What restricts your program

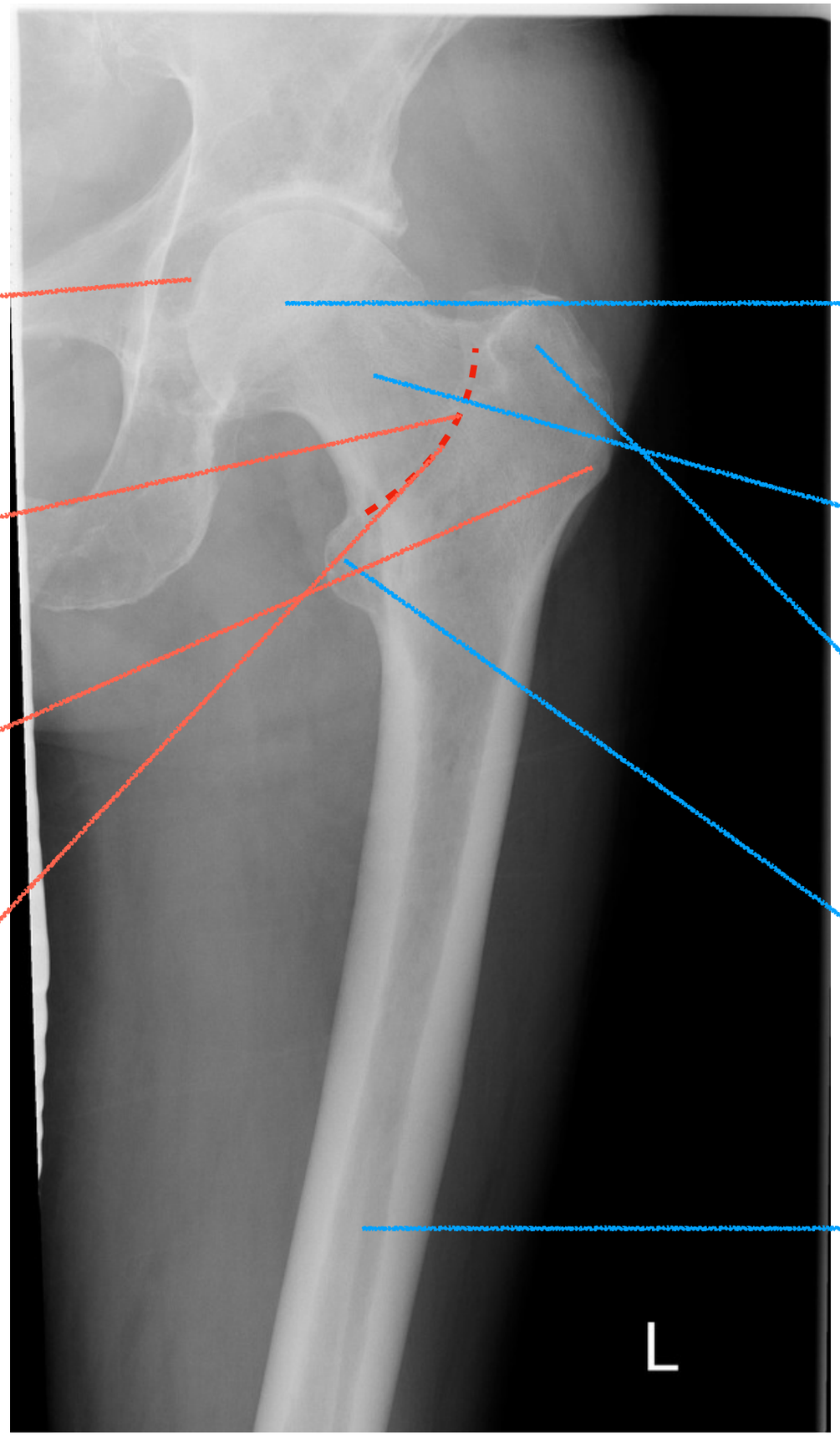
- **IO wait**
    - HDD < SSD < Memory
    - SATA < NVMe, independent disks < hardware RAID
- **Memory limit**
    - Virtual Memory (Swap)
- **CPU overload**
    - Parallelism

multiprocessing (Python)
Parallel Computing Toolbox (MATLAB)
parallel (R)

What is Knowledge?

