CS 2080: PROGRAMMING WITH UNIX

DR. ARMIN MOIN, ASSISTANT PROFESSOR

QUANTUM-CLASSICAL AI AND SOFTWARE ENGINEERING (QAS) LAB

DEPARTMENT OF COMPUTER SCIENCE

UNIVERSITY OF COLORADO COLORADO SPRINGS (UCCS)

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LECTURE 3: UNIX AND GNU/LINUX BASICS; THE UNIX AND FREE, OPEN-SOURCE PHILOSOPHIES

- Outline:
  - UNIX & UNIX-like OSs
  - The UNIX philosophy
  - The Free, Open-Source Software philosophy
  - GNU/Linux

UNIX & UNIX-LIKE OPERATING SYSTEMS

- UNIX: Originated at AT&T Bell Labs in the early 1970s
- Written in C and assembly language
- Since UNIX was portable on various platforms from different vendors, many different UNIX-like OSs emerged: E.g., BSD from the University of California, Berkeley, Solaris from Sun Microsystems, Mac OS X from Apple, and various GNU/Linux distributions

UNIX & UNIX-LIKE OPERATING SYSTEMS

- The POSIX international standard
  - The Portable Operating System Interface
  - IEEE/Open Group 1003.1-2017

THE UNIX PHILOSOPHY

1. Write programs that do one thing and do it well.
2. Write programs to work together. Expect the output of one program to become the input of another.
3. Design and build software (including operating systems) to be tried early, ideally within weeks.
4. Write programs to handle text streams since that is a universal interface.

THE FREE, OPEN-SOURCE SOFTWARE PHILOSOPHY

- Early days of computing (1950s): software distributed as source + binary
- By the 1980s: (proprietary) software was normally distributed in the binary form only
- In 1984, Richard Stallman started developing a free, open-source, UNIX-like OS called GNU

THE FREE, OPEN-SOURCE SOFTWARE PHILOSOPHY

- The GNU project pioneered the free software movement
- Free in this case refers to the freedom of use, not free as in free beer or free lunch.
- All *free* software (Free Libre Open-Source Software, FLOSS) are open-source, but not all open-source software are *free*.

THE 4 ESSENTIAL FREEDOMS

1. The freedom to run the program as you wish, for any purpose (freedom 0).
2. The freedom to study how the program works, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this.
3. The freedom to redistribute copies so you can help others (freedom 2).
4. The freedom to distribute copies of your modified versions to others (freedom 3). By doing this, you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

- Source: https://www.gnu.org/philosophy/free-sw.en.html#four-freedoms

FREE SOFTWARE CAN BE COMMERCIAL

- There exist various business models for free, open-source software (e.g., dual licensing, service, training, etc.)
- Examples include but are not limited to dual licenses, Software as a Service (SaaS), professional services, as well as training and certification.
- Permissive open-source licenses (e.g., BSD, MIT, Apache, LGPL) vs. non-permissive open-source licenses (e.g., GPL)
- Freeware is about the price (being zero), but free software is about the 4 freedoms.

OPEN-SOURCE SOFTWARE CAN BE NON-”FREE”

- There exist software applications that are open-source but do not comply with the Free, Open-Source Software definition and terms (i.e., do not protect the 4 freedoms!)
- For example, Royalty-Free Software (e.g., Nokia)

GNU/LINUX

- GNU: Recursive acronym for *GNU's Not UNIX*
- Richard Stallman – 1984
- By 1991, the GNU project had developed compilers, editors, utilities, libraries, and games.

GNU/LINUX

- However, the GNU kernel never became ready.
- In 1991, a student in Finland, Linux Torvalds, released an open-source kernel using GNU compilers and tools and invited contributions worldwide.
- Linus Torvald's code constitutes less than 1% of the recent Linux kernels.

