SÜLEYMAN DEMİREL ÜNİVERSİTESİ
SİBER GÜVENLİK LABORATUVARI

Python Metaprogramming

Mehmet GÜRDAL

Metaprogram

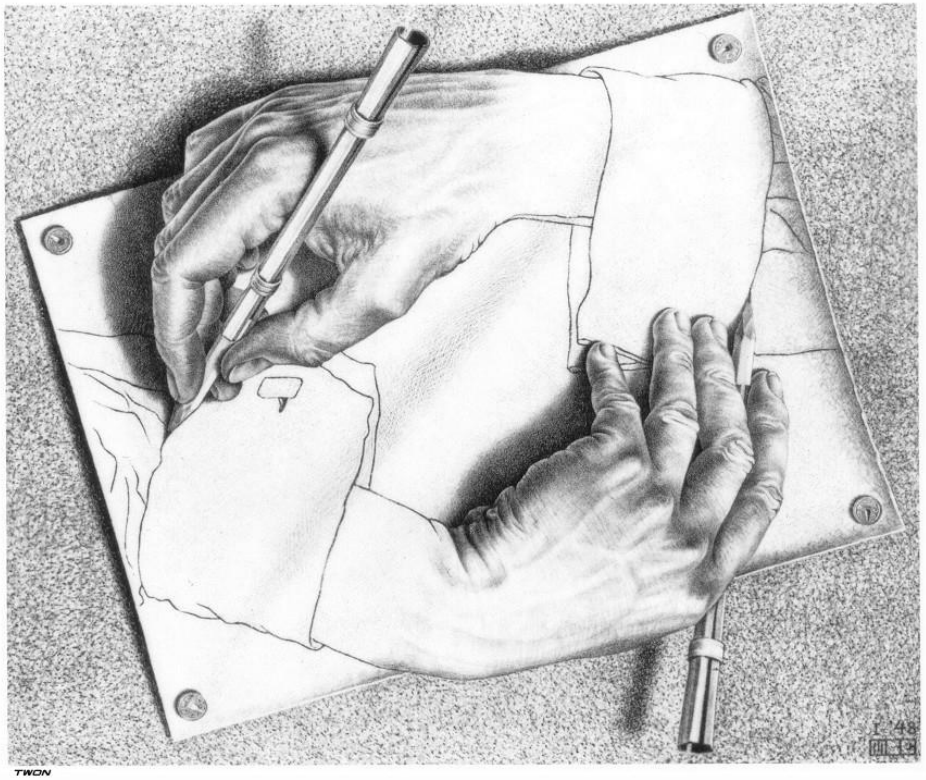
Diğer programları tasarlayan, oluşturan, analiz eden okuyan ve dönüştüren, hatta çalışma esnasında kendini değiştiren program.

Development süresini kısaltır

Yazılan satır sayısını azatır

Esneklik katar

Program yeniliklere ve değişikliklere açık olur



Program

```
class User:

    def add(self, name):
        return name

    def delete(self, name):
        return name

    def update(self, name):
        return name

    def delete(self, name):
        return name
.
.
```

Boss

Log Işlemi

```
import datetime, timeit

def add(self, name):
    start = timeit.timeit()
    try:
        return name
    finally:
        stop = timeit.timeit()
        print("{} fonksiyonu {} tarihinde çalıştırıldı ve {}sn sürdü".format(
                "add",
                datetime.date.today(),
                start- stop
            ))
.
.
.
```

Decorator

Decorator

Decorator Kullanımı

```
def log(func):

    def wrapper(*args, **kwargs):
        start = timeit.timeit()
        try:
            return func(*args, **kwargs)
        finally:
            stop = timeit.timeit()
            print("{} fonksiyonu {} tarihinde çalıştırıldı ve {}sn sürdü.".format(
                func.__qualname__,
                datetime.date.today(),
                start- stop
                ))
    return wrapper
```

Decorator Kullanımı

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def log(func):

    def wrapper(*args, **kwargs):
        start = timeit.timeit()
        try:
            return func(*args, **kwargs)
        finally:
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            print("{} fonksiyonu {} tarihinde çalıştırıldı ve {}sn sürdü".format(
                func.__qualname__,
                datetime.date.today(),
                start- stop
                ))
    return wrapper
```

Eski fonksiyonun yerini tutacak bir fonksiyon tanımla

Asıl fonksiyonu çalıştır ve oluşan değeri döndür

Olusturulan yeni fonksiyonu döndür

Decorator'e parametre ekleme

