# CompSci 101
# Introduction to Computer Science

Nov 28, 2017

Prof. Rodger

# Announcements

- Last RQ, RQ18 Thursday!
- Assign 8 due Dec 5, Assign 9 due Dec 8
- APT 8 Due Dec 7
- Exam 2 back – Regrades through Dec 7
- Lab this week

- Today:
  - Assign 8 - Recommender
  - How do you access directories/folders
  - Recursion – Solving problems by solving smaller and smaller similar problems

# Exam 2 Back

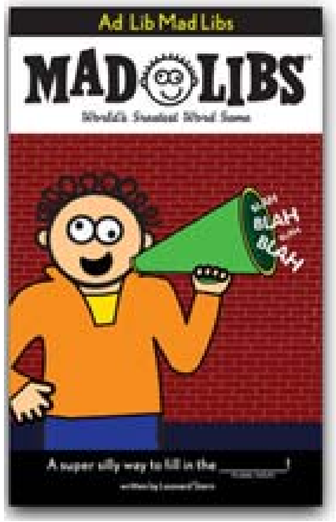
- Stats
  - Average 85/92

- Request regrade through gradescope by Dec 7

- Questions?

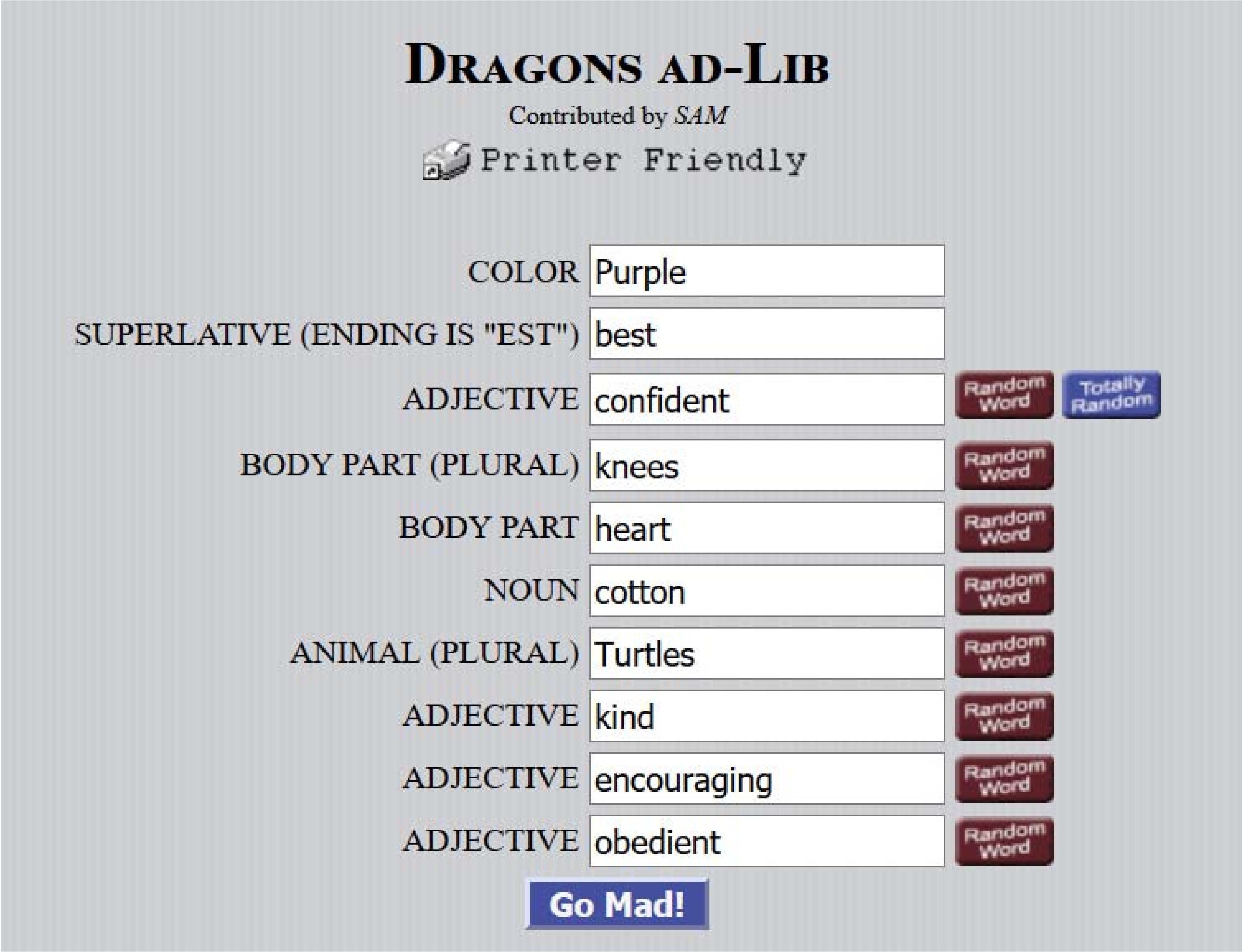
# Final Exam – SECTION 02

- You can sign up to take the Final exam earlier with Section 01 at 9am Thursday, Dec 14.
- Sign up on the course web page on the forms tab!
- Space is limited!


