CIS 210
Fall 2012 Final Exam

Write your name at the top of **each page** before you begin. [5 points]

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

```
def q1():
    x = 10
    y = 7
    x = x - y
    if x > y:
        x = 42
    if y > x:
        y = 42
    print(x, y)
```

3 42

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

```
def rescale(x, low, high):
    if x < low:
        return 0
    if x > high:
        return 100
    x = (100 * (x - low)) // (high - low)
    return x

def q2():
    minscore = 10
    maxscore = 30
    x = rescale(35, minscore, maxscore)
    y = rescale(20, minscore, maxscore)
    print(x, y)
```

100 50

(score)

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

```
class Account:

    def __init__(self, account_name):
        self.name = account_name
        self.value = 0

    def deposit(self, amt):
        self.value += amt

    def withdraw(self, amt):
        self.value = self.value - amt

def q3():
    travel = Account("Travel")
    travel.deposit(100)
    books = Account("Books")
    books.deposit(100)
    travel.withdraw(30)
    books.withdraw(50)
    print("Travel funds available:", travel.value)
    print("Book funds available:", books.value)
```

Travel funds available: 70
Book funds available: 50

(I was just checking your understanding of the basic mechanics of classes and objects ... making sure you understood that *travel* and *books* were references to two different objects from class *Account*, with their own *value* attributes. It looks like most of you got that.)

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

```
def swap(ar, i, j):
    t = ar[i]
    ar[i] = ar[j]
    ar[j] = t

def q4():
    a_lis = [ 10, 20, 30 ]
    b_lis = a_lis
    c_lis = [ 1, 2, 3 ]
    swap(a_lis, 0, 2)
    swap(b_lis, 1, 2)
    swap(c_lis, 0, 1)
    print(a_lis[0] + c_lis[0])
    print(a_lis[1] + c_lis[1])
    print(a_lis[2] + c_lis[2])
```

32
11
23

I was checking your understanding of references here. First, I wanted to make sure you understood that, since list values are references to list objects in the heap, the *swap* function can change the list object and the value in q4 will "see" the change. Second, *b_lis* and *a_lis* are two references to the same list object, so *swap* gets called twice on that object. This one is not too hard if you draw the pictures, but it's hard to do in your head.

(score)

5. [10 points] Write the body of function span, consistent with its docstring, and without using Python's standard min, max, or sort functions.

```
def span(ar):
    """Find the difference between the maximum and minimum elements of
    a list of integers.
    Arguments:
        ar: a list of integers (not modified)
    Returns:
        The difference between the largest and smallest elements of ar.
        For lists with 0 elements, span(ar) is defined to be 0.
    Examples:
        span([ 0, 1, 2, 3, 4, 5 ]) = 5
        span([ -2, -6, 4, 10 ]) = 16
    """
    if len(ar) < 2:
        return 0
    min = ar[0]
    max = ar[0]
    for el in ar:
        if el < min:
            min = el
        if el > max:
            max = el
    span = max - min
    return span
```

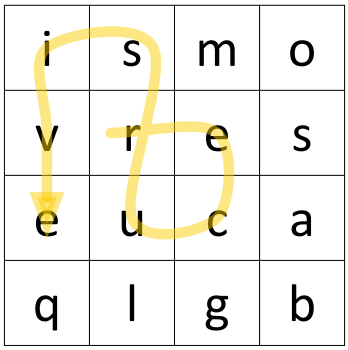
6. [15 points] Write the body of function dedup, consistent with its docstring. It may help to remember that you can build up strings by appending each character to the end using "+", e.g., `"cod" + "e" == "code"`.

```
def dedup(w):
    """Return a copy of w with runs of identical characters collapsed.
       Arguments:
           w:  A string of letters
       Returns:
           A string identical to w, except that wherever two or more
           identical characters appeared consecutively in w, only
           one copy appears in the returned string.
        Examples:
           dedup("abbcdefffgfgfgxxx") => "abcdefgfgfgx"
           dedup("abcdef") => "abcdef"
           dedup("xxxxxxxxxx") => "x"
           dedup("") => ""
    """
    result = ""
    prior = ""
    for ch in w:
        if ch == prior:
            pass
        else:
            result = result + ch
            prior = ch
    return result
```

You can get shorter code by reversing the test in the loop and eleminating the *pass* branch. I chose this arrangement because I thought it was slightly clearer. I also saw some student answers test against last character in *result* and eliminate the need for the *prior* variable, which is nice.

(score)

7. [15 points] This problem (continued on the next page) may remind you of our Boggler project, but it has been considerably simplified. We search for a single word in a board with four rows and four columns. A word must be spelled out by moving left, right, up, or down. There are no diagonal moves, and it is ok to use a letter more than once, as 'r' is used twice to find"recursive" in this board:



Most of the `WordBoard` class is provided, but you must fill in the recursive depth-first search for matching a word. Note the method `match_letter` will work and return False if you check for a letter matching a position that is not on the board (e.g., if you look for the letter '*a*' in row -3, column 5), so you should not make redundant checks in your search method. Think of the variable `pos` as a finger keeping track of which letter of the word to match next.

```
class WordBoard():
    """A word puzzle board, 4 rows (0..3) by 4 columns (0..3)"""

    def __init__( self, text ):
        """Create a 4x4 puzzle board from 16 characters of text."""
        self.board = [ text[0:4], text[4:8], text[8:12], text[12:16] ]

    def match_letter(self, letter, row, col):
        """Check for letter match at row, col.
           Returns True iff row, col is on the board
                   and the character at board[row][col] matches letter.
        """
        if row < 0 or row > 3 or col < 0 or col > 3:
            return False
        return self.board[row][col] == letter
```

(Continued on next page. You can tear this page out if you like.)

(*Class* `WordBoard` *continued from previous page. Complete the method* `find_suffix_at`.)

```
    def find(self, word):
        """Can word be spelled out on the board, starting
        anywhere and moving only up, down, left, right?
        Arguments:
            word: The word we're searching for
        Returns:
            True iff word can be spelled out by a series of
            only left, right, up, and down movements on the board.
        """
        for row in range(4):
           for col in range(4):
               if self.find_suffix_at(row, col, word, 0):
                   return True
        return False

    def find_suffix_at(self, row, col, word, pos):
        """Depth-first search for a word, continuing from
        board position (row, col) and index pos in word.
        If pos >= len(word), then it has been fully matched.
        Note self.match_letter(letter,row,col) returns False
        if row,col is not on the board.
        Arguments:
            row, col:  Looking for it starting in this position.
            word: The word we're looking for
            pos:  Looking for the suffix that starts at word[pos].
        Returns:
            True if the letters from word[pos] to word[len(word)-1]
            can be found starting at board[row,col].
        """
        if pos >= len(word):
            return True
        if not self.match_letter(word[pos], row,col):
            return False
        return (self.find_suffix_at(row+1, col, word, pos+1) or
                self.find_suffix_at(row, col+1, word, pos+1) or
                self.find_suffix_at(row-1, col, word, pos+1) or
                self.find_suffix_at(row, col-1, word, pos+1) )
```

A lot of the test answers I've seen so far make the recursive calls, but don't do anything with the boolean value it returns. There are several possible variations of the answer given here, broken into more or fewer statements. A single complex boolean expression is possible ... I just don't think it's quite as clear as this.

(score)