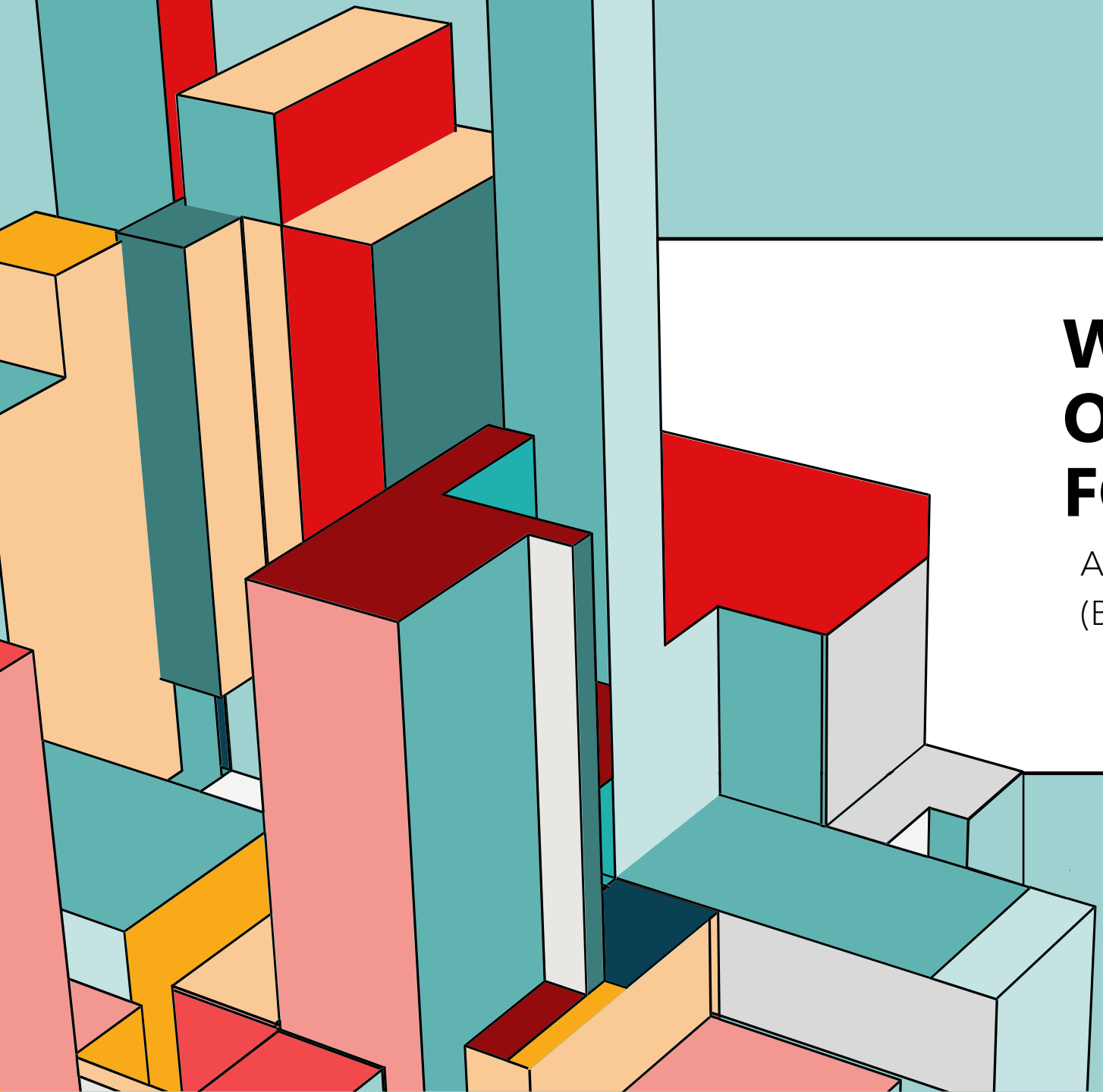


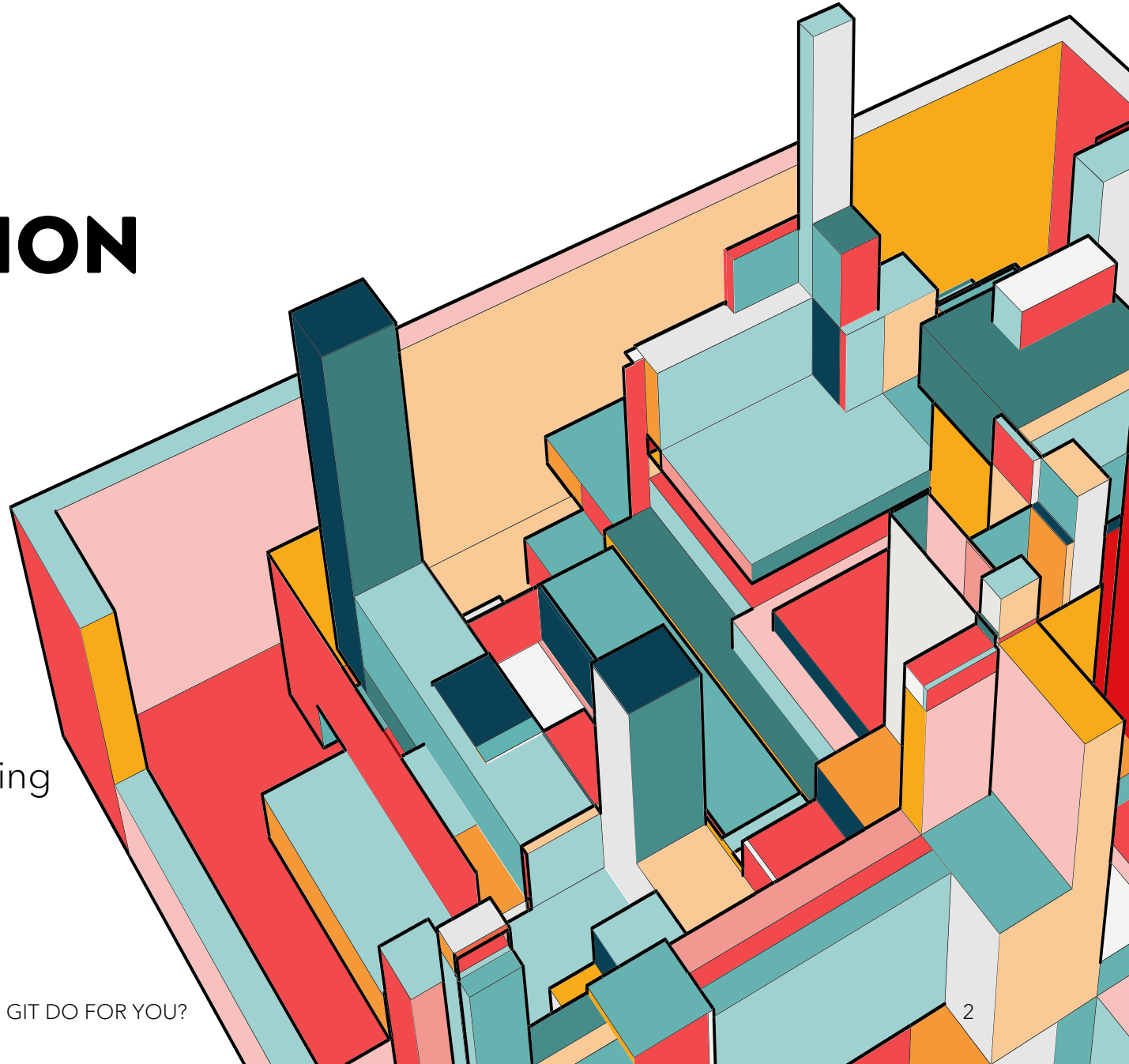
WHAT COULD OOP AND GIT DO FOR YOU?

Ambre VISIVE
(BE-EA-PR)

OPERA-2D & PYTHON

- Newest versions of Opera-2D meant to be use with Python

- Python
  - Functional Programming
  - Object-Oriented Programming



PRESENTATION OVERVIEW

What is OOP?

Simple explanation for non-computer scientists

How can OOP be used?