Ad Lib Mad Libs
MAD LIBS
World's Greatest Word Game
BLAH BLAH BLAH
A super silly way to fill in the ___!

# Lab this week!

MAD TAKES



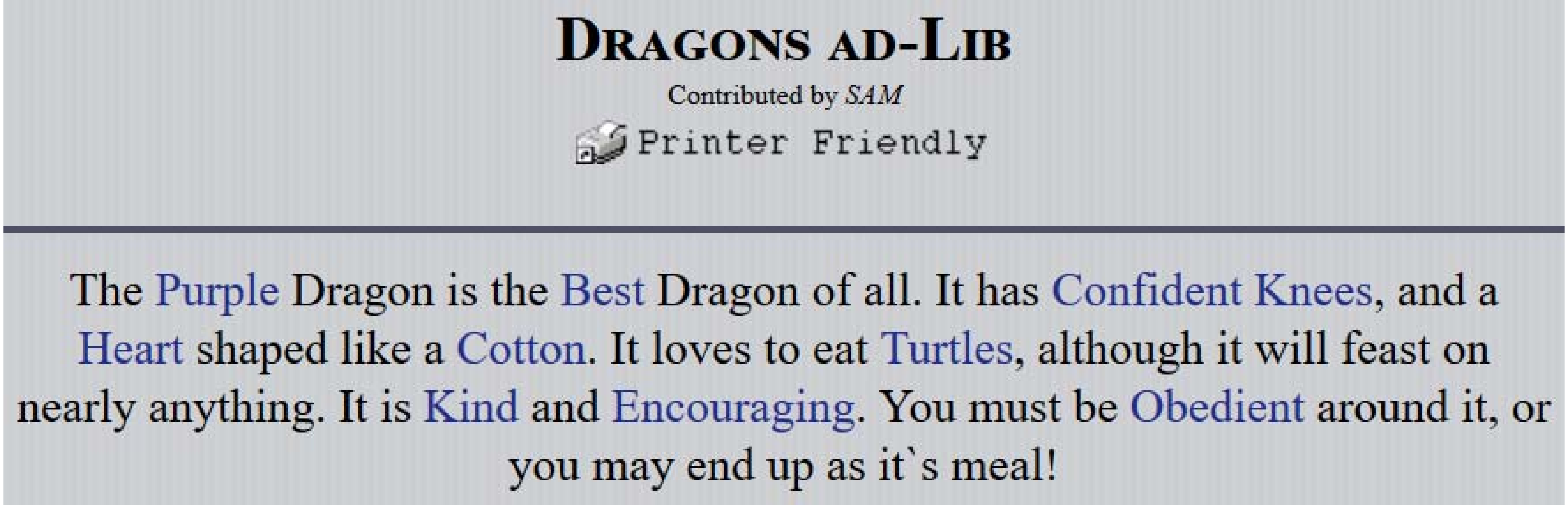
## Dragons ad-Lib

Contributed by *SAM*

Printer Friendly

| | |
|---|---|
| COLOR | Purple |
| SUPERLATIVE (ENDING IS "EST") | best |
| ADJECTIVE | confident |
| BODY PART (PLURAL) | knees |
| BODY PART | heart |
| NOUN | cotton |
| ANIMAL (PLURAL) | Turtles |
| ADJECTIVE | kind |
| ADJECTIVE | encouraging |
| ADJECTIVE | obedient |

# Lab this week (cont)



**DRAGONS AD-LIB**

Contributed by *SAM*

Printer Friendly

The Purple Dragon is the Best Dragon of all. It has Confident Knees, and a Heart shaped like a Cotton. It loves to eat Turtles, although it will feast on nearly anything. It is Kind and Encouraging. You must be Obedient around it, or you may end up as it`s meal!

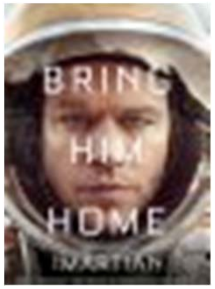
# Math, Engineering, Sociology

- Netflix prize in 2009
  - Beat the system, win
  - http://nyti.ms/sPvR

# Assignment 8: Collaborative Filtering

- How does Amazon know what I want?
  - Lots of customers, lots of purchases
- How does Pandora know music like Kanye's?
  - This isn't really collaborative filtering, more content-based
- How does Netflix recommend movies?
  - Why did they offer one million $$ to better their method?
- Students at Duke who like Compsci also like …
  - Could this system be built?

