Context Managers:
You Can Write Your Own!

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Me!

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Agenda

It's pretty packed...

- Context managers: What and why?

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- Context managers: What and why?
- Core Python examples.

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- Context managers: What and why?
- Core Python examples.
- The hard way.

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- Context managers: What and why?
- Core Python examples.
- The hard way.
- The easy way!

Agenda

It's pretty packed...

- Context managers: What and why?
- Core Python examples.
- The hard way.
- The easy way!
- Best practices, gotchas, and more.

What are context managers?

You've seen them, you just don't know it!

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```
1 with
```

What are context managers?

You've seen them, you just don't know it!

```
1 with                              as
```

What are context managers?

You've seen them, you just don't know it!

```
1 with open("myfile.txt") as f:
2     content = f.read()
3     print(content)
```

Why use context managers?

They're pretty and safe is why!

- You can't forget to close resources.

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- They can make complex logic simpler.
- They are neat little bundles of abstraction.
- More!

Why use context managers?

They're pretty and safe is why!

>>> import this

The Zen of Python, by Tim Peters

Beautiful is better than ugly.

Simple is better than complex.

Readability counts.

Context managers in core Python

contextlib.suppress

```
1 def kill_process(pid):
2     try:
3         os.kill(pid, signal.SIGKILL)
4     except ProcessLookupError:
5         pass
```

Context managers in core Python

contextlib.suppress

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```

Context managers in core Python

ThreadPoolExecutor - Bad version!

```
1 # Bad!!!
2 pool = ThreadPoolExecutor()
3 for k, v in data.items():
4     pool.submit(myfunc, k, v)
5 # Wait on the results and do something with them.
6 pool.shutdown()
```

Context managers in core Python

ThreadPoolExecutor - Good version!

```
1 # Bad!!!
2 pool = ThreadPoolExecutor()
3 for k, v in data.items():
4     pool.submit(myfunc, k, v)
5 # Wait on the results and do something with them.
6 pool.shutdown()
```

```
1 # Good, safe, context managed!
2 with ThreadPoolExecutor() as pool:
3     for k, v in data.items():
4         pool.submit(myfunc, k, v)
```

Context managers in core Python

ThreadPoolExecutor - Good version!

```
1 data = {
2     "Watermelon": "delicious",
3     "Fruit": "spectacular",
4     "Dairy": "scary",
5     "Chicken": "not cool",
6 }
```

Context managers in core Python

ThreadPoolExecutor - Good version!

```
1 data = {
2     "Watermelon": "delicious",
3     "Fruit": "spectacular",
4     "Dairy": "scary",
5     "Chicken": "not cool",
6 }
7
8 def myfunc(noun, adj):
9     return f"{noun} is {adj}!"
```

Context managers in core Python

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1 data = {
2     "Watermelon": "delicious",
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4     "Dairy": "scary",
5     "Chicken": "not cool",
6 }
7
8 def myfunc(noun, adj):
9     return f"{noun} is {adj}!"
```

```
$ python3 example.py
Meat is not cool!
Dairy is yucky!
Fruit is spectacular!
Watermelon is delicious!
```

Write your own context managers!

Our very own context manager!

Simple!

```
 1 class MyContextManager:
 2     def __enter__(self):
 3         print("Enter!")
 4
 5     def __exit__(self, *exc):
 6         print("Exit!")
 7
 8
 9 with MyContextManager():
10     print("Inside the block!")
```

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Our very own context manager!

Super simple!

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 1 class MyContextManager:
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 5     def __exit__(self, *exc):
 6         print("Exit!")
 7
 8
 9 with MyContextManager():
10     print("Inside the block!")
```

```
$ python3 example.py
Enter!
Inside the block!
Exit!
```

As neat as it gets!

```
 1 class FoodContextManager:
 2     def __init__(self):
 3         self.data = {}
 4
 5     def __enter__(self):
 6         print(f"Enter: {self.data}")
 7         return self.data
 8
 9     def __exit__(self, *exc):
10         print(f"Exit: {self.data}")
11
12 with FoodContextManager() as data:
13     data["fruit"] = "delicious"
```

As neat as it gets!