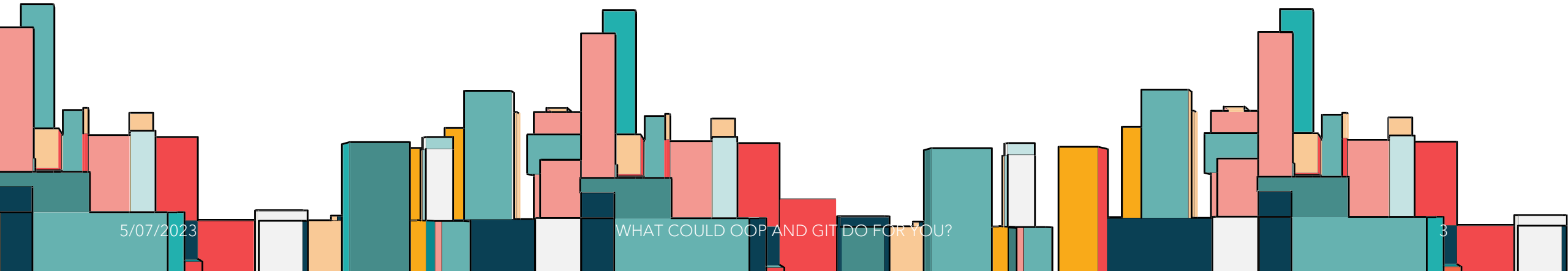
Type of classes and methods that can be created

But why Git?

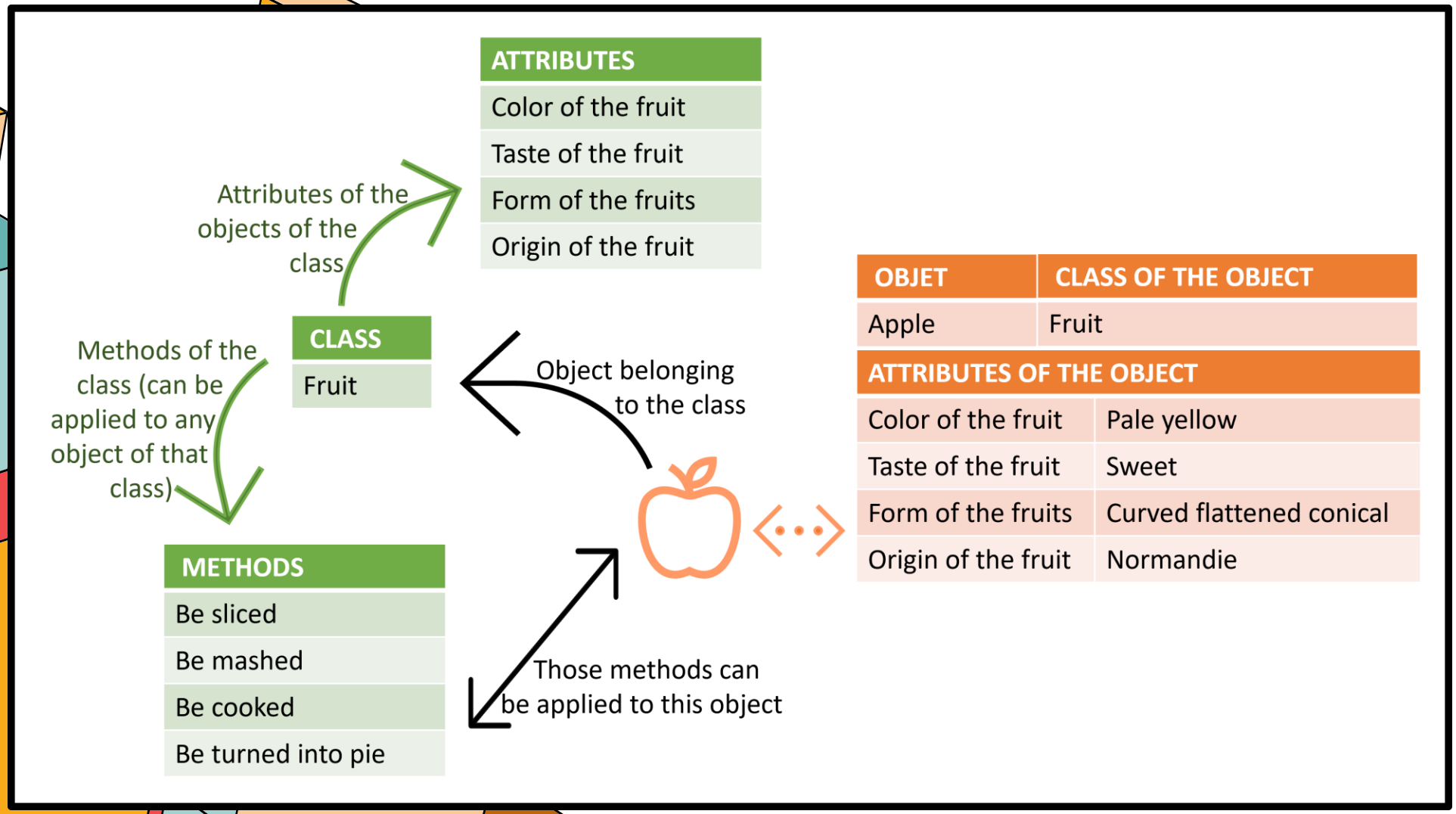
Version-Controlled system to keep track of all changes

