hylang

A short tour of a lisp embedded within python

Arch Lisp Meetup : Thursday, July 13, 2017

Features & Observations

- transforms Lisp code into the Python Abstract Syntax Tree
- interopt with python in both directions
  - call Lisp/Hy from Python code
  - call Python from Hy code
- Lisp syntax inspired by Clojure
- Can be a fun & fast way to start exploring Lisp
- Both 2.7.x and Python 3.x compatible (More portable than normal python!)

`https://github.com/hylang/hy`

Installation/Experimentation

(assuming you've already got python installed on your system)

```
# create a "playground"
mkdir hy-play && cd hy-play

# create virtualenv
virtualenv hy-venv

# activate the virtualenv
source hy-venv/bin/activate

# install it
pip install git+https://github.com/hylang/hy.git

# start up a REPL
hy
```

Quickstart

```
$ hy
hy 0.13.0+26.g5610d7d using CPython(default) 3.6.1 on Darwin
=> (print "Hy!")
Hy!
=> (defn salutations [name] (print (+ "Hy " name "!")))
=> (salutations "Dude")
Hy Dude!
=> <Ctrl+D> ; exit
now exiting HyREPL...
```

Can make executable lisp/hy scripts as well!

```
$ ./examples/hi.hy
Howdy!
```

Syntax

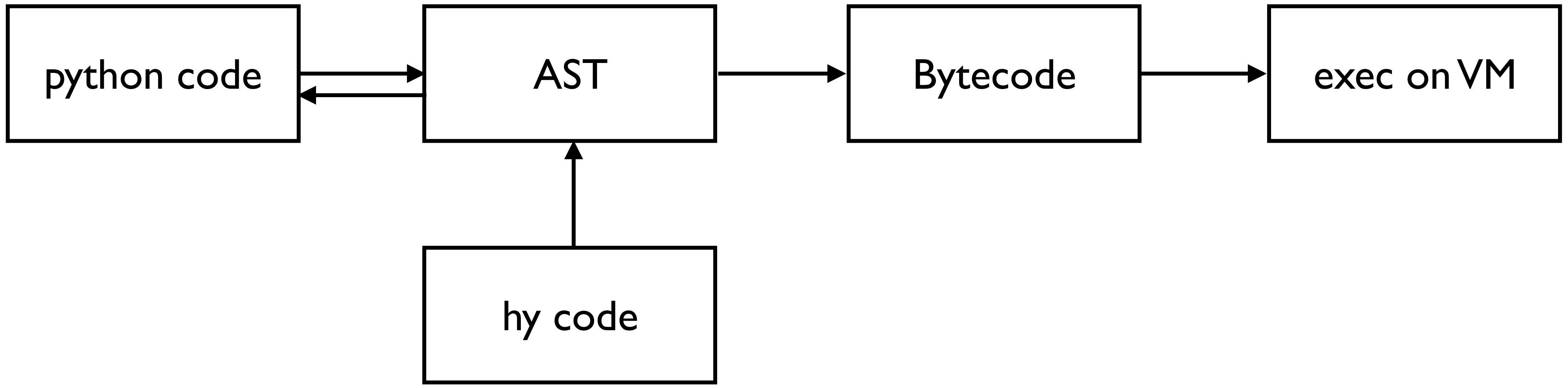
```
=> (.rstrip "foooo     ")
‘foooo'

=> (setv this-string "foooo     ")
=> (this-string.strip)
‘foooo'

=> (.strip this-string)
'foooo'
```

How does this work?

The Abstract Syntax Tree (AST)



```
 hy2py examples/hi.hy     # translate to python2
(hy2py3 examples/hi.hy    # translate to python3)
 hy2py -a examples/hi.hy  # dump AST logic
```

Data Types

```
; python lists
=> [1 2 3]
[1, 2, 3]

; python dictionaries
=> {"dog" "bark"
... "cat" "meow"}
{'dog': 'bark', 'cat': ‘meow'}

; python tuples
=> (, 1 2 3)
(1, 2, 3)

; python sets
=> #{3 1 2}
{1, 2, 3}

; extra: Fraction Literal – just like Clojure
=> 1/2
Fraction(1, 2)
```

```
; keyword syntax
=> {:dog "bark"
... :cat "meow"}
{'\ufdd0:dog': 'bark',
 ‘\ufdd0:cat': 'meow'}
```

Conditionals

Simple

```
(if (= 1 1)
  (print "if it's true")
  (print "if it's false"))
; "if it's true
```

Complex

```
(setv somevar 33)
(cond
 [(> somevar 50)
  (print "That variable is too big!")]
 [(< somevar 10)
  (print "That variable is too small!")]
 [True
  (print "That variable is jussssst right!")]])
; That variable is jussssst right!
```

