§10.0-10.7, Py tut §9.0-9.2: Namespaces and Scope

14 Nov 2007
CMPT14x
Dr. Sean Ho
Trinity Western University

Namespaces

- A namespace is a mapping from names (identifiers) to objects
  - math.pi is a mapping from the name 'pi' to the float object 3.1415926535...
  - math.pi is in the namespace provided by the math standard library module
- At a given point in the execution of a program, any number of namespaces may be current:
  - Defines what names are valid at that point

Creating namespaces

- The default namespace is present as long as the Python interpreter/compiler is active
  - Contains built-in names like abs(), float(), ZeroDivisionError, etc.
- Each module has a global namespace visible everywhere in that module
  - Variables defined in the outermost level of your Python file
- Each function invocation and class definition also defines a new local namespace
  - Can be nested

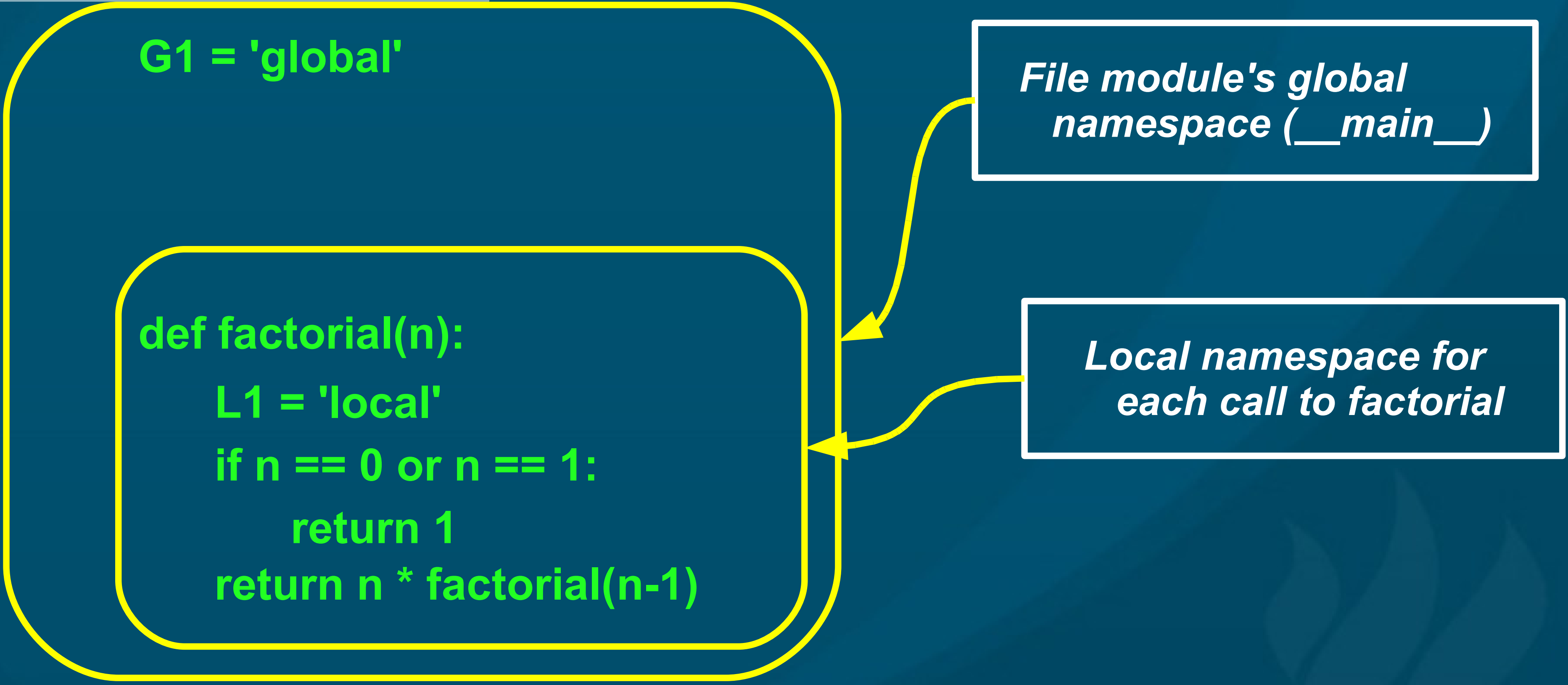
Namespaces avoid name collision

- The point of namespaces is to avoid name collision:
- Names defined in one namespace do not conflict with names defined in another namespace

```
import math
print math.pi          # namespace of math module
pi = 3                 # namespace of current file: __main__
```

- Two libraries, or two classes, can define functions with the same name without conflict
  - complex.add() and Fraction.add()

Example of namespaces



```
G1 = 'global'

def factorial(n):
    L1 = 'local'
    if n == 0 or n == 1:
        return 1
    return n * factorial(n-1)
```

File module's global namespace (__main__)
Local namespace for each call to factorial

Scope

- "A scope is a textual region of a Python program where a namespace is directly accessible."
  - Can access without using module name
    - e.g., pi rather than math.pi
- Scope deals with the order in which namespaces are searched to resolve a name
  - First search local scope
  - Then search enclosing functions/classes
  - Then search global scope for that file/module
  - Then search built-in names

New names add to local scope

- New names are created by:
  - Assignment: x = 5
  - Function definitions: def factorial(n):
  - Class definitions: class Fraction:
  - Imports: from math import *
- New names always add to the local scope

```
def distance(x1, y1, x2, y2):
    from math import sqrt
    return sqrt((x2-x1)**2 + (y2-y1)**2)
sqrt                        # not defined here!
```

The *global* directive

- Names outside the local scope are read-only
  - Attempts to modify them result in creating a new local copy

```
G1 = 'global'
def fun():
    G1 = 'local'       # creates local copy of G1
fun()
G1                     # G1 is unchanged
```

- The global directive says that references to those names refer to the file/module's global scope

Backtracking: recursion appl.

- Knight's tour classic chess problem:
  - Find a sequence of legal knight moves that touches every square of the board once
    - Input: size of board, starting position
    - Output: sequence of board coordinates (x,y)
- Algorithm:
  - Find possible moves from current position
    - Omit squares we've already touched
  - For each move, take the move and recurse
  - If no possible moves, return (backtrack)

TODO

- Lab08 due tonight:
  - Robust user input
- Quiz08 on Fri
- Midterm next week: Wed 21Nov
  - Covers lectures #25-38 (through today)
  - M2 chs8-10
  - Py ch11-17
  - Python.org tutorial ch8, 9.0-9.2