

# ENBIOS




15.02.24

Version 2.2.7

LivenLab installation party/workshop

# Outline

- Basics of ENBIOS (current state)
- Setup – 10:00 ...  ?
- Running the first demo
- Freestyle fun (TBD)

# Enbios Experiment structure

- **Hierarchy**

the “dendrogram” consisting of nodes

- **Adapters, Aggregators**

builtin or external python files, which run code for nodes

- **Scenarios**

Outputs for bottom nodes in the hierarchy

Node

name, config

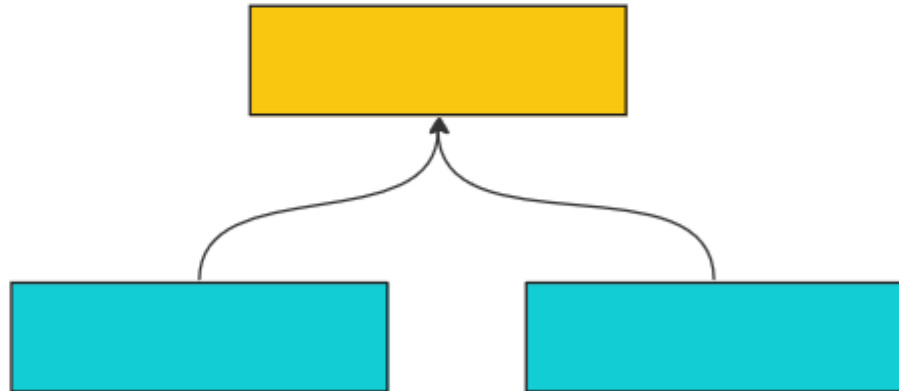
functional nodes

Aggregator

Structural nodes

Adapter

# Hierarchy



# Adapters/Aggregators

- Name (of the builtin A/A)
- Path to the module that contains the A/A (alt.)
- Config
- Methods (for Adapters)Adapters/Aggregators

# Scenario

- Assigning outputs to bottom nodes

e.g.

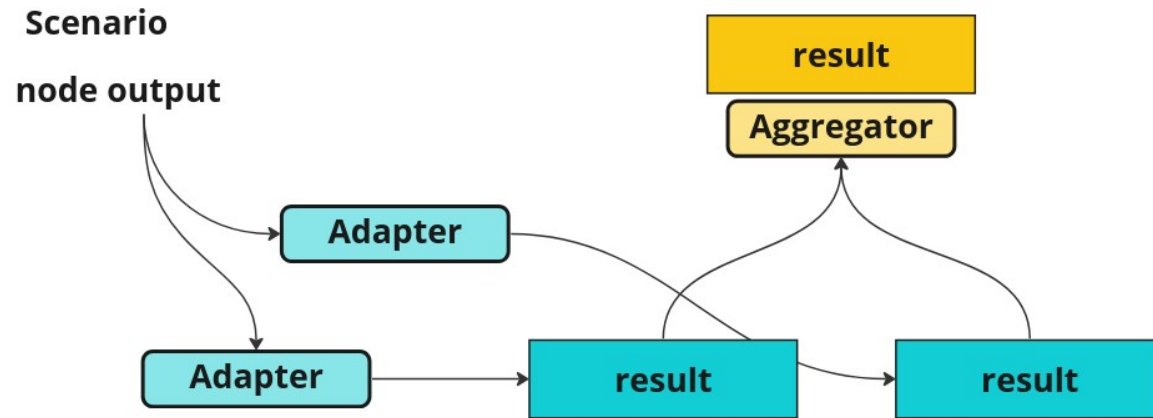
```
"scenarios": [  
  {  
    "nodes": {  
      "solar": {  
        "unit": "MWh",  
        "magnitude": 30  
      },  
      "wind": {  
        "unit": "MWh",  
        "magnitude": 20  
      }  
    }  
  }  
]
```

# When you initiate an experiment

- Validate basic experiment structure
- Load ada/agg modules.
- Validate ada/agg *config* against loaded ada/agg
- validate hierarchy
  - validate basic structure
  - validate each nodes *config* against its specified ada./agg.
- validate scenarios
  - Validate node output against adapter configs of corresponding node

