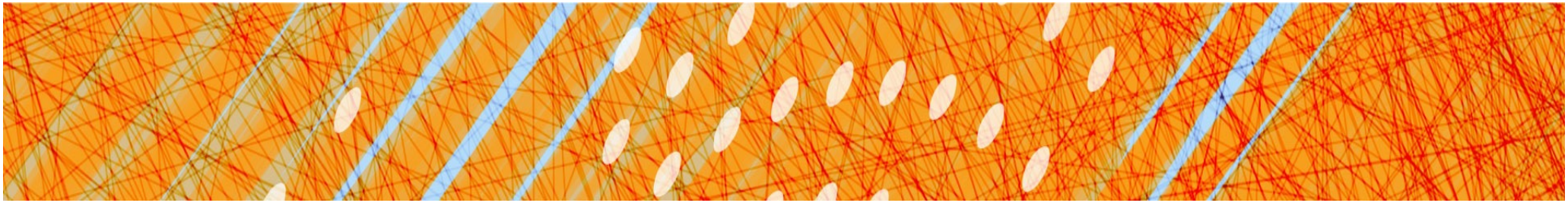


# Lecture 12: Nested Lists

(Sections 10.8-10.13, 12.1, 12.2)

CS 1110

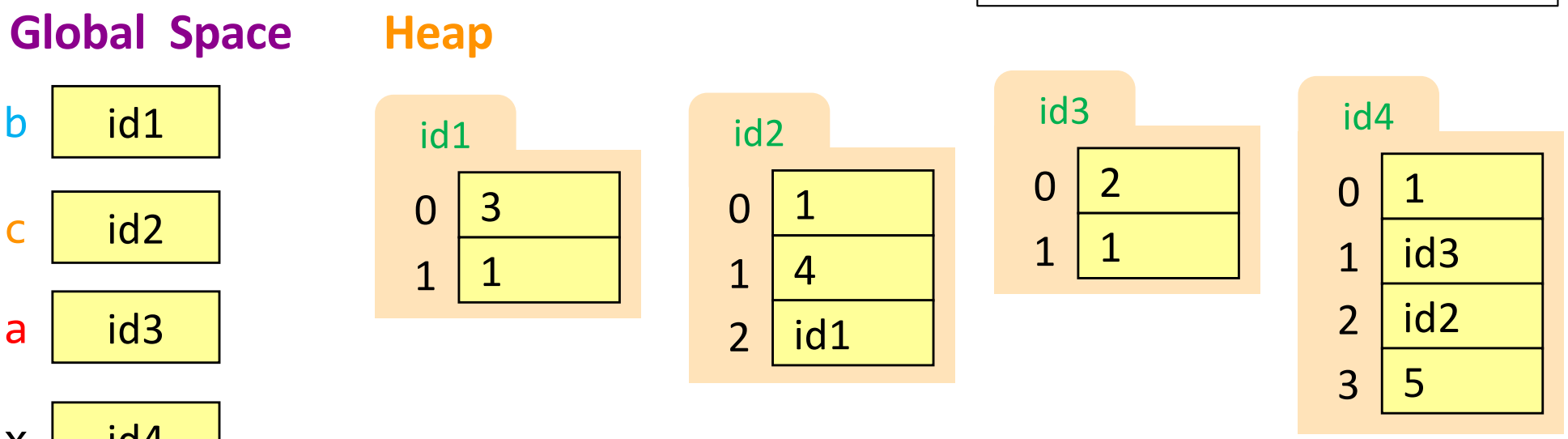
Introduction to Computing Using Python

[E. Andersen, A. Bracy, D. Gries, L. Lee, S. Marschner, C. Van Loan, W. White]

# Nested Lists

- Lists can hold any objects
- Lists are objects
- Therefore lists can hold other lists!

```
b = [3, 1]
c = [1, 4, b]
a = [2, 1]
x = [1, a, c, 5]
```



