

Operating Systems

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Lecture 1:

Definition of OS. Interfaces of OS.

Case study: Linux GUI.

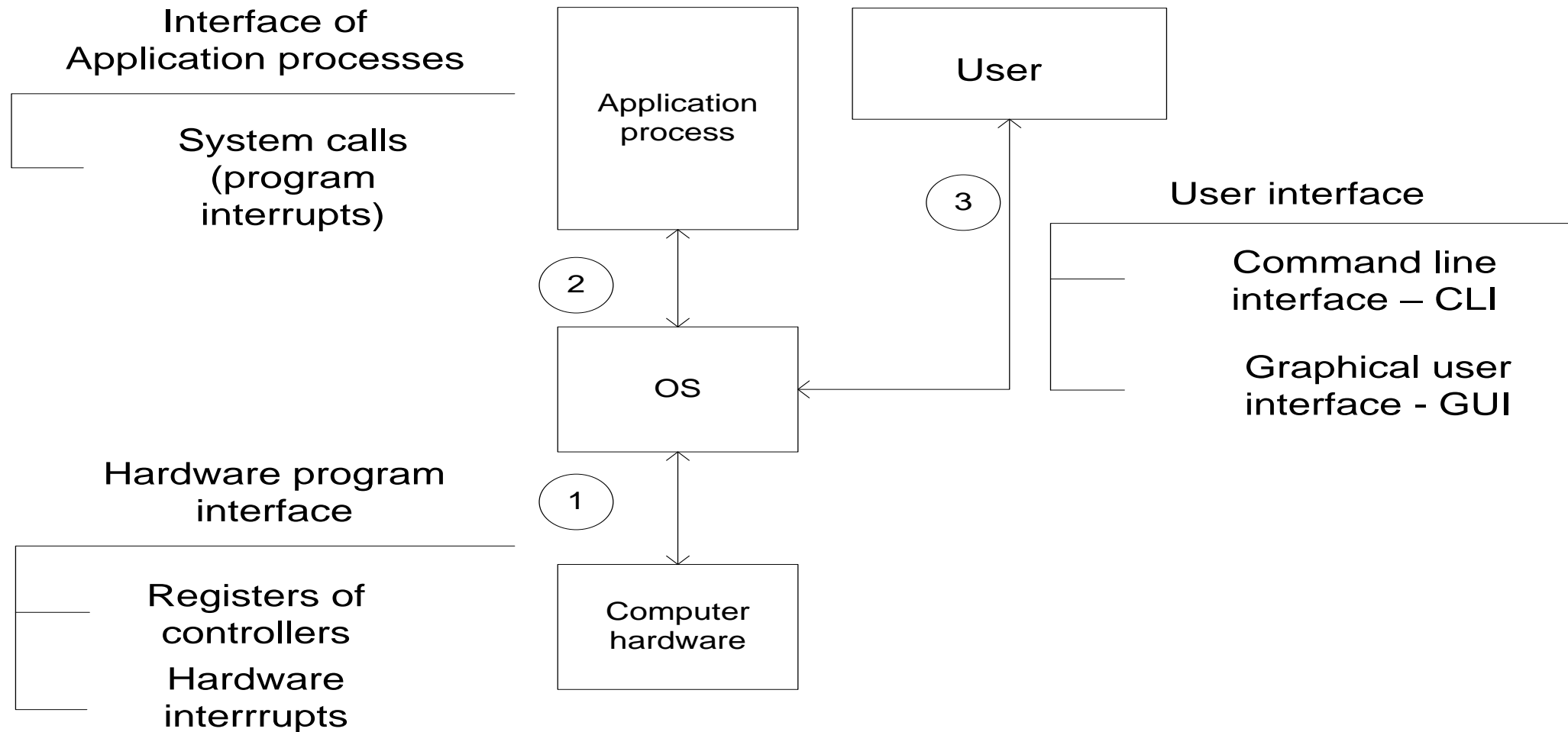
Definitions of OS

- Operating system is a software complex for ***control*** of computer resources and ***interaction*** with hardware, programs, and users.
- Operating system is an extension of hardware.
- Operating system is an instrument to launch and run user programs on computer and store user data.
- etc

Operating System (OS):

- Control of computer resources –
operations over resources
- Interaction with
 - ✓ Hardware
 - ✓ Running programs
 - ✓ Users – *graphical and command line interface*

Interfaces of OS



OS interface with computer hardware

- I/O ports – registers of hardware
 - ✓ Read registers – state of device, bits are set/reset by hardware and read by OS
 - ✓ Write registers – commands to execute, bits are set/reset by OS and read and executed by device
- I/O interrupts – procedures of switching between running programs initiated by external events associated with devices
 - ✓ Interrupt number and priority/mask
 - ✓ Vector of interrupt – new PC and PSW

