volib
A Python implementation of the VO Data Modeling Language

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SAO

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- Provide VO users with friendly, extensible I/O libraries while shielding them from the technical details of the data models specs
- Stress on a clean, simple API. “Focus on the science, not on the specifications”
- Code generation, if needed

Specifications

- **VO-DML** WD: Consistent language for describing data models
  - Machine-readability
  - Model reuse
  - Model extensibility
  - Portable identifiers
  - Backward compatibility with older serializations
- **Mapping Data Models to VOTable** WD: define a standard strategy for serializing any data model instance to VOTable

Features

- **VO-DML** WD: Consistent language for describing data models
  - Model reuse —> Reusable libraries
  - Model extensibility —> Inheritance/Polymorphism
  - Machine-readability —> Model-agnostic. Code generation.
  - Portable identifiers —> Context and Resolvers
  - Versioning
- **Mapping Data Models to VOTable** WD: define a standard strategy for serializing any data model instance to VOTable
  - VOTable I/O

Representing Data Models

```
class SkyCoordinate(DataType):
    vodml_id = 'source.stc.SkyCoordinate'

    longitude = Attribute(ivoa_1_0.RealQuantity,
                          'source.stc.SkyCoordinate.longitude',
                          doc="""The longitude part of this position in units of degrees.""")

    latitude = Attribute(ivoa_1_0.RealQuantity,
                          'source.stc.SkyCoordinate.latitude',
                          doc="""The latitude part of this position in units of degrees.""")

    error = Attribute(SkyError,
                          'source.stc.SkyCoordinate.error',
                          doc="""None""")

    frame = Reference(SkyCoordinateFrame,
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VO-DML Types

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Types from Imported Models

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VO-DML Types

Types from Imported Models

Types from Same Model

Declarative approach allows users/developers/providers to easily create new classes and serialize them as compliant VOTable and VO-DML/XML

Inheritance/Polymorphism

```
class SkyError(DataType):
    vodml_id = 'source.stc.SkyError'

class CircleError(SkyError):
    vodml_id = 'source.stc.CircleError'

    radius = Attribute(ivoa_1_0.real,
                       'source.stc.CircleError.radius',
                       doc="""TODO : Missing description : please, update your UML model asap

class GenericEllipse(SkyError):
    vodml_id = 'source.stc.GenericEllipse'

    major = Attribute(ivoa_1_0.real,
                      'GenericEllipse.major',
                      doc="""major axis of error ellipse""")

    minor = Attribute(ivoa_1_0.real,
                      'source.stc.GenericEllipse.minor',
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Parent Class

Inheritance/Polymorphism

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Parent Class

Extensions

Inheritance/Polymorphism

Inheritance/Polymorphism

```
>>> from reference.ref_1_0.source.stc import CircleError, GenericEllipse
>>> error = CircleError()
>>> coord.error = error
>>> s.position = coord
>>> s.position.error.radius = 1
>>> print s.position.error.radius
1.0

>>> coord.error = GenericEllipse()
>>> coord.error.major = 0.1
>>> coord.error.minor = 0.1
>>> coord.error.pa = 20
>>> s.position.error
<reference.ref_1_0.source.stc.GenericEllipse object at 0x101228610>
>>> s.position.error.pa
20.0
```

Any children of SkyError can be used as coordinate errors

Inheritance/Polymorphism

```
>>> from reference.ref_1_0.source.stc import CircleError, GenericEllipse
>>> error = CircleError()
>>> coord.error = error
>>> s.position = coord
>>> s.position.error.radius = 1
```

```
>>> coord.error = Source()
ERROR:volib.model:Cannot cast value <reference.ref_1_0.source.Source object at 0x101228550> to datatype
```

```
>>> coord.error = GenericEllipse()
>>> coord.error.major = 0.1
>>> coord.error.minor = 0.1
>>> coord.error.pa = 20
>>> s.position.error
<reference.ref_1_0.source.stc.GenericEllipse object at 0x101228610>
>>> s.position.error.pa
20.0
```

Any children of SkyError can be used as coordinate errors

Inheritance/Polymorphism

```
>>> from reference.ref_1_0.source.stc import CircleError, GenericEllipse
>>> error = CircleError()
>>> class MyEllipseError(GenericEllipse):
...     def area(self):
...         import math
...         return math.pi*self.major*self.minor
>>> myerror = MyEllipseError()
>>> myerror.minor = 1.5
>>> myerror.major = 3.1
>>> coord.error = myerror
>>> s.position.error.area()
14.608405839192539
>>> s.position.error.pa
20.0
```

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Inheritance/Polymorphism

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```

This custom class can be serialized just as a GenericEllipse

```
20.0
```

Any children of SkyError can be used as coordinate errors

Some useful properties

```
>>> from reference.ref_1_0.source import Source, SourceClassification
>>> s = Source()
>>> s.classification = SourceClassification.STAR
>>> s.classification
<volib.model.Enum object at 0x101220c10>
>>> print s.classification
star
```