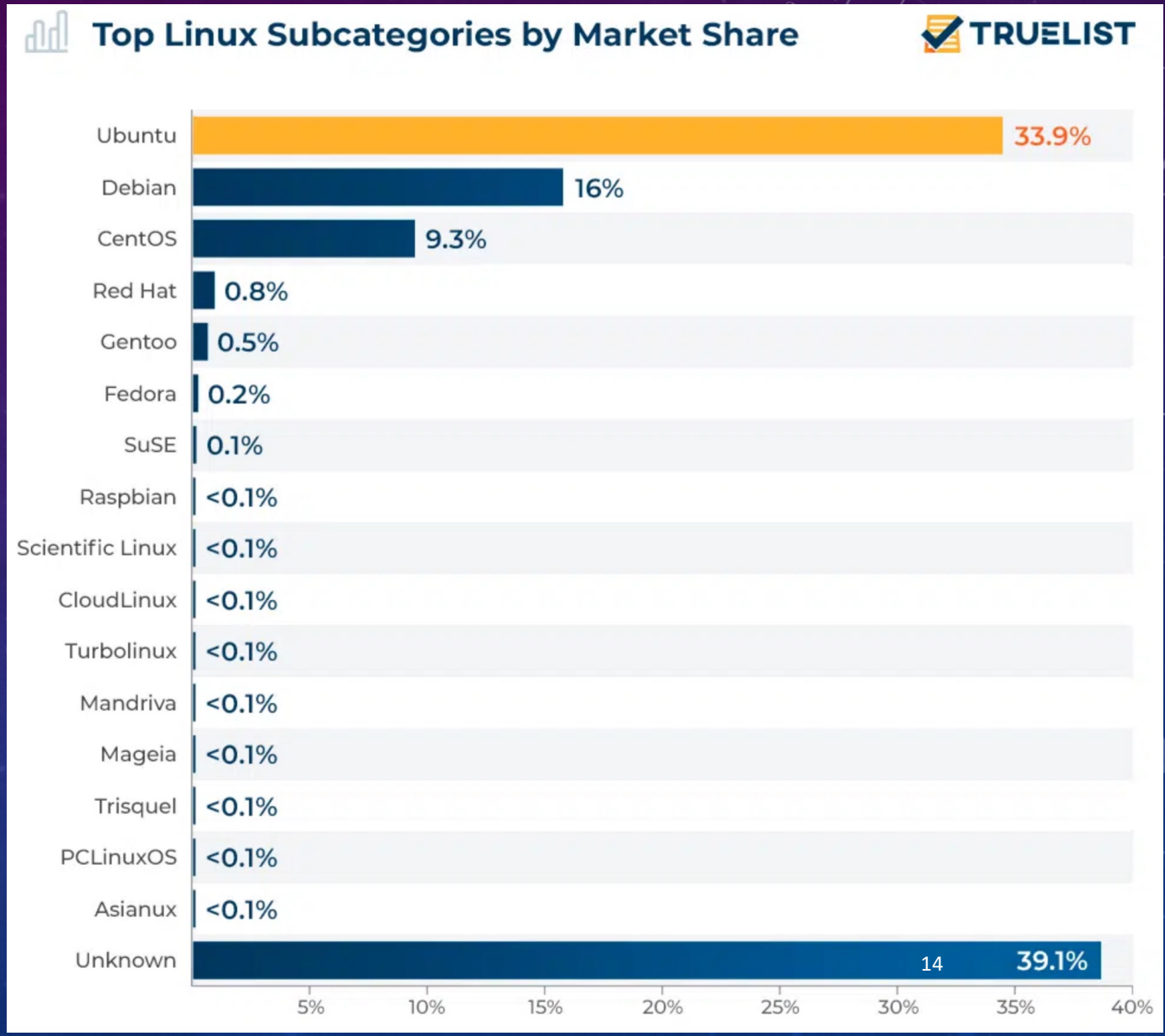
WHY LINUX?

- 100% of all the top 500 supercomputers use Linux.
- 86% global market share for Android (Linux-based) smartphones.
- 90% of the public cloud workload and 96% of top 1 million web servers run Linux.
- The initial Linux kernel had only 10K LOC. Today's Linux kernels have 10-30M LOC.
- Almost all military and space programs worldwide use Linux.

Sources https://thedeveloperstory.com/2021/08/26/linux-turns-30-here-are-16-facts-that-make-linux-the-most-important-os-ever-created/, https://truelist.co/blog/linux-statistics/#:~:text=16.-,96.3%25%20of%20the%20top%20one%20million%20web%20servers%20are%20running,use%20Linux%2C%20server%20statistics%20indicate, and https://www.enterpriseappstoday.com/stats/linux-statistics.html.

