

Introduction How to Use the Computer Clusters Within the Department of Mathematics and Informatics

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C o m p u t e r I n t r o d u c t i o n

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1 Introduction

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1.1 Cluster Overview

cluster name	room	number of machines	machine names	for whom	processor	RAM	OS
CIP	G.14.11	24	l01, ..., l24	all	Intel Core2 Duo, 2.33 GHz ¹ ; Intel Core2 Quad, 3 GHz ²	4 GB	openSUSE Linux 13.2
IT	G.16.15	15	l101, ..., l115	all	Intel Core i7, 3.6 GHz	16 GB	openSUSE Linux 13.2
PI	G.16.13/ G.16.14	14	l201, ..., l214	master students (mathe- matics, IT, CSiS)	Intel Core i7, 2.8 GHz	4 GB	openSUSE Linux 13.2

All machines belong to the domain **studs.math.uni-wuppertal.de**—i. e. the complete name to access one of the machines from outside is e. g. **l111.studs.math.uni-wuppertal.de**.

¹l01, ..., l05, l08, ..., l12, l15, ..., l18, l20, ..., l23

²l06, l07, l13, l14, l19, l24

1.2 Contact Persons

name	room	phone	email
Dr. Peter Feuerstein	G.14.18	2818	fpf@math.uni-wuppertal.de
Dr. Holger Arndt	G.14.16	2033	arndt@math.uni-wuppertal.de
Prof. Dr. Hans-Jürgen Buhl	D.13.13	2524	buhl@math.uni-wuppertal.de

In case of problems, you can always send an email to **root** at your local machine or **root@math.uni-wuppertal.de**.

1.3 Accounts

- Accounts are managed by Dr. Feuerstein.
- Together with an account you will receive a card for the locking system of our computer rooms (10€ deposit).
- prerequisite for accounts: attending this course (or the German equivalent)
- If you already have access to some computer and printer, you might want to speed up the request for an account by bringing a filled application form with you.
address: <http://www-share.math.uni-wuppertal.de/accounts/>

Accounts/Zugangskarten für Ausbildungsrechner in der Fachgruppe Mathematik und Informatik

Benutzername _____ Karten-Nr. _____ (wird von der FG eingetragen)

Nachname **family name** _____ (bitte deutlich schreiben!)

Vorname **given name** _____

Adresse **address** _____

Matrikel-Nr. **matriculation number** _____ (nur für Student(inn)en)

Antrag für CIP (G.14.11) IT (G.16.15) PI (G.16.13)

Mitarbeiter(in) der Fachgruppe Mathematik und Informatik

Gast der Fachgruppe Gast von _____ voraussichtlich bis _____

Student(in) in Fakultät 4 Bachelor (Wirtschafts-)Mathematik Master Mathematik

Kombinatorischer Bachelor Mathematik / Informatik

Bachelor Angewandte Naturwissenschaften

Master Computer Simulation in Science (CSiS)

Master of Education Mathematik / Informatik

LA Mathe / Informatik Grundstudium Hauptstudium

Student(in) in Fakultät 3 Wirtschaftsinformatik Bachelor Master/M.Ed.

IT-Student(in) Bachelor IT Master IT Master WIngIT

Kursteilnehmer(in) Kurs/Projekt _____ Fakultät _____

Dozent(in) _____ Semester SS/WS

Ich habe die Benutzungsordnung der Fachgruppe Mathematik und Informatik zur Kenntnis genommen und verpflichte mich dazu, sie einzuhalten. Ich bin verpflichtet, regelmäßig meine E-Mails zu lesen und zu löschen, und damit einverstanden, dass mein Name und meine E-Mail-Adresse universitätsintern auf den Web-Seiten und im LDAP-Verzeichnis der Fachgruppe veröffentlicht wird. Nach Beendigung des Studiums/Kurses bzw. meiner Tätigkeit in der Fachgruppe werde ich dies der Fachgruppe mitteilen und die Zugangskarte zurückgeben. Das Pfand von 10 € wird bei Rückgabe der Karte erstattet.

