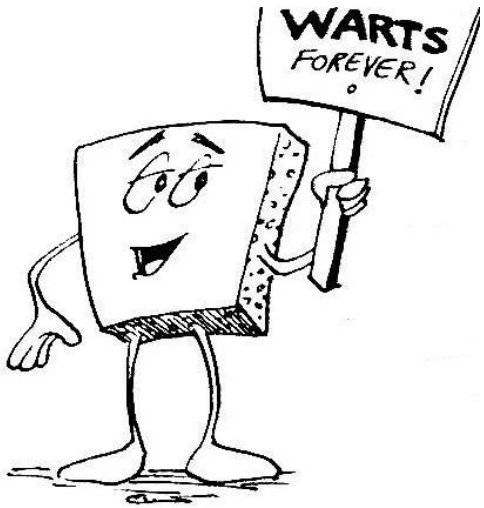
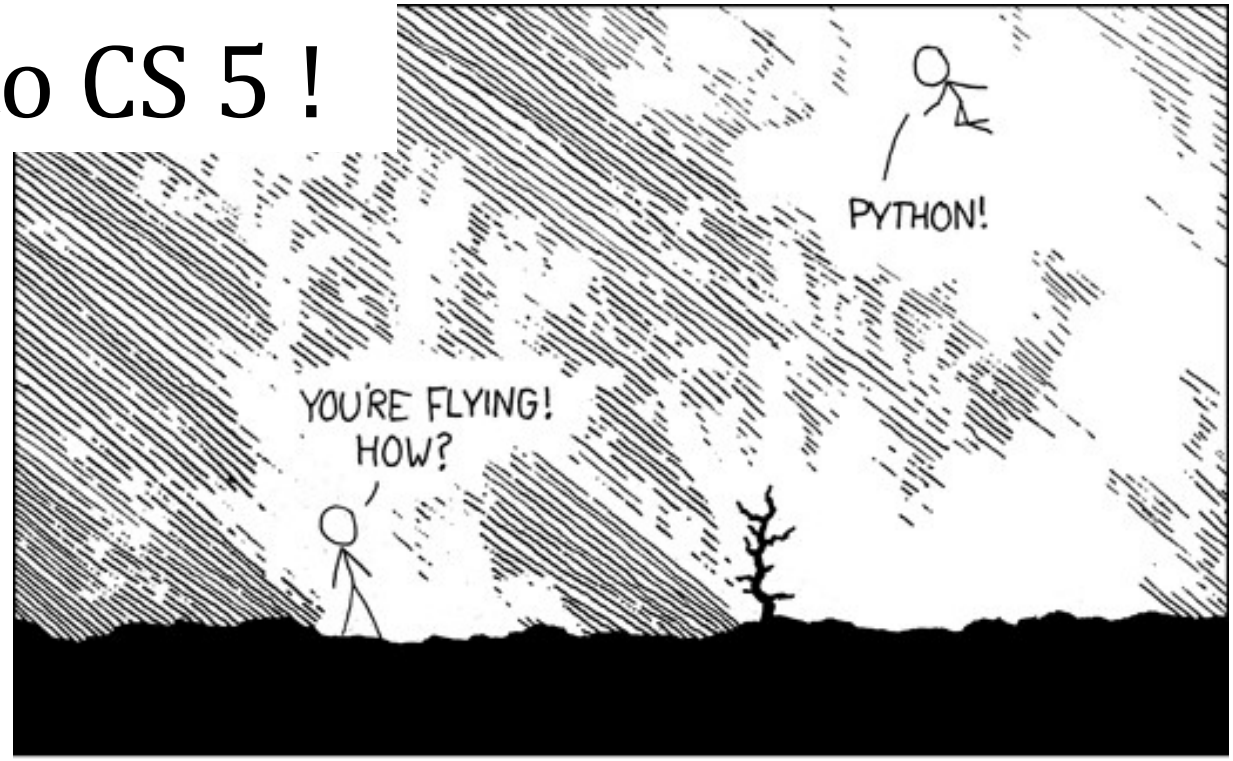
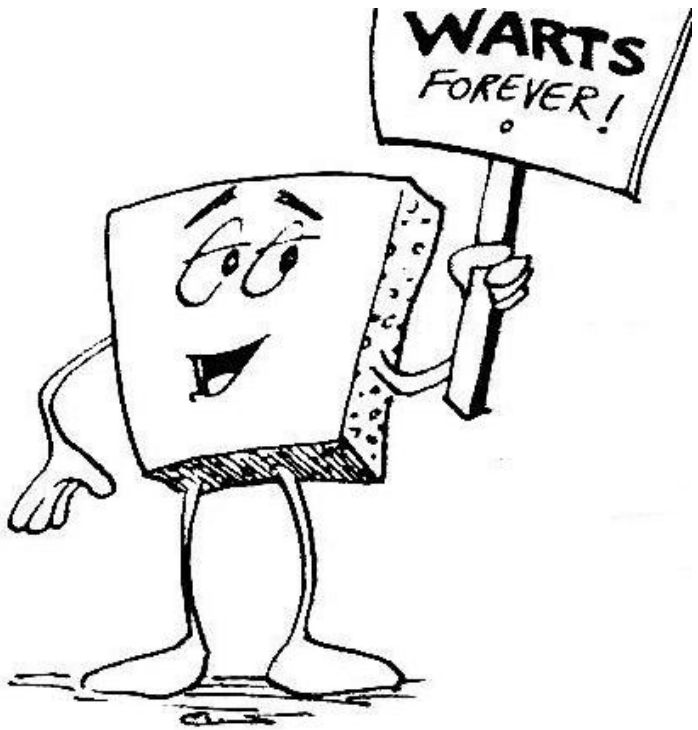
Welcome to CS 5 !