LINUX DISTRIBUTIONS

Ubuntu leads the market...

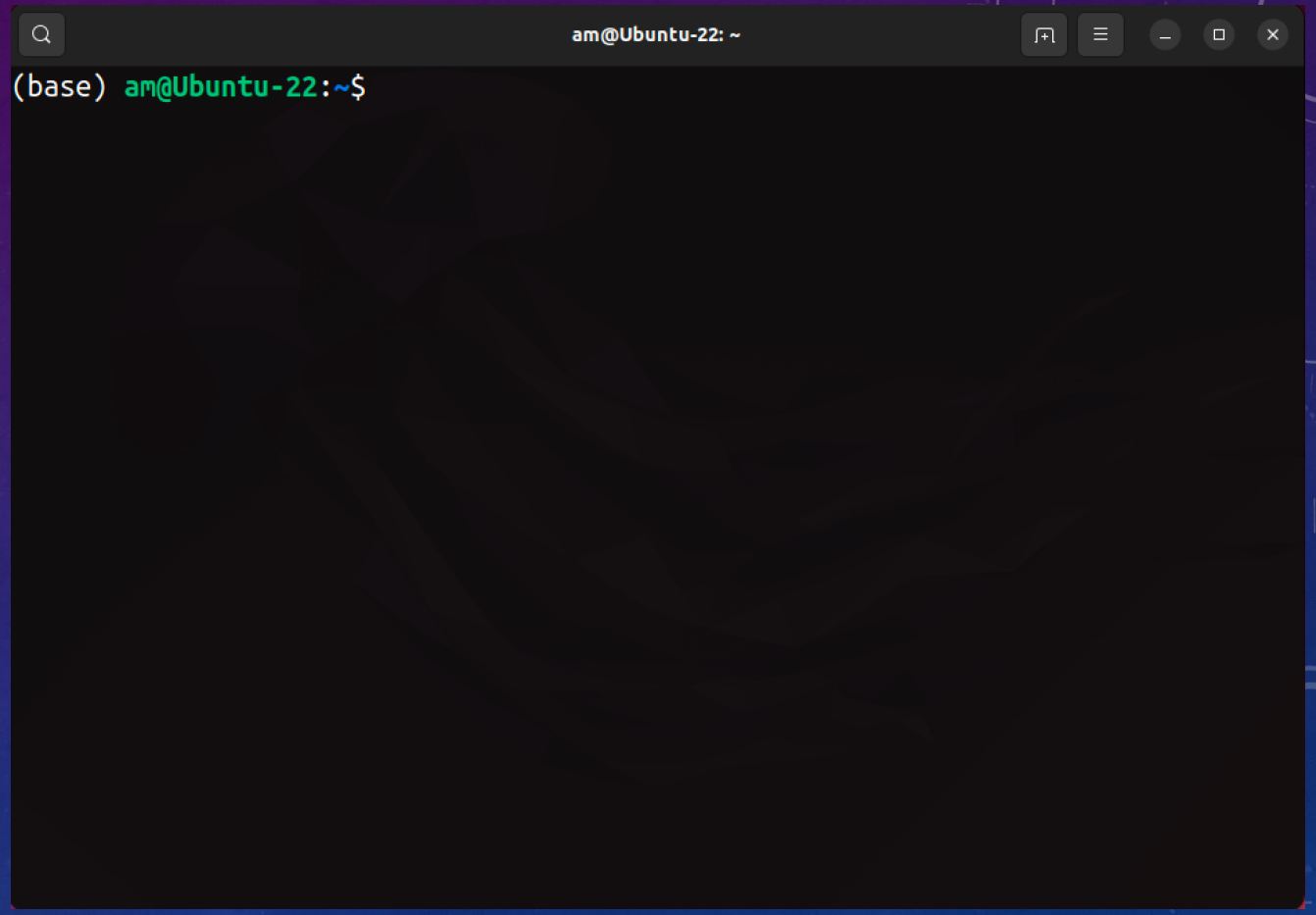


WE FOCUS ON LINUX (UBUNTU)