Wuppertal, den **date** _____

signature _____

Unterschrift der/des Antragstellenden

1.4 Dos and Don'ts

- Never switch off the computers!
- Keep your password secret. You are responsible for all actions from within your account.
- Read your emails regularly (to receive news from the administration).
- Don't fill paper into the printers by yourself, especially no recycled paper or paper already printed on.
- Remove pending print jobs when you leave.
- Respect the "Netiquette" (cf. <https://tools.ietf.org/html/rfc1855>).
- Leave adjustments of the air conditioning to our staff. Keep doors and windows shut if air conditioning is active.
- If you are the last to leave the room, close the door and windows and switch off the light.
- Don't switch on the heating.
- Don't eat or drink anything in the computer rooms.
- Don't plug your private computers (notebooks) into our network sockets.

1.4.1 Reasonable Usage of Resources

- Long running computing jobs should only be started after consulting one of the contact persons (see [1.2](#)).
- Don't print more than necessary. Printing of private data, scripts, and online handbooks is generally forbidden. Consult one of the contact persons for needed larger prints.
- Don't waste hard disk space, clean up your home directory from time to time.
- Don't use more than one computer at a time.
- Lock the screen only if you leave the room for a few minutes, otherwise log out.

1.4.2 Even If You Could ...

- Don't observe what passwords other users enter.
- Don't read other users' files even if they forgot to prevent you from.
- If some user is logged in but not present in the room, log him out (maybe send an email-reminder to him/her).

2 Some Basics about Unix and Linux

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Unix is a:

- **multi-user** operating system

It can be used by multiple users, all having their own password and directory for personal files.

Several users can work on the same machine at the same time.

- **multi-tasking** operating system

Multiple programs can be run in parallel (by one or more users).

There are many variants of Unix, one of which is **Linux**.

2.1 Users

Each user

- has a unique **user name**,
- a **user ID**,
- belongs to (at least) one **user group**,
- has his own **password**, which must be kept secret,
- has his own **home directory** inside the file system to store personal files,
- where the total amount of occupied disk space per user is limited by a **quota**.

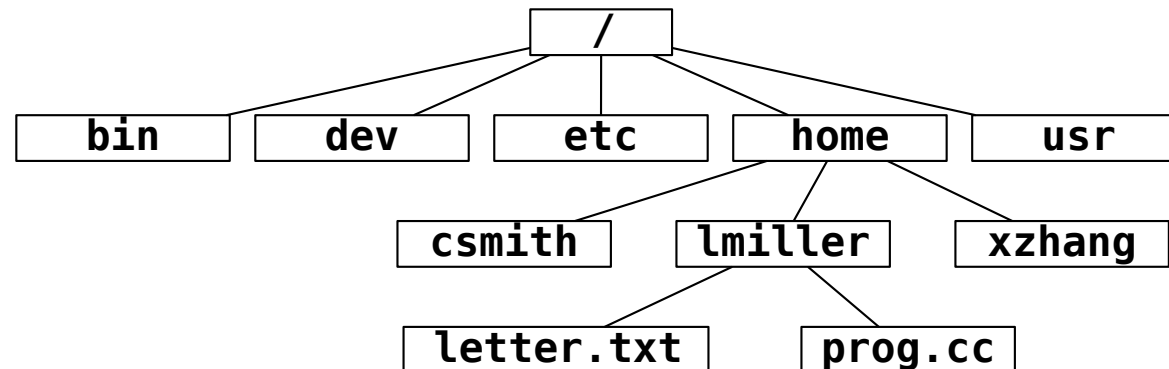
2.1.1 Paths to the Home Directories on Our Clusters

cluster	path
CIP and IT (shared)	/home/username
PI	/home/username

2.2 File System

The file system

- has a tree structure,
- consists of **directories** (folders) and **files**.
- The top directory is called **root**-directory, its name is `/`.
- There are no drive letters, instead subtrees might be physically located on different partitions or even different servers.
- Each file is owned by a user and a group.



