Denne forelesningsøkten vil bli tatt opp og lagt ut i emnet i etterkant.

<u>Hvis</u> du ikke vil være med på opptaket:

	La være å delta med webkameraet ditt.
	La være å delta med mikrofonen din.
	Still spørsmål i Chat i stedet for som lyd. Hvis du ønsker kan spørsmålet også sendes privat til foreleser.

Høyskolen Kristiania

Høyskolen Kristiania

PG3401 Programmering i C for Linux

Bengt Østby

In this lecture

Høyskolen Kristiania

- Structure of the course
- Introduction to C programming
- Setting up environment

Om Bengt Østby

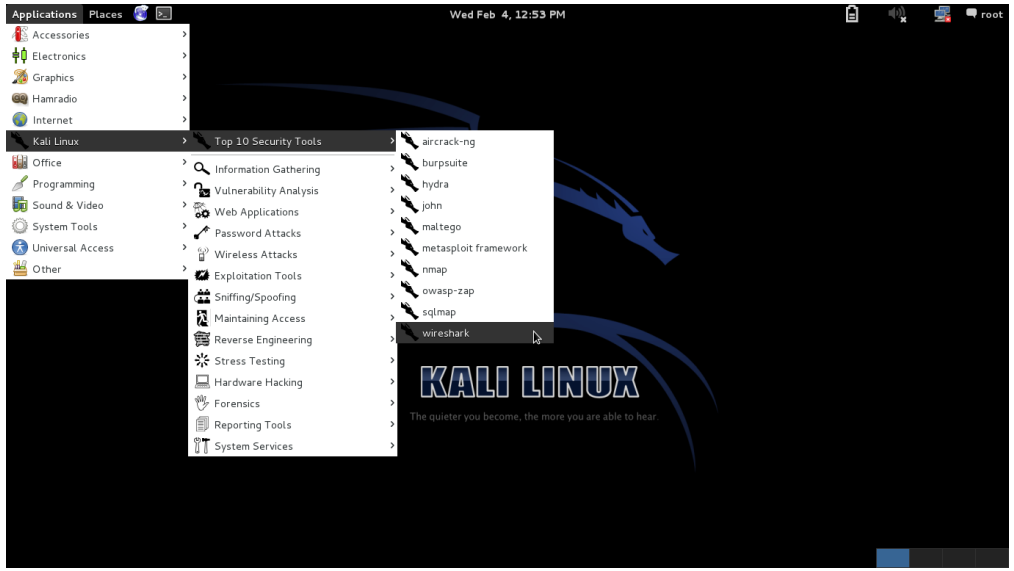
- C-programmerer og Hacker
- Windows system drivere
- 16 års erfaring fra anti-virus bransjen
- Jobbet med avansert video overvåking
- Etisk hacker og fysisk pentester

- Lead Programmer, Norman
- Enterprise Architect Security CoE, AVG
- Security Concepts Group
- Head of Offensive Security, Capgemini Cybersecurity
- Nordic lead Advanced Attack and Readiness Operations, ACN
- Foreleser Høyskolen Kristiania og USN
- Senior teknolog - Stortinget

Om Bengt Østby

Høyskolen Kristiania

- Jobber med Kali Linux på jobb



- Trener Kali Escrima på fritiden
- Og dirker låser…

Course structure

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- Slides are in English, lectures will be held in Norwegian

- 12 weeks of lectures and exercises
  - Lectures and lab exercises on campus
  - Thursdays 16.15 – 20.00
  - Course is built up of 12 lectures

- Exam
  - 2-week home exam
  - Exam will be practical with several problem-solving tasks, both chosen approach to a problem, code quality – and that it actually works will count towards your final grade

- Actual CODING is essential, there is only one way to learn to code… If you only attend lectures and no exercises you will not learn to code – only some theory :-)

Lecture Plan

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Lecture 1 - Introduction to the course and Linux - Why C?
Goal : -- Ability to use own Linux installation –

Lecture 2 - Intro to Tools - OS tools, Compiling tools, Debugging tools

Goal : -- Ability to write and compile a small C program–

Lecture 3 - Short intro to C, Primitive Data types, Control structures

Goal : -- Basic task solving ability –

Lecture 4 - Pointers and applications

Goal : -- Using memory better –

Lecture 5 - Strings, Arrays and Structs

Goal : -- Even more memories

Lecture Plan

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Lecture 6 - I/O - terminal and files

Goal : -- A complete small single module program with functional I/O

Lecture 7 - Module-based programming, function scopes, preprocessor

Goal : -- Better organization of program into modules –

Lecture 8 - Enumerated Types, Unions, Bit operations, Threads

Goal : -- Just letting you know –

Lecture 9 - Libraries, third-party sources, advanced debugging

Goal : -- To get you not to reinvent the wheel –

Lecture 10 – Networking in C

Goal : -- Widening your scope –

Lecture 11 – Safe Programming

Goal : -- Practical and safe usage –

Lecture 12 - Repetition and Summary

Timetable of lectures and exercises

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Thursday 26. August	16.15 – 20.00	Lecture 1 : Introduction to the course, and Linux
Thursday 2. September	16.15 – 20.00	Lecture 2 : Introduction to C and how to compile
Thursday 9. September	16.15 – 20.00	Lecture 3 : Datatypes and control structures
Thursday 16. September	16.15 – 20.00	Lecture 4: Pointers and applications
Thursday 23. September	16.15 – 20.00	Lecture 5: Strings, arrays and structs
Thursday 30. September	16.15 – 20.00	Lecture 6: I/O terminal and files
Thursday 7. October	16.15 – 20.00	Lecture 7: Functions and preprocessor
Thursday 14. October	16.15 – 20.00	Lecture 8: Advanced topics; unions, bits etc
Thursday 21. October	16.15 – 20.00	Lecture 9: Libraries, 3rd party and advanced debugging
Thursday 28. October	16.15 – 20.00	Lecture 10: Networking in C
Thursday 4.November	16.15 – 20.00	Lecture 11: Safe Programming
Thursday 11. November	16.15 – 20.00	Exam preparation and course summary

Exam dates not set

Books?

