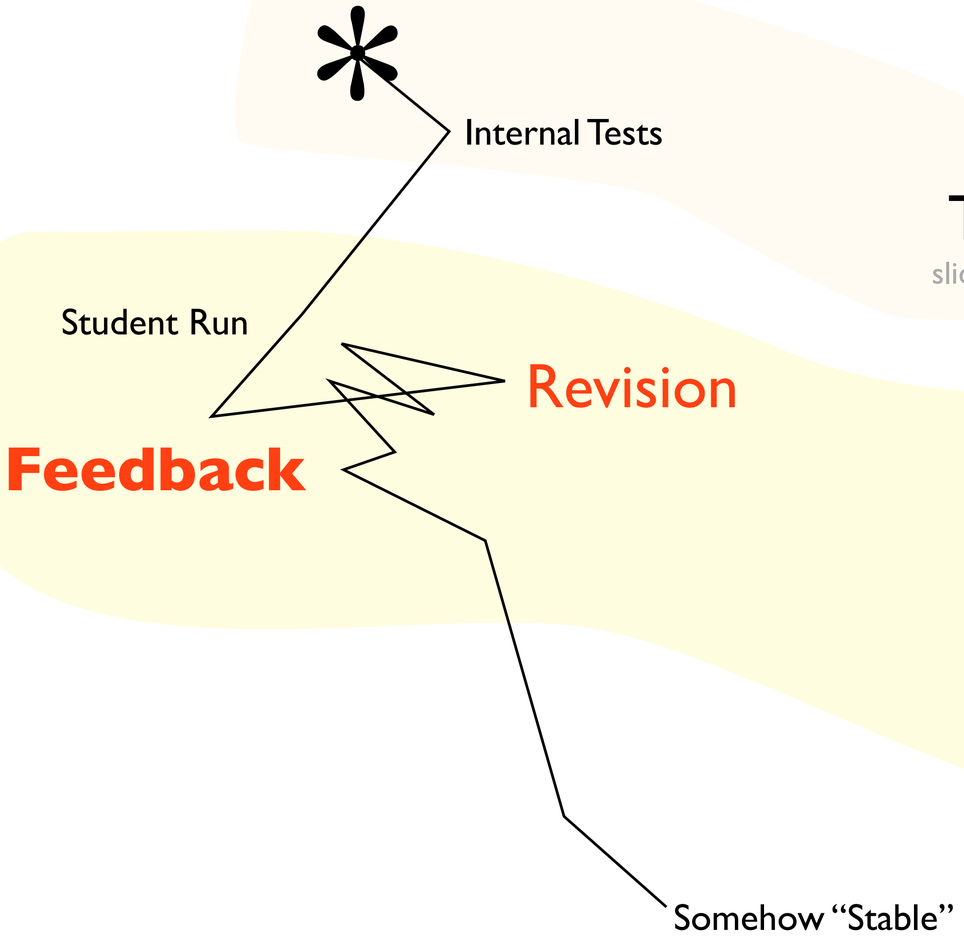
mop> do not forget to look at the routing table of PC4 here!
u> good point :)

jan> Did anyone get this running?
silvie> sure. Though we had to resetup. Probably we had a bug. Maybe you have a similar problem.

automatic diffs in correction



create your own exercise



~1h

Introductory Lecture

didactic concept | authoring tutorial | topic selection | assignment review teams