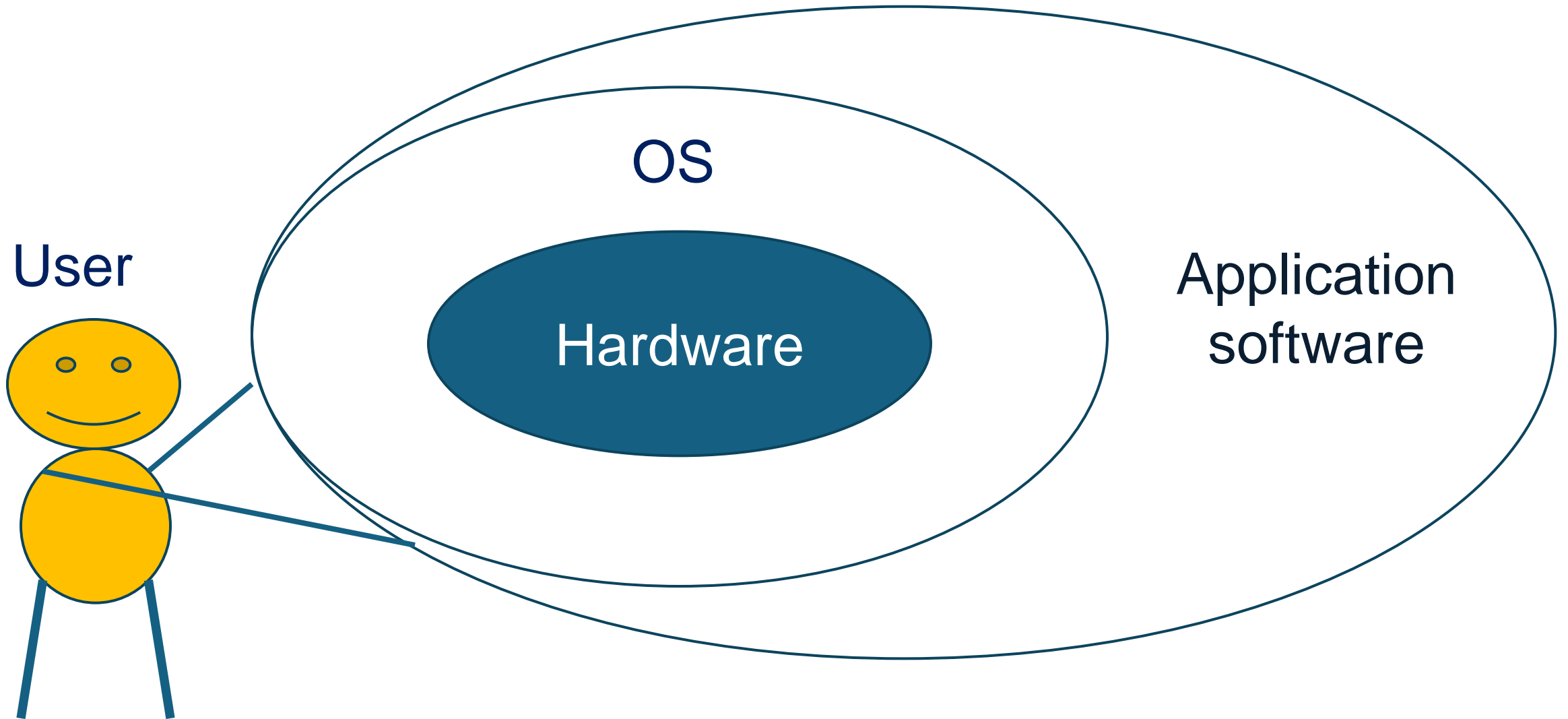
OS interface with running programs

- System calls – a running program asks for some service from OS
- Similar to a function call though requires switching of processor context – from user to system
- Traditionally implemented via a program interrupt because the interrupt vector contains both a new PC and PSW
- Modern OS implement hundreds of system calls
- Standard libraries of programming languages provide a series of convenient functions for system calls – wrappers for a single generic system call

OS interface with users

- Graphical User Interface (GUI):
 - ✓ Windows, menus, hot keys, widgets, buttons, check boxes, input fields, etc.
 - ✓ Convenient, though sometimes tangled with the function classification menus
- Command Line (User) Interface (CLI):
 - ✓ Type command and receive textual response
 - ✓ Brief and exact though requires knowledge of command names
 - ✓ Extended with programming features to compose scripts

OS as an extension of hardware



GUI

- Desktop, icons and windows
- Mouse and touchpad
- Menu and hot keys
- System feed-back: pop-up windows, hints
- MS Windows
- Unix/Linux – XWindow
- Unix/Linux – Gnome, KDE, etc

Linux/Unix skill is a must for IT professional

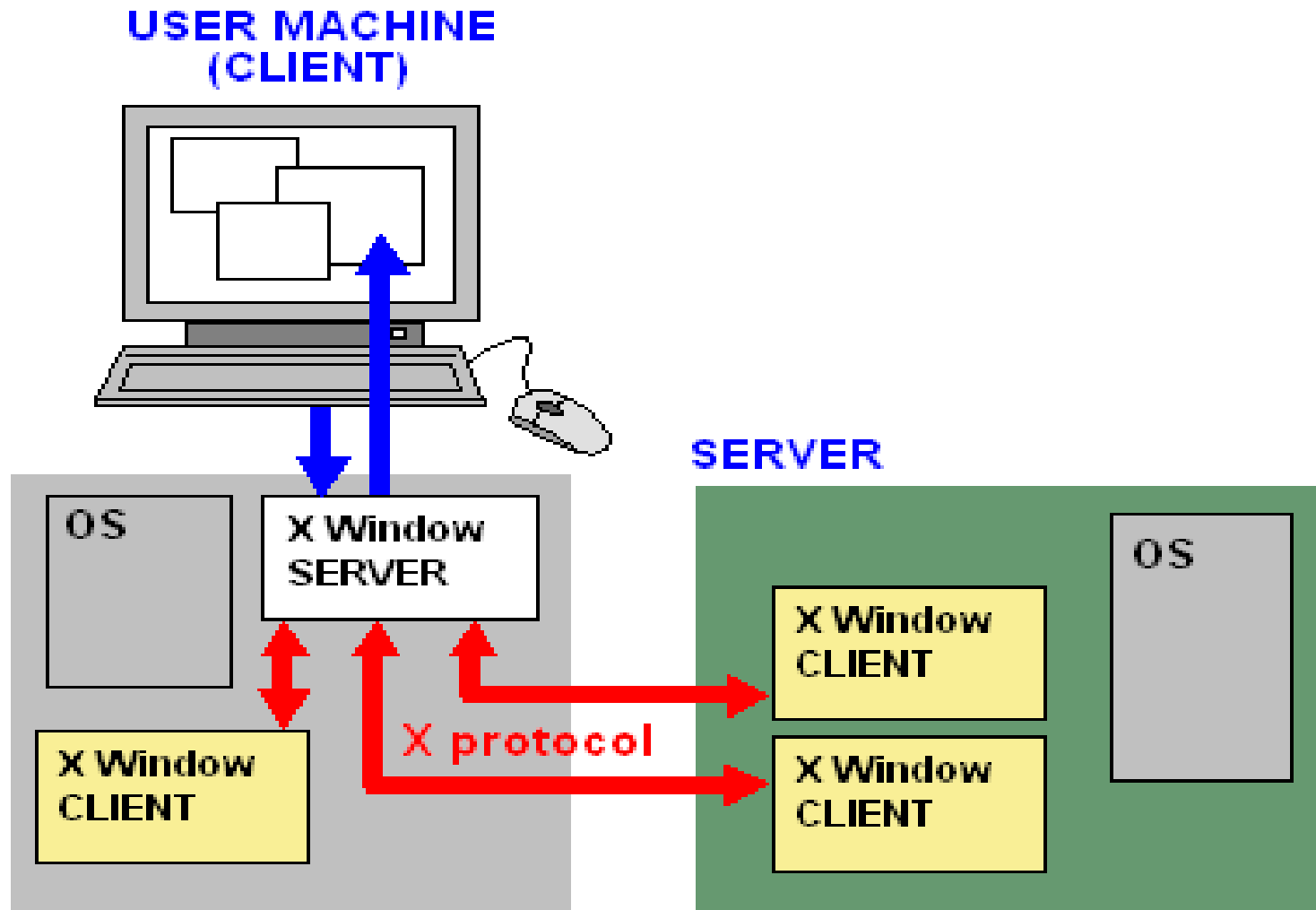
- Linux powers 100% of the world's top 500 supercomputers.
- Linux has over 97% share in the worldwide embedded systems market.
- Linux runs 96.3% of the top million web servers and 90% of the cloud.
- Linux is estimated to power over 80% of the global stock market.
- Android, based on the Linux kernel, has over 75% of the global mobile operating system market share.
- Over 70% of web servers run on Linux



