

On your way in...(on the side table)

Pick-Up:

1. HW 02, graded
2. POGIL Activity 22 – List Comprehensions



CS THESIS PROPOSALS THIS FRIDAY

2:35P IN TCL 123 (WEGE)

- Will Burford
- Tongyu Zhou*
- Adly Templeton
- Josh Kang

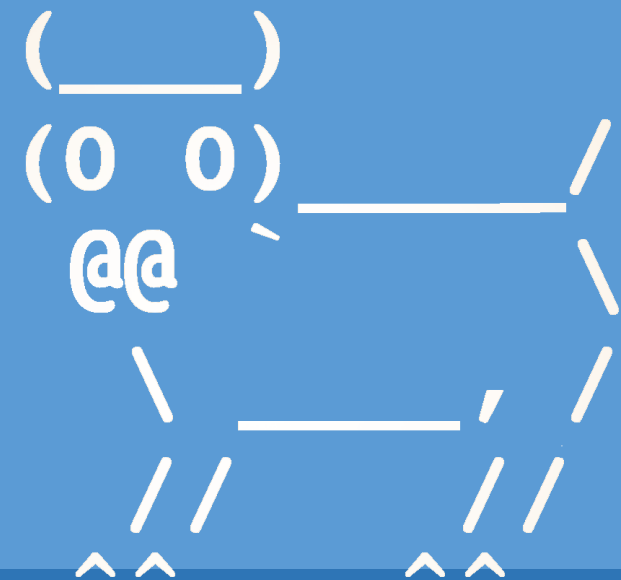
Come see what CS seniors are up to!
If you're interested in majoring in Computer Science, you'll need 20 colloquium to graduate, and any you sign-in for now will count!



Welcome to CS 134!

Introduction to Computer Science
Iris Howley

-Files & List Comprehensions-



Continuing from Wednesday

- How to take any string and insert a comma after the 5th element?

```
>>> str = "hello there!"
```

```
>>> newstr = str[:5] + ',' + str[5:]
```

```
■ >>> str[:5]
```

```
○ 'hello'
```

```
■ >>> str[5:]
```

```
○ ' there!'
```

```
>>> newstr
```

```
'hello, there!'
```

- How to take any tuple and insert a 2020 after the 5th element?

```
>>> tup = (1, 2, 3, 4, 5, 6, 7, 8, 9)
```

```
>>> newtup = tup[:5] + (2020,) + tup[5:]
```

```
■ >>> tup[:5]
```

```
○ (1, 2, 3, 4, 5)
```

```
■ >>> tup[5:]
```

```
○ (6, 7, 8, 9)
```

```
>>> newtup
```

```
(1, 2, 3, 4, 5, 2020, 6, 7, 8, 9)
```

Strings & Tuples are immutable, so we must make a new one to modify them!

TODAY'S LESSON

Files

(A persistent store between python sessions)

Reading Files

Opens the file

Filename as a string

Opens filename calls it fin

- `with open('prideprejudi.txt') as fin:`
 - `for line in fin:` For each line in our file, fin
 - `pass` Does nothing, why's it here? What should be here?

Once we leave the "with" indentation, the file is closed!

- `# file is implicitly closed`

FILES MUST BE OPENED, READ, AND THEN CLOSED

Writing Files

Specifies mode. w means?

What if we had 'r' here?

Opens the file

Filename as a string

Opens filename calls it fout

• `with open('newFile.txt', 'w') as fout:`

• `fout.write("Hello!!")` Writes to the file, "Hello!!"

• `for item in mylist:`

• `fout.write(item)`

Writes an entire list to a file

Once we leave the "with" indentation, the file is closed!

• `# file is implicitly closed`

If unable to use the 'with' keyword, can also use `fout.close()` to explicitly close file

FILES MUST BE OPENED, WRITTEN, AND THEN CLOSED

TODAY'S LESSON

Reading CSV Files

(A common format for text data files)

Reading CSV Files

- What is a CSV file?
 - Comma Separated Values

It's a raw text format way to save data that is typically organized into rows & columns

Warning: Possible Data Loss. Some features might be lost if you save this workbook in the comma-delimited (.csv) format. To preserve these features, you should save the workbook as a binary Excel file.