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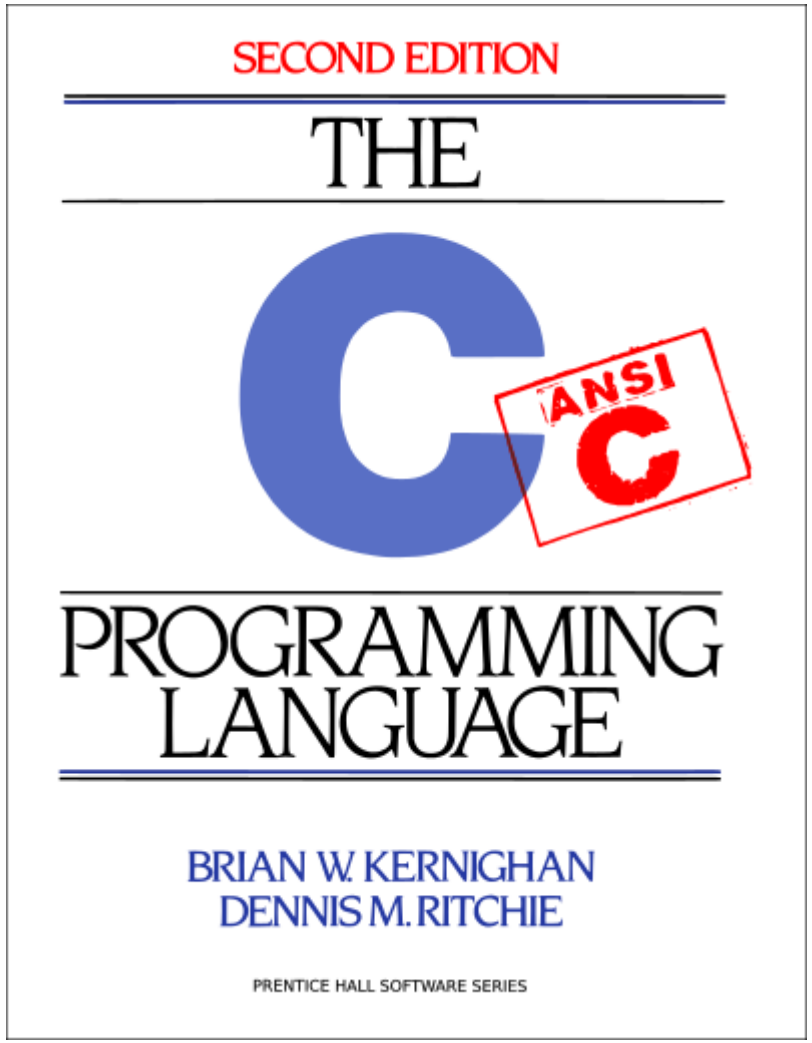
There are written thousand's of books on C.

K&R Second Edition is good

Important to support «all» embedded compilers is to learn traditional C (before C99), that is the reason for this course teaching «ANSI C»

Dennis Ritchie INVENTED the C programming language, so why read someone elses book on his language :-)



Options for environment

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Course covers Linux, but the focus is on C programming.

You can run Linux in a virtual machine:

- Ubuntu
- Debian (I use Kali Linux, which is based on Debian)

You can install manually, or use preinstalled images from osboxes.org.

To run a virtual machine, you have many options:

- Virtual Box (free for students)
- VM Ware Player (free for students)
- Vm Ware Workstation

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Start downloading now…

Google: “Running Debian in a vmware image” or go to:

- https://www.osboxes.org/debian/#debian-10-vmware
  (about 1Gbyte download, 5-6 Gbyte unpacked)
- Same site can also be used for Virtualbox (in other pane)

Google: “download vmware player” or:

- https://www.vmware.com/products/workstation-player/workstation-player-evaluation.html