Looping

Basic

```
(for [i (range 3)]
  (print (+ "'i' is now at " (str i))))
; 'i' is now at 0
; 'i' is now at 1
; 'i' is now at 2
```

List Comprehensions

```
 (setv odds-squared
   (list-comp
     (pow num 2)
     (num (range 100))
     (= (% num 2) 1)))
```

(hylang)

```
odds_squared = [
  pow(num, 2)
  for num in range(100)
  if num % 2 == 1]
```

(python)

Argument Passing

(python)

```
def optional_arg(pos1, pos2, keyword1=None, keyword2=42):
    return [pos1, pos2, keyword1, keyword2]
```

(hylang: standard)

```
(defn optional-arg [pos1 pos2 &optional keyword1 [keyword2 42]]
  [pos1 pos2 keyword1 keyword2])
```

(hylang: keyword-style)

```
(optional-arg :keyword1 1
              :pos2 2
              :pos1 3
              :keyword2 4)
```

(hylang: dictionary-style)

```
(defn another-style [&key {"key1" "val1" "key2" "val2"}]
  [key1 key2])
```

(hylang: destructuring)

```
(defn multiarr [[x y] z]
  (+ x y z))

=> (multarr [1 2] 3)
6
```

*arg and **kwarg support

```
def some_func(foo, bar, *args, **kwargs):
  import pprint
  pprint.pprint((foo, bar, args, kwargs))
```

← *(python)*

(hylang) →

```
(defn some-func [foo bar &rest args &kwargs kwargs]
  (import pprint)
  (pprint.pprint (, foo bar args kwargs)))
```

context managers / file handling

```python
with open("/tmp/data.in") as f:
    print f.read()
```

(python)

```
(with [f (open "/tmp/data.in")]
  (print (.read f)))
```

(hylang : using direct python calls)

```
(with [f (open "thing.hy")]
   (try
     (while True
            (setv exp (read f))
            (print "OHY" exp)
            (eval exp))
     (except [e EOFError]
            (print "EOF!"))))
```

(hylang : using the `read` *function)*

Classes

```python
class FooBar(object):
    """
    Yet Another Example Class
    """
    def __init__(self, x):
        self.x = x

    def get_x(self):
        """
        Return our copy of x
        """
        return self.x

# Usage
bar = FooBar(1)
print bar.get_x()
```

python

```hy
(defclass FooBar [object]
  "Yet Another Example Class"

  (defn --init-- [self x]
    (setv self.x x))

  (defn get-x [self]
    "Return our copy of x"
    self.x))

;; Usage
(setv bar (FooBar 1))
(print (bar.get-x))

;; or
(print (.get-x (FooBar 1)))
```

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Macros

```
(defmacro hello [person]
  `(print "Hello there," ~person "!"))
(hello “Human")

=> (hello “Human)
Hello there, Human !
```

```
(defmacro rev [code]
  (setv op (last code) params (list (butlast code)))
  `(~op ~@params))

(rev (1 2 3 +))

=> (rev (1 2 3 +))
6
```

hy <=> python interop

python calling hy code

file: greetings.hy

```
(defn greet [name] (print "hello from hy," name))
```

file: greet.py

```
#!/usr/bin/env python

import hy
import greetings

greetings.greet("Foo")
```

---

shell command:

```
python greet.py
```

hy <=> python interop

hy calling python code

```
(import os)

(if (os.path.isdir "/tmp/somedir")
  (os.mkdir "/tmp/somedir/anotherdir")
  (print "Hey, that path isn't there!"))
```

Multiple Packages Imports, choosing selective functions, & alt. namespacing

```
(import [functools [reduce]]
        [pprint [pprint]]
        [cytoolz [itertoolz]]
        [numpy :as np]
        [matplotlib :as mpl]
        [matplotlib.pyplot :as plt]
        [seaborn :as sns])
```

Need to use the `require` function to import macros from other modules

```
(require hy.contrib.loop)
```

useful functions & macros

Some Example functions:

```
., ->, ->>, apply, assoc, cons, cond, continue, fn, do, doto,
eval, first, last, rest, cut, for, get, nth, empty?, inc, dec,
list-comp, dict-comp, set-comp, quote, when, with,
with-decorator
```

http://docs.hylang.org/en/stable/language/core.html#

http://docs.hylang.org/en/stable/language/api.html#built-ins

http://docs.hylang.org/en/stable/extra/index.html

toolz / cytoolz

`toolz` : a pure python library that provides a suite of utility functions for data processing commonly found in functional languages

`cytoolz` : `toolz` ported to compiled C code via Cython (better performance on large data sets)

```
pip install tools
pip install cytoolz
```

Some Example functions:

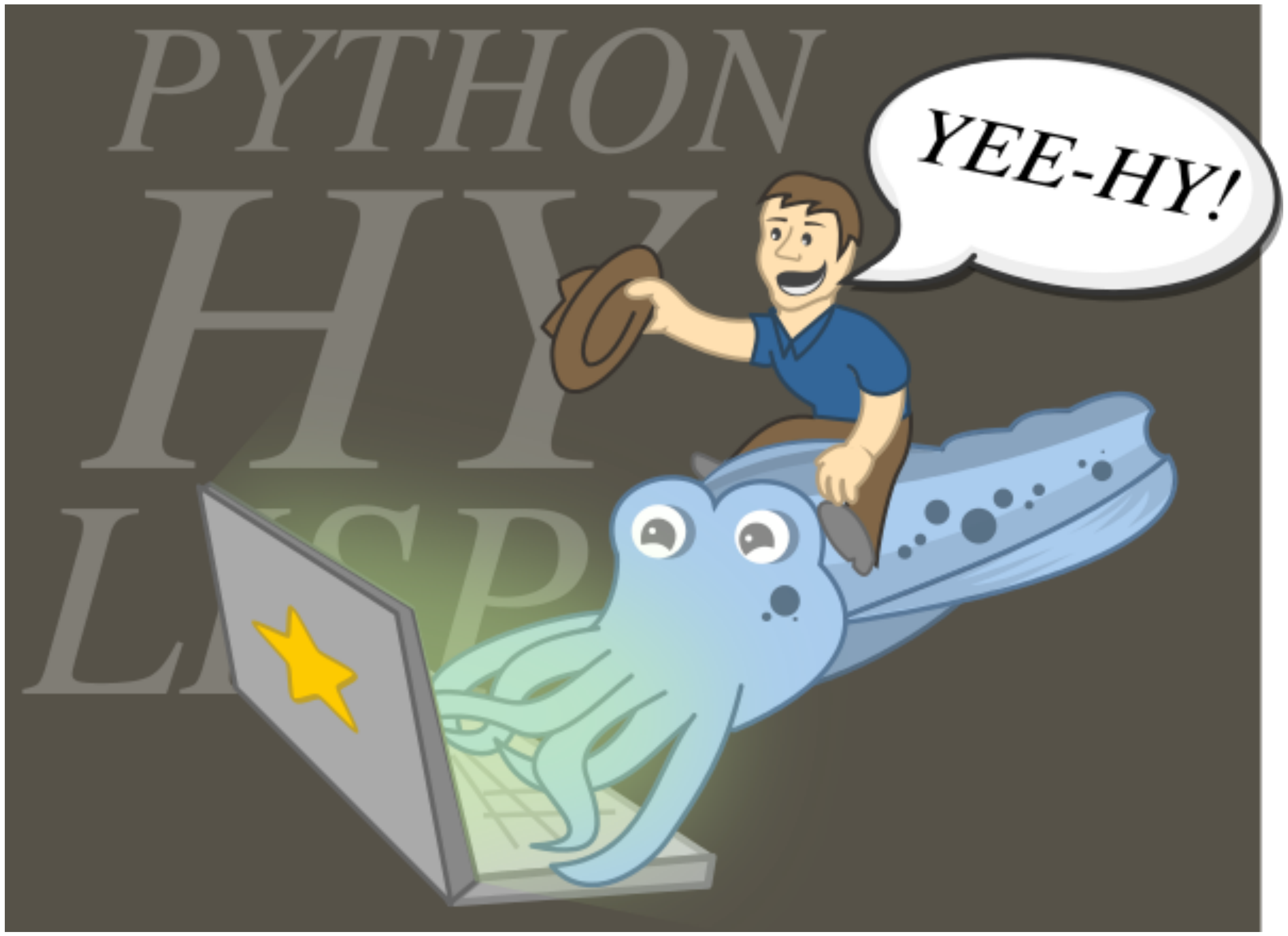
```
frequencies, groupby, interleave, interpose,
mapcat, nth, countby, partitionby, assoc, merge,
```

http://toolz.readthedocs.io/en/latest/api.html

“practical” examples

Further Reading & Watching

- Hylang's Documentation
  http://docs.hylang.org
- Hy Playlist on YouTube
  http://goo.gl/imYuG1
- OMG A Lisp that runs python
  https://goo.gl/e6eFqB
- Scientific Computing with Hy: Linear Regressions
  https://goo.gl/SfaMsd



Happy Lisping!

Epilogue

There was discussion at the meet up on why the let expression was removed from hylang. Please see the following github issue and pull request, and the other mentioned issues within them, for the gory details:

- Get rid of let
  https://github.com/hylang/hy/issues/844

- Burninate `let`
  https://github.com/hylang/hy/pull/1216