Enhancing Decorators with Type Annotations: Techniques and Best Practices

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Goal

- Understand Complex Decorators with Type Annotations
- Prevent and Detect Bugs Early
- Best Practices for Typing Decorators

About Me

- Occupation: Software Engineer at Tractable, based in Tokyo
- OSS Contributions:
  - Developing PyCharm plugins for Pydantic and Ruff
  - Creating "datamodel-code-generator", a code generator used by Pydantic and in dataclasses models.
- GitHub: https://github.com/koxudaxi

How I Came Up With This Talk

- Motivation: Type hinting is valuable but challenging with decorators.
- Key Questions:
  1. How to define Callable types without ellipsis?
  2. How to manage functions with flexible arguments?
  3. Where to find the best practices?
- Goal: This talk will address these issues and enhance decorators with type annotations.

Structure for Each Section

1. Introduce the Feature
2. Show Sample Code
3. Identify Problems in Current Code
4. Apply the Feature to Fix the Code
5. Recap

Code repo URL of Talk

I'll explain these concepts by creating a logger decorator for HTTP clients.

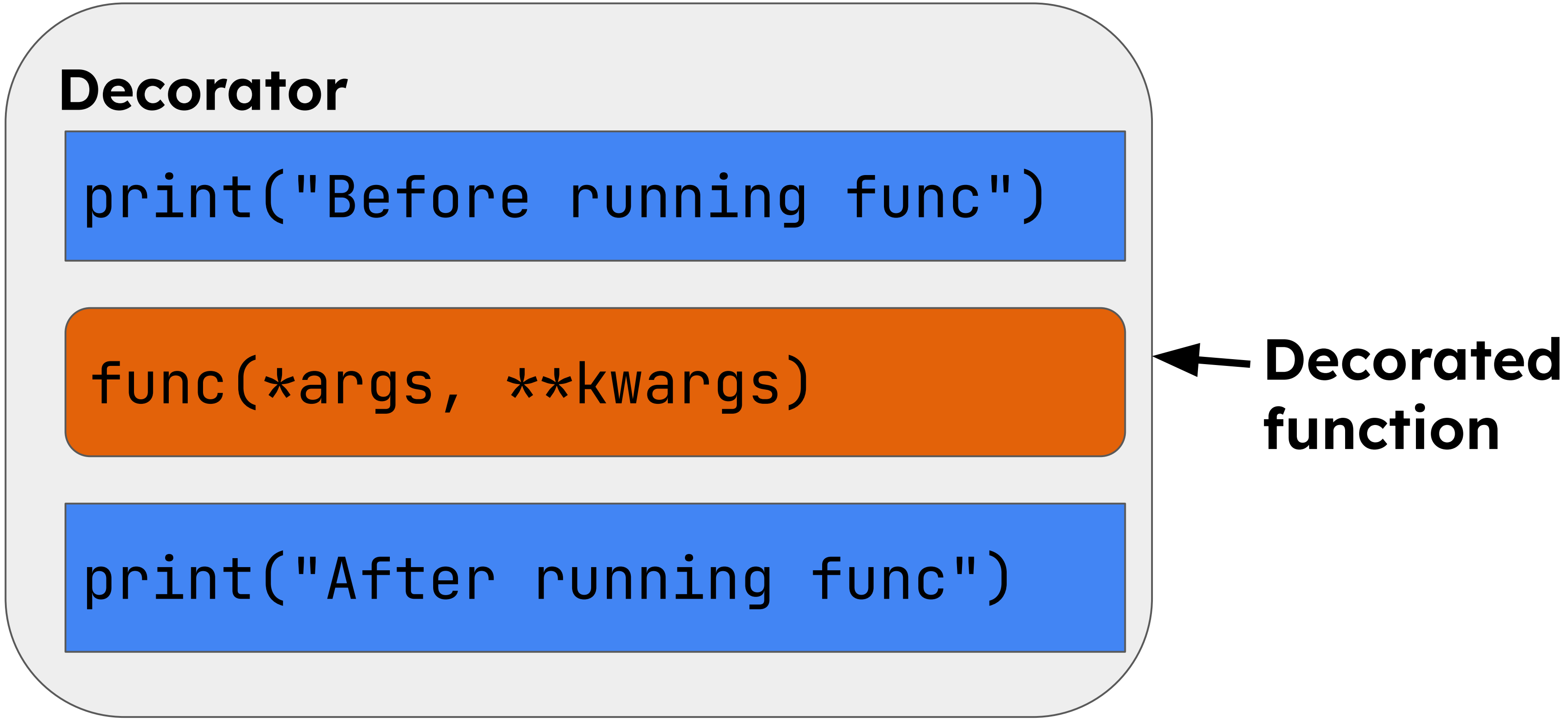
Agenda

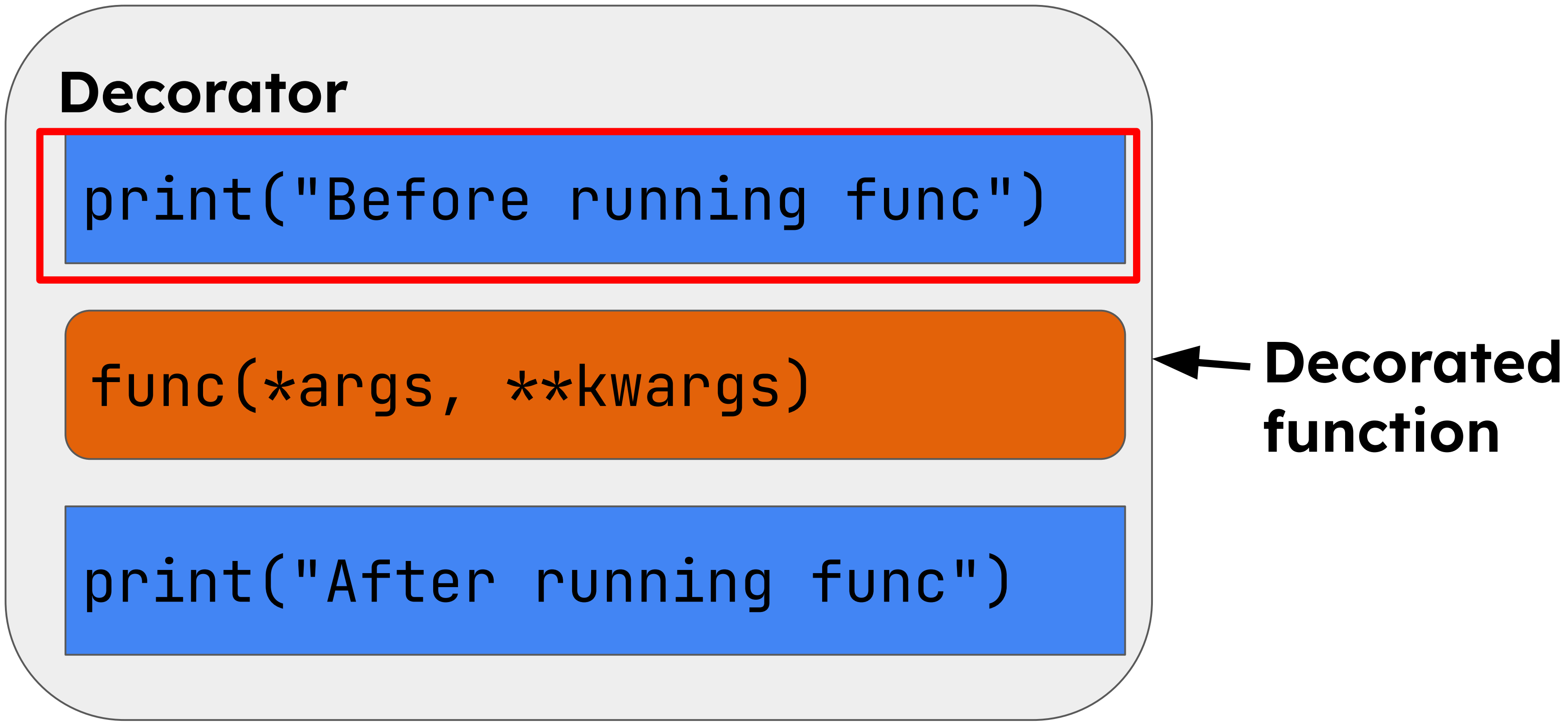
1. Basics of Decorators
2. typing.Protocol
3. typing.ParamSpec
4. typing.Concatenate
5. Type Parameter Syntax in Python 3.12
6. Practical Applications of Decorators
7. typing.TypeVarTuple

