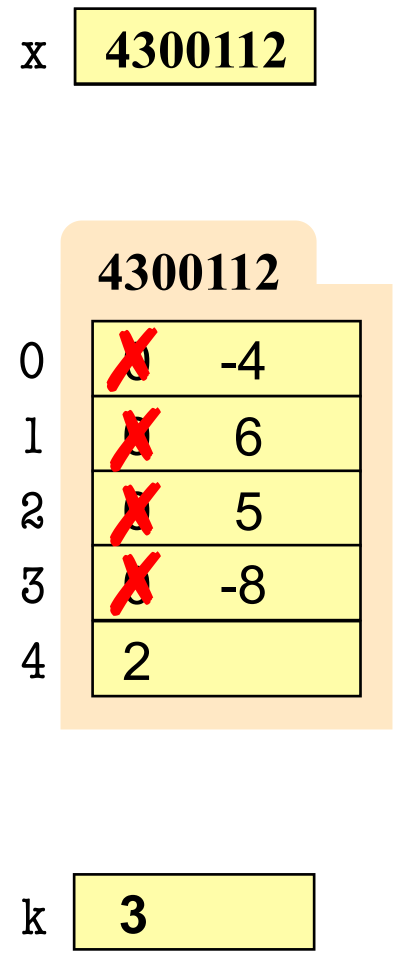
Review 4

Lists and Sequences

Overview of List Syntax

• `x = [0, 0, 0, 0]`	Create list of length 4 with all zeroes
• `x.append(2)`	Append 2 to end of list x (now length 5)
• `3 in x`	Evaluates to `False` (3 not in x)
• `x[2] = 5` • `x[0] = –4`	Assign 5 to element 2 and –4 to element 0
• `k = 3` • `x[k] = 2 * x[0]` • `x[k–2] = 6`	Assign -8 to x[3] and 6 to x[1]



Lists vs. Tuples vs. Strings

Lists

- **Creation**
  x = [a1, a2, a3, …]
  Can contain anything
- **len(x) is length**
- **Supports slicing**
  Example: x[1:2]
  x[i] is an element
- **Can concatenate**
  y = x + [1, 2]
  Makes a new list
- **Is mutable**
  x.append(5)

Tuples

- **Creation**
  x = (a1, a2, a3, …)
  Can contain anything
- **len(x) is length**
- **Supports slicing**
  Example: x[1:2]
  x[i] is an element
- **Can concatenate**
  y = x + (1, 2)
  Makes a new tuple
- **Is not mutable**

Strings

- **Creation**
  x = 'Hello'
  Only contains chars
- **len(x) is length**
- **Supports slicing**
  Example: x[1:2]
  x[i] is a substring
- **Can concatenate**
  y = x + ' World'
  Makes a new string
- **Is not mutable**

Lists vs. Tuples vs. Strings

Did not use this semester, but work almost like lists do.

Lists

- **Creation**

  x = [a1, a2, a3, …]

  Can contain anything
- **len(x) is length**
- **Supports slicing**

  Example: x[1:2]

  x[i] is an element
- **Can concatenate**

  y = x + [1, 2]

  Makes a new list
- **Is mutable**

  x.append(5)

Tuples

- **Creation**

  x = (a1, a2, a

  Can contain a
- **len(x) is length**
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  Example: x[1:2]

  x[i] is an element
- **Can concatenate**

  y = x + (1, 2)

  Makes a new tuple
- **Is not mutable**

Strings

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- **len(x) is length**
- **Supports slicing**

  Example: x[1:2]

  x[i] is a substring
- **Can concatenate**

  y = x + ' World'

  Makes a new string
- **Is not mutable**

Modified Question 4 from Fall 2011

Each elements in the list `scores` contains the number of students who received score i on a test. For example, if 30 students got 85, then `scores[85]` is 30.Write the body of function `histogram`, which returns a histogram as a list of strings. (You need not write loop invariants.) For example, if scores = [7, 0, 4, 3, 2, 0, …] then the first elements of the resulting string list are:

```
'00 *******'
'01 '
'02 ****'
'03 ***'
'04 *'
'05 '
```

Modified Question 4 from Fall 2011

```
def histogram(scores):
    """Return a list of Strings (call it s) in which each s[i] contains:
        (1) i, as a two-digit integer (with leading zeros if necessary)
        (2) a blank,
        (3) n asterisks '*', where n is scores[i].
    Precondition: scores is a list of nonnegative integers, len(scores) < 100"""
    # IMPLEMENT ME
```

Modified Question 4 from Fall 2011

```
def histogram(scores):
    """Return a list of Strings (call it s) in which each s[i] contains:
        (1) i, as a two-digit integer (with leading zeros if necessary)
        (2) a blank,
        (3) n asterisks '*', where n is scores[i].
    Precondition: scores is a list of nonnegative integers, len(scores) < 100"""
    s = []   # List to contain the result.
    for i in range(len(scores)):   # Need the value i, not the elements of scores
        row = str(i)+' '   #  Row is the string for this row
        for n in range(scores[i]):   # Loop over number of elements in scores[i]
            row = row+'*'   # Add another * to the row
        s.append(row)     # Add row to the list
    return s
```

