



Essential NumPy Concepts for IQ Data and SDR

1. Array creation & data types

- Creating arrays (`np.array` , `np.zeros` , `np.ones` , `np.arange` , `np.linspace`)
- Understanding data types (`dtype`), especially complex types (`np.complex64` , `np.complex128`)

2. Indexing & slicing

- Basic and advanced indexing (integer, boolean, fancy)
- Negative indexing and step slicing
- Multi-dimensional slicing

3. Broadcasting

- Rules and examples (including `np.newaxis`)
- Practical use cases in signal scaling, mixing, filtering

4. Memory views and copies

- Difference between views and copies
- How slicing returns views
- Impact on memory and performance

5. Array reshaping and dimension manipulation

- `reshape()` , `ravel()` , `flatten()`
- `transpose()` , `swapaxes()`
- `expand_dims()` , `squeeze()`

6. Vectorized operations

- Arithmetic on arrays without loops
- Applying mathematical functions element-wise (`np.sin` , `np.abs` , etc.)

7. Complex number operations

- Handling IQ data as complex arrays
- Extracting real, imaginary, magnitude, phase (`np.real` , `np.imag` , `np.abs` , `np.angle`)

8. Statistical and aggregation functions

- `mean()` , `std()` , `sum()` , `max()` , `min()`
- Along axes for multi-dimensional data

9. File I/O with NumPy

- Saving and loading arrays (`np.save` , `np.load` , `np.fromfile`)

- Working with raw IQ data files

10. Linear algebra basics

- Dot products, matrix multiplication (`np.dot` , `@` operator)
- Useful for MIMO SDR processing or beamforming

11. Fast Fourier Transform (FFT) basics

- `np.fft.fft` , `np.fft.ifft` , frequency bins understanding
- Windowing and zero-padding (prepare for spectral analysis)

12. Masking and filtering

- Boolean masks to select data
 - Applying filters or thresholding
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