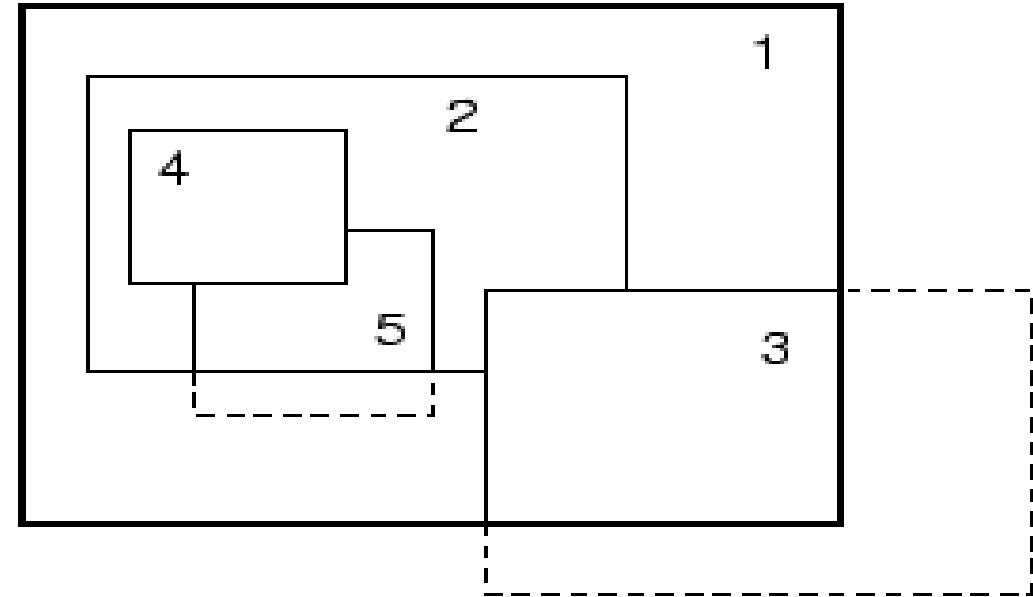
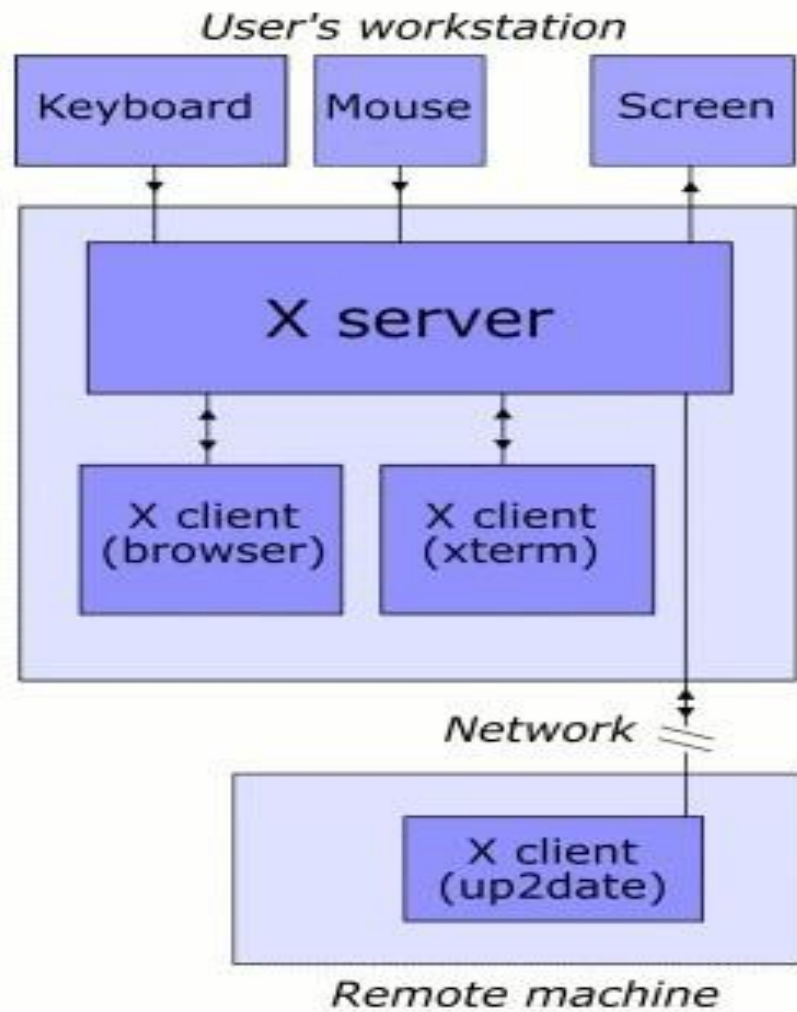
History of Unix/Linux – de facto standard of OS

