

1 Functions

Questions

- 1.1 Determine what the Python interpreter will output given the following lines of code.

```
>>> from operator import add, mul
```

```
>>> mul(add(5, 6), 8)
```

88

```
>>> print('x')
```

X

```
>>> y = print('x')
```

X

```
>>> print(y)
```

None

```
>>> print(add(4, 2), print('a'))
```

a
6, None

- 1.2 Determine what the Python interpreter will output given the following lines of code.

```
>>> def foo(x):
```

```
    print(x)
```

```
    return x + 1
```

```
>>> def bar(y, x):
```

```
    print(x - y)
```

```
>>> foo(3)
```

3

```
>>> bar(3)
```

error

```
>>> bar(6, 1)
```

-5

```
>>> bar(foo(10), 11)
```

10

0

2 Control

Questions

- 2.1 Which numbers will be printed after executing the following code?

```
n = 0
if n:
    print(1)
elif n < 2:
    print(2)
else:
    print(3)
print(4)
```

1, 4

- 2.2 WWPDP (What would Python Display) after evaluating each of the following expressions?

```
>>> 0 and 1 / 0
```

error

```
>>> 6 or 1 or "a" or 1 / 0
```

True

```
>>> 6 and 1 and "a" and 1 / 0
```

error

```
>>> print(print(4) and 2)
```

False

```
>>> not True and print("a")
```

False

- 2.3 Define a function, `count_digits`, which takes in an integer, `n`, and counts the number of digits in that number.

```
def count_digits(n):
    '''
```

```
>>> count_digits(4)
```

```
1
```

```
>>> count_digits(12345678)
```

```
8
```

```
>>> count_digits(0)
```

```
0
'''
```

k, last = 0, 0

while n > 0:

last, n = n % 10, n // 10

if last != 0:

k += 1

return k

- 2.4 Define a function, `count_matches`, which takes in two integers `n` and `m`, and counts the number of digits that match.

```
def count_matches(n, m):
    ...

>>> count_matches(10, 30)
1
>>> count_matches(12345, 23456)
0
>>> count_matches(121212, 123123)
2
>>> count_matches(111, 11) # only one's place matches
2
>>> count_matches(101, 10) # no place matches
0
```

Handwritten code:

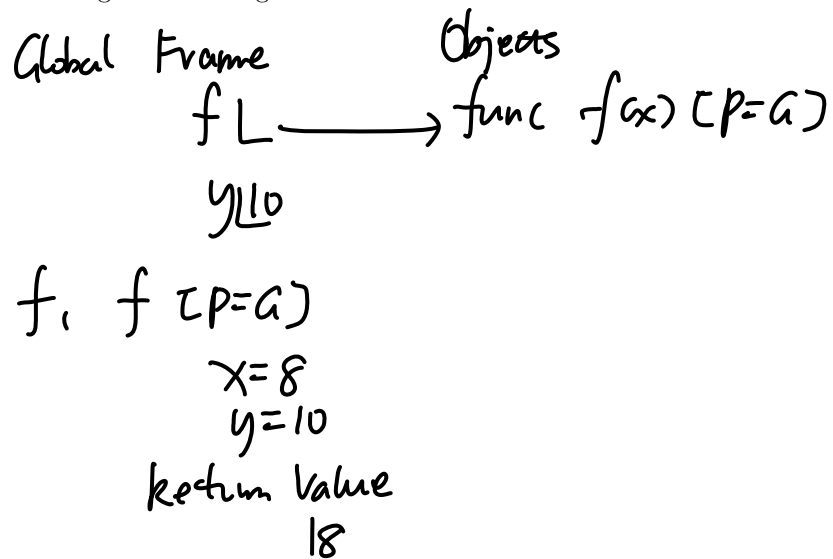
```
last_1, last_2 = 1, 2
k = 0
while n > 0 or m > 0:
    last_1, n = n % 10, n // 10
    last_2, m = m % 10, m // 10
    if last_1 == last_2:
        k += 1
return k
```

