

Basic UNIX

Today's Programme

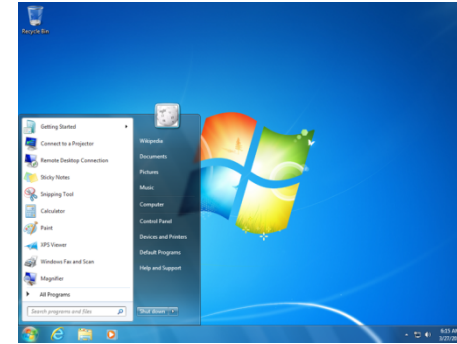
- Biological databases
- Brief introduction
 - What is UNIX?
 - Why should you learn UNIX?
- Bioinformatics Core Facility
- Setting up your laptops

- Very briefly on the Unix shell, file system and some commands
- UNIX basics exercise
- Tomorrow, continue on databases & working with biological sequences

What about those of you that know Unix and Python very well?

Operating systems

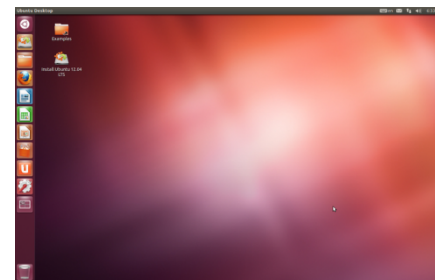
- Software that manages computer hardware
 - Reading input from keyboard and pointing devices
 - Sending output to screen
 - Keeping track of, reading and writing files
- Provides common services for computer programs



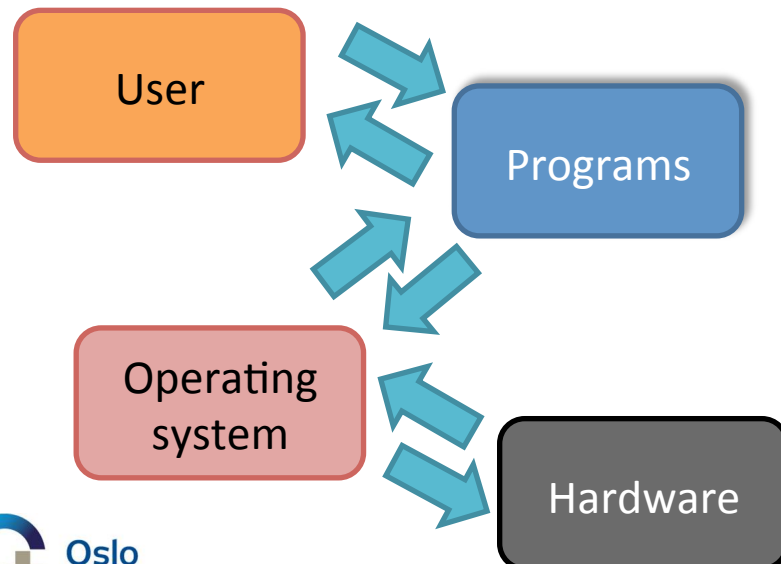
Microsoft
Windows



(Mac) OS X



UNIX
(Linux,
Ubuntu)

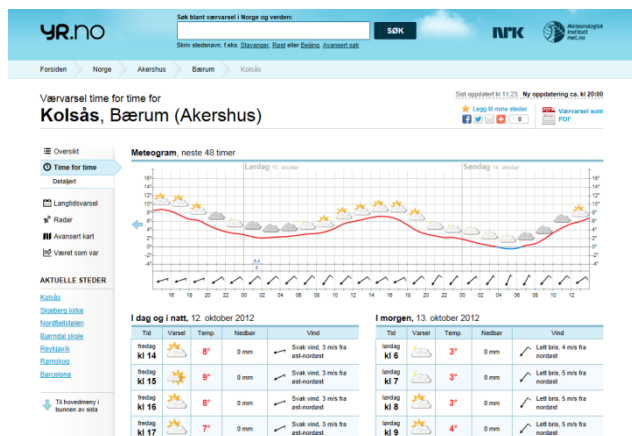


UNIX

- UNIX was developed in the early 1970s
- Is extremely well-tested and powerful
 - multiuser
 - multi-tasking
 - available on many architectures
 - extremely rich is commands, possibilities, flexibility
- Extensively used in academic institutions/universities (and industry) for decades, *e.g.* in physics, computational chemistry, and meteorology
- The operating system of the WWW – most web servers run on UNIX machines
- Most software developed at academic institutions for scientific data analysis and simulations

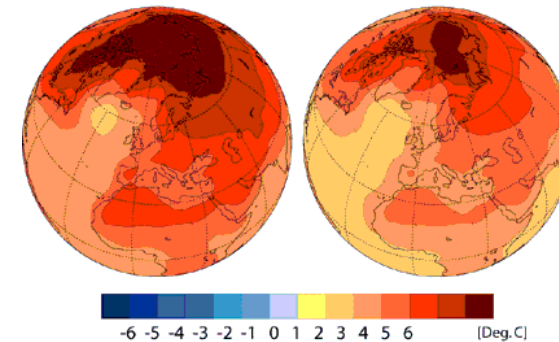


New supercomputer Abel
(and old Titan) at UiO



Weather
forecast or
climate
modelling –
developed and
run under UNIX

Average of all IPCC Models: Temperature Change in 2070
IPCC SRES Scenarios a2 (left) und b2 (right)

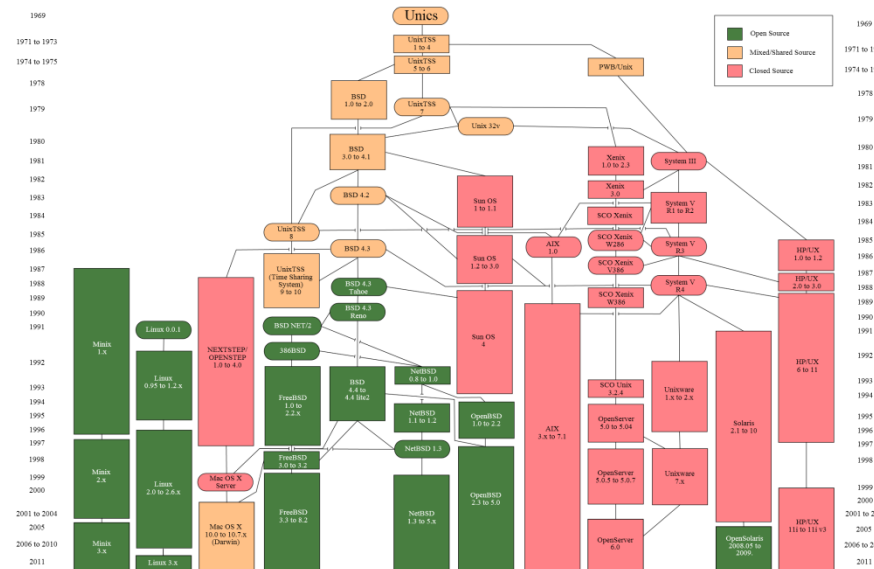


Why should (some) life scientists learn UNIX?