- AT&T Unix, Bell Labs, 1969 (Ken Thompson, Dennis Ritchie, Douglas McIlroy, and Joe Ossanna)
- BSD, Xenix, AIX, Solaris, SCO
- Open source, C
- Kernel, packages
- Networking
- Linus Torvalds, 1991
- Debian, Ubuntu, Fedora etc

Unix/Linux GUI: X Window servers & clients



X Window work



An example of GNOME

The image displays a GNOME desktop environment. The top panel shows the 'Activities' button, the 'Document Viewer' window title, the date and time 'Oct 29 03:51', and system status icons for language (en), network, and battery. The desktop background is a vibrant image of blue forget-me-not flowers. On the left, a vertical dock contains icons for the Dash, Home Folder, Files, Text Editor, Document Viewer, LibreOffice, and the Dash icon. The main window is a 'Document Viewer' titled 'wsiz-tt-21-22-aut.pdf', showing page '1 of 11' at a zoom level of '172.8%'. The PDF content displays a table of class schedules for Friday, with the first page showing a calendar view and the second page showing a detailed table.

Classes for the day of the week: Friday

Dates of classes	From	To	Study path	Group	Room	Course	Number of Hours
15/10	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
22/10	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
22/10	15:25	17:05	5 LID-A/2019/P	ASS02,3	Z-online	Thesis Seminar	2
29/10	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
05/11	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
12/11	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
19/11	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
26/11	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
03/12	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
10/12	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
10/12	15:25	17:05	5 LID-A/2019/P	ASS02,3	Z-online	Thesis Seminar	2
17/12	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
14/01	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
21/01	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	2
21/01	15:25	17:05	5 LID-A/2019/P	ASS02,3	Z-online	Thesis Seminar	2
28/01 (Exam)	13:35	15:15	3 LID-A-P/2020	ASW01	Z-online	Operating systems	0

CLI within GUI - Terminal

The screenshot displays a Linux desktop environment with a blue floral wallpaper. In the background, a file manager window shows the 'Documents' directory with files like 'misc', 'wsiz21', 'ANG-INSTR-90-2020-NEW.pdf', 'beg-meet.txt', 'l3-xwin.pptx', 'lectures-records.txt', and 'LI-A-2020_Operating systems...'. In the foreground, there are two terminal windows. The top window, titled 'daze@hare: ~', shows the output of the 'top' command, displaying system statistics and a list of running processes. The bottom window is the 'GNOME Terminal' application window, showing the version '3.36.2' and copyright information.

GNOME Terminal
3.36.2
A terminal emulator for the GNOME desktop
Using VTE version 0.60.3 +BIDI +GNUTLS +ICU +SYSTEMD
[Website](#)
Copyright © 2002–2004 Havoc Pennington
Copyright © 2003–2004, 2007 Mariano Suárez-Alvarez
Copyright © 2006 Guilherme de S. Pastore
Copyright © 2007–2019 Christian Persch
Copyright © 2013–2019 Egmont Koblinger

Terminal Output (top command):

```
top - 04:37:43 up 3:25, 1 user, load average: 0.75, 0.83, 0.76
Tasks: 314 total, 1 running, 312 sleeping, 0 stopped, 1 zombie
%Cpu(s): 1.9 us, 0.7 sy, 0.0 ni, 97.3 id, 0.1 wa, 0.0 hi, 0.0 si, 0.0 st
MiB Mem : 7870.1 total, 749.8 free, 2052.3 used, 5068.0 buff/cache
MiB Swap: 2048.0 total, 2048.0 free, 0.0 used, 5480.9 avail Mem
```

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
2731	daze	20	0	4360464	362072	112516	S	4.6	4.5	10:33.80	gnome-s+
2540	daze	20	0	723216	160172	87432	S	4.0	2.0	10:37.74	Xorg
8367	daze	20	0	826912	57864	43388	S	3.3	0.7	0:22.93	gnome-t+
815	root	-51	0	0	0	0	S	1.7	0.0	4:47.12	irq/53+
22071	daze	20	0	14824	3976	3216	R	0.7	0.0	0:00.09	top
3075	daze	20	0	68780	26116	11128	S	0.3	0.3	0:02.20	hp-syst+
5692	daze	20	0	860484	286720	130692	S	0.3	3.6	0:10.60	telegra+
18476	root	20	0	0	0	0	I	0.3	0.0	0:01.05	kworker+
19871	root	20	0	0	0	0	I	0.3	0.0	0:01.49	kworker+
20682	root	20	0	0	0	0	I	0.3	0.0	0:00.29	kworker+
1	root	20	0	169280	13488	8444	S	0.0	0.2	0:05.90	systemd
2	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kthreadd
3	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_gp
4	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	rcu_par+
6	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	kworker+
9	root	0	-20	0	0	0	I	0.0	0.0	0:00.00	mm_perc+
10	root	20	0	0	0	0	S	0.0	0.0	0:00.00	rcu_tas+

Configure Ubuntu

Activities Settings ▾ Oct 29 04:01 en ▾

Settings

Sharing

Sound

Power

Displays

Mouse & Touchpad

Keyboard Shortcuts

Printers

Removable Media

Color

Region & Language

Universal Access


Users

Default Applications

Date & Time

About

About



Device Name hare >

Memory 7.7 GiB

Processor Intel® Core™ i5-5200U CPU @ 2.20GHz × 4

Graphics NVIDIA Corporation GK208BM [GeForce 920M] / GeForce 920M/PCIe/...

