PHY224 Introduction to C++

Lecture notes prepared by Steven J. Lee

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Course outline

1. Introduction to programming in Linux (Today).
2. Introduction to basics of programming.
3. Data processing in C/C+.+.
4. Data handling in C/C++.
5. Memory management in C/C++.
6. Handling large data in C and C++.
7. Object and Classes.
8. Scripting using ROOT 5 and 6.
9. Programming using ROOT 5 and 6 packages.
10. Parallel programming in C/C++ (Last day).

The course will run from 0900~1145 on Monday August 25 to Friday September 2

Course Schedule

0900~0915: I will give you an introduction to the first topic for the day (Except for today’s lecture due to extended introduction).

0915~1015: For 1 hour, we will divide into smaller groups and work on the exercises.

1015~1030: We will take a short coffee/bathroom break.

1030~1045: I will give you an introduction to the second topic for the day.

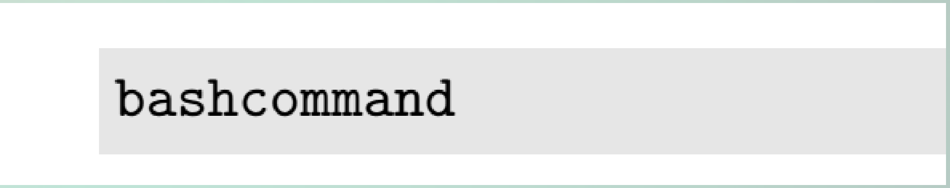
1045~1130: For 45 minutes, we will divide into smaller groups and work on the exercises.

1130~1145: We will address last minute questions and I will conclude the lecture for the day.

Structure of lecture notes

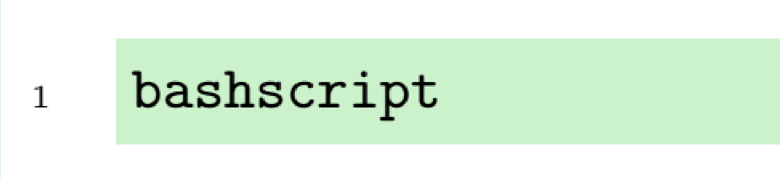
There will be 3 colours used to distinguish between

Bash command (direct command line):



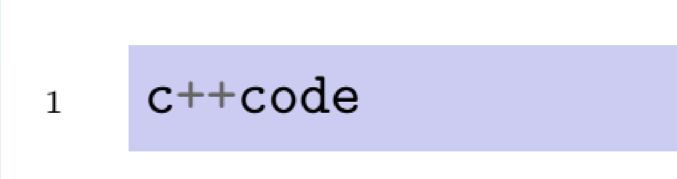
```
bashcommand
```

Bash script (directly executable from command line):



```
bashscript
```

C++ code:



```
c++code
```

Course requirements

This is the first time we’re running the course in person in a few years but we still request that you use your own computer for the exercises.

This means you need to have some form of Linux environment. There are 4 options:

1) Virtual Box: You install a virtual version of linux inside your current computer and operating system.

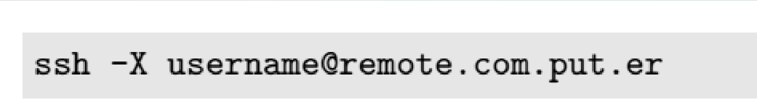
2) Full Linux installation, not the best option for a 2 weeks compressed block course because things can go wrong, unless if you already have it.