- More or less all development of bioinformatics tools and algorithms is done on UNIX computers
 - If you want to run the programs with all options and all flexibilities in the same environment as the program developer, you must use UNIX
- Extremely well tested, flexible and constantly evolving
 - A major fraction of the world's information technology scientists and program developers, including "all" bioinformaticians, are using UNIX in their daily work
- One can easily set up pipelines and automatically run scripts that make it simple to set up work flows and reduce the need for manually manipulating data
- Sharing and limiting access to data is trivial, secure and extremely well tested
 - Data can be protected by using established technology based on encryption and password protection and users can be grouped in user groups that can access each others data while other data is kept private
- *Researchers using bioinformatics tools beyond the most elementary level should definitely invest a week or two in order to learn UNIX*

More on UNIX

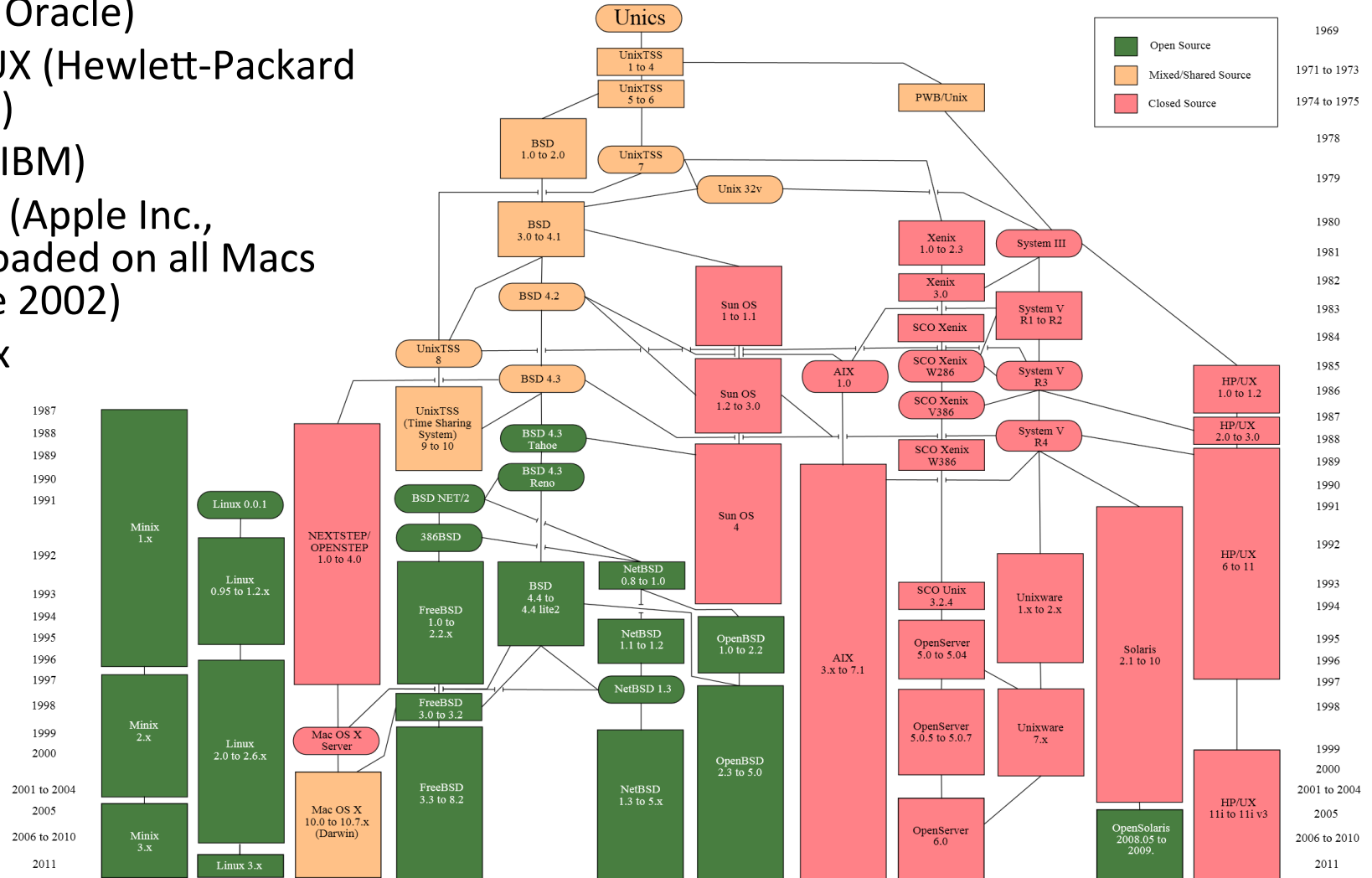
- Security
 - multiple users with multiple environments/data
 - extremely well tested systems for keeping information private
 - (almost) free from viruses and other forms of malware
- University of Oslo
 - user database, systems for e-mail and backup, web servers and much more is running under UNIX
 - everyone with a UiO user account also have a personal UNIX user account (you can log onto a UNIX machine)
- Many variants
 - open source
 - closed source



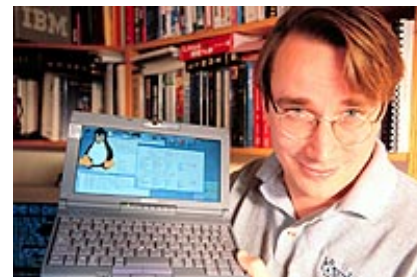
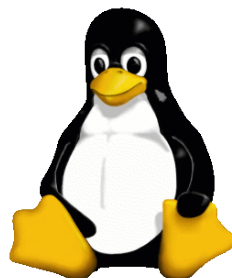
<http://www.levenez.com/unix>

UNIX variants

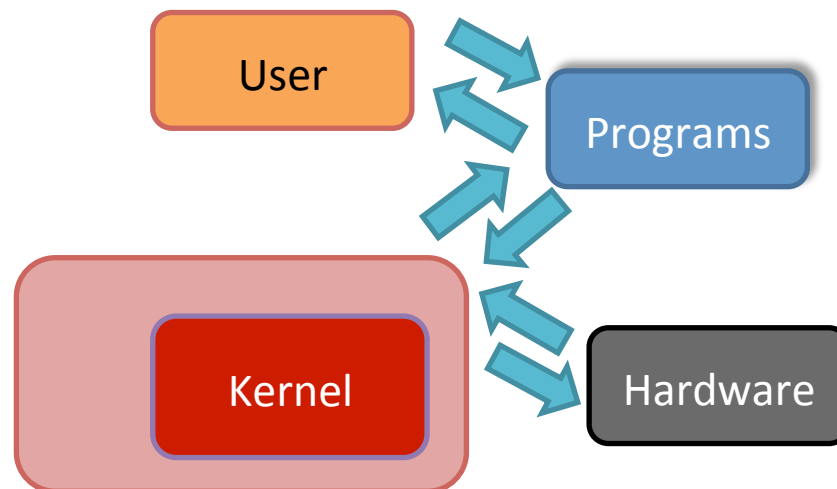
- Solaris (Sun Microsystems, now Oracle)
- HP-UX (Hewlett-Packard UniX)
- AIX (IBM)
- OS X (Apple Inc., preloaded on all Macs since 2002)
- Linux