```
def log(func=None, *, prefix=''):
    if func is None: return partial(log, prefix=prefix)
    @wraps(func)
    def wrapper(*args, **kwargs):
        start = timeit.timeit()
        try:
            return func(*args, **kwargs)
        finally:
            stop = timeit.timeit()
            print("{}{} fonksiyonu {} tarihinde çalıştırıldı ve {}sn sürdü.".format(
                prefix,
                func.__qualname__,
                datetime.date.today(),
                start- stop
                ))
    return wrapper
```

Decorator'e parametre ekleme

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def log(func=None, *, prefix=''):
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        finally:
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                func.__qualname__,
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                ))
    return wrapper
```

Func ile ilgili bilgileri wrapper'a aktar

Decorator'e parametre ekleme

```
def log(func=None, *, prefix=''):
    if func is None: return partial(log, prefix=prefix)
    @wraps(func)
    def wrapper(*args, **kwargs):
        start = timeit.timeit()
        try:
            return func(*args, **kwargs)
        finally:
            stop = timeit.timeit()
            print("{}{} fonksiyonu {} tarihinde çalıştırıldı ve {}sn sürdü.".format(
                prefix,
                func.__qualname__,
                datetime.date.today(),
                start- stop
                ))
    return wrapper
```

Eğer decorator, fonksiyon şeklinde kullanılmadıysa fonksiyonmuş gibi çalıştır

Func ile ilgili bilgileri wrapper'a aktar

Decorator'e parametre ekleme

```
def log(func=None, *, prefix=''):
    if func is None: return partial(log, prefix=prefix)
    @wraps(func)
    def wrapper(*args
        start = timeit.tim
        try:
            return func(*
        finally:
            stop = timeit.
            print("{}{} fonksiyonu {} tarihinde çalıştırıldı ve {}sn sürdü.".format(
                prefix,
                func.__qualname__,
                datetime.date.today(),
                start- stop
                ))
    return wrapper
```

nksiyon şeklinde
nksiyonmuş gibi çalıştır

gileri wrapper'a aktar

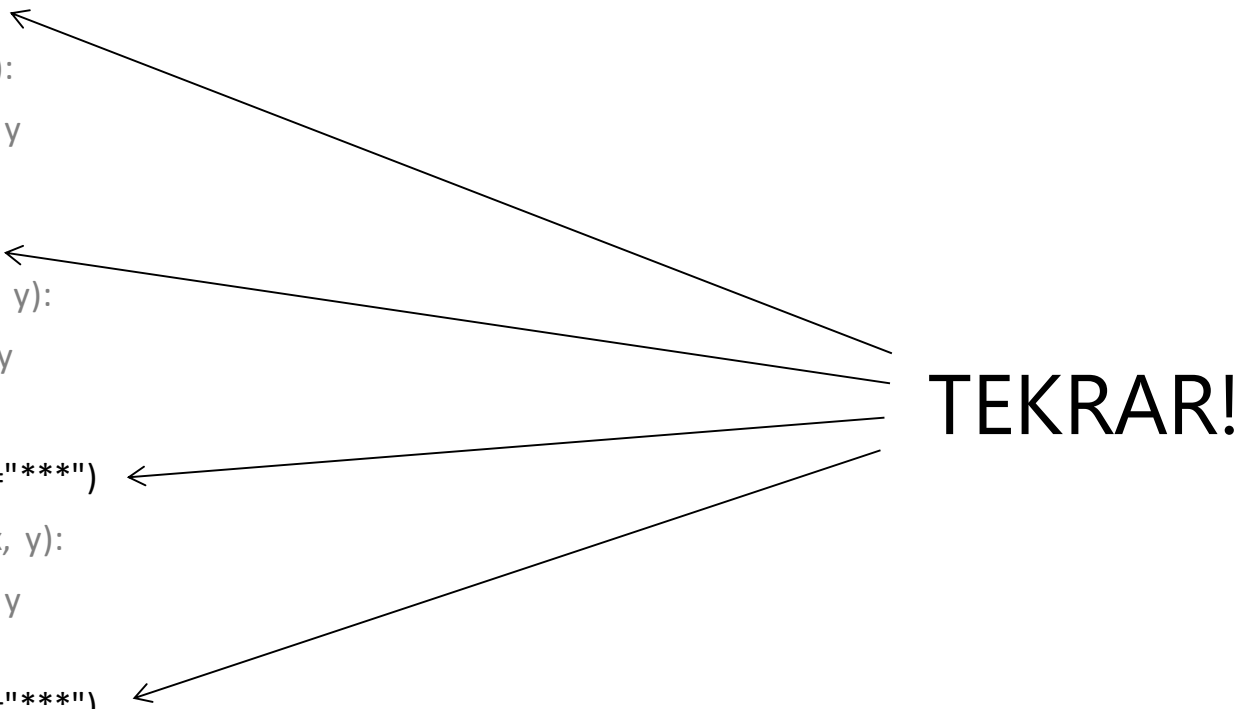
Tekrar

```
@log
def add(x, y):
    return x + y

@log
def delete(x, y):
    return x - y

@log(prefix="***")
def update(x, y):
    return x * y

@log(prefix="***")
def get(x, y):
    return x // y
```