Example of application

The Tool, PyMagnets and the EA Magnet Database



OBJECT-ORIENTED PROGRAMMING



HOW CAN IT BE USED? (1/2)

CLASSES

- Type of Materials
- BH Libraries
- Type of Magnets
- Type of Coils
- *Postprocessor*
- ….

ATTRIBUTES

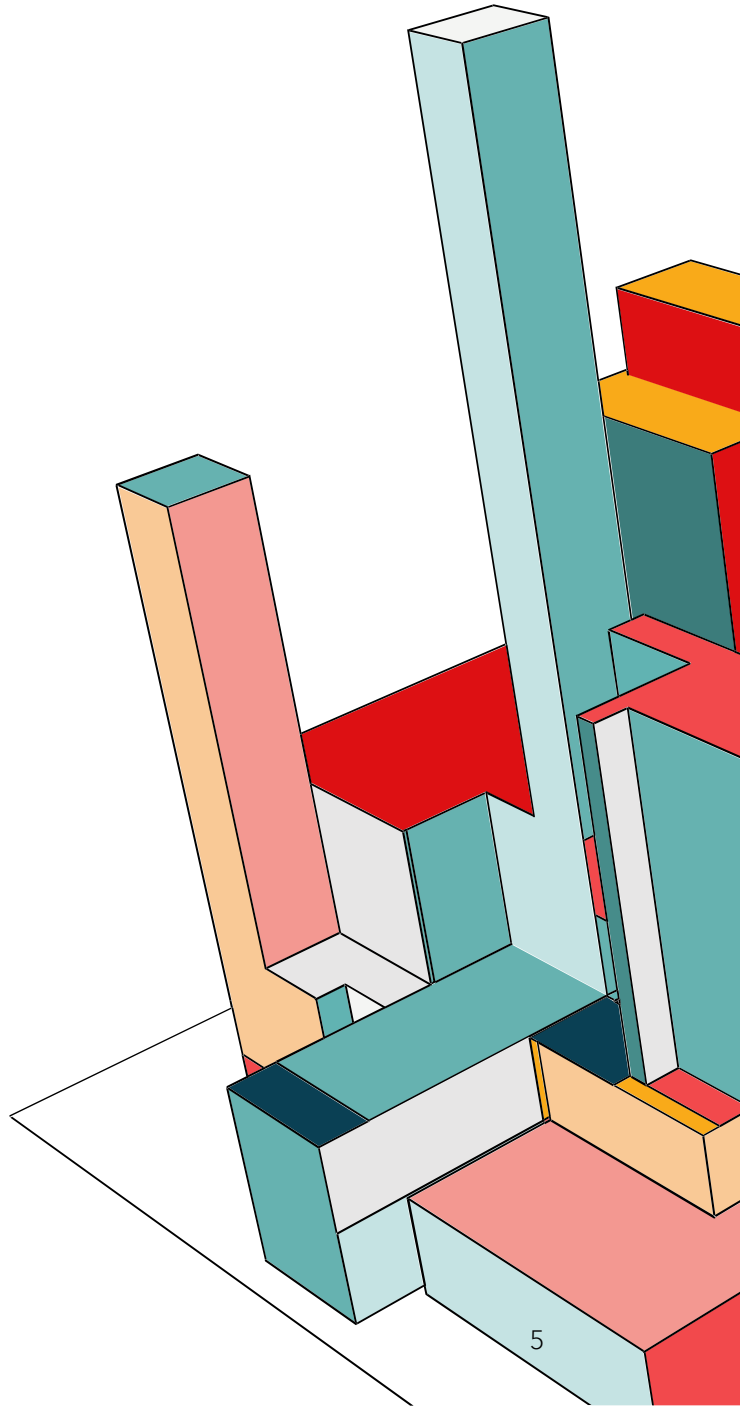
Anything that *belongs* to an object of a certain defined class