Linux



- UNIX-like OS
 - free and open source software
 - Linux kernel first developed by Linus Torvalds in the early 1990's
- Variants
 - Red Hat Enterprise Linux
 - CentOS
 - Ubuntu
 - Debian
- Can be installed on nearly all standard Windows laptops/desktops
- Is the OS of >92% of the worlds Top500 supercomputers (including Abel at UiO)



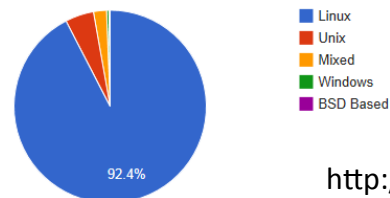
TOP500 Statistics

TOP500 Release:

Category:

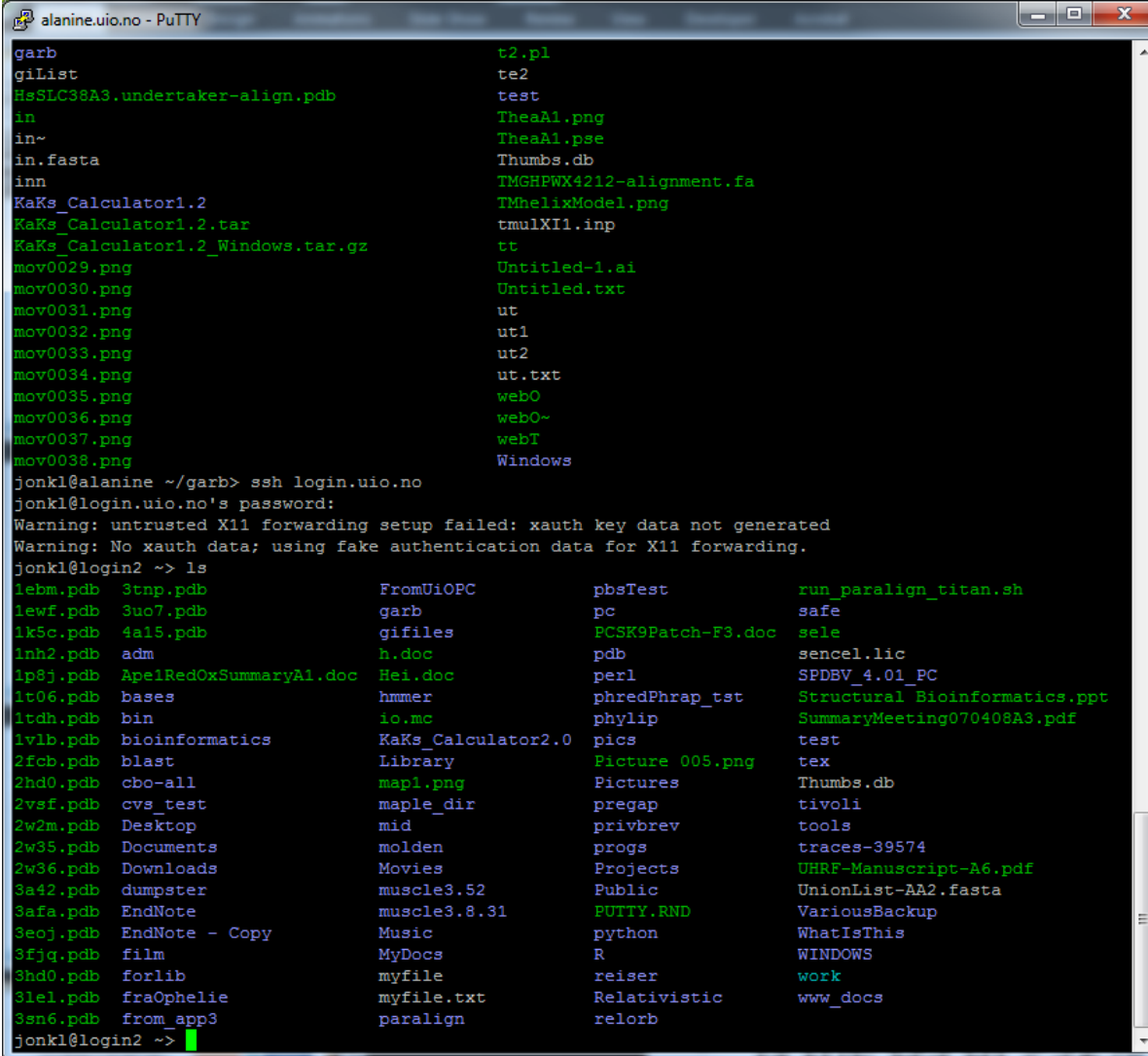
R_{max} and R_{peak} values are in GFlops. For more details about other fields, check the [TOP500 description](#).