1. Basics of Decorators

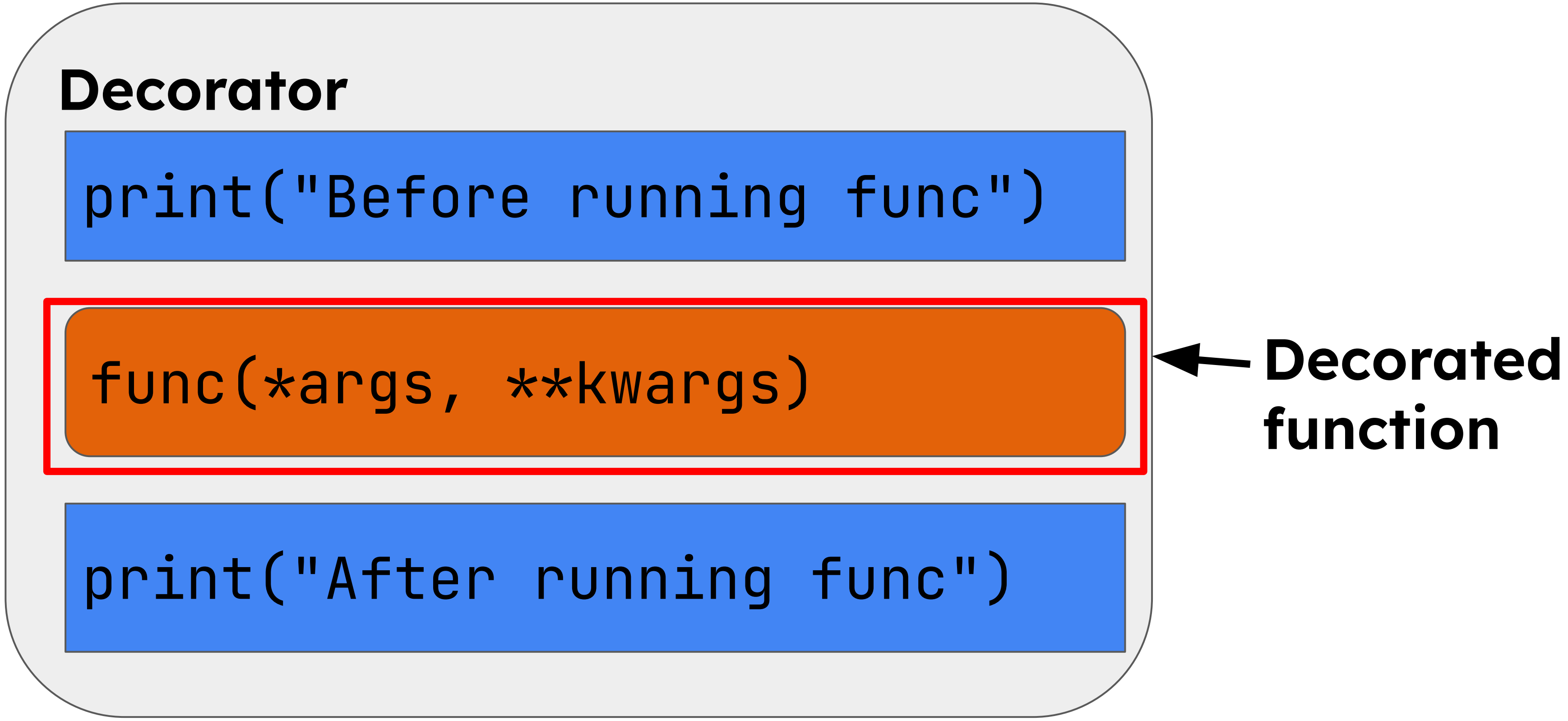
- A decorator is a syntax in Python for higher-order functions.
- Processing can be added before or after a function call.

PEP 318 – Decorators for Functions and Methods

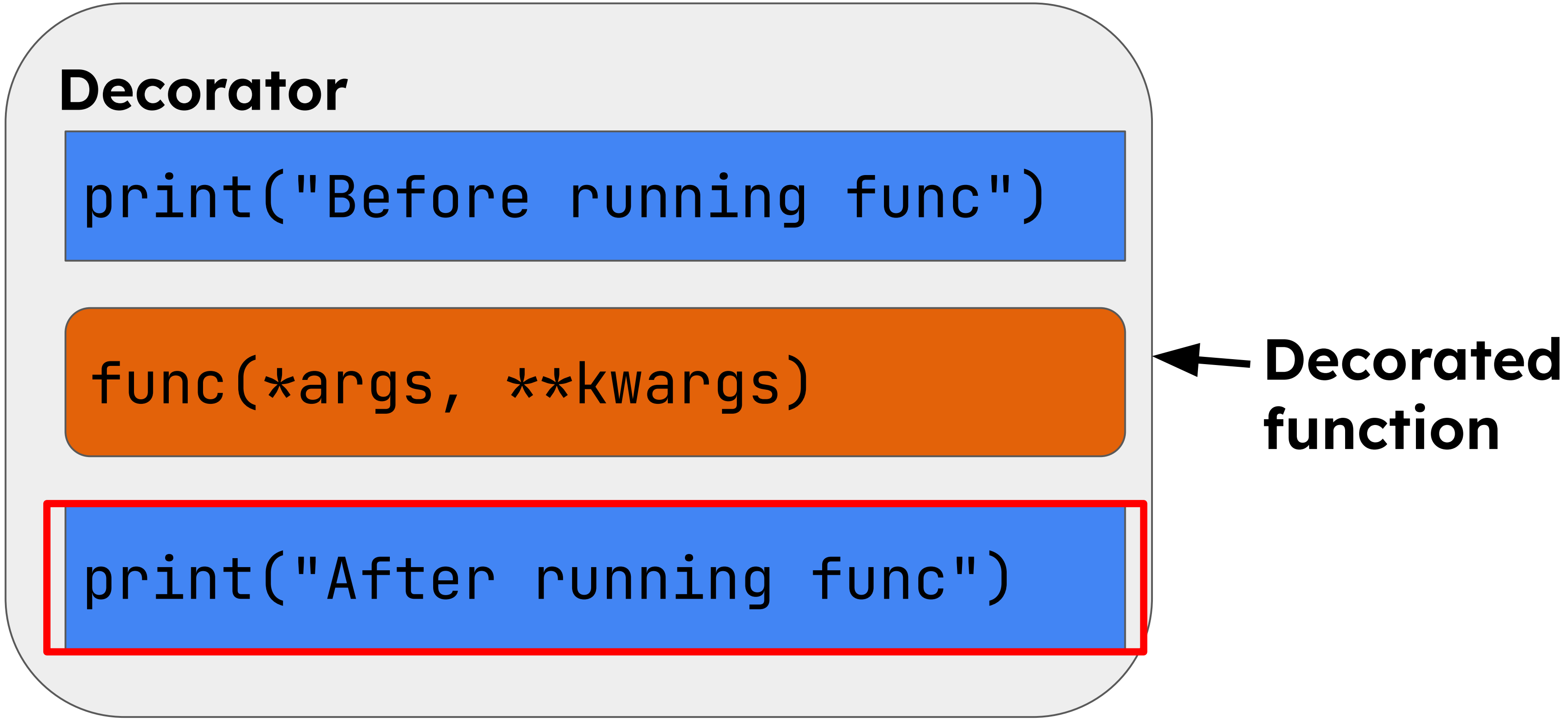

Decorator
print("Before running func")
func(*args, **kwargs)
print("After running func")
Decorated function



```
print("Before running func")
func(*args, **kwargs)
print("After running func")
```



```
print("Before running func")
func(*args, **kwargs)
print("After running func")
```