Overview of Two-Dimensional Lists

- Access value at row 3, col 2:

  `d[3][2]`

- Assign value at row 3, col 2:

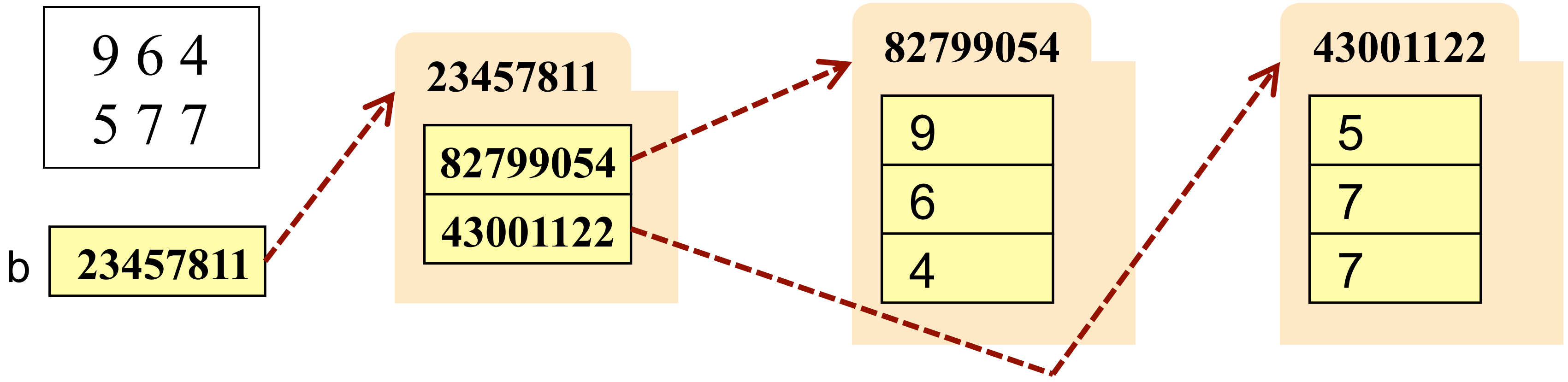
  `d[3][2] = 8`

- **An odd symmetry**
  - Number of rows of d: `len(d)`
  - Number of cols in row r of d: `len(d[r])`

d	0	1	2	3
0	5	4	7	3
1	4	8	9	7
2	5	1	2	3
3	4	1	2	9
4	6	7	8	0

How Multidimensional Lists are Stored

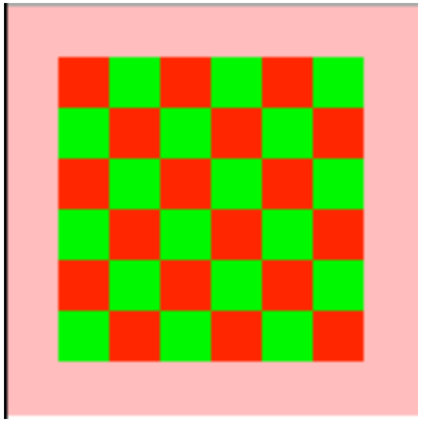
- `b = [[9, 6, 4], [5, 7, 7]]`



- b holds name of a one-dimensional list
  - Has len(b) elements
  - Its elements are (the names of) 1D lists
- b[i] holds the name of a one-dimensional list (of ints)
  - Has len(b[i]) elements

Modified Question 4 from Fall 2010

Recall drawing GRectangles in A7. Write method placeSquares, whose requirements appear below. It draws square bricks as shown to the right and returns them as a 2d list of GRectangle



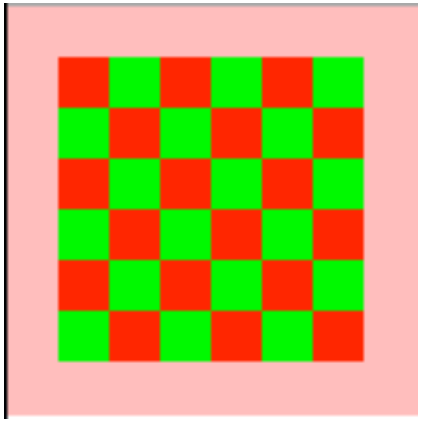
```
def placeSquares(self, m):
    """Create a list of m x m squares (GRectangle), as specified
    below, adding the squares to the GUI, and return the list."""
```

Method Requirements:

- There are m columns and rows of squares; precondition: 0 < m.
- Each square has side length BRICK_SIDE; there is no space between them.
- The bottom-left square is at the bottom-left corner (0,0) of the GUI. Squares in columns and rows 0 and m-1 have color colormodel.PINK
- Inner squares have checkerboard pattern of colormodel.RED and colormodel.GREEN, as shown (bottom-left one is green; one next to it, red).