Class Decorator

```
def clslog(cls):
    for key, val in vars(cls).items():
        if callable(val):
            setattr(cls, key, log(val))
    return cls

@clslog
class User:
    def add(self, name, passwd):
        pass
```

Class Decorator

```
def clslog(cls):
    for key, val in vars(cls).items():
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    return cls

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Class'ı parametre olarak al

Class Decorator

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def clslog(cls):
    for key, val in vars(cls).items():
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@clslog
class User:
    def add(self, name, passwd):
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```

Class'ı parametre olarak al

Içerisinde tanımlı değişkenlere ve fonksiyonlara eriş

Class Decorator

```
def clslog(cls):
    for key, val in vars(cls).items():
        if callable(val):
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@clslog
class User:
    def add(self, name, passwd):
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```

Class'ı parametre olarak al

Içerisinde tanımlı değerlere eriş

Eğer fonksiyonsa
Fonksiyonu loglanmış haliyle değiştir

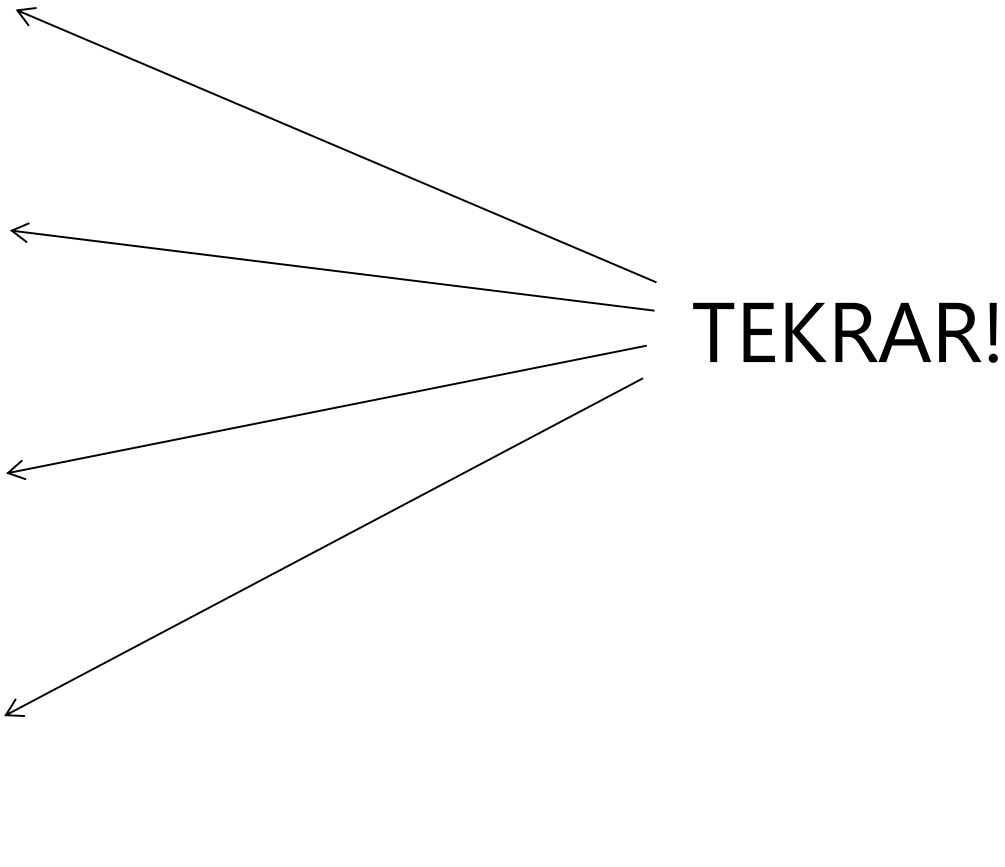
Tekrar

```
@clslog
class A:
    pass

@clslog
class B:
    pass

@clslog
class C:
    pass

@clslog
class D:
    pass
```



