CS 1110 Review: Final Worksheet Solutions

This worksheet contains various problems for you to practice. We will go over only some problems during the final review session and will let you take this worksheet home to practice more.

List and sequences

```
def find_in_list(lst, v):
    """ Returns: the position of the first occurrence of v in lst or -1
    if not found
    Parameters:
    lst - a possibly empty list
    v   - a value that may or may not be in the list"""

    for i in range(len(lst)):
        if v == lst[i]:
            return i
    return -1
```

```
def sum_nums(s):
    """ Returns a string representing the sum of the numbers separated by
    spaces in the string s (Example: '100 2 34' will return '136')
    Parameter: s is a string with spaces and/or digits"""

    lst = s.split() #if you do s.split(' '), lst may have empty strings!
    acc = 0
    for num in lst:
        acc += int(num)
    return acc
```

```
def transpose(x):
    """ Returns: a nested list representing the transposed matrix x.

    Example: transpose([[1,2,3],[4,5,6]]) returns [[1,4],[2,5],[3,6]]

    Parameter: x - a nested list representing a rectangular matrix (the
    length of each row is the same)"""

    newrow = len(x[0])
    newcol = len(x)
    newx = []
    for i in range(newrow):
        row = []
        for j in range(newcol):
            row.append(x[j][i])
        newx.append(row)
    return newx

    # A matrix can be represented as a 2D list. In this case,
    # transpose would take a matrix and change it like so:
        #       [[1, 2, 3],    turns to    [[1,4],
        #        [4, 5, 6]]    -------->    [2,5],
        #                                   [3,6]]
```

```
def creditsToClasses(classes):
    """Returns: a dict with number of credits (ints) as keys and the
    corresponding classes (a list of str) as values. The order of the
    classes within the lists does NOT matter.

    Example: given classes {'CS 1110': 4,'CS 7090': 1, 'CS 1112': 4},
    you would return {4: ['CS 1110', 'CS 1112'], 1: ['CS 7090']}

    Parameter: classes is a dict with the keys being course names as
    strs (e.g. 'CS 1110') and the values being the number of credits as
    ints (e.g., classes['CS 1110'] = 4) """

    numToClass = {}
    for c in classes:
        if classes[c] in numToClass:
            numToClass[classes[c]].append(c)
        else:
            numToClass[classes[c]] = [c]
    return numToClass
```

The following function is supposed to take in a list `lst` and a value `v` that occurs more than once in `lst`, and return the index of the second occurrence of v. However, this is not what happens. Instead, the function always returns the index of the first occurrence of `v`. For example, the output of `secondInd([1,2,3,1], 1)` is equal to `0`. What is the issue?

```
def secondInd(lst,v):
    """ Given a list lst and value v that occurs more than once in lst,
    return the index of the second position where v occurs in lst.

    Returns: the index of the second occurence of v
    Precondition: v appears more than once in lst """

    seen_once = False
    for i in lst:
        if i == v:
            if not seen_once:
                seen_once = True
            else:
                return lst.index(v)
```

The issue is that this implementation returns the index of the first istance of the value rather than the second. An easy fix is to reimplement this function using a for loop with range(len(lst)) so we are keeping track of the indicies. A possible implemenation is as so:

```
def secondInd(lst,v):
    seen_once = False
    for i in range(len(lst)):
        if lst[i] == v:
            if not seen_once:
                seen_once = True
            else:
                return i
```

The following function is supposed to remove all values of `lst` that are even. However, the function does not behave as expected. Why did this happen?

```
def removeEvens(lst):
    """ Given a list lst, remove all even elements from lst in-place
    (does not return)

    Precondition: lst is a list of ints """

    for i in lst:
        if i%2 == 0:
            lst.remove(i)

>>> a = [1,1,2,2,2,3,3,4,4,4]
>>> removeEvens(a)
>>> a
[1, 1, 2, 3, 3, 4]
```

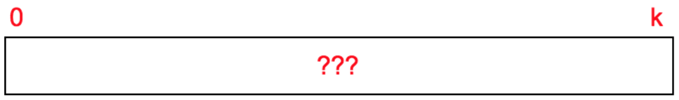
In this function, the list is modified as it is iterated through. Thus, this code would skip an element if the element before it was removed. A possible fix for this code is to use a while loop. Challenge yourself to fix it!

