PRACTICE EXAM *for* MIDTERM 2 SOLUTIONS

PRACTICE MIDTERM 2

Computer Science 61A . October 13, 2015 . alvinwan.com/cs61a

- You have 1.5 hours to complete the exam.
- The exam is closed book, closed notes, closed computer, closed calculator, except one hand-written 8.5" × 11" crib sheet of your own creation and the official 61A midterm 1 study guide attached to the back of this exam.
- Mark your answers ON THE EXAM ITSELF. If you are not sure of your answer you may wish to provide a brief explanation.

First Name	
Last Name	
SID	
Email (...@berkeley.edu)	
Login (e.g., cs61a-ta)	
TA & section time	
Name of person to your left	
Name of person to your right	
All the work on this exam is my own. **(please sign)**	

00. (1 Point) On a scale of Brian to Sumukh, how do you feel? Brian _____ Sumukh

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01. (4 Points) PUMPKIN FUN

For each of the expressions in the table below, write the output displayed by the interactive Python interpreter when the expression is evaluated. **The output may have multiple lines**. Expressions are evaluated in order, and **expressions may affect later expressions**.

Whenever the interpreter would report an error, write `Error`. If execution would take forever, write `Forever`. Assume that you have started Python 3 and executed the following statements:

```
class Patch:
    pop = [0, 1, 2, 3, 4]
    best = 3

    def harvest(self, i):
        if self.pop.pop(i):
            print('Goodbye', i, ':(')
            self.steal(i-1)

    def steal(self, i):
        print(self.pop)
        if i % 2 == 0:
            self.pop.append(self.pop[:i])
        self.harvest(i)
```

Expression	Interactive Output

`p = Patch()`
`q = Patch()`
`p.harvest(2)`
	`Goodbye 2 :(`
	`[0, 1, 3, 4]`
	`Goodbye 1 :(`
	`[0, 3, 4]`

`q.harvest(1)`
`p.pop = [0, 1, 2, 3]`
	`Goodbye 1 :(`
	`[3, []]`
	`Goodbye 0 :(`
	`[[], []]`

`Patch.steal(q)`	`Error`
`p.harvest(len(q.pop))`	`Goodbye 1 :(` `[0, 2, 3]`

02. (8 Points) TO BRIAN OR TO SUMUKH

Fill in the environment diagram that results from executing the code below until the entire program is finished, an error occurs, or all frames are filled. You may not need to use all of the spaces or frames.

A complete answer will:

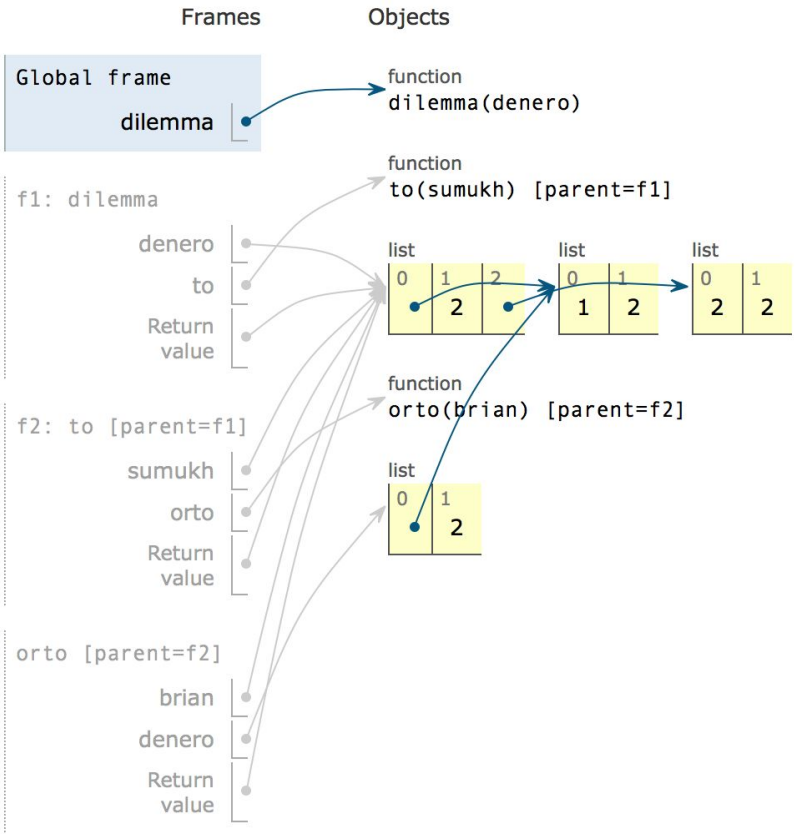
- Add all missing names and parent annotations to all local frames. • Add all missing values created or referenced during execution.
- Show the return value for each local frame.