xkcd, CS's id



Wally Wart, a protrusive advocate of ***concrete*** computing

Welcome to CS 5 !

Grab these lecture notes…

Introduction to CS

We don't have words strong enough to describe this class.

- US News and Course Report

Everyone will get out of this course – a lot!

- NYTimes Review of Courses

We give this course two thumbs…

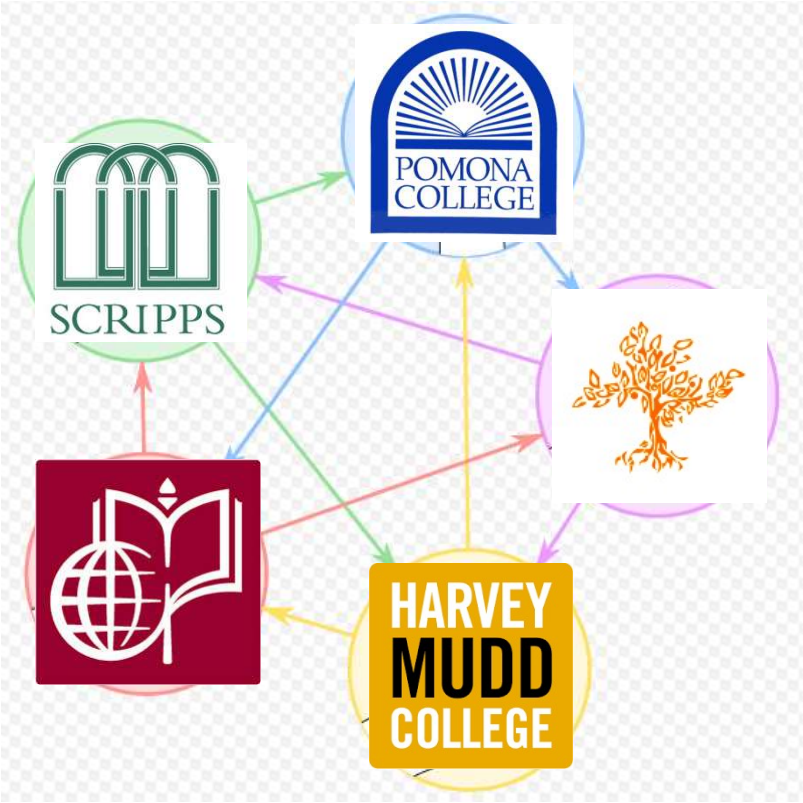
- *Meta*metacritic

1 handout…

slides & syllabus

official alien of CS 5 Gold

A word on 5 spots…



Welcome, not only to HMC, but *to all 5Cs*!

Introductions...

