

## How to Draw an Environment Diagram

Functions

When a function is defined:

Create a function value: `func <name>(<formal parameters>) [parent=<label>]`

Its parent is the current frame.

`f1: make_adder`      `func adder(k) [parent=f1]`

Bind <name> to the function value in the current frame

When a function is called:

1. Add a local frame, titled with the <name> of the function being called.
- ★ 2. Copy the parent of the function to the local frame: `[parent=<label>]`
3. Bind the <formal parameters> to the arguments in the local frame.
4. Execute the body of the function in the environment that starts with the local frame.

## ENVIRONMENTS

CS 61A

## 1 Environment Diagrams

1. When do we make a new frame in an environment diagram?

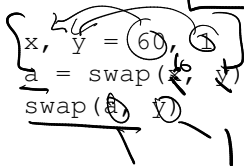
Everytime a function is called ✓

2. Draw the environment diagram that results from running the following code.

→ `def swap(x, y):`

`x, y = y, x`  
`return print("Swapped!", x, y)`

Global frame



Swap L → Func swap(x, y)  
[parent: Global]

- x 60

- y 1

a None

x F1: swap [parent: Global]

- x 60

- y 60

r\ / None

F2: swap [parent: Global]

x None

y None

r\ / None

Output

Swapped! 1 60

Swapped! 1 None

①

3. Draw the environment diagram that results from running the following code.

```
def funny(joke):  
    hoax = joke + 1  
    return funny(hoax)  
  
def sad(joke):  
    hoax = joke - 1  
    return hoax + hoax  
  
funny, sad = sad, funny  
result = funny(sad(2))
```

4. Draw the environment diagram that results from running the following code.

```
a = 1  
c = 2  
def b(b):  
    def d():  
        return b + c  
    return d()  
c = b(a)  
a = b(c)
```

**2 Control**

1. Write a function that returns true if a number is divisible by 4 and false otherwise.
- if else

hint:  $n$  is divisible by 4

```
def divisible_by_4(x):  
    if x % 4 == 0:  
        return True  
    else:  
        return False
```

```
def div(x):  
    return x % 4 == 0
```

✓      ✓  
    ↔

2. Write a function, `is_leap_year`, that returns true if a number is a leap year and false otherwise. Recall that a *leap year* is divisible by 4 unless the year is not divisible by 400.

3. Implement `fizzbuzz(n)`, which prints numbers from 1 to `n` (inclusive). However, for numbers divisible by 3, print "fizz". For numbers divisible by 5, print "buzz". For numbers divisible by both 3 and 5, print "fizzbuzz".

```
def fizzbuzz(n):  
    """  
    >>> result = fizzbuzz(16)  
    1  
    2  
    fizz  
    4  
    buzz  
    fizz  
    7  
    8  
    fizz  
    buzz  
    11  
    fizz  
    13  
    14  
    fizzbuzz  
    16  
    >>> result is None  
    True  
    """
```

### 3 Challenge Questions

---

1. Fill out the function `digit_div` which returns an integer that contains in any order all the digits of `k` that divide `n` evenly. If no such digit of `k` exists, the function should return 0. Assume that both `n` and `k` are positive integers.

```
def digit_div (n, k):  
    >>> digit_div(4, 1234567890)  
    421  
    >>> digit_div(4, 2323)  
    22  
    >>> digit_div(7, 2323)  
    0  
    ""  
  
    while _____:  
        curr_digit = k % 10  
        if _____:  
            _____  
            _____  
    return _____
```

### 3 Challenge Questions

---

1. Fill out the function `digit_div` which returns an integer that contains in any order all the digits of `k` that divide `n` evenly. If no such digit of `k` exists, the function should return 0. Assume that both `n` and `k` are positive integers.

```
def digit_div (n, k):  
    >>> digit_div(4, 1234567890)  
    421  
    >>> digit_div(4, 2323)  
    22  
    >>> digit_div(7, 2323)  
    0  
    ""  
  
    while _____:  
        curr_digit = k % 10  
        if _____:  
            _____  
            _____  
    return _____
```