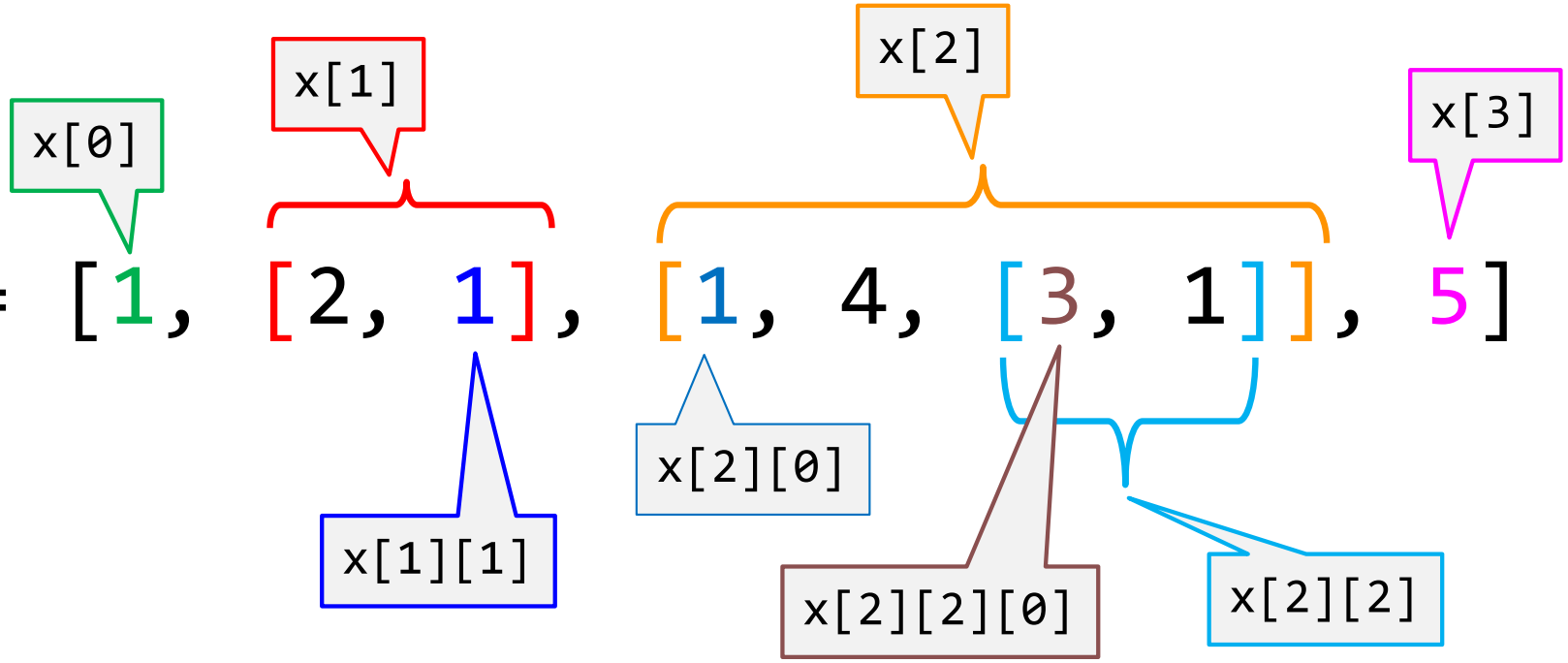

This is drawing accurate, but a little hard to reason about…

# Nested Lists

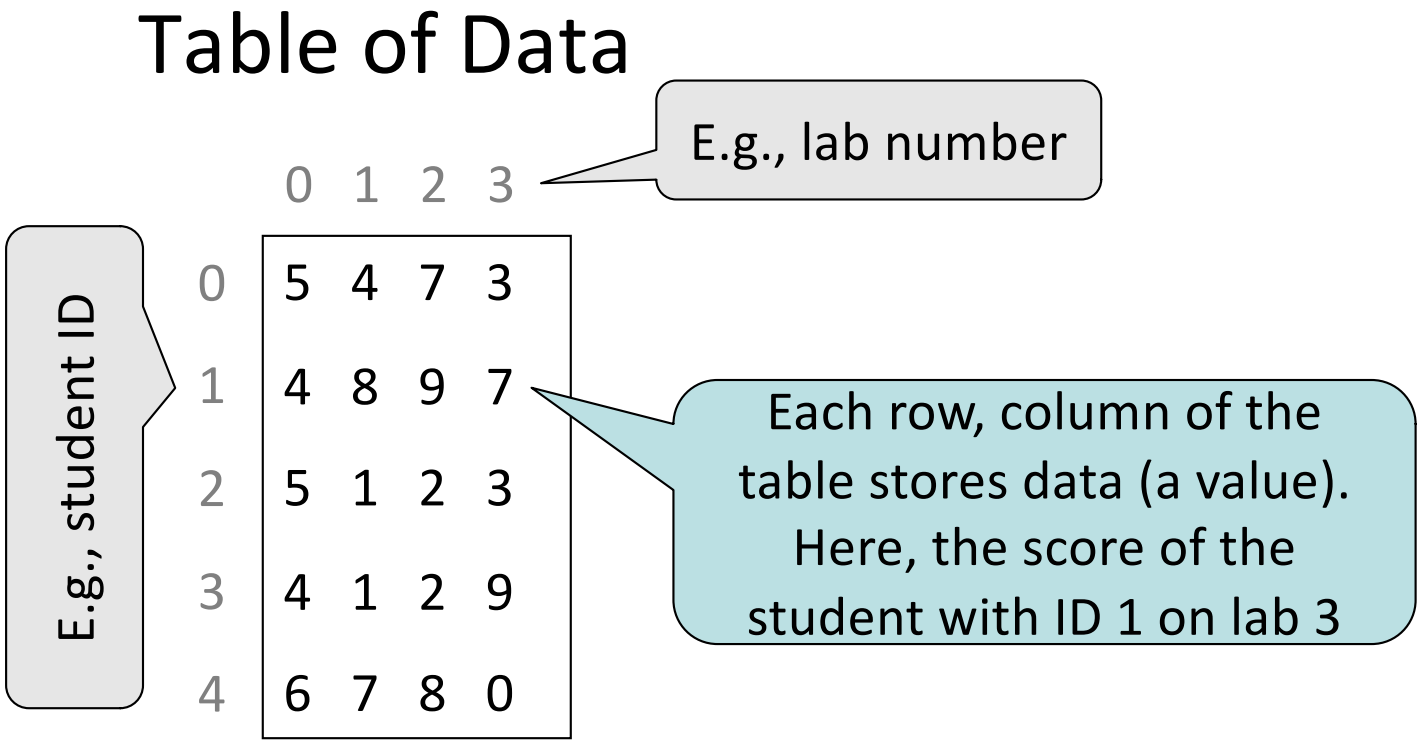
Conceptually, you can visualize nested lists like this:

```
b = [3, 1]
c = [1, 4, b]
a = [2, 1]
x = [1, a, c, 5]
```

