NumPy Complete Roadmap for AI & ML (Basic to Advanced)

Phase 1: Foundations

- Introduction to NumPy (ndarray, why faster than lists, installation)
- Creating Arrays (array, zeros, ones, arange, linspace, random, eye)
- Array Attributes (shape, size, ndim, dtype)
- Indexing & Slicing (1D, 2D, boolean, fancy indexing)
- Basic Array Operations (arithmetic, broadcasting, vectorization)

Phase 2: Intermediate Concepts

- Mathematical Functions (sum, mean, std, var, min, max, sqrt, log, exp)
- Reshaping & Manipulation (reshape, flatten, transpose, concatenate, split)
- Linear Algebra Basics (dot, matrix multiplication, inverse, determinant)
- Random Module (seed, normal distribution, uniform distribution, shuffle)

Phase 3: Advanced NumPy

- Memory & Performance (views vs copies, strides, vectorization vs loops)
- Advanced Indexing & Masking (where, conditional filtering)
- Structured Arrays & Custom dtypes
- Numerical Stability (floating point precision, overflow, clipping)

Phase 4: NumPy in Machine Learning

- Implement Linear Regression using NumPy
- Implement Logistic Regression using NumPy
- Gradient Descent from scratch
- Build Neural Network using NumPy only
- PCA implementation using NumPy

Phase 5: NumPy Ecosystem Integration

- NumPy with Pandas
- NumPy with Matplotlib

- NumPy with Scikit-learn
- NumPy vs Tensors (TensorFlow & PyTorch)
- Best Practices & Industry Usage