3) Mac is built on Unix, which is very close to Linux

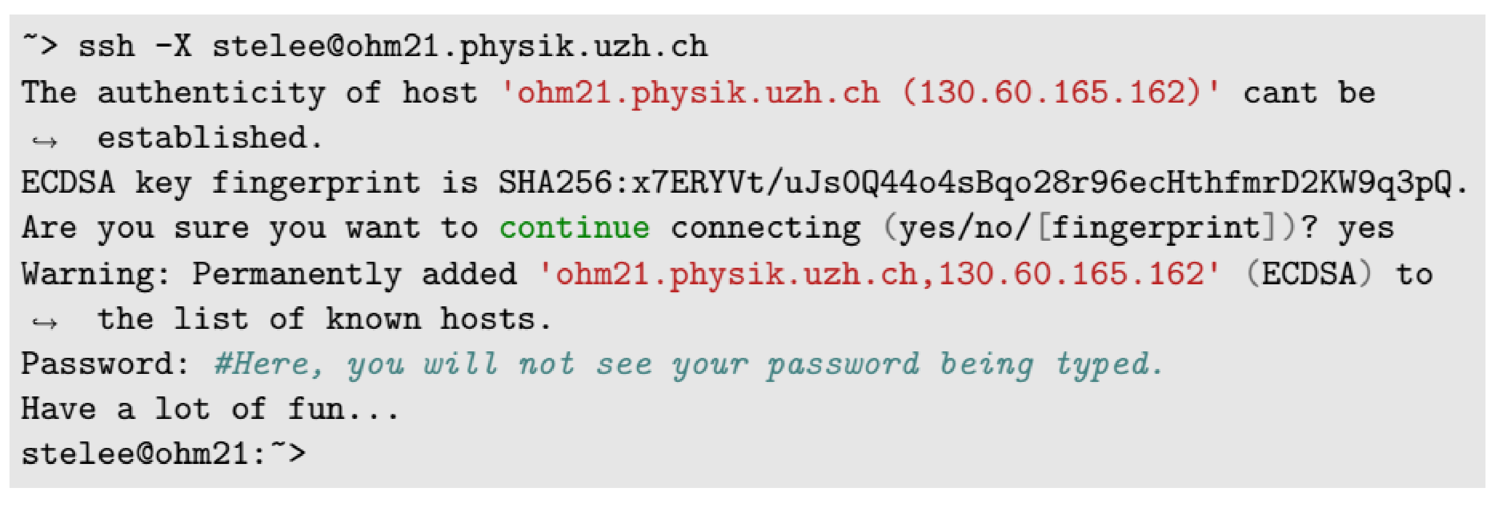
4) For Windows users, we can use “Windows subsystem Linux”

Course requirements

You also have the option to use the virtual machines remotely using open secure shell “ssh” and the command looks similar to this:



```
ssh -X username@remote.com.put.er
```



```
~> ssh -X stelee@ohm21.physik.uzh.ch
The authenticity of host 'ohm21.physik.uzh.ch (130.60.165.162)' cant be
↪  established.
ECDSA key fingerprint is SHA256:x7ERYVt/uJs0Q44o4sBqo28r96ecHthfmrD2KW9q3pQ.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'ohm21.physik.uzh.ch,130.60.165.162' (ECDSA) to
↪  the list of known hosts.
Password: #Here, you will not see your password being typed.
Have a lot of fun...
stelee@ohm21:~>
```

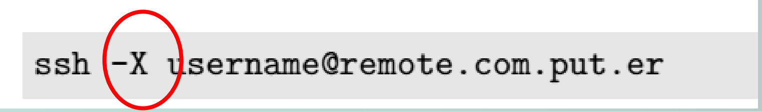
You will also have to make sure the display works in between computers.

Course requirements

On Windows, I recommend using X-Ming (http://www.straightrunning.com/XmingNotes/)

And on Mac, I recommend X-Quartz (https://www.xquartz.org/)

