

Lecture 11

# **Asserts and Error Handling**

# Announcements for Today

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## Reading

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- Reread Chapter 3
- 10.0-10.2, 10.4-10.6 for Tue

- **Prelim, Oct 11<sup>th</sup> 7:30-9:00**
  - Material up October 2nd
  - Study guide next week
- **Conflict with Prelim time?**
  - Submit to Prelim 1 Conflict assignment on CMS
  - Do not submit if no conflict

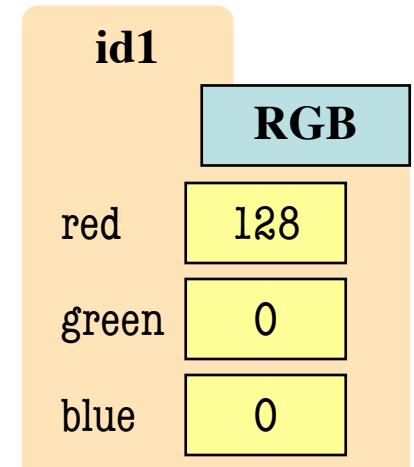
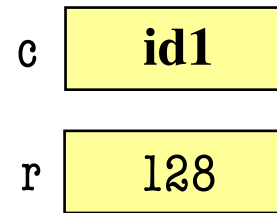
## Assignments

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- Assignment 1 should be done
  - If not, you got an e-mail
- Assignment 2 in progress
  - Solutions posted in CMS
  - Look for Gradescope e-mail
- Assignment 3 due next week
  - Before you leave for break
  - Same “length” as A1
  - Get help now if you need it

# Using Color Objects in A3

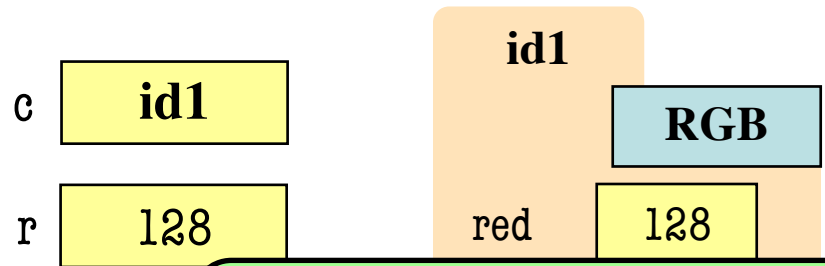
- New classes in introsocs
  - RGB, CMYK, and HSV
- Each has its own attributes
  - **RGB**: red, blue, green
  - **CMYK**: cyan, magenta, yellow, black
  - **HSV**: hue, saturation, value
- Attributes have *invariants*
  - Limits the attribute values
  - Example: red is int in 0..255
  - Get an error if you violate



```
>>> import introsocs
>>> c = introsocs.RGB(128,0,0)
>>> r = c.red
>>> c.red = 500 # out of range
AssertionError: 500 outside [0,255]
```

# Using Color Objects in A3

- New classes in introsocs
  - RGB, CMYK, and HSV
- Each has its own attributes
  - **RGB**: red, blue, green
  - **CMYK**: cyan, magenta, yellow, black
  - **HSV**: hue, saturation, value
- Attributes have *invariants*
  - Limits the attribute values
  - Example: red is int in 0..255
  - Get an error if you violate



Constructor function.  
To make a **new** color.

```
>>> import introsocs
>>> c = introsocs.RGB(128,0,0)
>>> r = c.red
>>> c.red = 500 #
AssertionError: 500
```

Accessing  
Attribute

# How to Do the Conversion Functions

---

```
def rgb_to_cmyk(rgb):
```

```
    """Returns: color rgb in space CMYK
```

```
    Precondition: rgb is an RGB object"""
```

```
    # DO NOT CONSTRUCT AN RGB OBJECT
```

```
    # Variable rgb already has RGB object
```

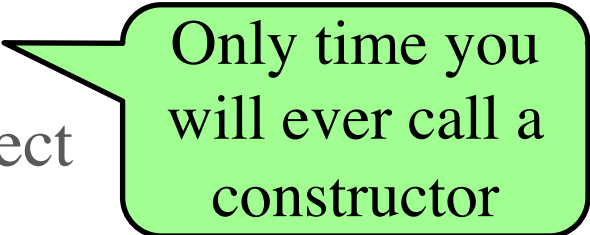
```
    # 1. Access attributes from rgb folder
```

```
    # 2. Plug into formula provided
```

```
    # 3. Compute the new cyan, magenta, etc. values
```

```
    # 4. Construct a new CMYK object
```

