جامـــــعة المـــــستـقبـل
AL MUSTAQBAL UNIVERSITY

كلية العلـوم

قسـم الأنظمة الطبية الذكية

المحاضرة الثانية

المادة: Simulation and Modeling
المرحلة: الرابعة
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Industry-Standard Software Tools for Medical Simulation

Introduction

Overview of tools used in medical simulation:

MATLAB

Python

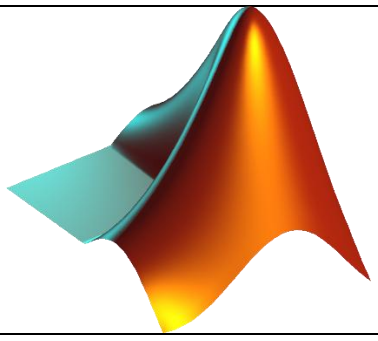
R

We'll explore their features, strengths, and use cases in healthcare.

Why Are These Tools Important?

- Simulate complex medical processes
- Analyze clinical and imaging data
- Train AI models to assist diagnosis
- Reduce risks and improve planning

MATLAB – Overview

▪ **Numerical computing platform** ▪ **Specialized toolboxes (Signal, Image, ML)** ▪ **Used in ECG, EEG, MRI analysis** ▪ **Great for prototyping and visualization**	

MATLAB – Pros & Cons

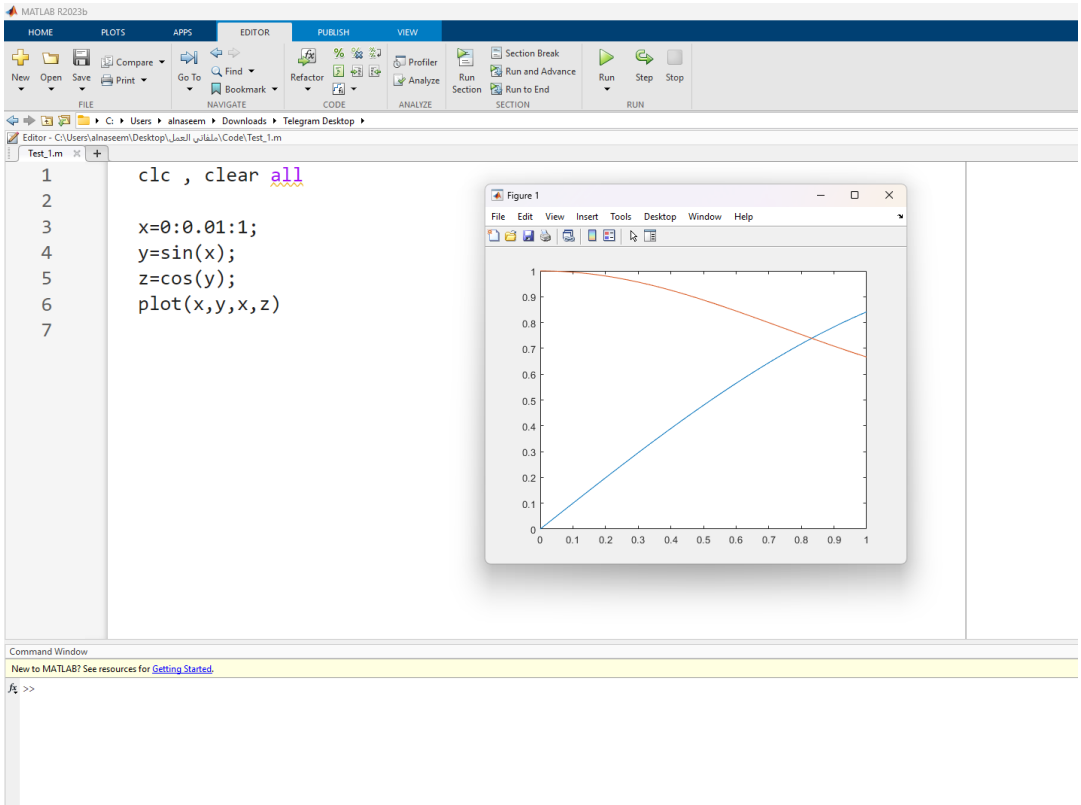
Pros:

- Easy to use in academia
- Built-in visualization tools

Cons:

- Paid license
- Less flexible than Python for AI

MATLAB interface



Python – Overview

- **Open-source, general-purpose**
- **Popular libraries: NumPy, Pandas, TensorFlow**
- **Used for deep learning, image analysis**
- **Flexible and scalable**

Py (Colab) interface

Python – Pros & Cons

Pros:

- Free and widely used
- Best for AI and ML integration

Cons:

- Slower for real-time systems
- Less GUI support compared to MATLAB

R – Overview

▪ **Language for statistics and analysis** ▪ **Great for epidemiology and clinical data** ▪ **Common libraries: ggplot2, survival, tidyverse**	

R – Pros & Cons

- Excellent for statistical and visualizations
- Strong in medical research
- Not for real-time simulation
- Learning curve for programming

MATLAB vs Python vs R

- MATLAB: Best for simulation and engineering
- Python: Best for AI and image processing
- R: Best for stats and epidemiological studies

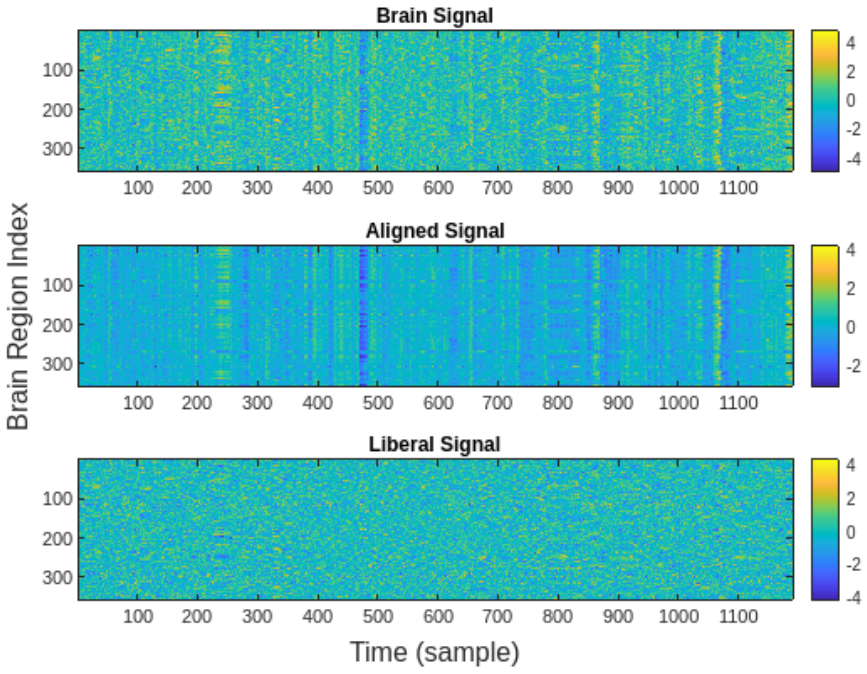
Choose based on your task and needs.

Applications in Medical Simulation

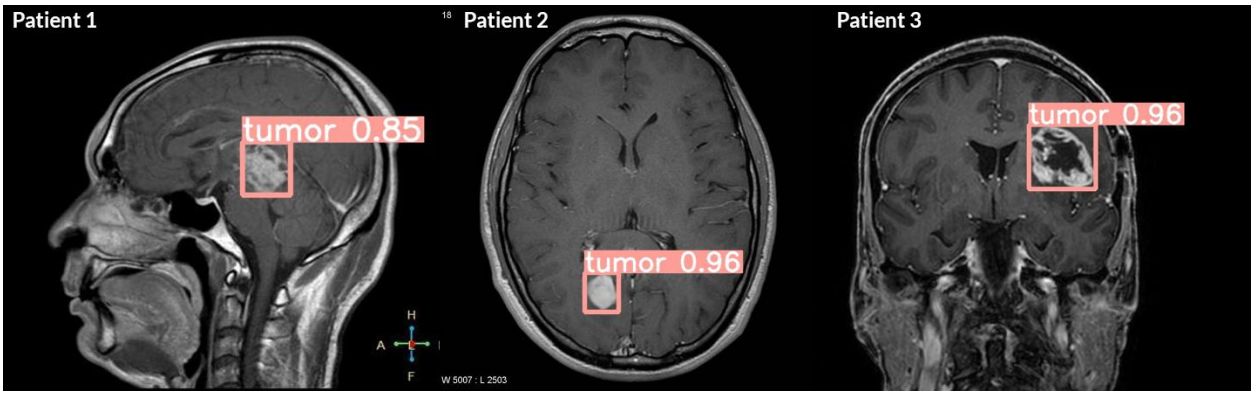
- MATLAB: Simulate brain signals, surgery plans
- Python: Detect tumors using deep learning
- R: Analyze treatment outcomes

Brain Signal Simulation

Visualization of brain activity over time from different brain regions. Tools like MATLAB and Python are used to process, align, and analyze these signals in medical research and simulation.