Tekrar

@clslog

pass

Metaclasslar

Metaclass

Metaclass

```
a = 5

type(a)       # int

type(int)     # type

type(str)     # type

type(object) # type
```

Metaclass

```
# type('name', (), {})   name, bases, classdict

User = type('User', (object,), {'name':'mehmet', 'email':'@gmail.com'})

u = User()

u.name
'mehmet'
```

Metaclass

```
class generic_type(type):
    def __new__(cls, name, parents, clsdict):
        clsobj = super().__new__(cls, name, parents, clsdict)
        new = clslog(clsobj)
        return new

class User(metaclass=generic_type):
        .
        .
        .
```

Metaclass

```
class generic_type(type):
    def __new__(cls, name, parents, clsdict):
        new = super().__new__(cls, name, parents, clsdict)
        new = clslog(new)
        return new

class User(metaclass=generic_type):
        .
        .
        .
```

Class oluşturmak için gerekli bilgileri al

Metaclass

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class generic_type(type):
    def __new__(cls, name, parents, clsdict):
        new = super().__new__(cls, name, parents, clsdict)
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class User(metaclass=generic_type):
        .
        .
        .
```

Class oluşturmak için gerekli bilgileri al

Type'ı kullanarak yeni bir class oluştur

Metaclass

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        new = clslog(new)
        return new

class User(metaclass=generic_type):
        .
        .
        .
```
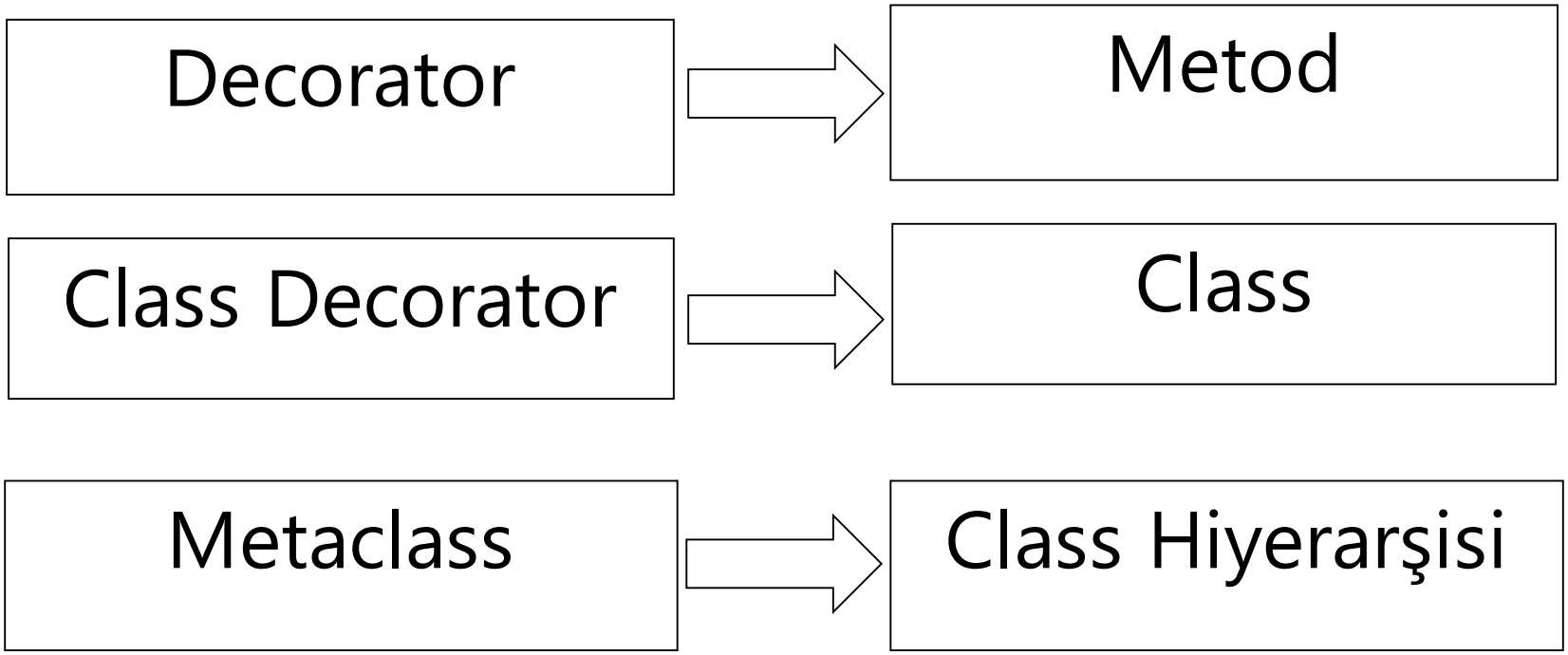