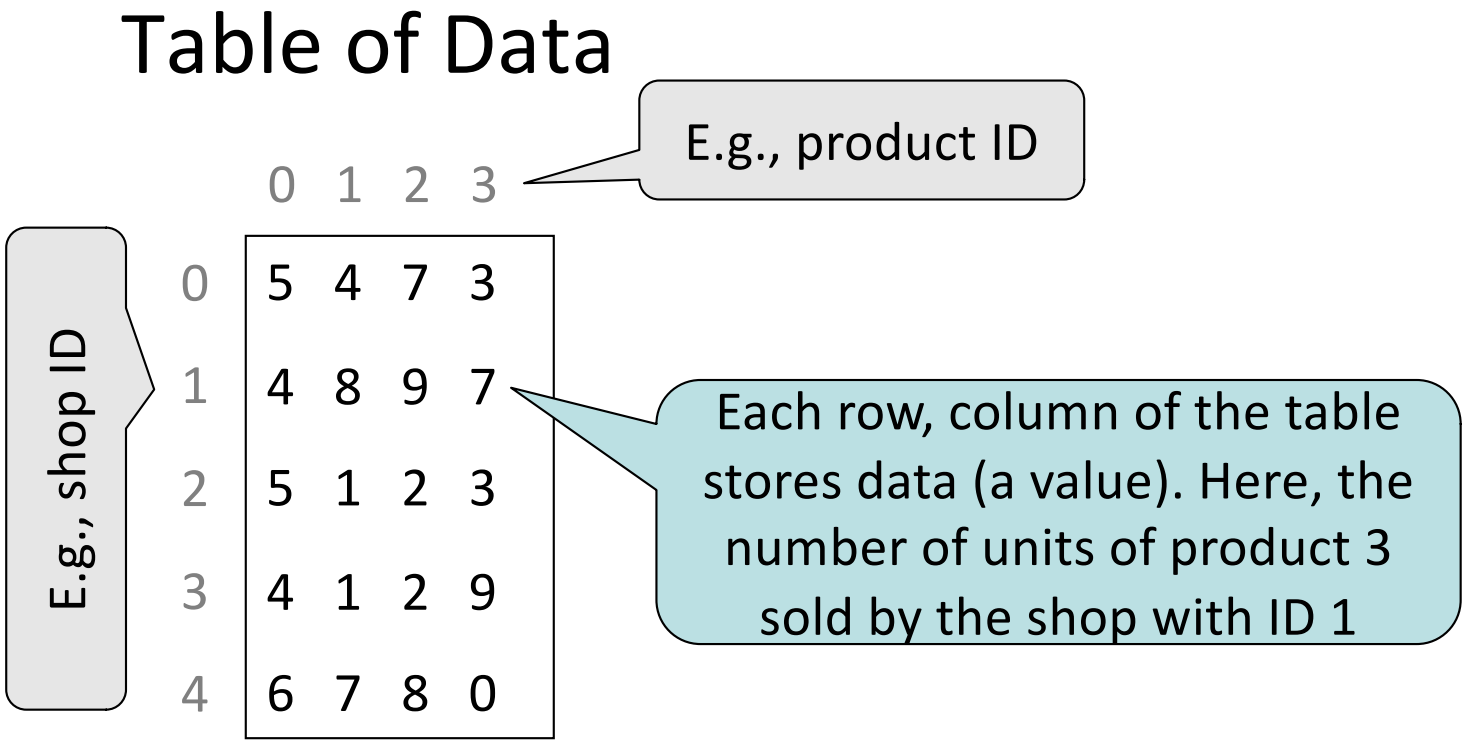
```
x = [1, [2, 1], [1, 4, [3, 1]], 5]
```