Operating system Family System Share



<http://www.top500.org>

UNIX is text-based OS



```
alanine.uio.no - PuTTY
garb                                t2.pl
giList                              te2
HsSLC38A3.undertaker-align.pdb     test
in                                  TheaA1.png
in~                                  TheaA1.pse
in.fasta                            Thumbs.db
inn                                  TMGHPWX4212-alignment.fa
KaKs_Calculator1.2                 TMhelixModel.png
KaKs_Calculator1.2.tar              tmulXI1.inp
KaKs_Calculator1.2_Windows.tar.gz  tt
mov0029.png                         Untitled-1.ai
mov0030.png                         Untitled.txt
mov0031.png                         ut
mov0032.png                         ut1
mov0033.png                         ut2
mov0034.png                         ut.txt
mov0035.png                         web0
mov0036.png                         web0~
mov0037.png                         webT
mov0038.png                         Windows

jonkl@alanine ~/garb> ssh login.uio.no
jonkl@login.uio.no's password:
Warning: untrusted X11 forwarding setup failed: xauth key data not generated
Warning: No xauth data; using fake authentication data for X11 forwarding.
jonkl@login2 ~-> ls
1ebm.pdb      3tnp.pdb          FromUiOPC          pbsTest          run_paralign_titan.sh
1ewf.pdb      3uo7.pdb          garb               pc               safe
1k5c.pdb      4a15.pdb          gifiles            PCSK9Patch-F3.doc sele
1nh2.pdb      adm               h.doc             pdb              sencel.lic
1p8j.pdb      ApelRedOxSummaryA1.doc Hei.doc           perl            SPDBV_4.01_PC
1t06.pdb      bases            hmmer             phredPhrap_tst  Structural_Bioinformatics.ppt
1tdh.pdb      bin               io.mc             phylip          SummaryMeeting070408A3.pdf
1v1b.pdb      bioinformatics   KaKs_Calculator2.0 pics             test
2fcb.pdb      blast            Library           Picture_005.png tex
2hd0.pdb      cbo-all          map1.png         Pictures         Thumbs.db
2vsf.pdb      cvs_test         maple_dir         pregap          tivoli
2w2m.pdb      Desktop          mid               privrev         tools
2w35.pdb      Documents        molden            progs           traces-39574
2w36.pdb      Downloads        Movies            Projects        UHRF-Manuscript-A6.pdf
3a42.pdb      dumpster         muscle3.52        Public          UnionList-AA2.fasta
3afa.pdb      EndNote          muscle3.8.31     PUTTY.RND      VariousBackup
3eoj.pdb      EndNote - Copy   Music             python          WhatIsThis
3fjq.pdb      film             MyDocs           R              WINDOWS
3hd0.pdb      forlib           myfile           reiser         work
3le1.pdb      fraOphelie      myfile.txt       Relativistic   www_docs
3sn6.pdb      from_app3        paralign         relorb

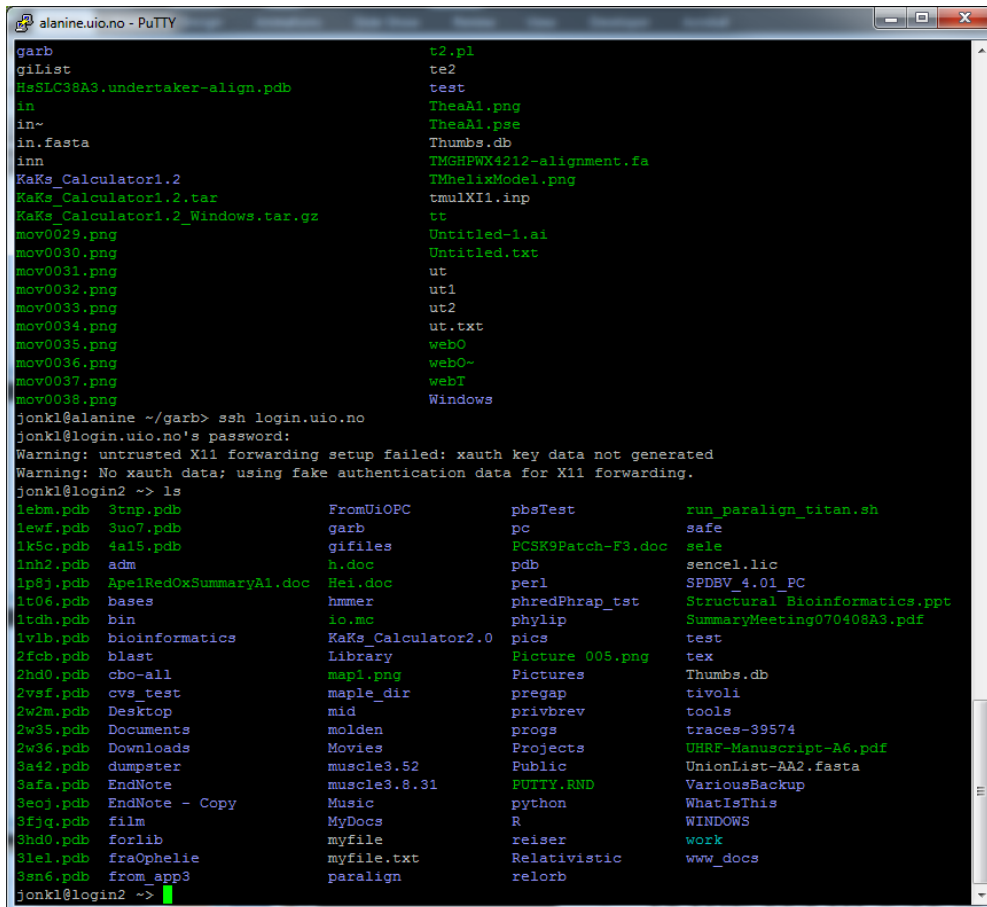
jonkl@login2 ~->
```

The user writes commands on the **command line**, usually in a **terminal window**

Command-line interface - interaction with a computer program where the user gives commands to the program in the form of successive lines of text

As opposed to **graphical user interfaces (GUI)**

UNIX is text-based OS



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inn                                  TMGHPWX4212-alignment.fa
KaKs_Calculator1.2                 TMhelixModel.png
KaKs_Calculator1.2.tar             tmulXII.inp
KaKs_Calculator1.2_Windows.tar.gz  tt
mov0029.png                        Untitled-1.ai
mov0030.png                        Untitled.txt
mov0031.png                        ut
mov0032.png                        ut1
mov0033.png                        ut2
mov0034.png                        ut.txt
mov0035.png                        webO
mov0036.png                        webO~
mov0037.png                        webT
mov0038.png                        Windows