- Many commands and programs will also work on other Unix-like OSs and UNIX
- Note: On some systems, including Ubuntu, you may need to install extra software packages

THE LINUX BASICS

- Interacting through a shell (terminal)

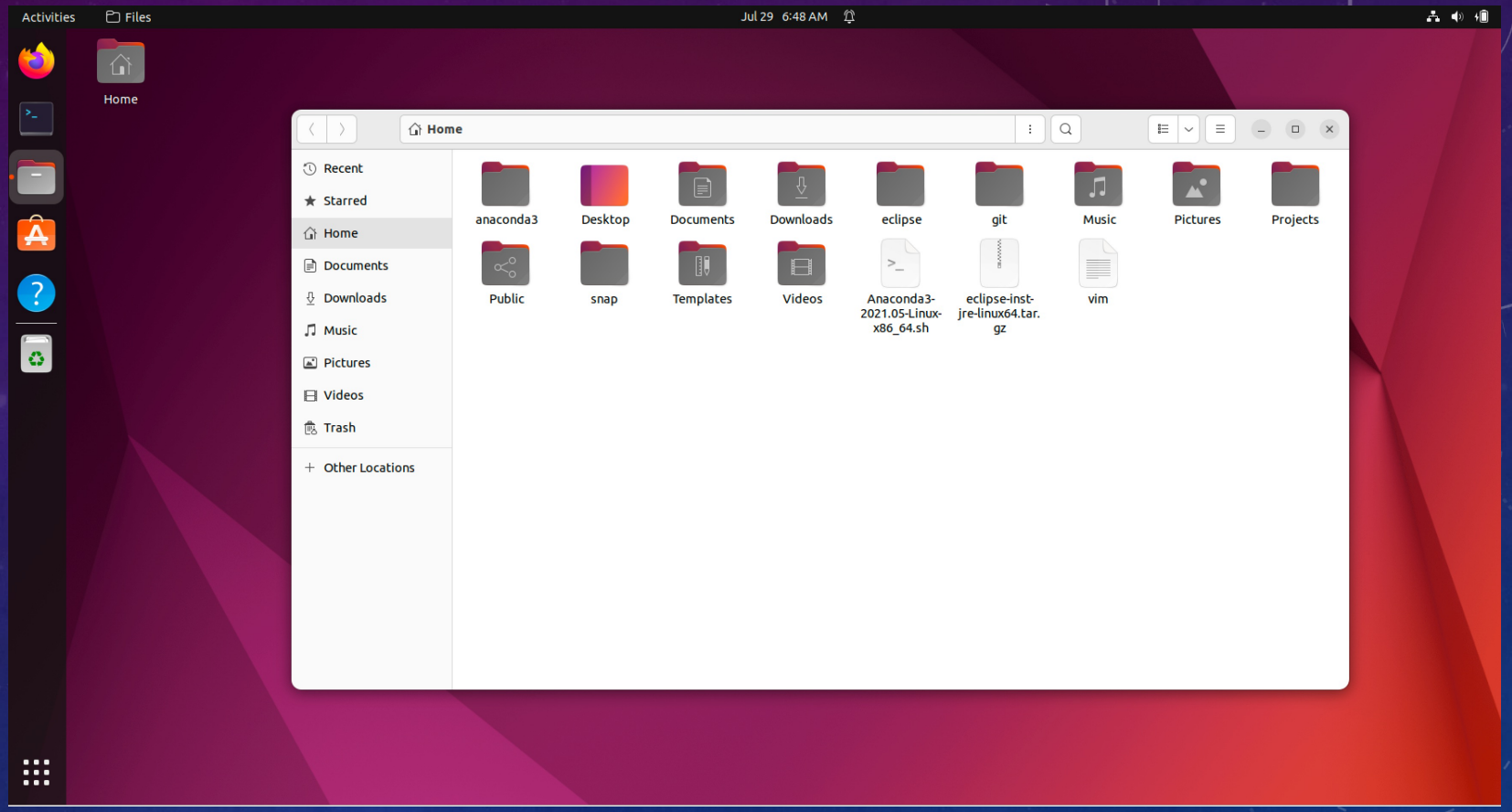


FINDING WHICH SHELL IS IN USE

- echo $SHELL
  - /bin/bash

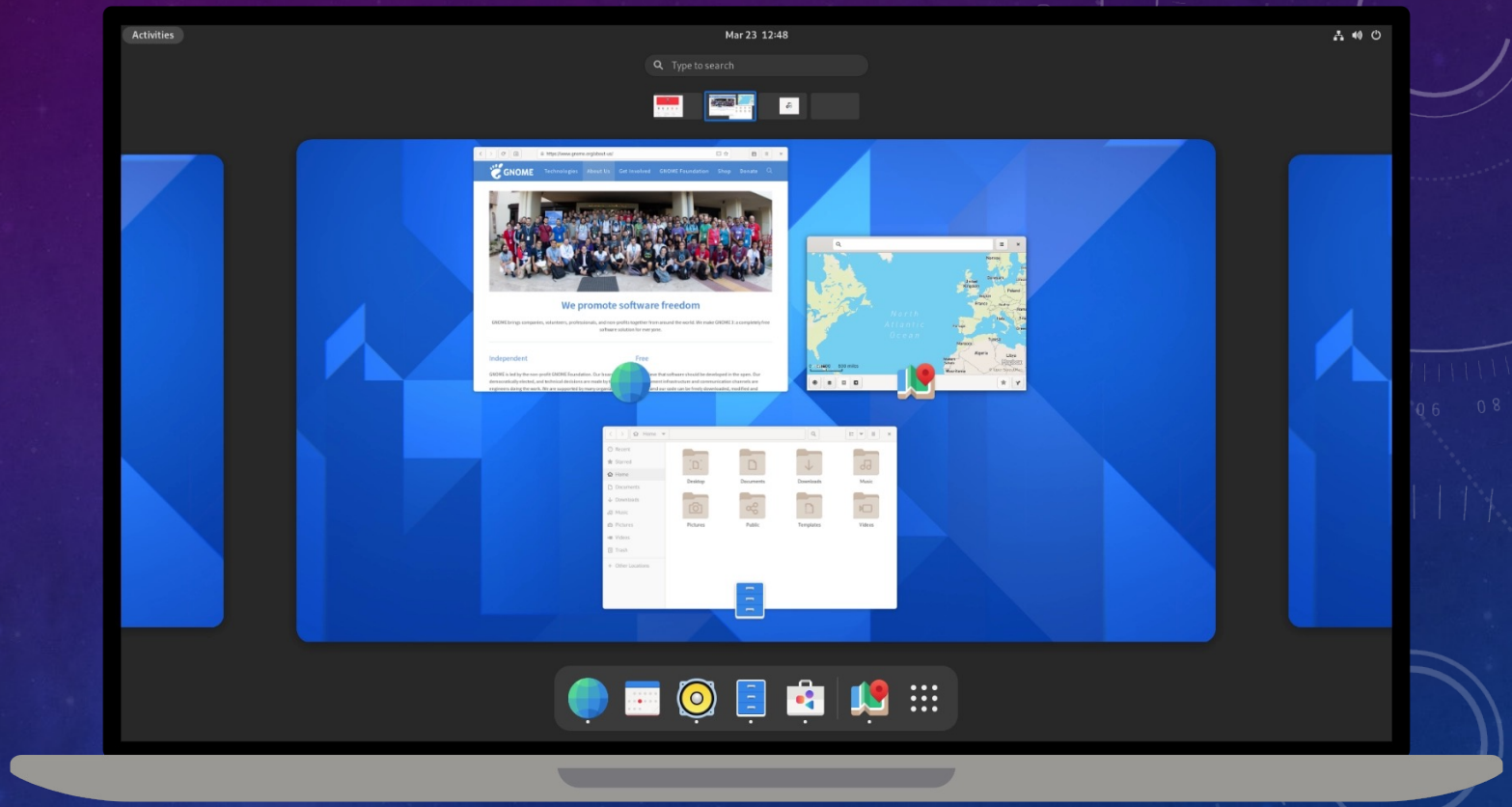
THE LINUX BASICS

- Interacting through a desktop Environment



THE LINUX BASICS

- GNOME