# From User Rating to Recommendations



| Spectre | Martian | Southpaw | Everest | PitchPerfect 2 |
|---|---|---|---|---|
| 3 | -3 | 5 | -2 | -3 |
| 2 | 2 | 3 | 2 | 3 |
| 4 | 4 | -2 | 1 | -1 |

- **What should I choose to see?**
  - **What does this depend on?**
- **Who is most like me?**
  - **How do we figure this out**

# ReadAllFood modules: Food Format

bit.ly/101f17-1128-1

- All Reader modules return a tuple of strings: itemlist and dictratings dictionary

```
Sarah Lee
(DivinityCafe)(3)
(IlForno)(3)
(TheSkillet)(-3)
(LoopPizzaGrill)(3)
(FarmStead)(3)
(Tandoor)(5)
(PandaExpress)(-3)
```

```
Melanie
(McDonalds)(1)
(Tandoor)(3)
(DivinityCafe)(5)
(TheCommons)(3)
(TheSkillet)(1)
(IlForno)(3)
(PandaExpress)(3)
J J
(TheSkillet)(1)
```

not<br>all<br>shown<br>…

- Translated to list and dictionary:

```
['IlForno', 'TheCommons', 'FarmStead', 'DivinityCafe', 'PandaExpress',
'TheSkillet', 'Tandoor', 'LoopPizzaGrill', 'McDonalds']
```

```
{'Sung-Hoon': [-1, 1, -1, 0, 3, -3, -3, 5, 1], 'Wei': [0, 3, 1, 1, 0, 0, 5,
3, -1], 'Sly one': [1, 3, 0, 5, 0, 3, 3, 3, 0], 'Nana Grace': [3, 3, 0, 5,
0, 0, 1, -5, -1], 'Melanie': [3, 3, 0, 5, 3, 1, 3, 0, 1], 'J J': [0, 0, 1,
0, 1, 1, 3, -1, 1], 'Harry': [0, 5, 3, 5, -5, 1, 0, -1, -3], 'Sarah Lee':
[3, 0, 3, 3, -3, -3, 5, 3, 0]}
```

# Data For Recommender

- Users/Raters rate Items
  - We need to know the items
  - We need to know how users rate each item
- Which eatery has highest average rating?
  - Conceptually: average columns in table
  - How is data provided in this assignment?

| | ABP | BlueEx | McDon | Loop | Panda | Nasher |
|---|---|---|---|---|---|---|
| Sam | 0 | 3 | 5 | 0 | -3 | 5 |
| Chris | 1 | 1 | 0 | 3 | 0 | -3 |
| Nat | -3 | 3 | 3 | 5 | 1 | -1 |

# Data For Recommender

- itemlist are provided in a list of strings
  - Parsing data provides this list
- dictratings provided in dictionary
  - Key is user ID
  - Value is list of integer ratings

| | **ABP** | **BlueEx** | **McDon** | **Loop** | **Panda** | **Nasher** |
|---|---|---|---|---|---|---|
| Sam | 0 | 3 | 5 | 0 | -3 | 5 |
| Chris | 1 | 1 | 0 | 3 | 0 | -3 |
| Nat | -3 | 3 | 3 | 5 | 1 | -1 |

# Data For Recommender

- Given Parameters
  - – itemlist: a list of strings
  - – dictratings: dictionary of ID to ratings list
- Can you write
  - – Average(itemlist, dictratings)

| | ABP | BlueEx | McDon | Loop | Panda | Nasher |
|---|---|---|---|---|---|---|
| Sam | 0 | 3 | 5 | 0 | -3 | 5 |
| Chris | 1 | 1 | 0 | 3 | 0 | -3 |
| Nat | -3 | 3 | 3 | 5 | 1 | -1 |

# Drawbacks of Item Averaging

- Are all ratings the same to me?
  - Shouldn't I value ratings of people "near" me as more meaningful than those "far" from me?
- Collaborative Filtering
  - https://en.wikipedia.org/wiki/Collaborative_filtering
  - How do we determine who is "near" me?
- Mathematically: treat ratings as vectors in an N-dimensional space, N = # ratings
  - Informally: assign numbers, higher the number, closer to me

# Collaborative Filtering: Recommender

- First determine closeness of all users to me:
  - "Me" is a user-ID, parameter to function
  - Return list of (ID, closeness-#) tuples, sorted

- Use just the ratings of person closest to me
  - Is this a good idea?
  - What about the 10 closest people to me?
- What about weighting ratings
  - Closer to me, more weight given to rating

# How do you calculate a similarity?

- Me: [3, 5, -3]
- Joe: [5, 1, -1]
- Sue: [-1, 1, 3]

- Joe to Me

- Sue to Me

# How do you calculate a similarity?

- Me:  [3, 5, -3]
- Joe:  [5, 1, -1]
- Sue:  [-1, 1, 3]

- Joe to Me

  = (3*5 + 5*1 + -3 * -1) = 23
- Sue to Me

  = (3*-1 + 5 * 1 + -3 * 3) = -7

# Collaborative Filtering

- For Chris: `12 * [1,1,0,3,0,-3] =`
  - `[12,12,0,36,0,-36]`
- For Sam: `[0,75,125,0,-75,125]`

Chris:12
Nat:37
Sam:25

| | ABP | BlueEx | McDon | Loop | Panda | Nasher |
|---|---|---|---|---|---|---|
| Sam | 0 | 3 | 5 | 0 | -3 | 5 |
| Chris | 1 | 1 | 0 | 3 | 0 | -3 |
| Nat | -3 | 3 | 3 | 5 | 1 | -1 |

# Adding lists of numbers

```
[12, 12,   0, 36,  0,-36]
[ 0, 75, 125,  0,-75,125]
[-111,111,111,185,37, -37]
---------------------------
[-99, 198, 236, 221, -38, 52]
```

- Adding columns in lists of numbers
  - Using indexes 0, 1, 2, … sum elements of list
  - `sum([val[i] for val in d.values()])`

