CSC148 winter 2014
stools, names, tracing
week 5

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Outline

prose to (recursive) code

memory model

tracing... or not
getting that recursive insight for Tower of Hanoi

In order to implement a function that moves $n$ cheeses from, say, stool 1 to stool 3, we’d first think of a name and parameters. We can start with `move_cheeses(n, source, dest)`, meaning show the moves from source stool to destination stool for $n$ cheeses.
stating that recursive insight:

The doodling on the previous slide breaks into a pattern, at least for the 2- and 3-cheese case:

► move all but the bottom cheese from source to intermediate stool (sounds recursive...)
► move the bottom cheese from the source to the destination stool (sounds like the 1-cheese move)
► move all but the bottom cheese from the intermediate to the destination stool (sounds recursive...)

The original problem repeats, except with different source, destination, and intermediate stools!

New name: move_cheeses(n, source, intermediate, destination)
write some code!

Fill in the three steps from the previous slide, using recursive calls to `move_cheeses(...)` with different values for the number of cheeses, the source, destination, and intermediate stools, where appropriate.

```python
def move_cheeses(n: int, source: int, intermediate: int, destination: int) -> None:
    """Print moves to get n cheeses from source to destination, possibly using intermediate""
    if n > 1:  # fill this in!
        move_cheeses( ?, ?, ?, ?, ?)
        move_cheeses( ?, ?, ?, ?, ?)
        move_cheeses( ?, ?, ?, ?, ?)
    else:  # just 1 cheese --- leave this out for now!
```

Now, fill in what you do to move just one cheese — don’t use any recursion! You will be returning a string that specifies you are moving from source to destination.

```python
def move_cheeses(n: int, source: int, intermediate: int, destination: int) -> None:
    """Print moves to get n cheeses from source to destination, possibly using intermediate""
    if n > 1:  # fill this in!
        move_cheeses(n - 1, source, destination, intermediate)
        move_cheeses(1, source, intermediate, destination)
        move_cheeses(n - 1, intermediate, source, destination)
    else:  # just 1 cheese --- fill this in now!
        return ?????
```
Once you have your code entered into some Python environment, you should run it with a few small values of n. As usual, you can get more intuition about it by tracing examples, working from small to larger n.
how much detail for developers?

Enough detail to predict results and efficiency of our code — more detail than end users, less than compiler/interpreter designers. In Python:

- Every name contains a value

- Every value is a reference to the address of an object
searching for names

```python
import ...
```

Python looks, in order:

- innermost scope (function body, usually) `local`
- enclosing scopes `nonlocal`
- `global` (current module or `__main__`)
- built-in names
- see scopes and namespaces
intense example

Try running `python docs namespace example` to check your comfort level
methods

The first parameter, conventionally called self, is a reference to the instance:

```python
>>> class Foo:
...    def f(self):
...        return "Hi world!"
...
>>> f1 = Foo()
```

Now `Foo.f(f1)` means `f1.f()`
hunting for a method...

Start in the nearest subclass and work upwards, for example visualize method
def rec_max(L):
    """
    Return the maximum number in possibly nested list of numbers.
    """
    >>> rec_max([17, 21, 0])
    21
    >>> rec_max([17, [21, 24], 0])
    24
    >>> rec_max([17, [21, 24], [18, 37, 16], 0])
    37
    """
    return max([rec_max(x) if isinstance(x, list) else x for x in L])

Recommended:

- trace the simplest (non-recursive) case
- trace the next-most complex case, plug in known results
- same as previous step...
In contrast to the step-by-step, plus abstraction (previous slide), you could trace this in the visualizer.