Function Access to Global Space

- All function definitions are in some module
- Call can access global space for **that module**
  - math.cos: global for math
  - temperature.to_centigrade uses global for temperature
- But **cannot** change values
  - Assignment to a global makes a new local variable!
  - Why we limit to constants

Global Space (for globals.py): a 4

show_a: 1

```
# globals.py
"""Show how globals work"""
a = 4 # global space

def show_a():
    print a # shows global
```

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 Komodo. Preferences → Editor

Errors and the Call Stack

Script code. Global space.

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
```

Where error occurred (or where was found)

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

Do not need to do in A3. But will do 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...
```

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 type(s) == str, str(s) + ' is not a string'
    assert s.isalphanum(), s + ' is not just letters and digits'
```

Returns True if s contains only letters, numbers.

Does this catch all violations?

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

Try-Except and the Call Stack

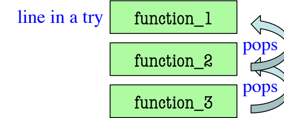
```
# recover.py

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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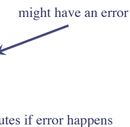


- Error "pops" frames off stack
  - Starts from the stack bottom
  - Continues until it sees that current line is in a try-block
  - Jumps to except, and then proceeds as if no error
- **Example**:

```
>>> 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

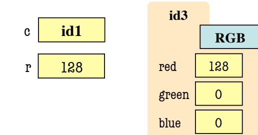
```
def first(x):
    print 'Starting first.'
    try:
        second(x)
    except:
        print 'Caught at first'
    print 'Ending first'

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(0)?

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]
```

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