# Then divide by number of nonzeros

```
[12, 12,   0, 36,  0,-36]
[ 0, 75, 125,  0,-75,125]
[-111,111,111,185,37, -37]
---------------------------
[-99, 198, 236, 221, -38, 52]
   /2     /3    /2    /2    /2    /3
[ -49,    66,     118,  110   -19,     17]
```

Recommend 3rd item

| | ABP | BlueEx | McDon | Loop | Panda | Nasher |
|---|---|---|---|---|---|---|
| Sam | 0 | 3 | 5 | 0 | -3 | 5 |
| Chris | 1 | 1 | 0 | 3 | 0 | -3 |
| Nat | -3 | 3 | 3 | 5 | 1 | -1 |

# Follow 12-step process

- ProcessAllFood first!
  - Read input and save it
  - Get list of restaurants – use that ordering! Set?
  - For each person
    - For each restaurant and its rating
      - Must find location of restaurant in itemlist
      - Then update appropriate counter
  - Print any structure you create to check it

# Plan for Today

- Recursion
  - Solving problems by solving similar but smaller problems
- Programming and understanding …
  - Hierarchical structures and concepts
    - What is a file system on a computer?
    - What is the Internet?
    - How does the Domain Name System Work?
- How do you access directories?
    - And all the files in a directory, and the …

# Recursion

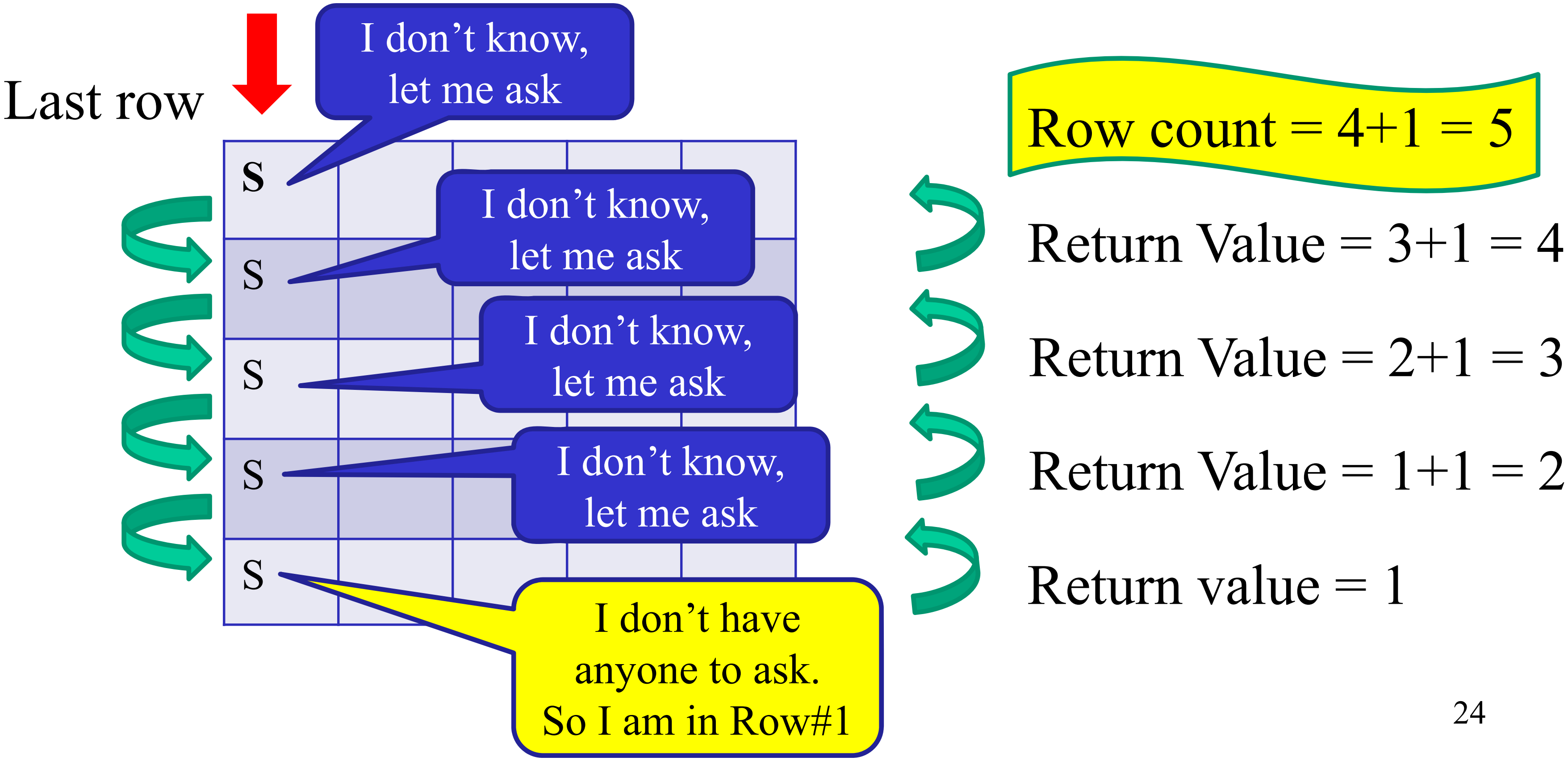
Solving a problem by solving similar but smaller problems