2.2.1 File Permissions

For each file and directory there are three sets of **permissions**:

u	user	the owner of the file/directory
g	group	all users belonging to the group owning the file
o	other	all other users

example:

output of the command `ls -l`:

The diagram illustrates the output of the `ls -l` command with arrows pointing to specific fields and their meanings:

- d if directory**: Points to the first character of the permission string.
- permissions for owner**: Points to the first three characters of the permission string.
- permissions for users of owning group**: Points to the next three characters of the permission string.
- permissions for other users**: Points to the last three characters of the permission string.
- owning user**: Points to the user name in the output.
- owning group**: Points to the group name in the output.
- file size**: Points to the numerical value representing the file size.
- date/time of last modification**: Points to the date and time in the output.
- file name**: Points to the name of the file or directory.

```

-rw-r--r-- 1 holger users 643 14. Feb 15:29 output.txt
drwxr-xr-x 2 holger users 4096 14. Feb 15:29 pictures
-rwxr-xr-x 1 holger users 17795 14. Feb 15:29 primes1
-rw-r--r-- 1 holger users 843 14. Feb 15:29 primes1.cc
  
```

meaning of the permission letters:

		for files:	for directories:
r	read	read the file (its content)	read the directory (file listing)
w	write	modify the file	make changes in the directory (create/rename/delete files)
x	execute	execute file as program	change into the directory

2.3 Processes

Each running program is managed as a **process**.

For each process the following information (among others) is available:

UID	user ID of the user who started and owns the process
PID	process ID
PPID	parent process ID
CMD	command by which the process was started

example:

partial output of the command **ps -ef**:

```

UID          PID    PPID  C  STIME TTY          TIME CMD
root          1      0    0  Jul26 ?           00:01:33 /usr/lib/systemd/systemd --syste
root          2      0    0  Jul26 ?           00:00:00 [kthreadd]
...
root        31255   1020    0  10:28 ?           00:00:00 sshd: holger [priv]
root        31261     2    0  10:28 ?           00:00:00 [lockd]
holger      31263  31255    0  10:28 ?           00:00:00 sshd: holger@pts/0
holger      31264  31263    0  10:28 pts/0       00:00:00 -bash
holger      31365  31264   19  10:29 pts/0       00:00:03 /usr/bin/emacs
...
holger      31391  31264    0  10:29 pts/0       00:00:00 ps -ef

```


3 Login

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To log in on one of the computers, you have to enter your user name and your password.

Normally this is done via a graphical dialog window.

3.1 Switching to a Text Console

If the graphical login fails (i. e. because of exceeding the quota), you can switch to a text console via **Strg-Alt-F1**, ..., **Strg-Alt-F6**.

switching back to graphics mode: **Alt-F7**

3.2 Changing Your Password

CIP/IT: Use the webpage

<https://lsrv0.studs.math.uni-wuppertal.de/suse/login.pl?doit=login&lang=EN>,
go to **Setup**, then **Password**.

PI: You can change your password with the command **passwd**.

In both cases you are asked to once enter your old password and twice enter a new password.

3.2.1 How Many Passwords Do You Have?

1. The CIP-, IT-, and IMAP-Account share one password.
2. The PI-password is independent of the first.

3.3 Remote Login

You can login from other computers via the network using an SSH (secure shell) connection:

```
ssh username@hostname
```

To access our clusters, the ssh client must support ssh protocol version 2. In case of problem, select method “keyboard interactive” and enter password as “authentication response”.

For an SSH login from outside of the university’s network you have to setup a VPN connection. For instructions see

<https://www.zim.uni-wuppertal.de/en/services/network-access/vpn-connections.html>.

3.4 Logout

Commands for leaving a command line / remote login:

exit, **logout**, or **Strg-D**

Graphical desktop environments like KDE have a logout button in their main menu or desktop menu.

4 Graphical Desktop Environments

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--	------------

default environment on our clusters: KDE

alternatives: Gnome (maybe others)

4.1 Switching to an English Environment

When you log in for the first time, you will get a German KDE desktop. Follow these steps for switching to English:

1. Click on the K-menu (lower left corner).
2. Choose **Systemeinstellungen** (in tab **Favoriten**).
3. Choose **Regionales** in area **Allgemeines Erscheinungsbild und Verhalten**.
4. Go to tab **Sprachen**.
5. Select **English (US)** and move it to **Bevorzugte Sprachen** (right arrow).
6. Click on the button **Anwenden**.
7. Close the window.
8. Log out:
 - a) Right-click on the desktop.
 - b) Choose **Verlassen ...**
 - c) Choose **Abmelden**
9. Log in again.

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Under KDE, a command line window (**konsole**) is started via



Under Unix systems, the command interpreter running inside is called **shell**.

A shell displays a command prompt, reads user commands, and executes these commands.

Under Linux the default shell is the **Bash** (Bourne-Again-Shell).

