Objectives

- Handling exceptions
- Two-dimensional lists

Computer Science Understanding

- Do you understand what a class is and its purpose? What is a class made up of?
- Can you implement a class (of "reasonable" size), given what it is supposed to represent and what it is supposed to do?
- Given a class's API, can you solve problems with it?
  - When you write the UI for FaceSpace, you are using the API for the `SocialNetwork` class
- Do you understand the strengths and weaknesses of linear and binary search? When would you use one over the other?

Handling Exceptions

- Using try/except statements
- Syntax:

```
try:
      <body>
except [<errorType>] :
      <handler>
```

Optional: use this to handle specific error types appropriately

- Example:

```
try:
      age = input(“Enter your age: ”)
      currentyear = input(“Enter the current year: ”)
except:
      print “ERROR: Your input was not in the correct form.”
      print “Enter integers for your age and the current year”
      return
```

`yearborn.py`

Handling Exceptions

- Could put `try/except` statements in a loop to make sure user enters valid input
  - Example: `birthyear3.py`
- Other types of exceptions
  - File exceptions:
    - File doesn’t exist
    - Don’t have permission to read/write file

`file_handle.py`

Lists

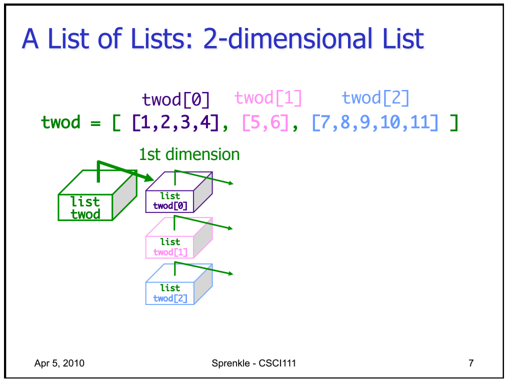
- We’ve used lists that contain
  - Integers
  - Strings
  - Cards (Deck class)
  - Persons (your Person class)
- We discussed that lists can contain multiple types of objects within the same list
  - Wheel of Fortune: [“Bankrupt”, 250, 350, …]
- Lists can contain *any* **type** of object
  - Even **LISTS**!

Review of Regular (1D) Lists

- Create a list `onedlist = [ 7, -1, 23 ]`

Elements in the list

- `len(onedlist)` is 3
- `onedlist[2]` is 23

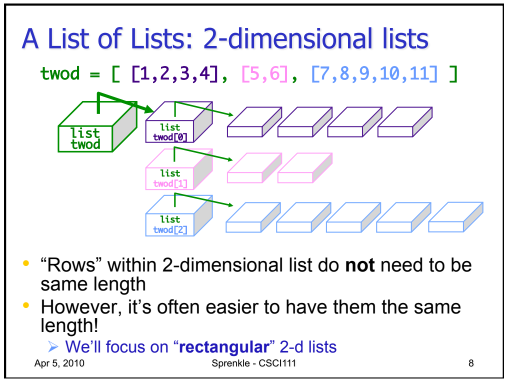


A List of Lists: 2-dimensional List

`twod[0]` `twod[1]` `twod[2]`

`twod = [ [1,2,3,4], [5,6], [7,8,9,10,11] ]`

1st dimension
list
twod
list
twod[0]
list
twod[1]
list
twod[2]

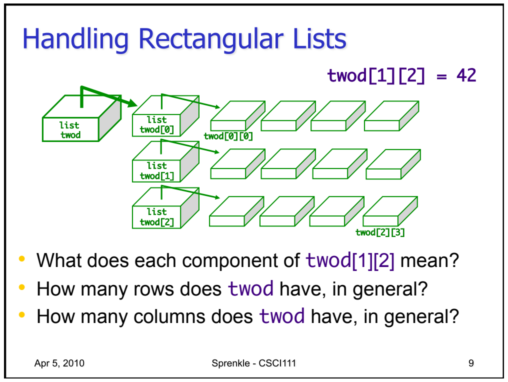


A List of Lists: 2-dimensional lists

`twod = [ [1,2,3,4], [5,6], [7,8,9,10,11] ]`

list
twod
list
twod[0]
list
twod[1]
list
twod[2]