Zach Dodds
Olin B163 (HMC)
dodds@cs.hmc.edu

pursuer of *low-level* AI

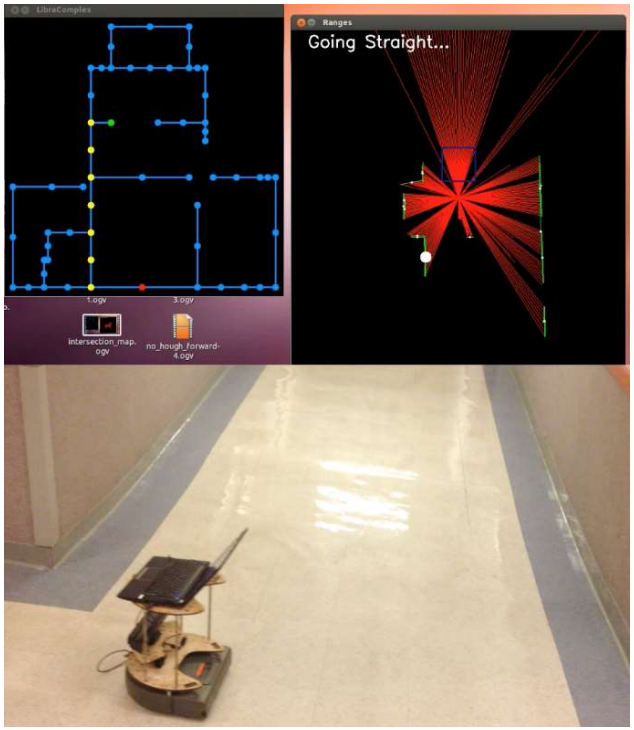
taker of *low-quality* selfies

fan of *low-tech* games

Speaking of introductions

How I spend my summers ...?

actually, this "I" is
not quite accurate...



Robots

Chairs?

Outreach

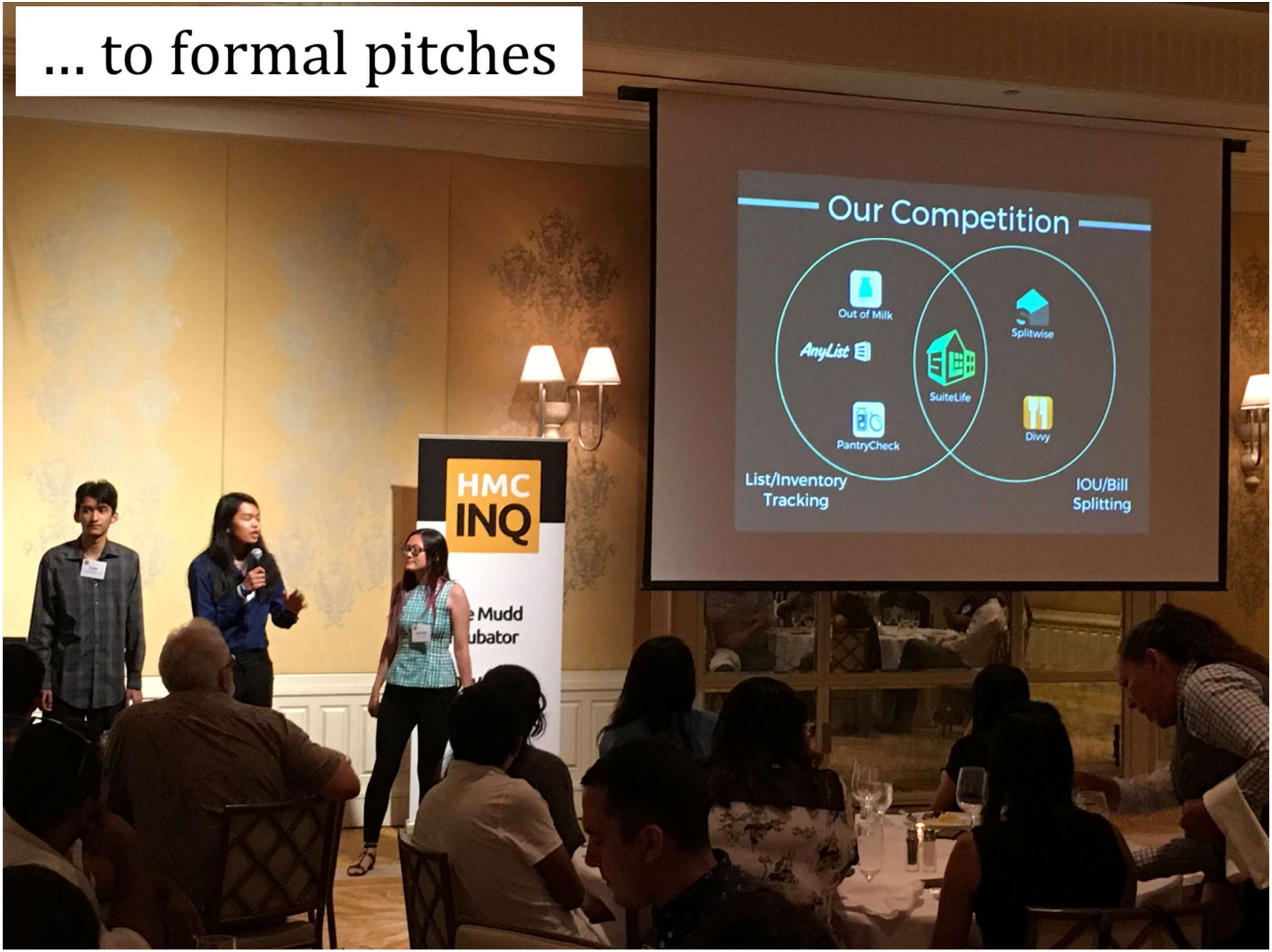
Who?!??