How to Get English Messages in a Shell

1. Open the file `.bashrc` in your home directory with a text editor.
2. Append the line:
LANG=en_US.UTF-8
3. Log out and in again.

5.1 How Commands are Found

Commands are

- either built-in commands of the shell
- or external programs inside a directory which is contained in the environment variable **\$PATH**.

example:

test	starts the built-in command doing nothing by default
./test	starts the program test from the current working directory (.) if it exists

5.2 Quoting

The **meta characters**

><; & () [] { } | \ \$? * ~ ' " ` !

have a special meaning and (sometimes) have to be **quoted** to be used as a normal character.

There are three different quoting mechanisms:

- `\`: Quote next character.
- `'...'`: Quote all included characters except `'` itself.
- `"..."`: Quote all included characters except `$`, `\`, ``` and `"` itself.

Via **command substitution** (``some command``) the result of a command can be used directly, e. g.

```
cat `find . -name "*.tex"`
```


5.2.1 Input/Output Redirection

myprog < ifile	redirecting standard input
myprog > ofile	redirecting standard output (overwrites ofile)
myprog >> ofile	redirecting standard output (append output at the end of ofile)
myprog 2> efile	redirecting standard error output
myprog > ofile 2>&1	redirecting standard and error output
myprog &> ofile	redirecting standard and error output (short form)

Pipes

firstprog secondprog	use output of firstprog as input for secondprog
-------------------------------	---

e. g.: **ls -l | less** to show a long directory listing page by page

5.3 Background Processes

After entering a command, the shell waits until the program has finished.

For programs running in their own window (e. g. a text editor) this is inconvenient.

solution: Starting the program as a **background process** by appending **&**.

```
l115 ~/CompIntr/sampleDir > emacs primes1.cc&
[1] 25793
l115 ~/CompIntr/sampleDir > g++ -Wall primes1.cc -o primes1
l115 ~/CompIntr/sampleDir >
[1]+  Done                  emacs primes1.cc
l115 ~/CompIntr/sampleDir >
```

6 Some Basic Unix Commands

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Although most of the following tasks can be handled by a file manager as well, working on a command line can be faster or even necessary (for remote logins).

6.1 Handling Files and Directories

6.1.1 Wildcards

File and directory names can be abbreviated by **wildcards**:

*	any character sequence (can also be empty)
?	one character
~	the name of your home directory
.	the current working directory
..	the parent directory

6.1.2 Getting and Changing the Current Working Directory

pwd	print working directory
cd <i>/some/absolute/path</i>	change directory to a directory given by its complete path starting at root
cd <i>subdirectory</i>	change directory to a subdirectory
cd	change to home directory

6.1.3 Listing Directory Contents

<code>ls</code>	list current directory
<code>ls name(s)</code>	list specified files/directories
<code>ls -a ...</code>	show also hidden files (starting with a dot, e. g. .bashrc)
<code>ls -d ...</code>	with directories: show their names instead of content
<code>ls -F ...</code>	append / for directories, @ for links, * for executables
<code>ls -l ...</code>	long version, showing permissions, size, owner, group, date
<code>ls -R ...</code>	list all subdirectories recursively

Usually the options can be combined, e. g. `ls -alF`.

6.1.4 Copying, Moving, and Renaming

<code>cp file newname</code>	copy a file giving it a new name
<code>cp file(s) directory</code>	copy file(s) to a different directory
<code>cp -R directory otherdirectory</code>	recursively copy a whole directory to a different directory
<code>mv oldname newname</code>	rename a file or directory
<code>mv name(s) directory</code>	move files/directories to a different directory
<code>cp -i .../mv -i ...</code>	interactive, i. e. overwriting existing files has to be confirmed

6.1.5 Creating and Removing Directories and Files

mkdir <i>directory</i>	make (create) directory
rmdir <i>directory</i>	remove (an empty) directory
rm <i>file(s)</i>	remove files
rm -i ...	ask for confirmation before removing
rm -r <i>directory/ies</i>	remove complete directories (use with care!)
touch <i>file(s)</i>	create empty files

6.1.6 Links

A **(symbolic) link** is a pointer to an already existing file or directory.

