Numeric Data with Numpy and HDF5

Biomedical Data Analysis in Python3

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

- Introduction
- Mathematics
  - Linear Algebra (Scalar, Vector, Matrix, Tensor)
  - Complex Number
  - Symbolic Computation versus Numerical Computation
  - DSP
- Numpy Practical Exercises

Introduction

- Basic Data Types
- HDF5 format and MAT files

Data Types

- Integers
- Floating Numbers
- Bits versus Bytes
- Signed versus Unsigned

Numpy	C
Int8	Char
Int16	Short
Int32	Long
Int64	Long long
Float16	Half
Float32	Float, Single
Float64	Double

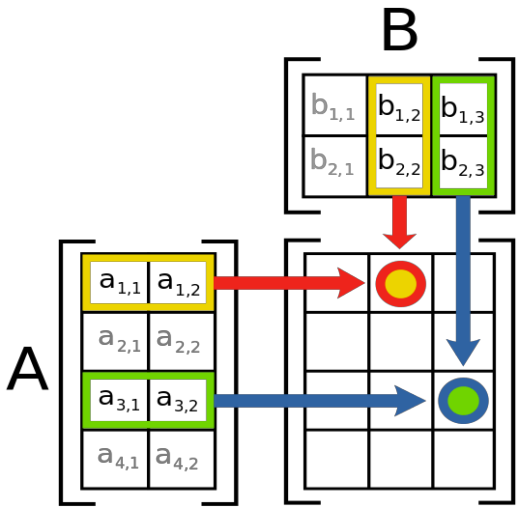
HDF5 format and MAT files

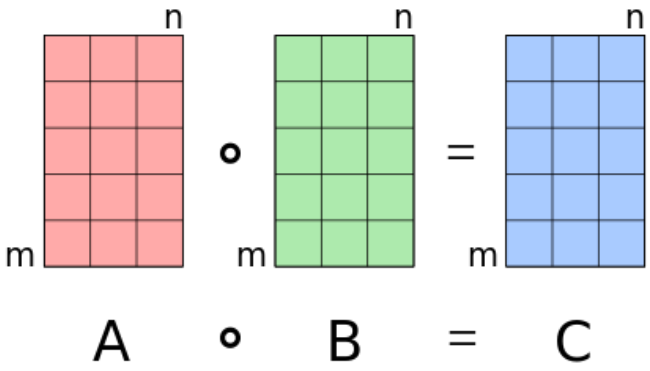
- NEVER keep your numeric data in plain text format!
- bam, tif, avi, mat, hdf5, etc.
- MAT: compatible with MATLAB (**scipy.io**)
- HDF5: Hierarchical Data Format (**h5py**)

Basic Linear Algebra

$$\mathbf{a} \cdot \mathbf{b} = ||\mathbf{a}|| \cdot ||\mathbf{b}|| \cdot cos(\theta)$$

- scalar, vector, matrix, tensor
- dot product
- matrix product
- entrywise product
- cross product

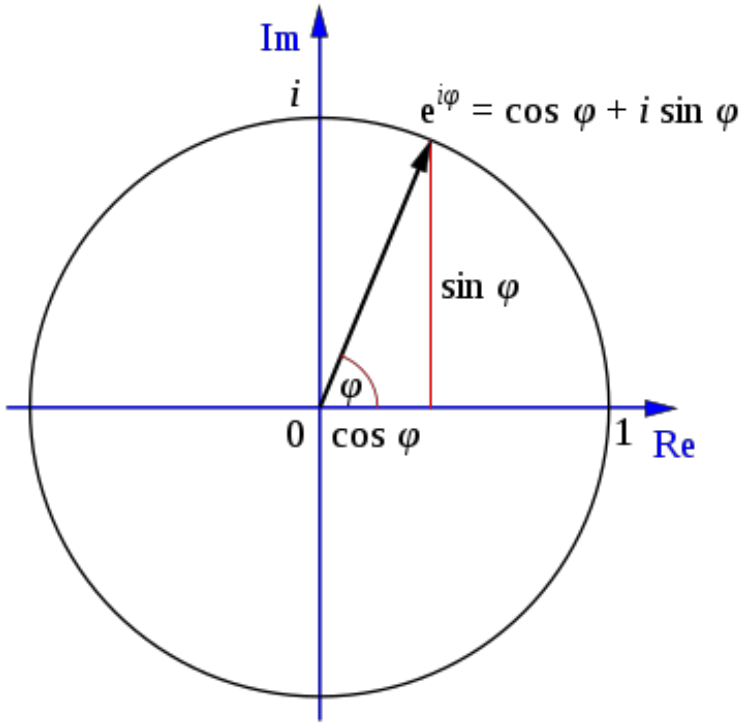




$$\mathbf{a} \times \mathbf{b} = ||\mathbf{a}|| \cdot ||\mathbf{b}|| \cdot sin(\theta)\ \mathbf{n}$$

Complex Number and Euler's Formula

$$Ae^{i\phi} = A \cdot cos\phi + Ai \cdot sin\phi$$



- Complex Number and Vector
- Addition and Subtraction
- Multiplication and Division

Digital Signal Processing

- Time Series
- Fourier Transformation
- Hilbert Transformation
- Wavelet Transformation

Numpy Exercises

- Orientation Selectivity, discrete data, 1d
- Event-Related Potential, continuous data, 2d
- Monochrome Image Filter, imaging, 3d