Dinos!

Algorithmic improvisation

Start-up ideas…

… to formal pitches



CS Staff: *Rising sophomores*, unite!

CS Staff: *Rising sophomores*, unite!

Teacher Outreach in S.F.

CS Staff: *Rising sophomores*, unite!

CS Staff: *Rising sophomores*, unite!

Lots of opportunities surrounding computing...
(*at the 5Cs and beyond*)

Today in CS5

2) How CS 5 runs…

3) Python?!

Shouldn't there be an alien in this game?

1) What ***is*** CS?

CS is just programming, right?

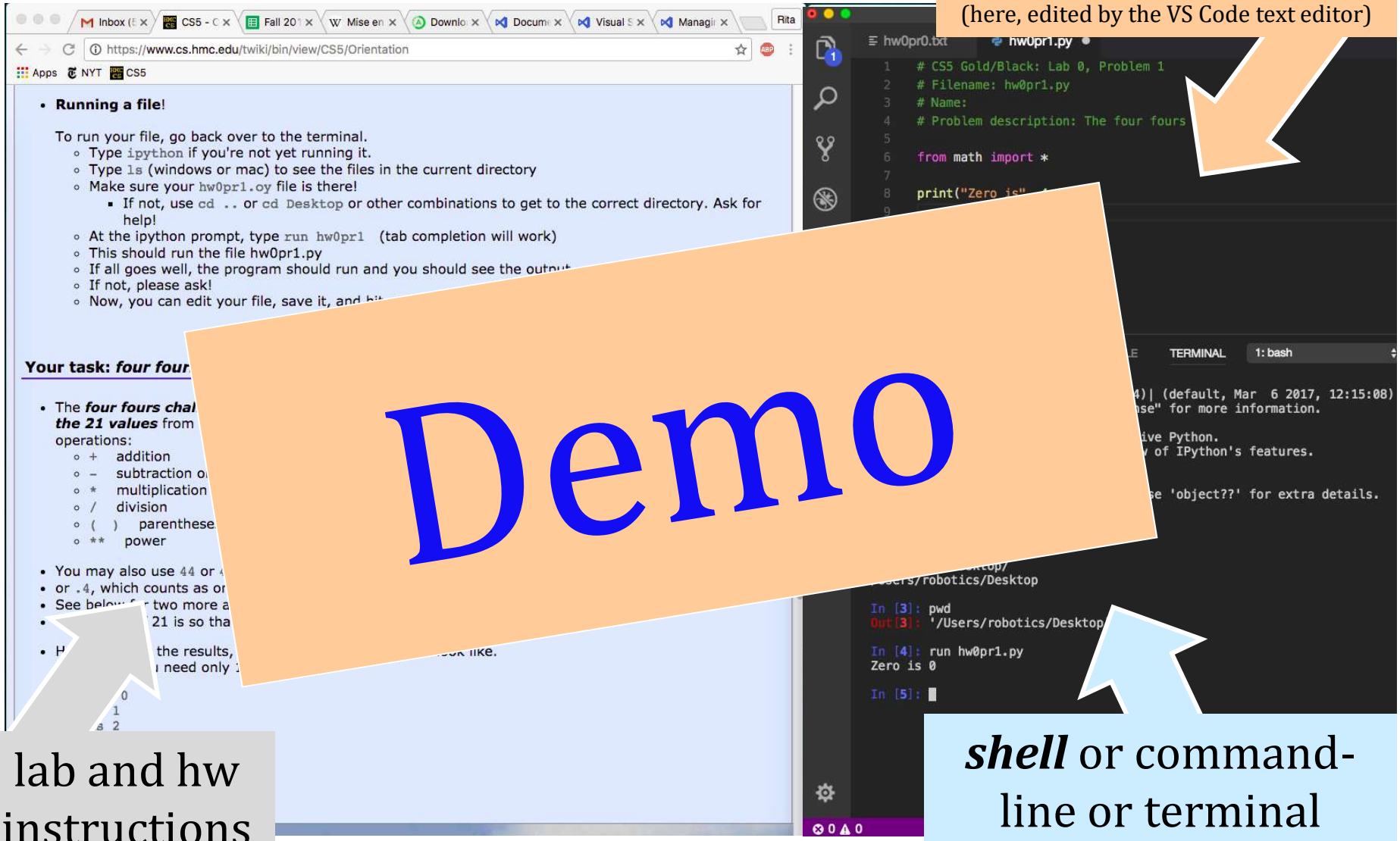
Whatever it is,
it's definitely *alien*!