Remember: Do not add a new frame when calling a built-in function (such as `abs`). The built-in `abs` function is always written as `func abs(...) [parent=Global]`.

```
def dilemma(denero):
    def to(sumukh):
        nonlocal denero
        def orto(brian):
            denero = sumukh[:2]
            brian[2] = sumukh[1:]
            return sumukh
        sumukh[0] = [1, 2]
        denero = orto(sumukh)
        return denero
    return to([denero]*3)

dilemma(2)
```

Python Tutor



03. (15 Points) TREES ARE FOR KIDS

(a) **(8 points)** Implement `max_function`, which returns the maximum value of `f(x, y)`, where x is an entry and y is one of its children. Both the `Tree` class and the tree data abstraction appear on the midterm 2 study guide.

Warning: Do not violate the tree data abstraction! (Exams are flammable.)

```
def max_function(t, f):
    """Returns the maximum value of f(x, y) where x is the value of an
      entry and y is the value of that entry's immediate child. 0 is the
      smallest possible value.

    >>> dist = lambda x, y: pow(x**2 + y**2, 1/2)
    >>> t = tree(3, [tree(4, [tree(5), tree(6)]),
    ... tree(2, [tree(1), tree(3), tree(7, [tree(8)])])])
    >>> max_function(t, dist)  # sqrt( 7 ^ 2 + 8 ^ 2 )
    10.63014581273465
    >>> diff = lambda x, y: y-x
    >>> max_function(t, diff)  # 7 - 5
    5
    """
    if is_leaf(t):
        return 0
    children = [f(root(t), root(b)) for b in branches(t)]
    return max(children + [max_function(b, f) for b in branches(t)])
```

(b) **(5 points)** Using only parentheses, square brackets, "tree," and "lambda", complete the following so that `max_function(hug, denero)` yields `2015`. Only one of the four items above may go in each blank.

```
denero = lambda x, y: x()[0] * y
hug = tree(lambda: [2015], [tree(1)])
max_function(hug, denero)
```

(c) **(2 points)** Compute the runtime of `max_function` with respect to the number of nodes in the tree, assuming the definition of f below is passed in as `max_function(t, f)`:

```
def f(x, y):
      for i in range(x):
            print(i)
```

Runtime: O(n)

04. (10 Points) TREE TRIMMING

Implement `is_uniform`, which takes in a tree and determines whether or not the tree is uniformly wide at each level. The width of a tree at level i, is the sum of all entries at depth i. Note that this solution implements *breadth-first search*, where the tree is traversed and consequently processed a level at a time.

```
def is_uniform(t):
    """
    >>> t = tree(3, [tree(4, [tree(5), tree(6)]), tree(2,
    ... [tree(1), tree(3), tree(7, [tree(8)])])])
    >>> is_uniform(t)
    False
    >>> t = tree(8, [tree(6, [tree(3), tree(5)]), tree(2), tree(0)])
    >>> is_uniform(t)
    True
    >>> t = tree(8, [tree(6, [tree(2), tree(1)]), tree(2,
    ... [tree(2), tree(3), tree(0, [tree(8)])])])
    >>> is_uniform(t)
    True
    """
    queue, curr, vals, width = [t], [], [], root(t)
    while queue or curr:
        t = queue.pop()
        curr = curr + branches(t)
        vals.append(root(t))
        if not queue:
            if width != sum(vals):
                return False
            queue, curr, vals = curr, [], []
    return True
```

BONUS. (0 Points) CINDY'S SOCKS AND SANDALS

Cindy is starting a new trend in footwear, but even divas need breaks. Using the following rules, determine if Cindy can and should wear sandals based on the weather:

- Cindy does not wear socks and sandals within 2 days of a rainy day.
- Nathan steals Cindy's socks and sandals every other day after a rainy day.
- Paul performs a rain dance after six days without rain, to invoke another rainstorm.
- Assume the first day is a rainy day.

```
# WARNING: I assumed a few strange constraints in this problem. It's poorly written.
def siri_generator():
    """
    >>> siri = siri_generator()
    >>> siri()
    'Just rained.'
    >>> siri()
    'The Nathan attacked!'
    >>> siri(4)
    'Paul danced.'
    >>> siri(3)
    'Cindy wore socks and sandals.'
    """
    data = 0
    def siri(days=1):
        nonlocal data
        msg = ''
        data += (days * 100) + (days * 10) + days
        rain, nathan, paul = data % 10, data % 100 // 10, data // 100
        if paul == 6:
            msg, paul, nathan, rain = 'Paul danced.', 0, 0, 0
        elif nathan == 2:
            msg, nathan = 'The Nathan attacked!', 0
        elif rain == 1:
            msg = 'Just rained.'
        else:
            msg = 'Cindy wore socks and sandals.'
        data = (paul * 100) + (nathan * 10) + rain
        return msg
    return siri
```