Some useful properties

```
>>> from reference.ref_1_0.source import Source, SourceClassification
>>> s.classification = 'galaxy'
>>> s.classification
<volib.model.Enum object at 0x101220c50>
>>> print s.classification
galaxy

>>> s.classification = 'foo'
Traceback (most recent call last):
    ...
TypeError: Wrong value for Enum SourceClassification. Valid values: SourceClassification.PLANET or "planet",
    SourceClassification.AGN or "AGN", SourceClassification.STAR or "star",
    SourceClassification.GALAXY or "galaxy", SourceClassification.UNKNOWN or "unknown"
```

Some useful properties

```
>>> from reference.ref_1_0.source import Source, SourceClassification
```

```
>>> s.classification = 'galaxy'
>>> s.classification
```

```
>>> from reference.ref_1_0.source.stc import SkyCoordinate
>>> coord = SkyCoordinate()
>>> print coord.longitude
None
```

Once instantiated, the SkyCoordinate object have attributes with no values. However, if we try to assign a value to the attribute:

```
>>> coord.longitude = 5
>>> coord.longitude.value
5.0
```

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- Implement VO-DML Quantities as Astropy Quantities (units conversions, quantity comparison/combinations)

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- Updates from latest draft, abstract types
- VOTable (de-)serialization
- VO-DML/XML generation from Python classes
- Implement VO-DML Quantities as Astropy Quantities (units conversions, quantity comparison/combinations)
- Data binding/Callbacks - Glue integration? (see C. Beaumont talk @ADASS about hackable interfaces)

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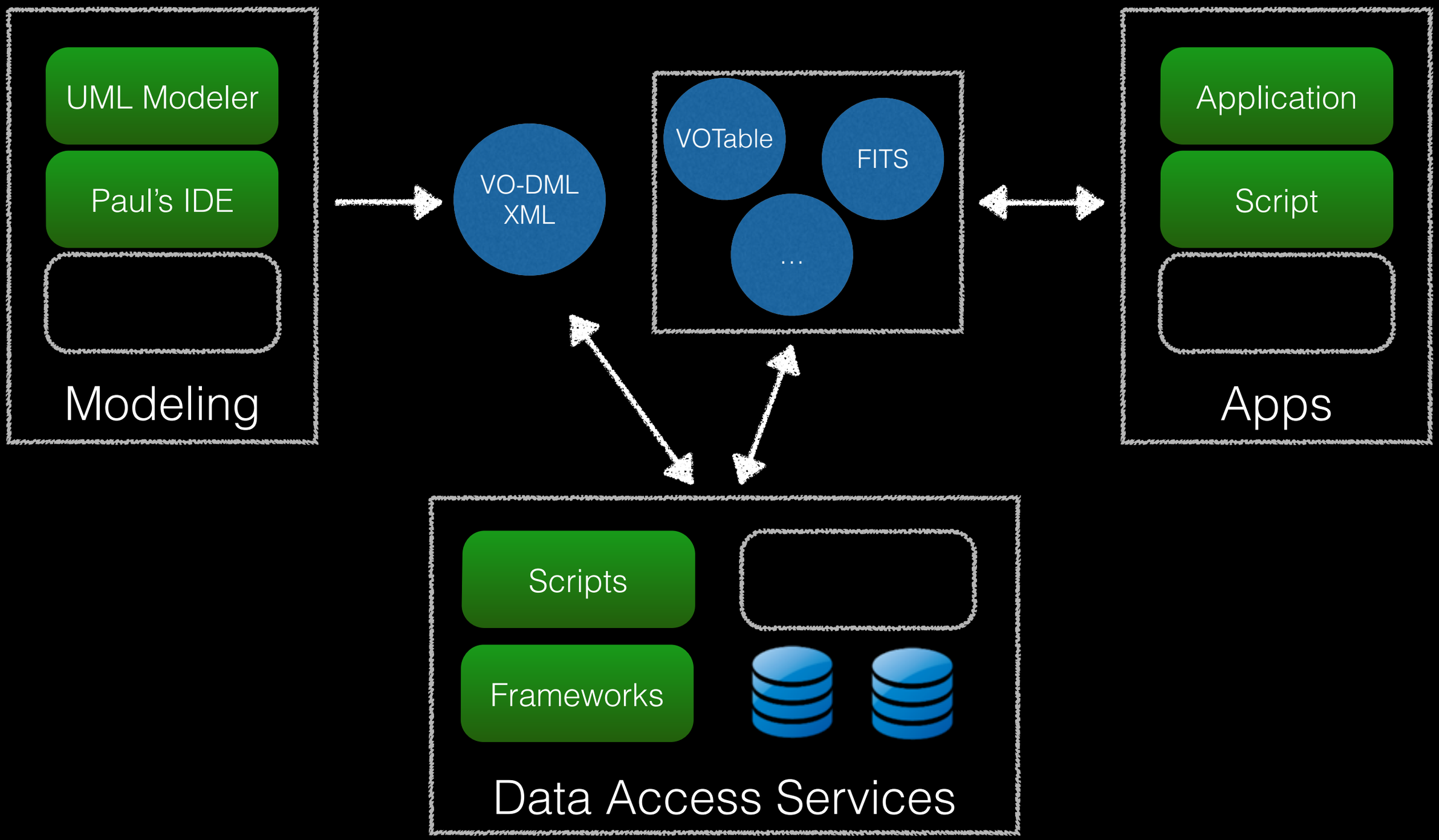
  - concentrate on science, not VO specs.
  - no need to be a Python guru to create your own interoperable classes/ models.
- Model/Serialization separation of concerns:
  - Drivers can provide alternative representation formats (e.g. HDF5, FITS)