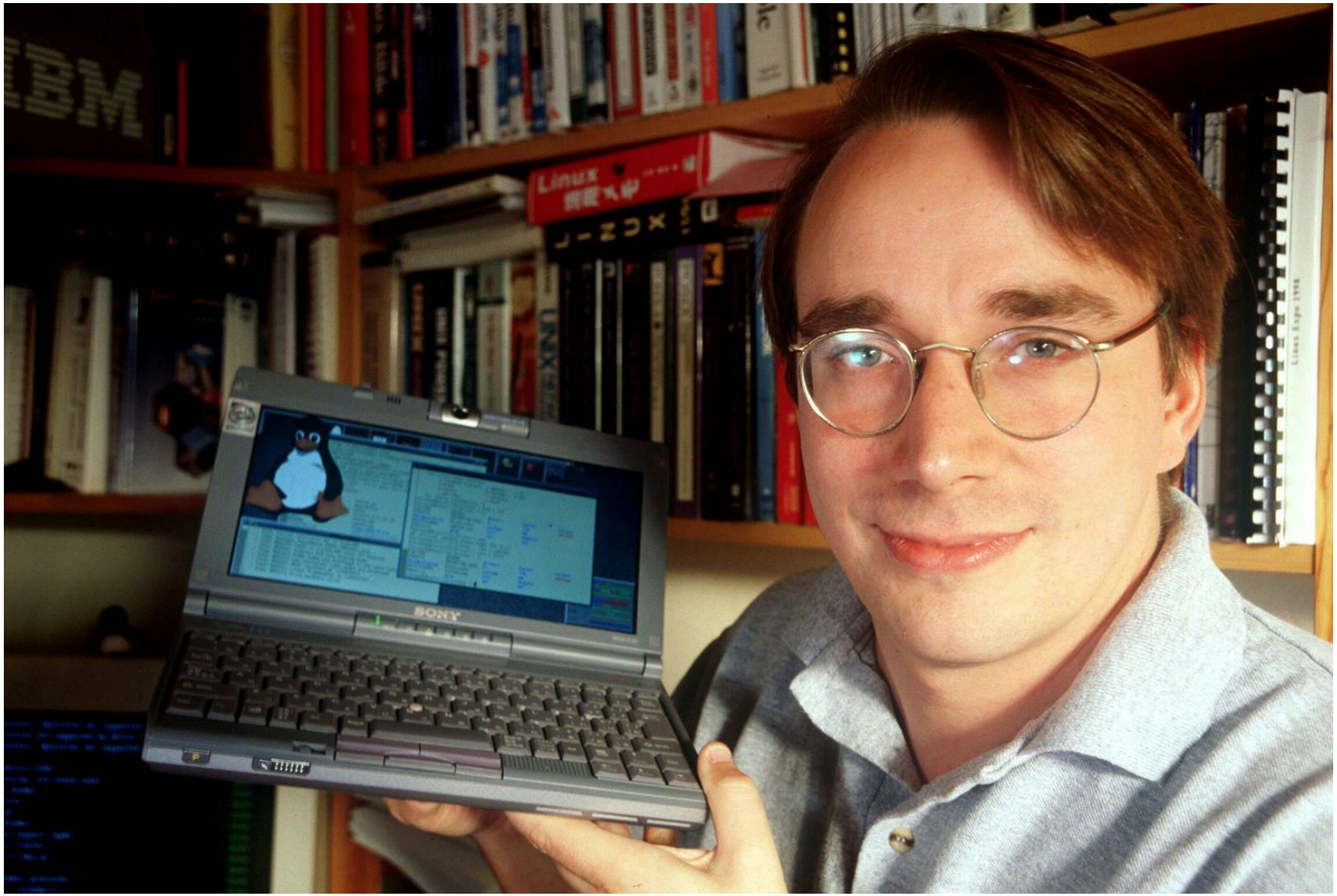
Or:

- https://www.virtualbox.org/wiki/Downloads

In the beginning, there was UNIX.

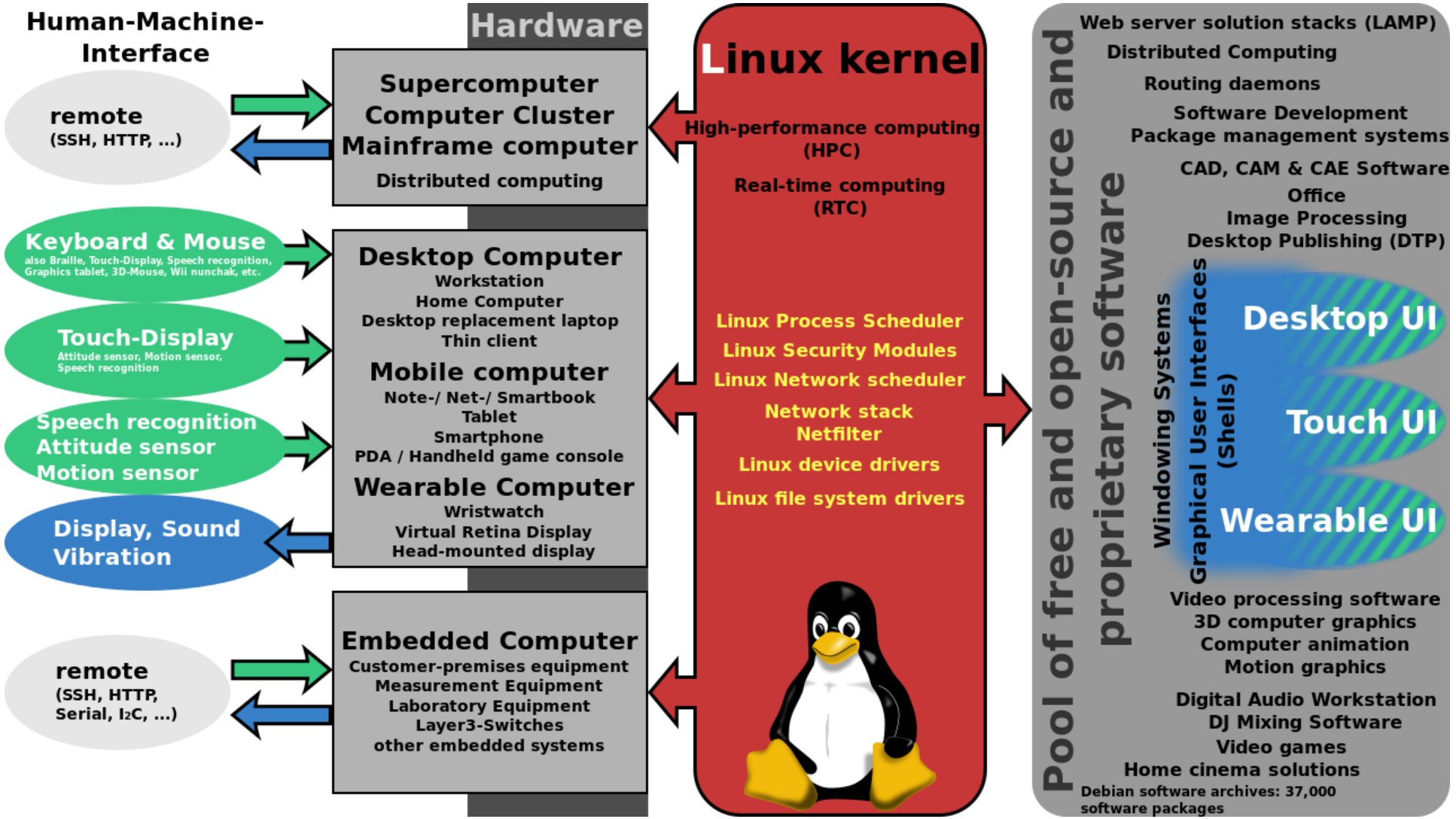
GNU is a free, cleanroom, implementation of Unix