Disk Capacity 1.0 TB

OS Name Ubuntu 20.04.3 LTS

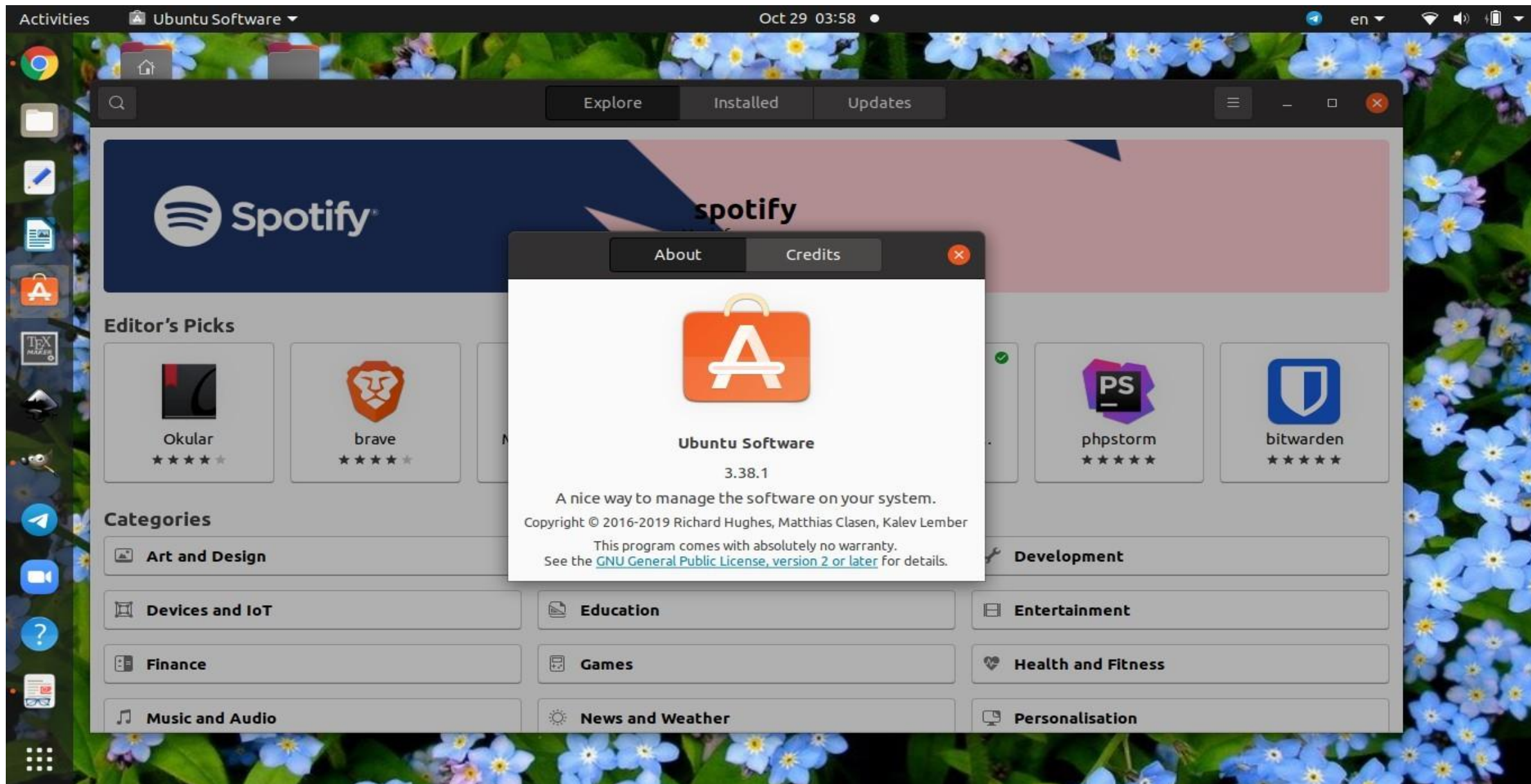
OS Type 64-bit

GNOME Version 3.36.8

Windowing System X11

Software Updates >

Install new software



Libre Office



- Writer — word processor



- Impress — presentation editor



- Calc — spreadsheet



- Draw — diagram and figure editor



- Base — database



- Math — mathematical equation editor

Presentations — Impress

The screenshot displays the LibreOffice Impress application window. The title bar at the top reads "l3-xwin.pptx - LibreOffice Impress". The menu bar includes "File", "Edit", "View", "Insert", "Format", "Slide", "Slide Show", "Tools", "Window", and "Help". Below the menu bar is a comprehensive toolbar with icons for various functions like opening files, saving, undo, redo, and inserting elements. The main workspace shows a presentation slide with a large dashed box in the center containing the text "Click to add Title".

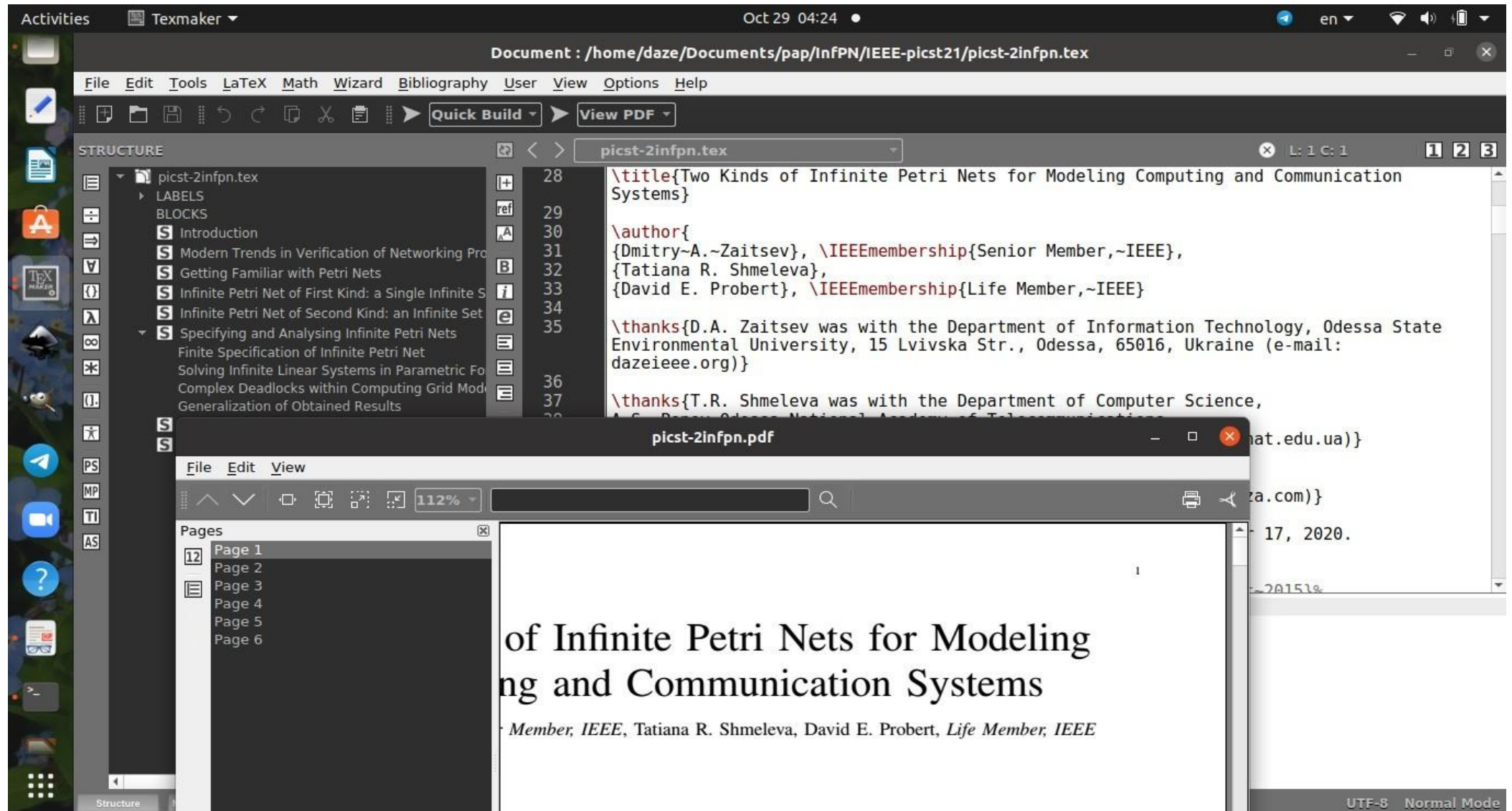
On the left side, there is a "Slides" panel showing a thumbnail view of the presentation. It lists slides 6 through 10. Slide 10 is currently selected and highlighted in orange. The thumbnails show various content: "X display manager", "An example of GNOME", "Configure Ubuntu", "Install new software", and "Libre Office".