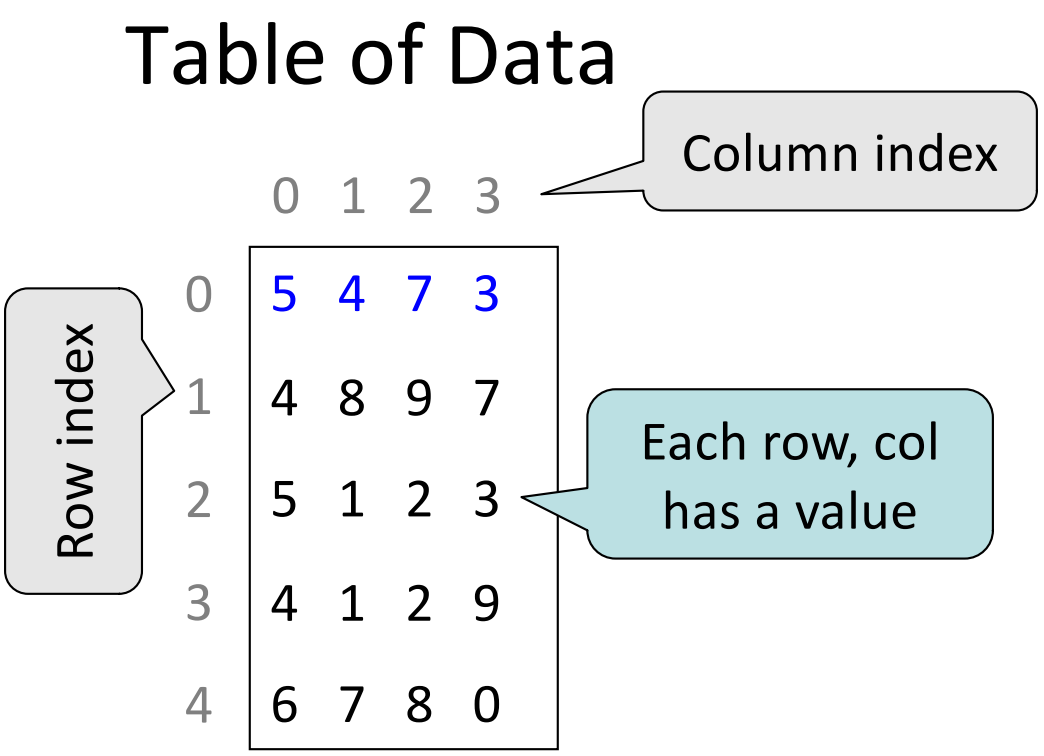
# "Table-shaped" Two-Dimensional Lists



# "Table-shaped" Two-Dimensional Lists



# "Table-shaped" Two-Dimensional Lists




Really a list of lists, but convenient to think about it as a table, since all inner lists (rows) have the same number of elements.

Store them as a list of lists ("row-major order")

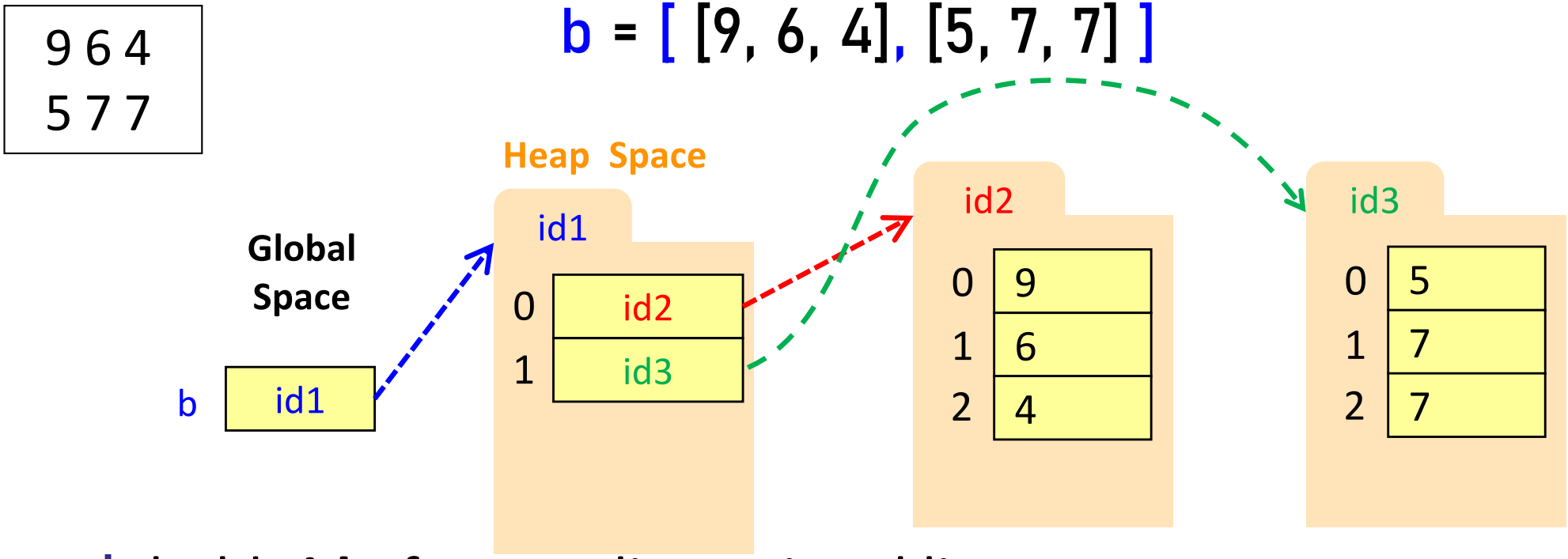
```
tdlist = [[5,4,7,3], [4,8,9,7], [5,1,2,3],
          [4,1,2,9], [6,7,8,0]]
```

# Overview of Two-Dimensional Lists

| | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| 0 | 5 | 4 | 7 | 3 |
| 1 | 4 | 8 | 9 | 7 |
| 2 | 5 | 1 | 2 | 3 |
| 3 | 4 | 1 | 2 | 9 |

```
>>> tdlist = [[5,4,7,3],[4,8,9,7],[5,1,2,3],[4,1,2,9]]
>>> tdlist[3][2]                    Access value at row 3, col 2
2
>>> tdlist[3][2] = 8                Assign value at row 3, col 2
>>> tdlist
[[5, 4, 7, 3], [4, 8, 9, 7],[5, 1, 2, 3], [4, 1, 8, 9]]
>>> len(tdlist)                     Number of rows of tdlist
4
>>> len(tdlist[2])                  Number of cols in row 2 of tdlist
4
```