Loop invariants and sequence algorithms

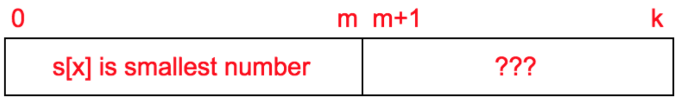
Draw boxes for the preconditions, postconditions, and invariant for the function smallest_index. Then, write the actual code for the loops. This loop should take a list of ints `s` and returns the index `x` of the smallest int (`s[x]`). `k` has been filled out for you.

```
def smallest_index(s):
    """ Returns: an int representing the index of the smallest
    number in s.
    Precondition: s is a non-empty list of integers.
    """
    x = 0
    m = 0
    k = len(s) - 1
    while m < k:
        if s[x] > s[m+1]:
            x = m + 1
        m += 1
    return x
```

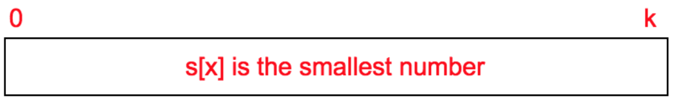
Pre: s[0..k] is ???



Invariant: s[x] is smallest number in s[0..m], s[m+1..k] is ???

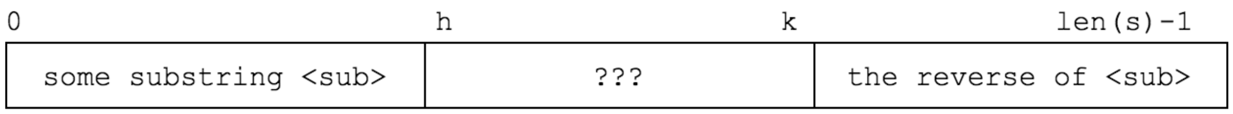


Post: s[x] is smallest number of s[0..k]



A palindrome is a sequence of characters which reads the same backward or forward. For example, madamimadam is a palindrome. Given the below function and invariant, fill in the missing lines of the function.

invariant:

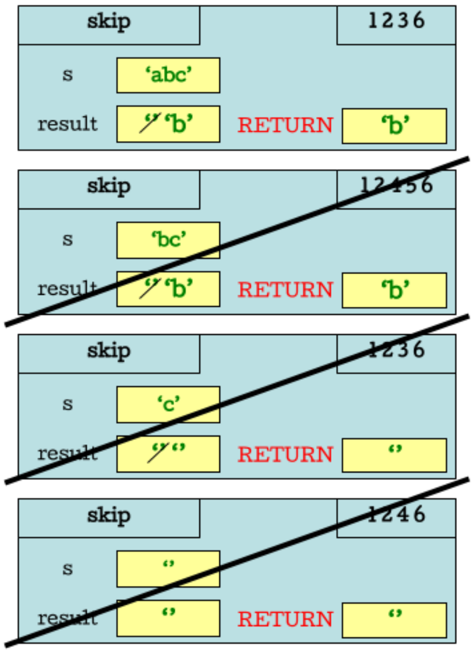


```
def is_palindrome(s):
    """Returns: True if the string is a palindrome, false otherwise
    Prec: s is a string"""
    #initialize loop variable here
    h = 0
    k = len(s)-1
    #invariant: s[0..h-1] is the reverse of s[k+1..len(s)-1]
    while h<=k:          # condition h<k also works in this case.
        if s[h]!=s[k]:
            return False
        h += 1
        k -= 1
    return True
```

Call Frames

Draw the entire call stack for skip('abc')

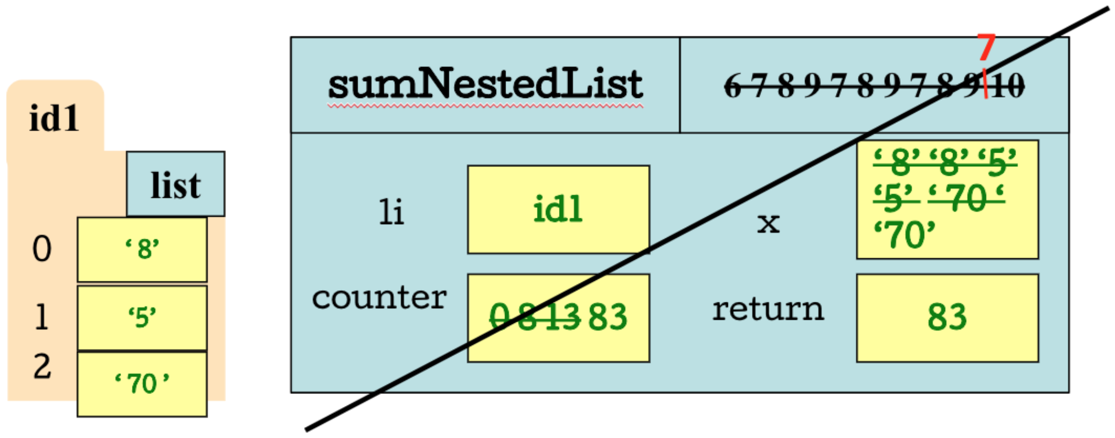
```
def skip(s):
    """Returns: copy of s odd (from end) skipped"""
1   result = ""
2   if (len(s) % 2 == 1):
3       result = skip(s[1:])
4   elif len(s) > 0:
5       result = s[0]+skip(s[1:])
6   return result
```



Note: The counter numbers would be all crossed out, but we have not done that for readability reasons.