On the right side, there is a "Navigator" panel. It shows a hierarchical tree of the presentation's content. The tree structure is as follows:

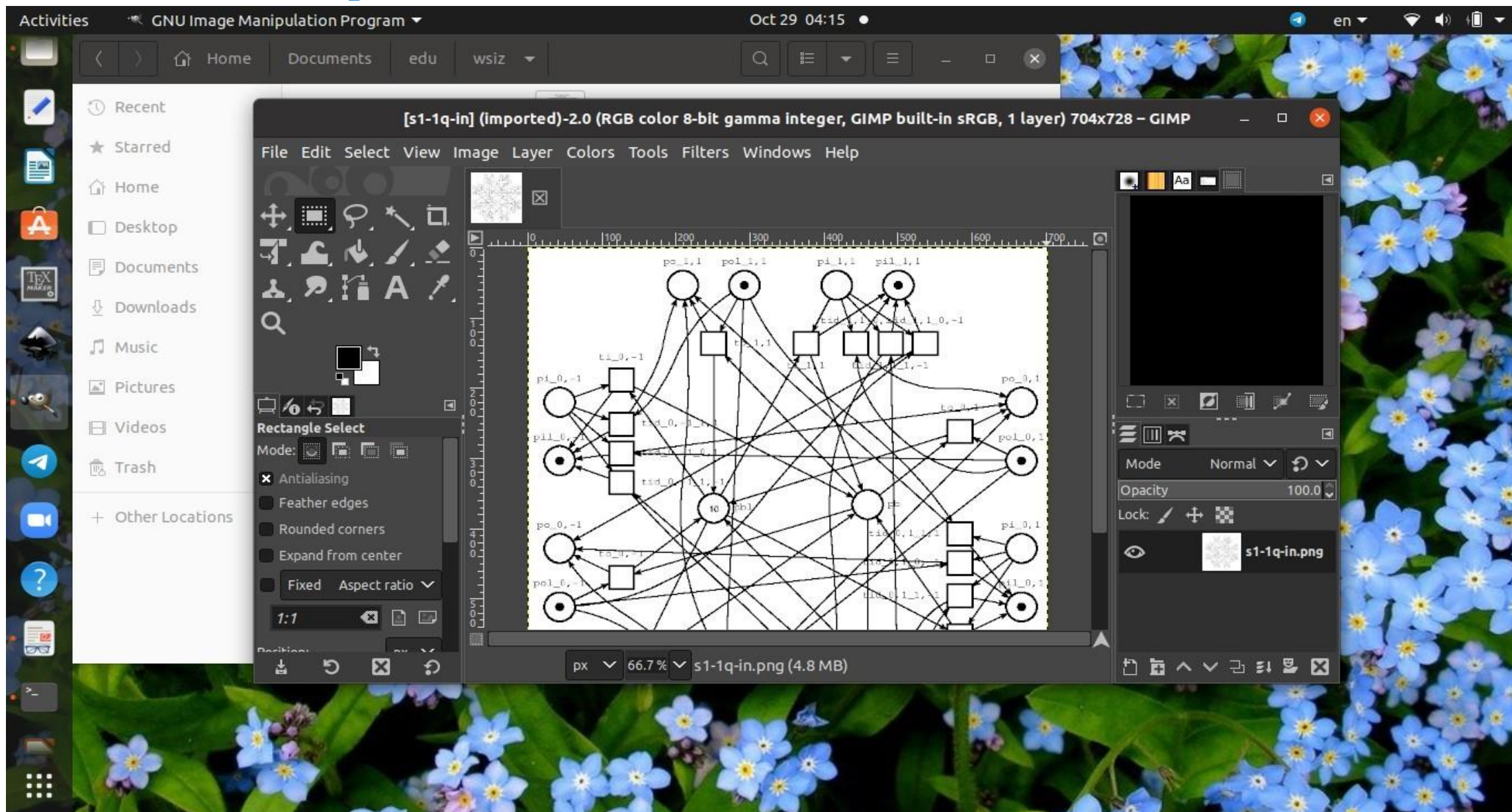
- Slide 1
 - TextShape 1
- Slide 2
 - TextShape 1
- Slide 3
 - TextShape 1
- Slide 4
 - TextShape 1
 - TextShape 2
- Slide 5
 - TextShape 1
 - TextShape 2
- Slide 6
 - TextShape 1
- Slide 7
 - TextShape 1
- Slide 8
 - TextShape 1
- Slide 9
 - TextShape 1
 - TextShape 2
- Slide 10 (selected)

At the bottom of the window, the status bar shows "Slide 10 of 10", "Title, Content", "22,61 / 4,67", "0,00 x 0,00", "Russian", and a zoom level of "68%".