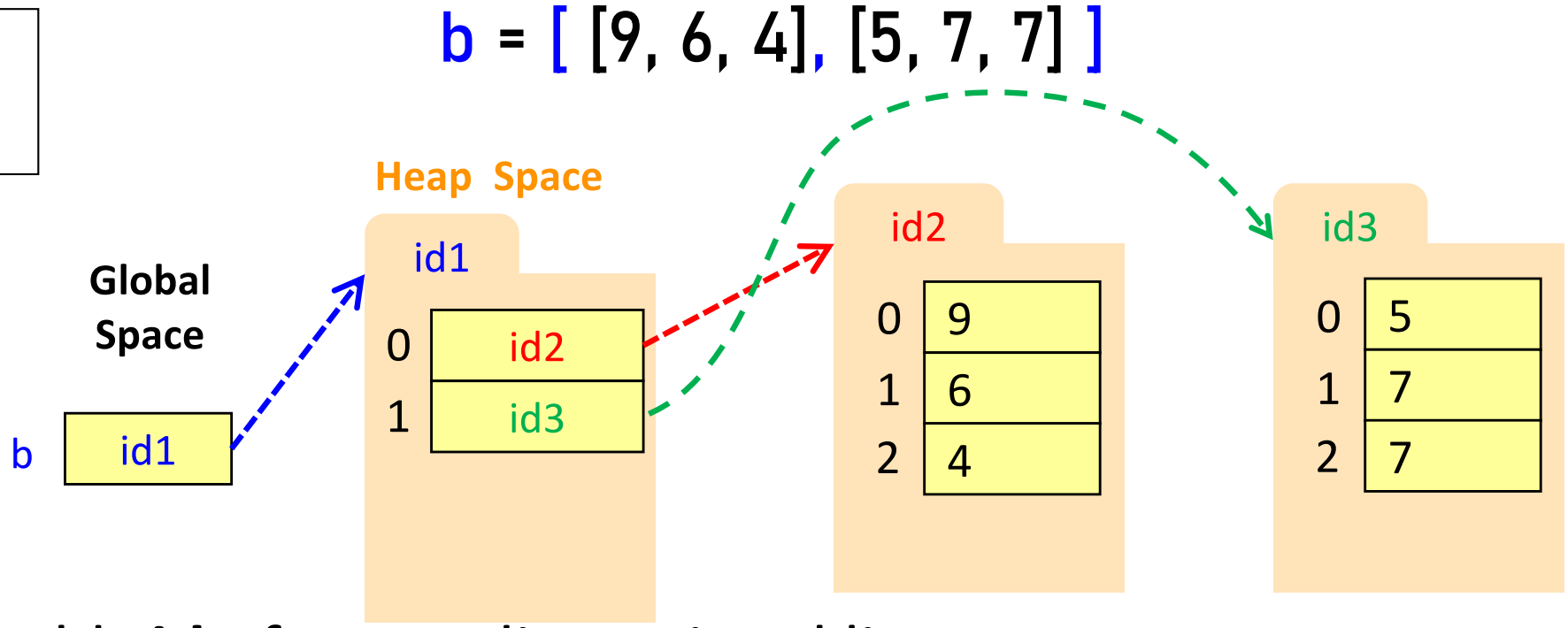
# How Multidimensional Lists are Stored




- b holds **id** of a one-dimensional list
  - Has len(b) elements
- b[i] holds **id** of a list
  - Has len(b[i]) elements

# How to access every element of nested list?

```
9 6 4
5 7 7
```




- b holds **id** of a one-dimensional list
  - Has len(b) elements `# len(b) rows`
- b[i] holds **id** of a list
  - Has len(b[i]) elements

```
# row i has len(b(i)) elements
```

Need: a loop to go row by row. At each row, a loop to go column by column.
→ Nested loops!

# Exercise 1

```
def print_all_rows(my_table):
    """Prints all rows of the table,
    one row (list) on each line.
    Preconditions:  my_table is a table of numbers
                    my_table is not empty  """
```