Draw the call stack for sumStringList([‘ 8’, ’5’, ‘ 70 ’])

```
def sumStringList(li):
"""Returns: the sum of a list of strings.
Precondition: li is list of strings of digits with
possible white space before or after the digits.
ex: li = [‘ 8 ’, ‘32’, ‘ 1’] returns 41"""
counter = 0
for x in li:
        x = x.strip()
        counter+=int(x)
return counter
```



Draw the diagrams for the 2 object folders and the class folder when you execute:

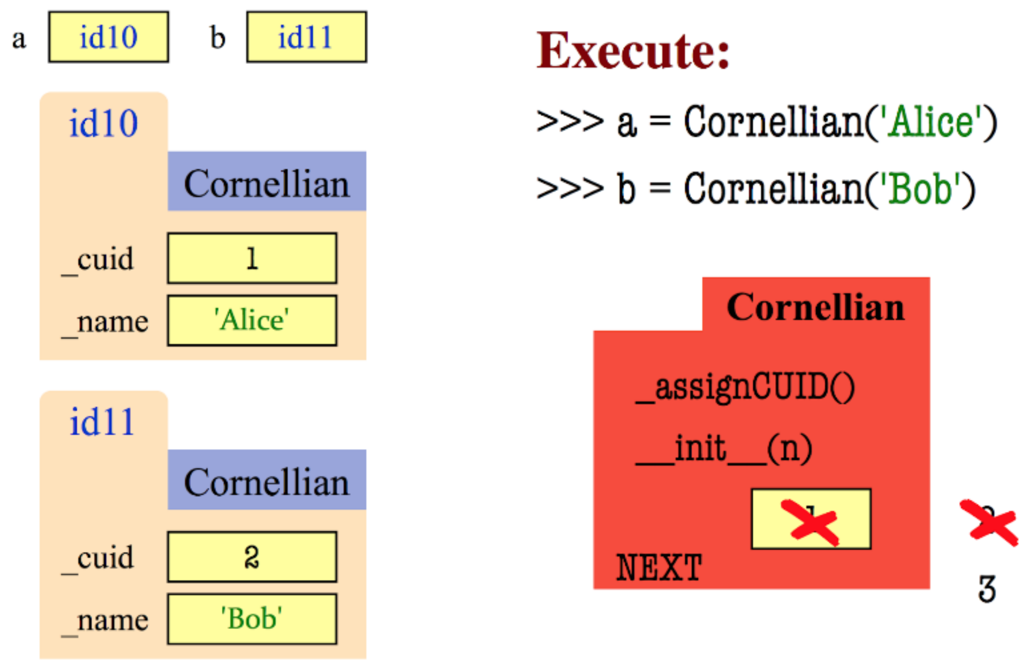
```
>>>a = Cornellian("Alice")
>>>b = Cornellian("Bob")

class Cornellian(object):
    """Instance attributes:
    _cuid: Cornell id [int > 0]
    _name: full name [nonempty str]"""

    NEXT = 1 # Class Attribute

    def _assignCUID(self):
        """Assigns _cuid to next Cornell id"""
        self._cuid = Cornellian.NEXT
        Cornellian.NEXT = Cornellian.NEXT+1

    def __init__(self, n):
        """Initializer: Cornellian with name n."""
        self._name = n
        self._assignCUID()
```



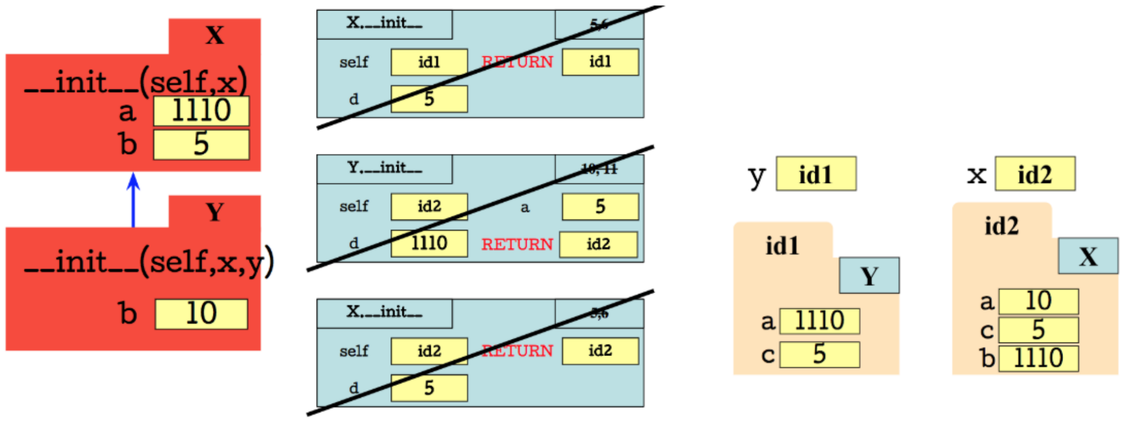
Note: self should be included in _assignCUID and __init__.