- “Rows” within 2-dimensional list do **not** need to be same length
- However, it’s often easier to have them the same length!
  - We’ll focus on “**rectangular**” 2-d lists

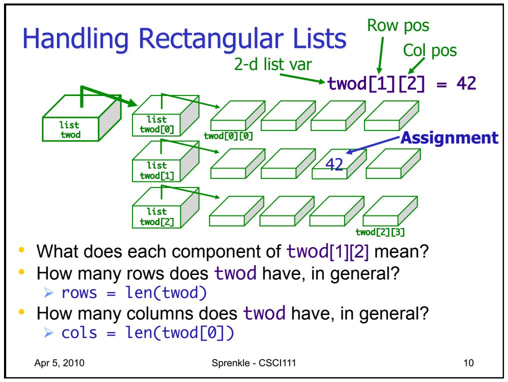


Handling Rectangular Lists

`twod[1][2] = 42`

list
twod
list
twod[0]
twod[0][0]
list
twod[1]
list
twod[2]
twod[2][3]

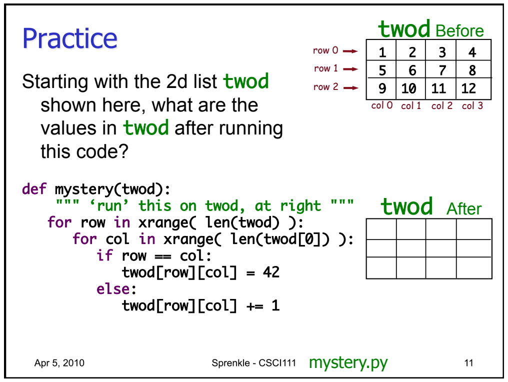
- What does each component of twod[1][2] mean?
- How many rows does twod have, in general?
- How many columns does twod have, in general?



Handling Rectangular Lists

Row pos
Col pos
2-d list var
twod[1][2] = 42
list
twod
list
twod[0]
twod[0][0]
Assignment
42
list
twod[1]
list
twod[2]
twod[2][3]

- What does each component of twod[1][2] mean?
- How many rows does twod have, in general?
  - `rows = len(twod)`
- How many columns does twod have, in general?
  - `cols = len(twod[0])`



Practice

Starting with the 2d list twod shown here, what are the values in twod after running this code?

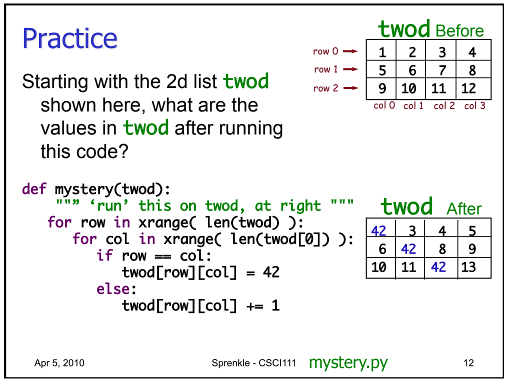
twod Before

row 0	1	2	3	4
row 1	5	6	7	8
row 2	9	10	11	12
	col 0	col 1	col 2	col 3

```
def mystery(twod):
    """ ‘run’ this on twod, at right """
   for row in xrange( len(twod) ):
      for col in xrange( len(twod[0]) ):
         if row == col:
            twod[row][col] = 42
         else:
            twod[row][col] += 1
```

twod After

mystery.py



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```

twod After

42	3	4	5
6	42	8	9
10	11	42	13

mystery.py

Creating a 2d List

```
twod = [ ]
```

- Need to create a row of the list

```
row = [1, 2, 3, 4]
```

- Then append that row to the list

```
twod.append( row )
print twod
```

  - [[1, 2, 3, 4]]
- Repeat

```
row = [1, 2, 3, 4]
twod.append( row )
print twod
```

  - [[1, 2, 3, 4], [1, 2, 3, 4]]