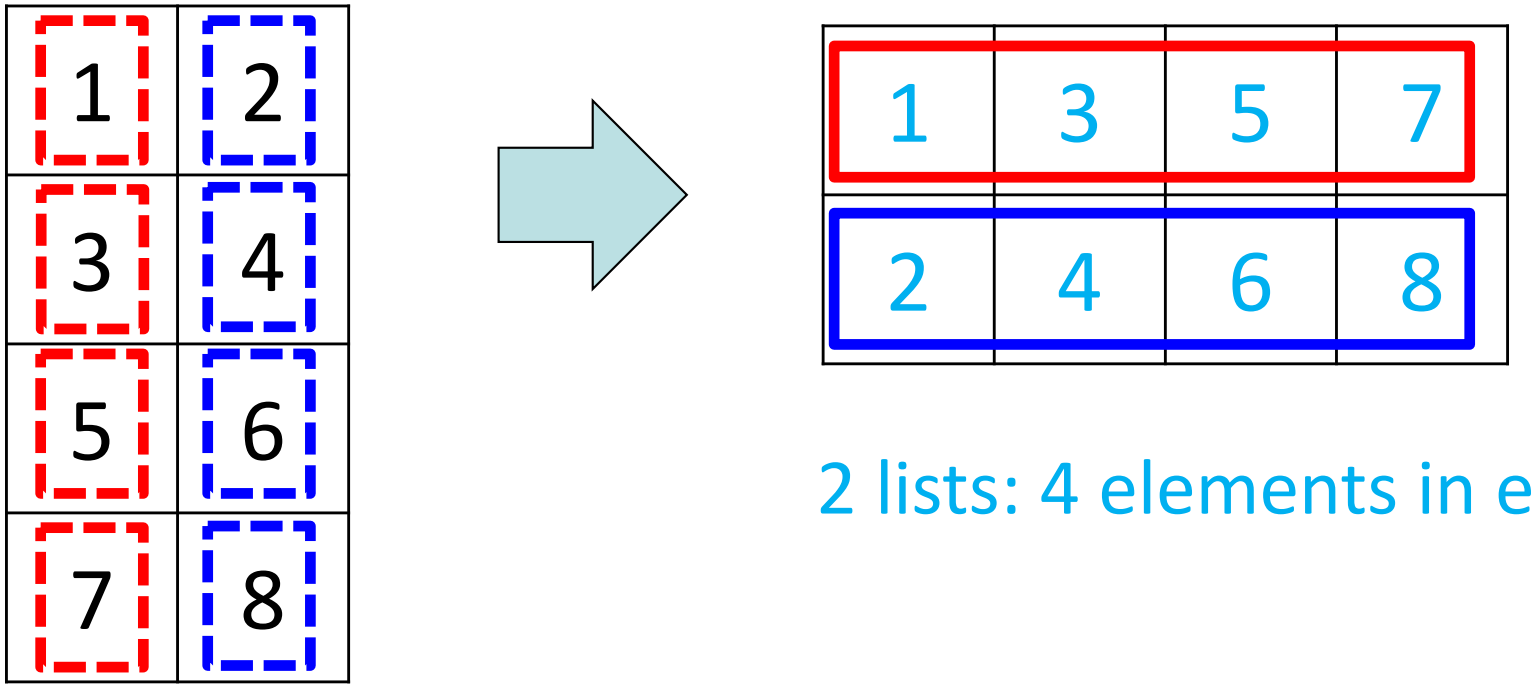
See table.py

# Exercise 2

```
def print_all_elements(my_table):
    """Prints all elements of the table,
    one element on each line.
    Preconditions:  my_table is a table of numbers
                    my_table is not empty  """
```