Diagram the class folder and the constructor call frames for the following two classes when you execute the following code:

```
 1  class X():
 2      b = 1110
 3      a = 5
 4      def __init__(self, d):
 5          self.a  = self.b
 6          self.c = d
 7  class Y(X):
 8      b = 10
 9      def __init__(self, d, a):
10          super().__init__(a)
11          self.b=d

>>>y = X(5)
>>>x = Y(1110,5)
```

Solution: **except the class labels on id1 and id2 should be swapped**



Classes

```
class Book():
    """Instance is a book that is currently being read
    Attributes:
        title [str]: title of the book
        sequel [Book]: sequel to the book, None if nonexistent
    pages_left [int]: number of pages still unread"""

    def __init__(self, t, s=None, p=0):
        """Initializer for class Book
        Default value for sequel is None
        Default value for pages_left is 0 """
        self.title = t
        self.sequel = s
        self.pages_left = p

    def __eq__(self, b):
        return ((self.title == b.title) and (self.sequel == b.sequel)
            and (self.pages_left == b.pages_left))

    def __str__(self):
        """Format: title (sequel, pages_left) """
        sequel_str = ""
        if self.sequel != None:
        sequel_str = str(self.sequel)
        return (self.title + "␣(" + sequel_str + ",␣" +
            str(self.pages_left) + ")")

    def readPages(self, n):
        """Read n number of pages in the book until the end"""
        self.pages_left = max(self.pages_left - n, 0)
```

What are the outputs when running the following pieces of code?

```
>>>b1 = Book("Eldest")
>>>b2 = Book("Eragon", b1, 30)
>>>b3 = Book("Eldest")
>>>b4 = b1
>>>
>>>print(b1 == b2)
>>>print(b1 is b2)
>>>print(b1 == b3)
>>>print(b1 is b3)
>>>print(b1 == b4)
>>>print(b1 is b4)
>>>print()
>>>print(b1.sequel)
>>>print(b1.pages_left)
>>>print(b2.sequel)
>>>print(b2.pages_left)
>>>print(b2)

False
False
True
```

```
False
True
True

None
0
Eldest (, 0)
30
Eragon (Eldest (, 0), 30)
```

```
#class Complex with the following specification
class Complex():
    """Instance is a complex number, with real and imaginary parts
    Attributes:
    real: real portion of the number   [float]
    imag: imaginary portion of number  [float]"""

    # initializer
    def __init__(self, real, imag):
        """Initializes attributes with floats
        Precondition: real, imag can be ints or floats"""
        self.real = float(real)
        self.imag = float(imag)

    # implement +
    def __add__(self, other):
        return Complex(self.real + other.real, self.imag + other.imag)

    # implement *
    def __mul__(self, other):
        """Note: (a + bi) * (c + di) = (ac - bd) + (ad + bc)i"""
        a = self.real
        b = self.imag
        c = other.real
        d = other.imag
        return Complex(a * c - b * d, a * d + b * c)

    # implement str: Complex(1, -2) looks like "1.0 + -2.0i"
    def __str__(self):
        return str(self.real) + "␣+␣" + str(self.imag) + "i"

    # implement ==
    def __eq__(self, other):
        return self.real == other.real and self.imag == other.imag

# subclass Real, instance is a real number
class Real(Complex):
    """Instance is a real number"""

    # initializer for Real
    def __init__(self, num):
        """Init for Real calls Complex __init__ method"""
        super().__init__(num, 0.0)
```

What is printed when the following code is executed?

```
>>>a = Complex(1, 2)
>>>print (a.getReal())
>>>print (a.getImag())
>>>print (a)
>>>b = Complex(-1, -2)
>>>print (b.getReal())
>>>print (b.getImag())
>>>print (b)
>>>c = Real(3)
>>>print (c.getReal())
>>>print (c.getImag())
>>>print (c)
>>>print ()
>>>print ("Operation␣results:␣")
>>>print (a + b)
>>>print (a - b)
>>>print (a * b)
>>>print (a == b)
>>>print (a == Complex(1, 2))
```

```
1.0
2.0
1.0 + 2.0i
-1.0
-2.0
-1.0 + -2.0i
3.0
0.0
3.0 + 0.0i

Operation results:
0.0 + 0.0i
2.0 + 4.0i
3.0 + -4.0i
False
True
```