```
 1 class FoodContextManager:
 2     def __init__(self):
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A fully fledged context manager!

```
 1 class FoodContextManager:
 2     def __init__(self, data):
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 1 class FoodContextManager:
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10         print(f"Exit: {self.data}")
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12 with FoodContextManager({"dairy": "yuck"}) as data:
13     data["fruit"] = "delicious"
```

"Boy, that sure was a lot of work"

— Me when I first wrote a context manager this way

There is an easier way!

`contextlib.contextmanager`

`@contextlib.contextmanager`

> This function is a decorator that can be used to define a factory function for with statement context managers, without needing to create a class or separate `__enter__()` and `__exit__()` methods.

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Decorators

Decorators

```
1 def my_decorator(func):
2     def new_func():
3         return func() + "!!!!"
4     return new_func
```

Decorators

🎁🎁🎁

```
1 def my_decorator(func):
2     def new_func():
3         return func() + "!!!!"
4     return new_func
5
6
7 def hello_pycon():
8     return "Hello Pycon AU 2018!"
9
10
```

Decorators

```
1 def my_decorator(func):
2     def new_func():
3         return func() + "!!!!"
4     return new_func
5
6 @my_decorator
7 def hello_pycon():
8     return "Hello Pycon AU 2018!"
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10
```

Decorators

```
1 def my_decorator(func):
2     def new_func():
3         return func() + "!!!!"
4     return new_func
5
6 @my_decorator
7 def hello_pycon():
8     return "Hello Pycon AU 2018!"
9
10 hello_pycon()
```

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Decorators

🎁🎁🎁

Hello Pycon AU 2018!!!!!

Decorators

🎁🎁🎁

```
1 @my_decorator
2 def hello_pycon():
3     return "Hello Pycon AU 2018!"
```

Decorators

```
1 @my_decorator
2 def hello_pycon():
3     return "Hello Pycon AU 2018!"
```

```
1 def hello_pycon():
2     return "Hello Pycon AU 2018!"
3 hello_pycon = my_decorator(hello_pycon)
```

Generators

Generating nothing but good times 🎉

Generators

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```
1 def first_n(n):
2     for i in range(n):
3         yield i
```

Generators

Generating nothing but good times 🎉

```
1 def first_n(n):
2     for i in range(n):
3         yield i
4
5 gen = first_n(5)
6 print(next(gen))
7 print(next(gen))
```

Generators

Generating nothing but good times 🎉

```
1 def first_n(n):
2     for i in range(n):
3         yield i
4
5 gen = first_n(5)
6 print(next(gen))  # 0
7 print(next(gen))
```

Generators

Generating nothing but good times 🎉

```
1 def first_n(n):
2     for i in range(n):
3         yield i
4
5 gen = first_n(5)
6 print(next(gen))  # 0
7 print(next(gen))  # 1
```

Generators

Generating nothing but good times 🎉

```
1 def first_n(n):
2     for i in range(n):
3         yield i
4
5 for i in first_n(5):
6     print(i)
```

Generators

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```
1 def first_n(n):
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Generators

Generating nothing but good times 🎉

```
1 def first_n(n):
2     for i in range(n):
3         yield i
```

```
1 def first_n(n):
2     nums = []
3     for i in range(n):
4         nums.append(i)
5     return nums
```

Generators

Generating nothing but good times 🎉

```
1 def first_n(n):
2     for i in range(n):
3         yield i
```

```
1 def first_n(n):
2     nums = []
3     for i in range(n):
4         nums.append(i)
5     return nums
```

