CS 61A Structure and Interpretation of Computer Programs

Fall 2017 Midterm 1

INSTRUCTIONS

- You have 2 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 CS 61A midterm 1 study guide.
- Mark your answers on the exam itself. We will *not* grade answers written on scratch paper.

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All the work on this exam is my own. (please sign)	

1. (10 points) I Wonder What Python Would Display

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. If an error occurs, write “Error”, but include all output displayed before the error. To display a function value, write “Function”. The first two rows have been provided as examples.

The interactive interpreter displays the value of a successfully evaluated expression, unless it is None.

Assume that you have first started python3 and executed the statements on the left.

```
aaron, burr = 2, 5 aaron, burr = 4,
aaron + 1 hamil = 10

def alex(hamil):
        def g(w):
                hamil = 2 * w
                print(hamil, w) w = hamil
                return hamil
        w = 5
        alex = g(w + 1)
        print(w, alex, hamil)

def el(i, za):
        def angelica():
                return i + 1
        if i > 10:
                return za()
        elif i > 4:
               print(angelica()) return el(i *
        i, za) else:
                return el(i * i,
                                    angelica) K =

lambda x: lambda y: x

def pr(x): print(x) return x
```

Expression	Interactive Output
pow(2, 3)	8
print(4, 5) + 1	4 5 Error
print(aaron, burr)	4 3
alex(3)	12 6 5 12 3
el(3, el)	10 4
K	Function
K(3)	function
K(3)(2)	3
pr(True) and pr(0) and pr(1)	True

2. (8 points) Environmental Influences

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, frames, or function values.*

A complete answer will:

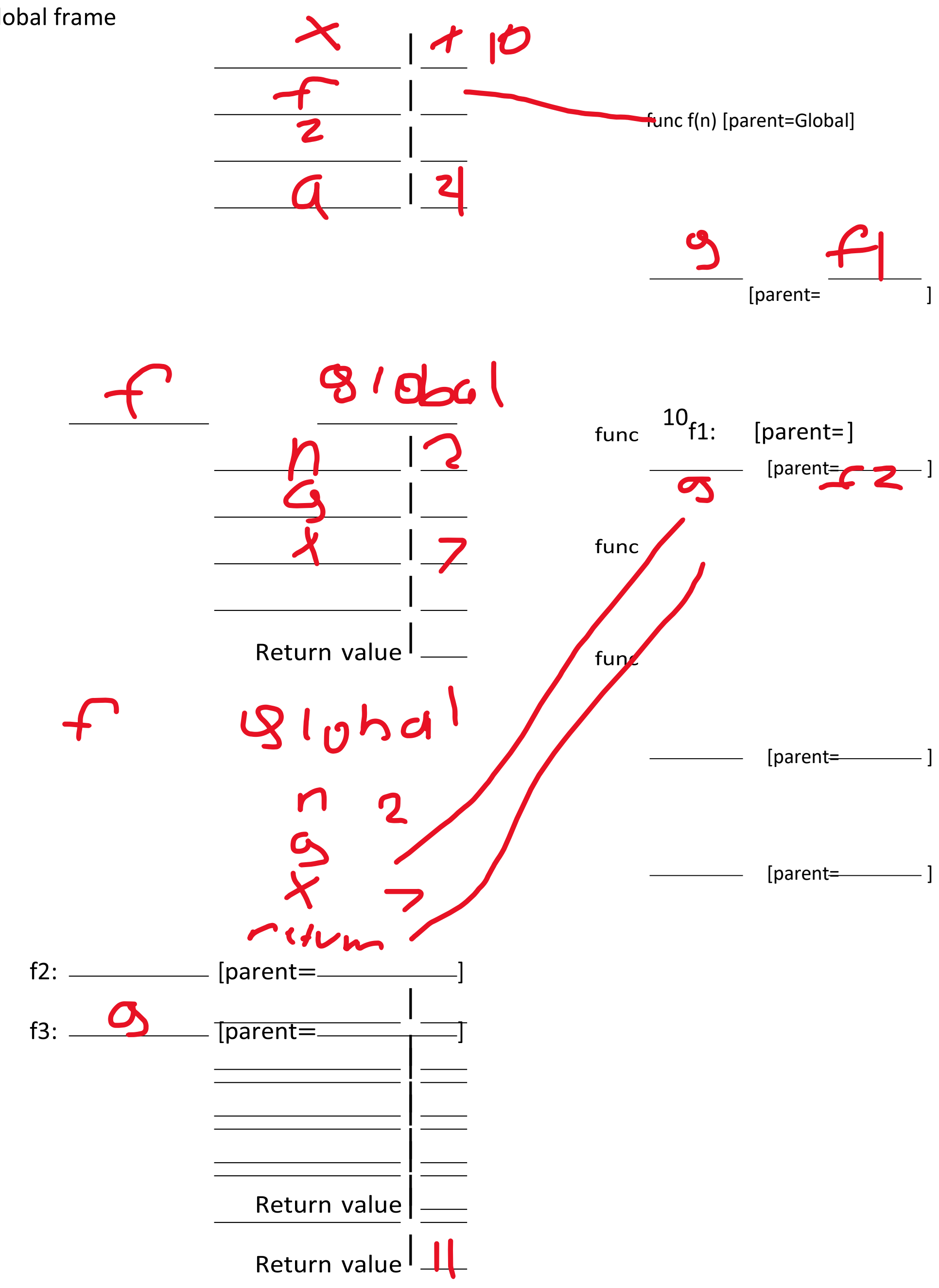
- Add all missing names and parent annotations to all local frames.
- Add all missing values created or referenced during execution.