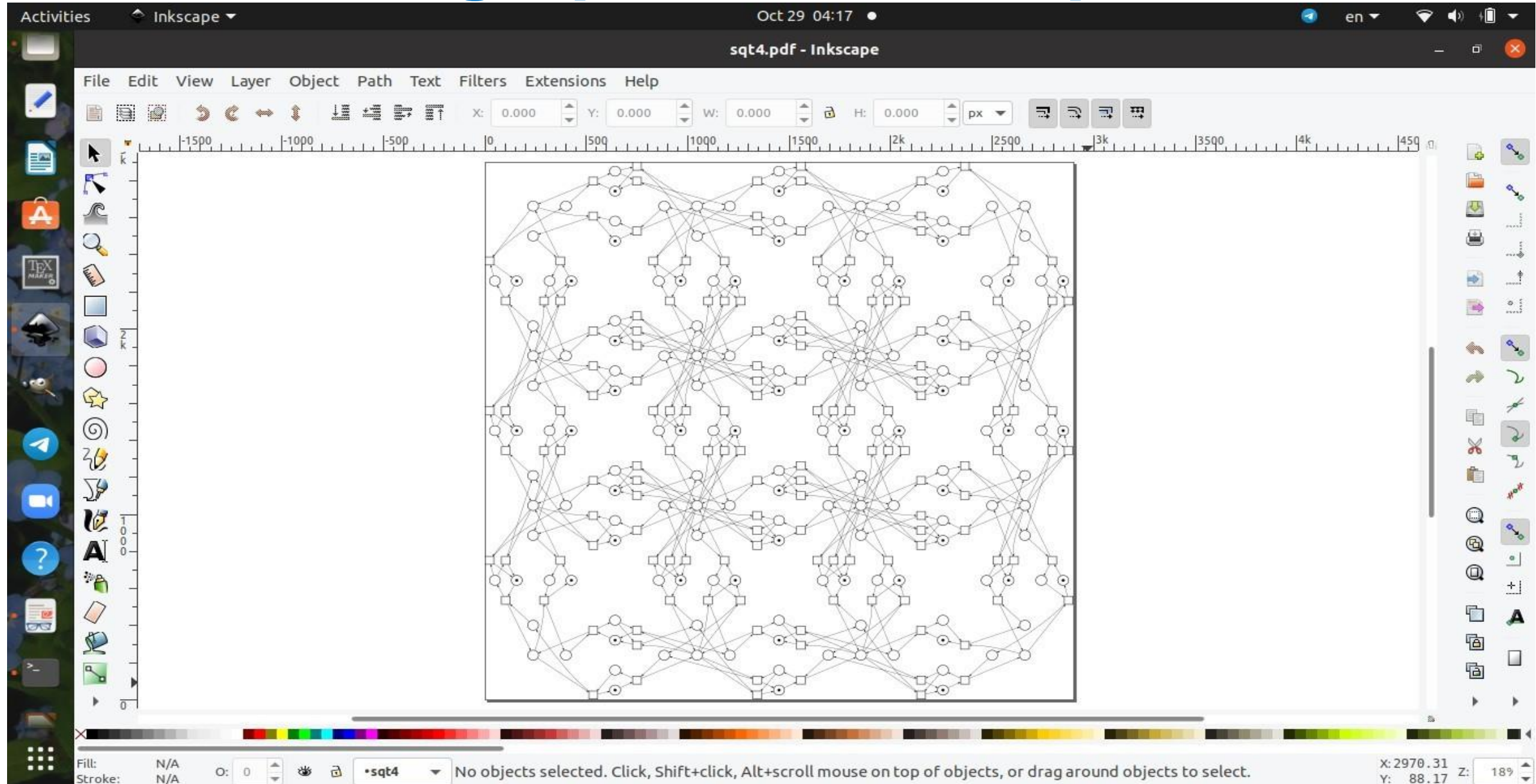
LaTeX word processor



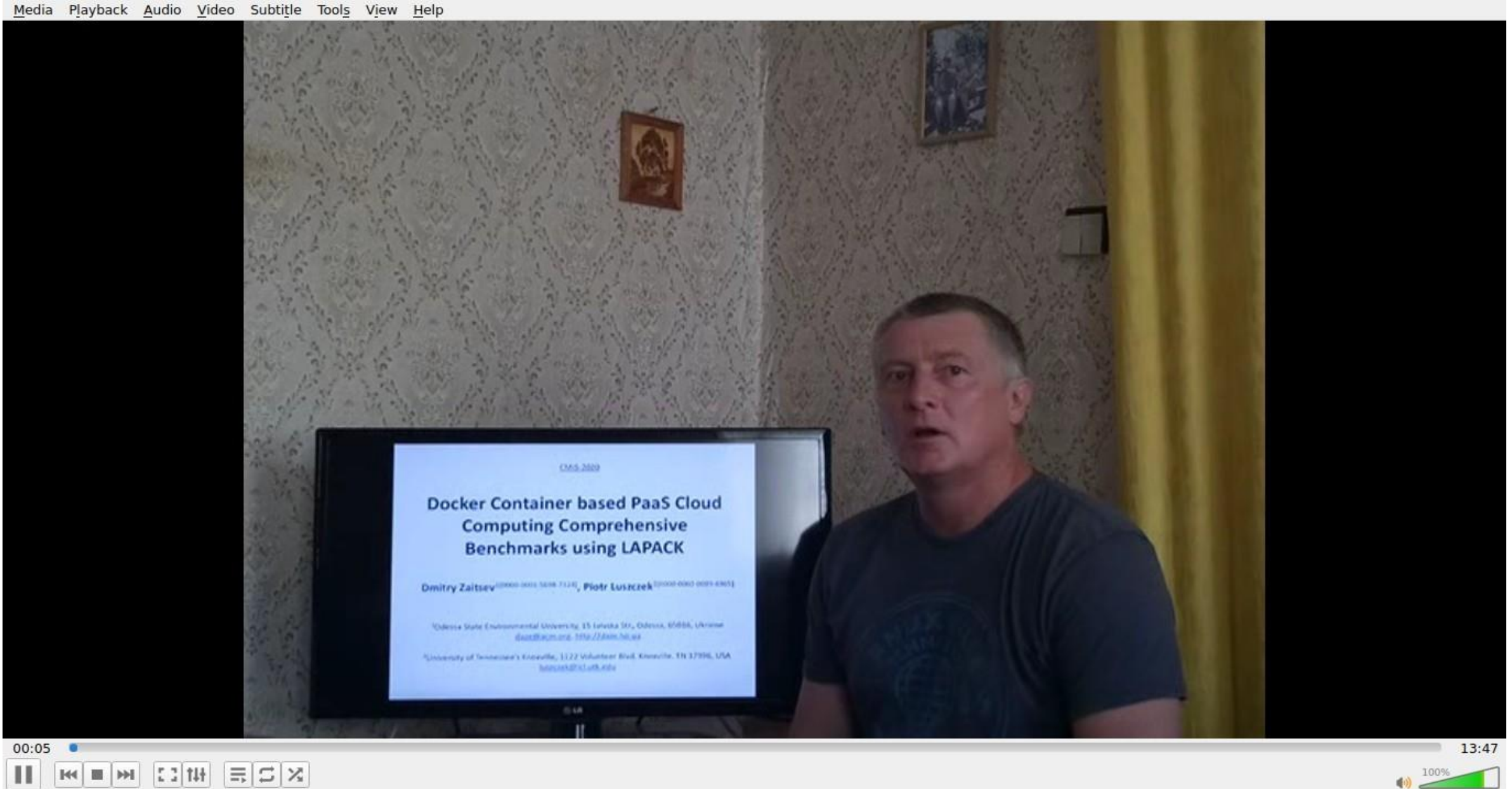
Graphical editor - GIMP



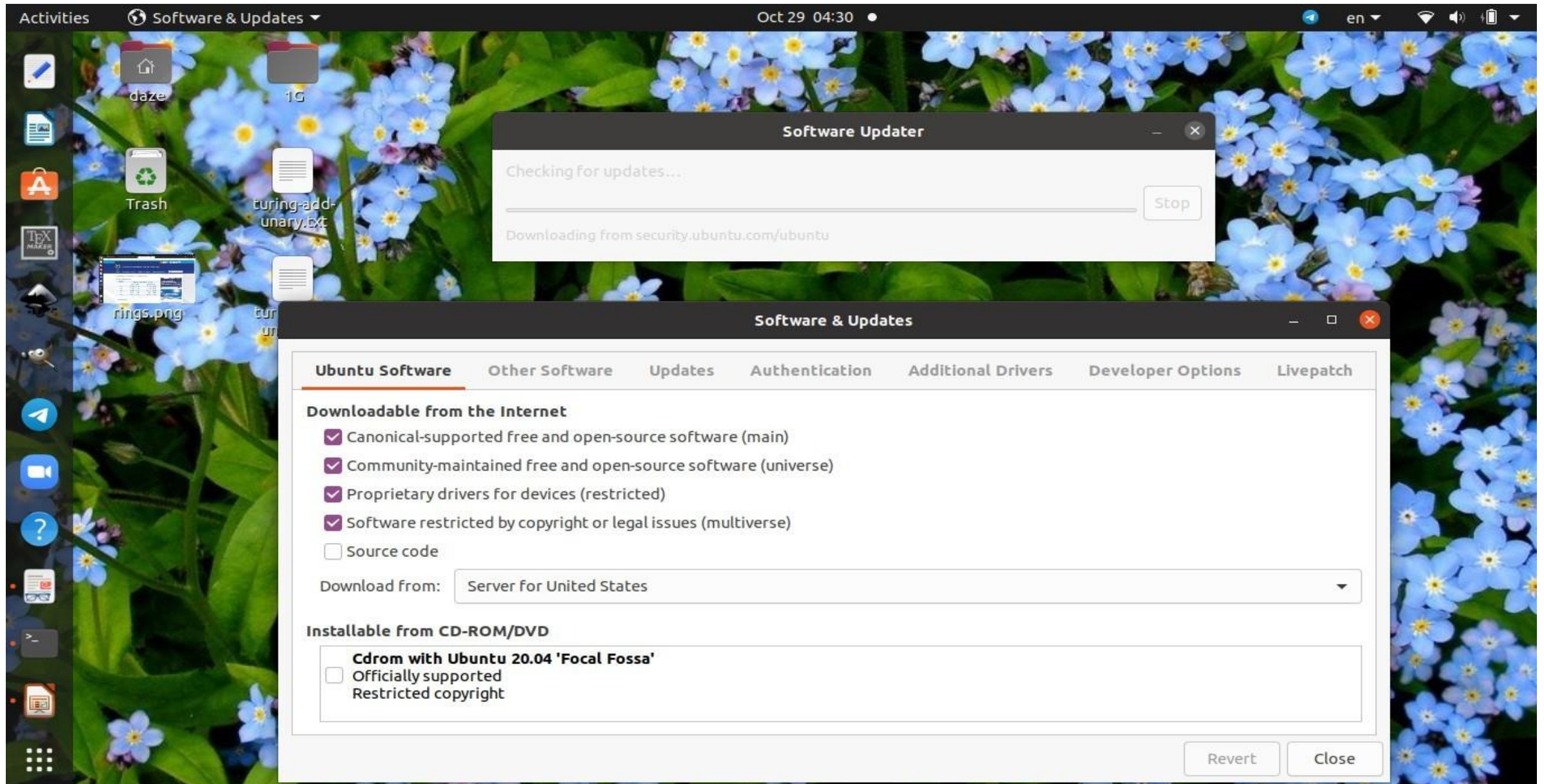
Vector graphics - Inkscape



Multimedia — VLC Media Player



Update Ubuntu



Install Ubuntu

- www.ubuntu.com
- Download a disc image
- Create bootable media (memory stick)
- Boot ubuntu image
- Live disc
- Compress Windows partition
- Install ubuntu
- Install & update