Class oluşturmak için gerekli bilgileri al

Type'ı kullanarak yeni bir class oluştur

Oluşan class'ı loglanmış haliyle değiştir

Metaclass


Decorator
Metod
Class Decorator
Class
Metaclass
Class Hiyerarşisi

Metaclass

```
class User:

    def __init__(self, name, email, age, passwd):
        self.name = name
        self.email = email
        self.age = age
        self.passwd = passwd

class Point:

    def __init__(self, x, y):
        self.x = x
        self.y = y

class Connection:

    def __init__(self, user, hostname, port):
        self.user = user
        self.hostname = hostname
        self.port = port
```

Metaclass

```
class Struct:
    _fields = []
    def __init__(self, *args, **kwargs):
        for key, value in zip(self._fields, args):
            setattr(self, key, value)

class User(Struct):
    _fields = ['name', 'email', 'age', 'passwd']
```

struct adında genel bir class tanımla
_fields değişkenleri tutacak

Metaclass

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class Struct:
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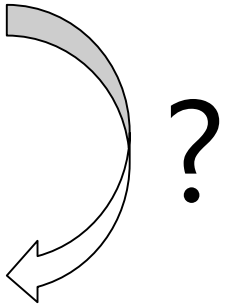
```

struct adında genel bir class tanımla _fields değişkenleri tutacak

__init__'e parametre olarak girilenler ile _fields listesindeki elemanları birleştirip class'a değişken olarak ata

Metaclass

u = User('mehmet', '@hotmail.com', 32, passwd='toor')



{'age': 32, 'email': '@hotmail.com', 'name': 'mehmet'}

Metaclass

```
from inspect import Signature, Parameter

def make_signature(fields):
    return Signature(Parameter(name, Parameter.POSITIONAL_OR_KEYWORD) for name in fields)

class Struct:
    __signature__ = make_signature([])
    def __init__(self, *args, **kwargs):
        bound = self.__signature__.bind(*args, *kwargs)
        for key, value in bound.arguments.items():
            setattr(self, key, value)

class User(Struct):
    __signature__ = make_signature(['name', 'email', 'age', 'passwd'])

u = User('mehmet', '@hotmail.com', age=32, passwd="toor")
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Normal bir listeden Signature üret

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Oluşturulan Signature'a fonksiyondaki argümanları bağla

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u = User('mehmet', '@hotmail.com', age=32, passwd="toor")
```

Normal bir listeden Signature üret

Oluşturulan Signature'a fonksiyondaki argümanları bağla

Signature'daki parametrelerle oluşan değişkenleri class'a ekle

Metaclass