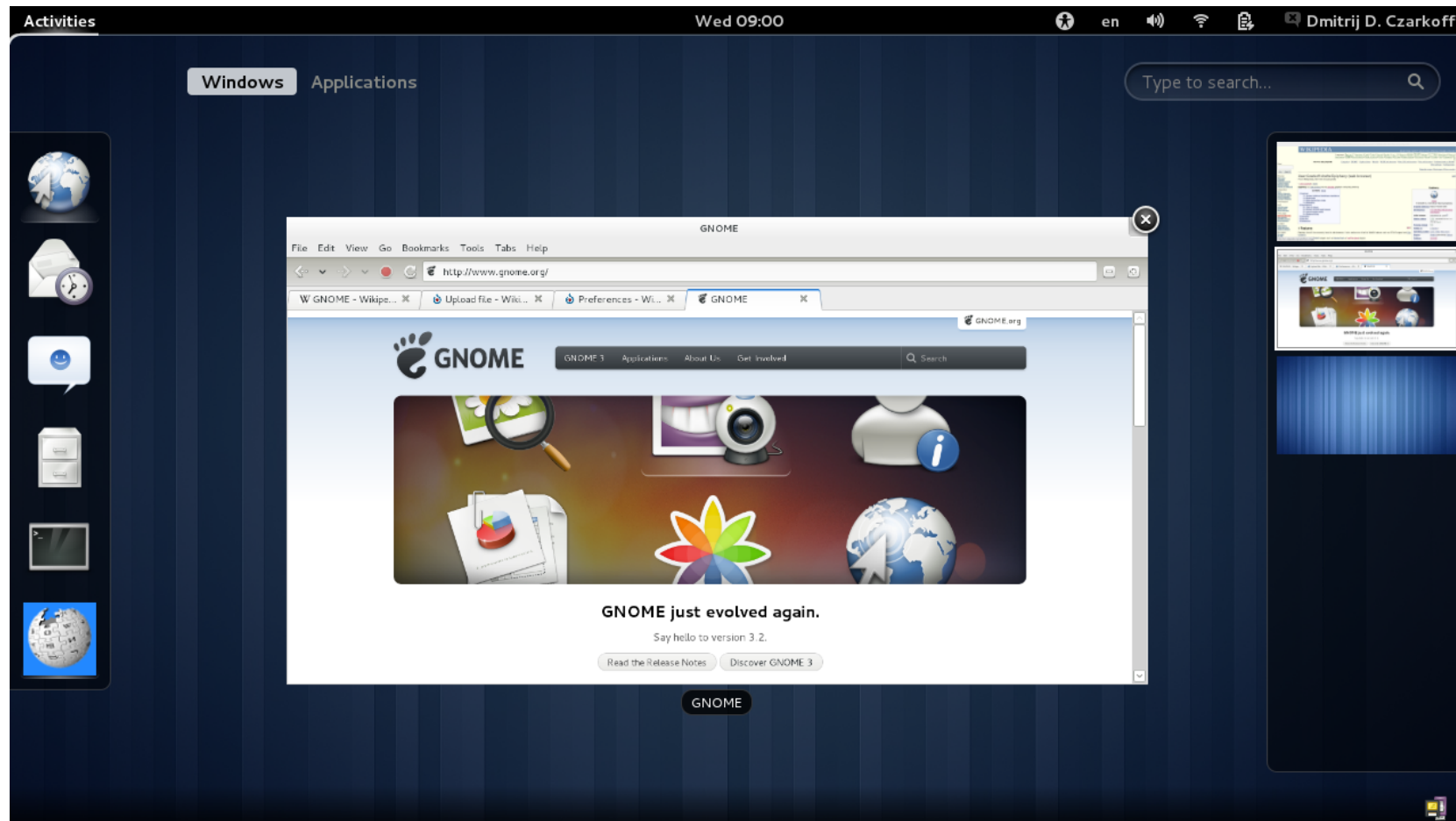
jonkl@alanine ~/garb> ssh login.uio.no
jonkl@login.uio.no's password:
Warning: untrusted X11 forwarding setup failed: xauth key data not generated
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jonkl@login2 ~-> ls
1ebm.pdb      3tnp.pdb          FromUiOPC      pbsTest        run_paralign_titan.sh
1ewf.pdb      3uo7.pdb          garb           pc              safe
1k5c.pdb      4a15.pdb          gifiles        PCSK9Patch-F3.doc sele
1nh2.pdb      adm               h.doc          pdb             sence1.lic
1p8j.pdb      Ape1RedOxSummaryA1.doc He1.doc        perl            SPDBV_4.01_PC
1t06.pdb      bases            hammer         phredPhrap_tst Structural Bioinformatics.ppt
1tdh.pdb      bin              io.mc          phylip          SummaryMeeting070408A3.pdf
1vlb.pdb      bioinformatics   KaKs_Calculator2.0 pics            test
2fcb.pdb      blast            Library        Picture 005.png tex
2hd0.pdb      cbc-all         map1.png      Pictures        Thumbs.db
2vsf.pdb      cvs test        maple_dir     pregap          tivoli
2w2m.pdb      Desktop         mid           privbrev        tools
2w35.pdb      Documents       molden        progs           traces-39574
2w36.pdb      Downloads       Movies        Projects        UHRF-Manuscript-A6.pdf
3a42.pdb      dumpster        muscle3.52    Public          UnionList-AA2.fasta
3afa.pdb      EndNote         muscle3.8.31  PUTTY_RND      VariousBackup
3eoj.pdb      EndNote - Copy  Music         python          WhatIsThis
3fjq.pdb      film            MyDocs        R              WINDOWS
3hd0.pdb      forlib          myfile        reiser          work
3le1.pdb      fraOphelie     myfile.txt    Relativistic   www_docs
3sn6.pdb      from_app3      paralign     relorb