# Running a scenario – what happens

- Scenario outputs for each bottom node is sent to their corresponding Adapter
- Adapter calculate the results (for the given methods). The adapters process all node outputs at once.
- Results are passed upwards
- Aggregators calculate the result values





LET'S GET INTO IT

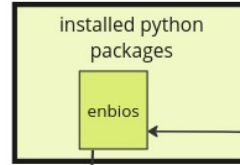


# Setup

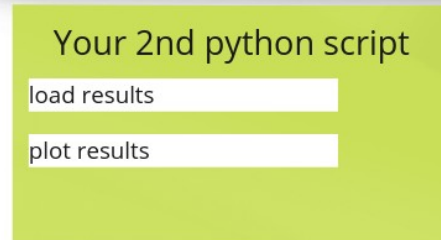
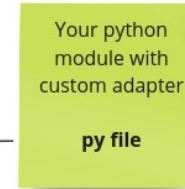
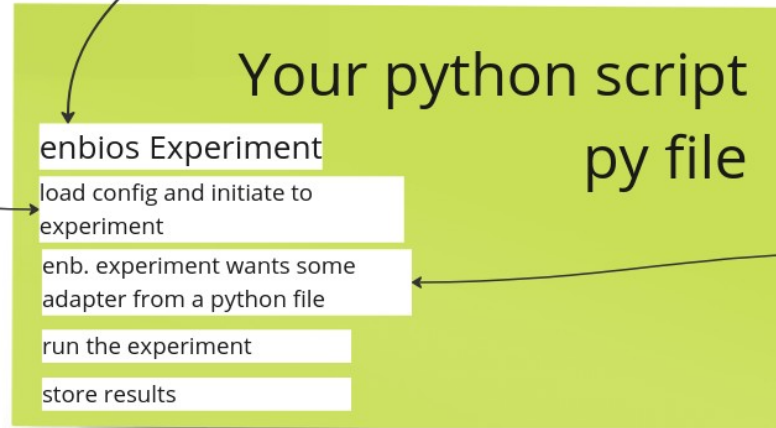
- get a computer
- install python
- install an integrated development environment (IDE) ([Pycharm](#), [MS Code](#))
- Create a project (for this workshop) (A folder)
- [create a python virtual environment](#) (a folder inside your project folder)
- install enbios in that environment ([how to use pip, enbios on pypi](#))
- [Download ecoinvent](#)
- create a python script to create a brightway project with the ecoinvent database
- create a python script (in the IDE) to run enbios experiment
- create experiment configuration file (basically just some brightway adapter stuff)
- run experiment in script with configuration file

Some python  
virtual environment  
you created for the  
project

**DON'T TOUCH**



your scripts runs  
inside the venv





# Python fundamentals

- Object oriented script language
- Dynamically typed (but type hints were recently introduced and make your program much much better)
- Code Structure through format: indentation (4 spaces, 2 tabs, ...)



# Object-oriented programming (OOP)

OOP is a programming style that uses "objects" -- data structures consisting of data fields and methods together -- to design and organize software programs. Classes, in this context, are blueprints for creating objects, offering a way to group related tasks and data together.



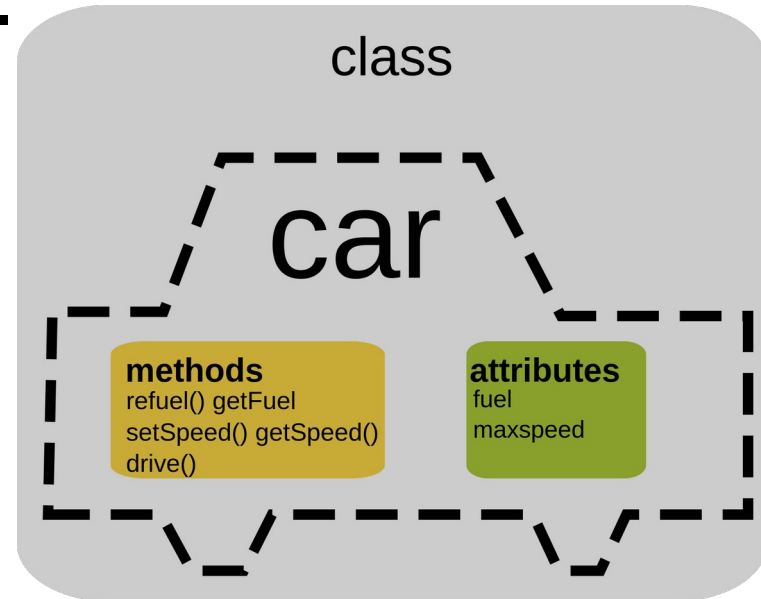
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# Objects