OBJECTS

- A BH curve
- A coil
- The Steel
- …

METHODS

- Plotting the flux lines
- Draw edges for a set of points
- Create field maps
- Set the current density
- Attribute a material to a body
- Measuring the field quality
- ….



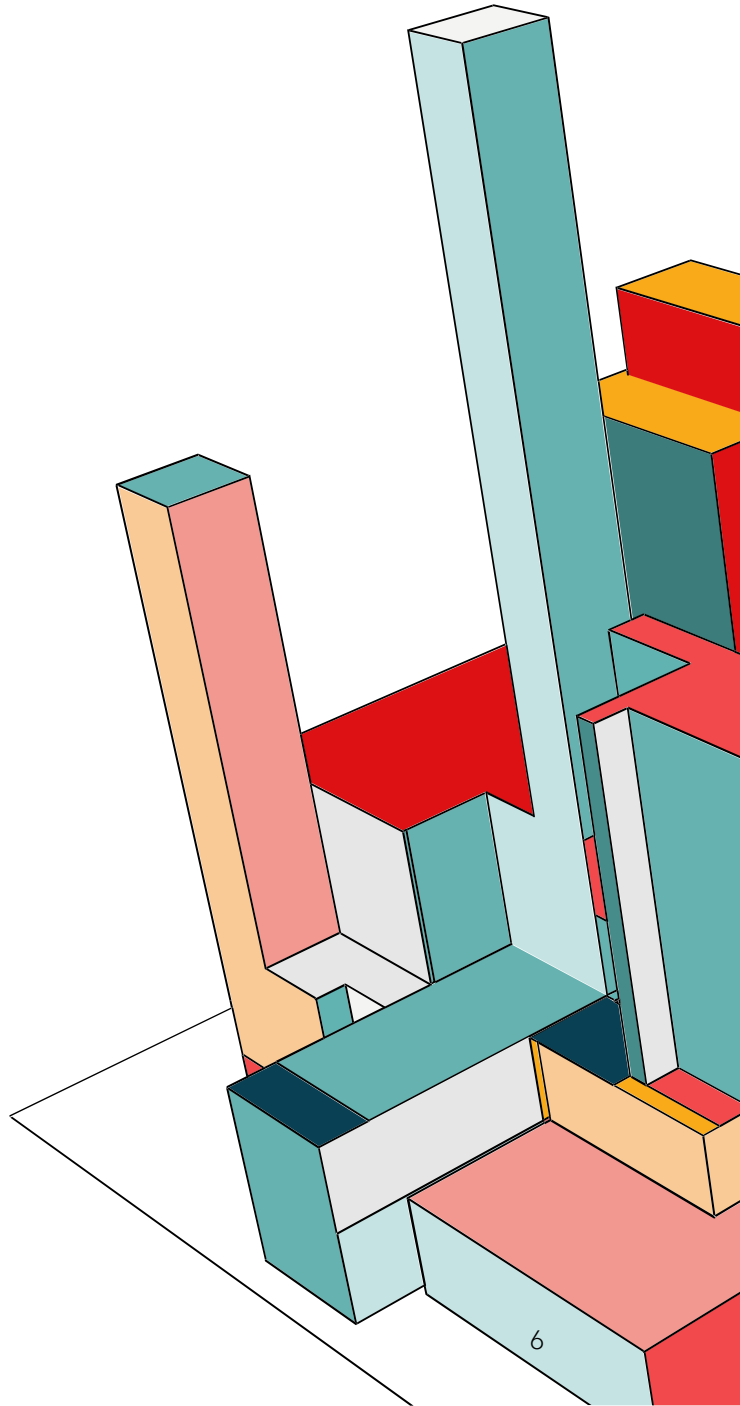
HOW CAN IT BE USED? (2/2)

