Function Examples
Class outline:

- Currying
- Decorators
- Review
Currying
Currying: Converting a function that takes multiple arguments into a single-argument higher-order function.

A function that currys any two-argument function:

```python
def curry2(f):
    def g(x):
        def h(y):
            return f(x, y)
        return h
    return g

from operator import add

make_adder = curry2(add)
make_adder(2)(3)

curry2 = lambda f: lambda x: lambda y: f(x, y)
```
Use case for currying #1

Whenever another function requires a function that only takes one argument:

```python
def transform_numbers(num1, num2, num3, transform):
    return transform(num1), transform(num2), transform(num3)

transform_numbers(3, 4, 5, curry2(add)(60))
```
Use case for currying #1

Whenever another function requires a function that only takes one argument:

```python
def transform_numbers(num1, num2, num3, transform):
    return transform(num1), transform(num2), transform(num3)
```

```python
transform_numbers(3, 4, 5, curry2(add)(60))
```

Alternate approach:

```python
transform_numbers(3, 4, 5, lambda x: add(60, x))
```
Use case for currying #2

Turning a generalized function into a specialized function:

```python
def html_tag(tag_name, text):
    return "<" + tag_name + ">

tp_tag = curry2(html_tag)("p")
p_tag("hello hello")
```
Use case for currying #2

Turning a generalized function into a specialized function:

```python
def html_tag(tag_name, text):
    return "<" + tag_name + ">" + text + "</" + tag_name + ">"

p_tag = curry2(html_tag)("p")
p_tag("hello hello")
```

Alternate approach:

```python
import functools

p_tag = functools.partial(html_tag, "p")
p_tag("hello hello")
```
Why learn currying in Python?

It's good for you!

CS61A introduces many concepts that aren't standard Python practice, but that show up in other languages.

Currying is a very common practice in functional programming languages like Haskell or Clojure.
Decorators
A tracing function

Let's make a higher-order tracing function.

def trace1(f):
    """Return a function that takes a single argument, x, prints it, computes and prints F(x), and returns the computed value.
    >>> square = lambda x: x * x
    >>> trace1(square)(3)
    -> 3
    <- 9
    9
    """
A tracing function

Let's make a higher-order tracing function.

def trace1(f):
    """Return a function that takes a single argument, x, prints it, computes and prints F(x), and returns the computed value.
    >>> square = lambda x: x * x
    >>> trace1(square)(3)
    -> 3
    <- 9
    9
    """
    def traced(x):
        print("->", x)
        r = f(x)
        print("<-", r)
        return r
    return traced
A tracing decorator

What if we always wanted a function to be traced?

```python
@trace1
def square(x):
    return x * x
```

That's equivalent to..

```python
def square(x):
    return x * x
square = trace1(square)
```
General decorator syntax

The notation:

```python
@ATTR
def aFunc(...):
    ...
```

is essentially equivalent to:

```python
def aFunc(...):
    ...
    aFunc = ATTR(aFunc)
```

**ATTR** can be any expression, not just a single function name.
Review
What Would Python Do? #1

WWPD exercises test our understanding of how Python evaluates code and what it chooses to display in the shell.

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```python
given expression
> 5
5
5
```
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```python
>>> 5
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>>> print(5)
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```python
>>> 5
5
>>>(print(5))
5
>>>(print(print(5)))
5
None
```
What Would Python Do? #2

def delay(arg):
    print('delayed')
    def g():
        return arg
    return g

def g():
    return arg

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def pirate(arggg):
    print('matey')
def plunder(arggg):
    return arggg
return plunder

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A name evaluates to the value bound to that name in the earliest frame of the current environment in which that name is found.
def pirate(arggg):
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    return plunder

The expression                  Evaluates to   Interactive output
---------------------------------------------
pirate('treasure')('scurvy')      'scurvy'
---------------------------------------------
add(pirate(3)(square)(4), 1)
---------------------------------------------
pirate(pirate(pirate)(5)(7))
What Would Python Do? #3

```python
def pirate(arggg):
    print('matey')
    def plunder(arggg):
        return arggg
    return plunder
```

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# What Would Python Do? #3

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def pirate(arggg):
    print('matey')
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What Would Python Do? #3

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def pirate(arggg):
    print('matey')
def plunder(arggg):
    return arggg
return plunder
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What Would Python Do? #3

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def pirate(arggg):
    print('matey')
    def plunder(arggg):
        return arggg
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A name evaluates to the value bound to that name in the earliest frame of the current environment in which that name is found.
What Would Python Do? #3

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|                        |              | 'scurvy' |
| add(pirate(3)(square)(4), 1) | 17 | matey
|                        |              | 17 |
| pirate(pirate(pirate))(5)(7) | Error | matey
|                        |              | Error |

A name evaluates to the value bound to that name in the earliest frame of the current environment in which that name is found.
def horse(mask):
    horse = mask
    def mask(horse):
        return horse
        return horse(mask)

mask = lambda horse: horse(2)
horse(mask)

Global frame

```
       horse
         ___
        |    |
        | mask|
        |
```

f1:

```
       Return value
          |
```

f2:
f3:

Return value
Implementing a function

def remove(n, digit):
    """Return digits of non-negative N that are not DIGIT, for some non-negative DIGIT less than 10.
    >>> remove(231, 3)
    21
    >>> remove(243132, 2)
    4313
    """
    kept = 0
digits = 0
    while ____________________________:
        last = n % 10
        n = n // 10
        if ____________________________:
            kept = ______________________
            digits = ______________________
    return ____________________________
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    return ___________________________
Implementing a function

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    return __________________________
```

- Read the description
- Verify the examples & pick a simple one
- Read the template
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    """Return digits of non-negative N that are not DIGIT, for some non-negative DIGIT less than 10.
    >>> remove(231, 3)
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Implementing a function

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def remove(n, digit):
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    """
kept = 0
digits = 0
while ____________________________:
    last = n % 10
    n = n // 10
    if ____________________________:
        kept = __________________
        digits = _________________
    return _________________________
```

- Read the description
- Verify the examples & pick a simple one
- Read the template
- Implement without the template, then change your implementation to match the template. OR If the template is helpful, use it.
- Annotate names with values from your chosen example
Implementing a function

```python
def remove(n, digit):
    """Return digits of non-negative N that are not DIGIT, for some non-negative DIGIT less than 10.
    >>> remove(231, 3)
    21
    >>> remove(243132, 2)
    4313
    """
    kept = 0
digits = 0
    while ____________________________:
        last = n % 10
        n = n // 10
        if ________________________________:
            kept = ______________________
            digits = ______________________
    return _____________________________
```

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- Verify the examples & pick a simple one
- Read the template
- Implement without the template, then change your implementation to match the template.
  OR If the template is helpful, use it.
- Annotate names with values from your chosen example
- Write code to compute the result
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- Check your solution with the other examples
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    """
    kept = 0
    digits = 0
    while n > 0:
        last = n % 10
        n = n // 10
        if last != digit:
            kept = kept + (last * 10 ** digits)
            digits = digits + 1
    return kept