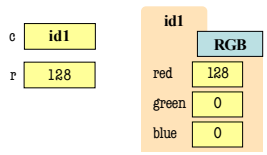
Using Color Objects in A3

- New classes in introcs
  - 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 introcs
>>> c = introcs.RGB(128,0,0)
>>> r = c.red
>>> c.red = 500 # out of range
AssertionError: 500 outside [0,255]
```

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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 Pulsar.

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Determining Responsibility

```
def function_1(x,y):
    """Returns: result of function_2
    Precondition: x, y numbers"""
    return function_2(x,y)

def function_2(x,y):
    """Returns: x divided by y
    Precondition: x, y numbers"""
    return x/y

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

```
Traceback (most recent call last):
  File "error1.py", line 32, in <module>
    print(function_1(1,0))
  File "error1.py", line 18, in function_1
    return function_2(x,y)
  File "error1.py", line 28, in function_2
    return x/y
ZeroDivision
```

Where is the error?

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Assert Statements

- **Form 1:** assert <boolean>
  - Does nothing if boolean is True
  - Creates an error is boolean is False
- **Form 2:** assert <boolean>, <string>
  - Very much like form 2
  - But error message includes the string
- Statement to **verify a fact is true**
  - Similar to assert_equals used in unit tests
  - But more versatile with complete **stack trace**

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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

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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(), repr(nid)+' is not letters/digits'
```

Returns True if s contains only letters, numbers.

Does this catch all violations?

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

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Using Try-Except

```
try:
    result = input('Number: ')      # g
    x = float(result)               # convert to float
    print('The next number is '+str(x+1))
except:
    print('That is not a number!')
```

Conversion may crash!

Execute if crashes

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

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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

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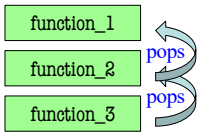
Try-Except and the Call Stack

```
# 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

line in a try



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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)?

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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)?

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