3 Environment Diagrams

Questions

3.1 Draw the environment diagram for evaluating the following code

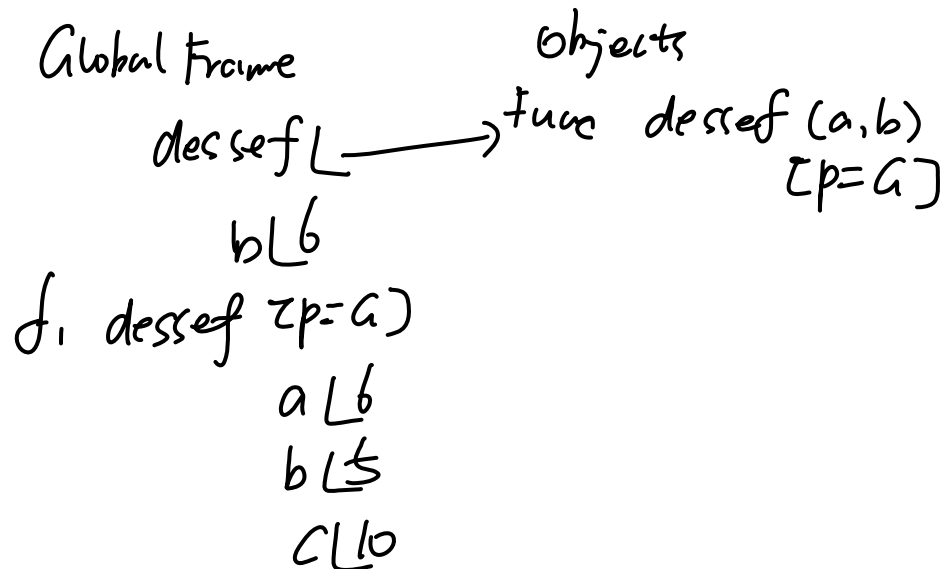
```
def f(x):
    return y + x
y = 10
f(8)
```



3.2 Draw the environment diagram for evaluating the following code

```
def dessef(a, b):
    c = a + b
    b = b + 1

b = 6
dessef(b, 4)
```

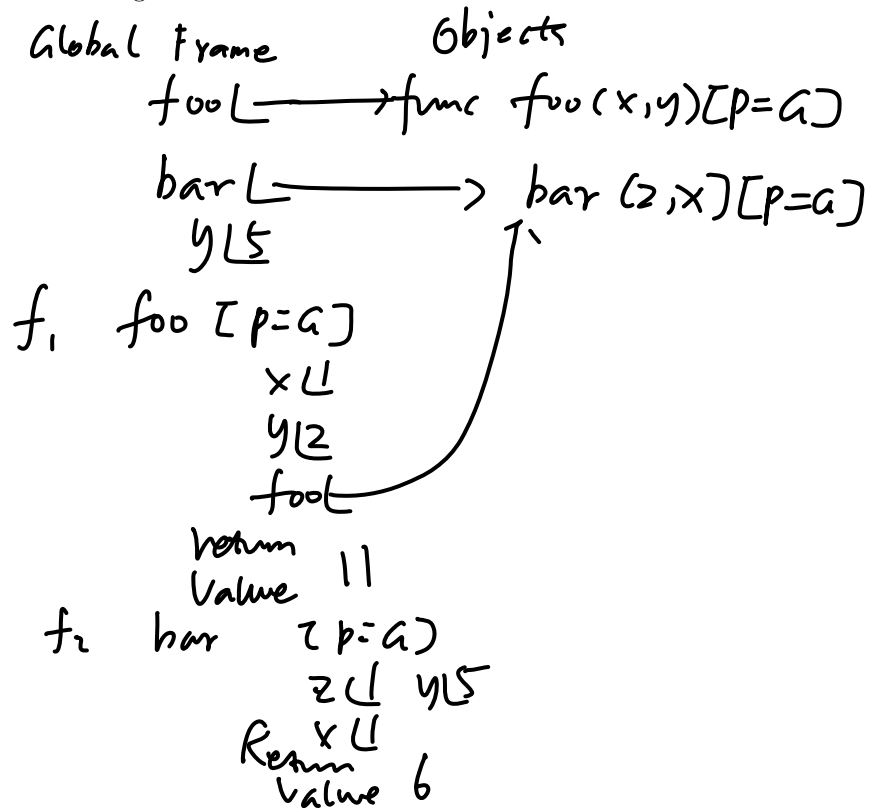
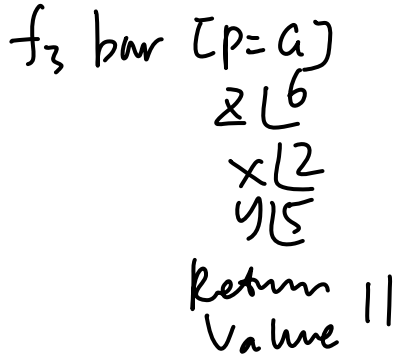


