Exam-Prep Section 5

OOP evaluation, OOP authoring, magic methods, growth, linked lists

Recap: magic methods

```
def str(x):
     if x has __str__:
          return x.__str__()
     elif x has __repr__:
          return x.__repr__()
     else:
          return “<Foo object…>”

def repr(x):
     if x has __repr__:
          return x.__repr__()
     else:
          return “<Foo object…>”
```

```
def interpreter(x):
     print(repr(x))

def print(x):
     display str(x)

str(“x”) -> ”x”
repr(“x”) -> “”x””
interpreter(str(“x”))
     -> interpreter(“x”)
     -> print(repr(“x”))
     -> print(“”x””)
     -> displays “x”
```

Evaluation rule: call expr where optr is class

```
x = Foo()
```

1. Look up Foo.
2. Create an empty (frame-like) box to represent the object and label it Foo object [p=class Foo].
3. Look up Foo.__init__. Call the method you find, passing the newly created object as the first argument.
4. “Return” the newly created object.

Evaluation rule: dot expr

a . b

1. Look up *a*. Go to the (frame-like) box that is a and look up the name b.
2. If the value you end up finding is a function and a was an object, pre-bind a as the value of the function's first argument.
3. The resulting value is the value of the dot expression.

Evaluation rule: class stmt

```
class Foo(Bar):
    a = 1
    def f(self):
        ...
```

1. Look up *Bar*.
2. Create an empty (frame-like) box to represent the class and label it class *Foo [p=class Bar]*.
3. Bind *Foo* in the current frame to the box.
4. In that frame, execute the assignment statement *a = 1*.
5. In that frame, execute the def statement *def f(self)*.

Fa14 Midterm 2 #1 OOP evaluation 25:00

- Practice OOP evaluation rules.
- See the necessity of a systematic way of keeping track of OOP on the exam.
- Practice and refine a method OOP environment diagramming.

Hints

- Do an environment diagram.
- Do an environment diagram.
- Do an environment diagram.

Expression	Interactive Output
`5*5`	25
`1/0`	ERROR
`Worker().work()`	`'Sir, I work'`
`jack`	`Peon`
`jack.work()`	`'Maam, I work'`

Expression	Interactive Output
`john.work()[10:]`	`Peon, I work` `'to gather wealth'`
`Proletariat().work(john)`	`Comrade Peon, I work` `Peon`
`john.elf.work(john)`	`'Comrade Peon, I work'`

Break

Missing content: binary tree

```
class BinaryTree:

    def __init__(self, label,

                 left, right):

        self.left = left

        self.right = right
```

- *Tree*
  - *t.label* is *
  - *t.branches* is *list[Tree]*
- *BinaryTree*
  - *t.label* is *
  - *t.left* is *Tree* or *BinaryTree.empty*
  - *t.right* is *Tree* or *BinaryTree.empty*

Terminology mismatch: label vs. entry

```
class Tree

    def __init__(self, label…
```

```
class Tree

    def __init__(self, entry...
```

- In some semesters, Trees have *label*
- In some semesters, Trees have *entry*
- They're the same

Fa14 Midterm 2 #4a OOP authoring

10:00

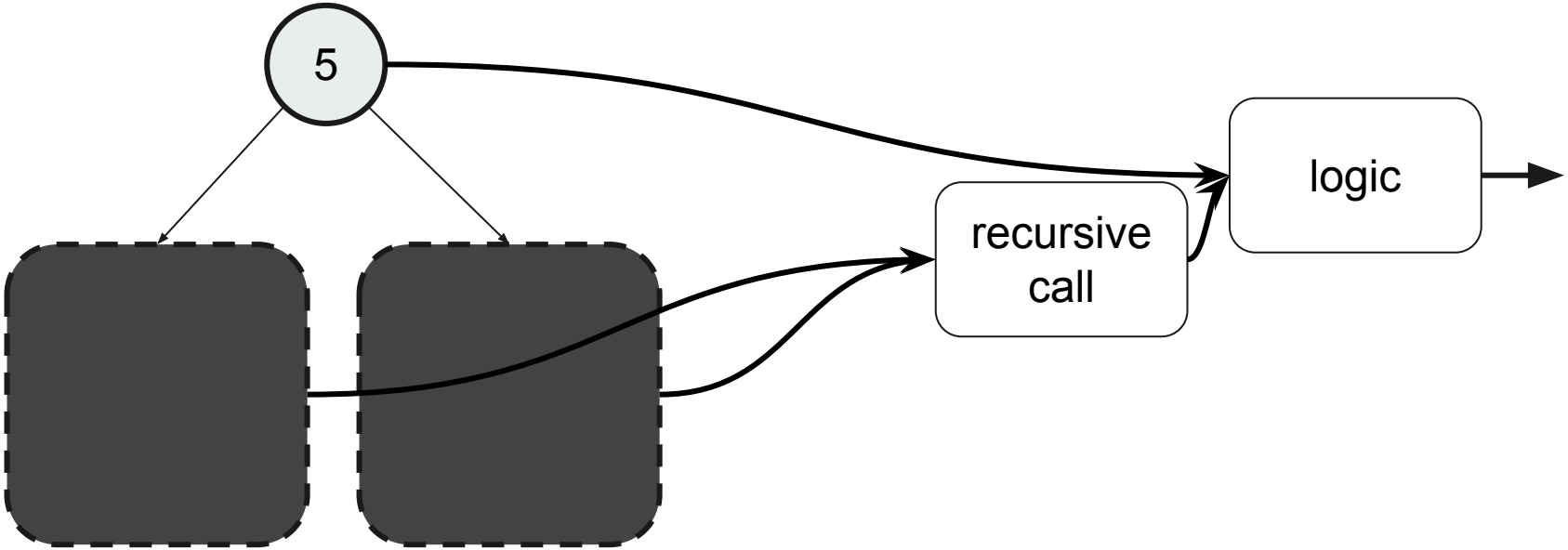
- Practice OOP authoring.
- Learn how to actually use objects to store and manipulate information.