jonkl@login2 ~->
```

Primitive and old-fashioned? *No!*

- Line-by-line
- Step-by-step
- Logical order of things
- Logical workflow
- Same way of thinking as in programming

X Window System (X11) with X display manager – basis for GUI



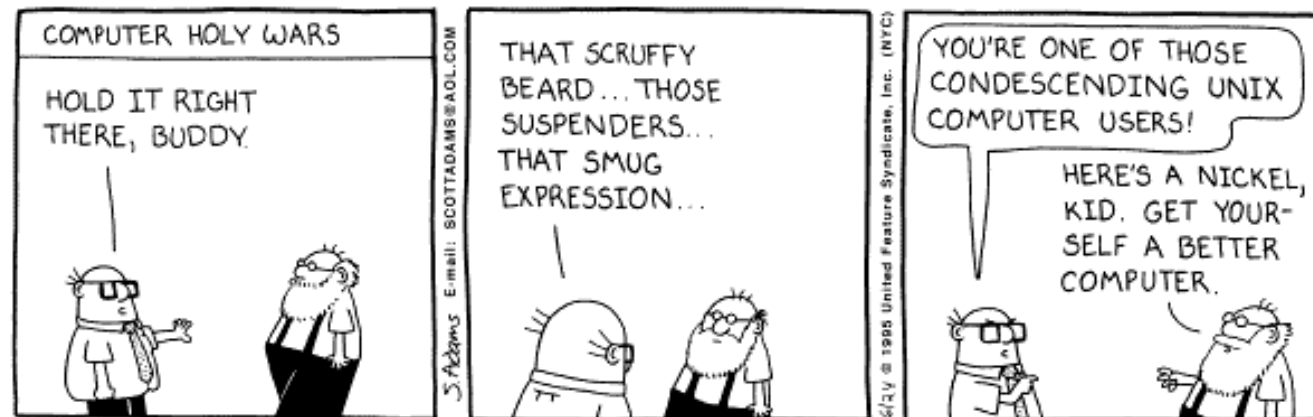
Setup – how to get access to a UNIX computer

- Linux (ok!)
- Mac (ok!)
- Windows
 - Use PuTTY, an open source and free UNIX terminal emulator
 - Installed already on all Windows laptops with a UiO image (UiO setup)
 - Can be downloaded and installed from here:

<http://www.chiark.greenend.org.uk/~sgtatham/putty>

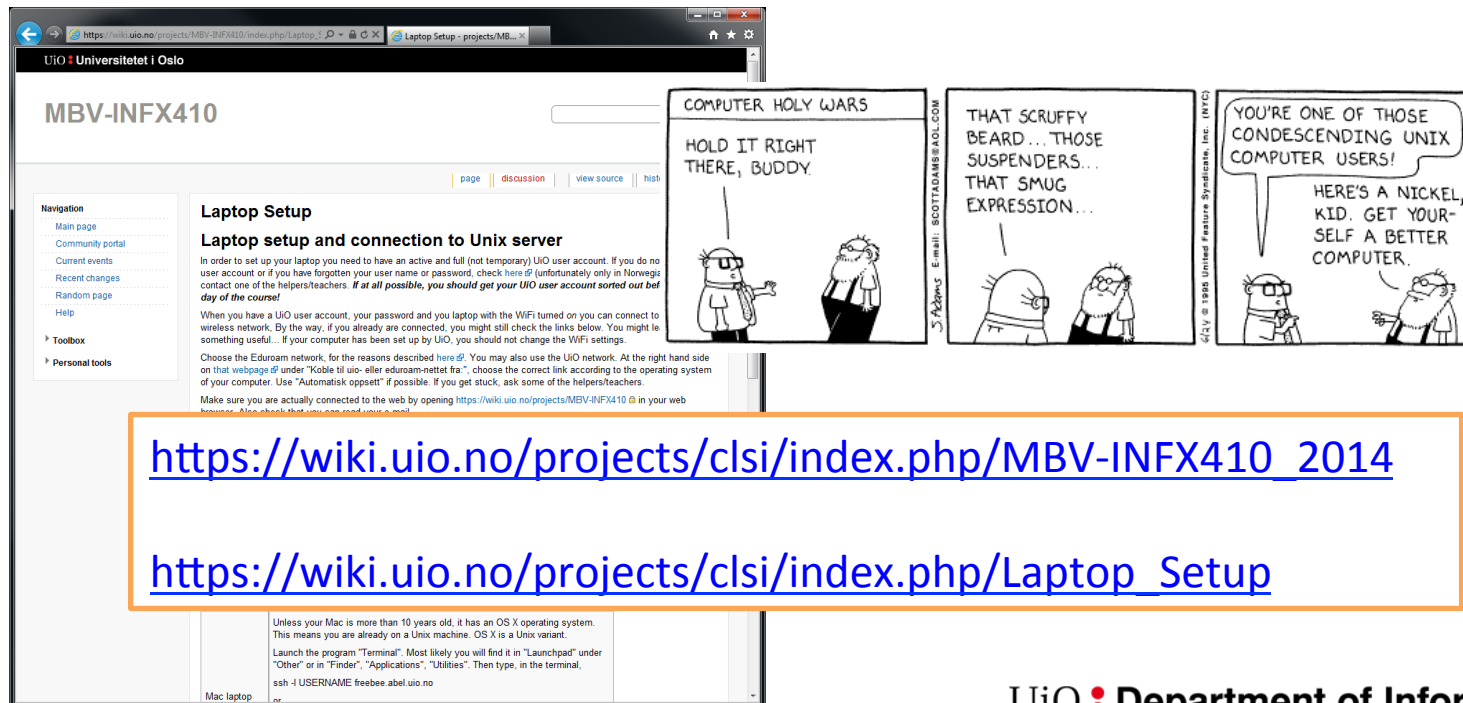


Simon Tatham,
developer of PuTTY



Time to set up the laptops and get connected!

- Set up all laptops correctly
 - *Do it yourself so that you learn something!*
- Today: Log in on the login.uio.no UNIX server
- Later: Log in on the freebee.abel.uio.no UNIX server



The image shows a screenshot of a web browser displaying a wiki page titled "Laptop Setup" on the MBV-INF410 course page. The page content includes instructions for setting up a laptop and connecting to a UNIX server. To the right of the page is a comic strip with three panels. The first panel shows a character saying "COMPUTER HOLY WARS" and another replying "HOLD IT RIGHT THERE, BUDDY." The second panel shows a character with a beard saying "THAT SCRUFFY BEARD... THOSE SUSPENDERS... THAT SMUG EXPRESSION..." The third panel shows a character saying "YOU'RE ONE OF THOSE CONDESCENDING UNIX COMPUTER USERS!" and another replying "HERE'S A NICKEL, KID. GET YOURSELF A BETTER COMPUTER." Below the screenshot, two URLs are highlighted in a blue box:

https://wiki.uio.no/projects/clsi/index.php/MBV-INF410_2014

https://wiki.uio.no/projects/clsi/index.php/Laptop_Setup

Bioinformatics Core Facility & National Bioinformatics Platform

Let us talk about these
nice people for a
while...

Today's Programme

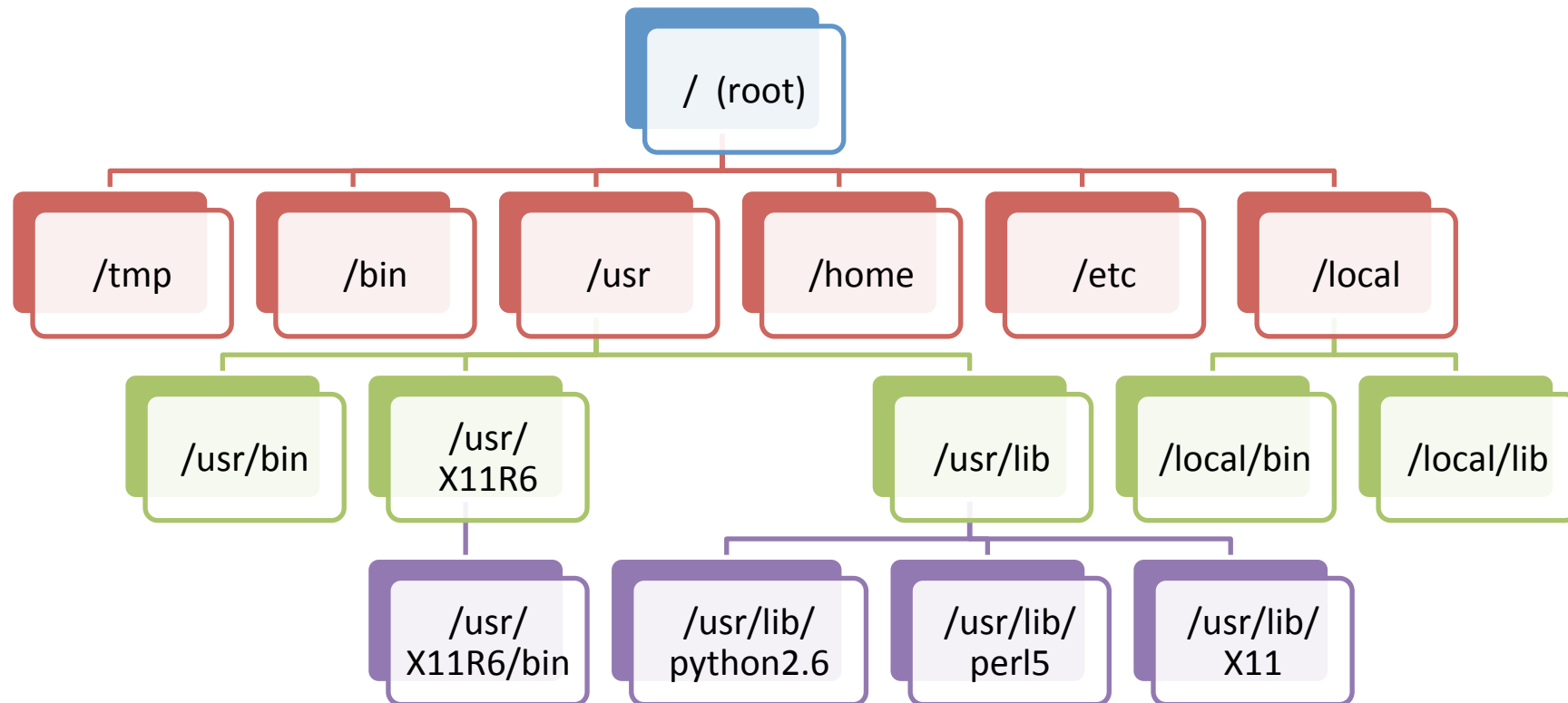
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What about those of you that
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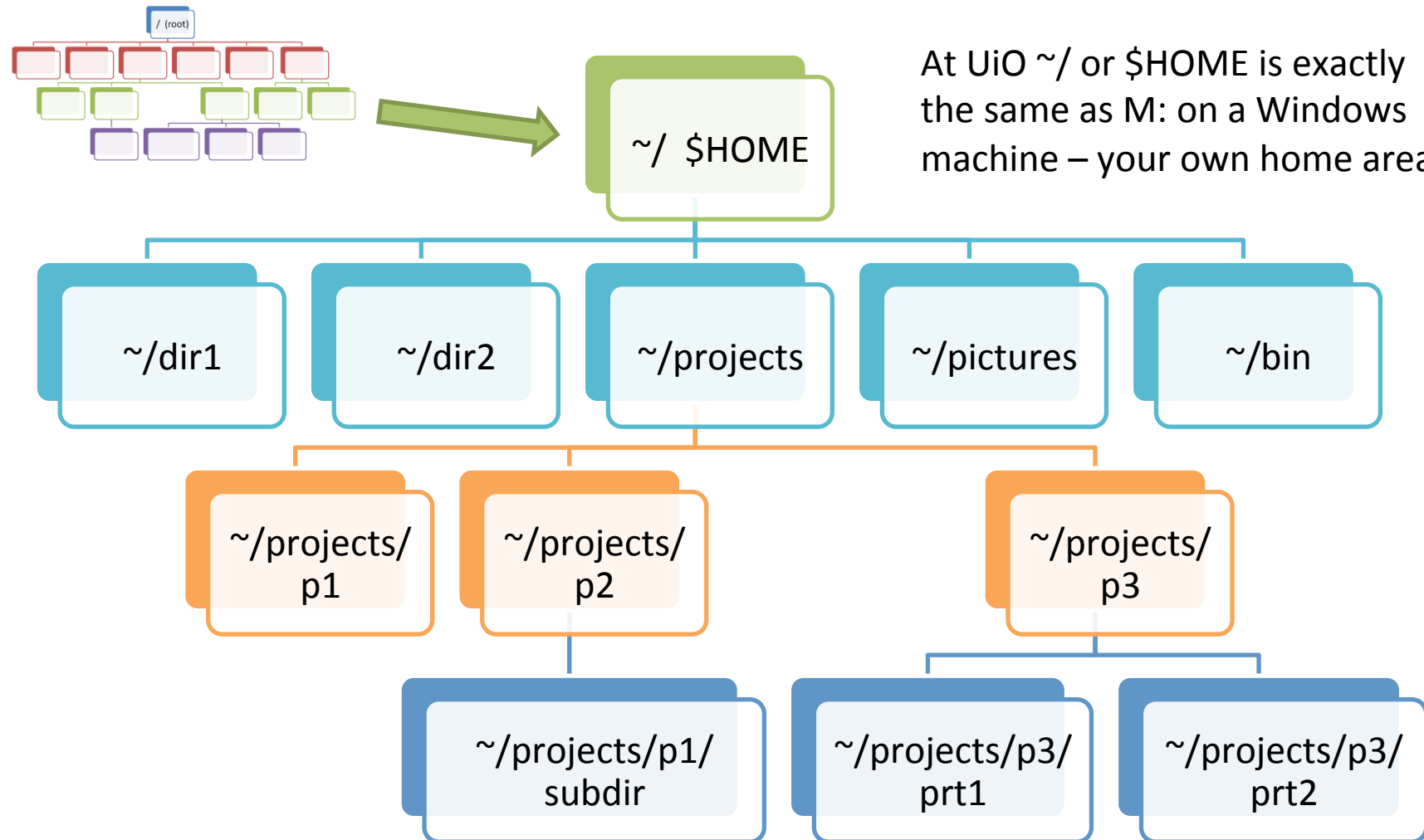
They have left the room...

- Very briefly on the Unix shell, file system and some commands
- UNIX basics exercise
- Tomorrow, continue on databases & working with biological sequences

UNIX file system hierarchy



File system hierarchy



UNIX and file system basics

- ~/ or \$HOME is your home area directory
- . is your current directory
- .. is the directory above the one your are in
- File names and commands are **case sensitive**
- MyFile.txt and myfile.txt are not the same
- ~/Pictures/Family/anna1.jpg and ~/Pictures/family/anna1.jpg are not the same (they are in different directories)
- Avoid spaces, special characters and Norwegian letters in file and directory names as this sometimes causes trouble

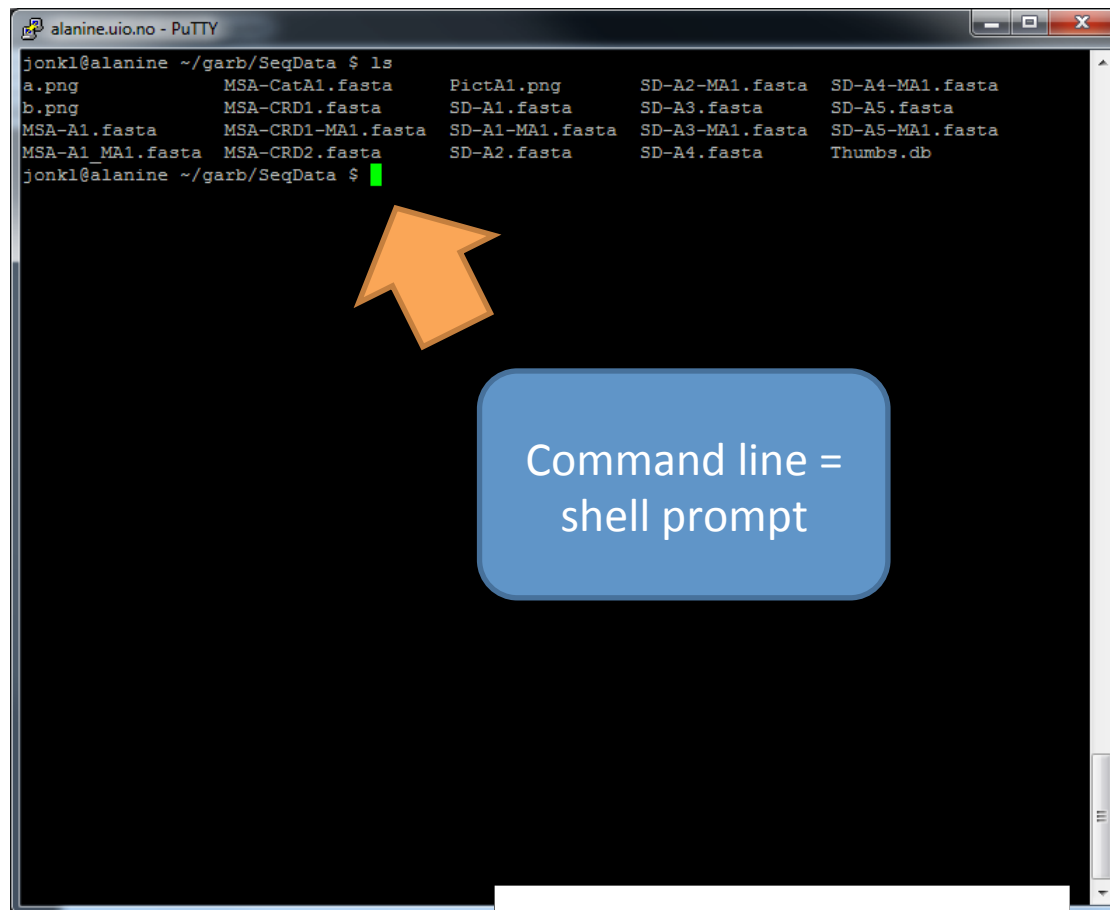
– ~/Pictures/Ølfest/anna1.jpg

– ~/Pics/Summer 2012/anna1.jpg

~/Pictures/Ol-fest/anna1.jpg

~/Pics/Summer_2012/anna1.jpg

UNIX command line