  - GNU Network Object Model Environment
  - Default on Ubuntu

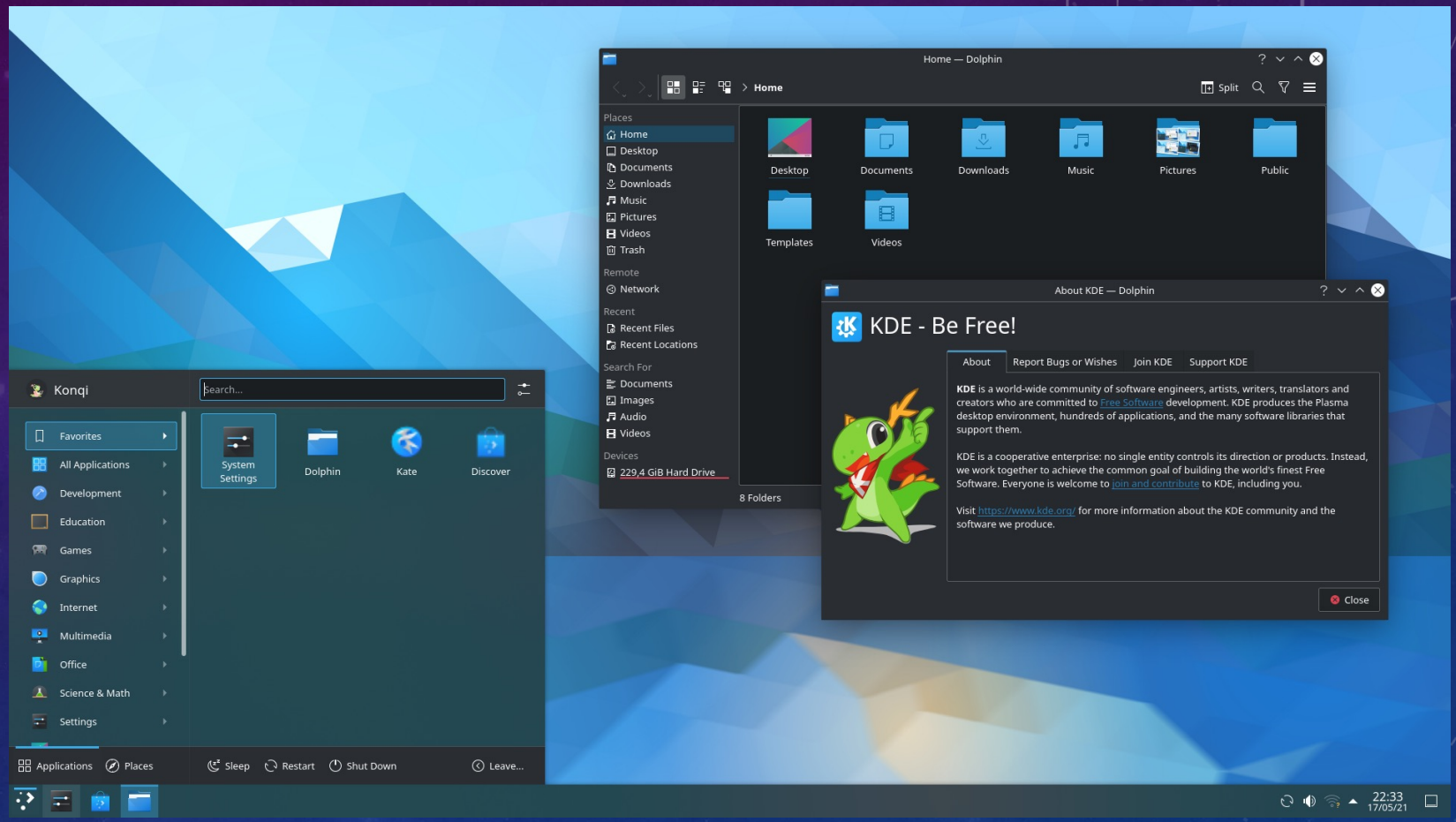


THE LINUX BASICS

- KDE
  - Developed by a student

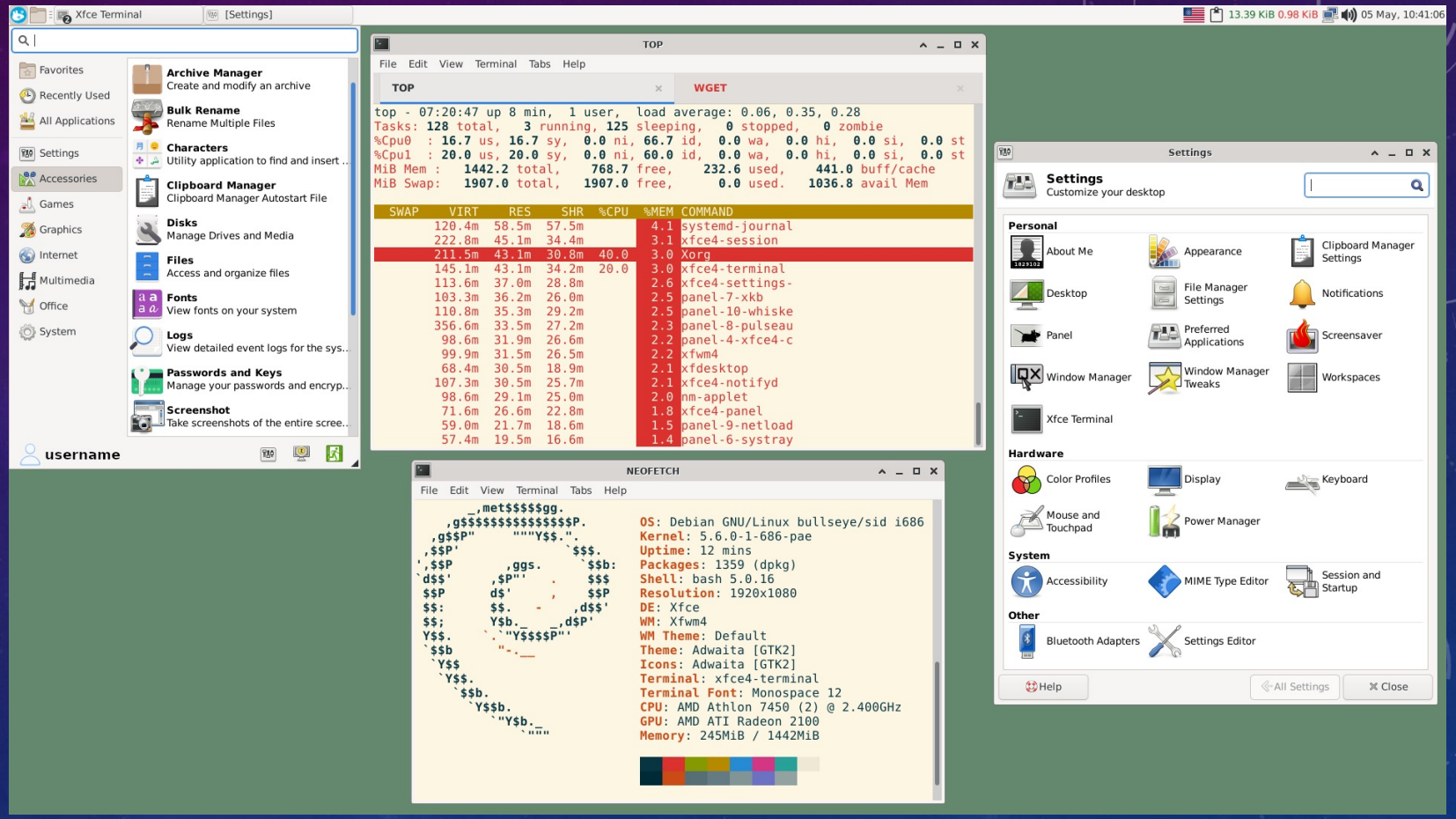
    At the University of Tübingen,