	A	B	C	D	E	F	G	H	I	J	K
1	Aalberts,Daniel P.	Professor of Physics	Physics Depa	1989, B.S., Massachusetts	1994, Ph.D., Massachusetts	Institute of Technology					
2	Adams,Colin	Thomas T. R	Mathematic	1978, B.S., Massachusetts	1983, Ph.D., University of Wisconsin	Madison					
3	Adhami,Zaid	Visiting Lect	Religion Dep	2010, B.A., S	2010, M.A., Stanford University						
4	Adler Mande	Visiting Assi	Economics D	2009, B.A., C	2010, M.A., U	2015, Ph.D., University of California, Santa Barbara					
5	Albrecht,Jeai	Associate Pri	Computer Sc	2001, B.S., G	2003, M.S., U	2007, Ph.D., University of California, San Diego					
6	Ali,Laylah	Professor of	Art Departm	1991, B.A., V	1994, M.F.A., Washington University						
7	Aliev,Baktygr	Assistant Pro	German and	2000, B.A., A	2007, M.A., f	2014, Ph.D., McGill University					
8	Allen,Kristop	Lyell B. Clay	Music Depar	1998, B.M., l	2004, M.M., State University of New York, Purchase						
9	Allen.Sarah	f	Visiting Assc	Comparative	1992, A.B., H	1996, M.A., l	2003, Ph.D., Harvard University				

```
Aalberts,Daniel P.,Professor of Physics,Physics Department,"1989, B.S., Massachusetts Institute of Technology"
Adams,Colin C.,Thomas T. Read Professor of Mathematics,Mathematics and Statistics, Ph.D., University of Wisconsin, Madison"
Adhami,Zaid R.,Visiting Lecturer in Religion,Religion Department,"2010, B.A., Stanford University"
Adler Mandelbaum,Sara E.,Visiting Assistant Professor of Economics,Economics Department, M.A., University of California, Santa Barbara","2015, Ph.D., University of California, San Diego"
Albrecht,Jeannie R.,Associate Professor of Computer Science,Computer Science Department, University of California, San Diego","2007, Ph.D., University of California, San Diego"
Ali,Laylah",Professor of Art,Art Department,"1991, B.A., Williams College","1994, M.F.A., Washington University"
Aliev,Baktygul A.,Assistant Professor of Russian,German and Russian Department, McGill University","2014, Ph.D., McGill University"
Allen,Kristopher D.,Lyell B. Clay Artist in Residence in Jazz Activities/Lectures,"1998, B.M., University of Hartford","2004, M.M., State University of New York, Purchase"
Allen,Sarah M.,Visiting Associate Professor of Comparative Literature,Comparative Literature Department, M.A., University of Michigan","2003, Ph.D., Harvard University"
Apotsos,Alex A.,Lecturer in Geosciences,Geosciences Department,"1999, B.S., State University of New York, Purchase"
Apotsos,Michelle M.,Assistant Professor of Art,Art Department,"1999, B.A., University of California, San Diego","2013, Ph.D., Stanford University"
App,Kevin M.,Assistant Professor of Physical Education and Head Men's Basketball Coach,Physical Education Department,"2008, B.S., State University of New York, Purchase"
```

Reading CSV Files

Adds the csv module to our list of possible tools to use

```
import csv
```

Filename as a string

```
def printCSVfile(filename):
```

Opens filename calls it f

```
with open(filename, 'r') as f:
```

```
    csvf = csv.reader(f)
```

Create a CSV reader object to parse the commas in f for us

```
    for row in csvf:
```

```
        print(row, end="\n\n")
```