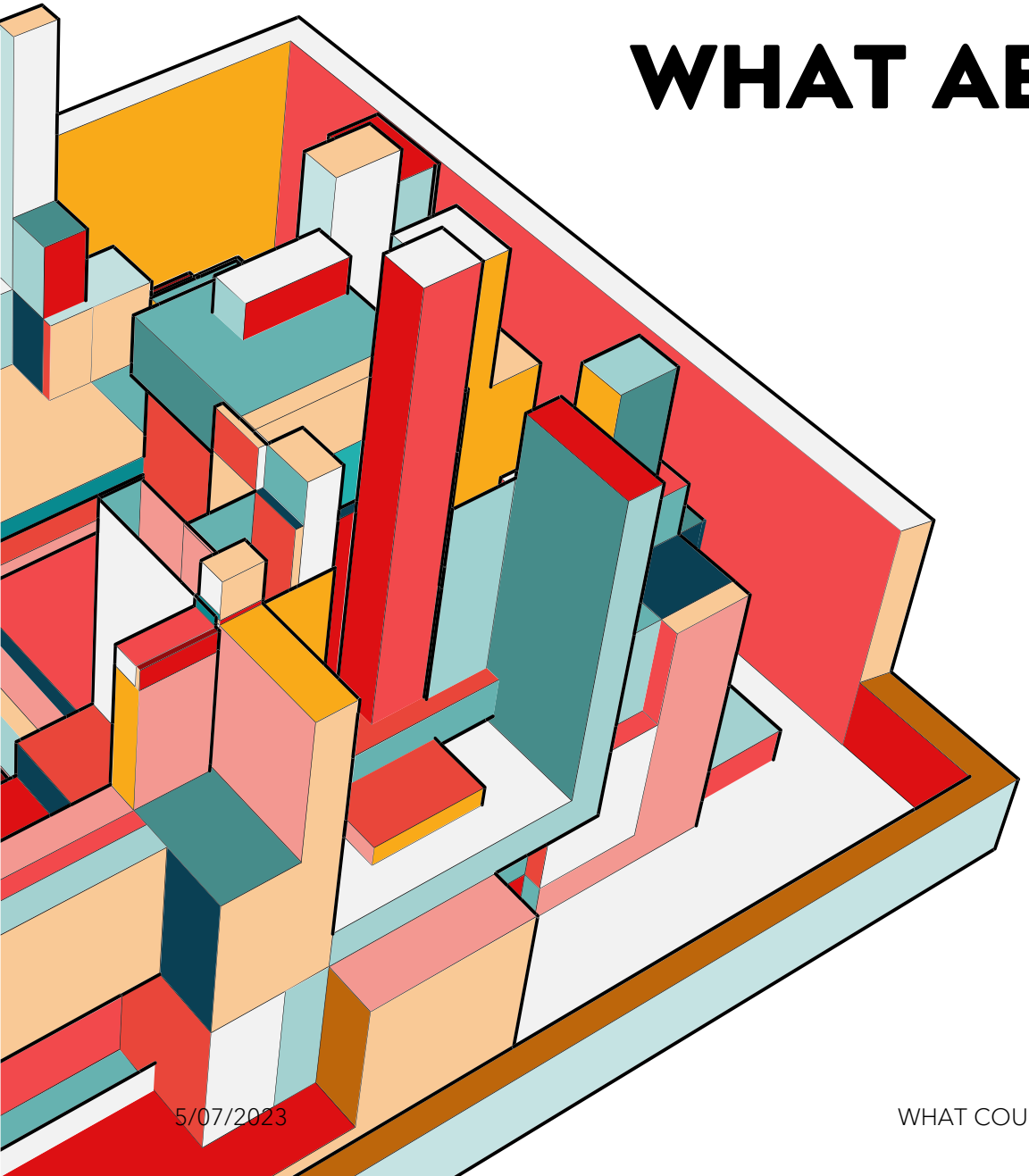
CLASSES
METHODS

PYTHON FILE 1
PYTHON FILE 2
PYTHON FILE 3
....