# Recursion

Solving a problem by solving similar but smaller problems

***Question*** - How many **rows** are there in this classroom?

***Similar but smaller question*** - How many **rows** are there until your row?



Last row

I don’t know, let me ask

I don’t know, let me ask

I don’t know, let me ask

I don’t know, let me ask

I don’t have anyone to ask. So I am in Row#1

Row count = 4+1 = 5

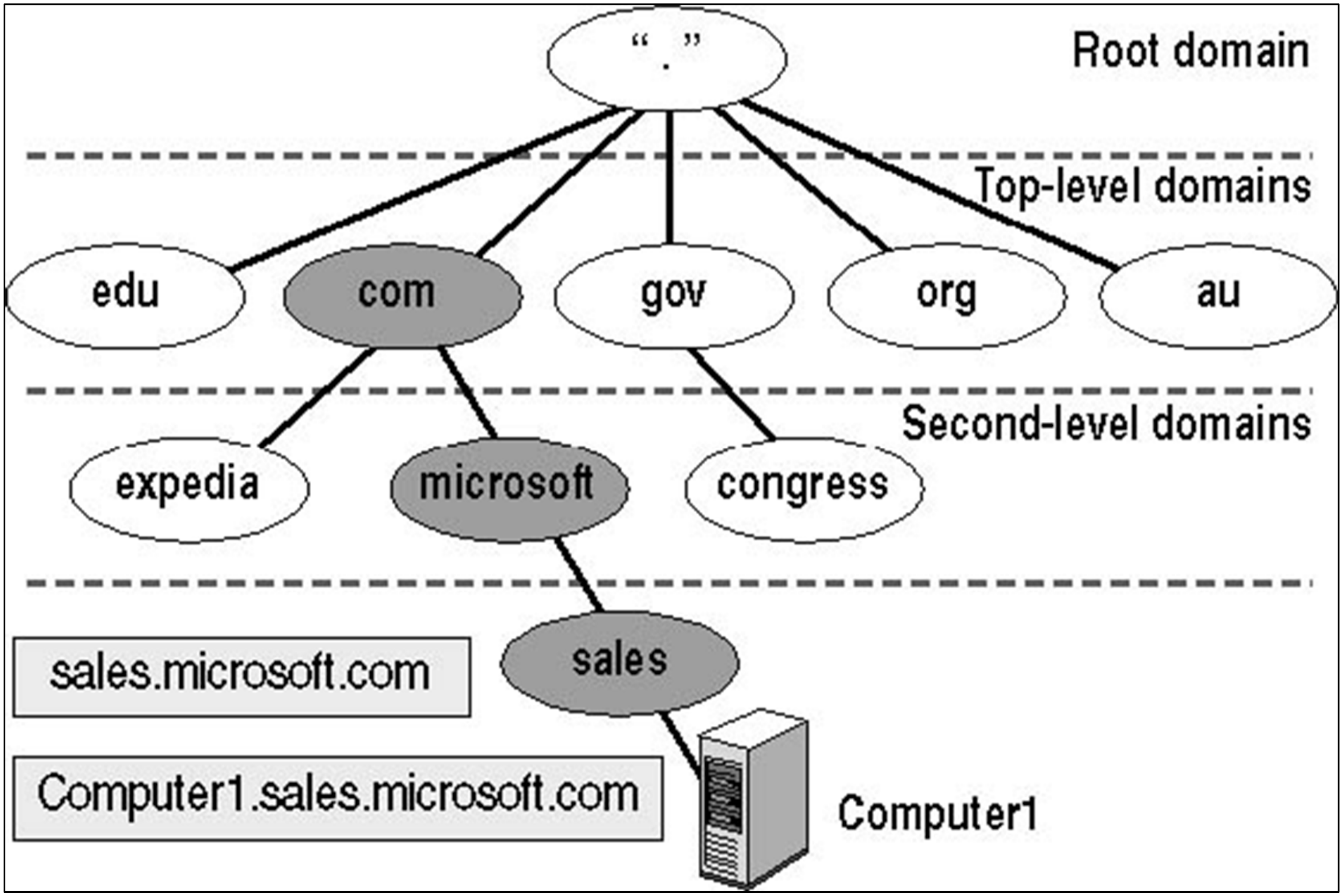
Return Value = 3+1 = 4

Return Value = 2+1 = 3

Return Value = 1+1 = 2

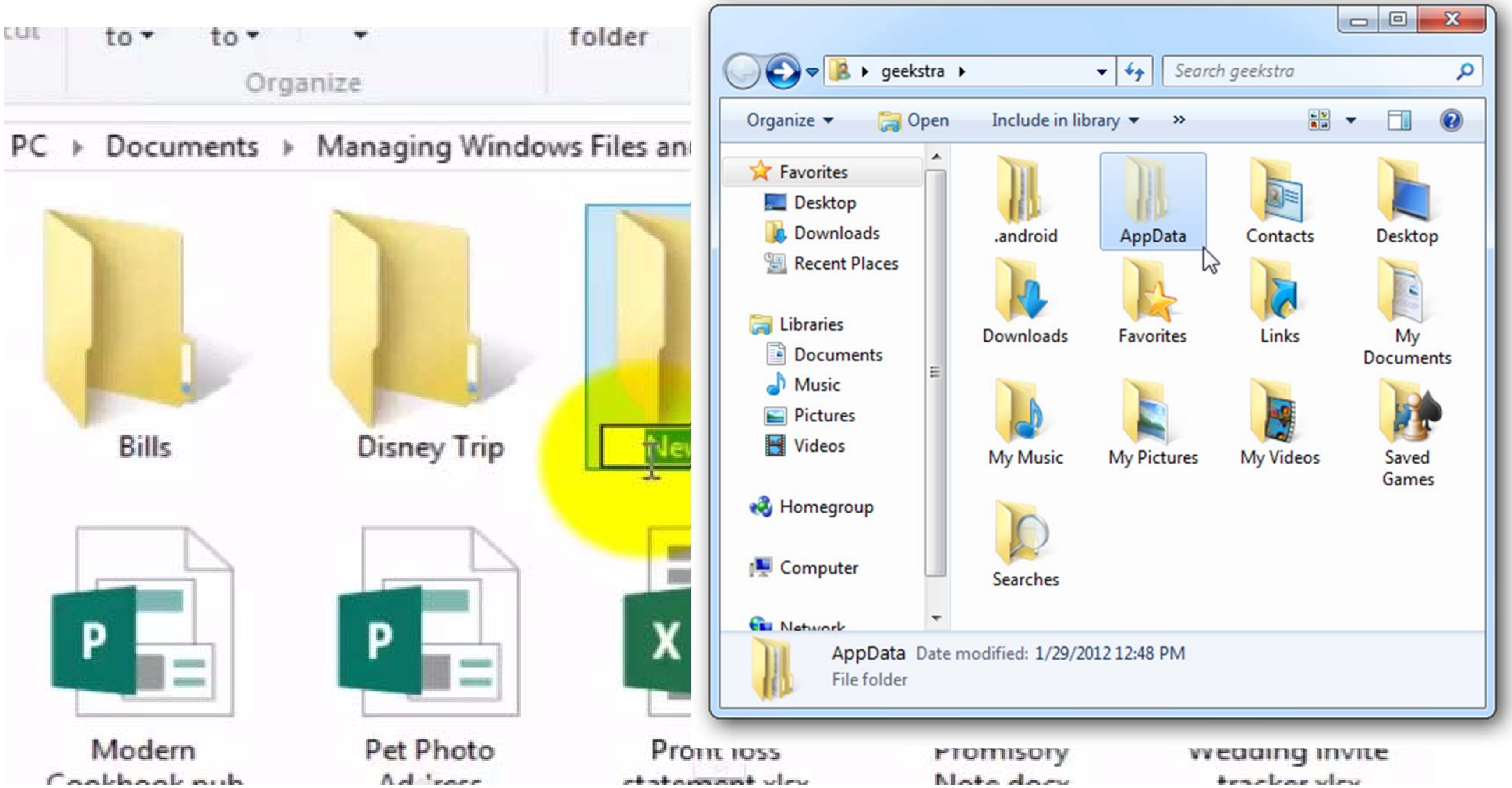
Return value = 1

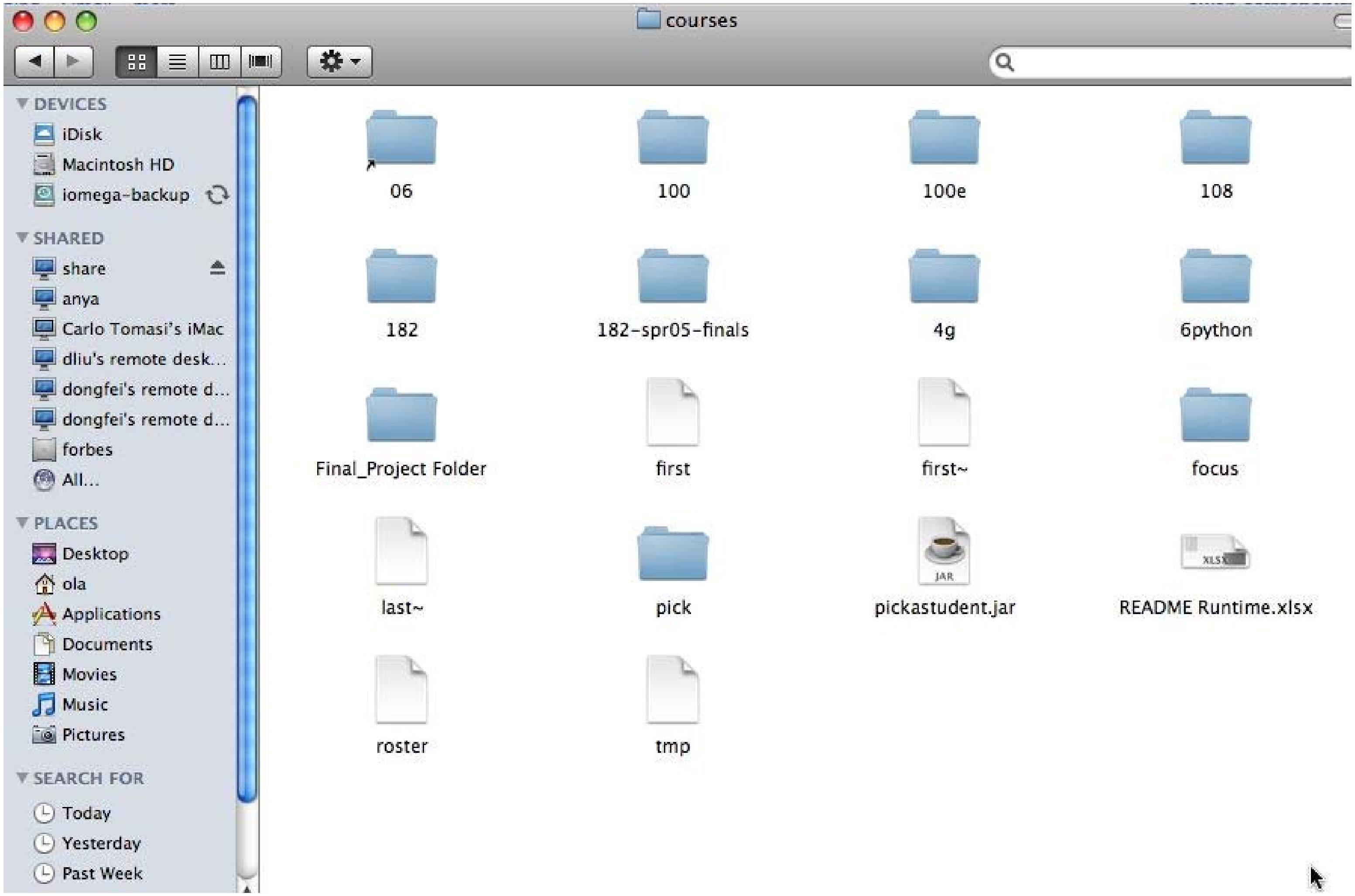
# Domain Name System (DNS)