Linux is the kernel GNU never made!



Linux is an extremely flexible OS.

Google™



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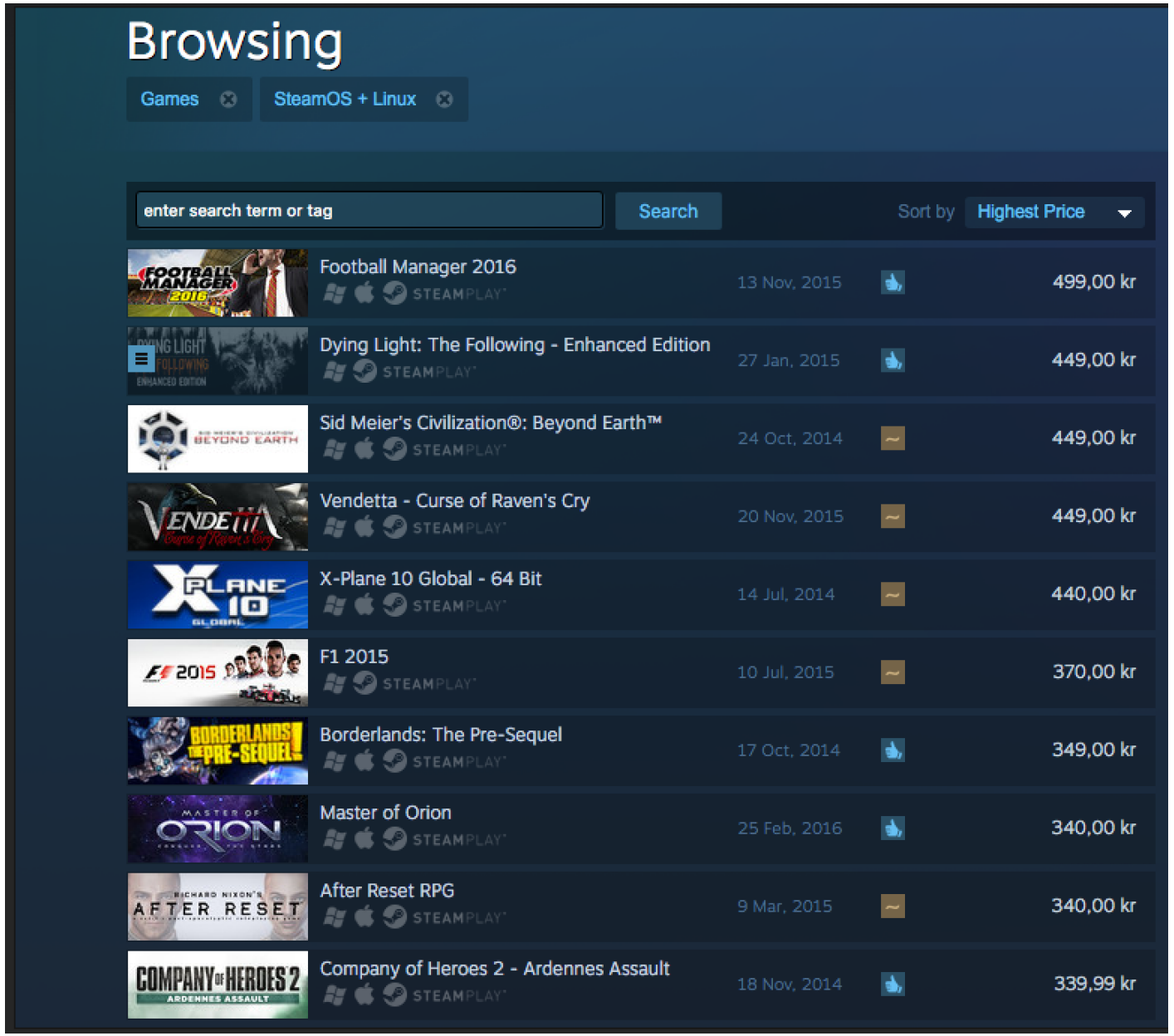
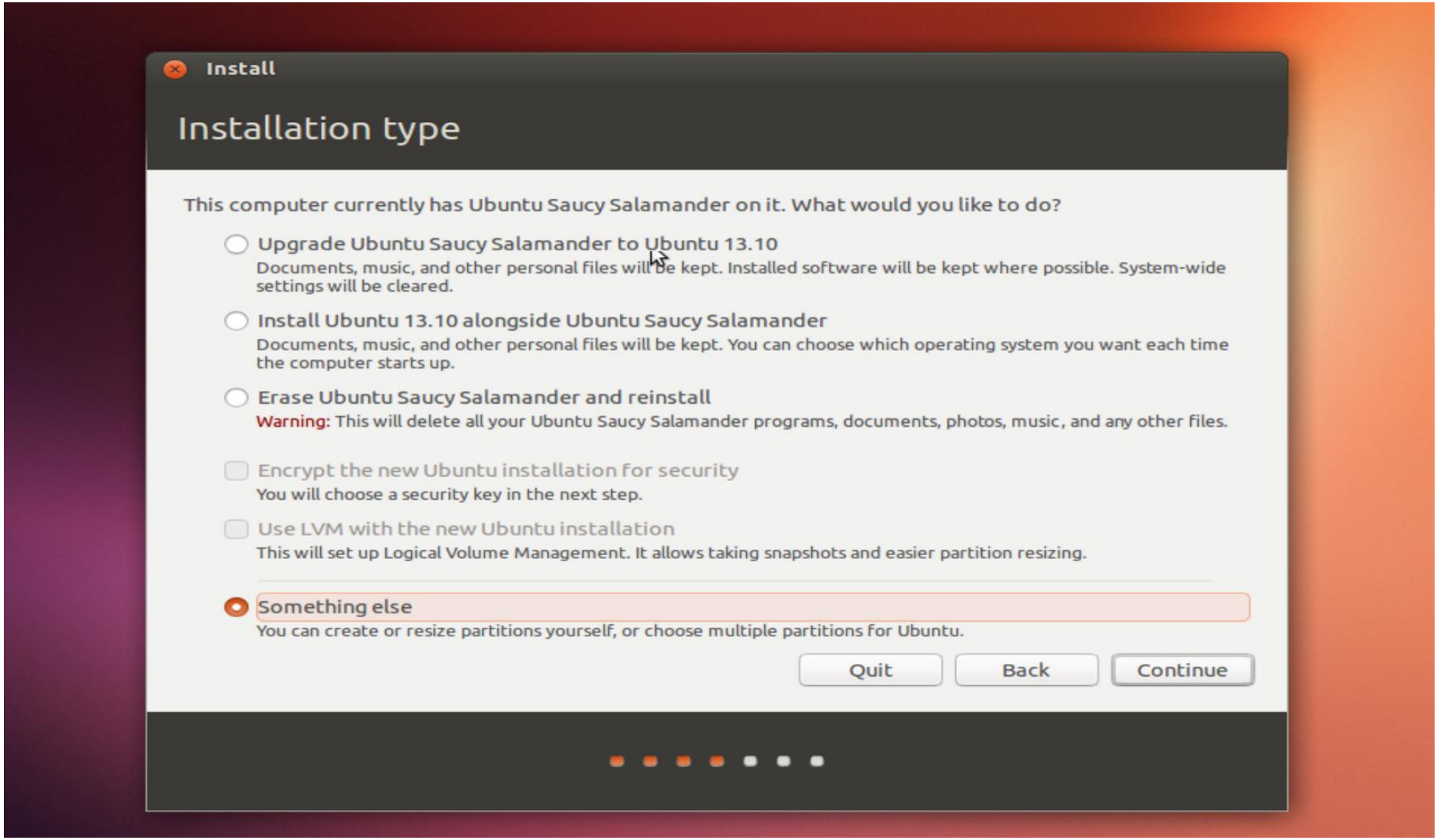
Now with games!