PYTHON PACKAGE

- Shared with your colleagues
- Imported directly in your script
- …





WHAT ABOUT GIT?

- Distributed Version Controlled System
- Works with Locally-Cloned Copies
- Save only the changes in its history

Thanks to VCS, you can keep the different versions of your script, packages and models !

+ they will be available to all your colleagues

EXAMPLE OF APPLICATION

Issues face by the physicists of EA:

- how to produce new magnetic field map not only of the GFR but all regions above 25mT?
- how to easily access existing ones?

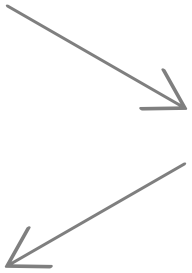
Solutions:

- Creating a intern tool for non-Opera users to create field maps
- Saving all created field maps and the magnet model in a Database

EXAMPLE OF APPLICATION

Methodology:

- Find geometry of magnet-type on technical drawings from 1970s
- Add the new magnet-type in the PyMagnets package
- Benchmark the model with the most recent available MM
- Adjust the BH curve



- new model ready to use by Users
- Users can create themselves field maps

EXAMPLE OF APPLICATION

PyMagnets

Model.py

- Model:
  - *Set_Units*
  - *Set_Settings*
  - *Generate_Mesh*
  - *Solve*
- Region:
  - *AssignMaterial*
  - *AssignCurrent*
- CurrentLibrary:
  - *Set_NoCurrent*
  - *Set_PosCurrent*
  - *Set_NegCurrent*
- PostProcessing:
  - *Plot_DensityMap*
  - *Plot_FluxMines*
  - *Plot_minmaxDensityMap*
  - *Create_Fieldmap_TXTFormat*
  - *Create_Fieldmap_BDSIMFormat*
- Edges:
  - *AssignMesh*
  - *AssignBoundary*
- BoundaryType:
  - *Set_Dirichlet*
  - *Set_Neumann*

Magnet.py

- Bodies:
  - *Set_Yoke_MCB*
  - *Set_Coil_1_MCB*
  - *Set_Coil_2_MCB*
  - *Set_Background_MCB*
  - *Set_Yoke_QSL*
  - *Set_Coil_1_QSL*
  - *….*
- Magnet:
  - *Set_MCB*
  - *Set_MBW*
  - *Set_QNL*
  - *…*