Upper extremity of femur

Femur



Case courtesy of Dr Piotr Gołofit, Radiopaedia.org, rID: 53032

Visualization with Matplotlib and more

Biomedical Data Analysis in Python3

All materials and slides are available on GitHub (ZaneMuir/FDU-DataAnalysis-Workshop).

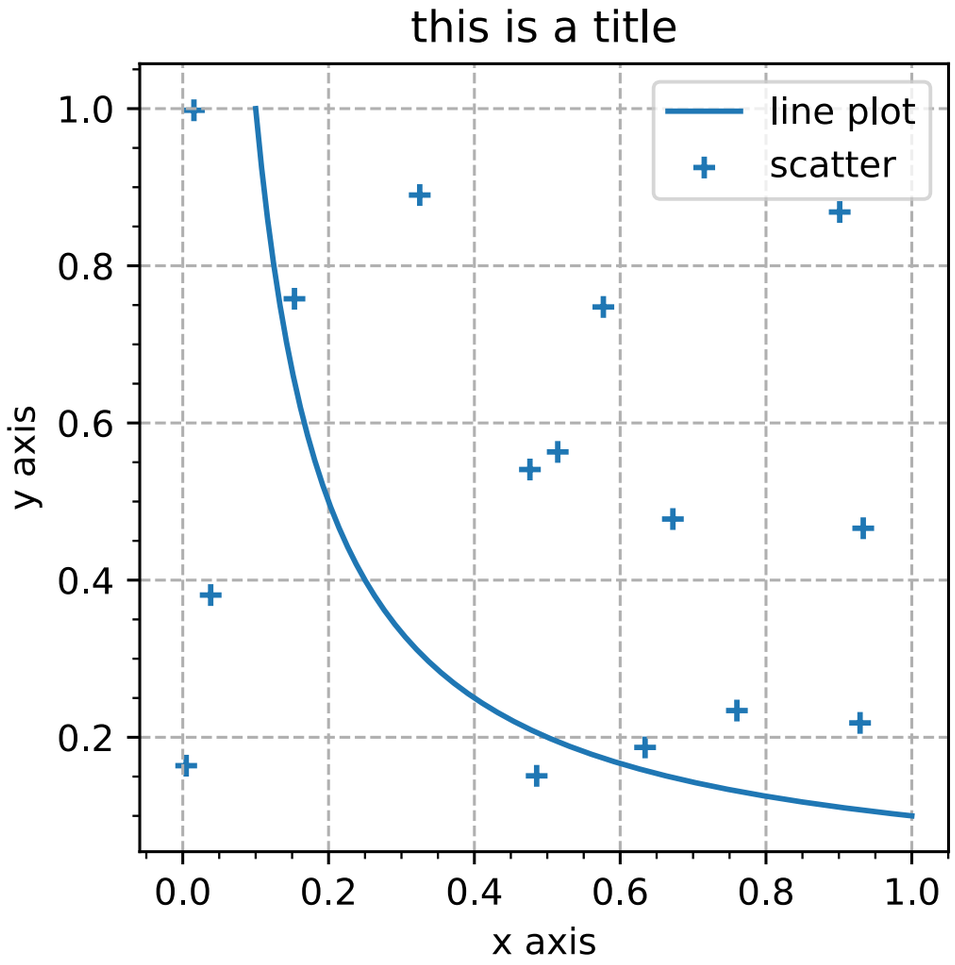
- More on File Types of Figures
- Basic Scientific Chart Types
- Matplotlib
- From Static to Animation and Interactive

File Types

- Bitmaps:
  - Compressed: jpeg, png, etc.
  - Uncompressed: tiff, bmp, hdf5, mat, etc.
- Vector: svg, eps, pdf, etc.