Modified Question 4 from Fall 2010

Recall drawing GRectangles in A7. Write method placeSquares, whose requirements appear below. It draws square bricks as shown to the right and returns them as a 2d list of GRectangle



```
def placeSquares(self, m):
    """Create a list of m x m squares (GRectangle), as specified
    on last slide, adding them to the GUI, and return the list."""
```

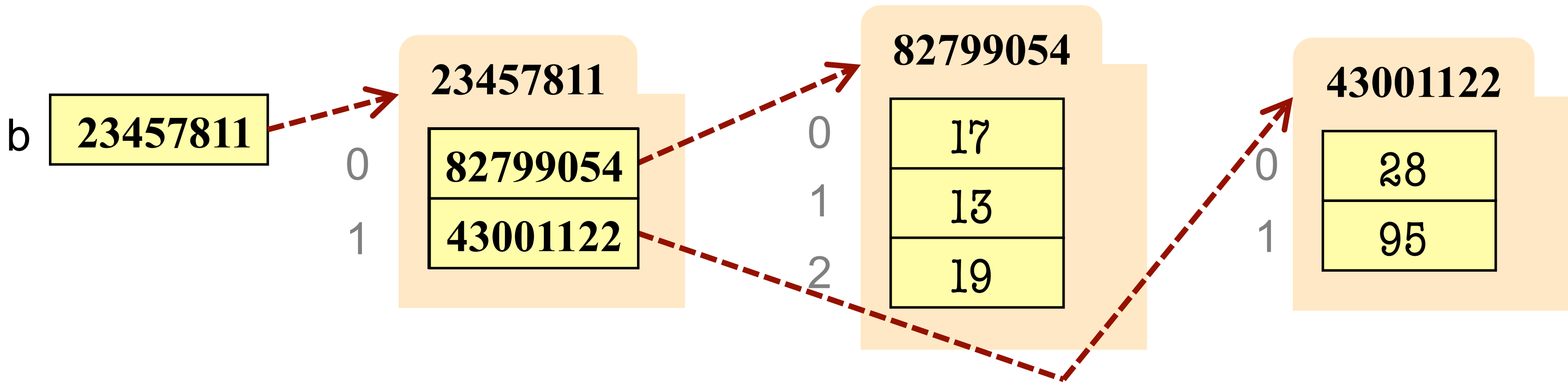
API Reminders:

- GRectangle has attributes pos (a 2 element tuple), size (a 2 element tuple), fillcolor, and linecolor
- You construct a GRectangle with keyword arguments: GRectangle(pos=(0,0),size=(10,10))
- You add to the GUI with self.view.add(...)

```python
def placeSquares(self, m):
    """Place the m x n Bricks, as requested on the exam and return the list"""
    bricks = [];  c = 0   # Make a new list to represent columns
    while c < m:   # Place col c of bricks
        row = [];  r = 0   # Make a new list to represent rows
        while r < m:
            color = colormodel.RED
            if r == 0 or r == m-1 or c == 0 or c == m-1:
                color = colormodel.PINK
            elif r+c % 2 == 0:
                color = colormodel.GREEN
            brick=GRectangle(pos=(r*BRICK_SIDE,c*BRICK_SIDE), fillcolor=color
                             size=(BRICK_SIDE,BRICK_SIDE), linecolor=color)
            row.append(brick)
            self.view.add(brick); r = r+1
        bricks.append(row)
        c= c+1
    return bricks
```

Ragged Lists: Rows w/ Different Length

- b = [[17,13,19],[28,95]]



- To create a ragged list
  - Create b as an empty list (b = [])
  - Create each row as a list (r1 = [17,13,19]; r2 = [28,95])
  - Append lists to b (b.append(r1); b.append(r2))

Modified Question 4 from Fall 2011

Someone messed up a method to create certain arrays for us. For example (and this is only an example), they produced the array:

3 1 2		1 2 3
2 1 7 8 5	instead of	1 7 8 5 2
5	the array	5
6 8		8 6

Thus, they put the last value of each row at the beginning instead of the end.

Write a procedure that fixes this by rotating each row one position to the left; each element is moved one position earlier, and the first element is placed in the last position. Do not use recursion. **DO NOT RETURN A VALUE**.

```
def rotate(b):
    """Rotate each row one position to the left, as explained above.
    Precondition: b is a list, might be ragged, and each row has >= 1 value"""
```

Modified Question 4 from Fall 2011

```
def rotate(b):
    """Rotate each row one position to the left, as explained on the previous slide.
    Precondition: b is a list, might be ragged, and each row has >= 1 value"""
    # invariant: rows 0..r−1 of b have been rotated
    r = 0
    while r < len(b):
        first = b[r][0]              # Rotate row r one position to the left;
        # inv: b[r][1..c−1] moved to b[r][0..c−2]
        c = 1
        while c < len(b[r])
            b[r][c-1]= b[r][c];
            c= c+1
        # post: b[r][1..] has been moved to b[r][0..]
        b[r][len(b[r])−1]= first;
    # post: rows 0..b.length−1 of b has been rotated
```