

Restructuring of the numpy integration in PyROOT

Fantastic features and where to find them

Eric Tejedor and Stefan Wunsch

ROOT

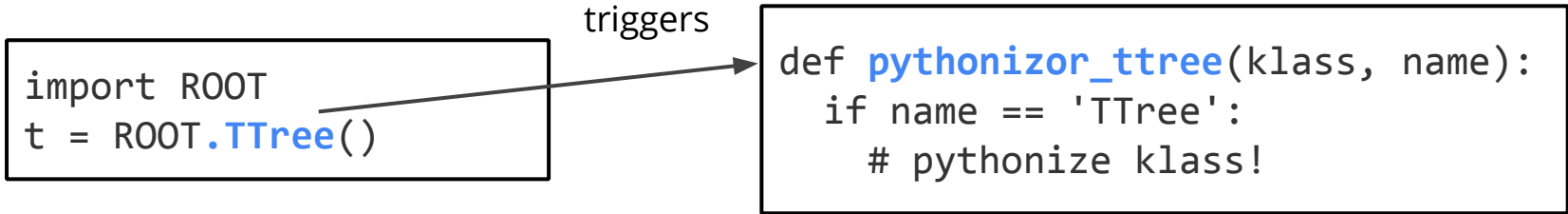
Data Analysis Framework

<https://root.cern>

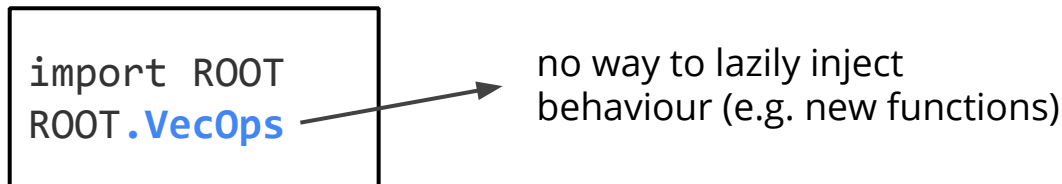


Laziness with cppy

- Cppy allows to register pythonizations that are executed **lazily**



- But this only works for **classes**
 - Not for class templates
 - Not for namespaces





Slimming down “import ROOT”

- We currently inject a few PyROOT features in C++ namespaces
- Problem: we don't do it lazily!
 - The injections happen at “import ROOT” time
 - They trigger the loading of many extra libraries (e.g. libTMVA)
- Particular cases discussed on next slide



Current status: injected features

- ROOT supports full interoperability with numpy for RVec, RTensor and RDataFrame
- The features are attached to the respective namespaces and lack visibility
- The current integration via the namespace make it impossible to include them fully lazily

Numpy to RVec

```
numpy = numpy.array(...)  
rvec = ROOT.TVecOps.AsRVec(numpy)
```

RVec to numpy

```
numpy = numpy.asarray(rvec)
```

Numpy to RTensor

```
numpy = numpy.zeros(shape)  
rten = ROOT.TMVA.Experimental.AsRTensor(numpy)
```

RTensor to numpy

```
numpy = numpy.asarray(rten)
```

Numpy to RDataFrame

```
data = {"x": numpy.array(...), "y": ...}  
df = ROOT.RDF.MakeNumpyDataFrame(data)
```

RDataFrame to numpy

```
data = df.AsNumpy()
```



Proposal: reorganization

- Move all numpy interoperability features to the `ROOT.Numpy` “namespace”
- Allows **lazy loading**, cuts down libraries loaded during `import ROOT` by half
- One place to find them all, simple grouping by purpose, better to document
- PR WIP:
<https://github.com/root-project/root/pull/5252>

Numpy to RVec

```
npv = numpy.array(...)  
rvec = ROOT.Numpy.AsRVec(npv)
```

Numpy to RTensor

```
npv = numpy.zeros(shape)  
rten = ROOT.Numpy.Experimental.AsRTensor(npv)
```

Numpy to RDataFrame

```
data = {"x": numpy.array(...), "y": ...}  
df = ROOT.Numpy.MakeDataFrame(data)
```