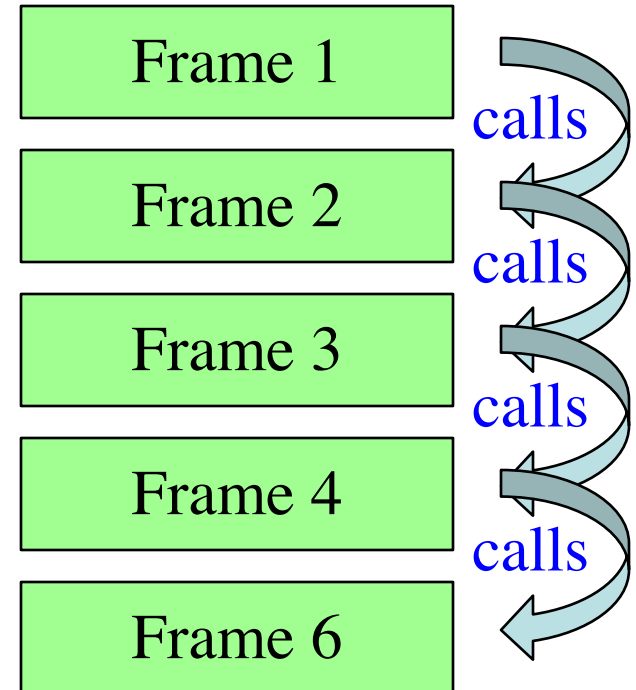
```
    # 5. Return the newly constructed object
```



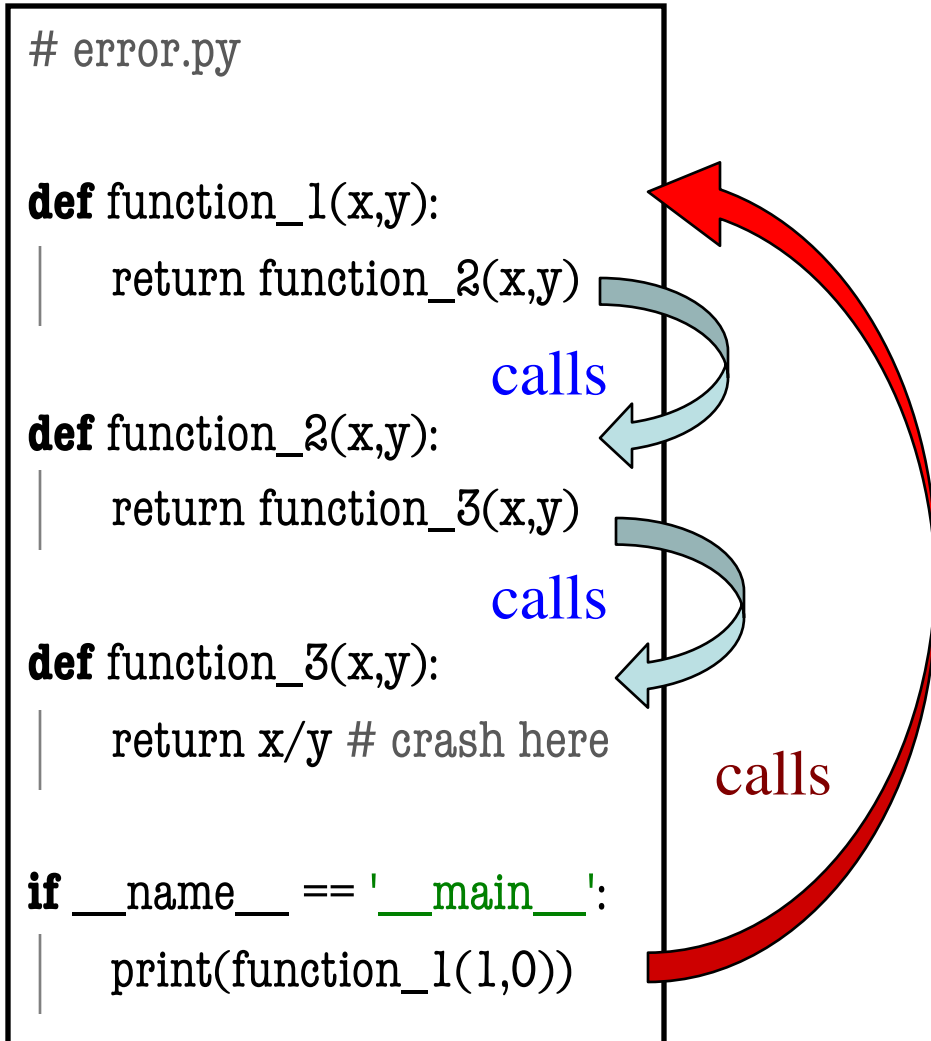
Only time you  
will ever call a  
constructor