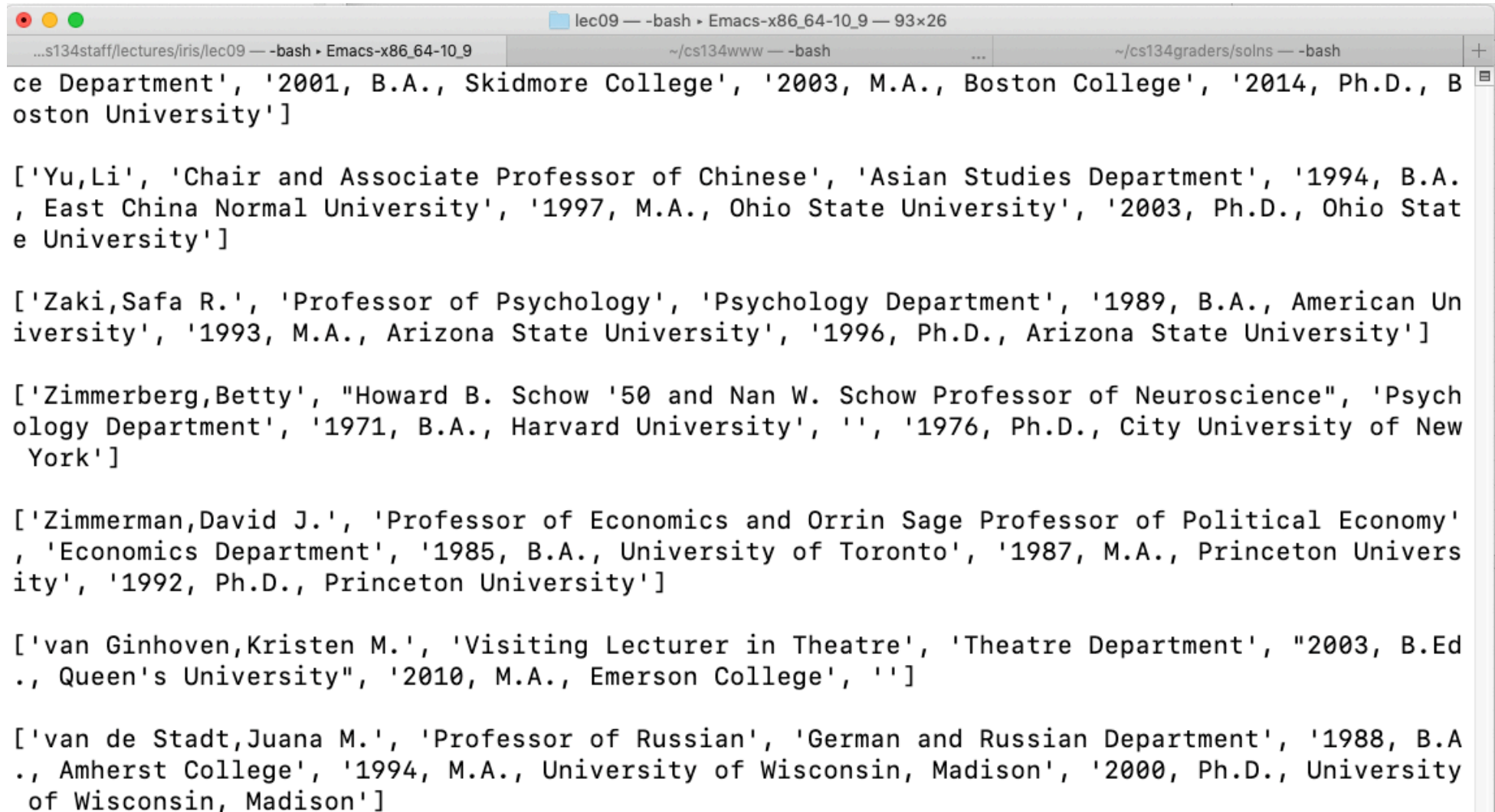
Print the row and place some extra newlines at the end for readability

For each 'row' (ended with a newline) in our CSV file reader...

Once we leave the "with" indentation, the file is closed!

Reading CSV Files

What is this?