See table.py

# Data Wrangling: Transpose Idea



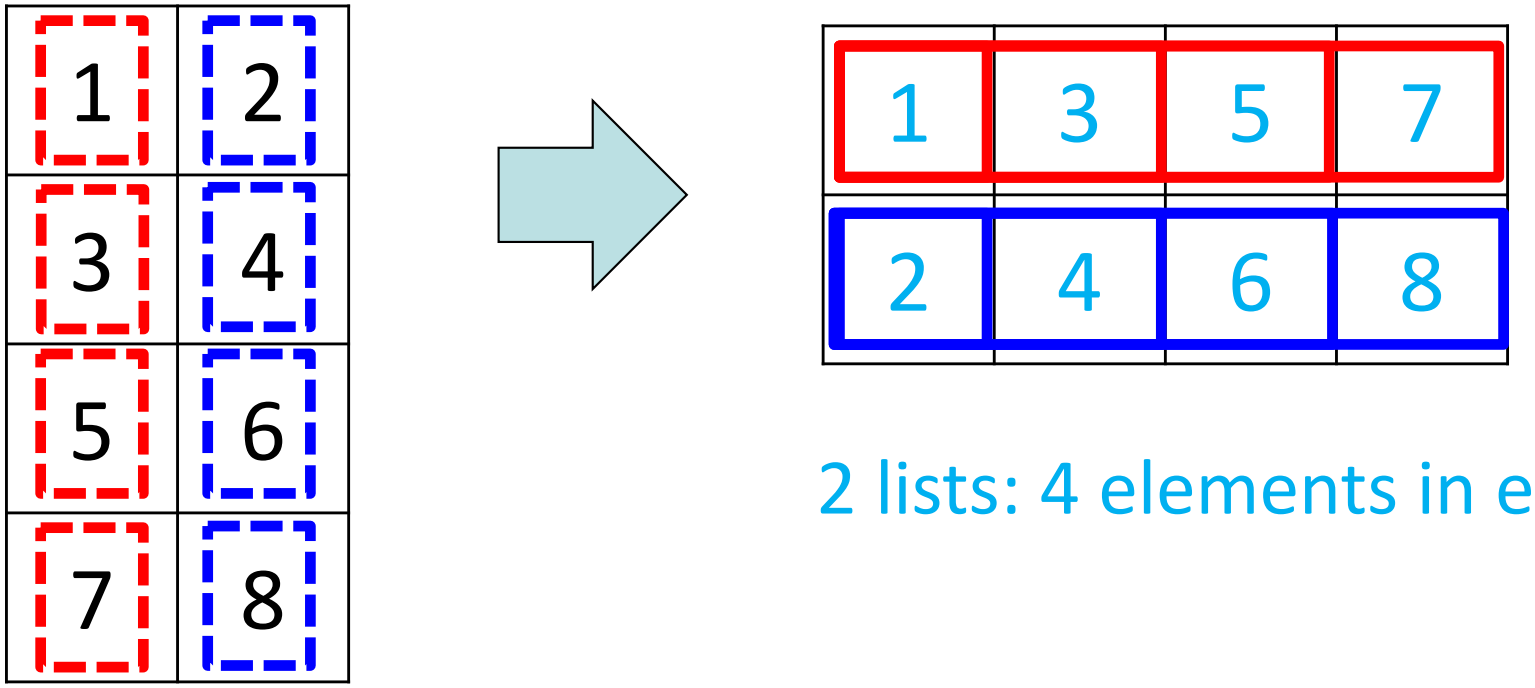

2 lists: 4 elements in each

4 lists: 2 elements in each

How to transpose?

- 1st element of each list gets appended to 1st list
- 2nd element of each list gets appended to 2nd list

# Data Wrangling: Transpose Idea




2 lists: 4 elements in each

4 lists: 2 elements in each

How to transpose?

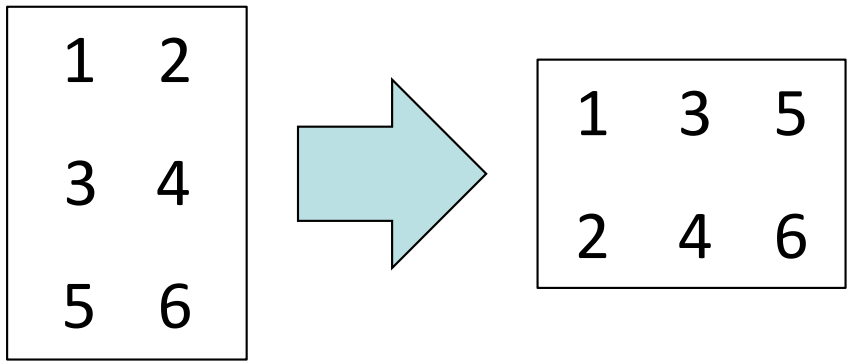
- 1st element of each list gets appended to 1st list
- 2nd element of each list gets appended to 2nd list

# Data Wrangling: Transpose Code

```
def transpose(table):
    """Returns: copy of table with rows and columns swapped
    Precondition: table is a (non-ragged) 2d List"""
    n_rows = len(table)
    n_cols  = len(table[0]) # All rows have same no. cols
    new_table = [] # Result accumulator
```

```
    return new_table

d = [[1,2],[3,4],[5,6]]
d_v2 = transpose(d)
```