# Recall: The Call Stack

- Functions are “stacked”
  - Cannot remove one above w/o removing one below
  - Sometimes draw bottom up (better fits the metaphor)
- Stack represents memory as a “high water mark”
  - Must have enough to keep the **entire stack** in memory
  - Error if cannot hold stack



# Errors and the Call Stack



# Errors and the Call Stack

```
# error.py

def function_1(x,y):
    return function_2(x,y)

def function_2(x,y):
    return function_3(x,y)

def function_3(x,y):
    return x/y # crash here

if __name__ == '__main__':
    print(function_1(1,0))
```

Crashes produce the call stack:

Traceback (most recent call last):

```
File "error.py", line 20, in <module>
    print(function_1(1,0))
File "error.py", line 8, in function_1
    return function_2(x,y)
File "error.py", line 12, in function_2
    return function_3(x,y)
File "error.py", line 16, in function_3
    return x/y
```

Make sure you can see line numbers in Atom.



# Errors and the Call Stack

```
#  
d  
|  
| return function_2(x,y)  
|  
|  
|  
| def function_2(x,y):  
| | return function_3(x,y)  
|  
|  
| def function_3(x,y):  
| | return x/y # crash here
```

Script code.  
Global space

Where error occurred  
(or where was found)

Crashes produce the call stack:

Traceback (most recent call last):

File "error.py", line 20, in <module>  
print(function\_1(1,0))

File "error.py", line 8, in function\_1  
return function\_2(x,y)

File "error.py", line 12, in function\_2  
return function\_3(x,y)

File "error.py", line 16, in function\_3  
return x/y

Make sure you can see  
line numbers in Atom.

# Assert Statements

`assert <boolean>` # Creates error if <boolean> false  
`assert <boolean>, <string>` # As above, but displays <String>

- Way to force an error
  - Why would you do this?
- Enforce preconditions!
  - Put precondition as assert.
  - If violate precondition, the program crashes
- Provided code in A3 uses asserts heavily

```
def exchange(from_c, to_c, amt)
    """Returns: amt from exchange
       Precondition: amt a float..."""
    assert type(amt) == float
    ...
```

Will do yourself in A4.

# Example: Anglicizing an Integer

---

```
def anglicize(n):
```

```
    """Returns: the anglicization of int n.
```

```
    Precondition: n an int, 0 < n < 1,000,000"""
```

```
    assert type(n) == int, repr(n)+' is not an int'
```

```
    assert 0 < n and n < 1000000, repr(n)+' is out of range'
```

```
    # Implement method here...
```

# Example: Anglicizing an Integer

---

```
def anglicize(n):
```

```
    """Returns: the anglicization of int n.
```

```
    Precondition: n an int, 0 < n < 1,000,000"""
```

```
    assert type(n) == int, repr(n)+' is not an int'
```

```
    assert 0 < n and n < 1000000, repr(n)+' is out of range'
```

```
    # Implement method here...
```

Check (part of)  
the precondition

Error message  
when violated

## Aside: Using repr Instead of str

---

```
>>> msg = str(var)+' is invalid'
```

```
>>> print(msg)
```

```
2 is invalid
```

- Looking at this output, what is the type of var?

**A: int**

**B: float**

**C: str**

**D: Impossible to tell**

## Aside: Using repr Instead of str

---

```
>>> msg = str(var)+' is invalid'
```

```
>>> print(msg)
```

```
2 is invalid
```

- Looking at this output, what is the type of var?