A screenshot of an Emacs editor window. The title bar shows 'lec09 — -bash • Emacs-x86_64-10_9 — 93x26'. The window contains several lines of CSV data, each enclosed in square brackets and separated by commas. The data represents academic records for various individuals, including their names, titles, departments, and degrees from different institutions.

```
...s134staff/lectures/iris/lec09 — -bash • Emacs-x86_64-10_9  ~/cs134www — -bash  ...  ~/cs134graders/solns — -bash  +
ce Department', '2001, B.A., Skidmore College', '2003, M.A., Boston College', '2014, Ph.D., B
oston University']

['Yu,Li', 'Chair and Associate Professor of Chinese', 'Asian Studies Department', '1994, B.A.
, East China Normal University', '1997, M.A., Ohio State University', '2003, Ph.D., Ohio Stat
e University']

['Zaki,Safa R.', 'Professor of Psychology', 'Psychology Department', '1989, B.A., American Un
iversity', '1993, M.A., Arizona State University', '1996, Ph.D., Arizona State University']

['Zimmerberg,Betty', "Howard B. Schow '50 and Nan W. Schow Professor of Neuroscience", 'Psych
ology Department', '1971, B.A., Harvard University', '', '1976, Ph.D., City University of New
York']

['Zimmerman,David J.', 'Professor of Economics and Orrin Sage Professor of Political Economy'
, 'Economics Department', '1985, B.A., University of Toronto', '1987, M.A., Princeton Univers
ity', '1992, Ph.D., Princeton University']

['van Ginhoven,Kristen M.', 'Visiting Lecturer in Theatre', 'Theatre Department', "2003, B.Ed
., Queen's University", '2010, M.A., Emerson College', '']

['van de Stadt,Juana M.', 'Professor of Russian', 'German and Russian Department', '1988, B.A
., Amherst College', '1994, M.A., University of Wisconsin, Madison', '2000, Ph.D., University
of Wisconsin, Madison']
```

Reading CSV Files

- python3 readFile.py

```
import csv

def printCSVfile(filename):
    with open(filename, 'r') as f:
        csvf = csv.reader(f)
        for row in csvf:
            # row[0] --> name
            # row[1] --> title
            # row[3] --> undergrad degree
            print(row[0], row[1], row[3], sep="\t", end="\n\n")
```

```
lec09 -- -bash - Emacs-x86_64-10_9 -- 93x26
...s134staff/lectures/iris/lec09 -- -bash - Emacs-x86_64-10_9
~/cs134www -- -bash
~/cs134graders/solns -- -bash

Wood,James B. Charles R. Keller Professor of History 1968, B.A., Eckerd College

Wootters,William K. Barclay Jermain Professor of Natural Philosophy 1973, B.S., Stanford
University

Yamamoto,Kasumi Professor of Japanese 1980, B.A., Aoyama Gakuin University

Yesnowitz,Joshua C. Visiting Assistant Professor of Political Science 2001, B.A., S
kidmore College

Yu,Li Chair and Associate Professor of Chinese 1994, B.A., East China Normal Univers
ity

Zaki,Safa R. Professor of Psychology 1989, B.A., American University

Zimmerberg,Betty Howard B. Schow '50 and Nan W. Schow Professor of Neuroscience 1971,
B.A., Harvard University

Zimmerman,David J. Professor of Economics and Orrin Sage Professor of Political Economy1
985, B.A., University of Toronto

van Ginhoven,Kristen M. Visiting Lecturer in Theatre 2003, B.Ed., Queen's University

van de Stadt,Juana M. Professor of Russian 1988, B.A., Amherst College
```

Splitting Strings on Commas

- `>>> str = "hello, world! i'm a programmer!"`
- `>>> str.split(",")`
- `['hello', ' world! i'm a programmer!']`

`.split('item')` will create a list of strings, split into elements based on `item`

```
>>> name = 'van de Stadt, Juana M.'
>>> name.split(',')
['van de Stadt', 'Juana M.']
>>> name.split(' ')
['van', 'de', 'Stadt, Juana', 'M.']
```

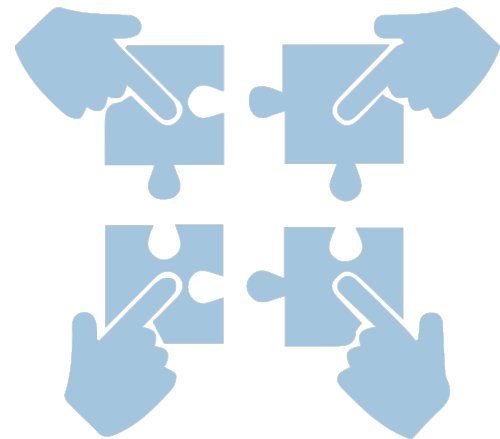
TODAY'S LESSON

List Comprehensions

(ways to iterate over items more efficiently)

POGIL Activity 22- List Comprehensions

- A briefer way to iterate over sequences
- Look at Python Activity 22, Question 1-6
- Find a partner and talk through the questions together



POGIL – Activity 22: Questions 1 & 2

```
0 monies = [1.22, 5.50, 3]
1 gbp = []
2 for usd in monies:
3     gbp.append(usd*0.77)
```

```
0 monies = [1.22, 5.50, 3]
1 gbp = [usd*0.77 for usd in monies]
```

These two code samples do the same thing, how?