I'm not so sure…

CS vs. programming ?

A *minute* of cs5 programming…

Python source code, a plain-text file
(here, edited by the VS Code text editor)



Demo

lab and hw instructions

shell or command-line or terminal
(the execution environment)

Lab 0: getting everything running ***on your own machine***

Lab 0: ***Happiness Suggestion***

Download the software
BEFORE coming to lab:

https://www.cs.hmc.edu/twiki/bin/view/CS5/OwnMachines

Homework Assignments and Labs

	Labs	Gold	Black
Week 0	Lab 0	Homework 0	Homework 0

Spot the difference here?

```
print('hi')
```

```
print 'hi'
```

I *still* confuse these!

Spot the difference here?

```
print('hi')
```

python 3

```
print 'hi'
```

python 2

We'll be using python 3 this term...

Spot the difference here?

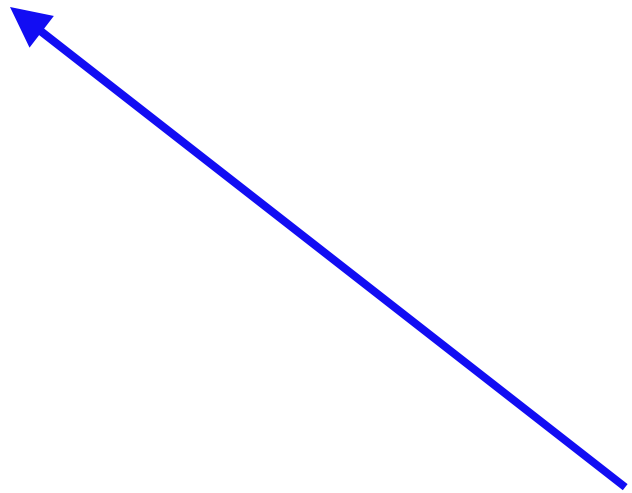
```
print('hi')
```

```
print 'hi'
```

Syntax!

We'll be using python 3 this term...

CS != programming



"not equal to"

CS != programming

programming : **CS** ::

longboards : HMC maybe 5Cs?

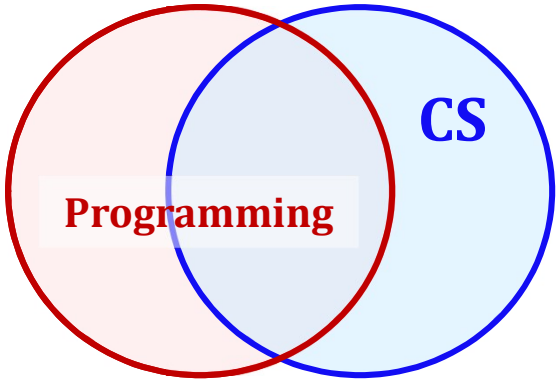
capital : business venture

equations : mathematics

language : ideas

web search : knowledge

Tesla : Google



programs are a ***vehicle***, but not the destination

CS != programming

So, what is CS?