    Germany, Matthias Ettrich
  - 1996



THE LINUX BASICS

- Xfce
  - Focused on being lightweight and fast



THE LINUX BASICS

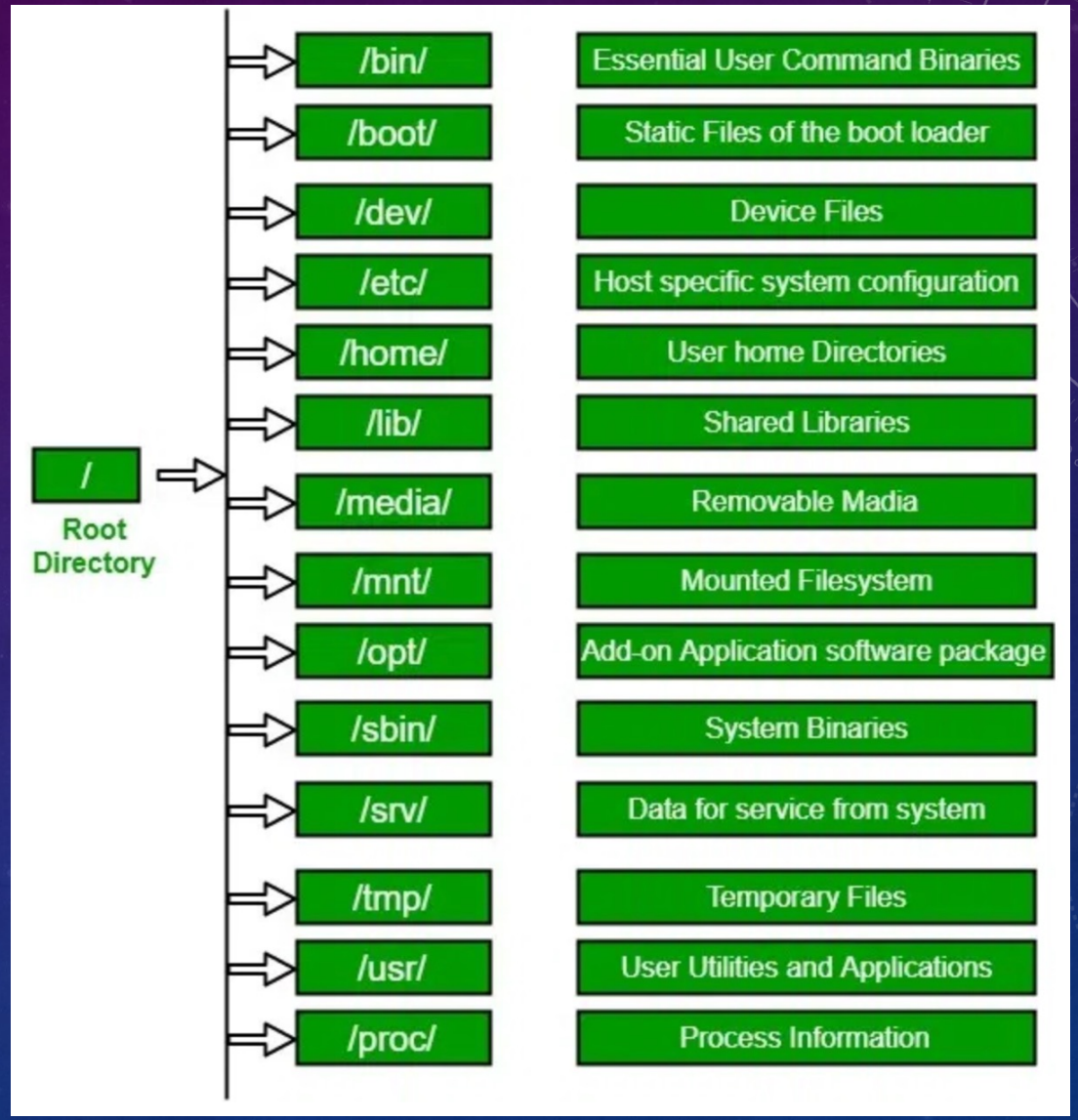
- LXDE
  - Focused on resource-constrained (low-power) platforms

FINDING WHICH DESKTOP ENVIRONMENT IS IN USE

- echo $XDG_CURRENT_DESKTOP
  - ubuntu:GNOME

FILESYSTEM STRUCTURE

/home/bob



Source: https://www.geeksforgeeks.org/linux-file-hierarchy-structure/

QUESTIONS?

See you!