- What part of code initializes the list gbp?

- What part of the code iterates through each element of the `monies` list?

- What part of the code converts the values of `monies` from USD to GBP?

List Comprehensions

- `words = ['aye', 'matey', 'yohoho']`

It's going to be a list

Variable to store results in What item to store in the variable

- `pirate = [wd+'arr' for wd in words]`

A for...loop that refers to each element in words (list) as wd

- `print(pirate)`

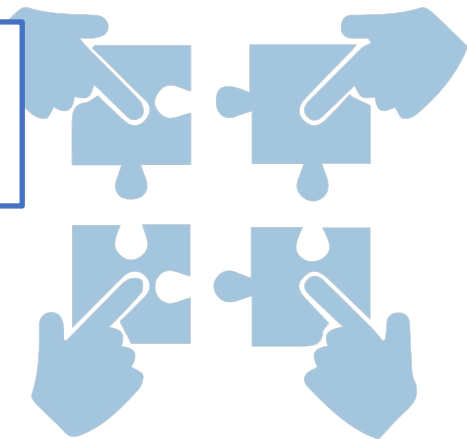
- `['ayearrr', 'mateyarr', 'yohohoarr']`

POGIL – Activity 22: Question 3

```
0 # Assume each element of the list words is a line from
0 # /usr/share/dict/words (the unix dictionary)
1 longer = [ wd for wd in words if len(wd) > 5 ]
```

- a. What differs in this list comprehension that we did not have in the previous USD/GBP example?

```
0 monies = [1.22, 5.50, 3]
1 gbp = [usd*0.77 for usd in monies]
```



POGIL – Activity 22: Question 3

```
0 # Assume each element of the list words is a line from
0 # /usr/share/dict/words (the unix dictionary)
1 longer = [ wd for wd in words if len(wd) > 5 ]
```

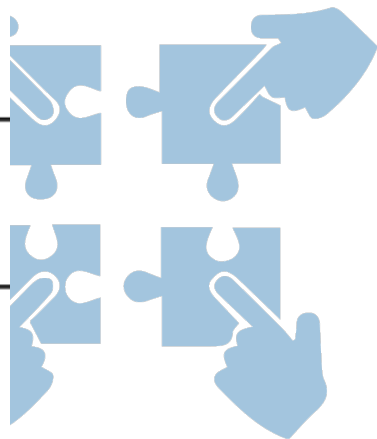
b. _____
What does the variable wd represent in this code?

c. _____
What does the code if len(wd) > 5 do?

d. _____
Why is this line of code enclosed in square brackets?

e. _____
When this code completes execution, describe what is stored in the `longer` variable:

f. _____
Write code to create a list that contains only words that begin with the letter 'w'. Use a list comprehension:



POGIL – Activity 22: Question 4

```
0 testStr = "Hello 12345 World"  
1 newList = []  
2 for x in testStr:  
3     if x.isdigit():  
4         newList.append(x)
```

a. What does the code on line 3 do?

b. What will newList contain when this code completes execution?

c. Construct a list comprehension that accomplishes the same tasks as this example code:

POGIL – Activity 22: Question 5

```
0 >>> def hasSub(word, substring):  
1 ...     return substring in word  
2 >>> names = ['pixel', 'tally', 'wally', 'linus', 'annie']  
3 >>> similar = [ dog for dog in names if hasSub(dog, 'lly') ]  
4 >>> similar  
5 ['tally', 'wally']
```

a. If we call hasSub(dog, 'lly'), what does the function return?