```
alanine.uio.no - PuTTY
jonkl@alanine ~/garb/SeqData $ ls
a.png          MSA-CatA1.fasta  PictA1.png      SD-A2-MA1.fasta  SD-A4-MA1.fasta
b.png          MSA-CRD1.fasta  SD-A1.fasta     SD-A3.fasta      SD-A5.fasta
MSA-A1.fasta   MSA-CRD1-MA1.fasta SD-A1-MA1.fasta SD-A3-MA1.fasta  SD-A5-MA1.fasta
MSA-A1_MA1.fasta MSA-CRD2.fasta  SD-A2.fasta     SD-A4.fasta      Thumbs.db
jonkl@alanine ~/garb/SeqData $
```

Command line =
shell prompt

The UNIX shell is a command-line interpreter

- a program that waits for your commands and executes them
- it is a shell around all programs being run

Various versions

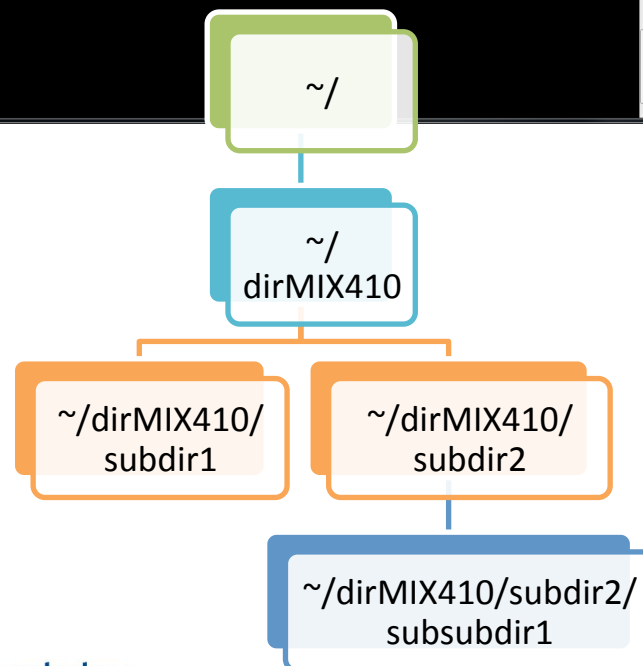
- C shell (csh)
- tcsh
- Bourne shell (sh)
- Bourne-again shell (bash)
 - Default on most Linux systems and Mac OS X

We will use bash



UNIX commands

