Python&BrainPy(programming basic)

- BrainPy github repository
  - Issues
  - Pull requests

Python Basics

- Spyder(类似于matlab)\Pycharm\Jupter Notebook\VSCode（通用编译器） Copilot
- Main Contents
  - Variable
    - Values
      - a value is the Fundamantal thing that a program manipulates
      - Values have many types
        - Bool
        - str
    - Keywords
      - Not allowed to use keywords,
    - Operators(对基本数据类型的操作)
      - Operators for integers and Floats
      - Booleans
    - Modules
      - not all functionaluty available comes automatically when starting python
      - import/from...import.../from...import*
    - Controlled statements
      - If
      - For
      - While
    - Functions
      - are used to abstract components of a programming
      - much like a mathematical function,they take some input and then find the result
  - Datatype
    - list
      - Group variables together
      - Specific order
      - Access item with brankets:
      - can be sliced/multiplied/added
      - are mutable
      - copy a list a=b.copy() 否则对应的是一个对象
    - Tuple
      - immutable
    - Dictionaries
      - a collection of key-value pairs
  - Class

- objects
  - 类，类的实例，数据类型都是对象
  - integer types
- Object oriented programming
  - attributes
  - methods
- Initializing an objecet
 - **init**method
- class has methods(similar to function)

NumPy Basics

- Introduction
  - Funfamental package for scientific computing with Python
  - N-dimensional array objects
  - 线性代数，傅里叶变换，随机数
- array(多维数组)
  - mutable
  - array attributes
- Array broadcasting
  - 维度扩增，对行列进行复制，同纬度计算
- Vector operations
  - inner product...
- Matrix operations
  - define some matrices
- Operations along axes
- Slicing arrays
- Reshape
- Matrix operations
- Linear algebra
- Fourier transform
- random sampling
- Scipy
  - a library of algorithms and mathematical tools built to work with NumPy arrays
    - *scipy.linalg* linear algebra
    - *scipy.stats* statistics
    - *scipy.optimize* optimization
    - *scipy.sparse* sparse matrices
    - *scipy.signal* signal processing
    - etc.

BrainPy Introduction

- modeling demands
- BrainPy Architecture
  - Infrastructure
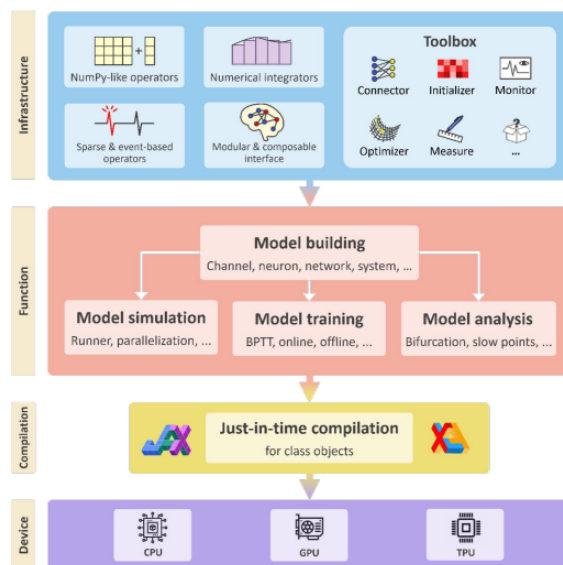 - function
  - JIT Compilation
  - Device
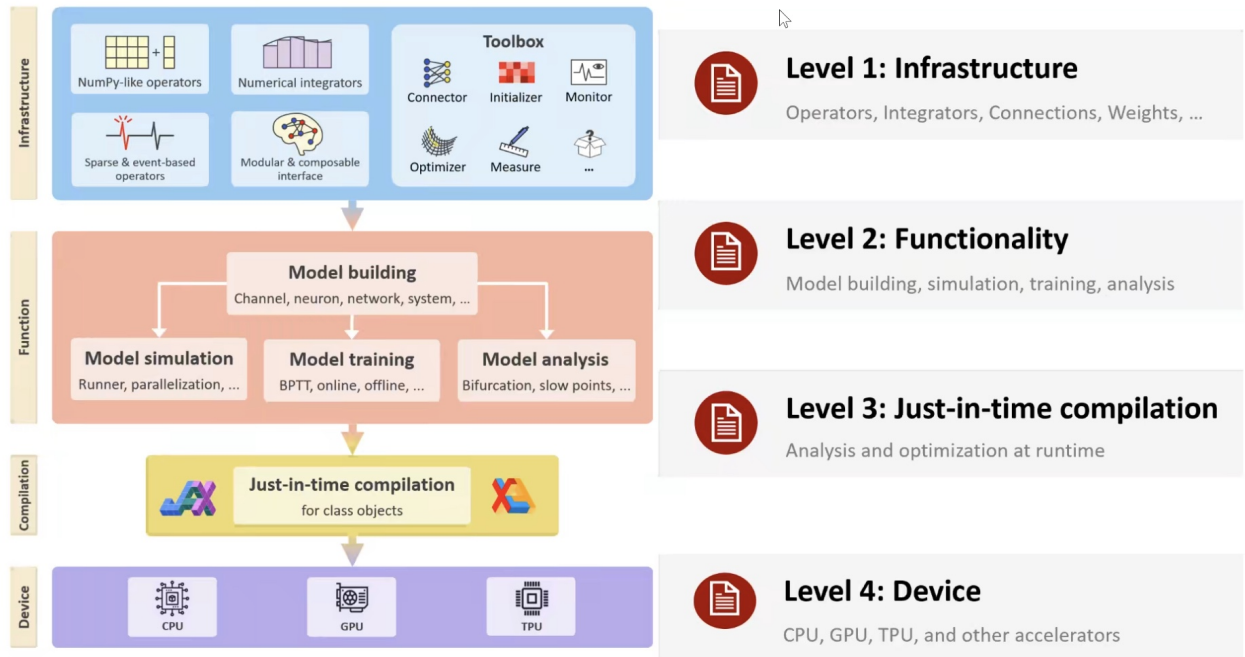
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- Main features
  - Dense Operators(brainpy.math)
  - Dedicated Operators
    - applies brain dynamics sparse connectivity properties with event-driven Computaional features
    - Reduce the complexity of brain dynamics simulation by several orders of magnitude
    - (surrogate gradient)
  - Numerical Integrators
    - ordinary differential equation:brainpy.odient
    - Stochasitic differential equation:brainpy.sdient
    - Fractionnal differential equation:brainpy.fdient
    - Delayed differential equation
  - Modular and composable(brain.DynamicalSystem)
  - Object-oriented JIT Compilation
    - bm.JIT
    - bm.grad
    - bm.forloop
    - bm.ifelse

- BrainPy programming Basics
  - Just-in-Time Compilation
    - static Compilation converts the code into a language for a Specific platform(C,C++)
    - An interpreter directly executes the source code(python)
    - object must be inherited from brainpy.BrainPyObject
    - all time-dependent variables must be defined as bm.Variable
    - How to debug turn off JIT compilation(in bp.DSRunner)
  - Data operations
    - arrays
      - brainpyarray&jaxarray
    - variables(动态的)
      - In-place updating
        - indexing and Slicing
        - v.value assignment
    - Control flows:
      - If-else
        - bm.where,bm.ifelse
      - for loop
- Conclusions

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