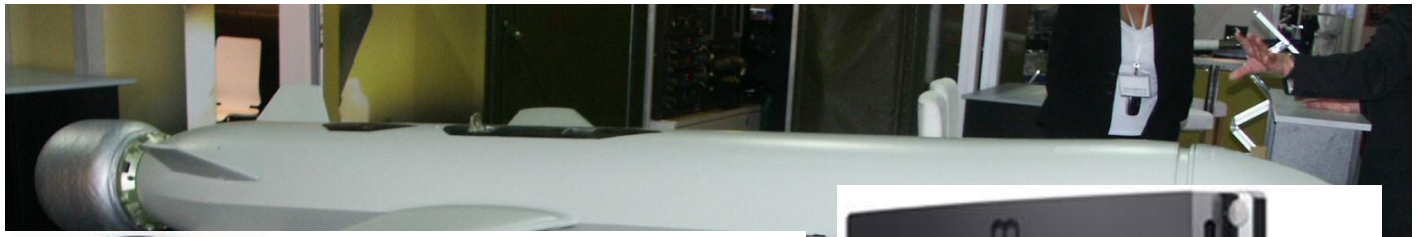
The General Public License allows redistribution, but requires you to grant the same rights to all.

Free as in Freedom

What is a “Linux Distribution”?



C is used EVERYWHERE, but you might not “C” it!



Which are the most popular programming languages in August according to TIOBE?

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https://www.tiobe.com/tiobe-index//

Aug 2020	Aug 2019	Change	Programming Language	Ratings	Change
1	2	↑	C	16.98%	+1.83%
2	1	↓	Java	14.43%	-1.60%
3	3		Python	9.69%	-0.33%
4	4		C++	6.84%	+0.78%
5	5		C#	4.68%	+0.83%
6	6		Visual Basic	4.66%	+0.97%
7	7		JavaScript	2.87%	+0.62%
8	20	⇈	R	2.79%	+1.97%
9	8	↓	PHP	2.24%	+0.17%
10	10		SQL	1.46%	-0.17%
11	17	⇈	Go	1.43%	+0.45%
12	18	⇈	Swift	1.42%	+0.53%
13	19	⇈	Perl	1.11%	+0.25%
14	15	↑	Assembly language	1.04%	-0.07%
15	11	⇊	Ruby	1.03%	-0.28%
16	12	⇊	MATLAB	0.86%	-0.41%
17	16	↓	Classic Visual Basic	0.82%	-0.20%

Embedded programming is making C popular (again)…

What is C?