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```

```
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```

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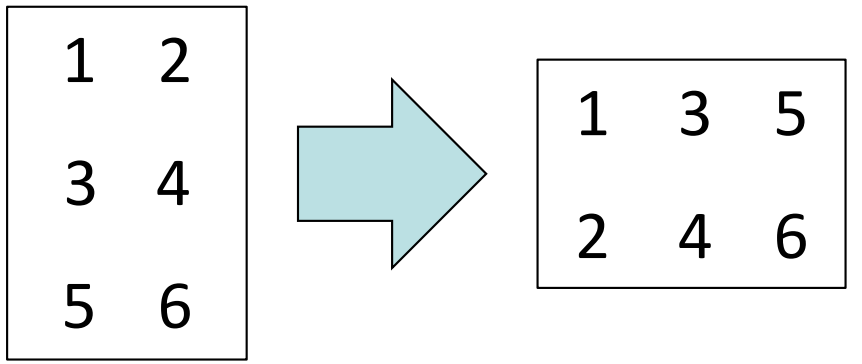

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    Precondition: table is a (non-ragged) 2d List"""
    n_rows = len(table)
    n_cols  = len(table[0]) # All rows have same no. cols
    new_table = [] # Result accumulator

    for c in range(n_cols):
        row = [] # Single row accumulator
        for r in range(n_rows):
            row.append(table[r][c]) # Build up new row
        new_table.append(row) # Add new row to new table
    return new_table
```
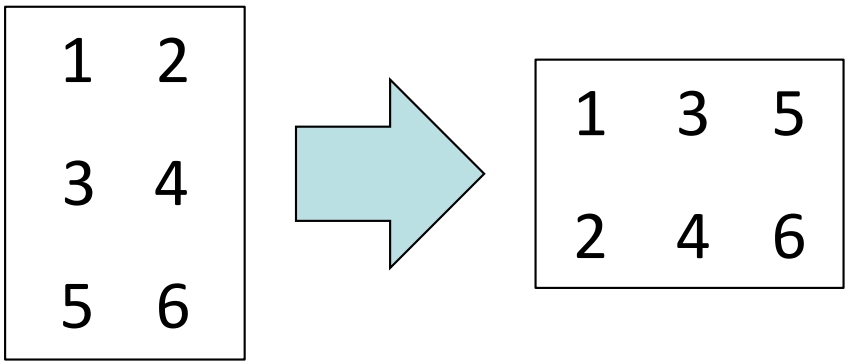
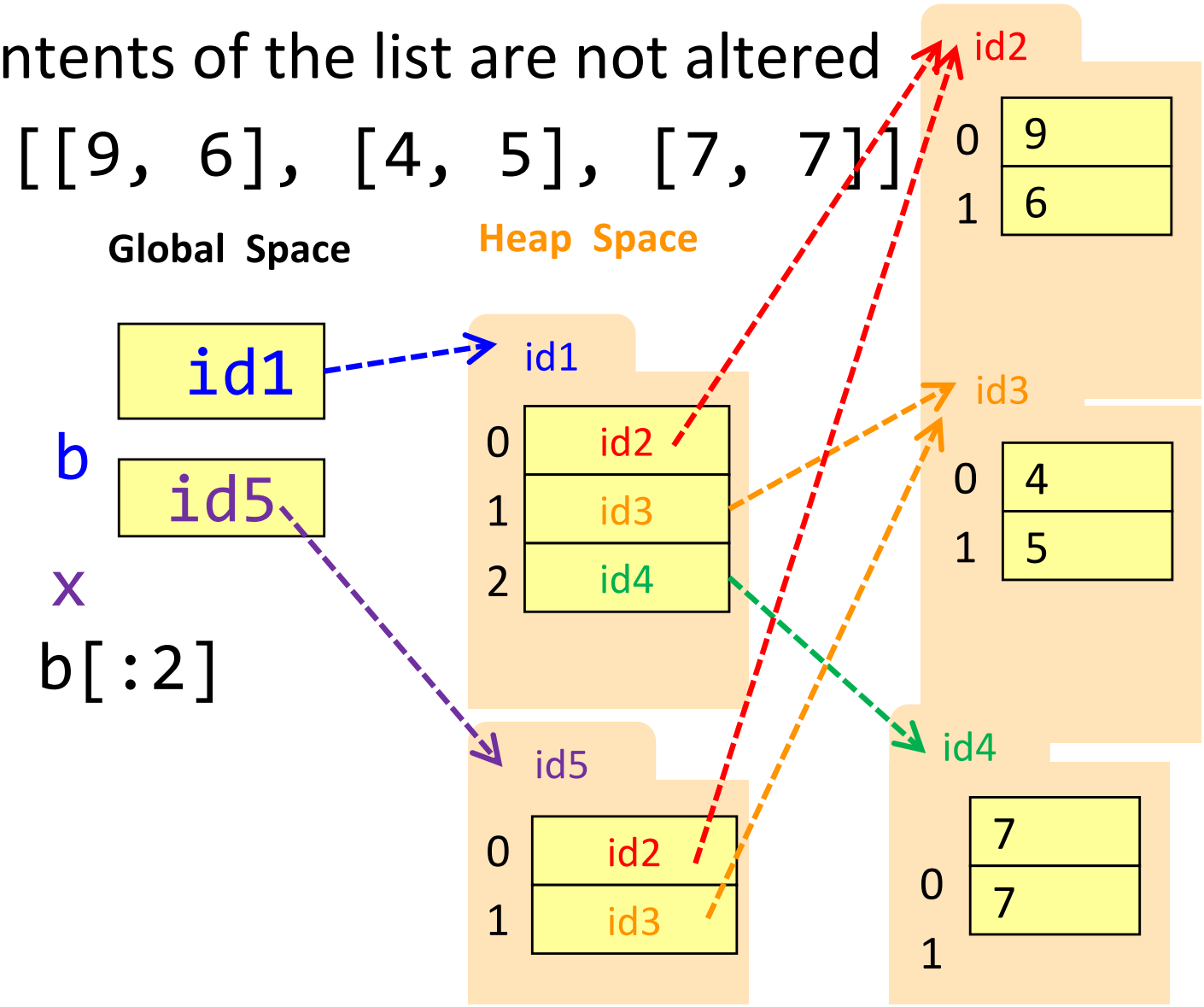

```
d = [[1,2],[3,4],[5,6]]
d_v2 = transpose(d)
```



# Slices and Multidimensional Lists

- Only “top-level” list is copied.
- Contents of the list are not altered

```
b = [[9, 6], [4, 5], [7, 7]]
x = b[:2]
```



# Slices & Multidimensional Lists (Q1)

- Create a nested list

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

- Get a slice

```
>>> x = b[:2]
```

- Append to a row of x

```
>>> x[1].append(10)
```

What is now in x?

A: `[[9,6,10]]`
B: `[[9,6],[4,5,10]]`
C: `[[9,6],[4,5,10],[7,7]]`
D: `[[9,6],[4,10],[7,7]]`
E: I don't know

# Slices & Multidimensional Lists (Q2)

- Create a nested list

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

- Get a slice

```
>>> x = b[:2]
```

- Append to a row of x

```
>>> x[1].append(10)
```

- x now has nested list

```
[[9, 6], [4, 5, 10]]
```

- What is now in b?

A: `[[9,6],[4,5],[7,7]]`
B: `[[9,6],[4,5,10]]`
C: `[[9,6],[4,5,10],[7,7]]`
D: `[[9,6],[4,10],[7,7]]`
E: I don't know