Python Meta-Programming

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Meta-Programming

What?

- **Programs that write programs**

Why?

- **Minimize duplicated code**
- **Create higher-level abstractions (DSL)**

Meta-Programming HW

Magma: low-level circuit language

Mantle

- **Maximize code reuse**
- **Implement new abstractions**
- **Meta-program Magma in python**

Key Concepts

Higher-order function

- **functions that accept a function as an operator and return a new function**

Introspection

Staging

Code generation

David Beazley

Meta-programming Talk

Metaclasses

What is type(k)?

What is type(Oopy)?

The type of a class is a metaclass

The metaclass is called to construct the type

Metaclasses

The metaclass is called to construct a new class.

- `def __prepare__(meta, clsname, bases)`
- `def __new__(meta, clsname, bases, clsdict)`
- `def __init__(cls, clsname, bases, clsdict)`
- `def __call__(*args, **kwargs)`

```
def DefineRegister(n):

  T = In(Array(n, Bit))
  class _Register(Circuit):
    name = 'Register'+str(n)
    IO = ["I",T,
          "O",T,
          "CLK", In(Bit)]

    @classmethod
    def definition(reg):
      ffs = join(FFs(n))
      wire(ffs(reg.I), reg.O)
      wire(reg.CLK, ffs.CLK)

    return _Register
```

Circuit Metaclass

Cache circuit based on name

Instantiate interface (IO)

Define circuit by calling definition

Implement special class methods like `place`

...

ast.py, hack.py