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- Programming Language…
- Brian Kernighan and Dennis Ritchie (K&R “C”)
- Powerful programming language

- Easy to write *compilers*
- *The compiler of C is written in C!*
- *The operating system is written in C!*
- *Most high-level languages use interpreters, written in C*

- With great power comes great responsibility

The philosophy of C

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- Trust the programmer
- Keep the language small and tidy
- Provide only one way to do an operation
- Make it fast, even if it’s not guaranteed to be portable
- Maintain conceptual simplicity
- Don’t prevent the programmer from doing what needs to be done.

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"Programming is hard. Programming correct C and C++ is particularly hard. Indeed, both in C and certainly in C++, it is uncommon to see a screenful containing only well defined and conforming code. Why do professional programmers write code like this? ***Because most programmers do not have a deep understanding of the language they are using.*** *While they sometimes know that certain things are undefined or unspecified, they often do not know why it is so."*

Olve Mauldal

Who does C?

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- Performance is priority
- Real-time system developers
- Limited resources – embedded systems
- Operating systems and drivers
- Parts of many AAA-games

- On a full and rich OS you can develop much faster in a high level language – but you can only develop what that language support!
- In C you can make everything, it will (or can) be fast and without overhead, but it is hard…
- If you are close to hardware, then you code in C

Why learn?

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- To be aware of pitfalls
- Ability to develop big projects with performance priority
- Reverse engineering
- Being forced [CUDA, OpenGL, Ffmpeg, pthreads]

Some of you will go on to learn C++, which is a fully modern language based on C.

- C then C++
- C++ is based on C
- C++ does not make sense without C
- C is easier to learn
- C gives a great perspective on the Object Oriented paradigm

- Objective-C is used for mobile development, which is also a variant of C

(Don’t ever try to use C– for anything…)

This course uses Virtual Machines

Virtualization allows running multiple simultaneous OS’es on the same HW.

- Send finished installations around
- For testing and experiments (snapshots…)
- Popular with (anti-)virus programmers
- Consolidating servers
- The basis of Cloud computing (VM-ware, AWS, Azure…)

Virtualisation comes with its own terminology

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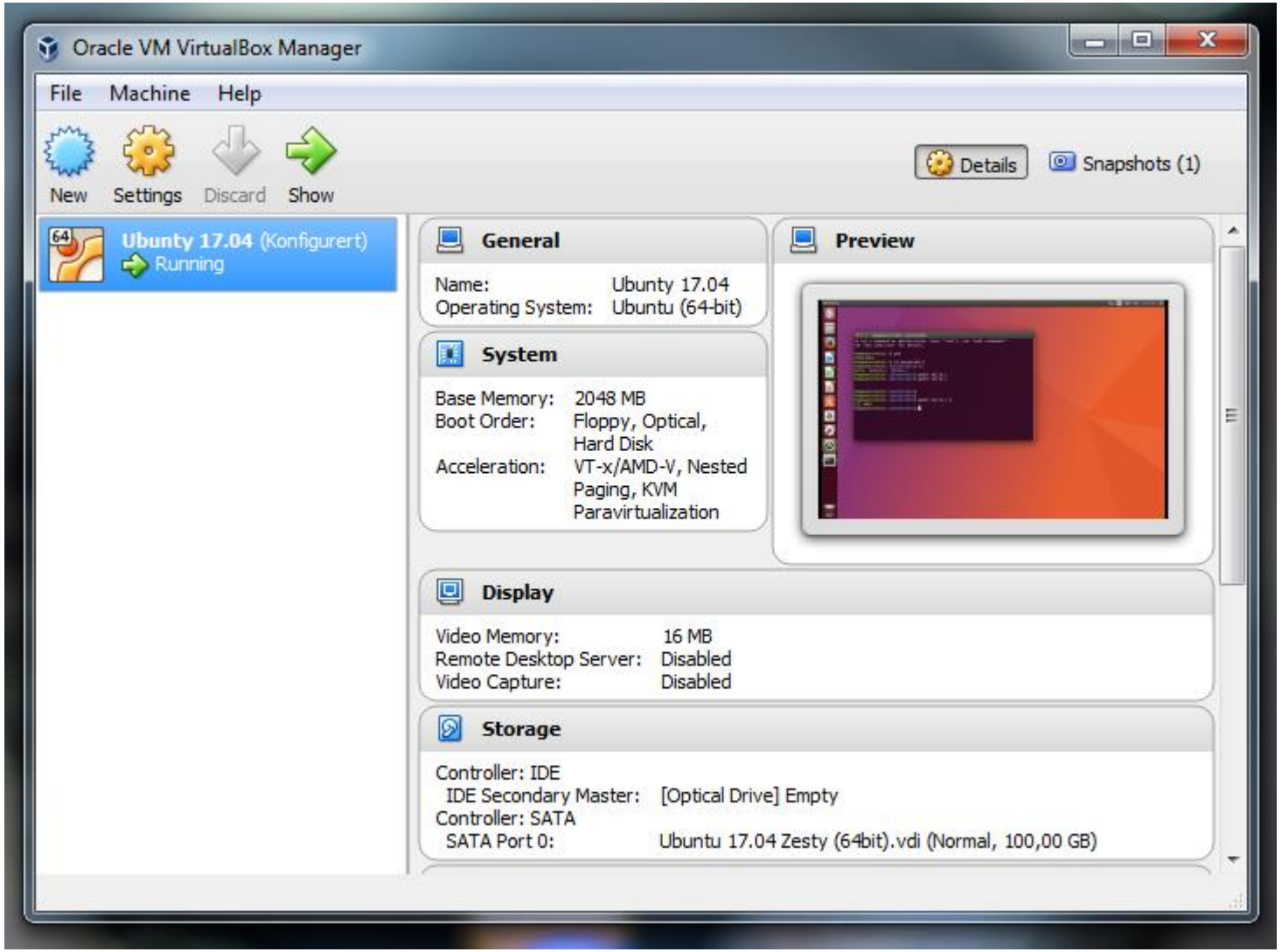
- Host operating system
- Hypervisor
- Virtual Machine
- Guest operating system
- Snapshot

This course will use VM-ware, but cannot promise help with others kinds...