```
class User(Struct):
    __signature__ = make_signature(['name', 'email', 'age', 'passwd'])

class Point(Struct):
    __signature__ = make_signature(['x', 'y'])

class Connection(Struct):
    __signature__ = make_signature(['user', 'hostname', 'port'])
```

Metaclass

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class User(Struct):
    __signature__ = make_signature(['name', 'email', 'age', 'passwd'])

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class Connection(Struct):
    __signature__ = make_signature(['user', 'hostname', 'port'])
```

Sadeleştirilebilir mi?


META-PROGRAMMING
IN PYTHON

Metaclass

```
class struct_meta(type):
    def __new__(cls, name, bases, clsdict):
        clsobj = super().__new__(cls, name, bases, clsdict)
        sign = make_signature(clsobj._fields)
        setattr(clsobj, "__signature__", sign)
        return clsobj

class Struct(metaclass=struct_meta):
    _fields = [] #__sigature__ = make_signature([])
    def __init__(self, *args, **kwargs):
        bound = self.__signature__.bind(*args, *kwargs)
        for key, value in bound.arguments.items():
            setattr(self, key, value)
```

Metaclass

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Class içindeki _fields listesinden signature oluştur

Metaclass

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```

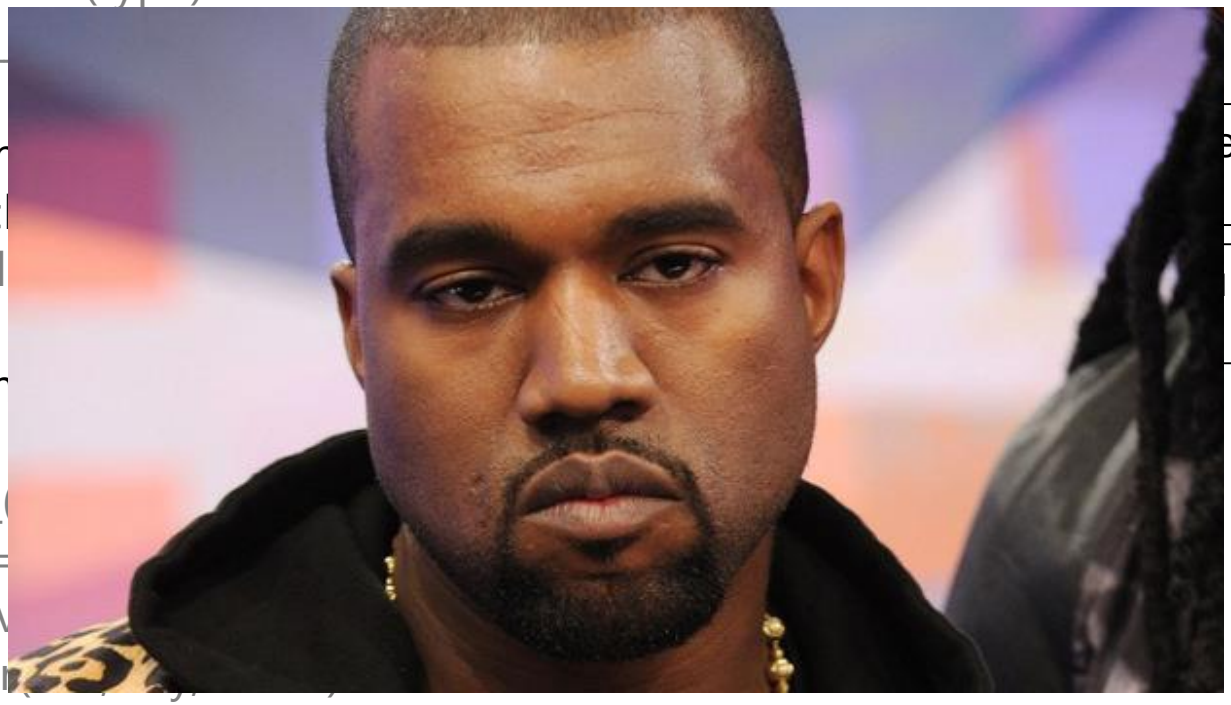
Class içindeki _fields listesinden signature oluştur