ln -s <i>oldname newname</i>	create link under new name
ln -s <i>name directory</i>	create link in directory

example:

```
l115 ~/CompIntr/sampleDir2 > touch letter.txt
l115 ~/CompIntr/sampleDir2 > ln -s letter.txt sameletter.txt
l115 ~/CompIntr/sampleDir2 > ln -s /home/modprog/Exercises .
l115 ~/CompIntr/sampleDir2 > ls -l
total 0
lrwxrwxrwx 1 holger users 23 Sep 27 11:30 Exercises -> /home/modprog/Exercises
-rw-r--r-- 1 holger users 0 Sep 27 11:29 letter.txt
lrwxrwxrwx 1 holger users 10 Sep 27 11:30 sameletter.txt -> letter.txt
l115 ~/CompIntr/sampleDir2 > cd Exercises
l115 ~/CompIntr/sampleDir2/Exercises >
```

6.1.7 Showing Text Files

<code>cat file(s)</code>	show the complete file(s) in the terminal
<code>more file(s), less file(s)</code>	show files page by page

commands within **more** and **less**:

space	next page
return	next line
b	one page back
:n	next file
/text	search for text
q	quit

6.1.8 Changing File Permissions

chmod <i>mode file(s)/directory/ies</i> change file mode

format of the file mode (without spaces): *who operator rights [, ...]*

<i>who</i>		<i>operator</i>		<i>rights</i>	
u	user	+	grant right	r	read
g	group	-	withdraw right	w	write
o	others			x	execute
a	all				

example:

```
l115 ~/CompIntr/sampleDir > ls -l doit
-rw-r--r-- 1 holger users 3 2007-09-06 15:35 doit
l115 ~/CompIntr/sampleDir > chmod ug+x,o-r doit
l115 ~/CompIntr/sampleDir > ls -l doit
-rwxr-x--- 1 holger users 3 2007-09-06 15:35 doit
```


6.1.9 Disk Usage and Quota

The allowed size and number of the files in your home directory is limited:

	CIP/IT		PI	
	permanent	few days	permanent	few days
size	1 GB	1.2 GB	2 GB	2.2 GB
number of files	50000	60000	90000	100000

commands:

du	disk usage of current directory
du <i>name(s)</i>	disk usage of specified files/directories
du -s ...	print only sum, not information of each subdirectory
finger <i>username</i>	print quota information (special solution for CIP/IT, information is updated once per hour)
quota -v	print quota information (PI, standard command)

6.2 Copying Files Over the Network Between Different Computers

scp <i>file(s) username@hostname:directory</i>	copy to remote host
scp <i>username@hostname:directory/files localdir</i>	copy from remote host

7 Where to Get Help

Manual Pages

man <i>name</i>	show manual page for a command or function
whatis <i>name</i>	show one-line description

Help Option of Commands

Many Linux commands have an option **--help**.

e.g.: **cp --help**

CIP help system (local information in German)

accessible with any browser at

<https://www.math.uni-wuppertal.de/information/it-dienste/dienste-fuer-studierende/cip-hilfesystem.html>

8 Common Problems

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8.1 Login Fails

problem: If you have exceeded your quota, the graphical login will fail.

solution: Switch to a text console, log in, clean up your home directory.

tip: The cache directories of browsers like **firefox** often contain many files that can be deleted—look e. g. into `~/ .mozilla` or `~/ .opera`.

8.2 Killing Processes

problem: How can you terminate a “hanging” program?

solution 1: If the program was started from a shell and not in the background, type **Strg-C**.

solution 2: Kill the process:

1. Find out the ID of the process with **ps -ef**.

You can restrict the output list to a certain process name with **ps -ef | grep procname**.

2. Terminate the process with **kill pid**.
3. If that didn't help, try **kill -9 pid**.

example 1: We assume the text editor **kwrite** is hanging:

```
l115 ~ > kwrite&
[1] 27333
l115 ~ > ps -ef
UID          PID  PPID  C  STIME TTY          TIME CMD
holger      27333 27281  8  11:04 pts/0        00:00:00 kwrite
holger      27350 27281  0  11:04 pts/0        00:00:00 ps -ef
l115 ~ > kill 27333
l115 ~ >
[1]+  Terminated                  kwrite
```

example 2: using **kill -9** now:

```
l115 ~ > kwrite&
[1] 27403
l115 ~ > ps -ef | grep kwrite
holger  27403 27281  8 11:06 pts/0    00:00:00 kwrite
holger  27406 27281  0 11:06 pts/0    00:00:00 grep kwrite
l115 ~ > kill 27403
l115 ~ > ps -ef | grep kwrite
holger  27403 27281  4 11:06 pts/0    00:00:00 kwrite
holger  27409 27281  0 11:07 pts/0    00:00:00 grep kwrite
l115 ~ > kill -9 27403
l115 ~ >
[1]+  Killed                  kwrite
```

solution 3: killing all processes with a certain name with **killall**

example: **killall kwrite** or **killall -9 kwrite**

8.3 Remote Kill

problem: The complete window system is blocked by some process.

