Introduction to Linux

EECS 211

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Outline

What is Linux?

- UNIX like OS which uses the **Linux kernel**
  - Originally developed by Linus Torvalds in 1991
  - Over 10 million lines of code
- The whole OS consists of kernel and user space (originally from GNU project)

  Kernel hardware management (device drivers), process and memory management, file systems, networking, ...

  User space init system, desktop environment, http server, web browser, video player, ...
- Very modular with numerous choices for components which provide the same functionality
- **Linux distributions** integrate components into a fully functioning OS. Examples for distributions are: Debian, Red Hat, SuSE, Gentoo, Ubuntu, Arch, ...

Why Should You Care?

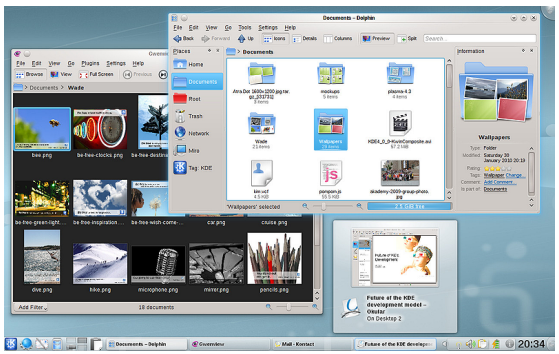
- The Linux ecosystem consists of free software
  - You are free to use it for any purpose
  - You are free to study how it works, and modify it to make it do what you wish
  - You are free to redistribute copies and modified versions
- It is important to be familiar with software development for Linux systems, as they are very widespread:
  - 60% of all web servers run Linux
  - 446 out of the top 500 fastest supercomputers run Linux
  - Intel and Nokia are working on "MeeGo", which will run on a wide range of consumer devices (cell phones, netbooks, in-vehicle...)
  - Google's Chrome OS is Linux based
  - Android uses the Linux kernel
- Looks good on your resume, many job opportunities

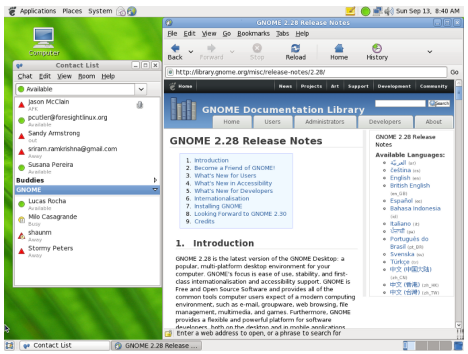
How to Get Started - Overview

- Choosing a Linux distribution
- Installation method
- First steps

Choosing a Linux Distribution

- There are many distributions (google for "Linux family tree")
- Do some research, criteria include:
  - Ease of installation and use: Mainstream distributions (Ubuntu, Fedora, SuSE, Mandriva,...) are easy to use but allow for little customization (and you will learn less)
  - Is the distribution actively developed?
  - How many software packages are available?
  - Which desktop environment(s) does it support?





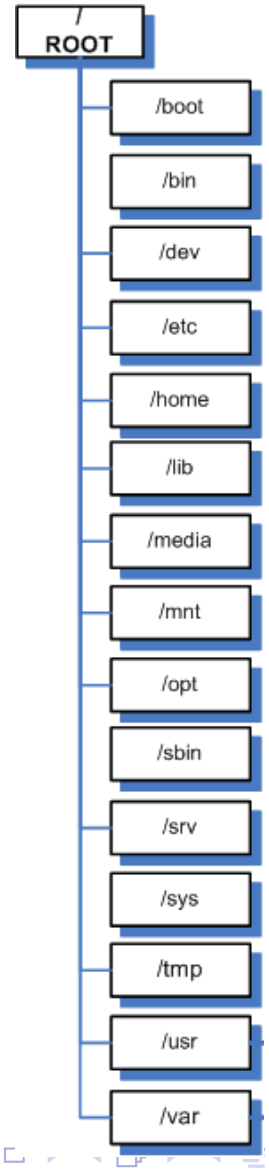
Installation Method

There are several ways you can "install" Linux:

- Use Linux inside a virtual machine
- Boot from CD/DVD or USB stick (for some distributions, e.g., Knoppix)
- Dual boot (requires changing the partition layout)
- Use Linux as primary OS (Windows inside a virtual machine)

First Steps

- Become familiar with the desktop environment
- Familiarize yourself with the directory structure
- Learn how to install additional software using a package manager
- Learn how to use the shell (terminal)
  - In many cases more efficient than using a GUI program
  - Automate tedious things using shell scripts
  - TAB completion is your friend



GNU Toolchain

- The **GNU toolchain** is most commonly used for C/C++ development under Linux
- The important parts for us are:

GCC	Suite of compilers for several programming languages (**G**NU **C**ompiler **C**ollection)
GNU make	Automation tool for compilation and build
GDB	Debugger (GNU Debugger)

GCC - **G**NU **C**ompiler **C**ollection

- Supports a large number of programming languages (C, C++, Java, Ada, Objective-C, Objective-C++, Fortran..) and platforms (x86, x86-64, ARM, MIPS, PowerPC..)
- Compiling a C++ program consisting of a single source file is very simple:

  `g++ main.cpp -g -o main`

  This compiles the source code directly into an executable
- Larger projects consist of multiple .cpp files
- To build an executable, each .cpp is first compiled into an object file (.o) which are then linked together to obtain an executable
- **GNU make** helps automating the build process

GNU make & Makefiles

- Make uses **makefile**(s) which specify how to obtain a **target** program from each of its **dependencies**
- The basic syntax for an entry is

```
<target>: [ <dependency > ]*
[ <TAB> <command> <endl> ]+}
```

- For the previous example a simple makefile could be

```
main: main.cpp
<TAB>  g++ main.cpp -g -o main
```

- For one source file using a makefile does not make too much sense
- Make is mostly useful when using multiple .cpp files

GNU make & Makefiles Cont.

- Assume you have 2 source files `main.cpp` and `file_reader.cpp`, in this case the makefile could be

```
main: main.o file_reader.o
<TAB>  g++ main.o file_reader.o -o main

main.o: main.cpp
<TAB>  g++ -c main.cpp

file_reader.o: file_reader.cpp
<TAB>  g++ -c file_reader.cpp
```

- A makefile like this quickly becomes tedious to maintain for larger projects
- Solution: use **macros**

GNU make & Makefiles Cont.

- A more sophisticated makefile using macros:

```
CXXFLAGS = -O2 -g -Wall
OBJS = main.o file_reader.o
LIBS =
TARGET = main

$(TARGET):  $(OBJS)
<TAB>  $(CXX) $(CXXFLAGS) -o $(TARGET) $(OBJS) $(LIBS)

all: $(TARGET)

clean:
<TAB>  rm -f $(OBJS) $(TARGET)
```

- The (builtin) **CXX** macro assumes that there is a .cpp file for each object file, it automatically compiles each .cpp file and links the object files together

Hands-on Demonstration

- Using Ubuntu in a virtual machine (VirtualBox)
- Desktop environment
- Installing software (CodeBlocks, GCC, GUN make, etc)
- Using CodeBlocks
- Sharing files with the host OS
- Using the shell and other useful tools