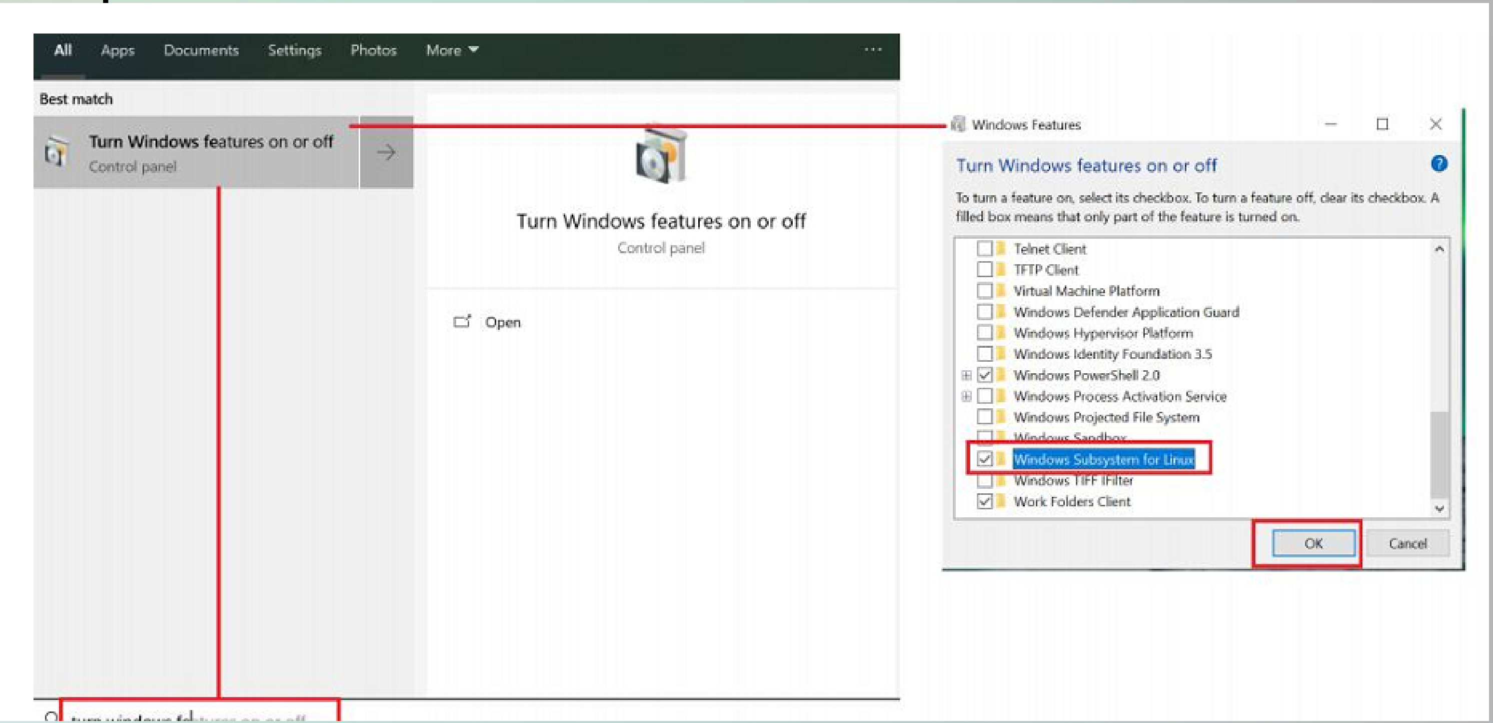
On Linux, you only need to keep in mind the option “-X” when using the SSH command.



```
ssh -X username@remote.com.put.er
```

Windows Subsystem Linux

For Windows Subsystem Linux (WSL), the steps can look intimidating but it is quite simple.


All
Apps
Documents
Settings
Photos
More
Best match
Turn Windows features on or off
Control panel
Turn Windows features on or off
Control panel
Open
turn windows features on or off