A: **int**

B: **float**

C: **str**

D: Impossible to tell

**CORRECT**

## Aside: Using repr Instead of str

---

```
>>> msg = str(var)+' is invalid'
```

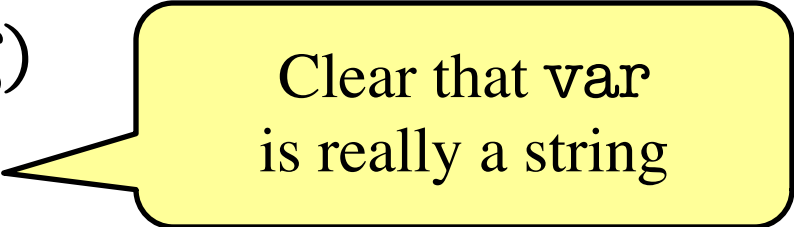
```
>>> print(msg)
```

```
2 is invalid
```

```
>>> msg = repr(var)+' is invalid'
```

```
>>> print(msg)
```

```
'2' is invalid
```



Clear that var  
is really a string

# Enforcing Preconditions is Tricky!

---

```
def lookup_netid(nid):
```

```
    """Returns: name of student with netid nid.
```

```
    Precondition: nid is a string, which consists of  
    2 or 3 letters and a number"""
```

```
    assert ?????
```

Assert use expressions only.  
Cannot use if-statements.  
Each one must fit on one line.

Sometimes we will  
only enforce part of  
the precondition



# Enforcing Preconditions is Tricky!

---

```
def lookup_netid(nid):
```

```
    """Returns: name of student with netid nid.
```

```
    Precondition: nid is a string, which consists of  
    2 or 3 letters and a number"""
```

```
    assert type(nid) == str, repr(nid) + ' is not a string'
```

```
    assert nid.isalnum(), nid+' is not just letters/digits'
```

Returns True if s contains  
only letters, numbers.

Does this catch  
all violations?

# Using Function to Enforce Preconditions

---

```
def exchange(curr_from, curr_to, amt_from):
```

```
    """Returns: amount of curr_to received.
```

```
    Precondition: curr_from is a valid currency code
```

```
    Precondition: curr_to is a valid currency code
```

```
    Precondition: amt_from is a float"""
```

```
    assert ??????, repr(curr_from) + ' not valid'
```

```
    assert ??????, repr(curr_to) + ' not valid'
```

```
    assert type(amt_from)==float, repr(amt_from)+' not a float'
```

# Using Function to Enforce Preconditions

---

```
def exchange(curr_from, curr_to, amt_from):
```

```
    """Returns: amount of curr_to received.
```

```
    Precondition: curr_from is a valid currency code
```

```
    Precondition: curr_to is a valid currency code
```

```
    Precondition: amt_from is a float"""
```

```
    assert iscurrency(curr_from), repr(curr_from) + ' not valid'
```

```
    assert iscurrency(curr_to), repr(curr_to) + ' not valid'
```

```
    assert type(amt_from)==float, repr(amt_from)+' not a float'
```

# Recovering from Errors

---

- try-except blocks allow us to recover from errors
  - Do the code that is in the try-block
  - Once an error occurs, jump to the catch
- **Example:**

try:

```
input = input()      # get number from user      might have an error
x = float(input)     # convert string to float
print('The next number is '+str(x+1))
```

except:

```
print('Hey! That is not a number!')
```

← executes if error happens

# Recovering from Errors

- try-except blocks allow us
  - Do the code that is in the try
  - Once an error occurs, jump

- **Example:**

try:

```
input = input()      # get number from user
x = float(input)     # convert string to float
print('The next number is '+str(x+1))
```

might have an error

except:

```
print('Hey! That is not a number!')
```

executes if error happens

Similar to if-else

- But always does try
- Just might not do **all** of the try block

# Try-Except is Very Versatile

---

```
def isfloat(s):
```

```
    """Returns: True if string  
    s represents a float"""
```

```
try:
```

```
    x = float(s)
```

```
    return True
```

```
except:
```

```
    return False
```