3.3 Draw the environment diagram for evaluating the following code

```
def foo(x, y):
    foo = bar
    return foo(bar(x, x), y)
```

```
def bar(z, x):
    return z + y
```

```
y = 5
foo(1, 2)
```

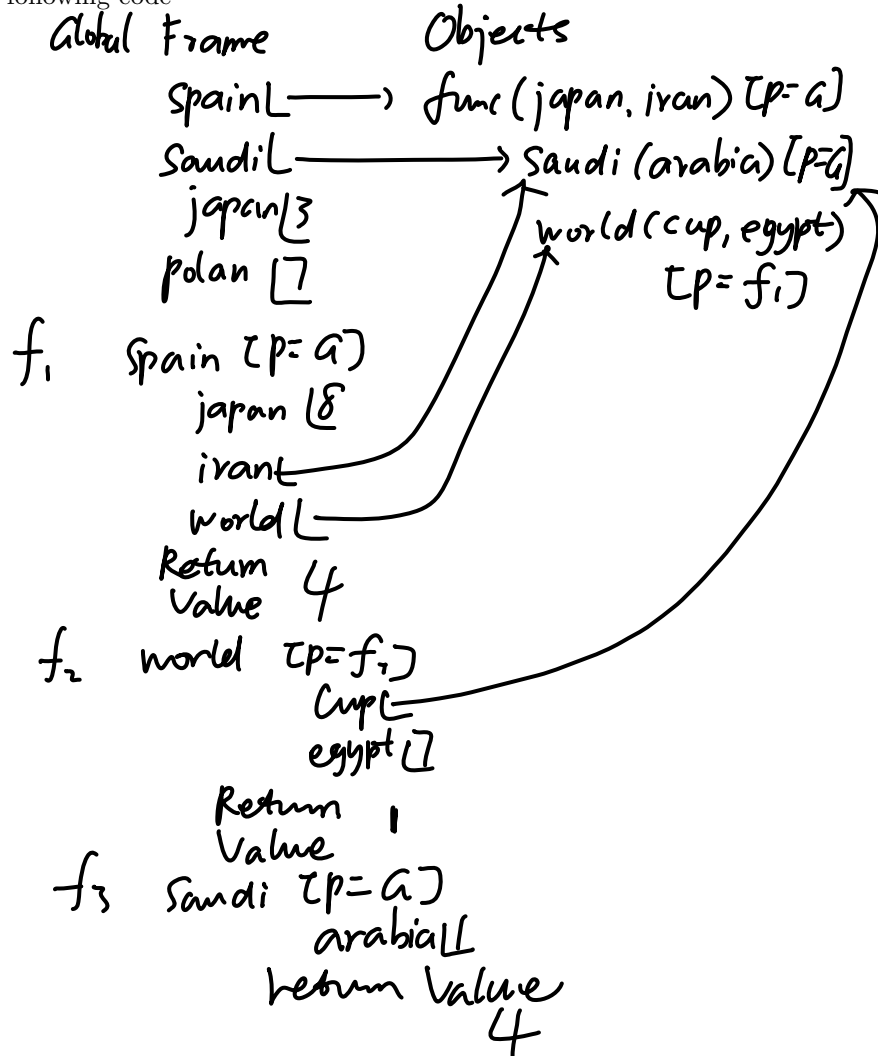


3.4 Draw the environment diagram for evaluating the following code

```
def spain(japan, iran):
    def world(cup, egypt):
        return japan-poland
    return iran(world(iran, poland))
```

```
def saudi(arabia):
    return japan + 3
```

```
japan, poland = 3, 7
spain(poland+1, saudi)
```