Windows Features

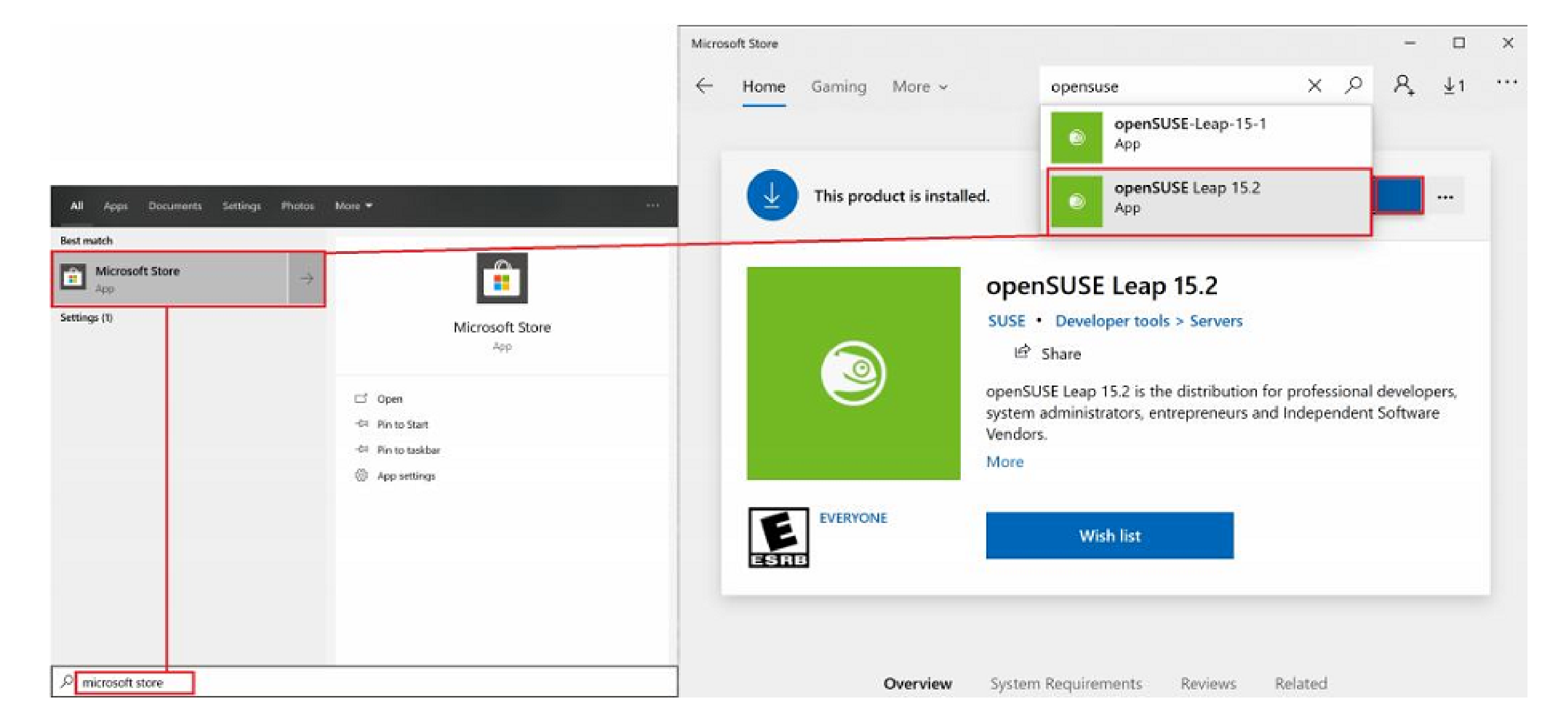
Turn Windows features on or off

To turn a feature on, select its checkbox. To turn a feature off, clear its checkbox. A filled box means that only part of the feature is turned on.

- □ Telnet Client
- □ TFTP Client
- □ Virtual Machine Platform
- □ Windows Defender Application Guard
- □ Windows Hypervisor Platform
- □ Windows Identity Foundation 3.5
- ☑ Windows PowerShell 2.0
- □ Windows Process Activation Service
- □ Windows Projected File System
- □ Windows Sandbox
- ☑ Windows Subsystem for Linux
- □ Windows TIFF IFilter
- ☑ Work Folders Client

OK Cancel

Windows Subsystem Linux

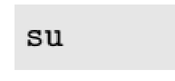


openSUSE Leap 15.2 is the distribution for professional developers, system administrators, entrepreneurs and Independent Software Vendors.

