CIS 210

Winter 2015 Final Exam

Your name: ____________________________________

Total: ____________ of 65 possible

1. [5 points] What does `q1( )` print?

```
def trans(li, delta):
    for i in range(len(li)):
        li[i] = li[i] + delta
    return

def q1( ):
    a = [ 1, 2, 3 ]
    b = [ 1, 2, 3 ]
    c = b
    trans(a,1)
    trans(b,1)
    trans(c,1)
    sum = 0
    for i in range(len(a)):
        sum = sum + a[i] + b[i]
    print(sum)
```

2. [5 points] What does `q2( )` print?

```
def q2():
    count = 0
    for i in range(10):
        for j in range(10):
            count += 1
    print(count)
```

(score)

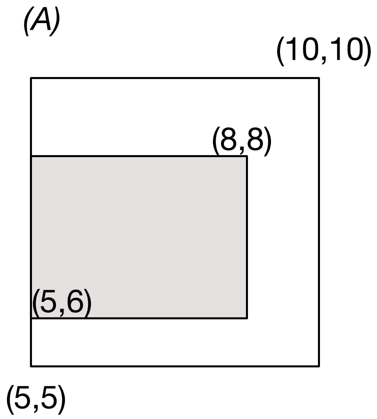
3. [5 points] What does `q3( )` print?

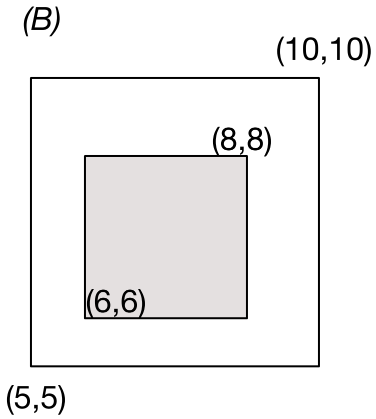
```
def compress(li):
    """You'll have to figure it out"""
    result = [ ]
    if len(li) == 0:
        return result
    prev = li[0]
    result.append(li[0])
    for item in li:
        if item != prev:
            result.append(item)
            prev = item
    return result

def q3():
    ar = [ 1, 1, 2, 3, 3, 3, 3, 4, 5, 5, 5, 5 ]
    ar = compress(ar)
    sum = 0
    for item in ar:
        sum += item
    print(sum)
```

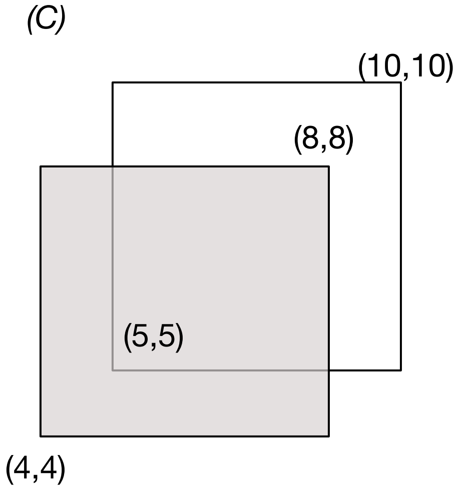
4. [5 points] What does q4( ) print?

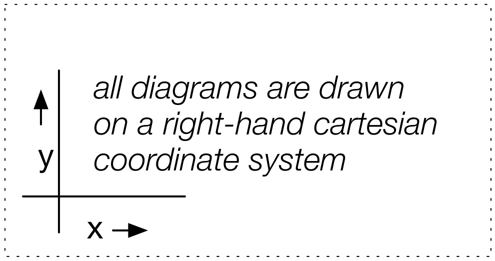
```
def pointwise(li, f):
    """Yes, yes we can"""
    result = [ ]
    for item in li:
        result.append( f(item) )
    return result

def plus_two(x):
    return x + 2

def q4():
    before = [1, 2, 3]
    after = pointwise(before, plus_two)
    print(after)
```

On the next page you will be asked to complete a a `covers` method that returns True iff a rectangle represented by a Rect object completely covers another Rect object. For example, consider cases (A), (B), and (C) below:








all diagrams are drawn on a right-hand cartesian coordinate system
y
x

In situation *(A)* the white rectangle does completely cover the grey rectangle, and also in situation *(B)*. However, in situation *(C)* parts of the grey rectangle are outside the white rectangle, so `Rect(Point(5,5),Point(10,10)).covers(Rect(Point(4,4),Point(8,8)))` should return False.