Punctuation matters!
So what? *is* CS

What is CS a science *of*?

the study of ***complexity***:

*How can **it** be done?*

*How well can **it** be done?*

*Can **it** be done at all?*

***it* ~ information**

or, more precisely, *a process transforming information from one form to another*

3 examples?
That's ***it*** for me!

We'll look at 3 examples – each of which you'll ***construct*** in CS 5 ...at least to some extent!

What is CS?

*How can **it** be done?*

*How well can **it** be done?*

*Can **it** be done at all?*

Can you solve the problem?

Can you create a *process* to solve such problems?

'HUMAN'

'CHIMPANZEE'

What is the ***Longest Common Subsequence*** between 2 strings?

biology's string-matching problem, "LCS"

'CGCTGAGCTAGGCC...'

'ATCCTAGGTAACTG...'

+10^9more

Eye oneder if this haz othur aplications?

What is CS?

Feels like home!

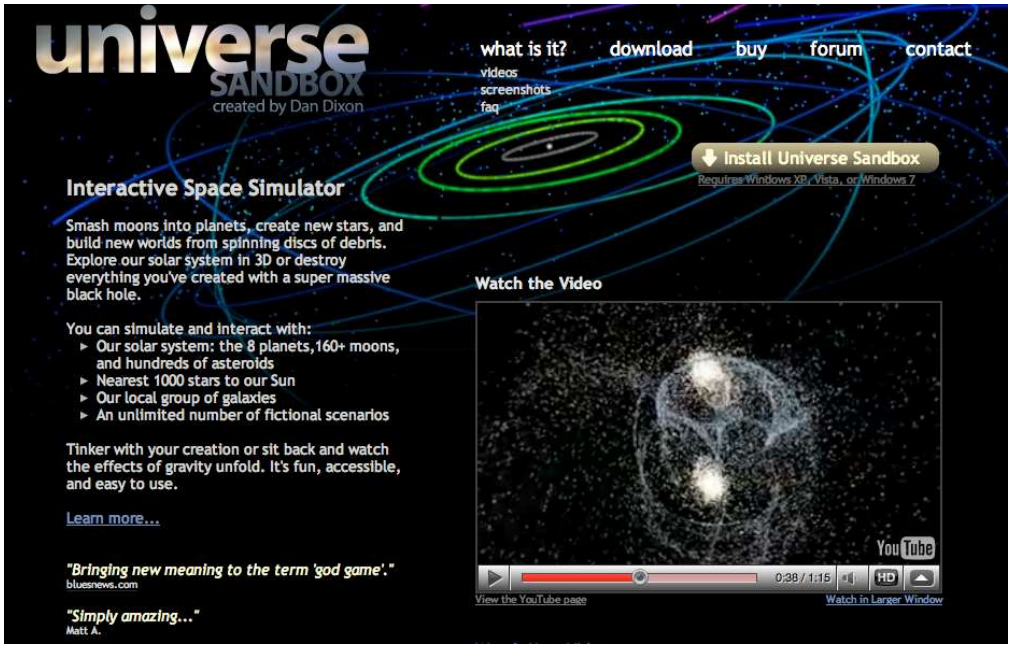
*How can **it** be done?*

*How well can **it** be done?*

*Can **it** be done at all?*

How *quickly* can you find a solution?

Is your solution the *"best"* possible?



How much work is needed to simulate N stars?

chemistry's + physics's "N-body" problem

What if N is a million-and-one...?

What is CS?

*How can **it** be done?*

*How well can **it** be done?*

*Can **it** be done at all?*

Is your problem *solvable*?

How can you tell !?

many problems are *uncomputable*...
... and you'll *prove* this!

Can we build a 3d model from one 2d image?

Andrew Ng's "Make3d"

All three eyes tell me that Make3d has just failed ~ epically!

What is CS?

CS is the study of ***complexity***

*How can **it** be done?*

*How well can **it** be done?*

*Can **it** be done at all?*

Can you solve this problem?

Can you create a process to solve such problems?

How quickly can you find solutions?

Do you have the "best" solution?

Is every problem solvable?