Generalize Creating a 2D List

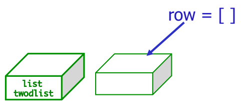
- Create a function that returns a 2D list with width ***cols*** and height ***rows***
  - Initialize each element in list to 0

Generalize Creating a 2D List

- Create a function that returns a 2D list with width ***cols*** and height ***rows***
  - Initialize each element in list to 0

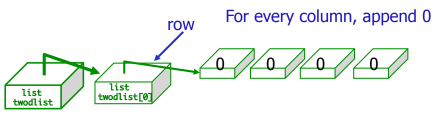
```
def create2DList(rows, cols):
   twodlist = [ ]
   # for each row
   for row in xrange( rows ):
      row = [ ]
      # for each column, in each row
      for col in xrange( cols ):
         row.append(0)
      twodlist.append(row)
   return twodlist
```

How Does This Work?



row = [ ]

How Does This Work?

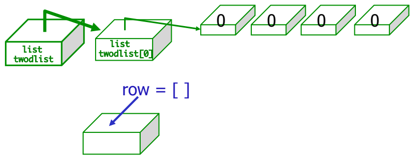


row

For every column, append 0

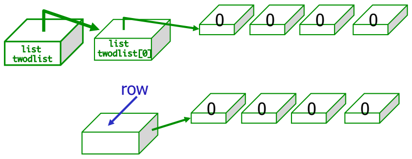
Append row to twodlist

How Does This Work?



row = [ ]

How Does This Work?



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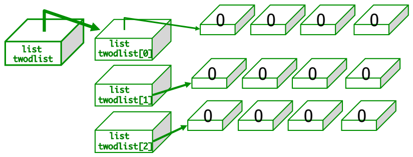


Generalize Creating a 2D List

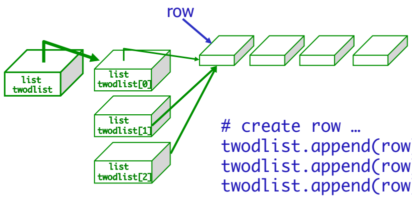
- The following code **won't** work. Why?
- Explain output from example program

```
def noCreate2DList(rows, cols):
   twodlist = [ ]
   row = [ ]
   # create a row with appropriate columns
   for col in xrange( cols ):
      row.append(0)
   # append the row rows times
   for row in xrange( rows ):
     twodlist.append(row)
   return twodlist
```

twod_exercises.py

All Rows Pointing at Same Block of Memory

- Each row points to the **same** row in memory



```
# create row …
twodlist.append(row)
twodlist.append(row)
twodlist.append(row)
```

Problem: Create a Tic-Tac-Toe board

- Returns a 2-d list that represents a tic-tac-toe board
  - What elements should be in the 2D list?

Problem: Tic-Tac-Toe

- How do we represent player's moves?
  - How do we update the board to say "Player X goes into the bottom right corner."

Problem: Print a Tic-Tac-Toe Board

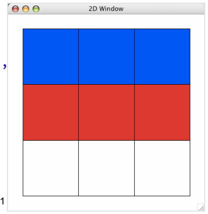
- Print the board in a “nice” way, such as

```
 x |   |
-----------
   | o |
-----------
   |   |
```

tictactoe.py

Graphical Representation of 2D Lists

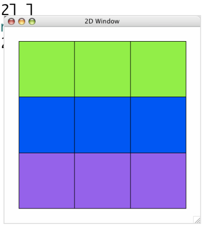
- Module: `csplot`
- Allows you to visualize your 2D list
  - Numbers are represented by different colors



```
import csplot
…
# create 2D list…
twodlist=[ [0,0,0], [1,1,1], [2,2,
# display list graphically
csplot.show(twodlist)
```

Graphical Representation of 2D Lists

- Can assign colors to numbers



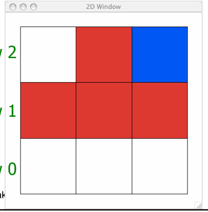
```
import csplot
…
# create 2D list…
twodlist=[ [0,0,0], [1,1,1], [2,2,2] ]
# create optional dictionary of nur
numToColor={0:”purple”, 1:”blue”, 2
csplot.show(twodlist, numToColor)
```

Graphical Representation of 2D Lists

- Note that representation of rows is backwards from how we’ve been visualizing

`matrix = [[0,0,0], [1,1,1], [0,1,2]]`

What values map to which colors?



