Lecture 11

Asserts and Error Handling

Announcements for Today

Reading

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

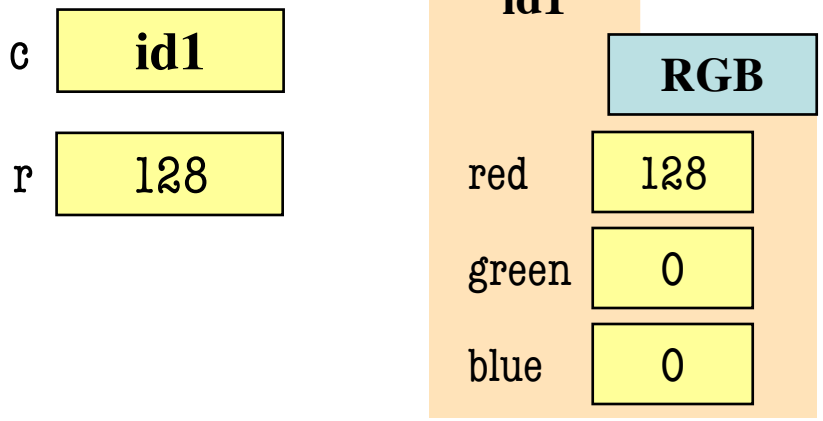
- **Prelim, Oct 13th 7:30-9:00**
  - Material up October 4th
  - Study guide next week
- **Conflict with Prelim time?**
  - Submit to Prelim 1 Conflict assignment on CMS
  - Do not submit if no conflict

Assignments

- Assignment 1 now complete
  - Unless we gave extension
- Assignment 2 in progress
  - Ready for pick-up **Thurs**
  - Solutions posted in CMS
- 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 colormodel
  - 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 colormodel
>>> c = colormodel.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 colormodel
  - RGB, CMYK, and HSV
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  - **RGB**: red, blue, green
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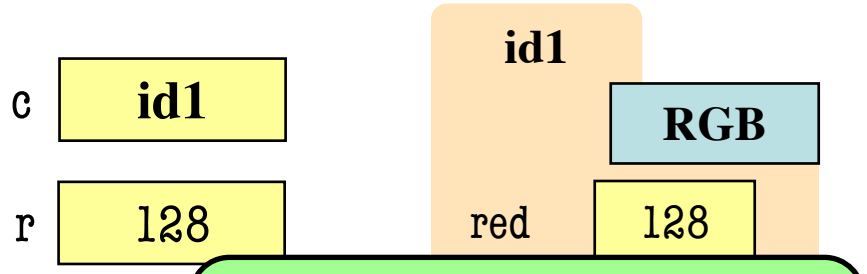


Constructor function. To make a **new** color.

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

Accessing Attribute

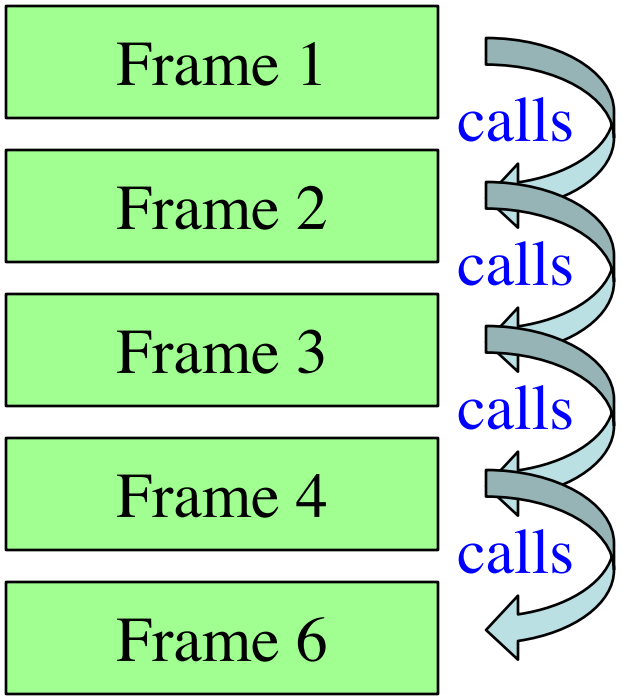
How to Do the Conversion Functions

```
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

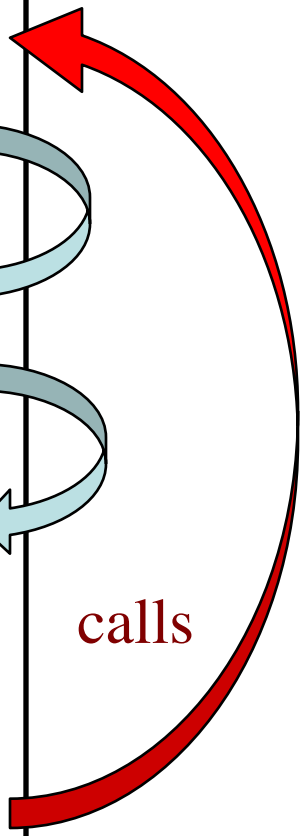
```
# error.py