The Big Picture



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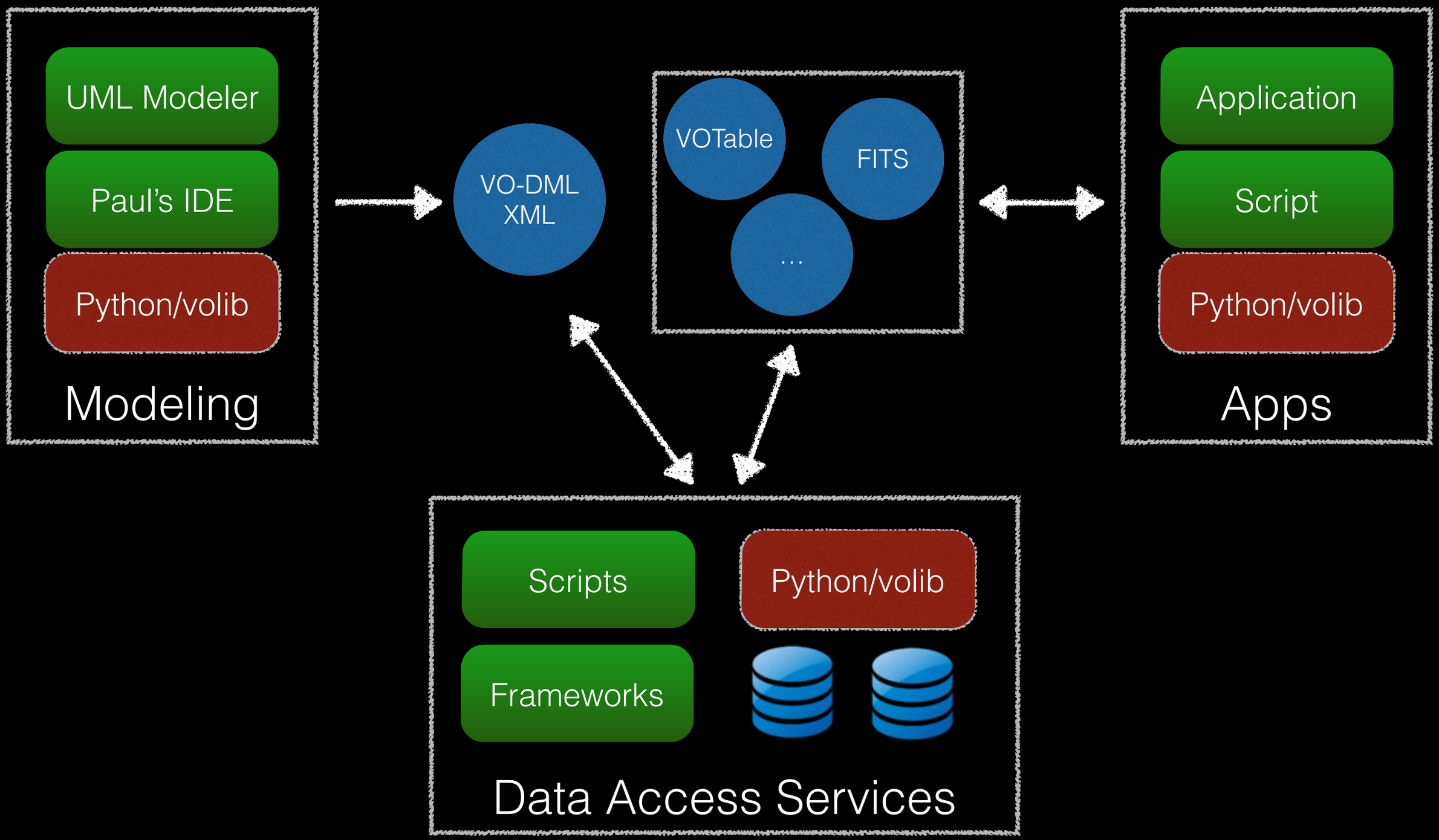

Fork me on GitHub

Thank you!

And thanks to Markus Demleitner for his input.

More information on VO-DML, with examples
in DM2, Saturday @ 11
https://github.com/olaurino/volib