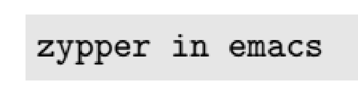
Windows Subsystem Linux

Then in addition, you must install Xming (https://www.physik.uzh.ch/dam/jcr:0b8cc71b-7788-4a7c-b0d0-d47b228bbf33/Xming-6-9-0-31-setup.exe)

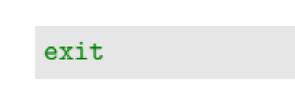
And a text editor within the WSL and configure the “.bashrc” and add in an “export line as follows:



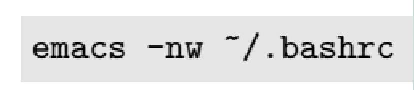
```
su
```



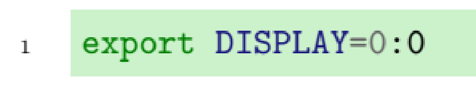
```
zypper in emacs
```



```
exit
```



```
emacs -nw ~/.bashrc
```



```
export DISPLAY=0:0
```

Mac users

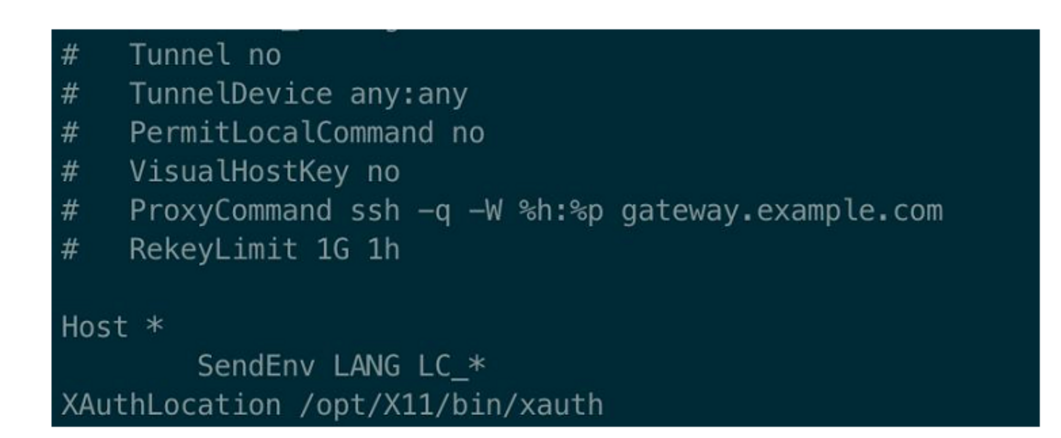
For Mac users, this is a little bit different. You must first install Xquarts (https://www.physik.uzh.ch/dam/jcr:ee978d2d-2c55-4ad5-949f-aea05eddb98f/XQuartz-2.7.11.dmg), then you must add the line:

```
XAuthLocation /opt/X11/bin/xauth
```

Into the file:

```
/etc/ssh/ssh_config
```

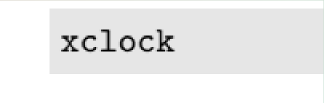
To look similar to this



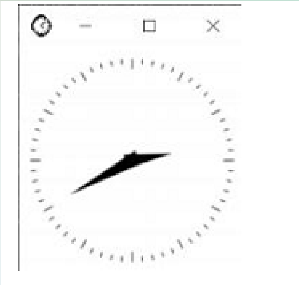
```
#   Tunnel no
#   TunnelDevice any:any
#   PermitLocalCommand no
#   VisualHostKey no
#   ProxyCommand ssh -q -W %h:%p gateway.example.com
#   RekeyLimit 1G 1h

Host *
        SendEnv LANG LC_*
XAuthLocation /opt/X11/bin/xauth
```

Testing

Once we’re all set up, let’s test to make sure we can see a simple x-generated clock called “xclock”



```
xclock
```



If this is working, let’s start programming!