- Show the return value for each local frame.

```
     x = 1 def
     f(n):
             def g(): return n + x
4            x = n + 5 if n % 3 ==
5            0: return g
6            else: return f(n + 1)
     x = 10 z = f(2)
7func q = x + z()
8
.,9
```

11

12



3. (3 points) Triangulate

It's easy to see that in any triangle, each side must be shorter than the sum of the other two. Implement triangle, which takes three positive numbers, a, b, and c, and returns whether these three numbers could possibly be the lengths of the three sides of a triangle.

```
def triangle(a, b, c):
    """Return whether a, b, and c could be the legs of a triangle.

    >>> triangle(3, 4, 5) True
    >>> triangle(3, 4, 6) True
    >>> triangle(6, 3, 4) True
    >>> triangle(3, 6, 4) True
    >>> triangle(9, 2, 2) False
    >>> triangle(2, 4, 2)
    False """



    longest = max(a,b,c)



    sum_of_others = a + b + c



    return longest < sum_of_others
```

4. (9 points) Digital

(a) (3 pt) Implement collapse, which takes a non-negative integer, and returns the result of removing all digits from it that duplicate the digit immediately to their right.

```
def collapse(n):
    """For non-negative N, the result of removing all digits that are equal to the digit on their
    right, so that no adjacent digits are the same.

    >>> collapse(1234)
    1234
    >>> collapse(12234441)
    12341
    >>> collapse(0) 0
    >>> collapse(3)
    3
    >>> collapse(11200000013333)
    12013
    """
```

```
left, last = n // 10, n % 10

if left == 0

  return last

elif last== left % 10:

  return last

elif last== left % 10

  return collapse

else



     return collapse(left) * 10 + last
```

(b) (6 pt) Implement find_pair, which takes a two-argument function, p, as input and returns another function. The returned function takes a non-negative integer n; it returns True if and only if p returns a true value when called on at least one pair of adjacent digits in n, and False otherwise.

```
def find_pair(p):
     """Given a two-argument function P, return a function that takes a non-negative integer and
     returns True if and only if two adjacent digits in that integer satisfy P (that is, cause P to return
     a true value).

           >>> z = find_pair(lambda a, b: a == b)                    # Adjacent equal digits
     >>> z(1313)
     False
     >>> z(12334)
     True
     >>> z = find_pair(lambda a, b: a > b)
     >>> z(1234)
```

```
False
>>> z(123412)
True
>>> find_pair(lambda a, b: a <= b)(9753)
False
    >>> find_pair(lambda a, b: a == 1)(1)            # Only one digit; no pairs.
False """ def
find(n):

    while n>=10

    if p((n//10)%10,n%10):

        return ture

    else:

        n= n//10

    return false

    return find
```

(10 points) Please Confirm

Definition. A *confirming function* for a sequence of digits, called a *code*, takes a single digit as its only argument. If the digit does not match the first (left-most) digit of the code to be confirmed, it returns False. If the digit does match, then the confirming function returns True if the code has only one digit, or another confirming function for the rest of the code if there are more digits to confirm.

(a) (5 pt) Implement confirmer so that when confirmer takes a positive integer code, it returns a confirming function for the digits of that code.

```
def confirmer(code):
    """Return a confirming function for CODE.
    >>> confirmer(204)(2)(0)(4) # The digits of 204 are 2, then 0, then 4.
    True
    >>> confirmer(204)(2)(0)(0) # The third digit of 204 is not 0.
    False

    >>> confirmer(204)(2)(1)             # The second digit of 204 is not 1.
    False
    >>> confirmer(204)(20)               # The first digit of 204 is not 20.
    False """ def
    confirm1(d, t):
        def result(digit):
                if d == digit:
                    return t
             else: return False
        return result

    def extend(prefix, rest):
        """Return a confirming function that returns REST when given the digits of PREFIX. For example, if c =
        extend(12, confirmer(34)), then c(1)(2) returns confirmer(34), so that c is a confirming function for
        1234.""" left, last = prefix // 10, prefix % 10


        If prefix < 10:


        Return confirm1(prefix,rest)


        Else:


        Return extend(left, confirm(last, rest))


        Return extend(code, true)
```

(b) (5 pt) Given a confirming function, one can find the code it confirms, one digit at a time. Implement decode, which takes a confirming function f and returns the code that it confirms.

```
def decode(f, y=0):
    """Return the code for a confirming function f.
```

```
>>> decode(confirmer(12001)) 12001
>>> decode(confirmer(56789))
56789
"""


d = 0


while d < 10:


    x, code = f(d), 10 * y + d


    if x == True: return code


    elif x == False:


    d=d+1


    else:


        return decode(x,code)
```