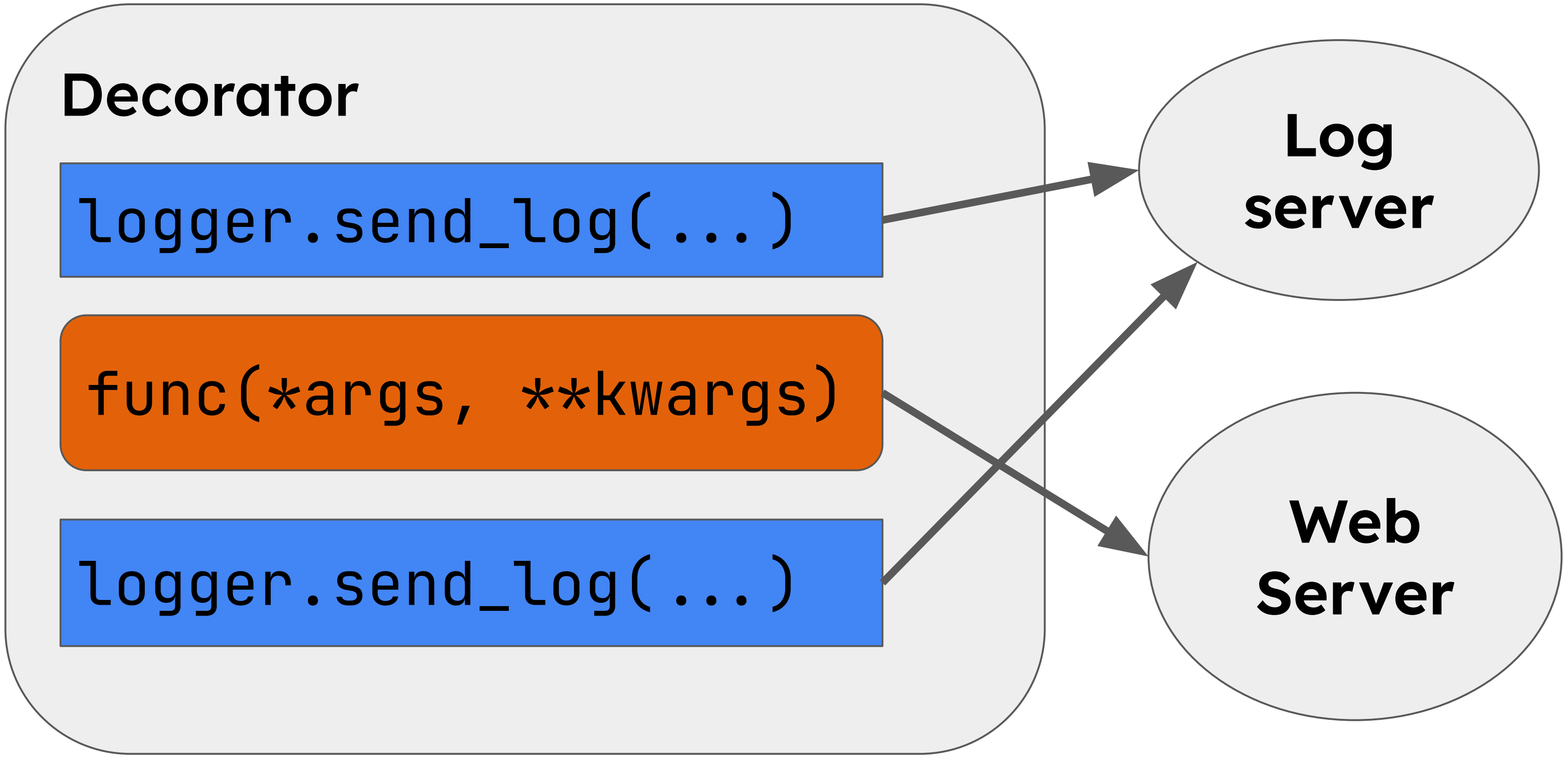


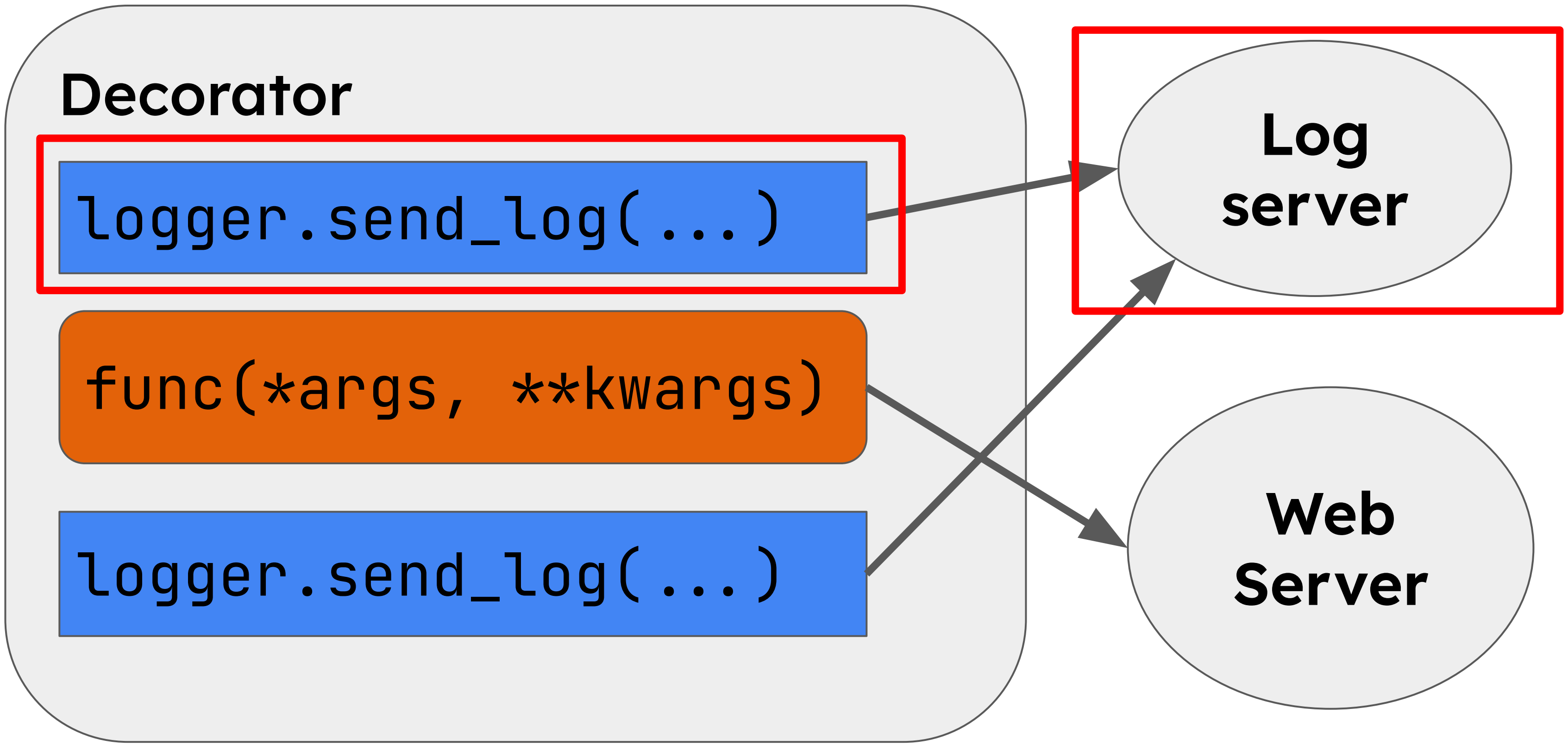
```
print("Before running func")
func(*args, **kwargs)
print("After running func")
```

Let's create a logging decorator for HTTP client

Requirements:

- log before and after the execution of a function.
- The decorator should be designed for HTTP client functions
- Use a custom remote logger class for logging