This is the luddite course!

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```
Welcome to Ubuntu 16.04.1 LTS (GNU/Linux 4.4.0-31-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

7 packages can be updated.
0 updates are security updates.


*** System restart required ***
Last login: Mon Aug 15 11:36:10 2016 from 81.175.52.98
kjetilr@oslo:~$ ls
kjetilr@oslo:~$ ls /etc/
X11                     console-setup    fstab            inputrc          libaudit.conf   mdadm
acpi                    cracklib         fuse.conf        insserv          libnl-3         mime.types
adduser.conf            cron.d           gai.conf         insserv.conf     lintianrc       mke2fs.conf
alternatives            cron.daily       groff            insserv.conf.d   locale.alias    modprobe.d
apm                     cron.hourly      group            iproute2         locale.gen      modules
apparmor                cron.monthly     group-           iscsi            localtime       modules-load.d
apparmor.d              cron.weekly      grub.d           issue            logcheck        mtab
apport                  crontab          gshadow          issue.net        login.defs      nanorc
apt                     crypttab         gshadow-         kbd              logrotate.conf  network
at.deny                 dbus-1           gss              kernel           logrotate.d     networks
bash.bashrc             debconf.conf     hdparm.conf      kernel-img.conf  lsb-release     newt
bash_completion         debian_version   host.conf        krb5.conf        ltrace.conf     nsswitch.conf
bash_completion.d       default          hostname         krb5.conf.old    lvm             ntp.conf
bindresvport.blacklist  deluser.conf     hosts            krb5.keytab      machine-id      opt
binfmt.d                depmod.d         hosts.allow      ld.so.cache      magic           os-release
byobu                   dhcp             hosts.deny       ld.so.conf       magic.mime      overlayroot.conf
ca-certificates         dpkg             init             ld.so.conf.d     mailcap         pam.conf