Class'ın __signature__'ını yeni signature ile değiştir

Metaclass

```
class struct_meta(type):
    def __new_
        clsobj =
        sign = m
        setattr(cl
        return cl

class Struct(m
    _fields = []
    def __init__(
        bound =
        for key, v
            setattr(
```



esinden

yeni

Descriptor

Metaclass

```
class Descriptor:
    def __init__(self, name=None):
        self.name = name
    def __set__(self, instance, value):
        print("set", value)
    def __delete__(self, instance):
        print("del", self.name)
```

Metaclass

```
class Descriptor:
    def __init__(self, name=None):
        self.name = name
    def __set__(self, instance, value):
        print("set", value)
    def __delete__(self, instance):
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```

Manipüle edeceğimiz değişkeni tuttuk

Metaclass

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class Descriptor:
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        print("del", self.name)
```

Manipüle edeceğimiz değişkeni tuttuk

Değiştirme ve silme özelliklerini yeniden tasarladık

Metaclass

```
class Descriptor:
    def __init__(self, name=None):
        self.name = name
    def __set__(self, instance, value):
        instance.__dict__[self.name]=value
    def __delete__(self, instance):
        del instance.__dict__[self.name]


class User(Struct):
    _fields = ['name', 'email', 'age', 'passwd']
    name = Descriptor('name')
    email = Descriptor('email')
    age = Descriptor('age')
    passwd = Descriptor('passwd')
```

Metaclass

```
class Typed(Descriptor):
    ty = object
    def __set__(self, instance, value):
        if not isinstance(value, self.ty):
            raise TypeError("Expected {}", self.ty)
        return super().__set__(instance, value)

class Integer(Typed):    ty = int

class String(Typed):    ty = str

class Float(Typed):    ty = float
```

Metaclass

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class Typed(Descriptor):
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    def __set__(self, instance, value):
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Descriptordaki __set__ metodunu ezdik

Metaclass

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```

Descriptordaki __set__ metodunu ezdik

Girilen değerin bizim belirlediğimiz tipte olup olmadığını sorguladık.

Metaclass

```
class User(Struct):
    _fields = ['name', 'email', 'age', 'passwd']
    name = String('name')
    email = String('email')
    age = Integer('age')
    passwd = Integer('passwd')
```

Metaclass

```
class User(Struct):
    _fields = ['name', 'email', 'age', 'passwd']
    name = String('name')
    email = String('email')
    age = Integer('age')
    passwd = Integer('passwd')
```

Metaclass

```
from collections import OrderedDict
class struct_meta(type):
    @classmethod
    def __prepare__(cls, name, bases):
        return OrderedDict()

    def __new__(cls, clsname, bases, clsdict):
        fields = [key for key, val in clsdict.items()
                  if isinstance(val, Descriptor)]
        for name in fields:
            clsdict[name].name = name

        clsobj = super().__new__(cls, clsname, bases, dict(clsdict))
        sign = make_signature(fields)
        setattr(clsobj, "__signature__", sign)
        return clsobj
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Metaclass

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        return OrderedDict()

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        fields = [key for key, va
                if isinstance(val,
        for name in fields:
            clsdict[name].name

        clsobj = super().__new_
        sign = make_signature(
        setattr(clsobj, "__signa
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Class oluşturulurken kullanılan sözlüğü üreten metod

Metaclass

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from collections import OrderedDict
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Class oluşturulurken kullanılan sözlüğü üreten metod

Descriptor tipinde tanımlı değişkenlerden signiture oluştururken kullandığımız fields'I oluştur

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Class oluşturulurken kullanılan sözlüğü üreten metod

Descriptor tipinde tanımlı değişkenlerden signiture oluştururken kullandığımız fields'I oluştur

name = String('name')

Metaclass

```
class User(Struct):
    name = String()
    email = String()
    age = Integer()
    passwd = Integer()

class Point(Struct):
    x = Float()
    y = Float()

class Connection(Struct):
    user = String()
    hostname = String()
    port = Integer()
```

Teşekkürler
Soru - Cevap

Kodlar ve Sunum
github.com/Anti-code/pymeta