Row 2

Row 1

Row 0

Game Board for Connect Four

- 6 rows, 7 columns board
- Players alternate dropping red/black checker into slot/column
- Player wins when have four checkers in a row vertically, horizontally, or diagonally

How do we represent the board as a 2D list, using a graphical representation?

Game Board for Connect Four

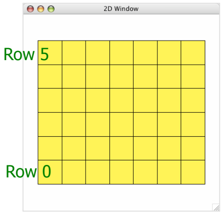
- How to represent board in 2D list, using graphical representation?

Number	Meaning	Color
0	Free	Yellow
1	Player 1	Red
2	Player 2	Black

Game Board for Connect Four

- How to represent board in 2D list, using graphical representation?

Number	Meaning	Color
0	Free	Yellow
1	Player 1	Red
2	Player 2	Black



Connect Four (C4): Making moves

- User clicks on a column
    - “Checker” is filled in at that column

```
# gets the column of where user clicked
col = csplot.sqinput()
```

Problem: C4 - Valid move?

- Need to enforce valid moves
    - In physical game, run out of spaces for checkers if not a valid move
- How can we determine if a move is valid?
    - How do we know when a move is ***not*** valid?

Problem: C4 - Valid move?

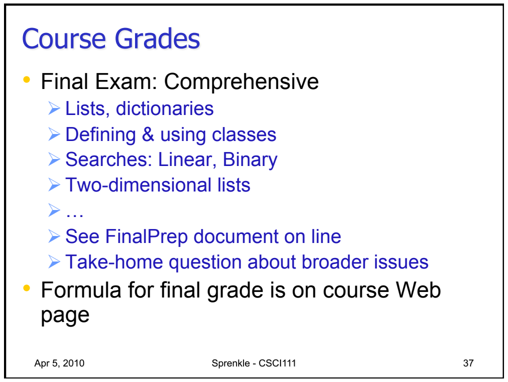
- Solution: check the “top” spot
    - If the spot is FREE, then it’s a valid move

ConnectFour Class

- Data
    - Board
- Methods
    - Constructor
    - Display the board
    - Play the game
        - Repeat:
            - Get input/move from user
            - Check if valid move
            - Display board
            - Check if win
            - Change player

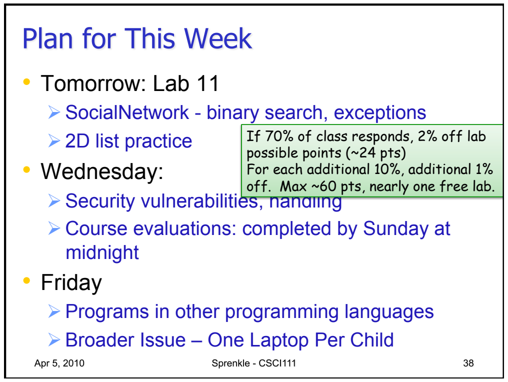
Problem: C4 - Making a Move

- The player clicks on a column, meaning that’s where the player wants to put a checker
- How do we update the board?



Course Grades

- Final Exam: Comprehensive
  - Lists, dictionaries
  - Defining & using classes
  - Searches: Linear, Binary
  - Two-dimensional lists
  - …
  - See FinalPrep document on line
  - Take-home question about broader issues
- Formula for final grade is on course Web page



Plan for This Week

- Tomorrow: Lab 11
  - SocialNetwork - binary search, exceptions
  - 2D list practice
- Wednesday:
  - Security vulnerabilities, handling
  - Course evaluations: completed by Sunday at midnight
- Friday
  - Programs in other programming languages
  - Broader Issue – One Laptop Per Child

If 70% of class responds, 2% off lab possible points (~24 pts)
For each additional 10%, additional 1% off. Max ~60 pts, nearly one free lab.