~10-12h

Team Prepares Exercise

slides for talk | prelab | lab | slides | tutor support

~2h

Intermediate Presentation

presentation | feedback | quality alignment

~10-12h

Review & Update

review team feedback | revision

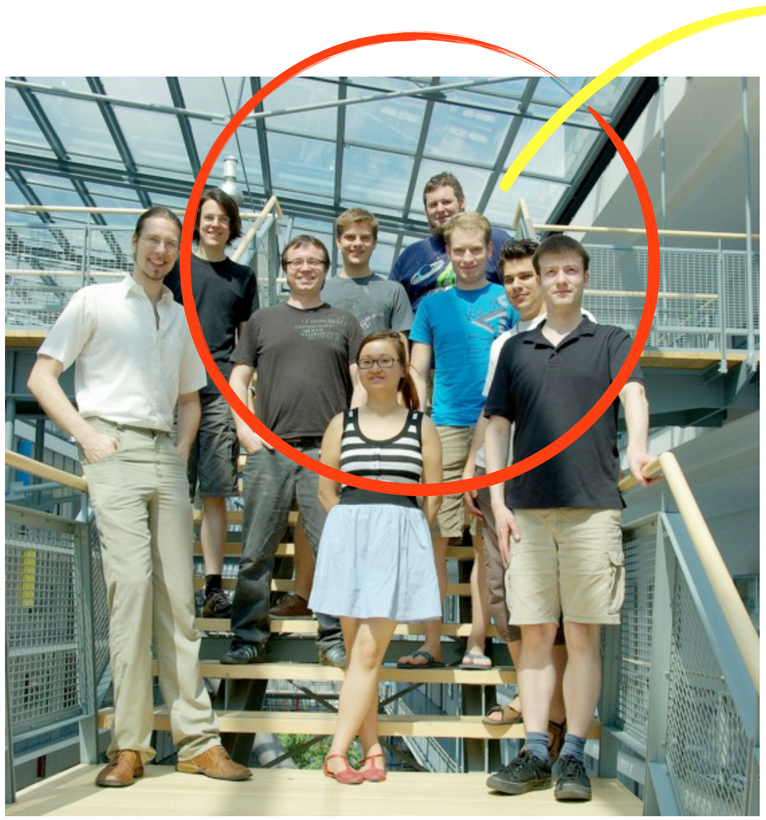
~2h

Final Presentation

how is it now | what did you change/ learn | your take home?

summary

in short



listen

variation: online + live
team work + individual
+ group

feedback

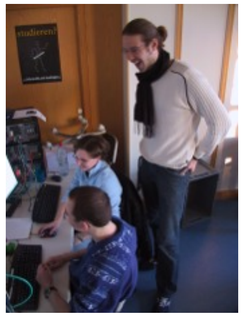
encouraging
environment

encourage

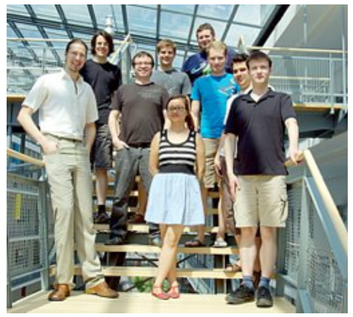
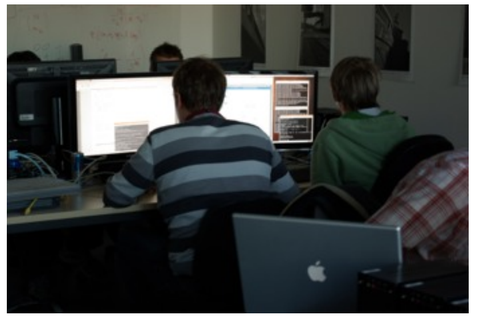
constantly improve

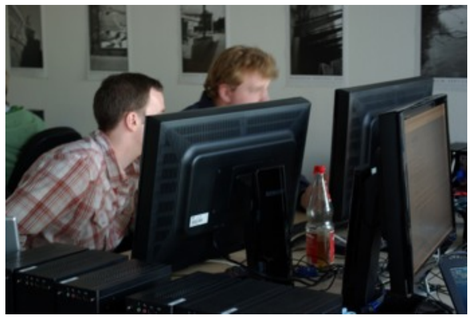
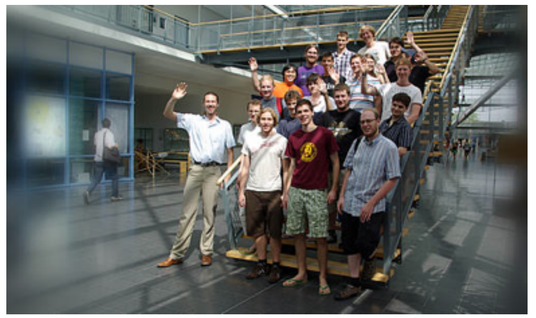
lots of happy faces





The iLab Experience

- http://ilab.net.in.tum.de/
  Bachelor/ Master course
- http://ilab2.net.in.tum.de/
  Master/ Bachelor course
- http://labsystem.sf.net/
  eLearning environment (*open source*)
- Marc-Oliver Pahl | pahl@net.in.tum.de
  http://pahl.de/