Conversion to a float might fail

If attempt succeeds, string s is a float

Otherwise, it is not

# Try-Except and the Call Stack

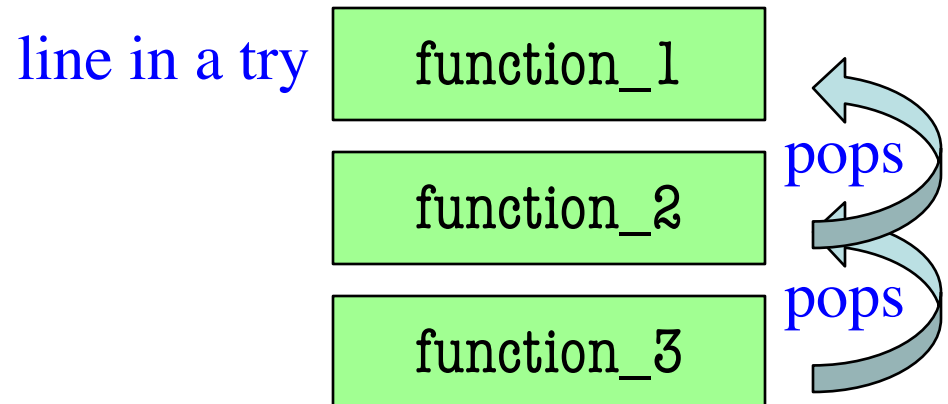
```
# recover.py

def function_1(x,y):
    try:
        return function_2(x,y)
    except:
        return float('inf')

def function_2(x,y):
    return function_3(x,y)

def function_3(x,y):
    return x/y # crash here
```

- Error “pops” frames off stack
  - Starts from the stack bottom
  - Continues until it sees that current line is in a try-block
  - Jumps to except, and then proceeds as if no error



# Try-Except and the Call Stack

```
# recover.py
```

```
def function_1(x,y):
```

```
    try:
```

```
        return function_2(x,y)
```

```
    except:
```

```
        return float('inf')
```

```
def function_2(x,y):
```

```
    return function_3(x,y)
```

```
def function_3(x,y):
```

```
    return x/y # crash here
```

How to return  
 $\infty$  as a float.

- Error “pops” frames off stack

from the stack bottom  
frames until it sees that  
current line is in a try-block

- Jumps to except, and then proceeds as if no error

- **Example:**

```
>>> print function_1(1,0)
```

```
inf
```

```
>>>
```

No traceback!



# Tracing Control Flow

```
def first(x):  
    print('Starting first.')  
    try:  
        second(x)  
    except:  
        print('Caught at first')  
    print('Ending first')
```

```
def second(x):  
    print('Starting second.')  
    try:  
        third(x)  
    except:  
        print('Caught at second')  
    print('Ending second')
```

```
def third(x):  
    print('Starting third.')  
    assert x < 1  
    print('Ending third.')
```

What is the output of first(2)?

# Tracing Control Flow

```
def first(x):  
    print('Starting first.')  
    try:  
        second(x)  
    except:  
        print('Caught at first')  
    print('Ending first')
```

```
def second(x):  
    print('Starting second.')  
    try:  
        third(x)  
    except:  
        print('Caught at second')  
    print('Ending second')
```

```
def third(x):  
    print('Starting third.')  
    assert x < 1  
    print('Ending third.')
```

What is the output of first(2)?

```
'Starting first.'  
'Starting second.'  
'Starting third.'  
'Caught at second'  
'Ending second'  
'Ending first'
```

# Tracing Control Flow

```
def first(x):  
    print('Starting first.')  
    try:  
        second(x)  
    except:  
        print('Caught at first')  
    print('Ending first')
```

```
def second(x):  
    print('Starting second.')  
    try:  
        third(x)  
    except:  
        print('Caught at second')  
    print('Ending second')
```

```
def third(x):  
    print('Starting third.')  
    assert x < 1  
    print('Ending third.')
```

What is the output of first(0)?

# Tracing Control Flow

```
def first(x):  
    print('Starting first.')  
    try:  
        second(x)  
    except:  
        print('Caught at first')  
    print('Ending first')
```

```
def second(x):  
    print('Starting second.')  
    try:  
        third(x)  
    except:  
        print('Caught at second')  
    print('Ending second')
```

```
def third(x):  
    print('Starting third.')  
    assert x < 1  
    print('Ending third.')
```

What is the output of first(0)?

```
'Starting first.'  
'Starting second.'  
'Starting third.'  
'Ending third'  
'Ending second'  
'Ending first'
```