5. [15 points] Complete the `covers` method. The previous page explains what it means for a rectangle to cover another rectangle.

```
class Point:
    """Two public fields representing x and y coordinates"""
    def __init__(self, x, y):
        self.x = x
        self.y = y

class Rect:
    """Defined by lower left and upper right points"""
    def __init__(self, ll, ur):
        assert ll.x < ur.x and ll.y < ur.y
        self.ll = ll
        self.ur = ur

    def covers(self, other):
        """
        Does this Rect entirely cover other?
        Args:
           other: Rect
        Returns:
           True iff this Rect entirely contains other.
        Examples:
           Rect(Point(5,5),Point(10,10)).covers(Rect(Point(5,6),Point(8,8)))  = True
           Rect(Point(5,5),Point(10,10)).covers(Rect(Point(4,4),Point(8,8)))  = False
           Rect(Point(2,2),Point(4,4)).covers(Rect(Point(2,2),Point(4,4))) = True
        """
        #complete the method here
```

6. [15 points]

Recall that we have used lists of lists to represent grids or matrices. For example, we can write $[[8,3,4,5],[1,2,7,9],[12,5,3,7]]$ to represent this matrix:

8	3	4	5
1	2	7	9
12	5	3	7

This problem asks you to find the *minimum* sum of the columns of such a matrix (e.g., 10 for this example). Column 0 of the matrix above has a sum of 21 $(8+1+12)$, column 1 has a sum of 10 $(3+2+5)$ and column 2 has a sum of 14 $(4+7+3)$, column 4 has sum 21 $(5+9+7)$, and the minimum of these is 10.

Finish function `min_col` on the next page. I believe it will be easiest if you also write a function to sum the values in one column; you can use this page to do that. (A docstring is not required.)

(score)

```
def min_col(ar):
    """
    Find the minimum sum of items in a column of a matrix (list of lists).
    Args:
       ar:  A list of lists of integers representing a rectangular matrix.
            ar has at least one row, and at least one column, and each
            row has the same number of columns.
    Returns:
       The smallest sum of values in a column of ar.
    Examples:
       min_col( [[9, 2, 3], [4, 5, 8], [9, 6, 9]]) = 13  (2+5+6)
       min_col( [[1, 2], [9, 2]] ) = 4 (2+2)
       min_col( [[ 8, 7 ]]) = 7
    """
    # Your code here
```

(score)

7. [15 points] An s-expression is a fully parenthesized expression in prefix notation. In Python, we can easily express s-expressions using tuples, e.g., expressing $(5 + 3) - 4$ as `(’-’,(’+’,5,3),4)`. This problem asks you to complete an evaluator for s-expressions representing only addition and subtraction of integers. You can use the built-in `isinstance` function to distinguish leaves (integers) from inner nodes (tuples that represent operations) by checking `isinstance(exp,tuple)` or `isinstance(exp,int)`.

```
def s_eval( exp ):
    """
    Evaluate an ’s-expression’.
    Args:
       exp is either an integer or a tuple (op,left,right)
             where op is one of ’+’ or ’-’
             left is an s-expression
             right is an s-expression
    Returns:
       The result of evaluating exp, where
          an int evaluates to itself  (e.g., s_eval of 5 is 5)
          a tuple (op,left,right) evaluates to the result of applying
             the corresponding operation to the values of the left and right operands.
    Examples:
       s_eval( 5 ) = 5
       s_eval( (’+’, 5, 4) ) = 9
       s_eval( (’-’, (’+’, 5, 4), (’-’, 5, 3)) ) = 7
    """
    # Your code here
```

(score)