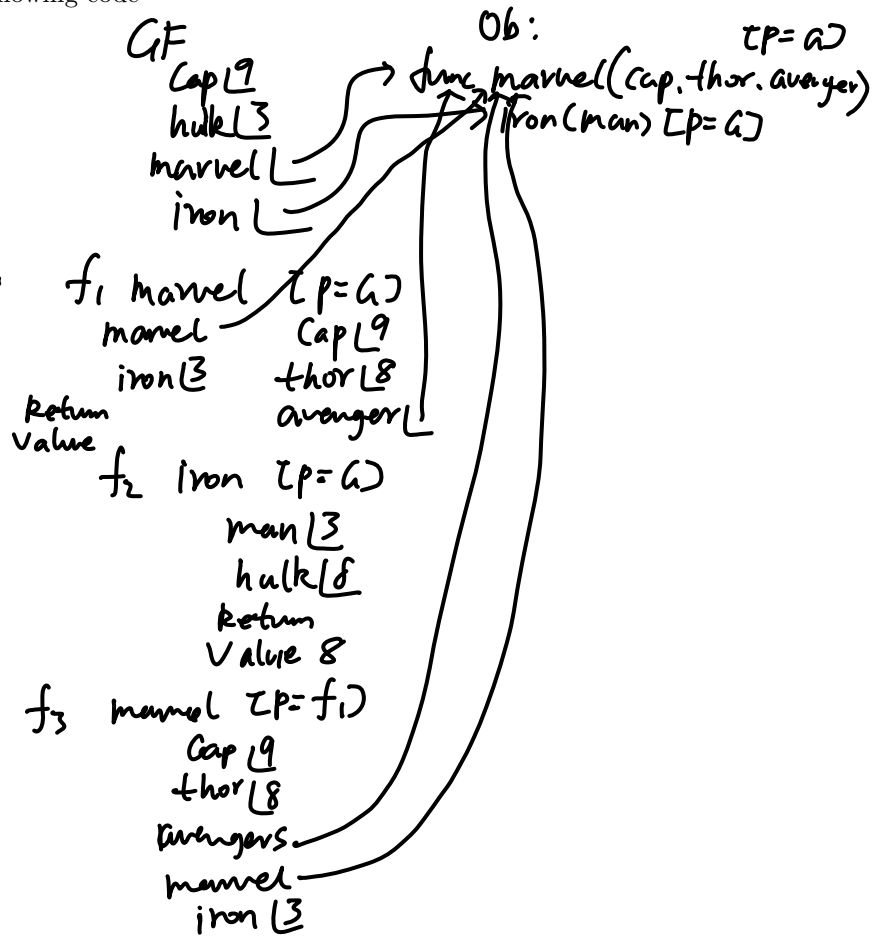
3.5 Draw the environment diagram for evaluating the following code

```
cap = 9
hulk = 3
```

```
def marvel(cap, thor, avengers):
    marvel = avengers
    iron = hulk + cap
    if thor > cap:
        def marvel(cap, thor, avengers):
            return iron
        ? P=?
    else:
        iron = hulk
    return marvel(thor, cap, marvel)
```

```
def iron(man):
    hulk = cap - 1
    return hulk
```

```
marvel(cap, iron(3), marvel)
```



4 Higher Order Functions

Questions

4.1 What do lambda expressions do? Can we write all functions as lambda expressions?

In what cases are lambda expressions useful?

① def a function quickly ② No ③ as arguments

4.2 Determine if each of the following will error:

>>> 1/0 ✓

>>> boom = lambda: 1/0 ✗

>>> boom() ✓

4.3 Express the following lambda expression using a **def** statement, and the **def** statement using a lambda expression.

pow = lambda x, y: x**y

```
def g(x):
    def h(y):
        return x+y
    return h
pow = g
```

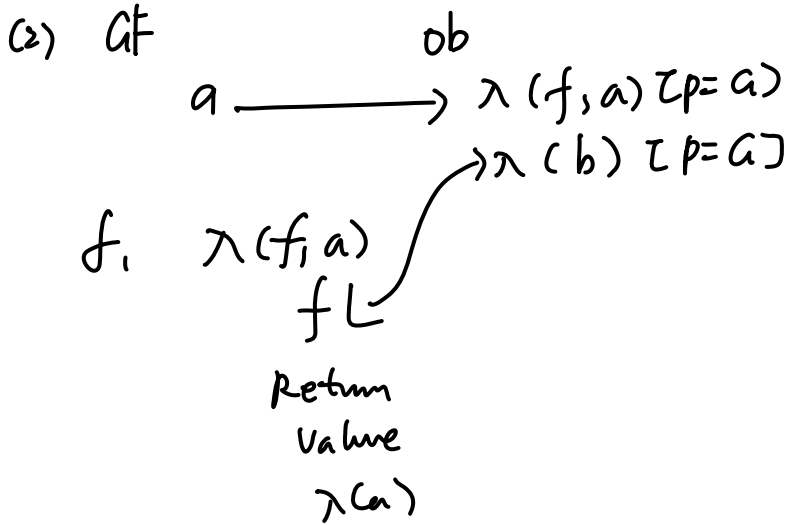
```
def foo(x):
    def f(y):
        def g(z):
            return x + y * z
        return g
    return f
```