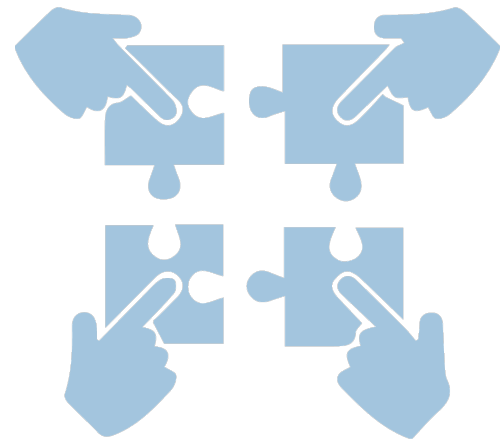
b. What might `substring in word`, do?

c. Construct a list comprehension that accomplishes the same tasks as this example code, but without the function hasSub(. . .):

POGIL – Activity 22: Question 6

```
combined = [ x+y for x in wds for y in wds if x+y in words ]
```

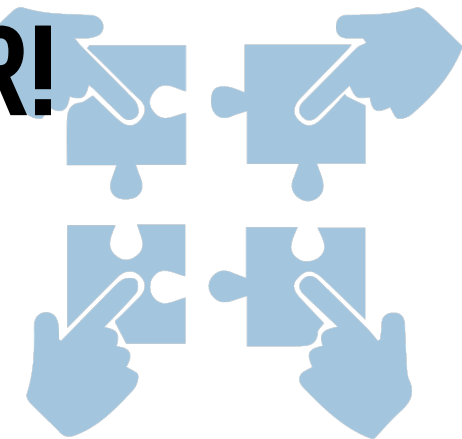
- Rewrite the above list comprehension as a multi-line statement:
- What does this list comprehension do?



**YOU SHOULD COMPLETE THE REST OF
ALL POGILS OUTSIDE OF CLASS.**

BEST DONE WITH A PARTNER OR STUDY GROUP.

CHECK YOUR ANSWERS ON A COMPUTER!



List Comprehensions

```
w4 = [word for word in words if len(word)==4]
```

- Is the same as:
- `w4 = []`
- `for word in words:`
 - `if len(word) == 4:`
 - `w4.append(word)`

List Comprehensions

- Can use nested for loops, too
- Find compound words made up of 2 four-letter words
- `ww8 = [w1+w2 for w1 in w4 for w2 in w4 if w1+w2 in words]`

5000 X 5000 combinations of words
See if it's in a list of several 100,000
...this will take awhile...

TODAY'S LESSON

More Lists

(a few more handy things we can do with lists)

Appending/Extending

- `l = [5, 16, 18]`
- `m = ['pixel', 'pup']`

- `l.append(m)`

- `l`
 - `[5, 16, 18, ['pixel', 'pup']]`

What happened here?

- `l = [5, 16, 18]`
- `m = ['pixel', 'pup']`

- `l.extend(m)`

- `l`
 - `[5, 16, 18, 'pixel', 'pup']`

What happened here?

Other List Functions

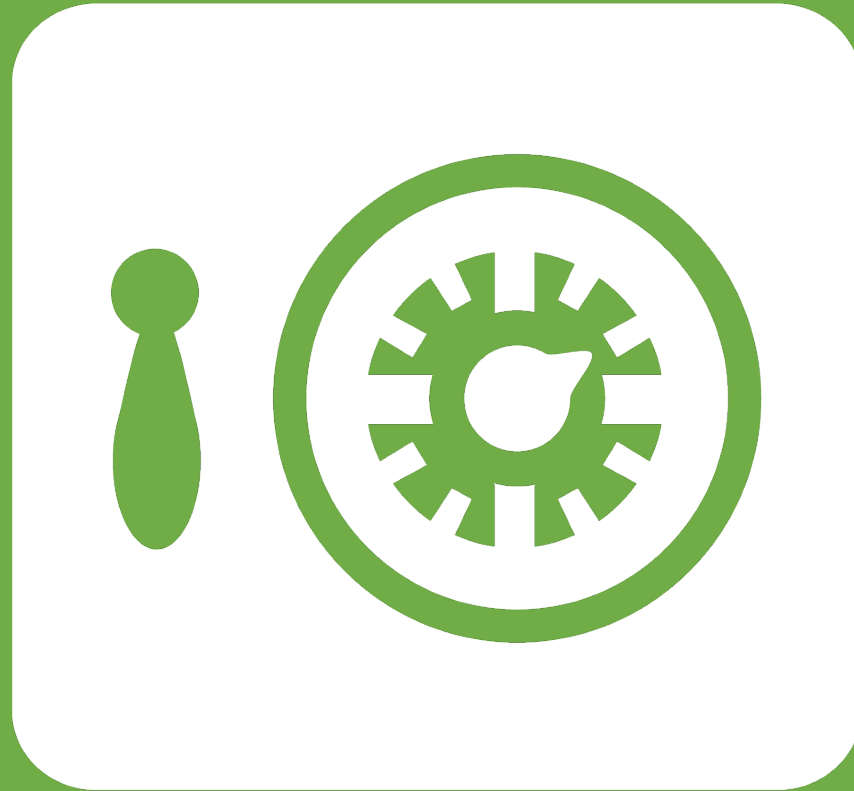
- `x = ['new']*3 + ['old']*8`
- `x`
 - `['new', 'new', 'new', 'old', 'old', 'old', 'old', 'old', 'old', 'old']`