```
>>> print(sum(first_n(10)))
```

Generators

Generating nothing but good times 🎉

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1 def first_n(n):
2     for i in range(n):
3         yield i
```
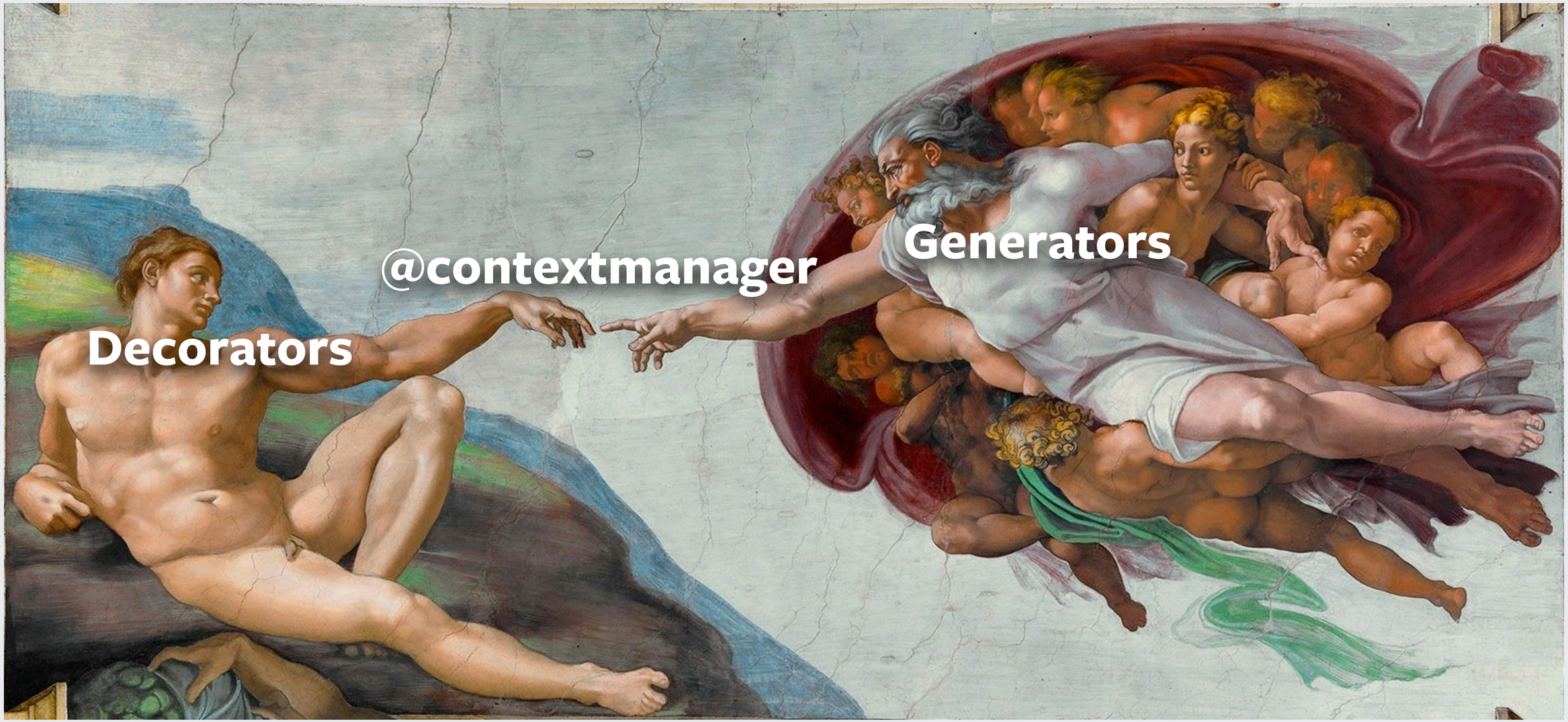

```
1 def first_n(n):
2     nums = []
3     for i in range(n):
4         nums.append(i)
5     return nums
```

```
>>> print(sum(first_n(10)))
45
```

Let's put them together



There is an easier way!

contextlib.contextmanager

```
1  class MyContextManager:
2      def __enter__(self):
3          print("Enter!")
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5      def __exit__(self, *exc):
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8
9  with MyContextManager():
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```

There is an easier way!

contextlib.contextmanager

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class MyContextManager:
    def __enter__(self):
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    def __exit__(self, *exc):
        print("Exit!")


with MyContextManager():
    print("Inside the block!")
```

```
@contextmanager
def my_context_manager():
    print("Enter!")
    yield
    print("Exit!")


with my_context_manager():
    print("Inside the block!")
```

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    def __enter__(self):
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```
@contextmanager
def my_context_manager():
    print("Enter!")
    yield
    print("Exit!")


with my_context_manager():
    print("Inside the block!")
```

Old school context management

```
 1 class FoodContextManager:
 2     def __init__(self, data):
 3         self.data = data
 4
 5     def __enter__(self):
 6         print(f"Enter: {self.data}")
 7         return self.data
 8
 9     def __exit__(self, *exc):
10         print(f"Exit: {self.data}")
11
12 with FoodContextManager({"dairy":"yuck"}) as data:
13     data["fruit"] = "delicious"
```

New hotness

contextlib.contextmanager

