KU LEUVEN

Scientific Computing with Python and Julia

MATLAB, Python and Julia

MATLAB

- Closed Source
- Licensing
  1. MATLAB: €2000 (standalone)
  2. Simulink: €3000 (standalone)
  3. Added cost for toolboxes
- Currently being phased out of KUL P&Os (perhaps more)
- Compatibility
- Strong IDE
- Simulink

Python and Julia

- Open Source
- No cost
- Easy, concise syntax
- Rapid development for testing
- Portability
- Performance

Noteworthy Points

Some similarities between Python and Julia

- Interoperability: can call one from another easily
- Interfaces with low level languages (e.g. Cython)
- Easily parallelizable

And some differences

- Julia has strong core language, built for scientific computing
- Python weak core, relies on third party libraries
- Julia has smaller user base

Pitfalls - Python

- Bracket notation: A[i,j] (Julia & Python)
- Python uses 0-based indexing (Julia is 1-based like MATLAB)

```
>>> x = np.array([1, 2])
>>> x[0]
>>> 1
```

- Python and Julia pass by reference (MATLAB passes by value)

```
>>> y = x
>>> y[0] = 3
>>> x
>>> array([3, 2]) #use np.copy instead!
```

- Python allows negative indexing (not in Julia)

```
>>> y[−1]
>>> 2
```

- Indentation is important in Python! (not in Julia)

Pitfalls Julia

- Calling an empty function needs parenthesis (Julia & Python)

```
>>> rand #prints the function (which is an object)
>>> rand (generic function with 35 methods)
>>> rand() #calls the function
>>> 0.21116569117315054
```

- Dot product returns a 1-dimensional array (Python: dot(a,b))

```
>>> [1;2;3]'*[4;4;0] < 10 #the doct product returns an array
>>> ERROR: MethodError: ‘isless‘ has no method
    matching isless(::Array{Int64,1}, ::Int64)
>>> ([1;2;3]'*[4;4;0])[1]<10 #you have to access the value
>>> false
```

- Logical operations with arrays

```
>>> [1;2]<[5;6] # this expression would work in MATLAB
>>> ERROR: MethodError: ‘isless‘ has no method matching
     isless(::Array{Int64,1}, ::Array{Int64,1})
     in < at operators.jl:33
>>> [1;2].<[5;6] #.operator (e.g. like .*)
>>> 2-element BitArray{1}:
     true
     true
```

List of Pitfalls

- Noteworthy Differences from MATLAB
  - Python: http://mathesaurus.sourceforge.net/matlab-numpy.html
  - Julia: http://docs.julialang.org/en/release-0.4/manual/noteworthy-differences/
  - ...and many other webpages!