What happened here?

- `x.count('new')`
 - 3
- `x.index('old')`
 - 3

QUESTIONS?





Leftover Slides

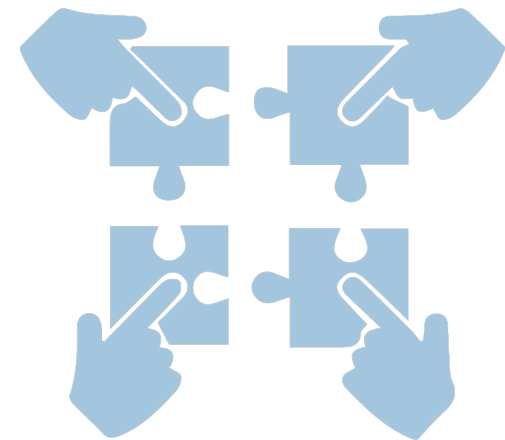
List Comprehensions

```
words = [line.strip() for line in open('/usr/share/dict/words')]
```

- Is the same as:
- `words = []`
- `for line in open('/usr/share/dict/words'):`
 - `words.append(line.strip())`

POGIL Activity 15- Writing to Files

- More data structures for sequences of objects
- Look at Python Activity 15, Question 1
- Find a partner and talk through the questions together



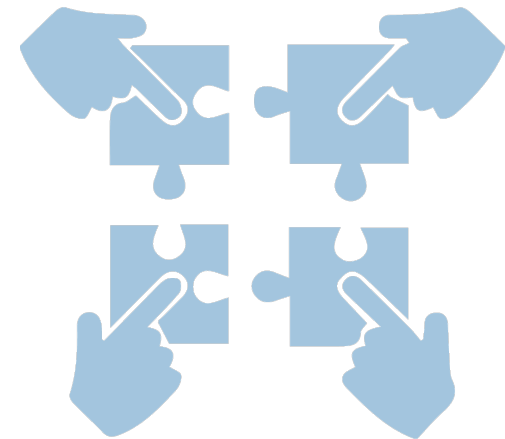
POGIL – Activity 15: Question 1

```
def studentInfo():  
    lastName = input("Last name: ")  
    firstName = input("First name: ")  
    studentID = input("Enter ID: ")  
  
    inFile = open("studentInfo.txt", "a")  
    inFile.write("Name: " + " firstName + " " + lastName)  
    inFile.write("StudentID: " + studentID)  
    inFile.write("\n")  
    inFile.close()  
    print("Done! Data is saved in file: studentInfo.txt")
```

- What output appears on the screen? _____
- What does the program do? _____

- Locate the file **studentInfo.txt** on your computer. The file is stored in the same folder as the program. What is stored in the file? _____
- Change the argument 'a' to 'w' in the call to the **open** function. What is the purpose of the "w" in the following line of code?

```
inFile = open("studentInfo.txt", 'w')
```



POGIL – Activity 15: Question 1

```
def studentInfo():  
    lastName = input("Last name: ")  
    firstName = input("First name: ")  
    studentID = input("Enter ID: ")  
  
    inFile = open("studentInfo.txt", "a")  
    inFile.write("Name: " + " firstName + " " + lastName)  
    inFile.write("StudentID: " + studentID)  
    inFile.write("\n")  
    inFile.close()  
    print("Done! Data is saved in file: studentInfo.txt")
```

- e. Did you create the file: **studentInfo.txt** separately from the program code? _____
- f. Execute the program again using different input. Open the **studentInfo.txt** file. What is in the file? Is the data from the first program execution still there?
-