solution 1: Change to a text console (cf. Section 3.1), log in, determine and kill the hanging process.

solution 2: If even the keys for switching to a text console don't work: Log in on some other computer, use **ssh** to log in on the hanging machine (cf. Section 3.3), proceed as above.

solution 3: If killing a certain process does not help, try killing the complete window manager.

- For KDE the window manager is called **kwin**.
- Try pressing **Strg-Alt-Backspace** twice on the hanging machine itself.

8.4 If Nothing Else Helps

- Don't hesitate to ask other students in the room.
- Ask one of the administrators (personally or by email).
- but: Never switch off or power-cycle the computers yourself!

9 Printing

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In all three rooms there is a laser printer.

Remember: You should use our resources economically—including paper and toner.

printing restriction on the CIP- and IT-cluster: at most 20 pages per 24 hours

9.1 What Can Be Printed?

The printers themselves can only handle postscript files (suffix **.ps**).

Most graphical programs have a print function that automatically generates the correct output format.

9.2 Printing from the Command Line

Printing Postscript Files

lp <i>file(s)</i>	print file(s)
lpr <i>file(s)</i>	print file(s)

Printing Text Files

a2ps <i>file(s)</i>	convert file(s) to postscript (including syntax highlighting) and print
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9.3 Cancelling Print Jobs

To **cancel** an already submitted but queued print job,

1. find out the job ID using **lpq** or **lpstat**,
2. cancel the job with **lprm** or **cancel**.

example 1:

```
wmai20 .../ModProg/CompIntr > lpr CompIntr.ps
wmai20 .../ModProg/CompIntr > lpq
wmailj03 is ready and printing
Rank   Owner   Job   File(s)                Total Size
active holger  830   CompIntr.ps           2084864 bytes
wmai20 .../ModProg/CompIntr > lprm 830
wmai20 .../ModProg/CompIntr > lpq
wmailj03 is ready
no entries
```

example 2:

```
wmai20 .../ModProg/CompIntr > lp CompIntr.ps
request id is wmailj03-831 (1 file(s))
wmai20 .../ModProg/CompIntr > lpstat
wmailj03-831      holger      2084864    Mi 02 Okt 2013 11:07:03 CEST
wmai20 .../ModProg/CompIntr > cancel 831
wmai20 .../ModProg/CompIntr > lpstat
```

If printing has already started,

1. switch the printer offline by pressing the button “Start”,
2. cancel the job as explained above,
3. press the cancel button (“Job abbrechen”) on the printer.

9.4 In Case of Problems

possible problems: out of paper, paper jam

solution: consult one of the administrators

another problem: wrong paper format (i. e. US-Letter)

solution: remove the print job; choose A4 in the print dialog if possible

important: Remove pending print jobs before you leave the room.

10 Email

Your CIP/IT-account includes an IMAP-account having the address

`username@studs.math.uni-wuppertal.de`

quota for the IMAP postbox: 10 MB

Configuration Data

- server for incoming mail (IMAP): **`lsrv0.studs.math.uni-wuppertal.de`**
- server for outgoing mail (SMTP): **`mail.uni-wuppertal.de`**
- security/encryption setting for both: SSL or TLS

Programs for Reading and Writing Email

- **thunderbird**
- **seamonkey**
- **kmail** (especially for KDE users)
- **evolution** (especially for Gnome users)
- any web browser using the web frontend
<https://lsrv0.studs.math.uni-wuppertal.de/suse/login.pl?doit=login&lang=EN>
should only be used for configuration (e. g. mail forwarding/filtering) because of a restricted number of licenses
- any web browser using the web frontend
<https://www-share.math.uni-wuppertal.de/mailclient/src/login.php>
switching to English: **Optionen - Voreinstellungen für Anzeige - Sprache** (switch to English)
- button **Senden**

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