Decorator
logger.send_log(...)
func(*args, **kwargs)
logger.send_log(...)
Log server
Web Server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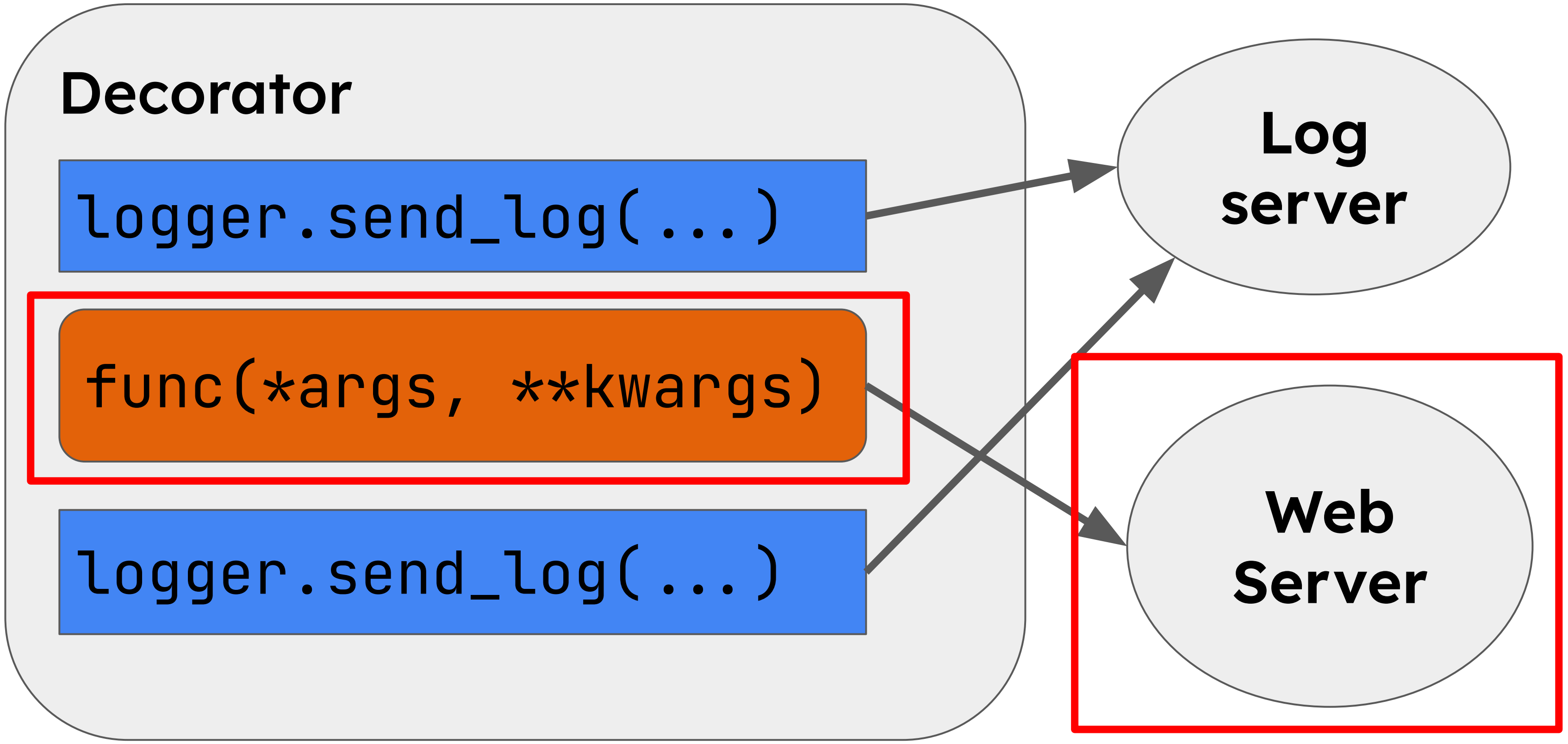
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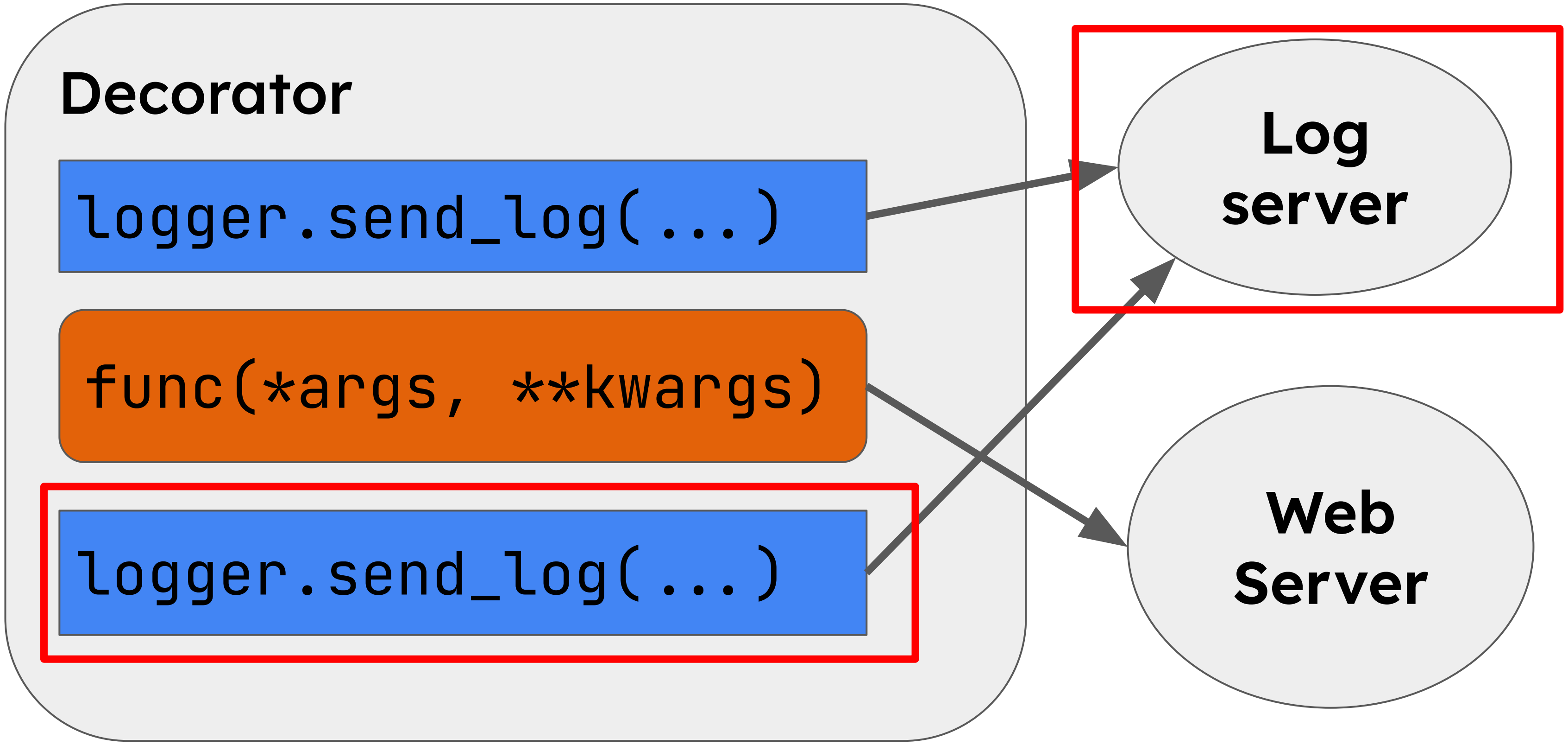
func(*args, **kwargs)
logger.send_log(...)
Log server
Web Server


Decorator
logger.send_log(...)
func(*args, **kwargs)
logger.send_log(...)
Log server
Web Server

A HTTP client function to apply the decorator

```python
import requests

def call_url(url: str) → Any:
  return requests.get(url)



call_url('https://www.example.com/')
```

Here is an example RemoteLogger class to send log

```
class RemoteLogger:
   def __init__(self, name: str, group: str,
level: int):
        ...

   def send_log(self, *args, **kwargs):
        ...
```

Here is an example RemoteLogger class to send log

```
class RemoteLogger:
    def __init__(self, name: str, group: str,
level: int):
        ...

    def send_log(self, *args, **kwargs):
        ...
```

Here is an example RemoteLogger class to send log

```
class RemoteLogger:
    def __init__(self, name: str, group: str,
level: int):
        ...

    def send_log(self, *args, **kwargs):
        ...
```

There is an example RemoteLogger class to send log

```
logger = RemoteLogger(
    name='test', group='admin', level=0
)
logger.send_log(
    message='hello', user_id=1
)

>> {"name": "test", "group": "admin",
"level": 0, "message": "hello", "user_id": 1}
```

There is an example RemoteLogger class to send log

```
logger = RemoteLogger(
    name='test', group='admin', level=0
)
logger.send_log(
    message='hello', user_id=1
)

>> {"name": "test", "group": "admin",
"level": 0, "message": "hello", "user_id": 1}
```

There is an example RemoteLogger class to send log

```
logger = RemoteLogger(
    name='test', group='admin', level=0
)
logger.send_log(
    message='hello', user_id=1
)

>> {"name": "test", "group": "admin",
"level": 0, "message": "hello", "user_id": 1}
```

There is an example RemoteLogger class to send log

```python
logger = RemoteLogger(
    name='test', group='admin', level=0
)
logger.send_log(
    message='hello', user_id=1
)
```

```
>> {"name": "test", "group": "admin",
"level": 0, "message": "hello", "user_id": 1}
```

Logging decorator with RemoteLogger

```python
def add_logging(group, level=0):
    def inner(func):
        logger = RemoteLogger(
                    func.__name__, group, level)
        def wrapper(*args, **kwargs):
            logger.send_log(args=args, kwargs=kwargs)
            result = func(*args, **kwargs)
            logger.send_log(result=result)
            return result
        return wrapper
    return inner
```