Detect tumors using deep learning



Python for Simulation & Modeling

Why Python for Simulation?

- Open-source and widely used in academia and industry
- Flexible for both scripting and large-scale simulations
- Integrates well with AI, ML, and data visualization tools
- Strong community support and active development

Key Python Libraries

NumPy: Numerical computing and array operations

Pandas: Data manipulation and preprocessing

Matplotlib / Seaborn: Data visualization and plotting

SciPy: Scientific computing and optimization

SimPy: Discrete-event simulation modeling

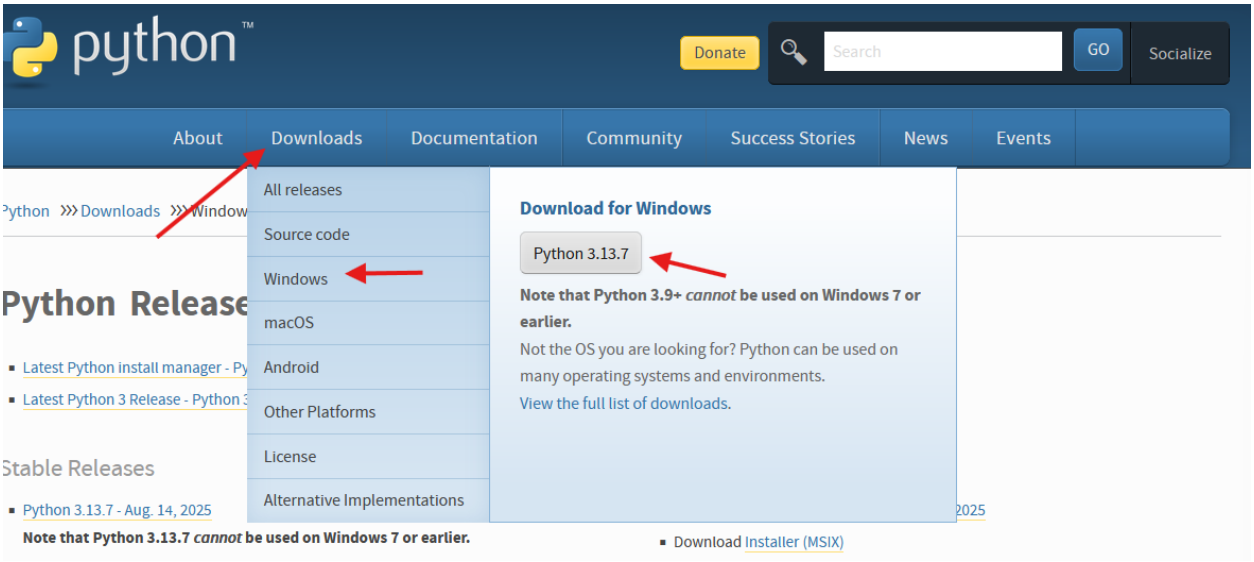
scikit-learn: Machine learning models

TensorFlow / PyTorch: Deep learning frameworks

Environment Setup

Open a Web browser and go to:

https://www.python.org/downloads/windows/



Development Environments python

Visual Studio Code

Open a Web browser and go to:

https://code.visualstudio.com/download

Windows
Windows 10, 11

User Installer x64 Arm64
System Installer x64 Arm64
.zip x64 Arm64

CLI x64 Arm64

.deb
Debian, Ubuntu

.rpm
Red Hat, Fedora, SUSE

.deb x64 Arm32 Arm64
.rpm x64 Arm32 Arm64
.tar.gz x64 Arm32 Arm64
Snap Snap Store

CLI x64 Arm32 Arm64

Mac
macOS 11.0+

.zip Intel chip Apple silicon Universal

CLI Intel chip Apple silicon