Hints

- Call through to parent __init__.
- When are you going to record a GrootTree's parent? When it's constructed? That's provably impossible.
- How about when its parent is constructed?

```
class GrootTree(BinaryTree):
    """A binary tree with a parent."""
    def __init__(self, entry, left=BinaryTree.empty, right=BinaryTree.empty):

        BinaryTree.__init__(self, entry, left, right)

        self.parent = BinaryTree.Empty

        for b in [left, right]:

            if b is not BinaryTree.empty:

                b.parent = self
```

Heuristic: recurse on the branches



Fa14 Midterm 2 #4b Recursion on trees 15:00

- Practice recursion on trees.
- Practice use of data structures to extract and store a solution.

Hints

- In a GrootTree with label *g.label*, left branch *g.left*, and right branch *g.right*, when else is there no root-to-anywhere path with the entries [x, ...]?
- Given that the first if-condition failed, what else do we need to know in order to assume there is exactly one such path?
- For sure, recurse on the branches in the list comprehension. But what to do with the results?

```
if g is BinaryTree.empty or s == [] or g.entry != s[0]:

    return 0

elif len(s) == 1 and g.entry == s[0]:

    return 1

else:

    extensions = [g.left, g.right, g.parent]

    return sum(paths(x, s[1:]) for x in extensions)
```

g(n) Growth 1:00

- See that orders of growth are about understanding a function, not matching it to a pattern.

Hints

- Try it out on some representative inputs.

$$\Theta(1)$$

explode(n) Growth 2:00

- Practice composition of orders of growth.

Hints

- How long does each call to explode(n) take?
- How many iterations does the loop go through?

$$\Theta(n^2)$$

a, b, d
Growth
3:00

- Practice basic orders of growth patterns.

Hints

- Columns of 0 tiles, then 1 tile, then 2 tiles, then 3 tiles, then 4 tiles next to one another fill in half of a 4x4 square.

$$\Theta(mn), \Theta(m + n), \Theta(m^2)$$

append, extend Growth 3:00

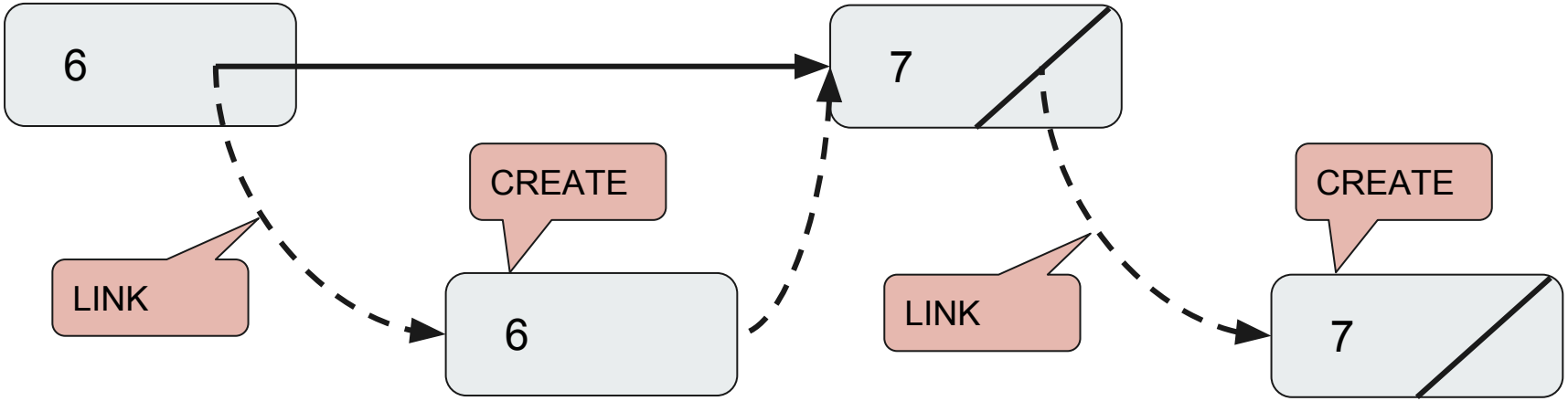
- Practice orders of growth in the context of an actual problem.

Hints

- How many steps does it take to append something?
- How long does append(<list of length x>) take? What list lengths does append get called on?

$$\Theta(n), \Theta(n^2)$$

Heuristic: draw before and after



Sp15 Midterm 2 #3d Linked lists 15:00

- Practice linked list manipulation.

Hints

- Mutative
- If there's only one element left, what do you need to do?
  - Do we assume there is a duplicate before it? Or are we responsible for adding the duplicate?
- Why would we not make any changes?
- If the other if-conditions failed, what is the situation and what do we need to do?

```
    if s is Link.empty:
        return 0
    elif s.rest is Link.empty:
        s.rest = Link(s.first)
        return 1
    elif s.first == s.rest.first:
        return double_up(s.rest.rest)
    else:
        s.rest = Link(s.first, s.rest)
        return 1 + double_up(s.rest.rest)
```

Do a practice test now!!!!

Attendance:
links.cs61a.org/512