Logging decorator with RemoteLogger

```
def add_logging(group, level=0):
    def inner(func):
        logger = RemoteLogger(
                    func.__name__, group, level)
        def wrapper(*args, **kwargs):
            logger.send_log(args=args, kwargs=kwargs)
            result = func(*args, **kwargs)
            logger.send_log(result=result)
            return result
        return wrapper
    return inner
```

Logging decorator with RemoteLogger

```python
def add_logging(group, level=0):
    def inner(func):
        logger = RemoteLogger(
                    func.__name__, group, level)
        def wrapper(*args, **kwargs):
            logger.send_log(args=args, kwargs=kwargs)
            result = func(*args, **kwargs)
            logger.send_log(result=result)
            return result
        return wrapper
    return inner
```

Apply the decorator to the function

```python
@add_logging('http client', 0)
def call_url(url: str) -> Any:
    return requests.get(url)
call_url('https://www.example.com/')
```

Apply the decorator to the function

```
@add_logging('http client', 0)
def call_url(url: str) → Any:
    return requests.get(url)
call_url('https://www.example.com/')

>> {"name": "call_url", "group": "admin",
"level": 0, "args":
["https://www.example.com/"], "kwargs": {}}
>> {"name": "call_url", "group": "admin",
"level": 0, "result": 200}
```

PEP 3102 – Keyword-Only Arguments

Enforce keyword arguments after the asterisk.

```
def compare(a, b, *, key=None):
    ...
compare(1, 2, key=lambda x: x) # OK
compare(1, 2, lambda x: x) # Throws TypeError
```

PEP 3102 – Keyword-Only Arguments

Enforce keyword arguments after the asterisk.

```
def compare(a, b, *, key=None):
    ...
compare(1, 2, key=lambda x: x) # OK
compare(1, 2, lambda x: x) # Throws TypeError
```

PEP 3102 – Keyword-Only Arguments

Enforce keyword arguments after the asterisk.

```
def compare(a, b, *, key=None):
    ...
compare(1, 2, key=lambda x: x) # OK
compare(1, 2, lambda x: x) # Throws TypeError
```

PEP 3102 – Keyword-Only Arguments

Enforce keyword arguments after the asterisk.

```
def compare(a, b, *, key=None):
    ...
compare(1, 2, key=lambda x: x) # OK
compare(1, 2, lambda x: x) # Throws TypeError
```

What is the problem with this decorator?

```
def add_logging(group: str, level: int = 0):
    def inner(func: Callable[..., Any] ) →
Callable[[Callable[..., Any]], Callable[...,
Any]]:
        logger = RemoteLogger(
            func.__name__, group, level)

        def wrapper(*args, **kwargs):
            logger.send_log(
                args=args, kwargs=kwargs)
```

The decorator has no argument restrictions.

```
def add_logging(group: str, level: int = 0):
    def inner(func: Callable[..., Any] ) →
Callable[[Callable[..., Any]], Callable[...,
Any]]:
        logger = RemoteLogger(
            func.__name__, group, level)

        def wrapper(*args, **kwargs):
            logger.send_log(
                args=args, kwargs=kwargs)
```

Guess argument types and order without the definition?

```
def add_logging(...

@add_logging(🤔🤔🤔🤔🤔)
def call_url(url: str) → int:
    return requests.get(url).status_code
```

If not specified with kwargs, an error will occur

```
def add_logging(group: str, *, level: int =
0
) → Callable[[Callable[..., Any]],
Callable[..., Any]]:
…

@add_logging('http client', 0)
def call_url(url: str) → int:
    return requests.get(url).status_code
```

If not specified with kwargs, an error will occur

```
def add_logging(group: str, *, level: int =
0
) →
Calla
…

@add_logging('http client', 0)
def call_url(url: str) → int:
    return requests.get(url).status_code
```

```
    @add_logging('http client', 0)
     ^^^^^^^^^^^^^^^^^^^^^^^^^^^^^
TypeError: add_logging() takes 1 positional
argument but 2 were given
```

If not specified with kwargs, an error will occur

```
def add_logging(group: str, *, level: int =
0
) →
Calla
…
```

PASSED ✅

```
@add_logging('http client', level=0)
def call_url(url: str) → Any:
    return requests.get(url)
```

1. Recap: Basics of Decorators

Enforce Keyword-Only Arguments with *:

- Ensures arguments after * must be keyword arguments, clarifying usage and preventing errors.

```python
def compare(a, b, *, key=None):
    ...
```

2. typing.Protocol

- Interface Definition: Provides a way to define expected methods and properties for classes.
- Type Safety: Helps catch implementation errors by enforcing method signatures.

PEP 544 – Protocols: Structural subtyping (static duck typing)

Define class interface type

```python
from typing import Protocol

class ResponseLike(Protocol):
    status_code: int

    def json(self) → dict:
        ...
```

Define class interface type

```
from typing import Protocol

class ResponseLike(Protocol):
    status_code: int

    def json(self) → dict:
        ...
>> response: ResponseLike =
requests.get('https://example.com')
>> response.json()
>> response.status_code
```

Define function interface type

```python
from typing import Protocol

class ClientGetFunction(Protocol):
    def __call__(self, url: str, timeout: float)
→ ResponseLike:
        ...
```

Define function interface type

```
from typing import Protocol

class ClientGetFunction(Protocol):
    def __call__(self, url: str, timeout: float)
→ ResponseLike:
        ...

>>def call_url(url: str, timeout: float) →
ResponseLike:
>>   return requests.get(url, timeout=timeout)
>>func: ClientGetFunction = call_url  # OK
```

Callable vs Protocol

Callable

```
from typing import
Callable, TypeAlias

GetStatus: TypeAlias =
Callable[[str, float],
ResponseLike]
```

Callable vs Protocol

Callable

```python
from typing import
Callable, TypeAlias

GetStatus: TypeAlias =
Callable[[str, float],
ResponseLike]
```

Protocol

```python
from typing import
Protocol

class GetStatus(Protocol):
   def __call__(
      self,
      url: str,
      timeout: float = 5
   ) → ResponseLike:
      ...
```

requests vs httpx

requests

```
from requests import
Response

response: Response =
requests.get(
'https://www.python.org/')
assert
response.status_code ==
200
```

httpx

```
from httpx import Response


response: Response =
httpx.get(
'https://www.python.org/')
assert
response.status_code ==
200
```

Different response types, same attribute

requests

```
from requests import
Response

response: Response =
requests.get(
'https://www.python.org/')
assert
response.status_code ==
200
```

httpx

```
from httpx import Response


response: Response =
httpx.get(
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Different response types, same attribute

requests

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from requests import
Response

response: Response =
requests.get(
'https://www.python.org/')
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response.status_code ==
200
```

httpx

```
from httpx import Response


response: Response =
httpx.get(
'https://www.python.org/')
assert
response.status_code ==
200
```

Different response types, same attribute

requests

```python
from typing import Protocol
import requests

class ResponseLike(Protocol):
    status_code: int
```

httpx

```python
from typing import Protocol
import httpx

class ResponseLike(Protocol):
    status_code: int
```

Different response types, same attribute

requests

```
from typing import Protocol
import requests

class ResponseLike(Protocol):
    status_code: int

response: ResponseLike =
requests.get('https://www.pyt
hon.org/')
assert response.status_code
== 200
```

httpx

```
from typing import Protocol
import httpx

class ResponseLike(Protocol):
    status_code: int

response: ResponseLike =
httpx.get('https://www.python
.org/')
assert response.status_code
== 200
```

ResponseLike supports httpx and requests’ response

```python
from typing import Any, Protocol

class ResponseLike(Protocol):
    status_code: int

…

        def wrapper(
            *args: Any, **kwargs: Any
          ) -> ResponseLike:
           …
```

2. Recap: typing.Protocol

Benefits:

- Interoperability: Works with multiple libraries (requests, httpx).
- Type Safety: Ensures response objects have a status_code.

```
class ResponseLike(Protocol):
    status_code: int
```

3. typing.ParamSpec

Key Benefits:

- Flexible Signature Handling: Capture the signature of functions to write decorators that are more flexible.
- Type Safety: Ensure that functions used with decorators maintain their original type annotations.