ca-certificates.conf    environment      init.d           ldap             mailcap.order   pam.d
calendar                fonts            initramfs-tools  legal            manpath.config  passwd
kjetilr@oslo:~$
```

We will learn to be “old-school”

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- For those familiar with modern IDE, coding and compiling on command-prompt on Linux will feel like exchanging a modern drill with a box of screwdrivers
- But you will all thank me when you work with embedded systems (or kernel mode drivers)
- Debugging crashes on a machine without a keyboard or monitor, or a system that crashes during boot sequence - is extremely difficult, but possible as long as we stay «old-school»

Today’s assignment

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- Install Linux
- Run Linux
- Make account with new password
- Delete old account
- Configure as you like it (keyboard layout??)
- Surf the web, check mail
- Try Gedit

Set NO as preferred keyboard layout

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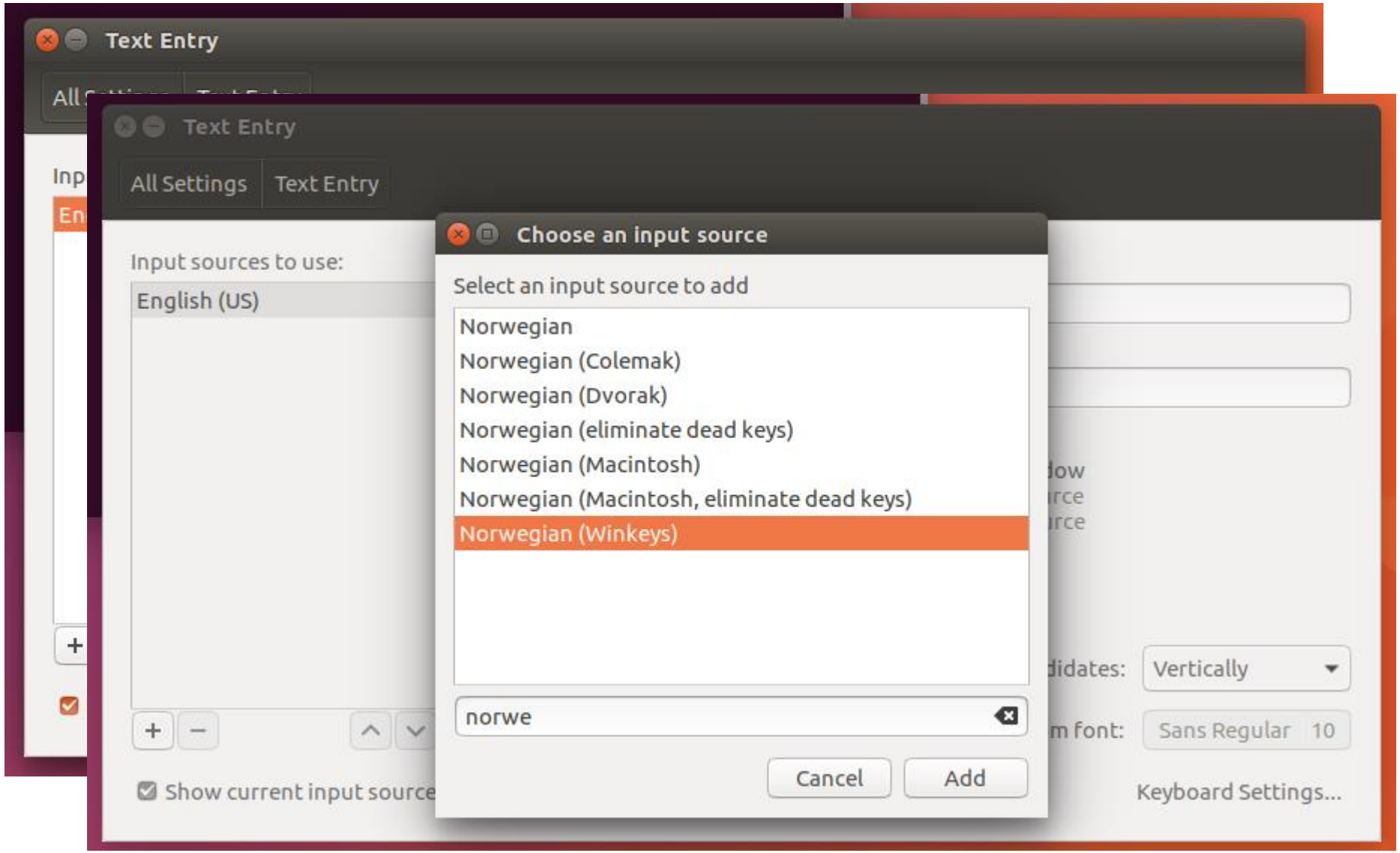

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Practical

Practical – Installing:

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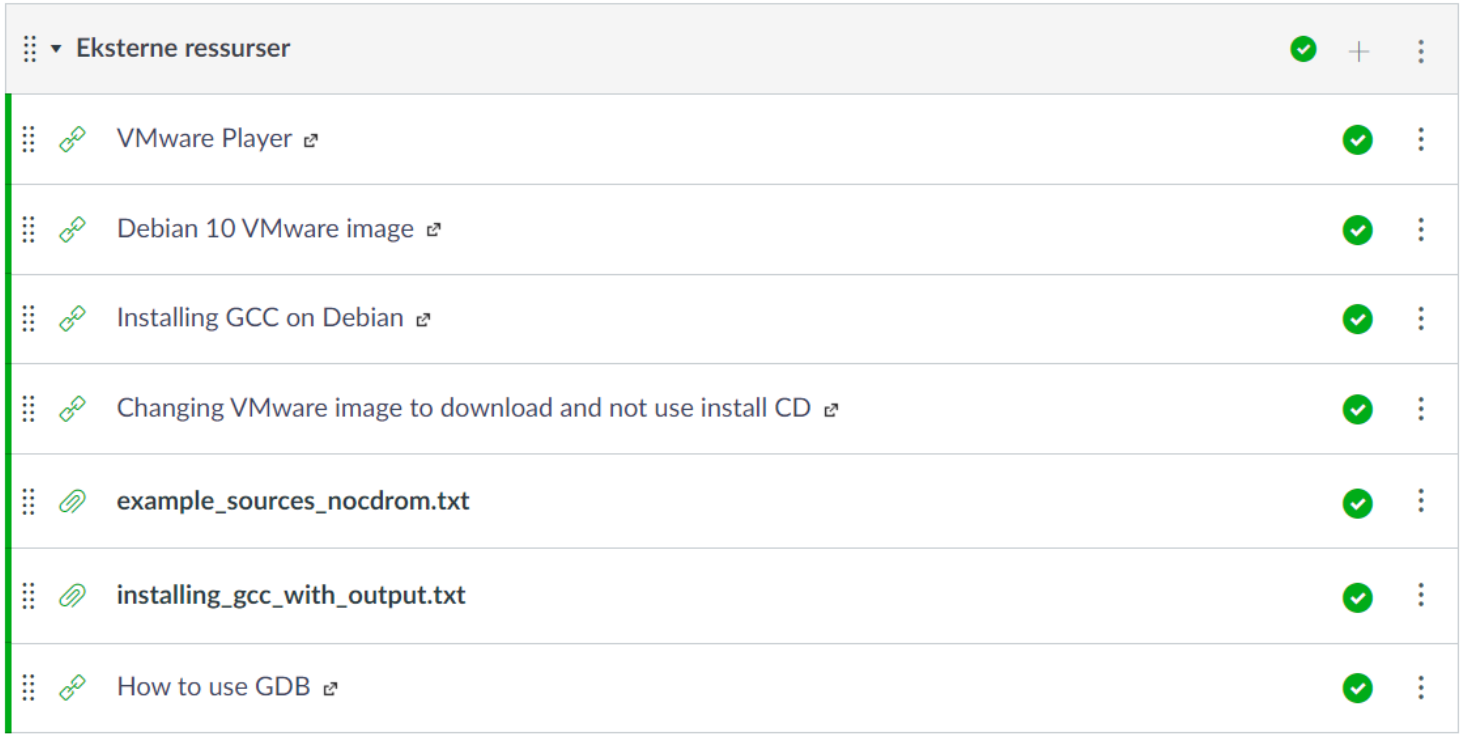
- **Install VmWare Player**
- **Install Debian 10 image**
- **Install GCC**

- **Linker ligger i Canvas:**



Practical – Linux :

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wget http://www.eastwillsecurity.com/pg3401/linux.txt

Try to read the file

Open a new tab in terminal

Follow the instructions from the file

Lab exercises

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Help each other becoming used to Linux. Some of you might have used it before, some are new to this OS. Make sure you all help each other – this is one of the most difficult courses you will take at this school, everyone of you will need help from the class! :-) You must attend Campus trainings, trying to learn it all your self will most often fail, hard…

After next week everyone in the class MUST have a running Linux environment and be able to edit and compile code!