Material.py

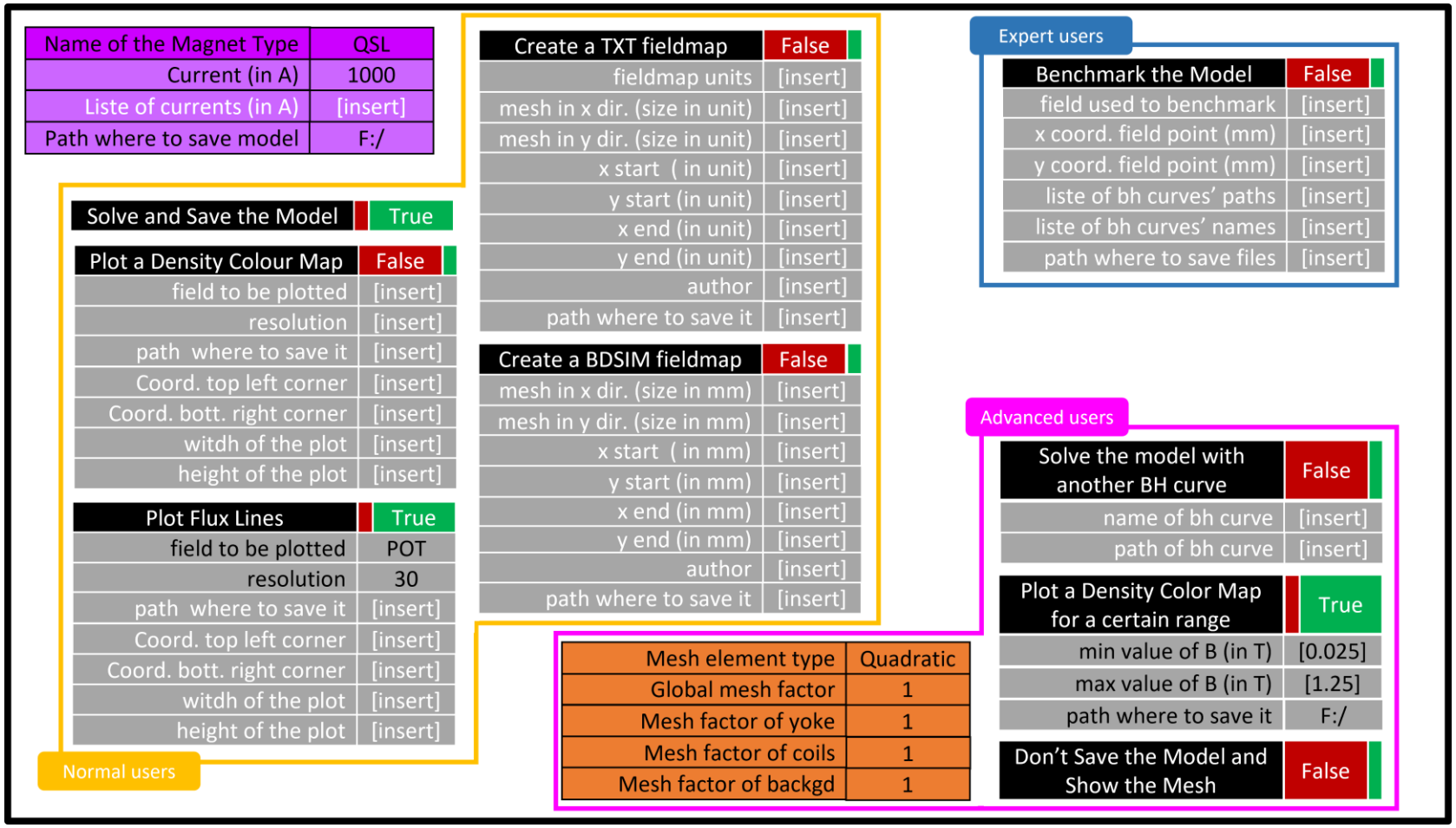
- MaterialLibrary: *Set_Air* *Set_Copper* *Set_Steel*
- BHcurveLibrary: *Set_UnknwonBHcurve* *Set_Default* *Set_Mildhigh* *Set_MBGSteel* *…*

Key:

Underlined = Classes

Italic = Methods

EXAMPLE OF APPLICATION



Script to be adapted every time by users and run in Opera-2D

Import the PyMagnets package

EXAMPLE OF APPLICATION

NCMagnets_GitRepository

- .gitlab-ci.yml
- README.md
- .gitmodules
- NCMagnets_UserScript.py

Fieldmaps

- .gitlab-ci.yml
- README.md
- QNL_fieldmapBDSIM_416A_pymagnetsV1-2-1_20230628-103438.dat
- MBW_fieldmapTXT_416A_pymagnetsV1-1-9_20230528-124558.txt
- …

PyMagnets

src/pymagnets

- __init__.py
- magnet.py
- material.py
- model.py

- .gitlab-ci.yml
- .gitignore
- LICENSE.txt
- README.md
- pyproject.toml
- setup.cfg
- setup.py
- Copy_UserScript.py

Where all the versions of the package can be found in the history

Documentations

- .gitlab-ci.yml
- README.md
- MCB_Documentation.pdf
- MCB_Benchmarking.xlsx
- …

OperaFE-2DModels

- .gitlab-ci.yml
- README.md
- QNL_Opera2D-FEmodelWithBHdefault_416A_pymagnetsV1-2-1_20230628-103438.op_h5
- QNL_Opera2D-FEmodelWithBHdefault_416A_pymagnetsV1-2-1_20230628-103438.res
- QNL_UserScript_416A_pymagnetsV1-2-1_20230628-103438.py
- …

Store the script + the Opera file of the saved model + compiled resources

EXAMPLE OF APPLICATION

Perks of The Tool:

- Physicists are now autonomous in their production of the *specific* field maps they need
- Everything is store in Git and accessible to all
- All results are reproducible even after a couple of years

- The Tool is just a start and can be extended to more applications

THANK YOU

Ambre VISIVE

BE-EA-PR