PEP 612 – Parameter Specification Variables

typing.ParamSpec example from PEP612

```
from typing import Awaitable, Callable, ParamSpec, TypeVar

P = ParamSpec("P")
R = TypeVar("R")

def add_logging(f: Callable[P, R]) → Callable[P, Awaitable[R]]:
 async def inner(*args: P.args, **kwargs: P.kwargs) → R:
   await log_to_database()
   return f(*args, **kwargs)
 return inner

@add_logging
def takes_int_str(x: int, y: str) → int:
 return x + 7

await takes_int_str(1, "A") # Accepted
await takes_int_str("B", 2) # Correctly rejected by the type checker
```

typing.ParamSpec example from PEP612

```
from typing import Awaitable, Callable, ParamSpec,
TypeVar

P = ParamSpec("P")
R = TypeVar("R")

def add_logging(f: Callable[P, R]) → Callable[P,
Awaitable[R]]:
 async def inner(*args: P.args, **kwargs: P.kwargs) → R:
   await log_to_database()
   return f(*args, **kwargs)
 return inner
```

typing.ParamSpec example from PEP612

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from typing import Awaitable, Callable, ParamSpec,
TypeVar
P = ParamSpec("P")
R = TypeVar("R")

def add_logging(f: Callable[P, R]) → Callable[P,
Awaitable[R]]:
 async def inner(*args: P.args, **kwargs: P.kwargs) →
R:
    await log_to_database()
    return f(*args, **kwargs)
 return inner
```

Keyword arguments is defined as Any

```
from typing import Callable, ParamSpec, Protocol

P = ParamSpec("P")

def add_logging(
    group: str, *, level: int = 0
) → Callable[[Callable[..., ResponseLike]], Callable[...,
ResponseLike]]:
    def inner(func: Callable[..., ResponseLike]) →
Callable[.., ResponseLike]:
        …
        def wrapper(*args: Any, **kwargs: Any) →
ResponseLike:
            …
```

ParamSpec provides P.kwargs for kwargs

```
from typing import Callable, ParamSpec, Protocol

P = ParamSpec("P")

def add_logging(
    group: str, *, level: int = 0
) → Callable[[Callable[P, ResponseLike]], Callable[P,
ResponseLike]]:
    def inner(func: Callable[P, ResponseLike]) →
Callable[P, ResponseLike]:
        …
            def wrapper(*args: P.args, **kwargs: P.kwargs) →
ResponseLike:
                …
```

3. Recap: typing.ParamSpec

- **Flexible Signature Handling: Capture function signatures for flexible decorators.**
- **Type Safety: Ensure functions maintain their original type annotations.**

```
P = ParamSpec("P")
def inner(func: Callable[P, ResponseLike]) →
      Callable[P, ResponseLike]:
    func(*args: P.args, **kwargs: P.kwargs)
→ ResponseLike:
```

4. typing.Concatenate

This feature is useful when:

- A decorator needs to adjust the function's signature.
- Adding or removing specific arguments while keeping the rest of the signature intact.

PEP 612 – Parameter Specification Variables

typing.Concatenate example from PEP612

```python
from typing import Concatenate

def with_request(f: Callable[Concatenate[Request, P], R]) -> Callable[P,
R]:
 def inner(*args: P.args, **kwargs: P.kwargs) -> R:
   return f(Request(), *args, **kwargs)
 return inner

@with_request
def takes_int_str(request: Request, x: int, y: str) -> int:
 # use request
 return x + 7

takes_int_str(1, "A") # Accepted
takes_int_str("B", 2) # Correctly rejected by the type checker
```

typing.Concatenate example from PEP612

```
def with_request(f: Callable[Concatenate[Request, P],
R]) → Callable[P, R]:
 def inner(*args: P.args, **kwargs: P.kwargs) → R:
   return f(Request(), *args, **kwargs)
 …
@with_request
def takes_int_str(request: Request, x: int, y: str) →
int:
 # use request
  …
takes_int_str(1, "A") # Accepted
```

typing.Concatenate example from PEP612

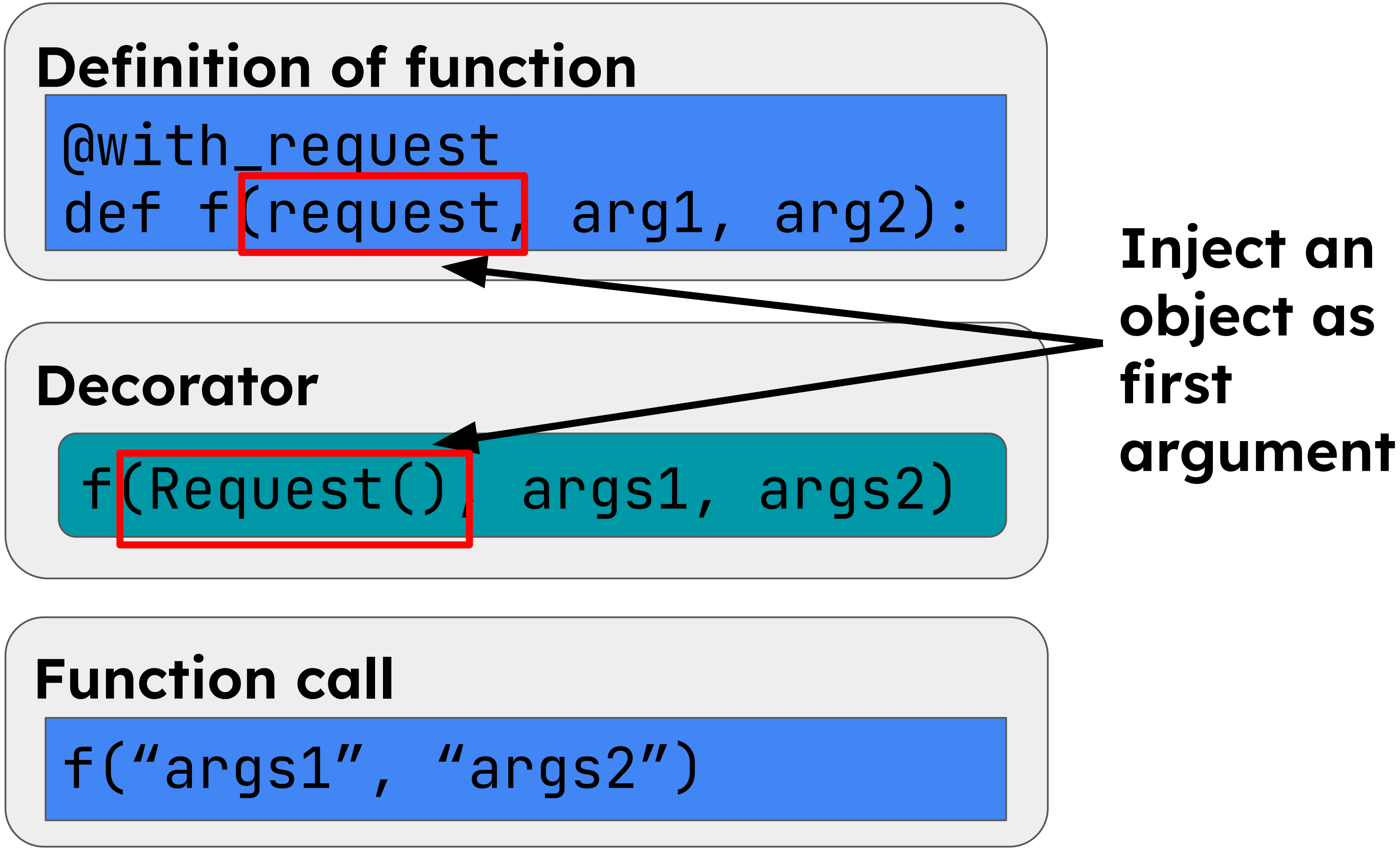
```
def with_request(f: Callable[Concatenate[Request, P],
R]) -> Callable[P, R]:
 def inner(*args: P.args, **kwargs: P.kwargs) -> R:
   return f(Request(), *args, **kwargs)
 …
@with_request
def takes_int_str(request: Request, x: int, y: str) ->
int:
 # use request
  …
takes_int_str(1, "A") # Accepted
```

typing.Concatenate example from PEP612

```
def with_request(f: Callable[Concatenate[Request, P],
R]) → Callable[P, R]:
 def inner(*args: P.args, **kwargs: P.kwargs) → R:
   return f(Request(), *args, **kwargs)
 …
@with_request
def takes_int_str(request: Request, x: int, y: str) →
int:
 # use request
  …
takes_int_str(1, "A") # Accepted
```

typing.Concatenate example from PEP612