(lambda x: (lambda y: (lambda z: x+y*z

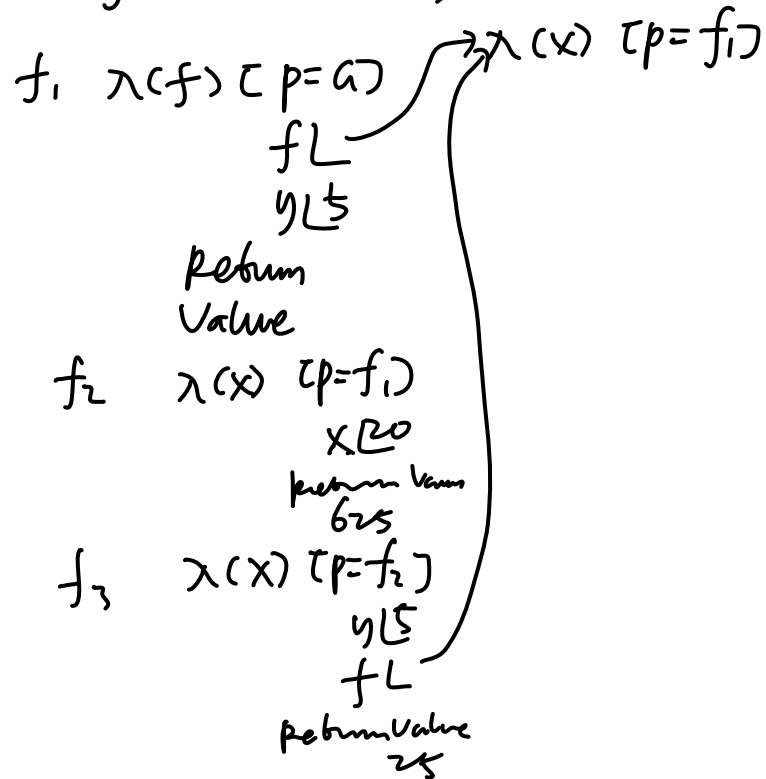
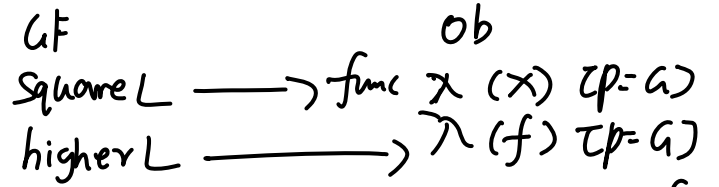
4.4 Draw Environment Diagrams for the following lines of code

square = **lambda** x: x * xhigher = **lambda** f: **lambda** y: f(f(y))

higher(square)(5)

a = (**lambda** f, a: f(a))(**lambda** b: b * b, 2)

(1)



- 4.5 Write **make_skipper**, which takes in a number *n* and outputs a function. When this function takes in a number *x*, it prints out all the numbers between 0 and *x*, skipping every *n*th number (meaning skip any value that is a multiple of *n*).

```
def make_skipper(n):
    """
    >>> a = make_skipper(2)
    >>> a(5)
    1
    3
    5
    """
    def skip(k):
        m = 1
        while m < k:
            m = n + m
        return m
    return skip
```

- 4.6 Write a function that takes in a function *cond* and a number *n* and prints numbers from 1 to *n* where calling *cond* on that number returns True.

```
def keep_ints(cond, n):
    """Print out all integers 1..i..n where cond(i) is true

    >>> def is_even(x):
    ...     # Even numbers have remainder 0 when divided by 2.
    ...     return x % 2 == 0
    >>> keep_ints(is_even, 5)
    2
    4
    """
    k = 1
    while k < n:
        if cond(k):
            return k
        k += 1
```

- 4.7 Write a function similar to `keep_ints` like before, but now it takes in a number `n` and returns a function that has one parameter `cond`. The returned function prints out numbers from 1 to `n` where calling `cond` on that number returns `True`.

```
def make_keeper(n):
```

```
    """Returns a function which takes one parameter cond and prints out
    all integers 1..i..n where calling cond(i) returns True.
```

```
>>> def is_even(x):
```

```
...     # Even numbers have remainder 0 when divided by 2.
```

```
...     return x % 2 == 0
```

```
>>> make_keeper(5)(is_even)
```

```
2
```

```
4
```

```
"""
```

```
def h (cond):
```

```
     $\forall i \in 1..n$ 
```

```
    return h
```