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)
```



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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 Komodo. Preferences ➔ Editor

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

if
```

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
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  File "error.py", line 16, in function_3
    return x/y
```

Make sure you can see line numbers in Komodo.
Preferences ➔ Editor

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 is 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, str(n)+' is not an int'
    assert 0 < n and n < 1000000, str(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, str(n)+' is not an int'
    assert 0 < n and n < 1000000, str(n)+' is out of range'
    # Implement method here...
```

Check (part of) the precondition

Error message when violated

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, str(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 ??????, str(curr_from) + ' not valid'
    assert ??????, str(curr_from) + ' not valid'
    assert type(amt_from)==float, str(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), str(curr_from) + ' not valid'
    assert iscurrency(curr_to), str(curr_to) + ' not valid'
    assert type(amt_from)==float, str(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 = raw_input() # get number from user
    x = float(input)        # convert string to float
    print 'The next number is '+str(x+1)
except:
    print 'Hey! That is not a number!'
```

might have an error

executes if error happens

Recovering from Errors

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

Similar to if-else
- But always does try
- Just might not do **all** of the try block

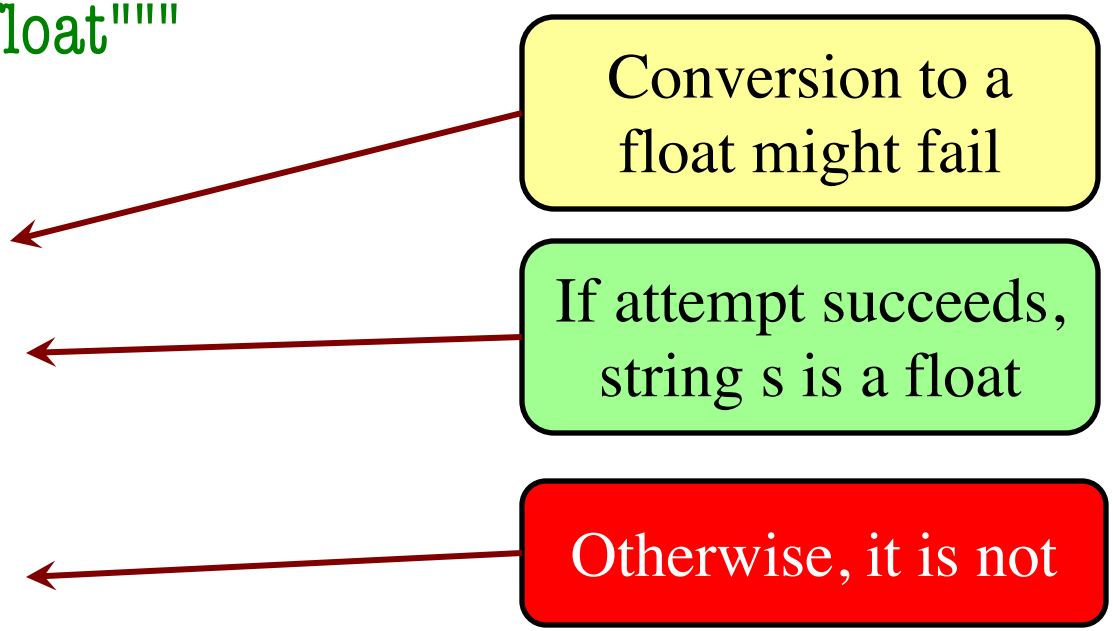
```
try:
    input = raw_input() # get number from user
    x = float(input)        # convert string to float
    print 'The next number is '+str(x+1)
except:
    print 'Hey! That is not a number!'
```

might have an error

executes if error happens

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
```



Try-Except and the Call Stack

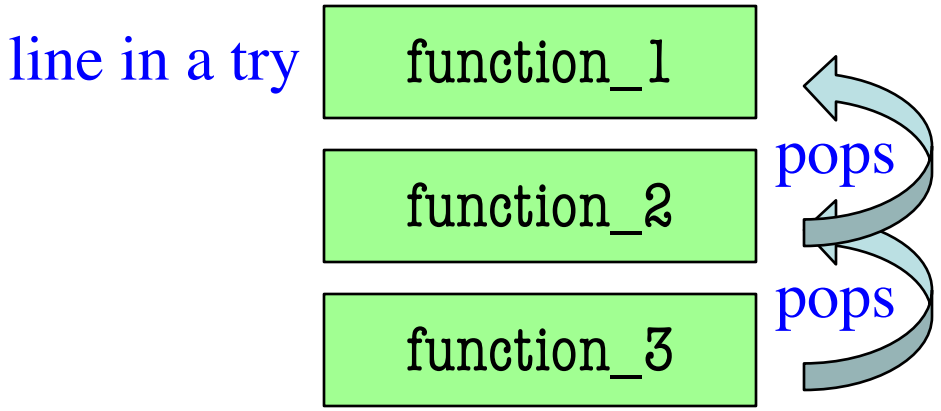
```
# recover.py

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



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

How to return ∞ as a float.

- Error "pops" frames off stack
  - om the stack bottom
  - es 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'
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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)
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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'