```python
def with_request(f: Callable[Concatenate[Request, P],
R]) -> Callable[P, R]:
 def inner(*args: P.args, **kwargs: P.kwargs) -> R:
   return f(Request(), *args, **kwargs)
 …
@with_request
def takes_int_str(request: Request, x: int, y: str) ->
int:
 # use request
  …
takes_int_str(1, "A") # Accepted
```



Definition of function

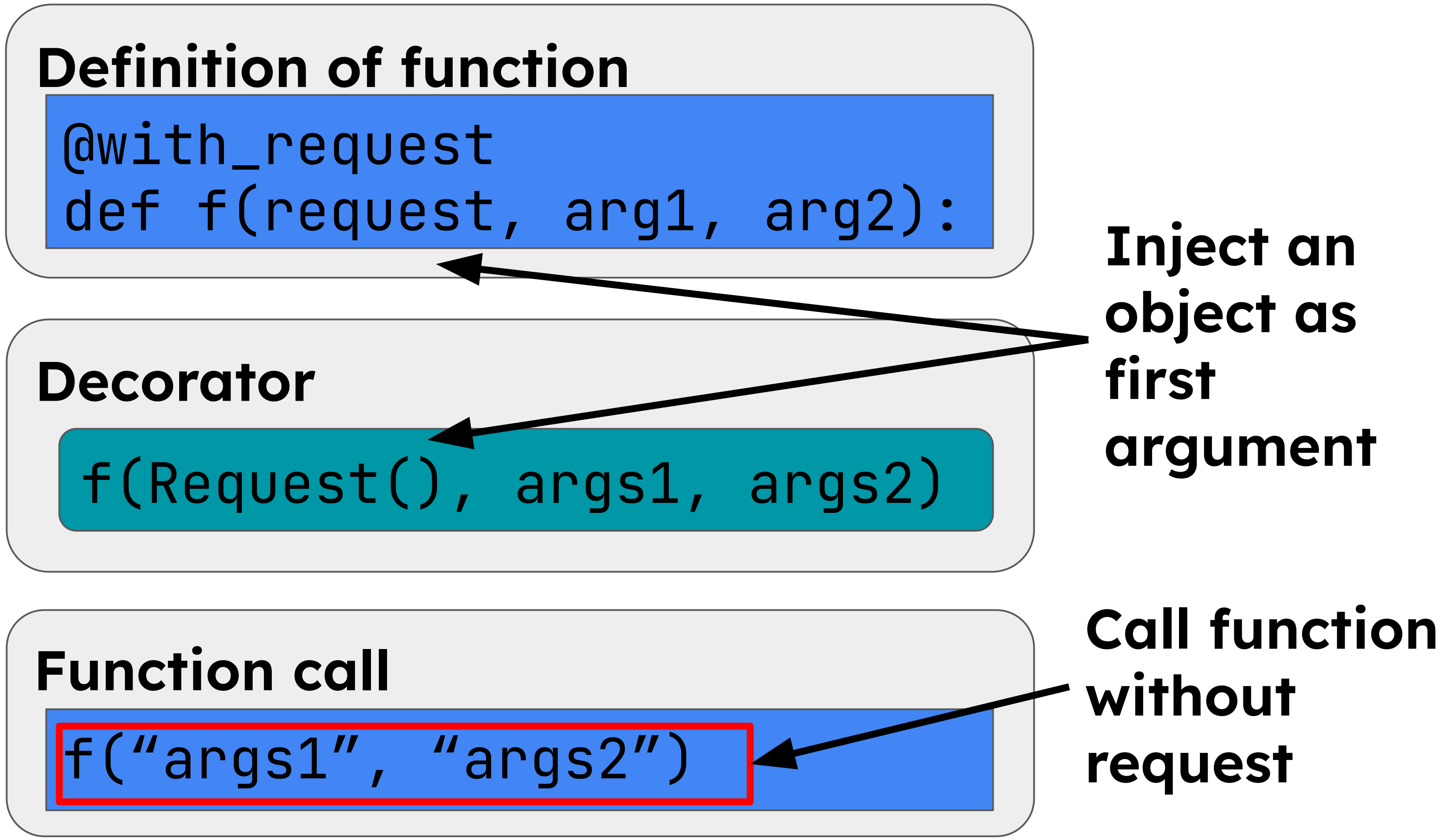
```python
@with_request
def f(request, arg1, arg2):
```

Decorator

```python
f(Request(), args1, args2)
```

Function call

```python
f(“args1”, “args2”)
```


Definition of function
Decorator
Function call
Inject an object as first argument
Call function without request

```python
@with_request
def f(request, arg1, arg2):
```

```python
f(Request(), args1, args2)
```

```python
f(“args1”, “args2”)
```

Want to use the logger inside the function

```
@add_logging('http client', level=0)
def call_url(logger: RemoteLogger, url:
str, timeout: int = 5) → ResponseLike:

    logger.send_log(message='in call_url')
    return requests.get(url,
timeout=timeout)

call_url('https://www.example.com/')
```

Want to use the logger inside the function

```
@add_logging('http client', level=0)
def call_url(logger: RemoteLogger, url:
str, timeout: int = 5) → ResponseLike:

    logger.send_log(message='in call_url')
    return requests.get(url,
timeout=timeout)

call_url('https://www.example.com/')
```

Inject logger object to first argument in function

```
@add_logging('http client', level=0)
def call_url(logger: RemoteLogger, url:
str, timeout: int = 5) → ResponseLike:

    logger.send_log(message='in call_url')
    return requests.get(url,
timeout=timeout)

call_url('https://www.example.com/')
```

Apply Concatenate

```
def add_logging(group: str, *, level: int=0) →
Callable[[Callable[Concatenate[RemoteLogger, P], ResponseLike]],
Callable[[Concatenate[P]], ResponseLike]]:
   def inner(func: Callable[Concatenate[RemoteLogger, P], ResponseLike]) →
Callable[[Concatenate[P]], ResponseLike]:
       logger = RemoteLogger(func.__name__, group, level)

       def wrapper(*args: P.args, **kwargs: P.kwargs) → ResponseLike:
           logger.send_log(args=args, kwargs=kwargs)
           result = func(logger, *args, **kwargs)
           logger.send_log(result=result)
           return result
       return wrapper
   return inner

@add_logging('http client', level=0)
def call_url(logger: RemoteLogger, url: str, timeout: int = 5) → ResponseLike:
   logger.send_log(message='in call_url)
   return requests.get(url, timeout=timeout)
```

```
 def inner(func: Callable[Concatenate[RemoteLogger,
P], ResponseLike]) → Callable[[Concatenate[P]],
ResponseLike]:
       logger = RemoteLogger(func.__name__, group,
level)

       def wrapper(*args: P.args, **kwargs: P.kwargs)
→ ResponseLike:
           logger.send_log(args=args, kwargs=kwargs)
           result = func(logger, *args, **kwargs)
      …
@add_logging('http client', level=0)
def call_url(logger: RemoteLogger, url: str, timeout:
int = 5) → ResponseLike:
```

```python
 def inner(func: Callable[Concatenate[RemoteLogger,
P], ResponseLike]) -> Callable[[Concatenate[P]],
ResponseLike]:
       logger = RemoteLogger(func.__name__, group,
level)

       def wrapper(*args: P.args, **kwargs: P.kwargs)
-> ResponseLike:
           logger.send_log(args=args, kwargs=kwargs)
           result = func(logger, *args, **kwargs)
         …
@add_logging('http client', level=0)
def call_url(logger: RemoteLogger, url: str, timeout:
int = 5) -> ResponseLike:
 def inner(func: Callable[Concatenate[RemoteLogger,
P], ResponseLike]) -> Callable[[Concatenate[P]],
ResponseLike]:
       logger = RemoteLogger(func.__name__, group,
level)

       def wrapper(*args: P.args, **kwargs: P.kwargs)
-> ResponseLike:
           logger.send_log(args=args, kwargs=kwargs)
           result = func(logger, *args, **kwargs)
          …
@add_logging('http client', level=0)
def call_url(logger: RemoteLogger, url: str, timeout:
int = 5) -> ResponseLike:
```

4. Recap: typing.Concatenate

- **Flexible Signature Manipulation: Enables adding extra parameters to functions while preserving the original signature.**
- **Type Safety: Ensures the modified signature remains type-safe, including additional parameters.**

```
from collections.abc import Callable
from typing import Concatenate
Callable[Concatenate[RemoteLogger, P], R]
```

6. Type Parameter Syntax in Python 3.12

1. Consistent Syntax:
   - Introduces a standard way to declare type parameters using class and def.
2. Clearer Code:
   - Improves readability and consistency by avoiding the use of complex type hints.

PEP 695 – Type Parameter Syntax

Have to import TypeAlias when define new Type

Python 3.11