```
 1 from contextlib import contextmanager
 2
 3 @contextmanager
 4 def FoodContextManager(data):
 5     print(f"Enter: {data}")
 6     yield data
 7     print(f"Exit: {data}")
 8
 9 with FoodContextManager({"dairy": "yuck"}) as data:
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New hotness

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 1 from contextlib import contextmanager
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 3 @contextmanager
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 9 with FoodContextManager({"dairy": "yuck"}) as data:
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New hotness

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```
 1 from contextlib import contextmanager
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```

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Phew, that was a lot

Let's take a moment

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- Context managers have:
  - `__enter__()`
  - `__exit__()`

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- Context managers have:
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- Generators and decorators are a thing that exist.

Phew, that was a lot

Let's take a moment

- Context managers have:
  - `__enter__()`
  - `__exit__()`
- Generators and decorators are a thing that exist.
- `@contextmanager` decorator is neat!

All the rest

Some things you should really know

- Scope
- Exceptions in `__exit__`
- try / finally with @contextmanager

Scope with Context Managers

Variables defined inside it still exist!

```
1 with open("myfile.txt") as f:
2     content = f.read()
3 print(content)
```

Scope with Context Managers

The thing yielded does too, but it'll be closed.

```
1 with open("myfile.txt") as f:
2     pass
3 content = f.read()
4 print(content)
5 # ValueError: I/O operation on closed file.
```

All the rest

Some things you should really know

- Scope
- **Exceptions in __exit__**
- try / finally with @contextmanager

Exceptions in __exit__

Making context managers even more powerful 💪

```
1 class MyContextManager:
2     def __enter__(self):
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Exceptions in __exit__

Making context managers even more powerful 💪

```
1  class MyContextManager:
2      def __enter__(self):
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5      def __exit__(self, *exc):
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9  with MyContextManager():
10     print("Inside the block!")
```

```
def __exit__(
    self,
    exc_type,
    exc,
    exc_tb,
):
    print("Exit!")
```

Exception handling in __exit__

It's a little tricky

- Want to ignore exception?
  - Return `True`
- Want to raise exception?
  - Return `False` (or do nothing)
- Do **not** explicitly re-raise the exception.

Exceptions in __exit__

Making context managers even more powerful 💪

```
1 class MyContextManager:
2     ...
4
5     def __exit__(self, exc_type, exc, exc_tb):
6         if exc:
7             print("Oh no!")
8             call_for_help()
9             return False
```

Exceptions in __exit__

Making context managers even more powerful 💪

```
1 class MyContextManager:
2     ...
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5     def __exit__(self, exc_type, exc, exc_tb):
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Exceptions in __exit__

Making context managers even more powerful 💪

```
 1 class suppress:
 2     def __init__(self, *exceptions):
 3         self.exceptions = exceptions
 4
 5     def __enter__(self):
 6         pass
 7
 8     def __exit__(self, exc_type, exc, exc_tb):
 9         return (
10             exc_type is not None and
11             issubclass(exc_type, self.exceptions)
12         )
```