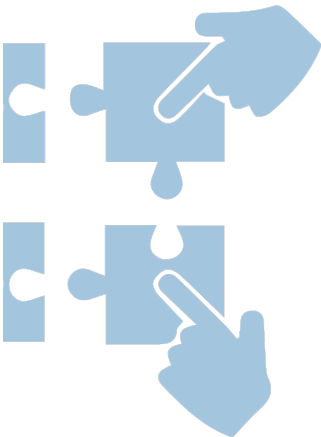
POGIL – Activity 15: Question 1

```
def studentInfo():  
    lastName = input("Last name: ")  
    firstName = input("First name: ")  
    studentID = input("Enter ID: ")  
  
    inFile = open("studentInfo.txt", "a")  
    inFile.write("Name: " + " " + firstName + " " + lastName)  
    inFile.write("StudentID: " + studentID)  
    inFile.write("\n")  
    inFile.close()  
    print("Done! Data is saved in file: studentInfo.txt")
```

g. Change the 'w' to 'a' in the open() function. Execute the program again with different input. Examine the **studentInfo.txt** file. What did 'a' as an argument in the open() function do? _____

h. Notice the function – write(). How many arguments does the write function have? _____

i. How does the write() function know what file to write to? _____

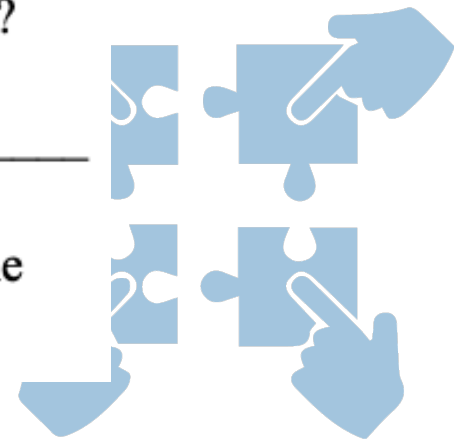


POGIL – Activity 15: Question 1

```
def studentInfo():  
    lastName = input("Last name: ")  
    firstName = input("First name: ")  
    studentID = input("Enter ID: ")  
  
    inFile = open("studentInfo.txt", "a")  
    inFile.write("Name: " + " firstName + " " + lastName)  
    inFile.write("StudentID: " + studentID)  
    inFile.write("\n")  
    inFile.close()  
    print("Done! Data is saved in file: studentInfo.txt")
```

j. What line of code closes the file? Where is the line of code positioned in the program?

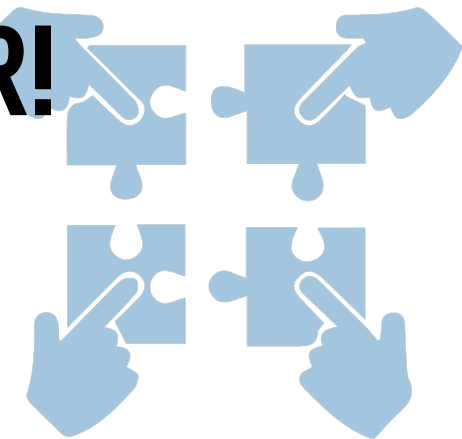
k. Rewrite the program so that the user can enter three names during one execution of the program. You may need to change the order of some of the code.



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More About the Built-in Format Function

```
print( '{:4}'.format(a*b), end=' ', file=out)
```

- `print('Num is {}'.format(3))`
 - 'Num is 3'
- `print('Num is {:10}'.format(3))`
 - 'Num is 3' → Gives 10 total characters to the {} (fills in with spaces)
- `print('Num is {:^10}'.format(3))`
 - 'Num is 3 ' → Center-aligns {} within those 10 spaces

More About the Built-in Print Function

```
print( '{:4}'.format(a*b), end='', file=out)
```

- `end= ''`
 - `print()` usually ends with a `'\n'` by default
 - Can change that!
- `file=out`
 - `Print()` usually prints to `std out` (the terminal) by default
 - Can change that!

Writing Files

You can also specify a file to print to using the `print(...)` function

```
with open('table.dat', 'w') as out:
    for a in range(1, 10+1):
        for b in range(1, 10+1):
            print('{:4}'.format(a*b), end='', file=out)
        print(file = out)
# out.close() happens here, implicitly
```

See [printwrite.py](#) and [filewrite.py](#) examples