```
from typing import
TypeAlias

Url: TypeAlias = str

def call_url(url: Url
   ) → Any:
    ...
```

Python 3.12 provides the new keyword "type"

Python 3.11

```python
from typing import
TypeAlias

Url: TypeAlias = str

def call_url(url: Url
    ) -> Any:
    ...
```

Python 3.12

```python
type Url = str

def call_url(url: Url
    ) -> Any:
    ...
```

Have to define “T” with Typing.TypeVar

Python 3.11

```python
from typing import
TypeVar

T = TypeVar("T")

def multiply(x: T, y:
int
    ) -> T:
      ...
```

New Syntax reduces steps to use “T”

Python 3.11

```
from typing import
TypeVar

T = TypeVar("T")

def multiply(x: T, y:
int
    ) → T:
     ...
```

Python 3.12

```
def multiply[T](x: T,
y: int
    ) → T:
     ...
```

Apply Type Parameter Syntax in Python 3.12

```
type LogFunc[** P, R] =
Callable[Concatenate[RemoteLogger, P], R]


def add_logging[** P](
        group: str, *, level: int = 0
) → Callable[[LogFunc[P, ResponseLike]],
Callable[P, ResponseLike]]:
    …
```

Apply Type Parameter Syntax in Python 3.12

```
type LogFunc[** P, R] =
Callable[Concatenate[RemoteLogger, P], R]



def add_logging[** P](
        group: str, *, level: int = 0
) → Callable[[LogFunc[P, ResponseLike]],
Callable[P, ResponseLike]]:
    …
```

6. Recap: Type Parameter Syntax in Python 3.12

- Consistent Syntax:
  - Provides a standardized way to declare type parameters in classes and functions.
- Clearer Code:
  - Enhances readability and consistency by eliminating complex type hints.

```
type LogFunc[** P, R] =
Callable[Concatenate[RemoteLogger, P], R]
def add_logging[** P](...
```

7. Practical Applications of Decorators

Advanced Decorator Example using ParamSpec, Concatenate, and Protocol

Requirements:

- Log the URL, status code, and function name using modern Python features for type safety.

Here is the code with all the steps applied so far

```python
from collections.abc import Callable
from typing import Concatenate, Protocol

import httpx
import requests

from .remote_logger import RemoteLogger

class ResponseLike(Protocol):
   status_code: int

type LogFunc[** P, R] = Callable[Concatenate[RemoteLogger, P],
R]

def add_logging[** P](
      group: str, *, level: int = 0
) → Callable[[LogFunc[P, ResponseLike]], Callable[P,
ResponseLike]]:
   def inner(func: LogFunc[P, ResponseLike]) → Callable[P,
ResponseLike]:
      logger = RemoteLogger(func.__name__, group, level)

      def wrapper(*args: P.args, **kwargs: P.kwargs) →
ResponseLike:
         logger.send_log(args=args, kwargs=kwargs)
         result = func(logger, *args, **kwargs)
         logger.send_log(status_code=result.status_code)
         return result
      return wrapper
   return inner
```

```python
@add_logging('http client', level=0)
def download_with_request(
      logger: RemoteLogger, url: str, timeout: float = 5
) → ResponseLike:
   logger.send_log(message='in download_with_request')
   return requests.get(url, timeout=timeout)


@add_logging('http client', level=0)
def download_with_httpx(
      logger: RemoteLogger, url: str, timeout: float = 5
) → ResponseLike:
   logger.send_log(message='in download_with_httpx')
   return httpx.get(url, timeout=timeout)


download_with_request('https://examples.com/', timeout=10)
download_with_httpx('https://examples.com/', timeout=10)
```

```
from collections.abc import Callable
from typing import Concatenate, Protocol


…

class ResponseLike(Protocol):
    status_code: int

type LogFunc[** P, R] =
Callable[Concatenate[RemoteLogger, P], R]
```

```python
from collections.abc import Callable
from typing import Concatenate, Protocol


…

class ResponseLike(Protocol):
    status_code: int

type LogFunc[** P, R] =
Callable[Concatenate[RemoteLogger, P], R]
```

```
def add_logging[** P](
        group: str, *, level: int = 0
) → Callable[[LogFunc[P, ResponseLike]],
Callable[P, ResponseLike]]:

    def inner(
        func: LogFunc[P, ResponseLike]
    ) → Callable[P, ResponseLike]:
        …
```

```python
def add_logging[** P](
        group: str, *, level: int = 0
) -> Callable[[LogFunc[P, ResponseLike]],
Callable[P, ResponseLike]]:

    def inner(
        func: LogFunc[P, ResponseLike]
    ) -> Callable[P, ResponseLike]:
        ...
```

```
def wrapper(
   *args: P.args, **kwargs: P.kwargs
) -> ResponseLike:
    logger.send_log(
       args=args, kwargs=kwargs
     )
     result = func(
       logger, *args, **kwargs
     )
    logger.send_log(
       status_code=result.status_code
     )
```

```
def wrapper(
    *args: P.args, **kwargs: P.kwargs
) -> ResponseLike:
    logger.send_log(
        args=args, kwargs=kwargs
    )
    result = func(
        logger, *args, **kwargs
    )
    logger.send_log(
        status_code=result.status_code
    )
```

```
@add_logging('http client', level=0)
def download_with_httpx(
    logger: RemoteLogger,
    url: str,
    timeout: float = 5
) → ResponseLike:
   logger.send_log(message='in the
funciton)
   return httpx.get(url, timeout=timeout)
download_with_httpx('https://examples.com/'
)
```

```
@add_logging('http client', level=0)
def download_with_httpx(
    logger: RemoteLogger,
    url: str,
    timeout: float = 5
) → ResponseLike:
   logger.send_log(message='in the
funciton)
   return httpx.get(url, timeout=timeout)
download_with_httpx('https://examples.com/'
)
```

7. typing.TypeVarTuple

Benefits:

- Safely handle functions with variable-length arguments.
- Enable advanced generic usage for decorators and classes.

PEP 646 – Variadic Generics

```python
from typing import TypeVar, TypeVarTuple

T = TypeVar("T")
Ts = TypeVarTuple("Ts")

def move_first_element_to_last(
    tup: tuple[T, *Ts]
) -> tuple[*Ts, T]:
   return (*tup[1:], tup[0])

move_first_element_to_last((1, 2, 3))
#                           ↑  ↑  ↑
#                           T  *Ts
```

```python
from typing import TypeVar, TypeVarTuple

T = TypeVar("T")
Ts = TypeVarTuple("Ts")

def move_first_element_to_last(
    tup: tuple[T, *Ts]
) -> tuple[*Ts, T]:
   return (*tup[1:], tup[0])

move_first_element_to_last((1, 2, 3))
#                           ↑  ↑  ↑
#                           T  *Ts
```

```python
from typing import TypeVar, TypeVarTuple

T = TypeVar("T")
Ts = TypeVarTuple("Ts")

def move_first_element_to_last(
    tup: tuple[T, *Ts]
) -> tuple[*Ts, T]:
    return (*tup[1:], tup[0])

move_first_element_to_last((1, 2, 3))
#                           ↑  ↑  ↑
#                           T  *Ts
```

```python
from typing import TypeVar, TypeVarTuple

T = TypeVar("T")
Ts = TypeVarTuple("Ts")

def move_first_element_to_last(
    tup: tuple[T, *Ts]
) -> tuple[*Ts, T]:
   return (*tup[1:], tup[0])

move_first_element_to_last((1, 2, 3))
#                           ↑  ↑  ↑
#                           T  *Ts
```

```python
from typing import TypeVar, TypeVarTuple

T = TypeVar("T")
Ts = TypeVarTuple("Ts")

def move_first_element_to_last(
    tup: tuple[T, *Ts]
) -> tuple[*Ts, T]:
    return (*tup[1:], tup[0])

move_first_element_to_last((1, 2, 3))
#                           ↑  ↑  ↑
#                           T  *Ts
```

7. Recap: typing.TypeVarTuple

Benefits:

- **Handle Variadic Arguments Safely: Allows functions to handle variable-length arguments with type safety.**

```
Ts = TypeVarTuple("Ts")
def move_first_element_to_last(
    tup: tuple[T, *Ts]
) → tuple[*Ts, T]:
…
```

Thank you very much!!

Here is the URL of Repository in the Talk

https://github.com/koxudaxi/pyconus_2024