Exceptions in __exit__

Making context managers even more powerful 💪

```
 1 class suppress:
 2     def __init__(self, *exceptions):
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All the rest

Some things you should really know

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- Exceptions in `__exit__`
- **Exception handling in @contextmanagers**

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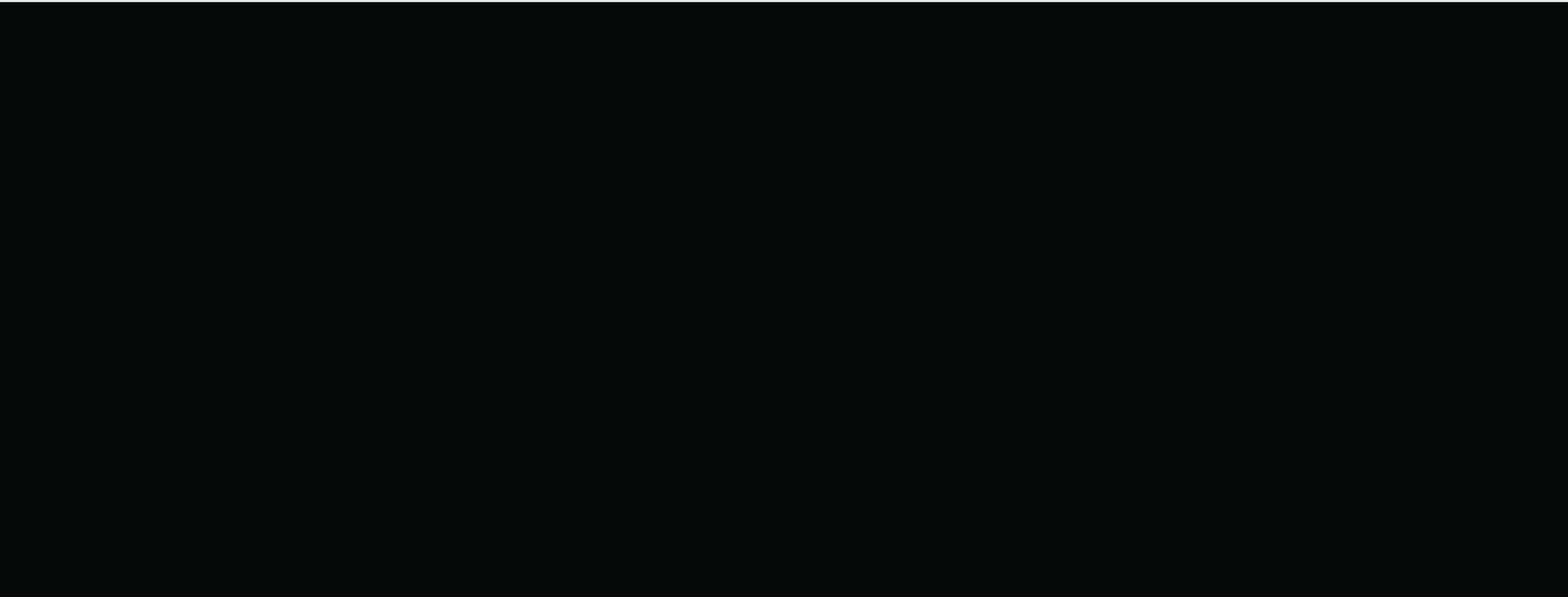
try / except / finally

Exception handling in @contextmanagers



try / except / finally

Exception handling in @contextmanagers

```
1 @contextmanager
2 def my_context_manager():
3     print("Before")
4     yield
5     print("After")
6
7 with my_context_manager():
8     print(f"Neat: {1/0}")
```

try / except / finally

Exception handling in @contextmanagers

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1 @contextmanager
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```

try / except / finally

Exception handling in @contextmanagers

```
$ python3 16_contextmanager_exceptions.py
Before
Traceback (most recent call last):
  File "example.py", line 10, in <module>
    print(f"I love this number: {1/0}")
ZeroDivisionError: division by zero
```

try / except / finally

Exception handling in @contextmanagers

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1 @contextmanager
2 def my_context_manager():
3     print("Before")
4     yield
5     print("After")
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7 with my_context_manager():
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try / except / finally

Exception handling in @contextmanagers

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1 @contextmanager
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```

```
1 @contextmanager
2 def my_context_manager():
3     print("Before")
4     try:
5         yield
6     except Exception as e:
7         print(f"Oh no: {e}")
8     finally:
9         print("After")
```

try / except / finally

Exception handling in @contextmanagers

```
1 @contextmanager
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8     finally:
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try / except / finally

Exception handling in @contextmanagers

```
$ python3 16_contextmanager_exceptions.py
Before
Oh no: division by zero
After
```

We made it!

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Best practices

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- Do not explicitly re-raise exceptions in `__exit__` methods.

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- In @contextmanagers however you must re-raise.

Best practices

- Do not explicitly re-raise exceptions in `__exit__` methods.
- In @contextmanagers however you must re-raise.
- Know the roles of `__init__` and `__enter__`
  - No side effects in `__init__`
  - Don’t make `__init__` too computationally expensive.

Other possible uses!

So many!

- Enclose an event and log based on what happens.

Other possible uses!

So many!

- Enclose an event and log based on what happens.
- Remote integration tests.