Link: http://computer1.sales.microsoft.com

# What's in a file-system Folder?

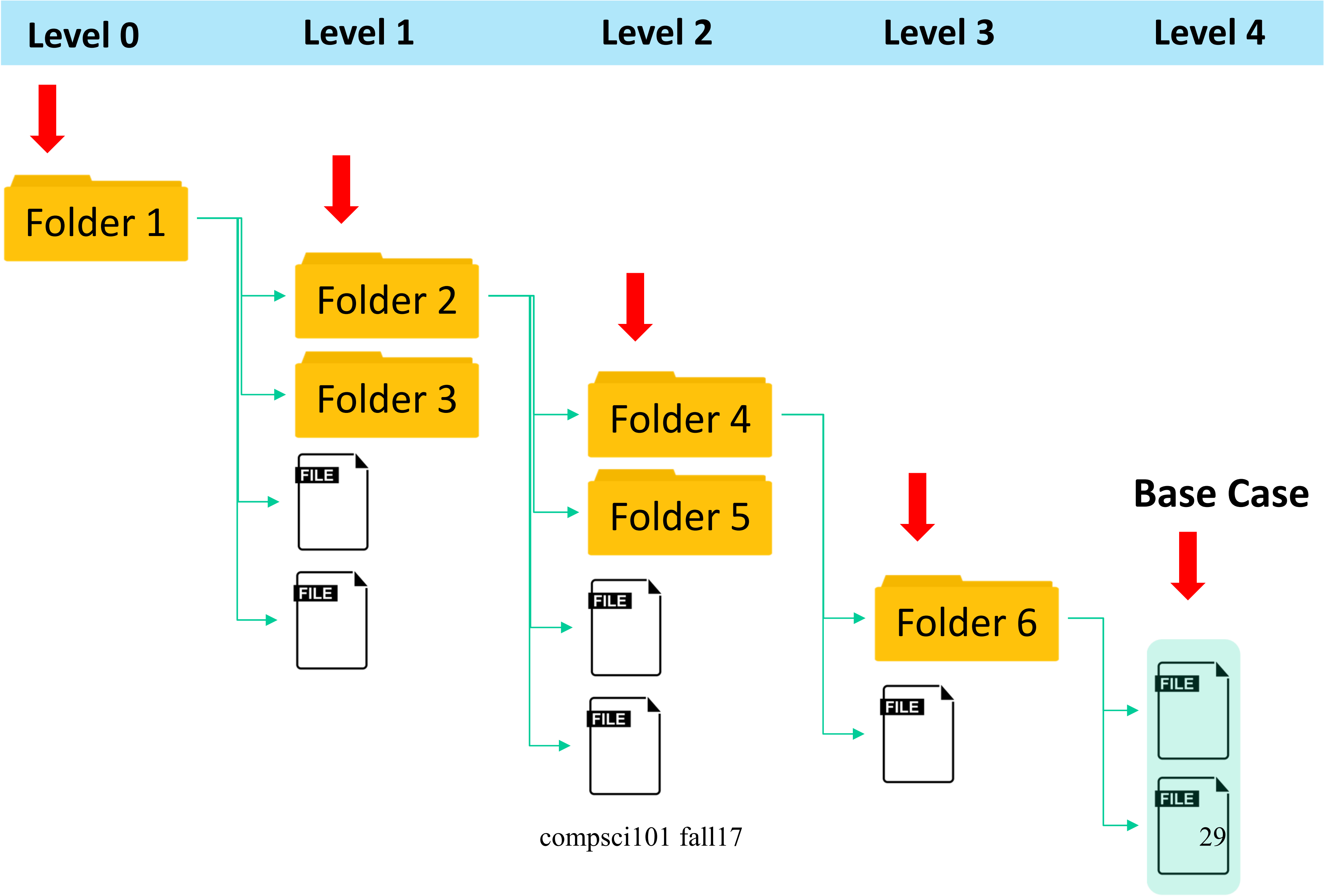



courses
DEVICES
iDisk
Macintosh HD
iomega-backup
SHARED
share
anya
Carlo Tomasi's iMac
dliu's remote desk...
dongfei's remote d...
dongfei's remote d...
forbes
All...
PLACES
Desktop
ola
Applications
Documents
Movies
Music
Pictures
SEARCH FOR
Today
Yesterday
Past Week
06
100
100e
108
182
182-spr05-finals
4g
6python
Final_Project Folder
first
first~
focus
last~
pick
pickastudent.jar
README Runtime.xlsx
roster
tmp

# What's in a folder on your computer?

- Where are the **large** files?
- How do you **find them**?
- They take up space!
  - What’s the plan –
    1. Erase?
    2. Backup?

# Hierarchy in Folder Structure



# Recursion to find ALL files in a folder

- A folder can have sub folders and files
- A file cannot have sub files

```
def visit(dirname):
    for inner in dirname:
        if isdir(inner):
            visit(inner)
        else:
            print name(inner), size(inner)
```

Is that a directory?

If not a directory, it will be a file

# Finding large files: FileVisit.py

```
def bigfiles(dirname,min_size):
    large = []
    for sub in os.listdir(dirname):
        path = os.path.join(dirname,sub)
        if os.path.isdir(path):
            subs = bigfiles(path,min_size)
            large.extend(subs)
        else:
            size = os.path.getsize(path)
            if size > min_size:
                large.append((path,size))
    return large

# on Mac like this:
#bigs = bigfiles("/Users/Susan/Documents",10000)
# on Windows like this:
bigs = bigfiles("C:\\Users\\Susan\\Documents",10000)
```

# Example Run

- ('C:\\Users\\Susan\\files\\courses\\cps101\\workspace\\spring2015\\assign4_transform\\data\\romeo.txt', 153088L)
- ('C:\\Users\\Susan\\files\\courses\\cps101\\workspace\\spring2015\\assign4_transform\\data\\twain.txt', 13421L)
- ('C:\\Users\\Susan\\files\\courses\\cps101\\workspace\\spring2015\\assign5_hangman\\src\\lowerwords.txt', 408679L)
- …

# Finding Large Files questions
# bit.ly/101f17-1128-2

# The os and os.path libraries

- Libraries use an API to isolate system dependencies
  - C:\\x\\y **# windows**
  - /Users/Susan/Desktop **# mac**

- FAT-32, ReFS, WinFS, HFS, HSF+, fs