```
jonkl@alanine ~ $ mkdir dirMIX410
jonkl@alanine ~ $ mkdir dirMIX410/subdir1
jonkl@alanine ~ $ mkdir dirMIX410/subdir2
jonkl@alanine ~ $ mkdir dirMIX410/subdir2/subsubdir1
jonkl@alanine ~ $ cd dirMIX410
./dirMIX410
jonkl@alanine ~/dirMIX410 $ cd ..
jonkl@alanine ~ $ cd .
jonkl@alanine ~ $ cd dirMIX410/subdir2/subsubdir1
./dirMIX410/subdir2/subsubdir1
jonkl@alanine ~/dirMIX410/subdir2/subsubdir1 $ cd
jonkl@alanine ~ $ cd dirMIX410/subdir2
./dirMIX410/subdir2
jonkl@alanine ~/dirMIX410/subdir2 $ pwd
/ifi/bifrost/a04/jonkl/dirMIX410/subdir2
jonkl@alanine ~/dirMIX410/subdir2 $ ls
subsubdir1
jonkl@alanine ~/dirMIX410/subdir2 $ █
```



- To make a new directory use **mkdir** (make directory)
 - **mkdir dirMIX410**
- To make subdirectories
 - **mkdir dirMIX410/subdir1**
 - **mkdir dirMIX410/subdir2**
 - **mkdir dirMIX410/subdir2/subsubdir1**
- To navigate use **cd** (change directory)
 - **cd dirMIX410**
 - **cd ..** (takes you one level up)
 - **cd .** (nothing happens, you stay where you are)
 - **cd** (takes you to your home directory)
- To find out where you are use **pwd** (print working directory)
- To see the files and directories in your current directory use **ls**

Time to try yourself!

Unix basics exercises