- Have the fields (variables) as defined in the class and provide the functions that can do operation on the object state...





# Classes in Enbios

- Experiment
- Scenario
- TreeNode
- Adapter, Aggregator (Abstract classes and some concrete implementations)





# Fundamental types in python

- Basic types: int, float, string, bool

## **Classes:**

- List: lists of something (anything). Items can anytime added, removed and accessed by index
- Dictionary: key, values pairs (keys: generally strings; values can be of any type. Items can be added, removed and accessed by the keys)
- Any arbitrary nesting of those 2 is possible (as it is in json)



# Modules (py files)

Contain: code (variable declarations, expressions), classes, functions

Individual parts can be imported in other modules

Import runs the whole imported module (that's why we have the `__name__ == "__main__"` condition

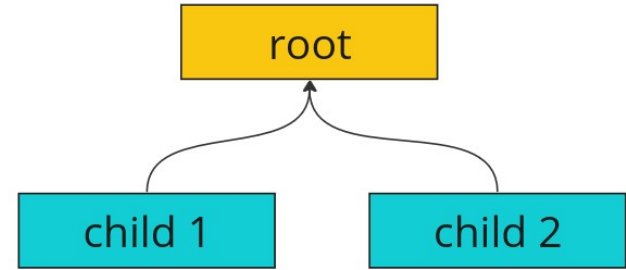


# TreeNode class in Enbios

Fields:

- name (unique in the tree)
- children
- parent
- data (e.g. output, result)

Functions: to add/remove children and navigate through the tree



# Package

- A self contained set of python modules (.py files) that have a specific purpose
- Can be published on Pypi
- Packages on Pypi can be installed with python pip
- E.g. numpy, scipy, matplotlib, brightway, enbios and thousand others



# Python virtual environments

- Little contained installations of python on your computer. Why?
  - Different projects sometimes need different versions of python or packages
  - Makes it much easier to reproduce project requirements
  - Easy to dispose



# Brightway

- LCA splitup in 3 (or more) packages
- Brightway projects are system wide
- Now: Create a BW project and import ecoinvent into it's database [\[LINK\]](#)

## Project

A project acts as a container for a set of *databases* and *LCIA methods*. Each project is independent, and has its own copy of all data. Projects have their own metadata and user preferences.

### Database

A inventory database is a generic container for datasets, but most of the time will include *activities* and *exchanges*.

### Activity

A node in the supply chain graph. Includes transforming activities, biosphere flows, and other custom types.

### Exchange

An edge between two nodes in the supply chain graph.

### Method

A impact assessment method stores data about *characterisation factors*. It is normally just a list of biosphere flows and characterisation factors, with or without uncertainty, but can also be regionalised or dynamic.

### Other objects

Projects also include *normalisation* and *weighting* factors, as well as project-specific code.

# Some Documentation

[https://github.com/LIVENlab/enbios/tree/main/d  
ocs](https://github.com/LIVENlab/enbios/tree/main/docs)

# Enbios Demo notebooks

- 1) Intro ++
- 2) Plotting?
- 3) Regionalization?
- 4) ... You decide



# Questions for your scenario?

- Whats your scenario? 1 sentence
- What would be the structural nodes? What are their possible outputs, what would be the methods of the Adapter(s) in your scenario.
- What would the Aggregators calculate/decide?