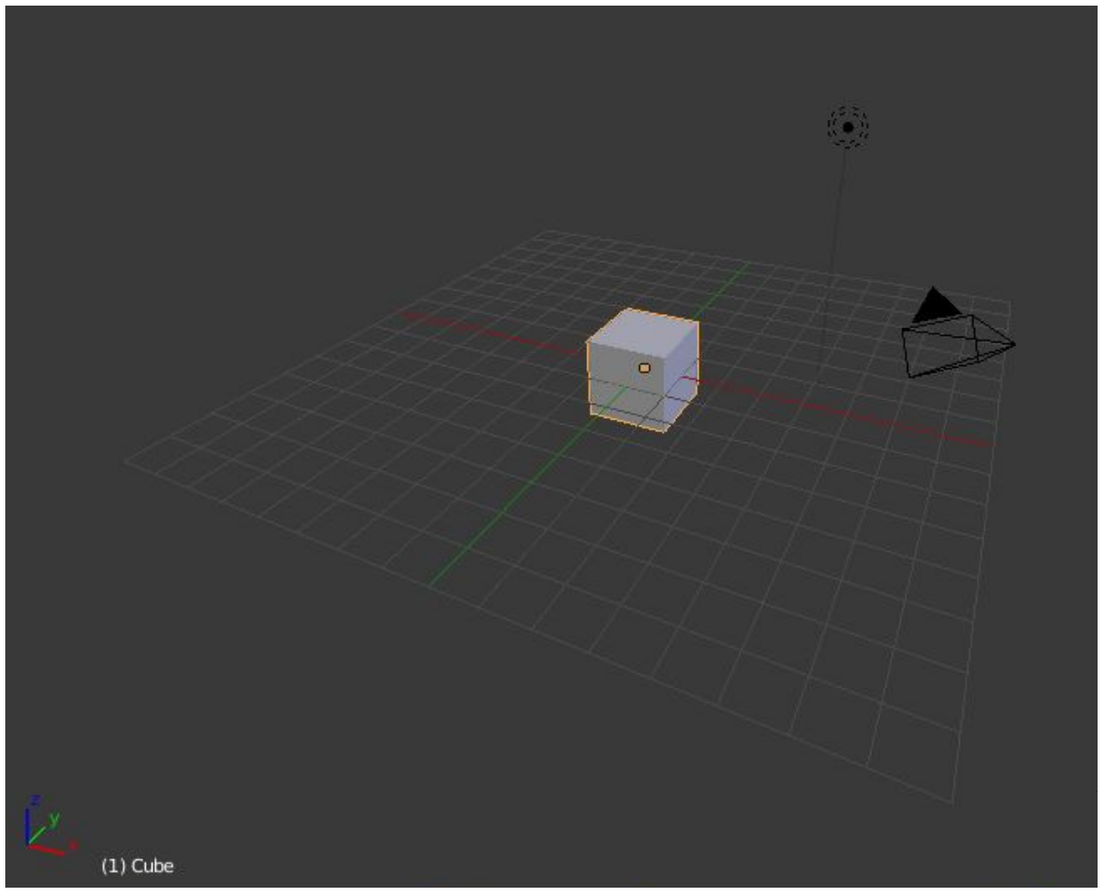
Parts of a Figure

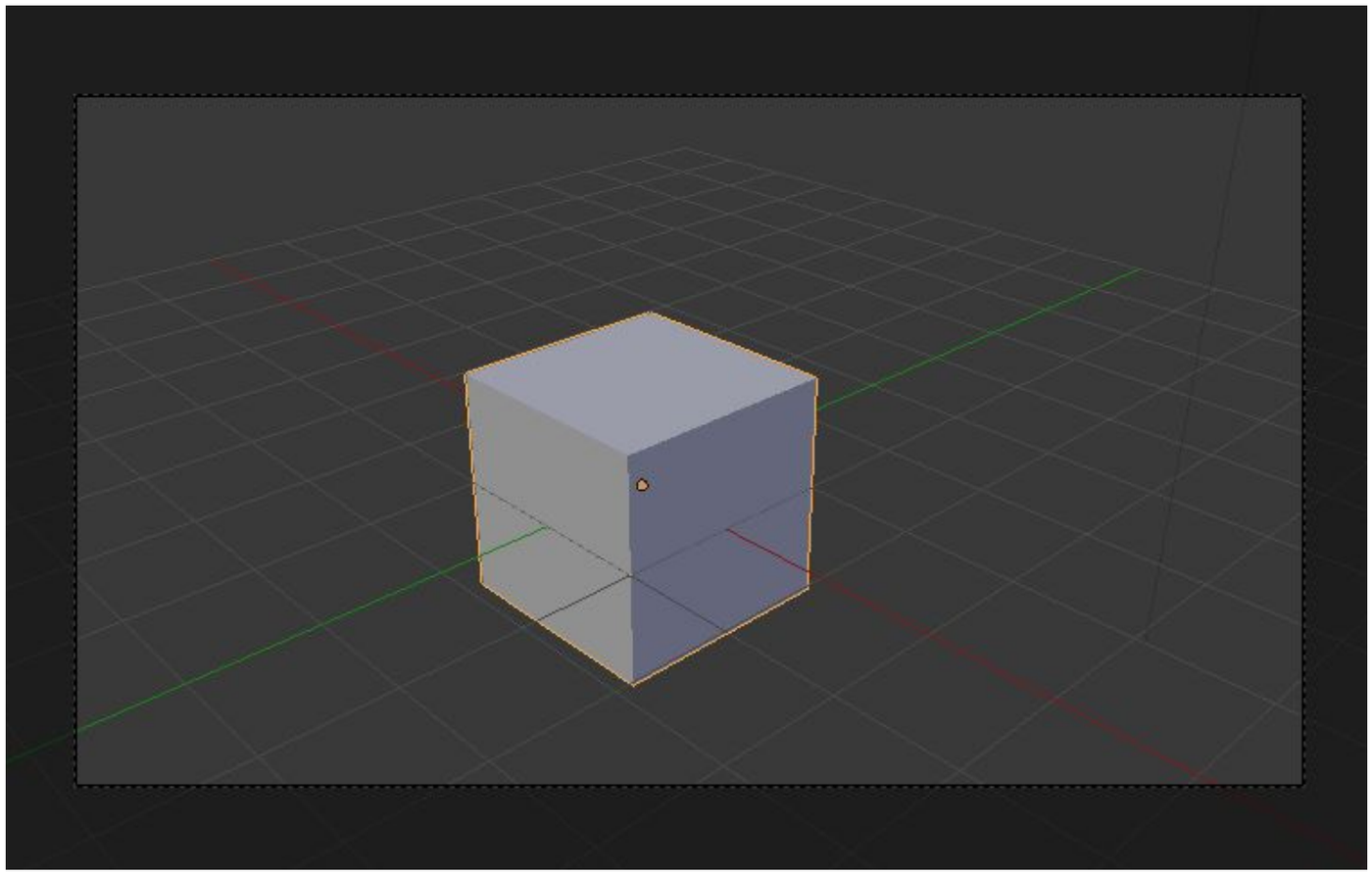
- **Figure**
- **Title**
- **Line**
- **Scatter**
- **Major Ticks**
- **Minor Ticks**
- **Grids**
- **Legend**
- **Axis Label**



Matplotlib — Demo

Interactive 3D Figures





Plotly — Demo

Animation from Scratch

- Video codec: `ffmpeg -codecs`

- Video bitrate, `-b:v`
  File size = bitrate (kilobits per second) x duration.

- Frame rate, `-r`

- Generate each frame and render into video with ffmpeg
  `ffmpeg -i <input> -r <fr> -b:v <br> <output>`

Animation - Demo