  - Underneath, these systems are different
  - Python API insulates and protects programmer

- Why do we have `os.path.join(x,y)`?
  - x = /Users/Susan/Documents
  - y = file1.txt
  - Output = /Users/Susan/Documents/file1.txt

# Dissecting FileVisit.py

- How do we find the contents of a folder?
  - Another name for folder: directory

- How do we identify folder? (by name)
  - os.listdir(dirname) returns a list of files and folder

- Path is c:\user\ola\foo or /Users/ola/bar
  - os.path.join(dir,sub) returns full path
  - Platform independent paths

- What's the difference between file and folder?
  - `os.path.isdir()` and `os.path.getsize()`

# Does the function call itself? No!

```
def visit(dirname):
    for inner in dirname:
        if isdir(inner):
            visit(inner)
        else:
            print name(inner), size(inner)
```

- Is a file inside itself? No!
- Does pseudo code make sense?
  - Details make this a little harder in Python, but close!

# Structure matches Code

**Find large files**

If you see a folder,

1. Find the large files and subfolders
2. For the subfolders, repeat the process of finding large files and any other folders within that subfolder
3. Repeat the process until you reach the last folder

**Compress or Zip a folder**

If you see a folder,

1. Find the files and subfolders
2. For the subfolders, repeat the process of finding files and any other folders within that subfolder
3. At the last stage, start compressing files and move up the folder hierarchy

# Structure matches Code

- Structure of list of lists
  - Can also lead to processing a list which requires processing a list which …

```
[ [ [a,b], [c,d], [a, [b,c],d] ]
(a *(b + c (d + e*f)) + (a* (b+d)))
```

# Recursion

- Simpler or smaller calls
- Must have a base case when no recursive call can be made
    - Example - The last folder in the folder hierarchy will not have any subfolders. It can only have files. That forms the base case

# Sir Anthony (Tony) Hoare

There are two ways of constructing a software design. One way is to make it so simple that there are obviously no deficiencies. And the other way is to make it so complicated that there are no obvious deficiencies.

Turing Award, didn’t get recursion…..

Inventor of quicksort