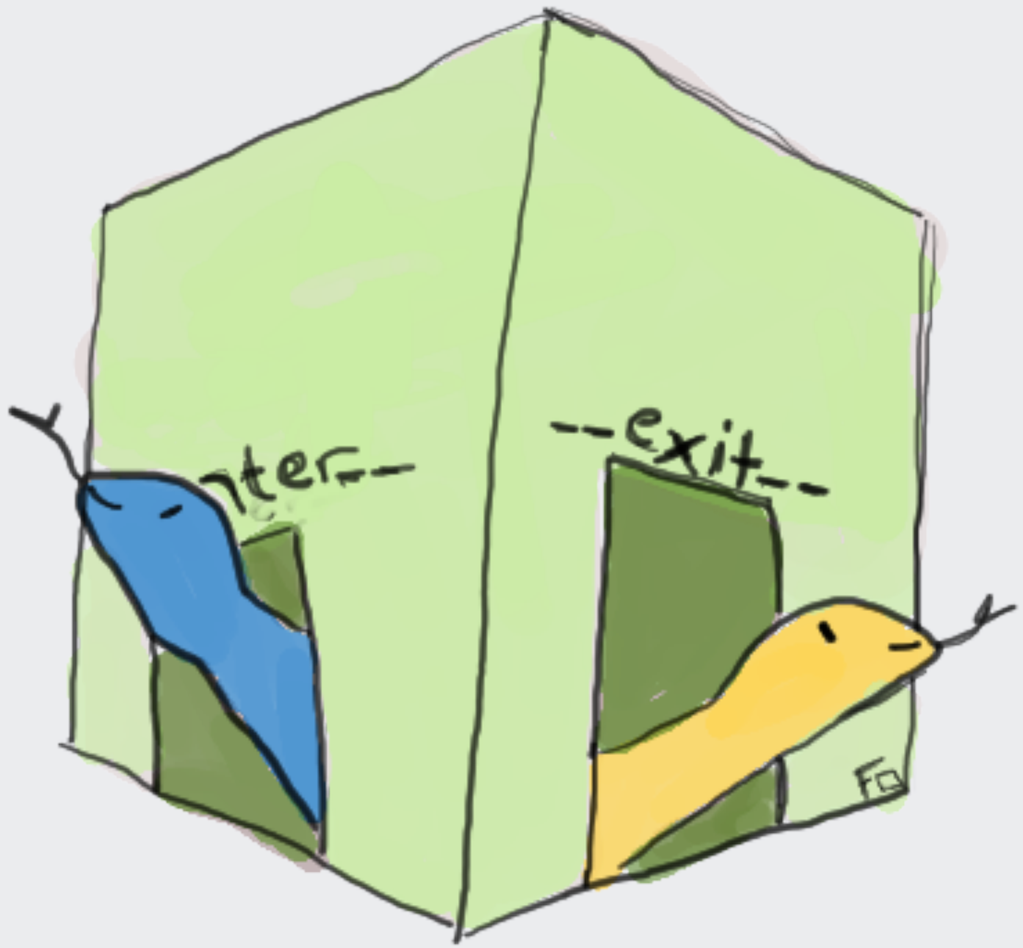
Other possible uses!

So many!

- Enclose an event and log based on what happens.
- Remote integration tests.
- More!

"Context managers are one honking great idea
-- let's use more of those!"

—Tim Peters (almost)



- @fatemabox

Thanks to these great folk

😍😍😍😍😍

- Lachlan, John, Luka, and Sam
  - For watching all my dry-runs
- Fatema and Kelly
  - For drawings and moral support

Questions?

Tweeter

@banool1000

Website

dport.me

Github

github.com/banool

facebook

Key take aways

🔑🔑🔑🔑🔑

- Use context managers!
- Context managers are one honking great idea -- let's use more of those!
- **Use context managers but bolded!**

First, the hard way

But not necessarily the wrong way

write a context manager for something we've seen before. hmm open is a builtin and threadpoolexecutor is too complex. suppress would necessitate explanation of exception handling

Typical usage:

```
@contextmanager
def some_generator(<arguments>):
    <setup>
    try:
        yield <value>
    finally:
        <cleanup>
```

equivalent to this:

```
<setup>
try:
    <variable> = <value>
    <body>
finally:
    <cleanup>
```

This makes this:

```
with some_generator(<arguments>) as <variable>:
    <body>
```