Is there a way to tell?

There isn't always!

CS's ***6*** big questions

Only <u>one</u> is programming. *Which one?*

What is CS?

CS is the study of ***complexity***

*How can **it** be done?*

*How well can **it** be done?*

*Can **it** be done at all?*

Can you solve this problem? CS

Can you create a process to solve such problems? *programming* + CS

How quickly can you find solutions? CS

Do you have the "best" solution? CS

Is every problem solvable? CS

Is there a way to tell? CS

There isn't always!

CS's ***6*** big questions

Only <u>one</u> is programming. *Which one?*

CS’s – and CS5's –
philosophy:

Whatever you are,
be a good one.

- Abraham Lincoln

More and more,
CS can help!

Take-home message...

depending on where "home" is, perhaps...

CS5 - WebHome

https://www.cs.hmc.edu/twiki/bin/view/CS5

Apps cs5 SubSite JSBoxCars cs35 GS Summer18

CS 5: *Welcome !*

Administration	Course Syllabus	Exams	Pairs Policy	Submission Info
Using Python	On your machine	In your browser	CS5's text	httlacs text
Useful/Helpful	GradeScope	CS5 Piazza	*Grutoring!*	Picobot
Related Courses	POM CS 51p	HMC CS 42	CS 5 Green	Extra Credit Labs

Homework Assignments and Labs

	Labs	Gold	Black
Week 0	Lab 0	Homework 0	Homework 0

Lecture Slides

(Before class, the previous term's slides might be posted; shortly after class the current slides will replace them.)

	Gold	Black
Week 0		
9/4/18	Lecture 0: Introduction	Lecture 0: Introduction
9/6/18	Lecture 1: Pico-fun!	Lecture 1: Map and Reduce

Yay! 2018:
Just Google for
hmc cs5

www.cs.hmc.edu/cs5

You're here ~ what's next?

2) How CS 5 runs…

3) Python?!

the first Python HW is ***choice!***

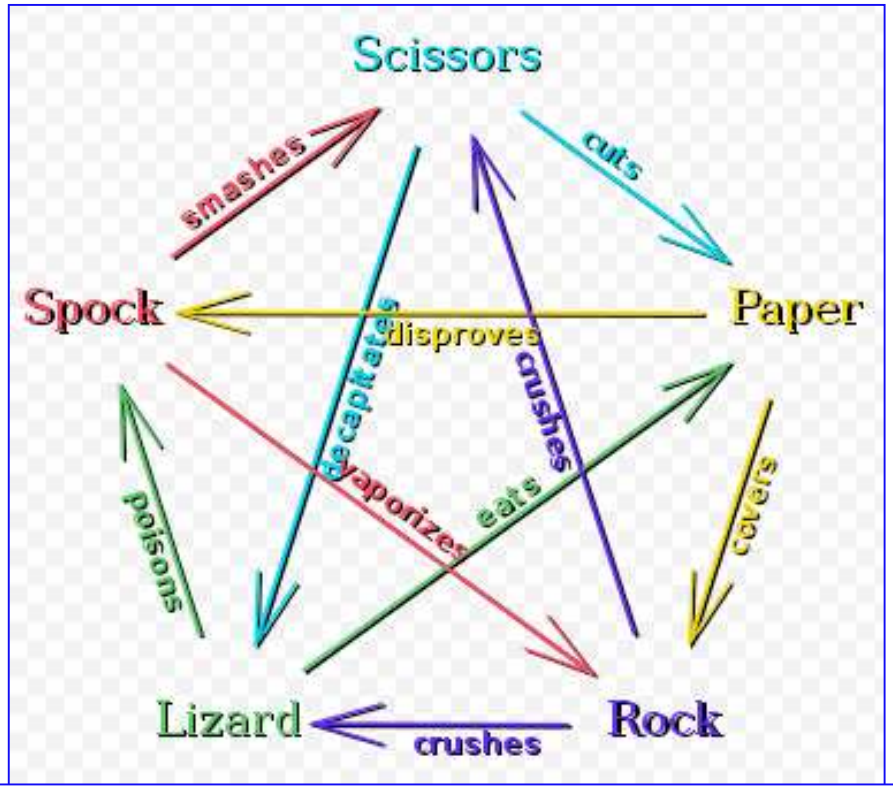
Shouldn't there be an alien in this game?

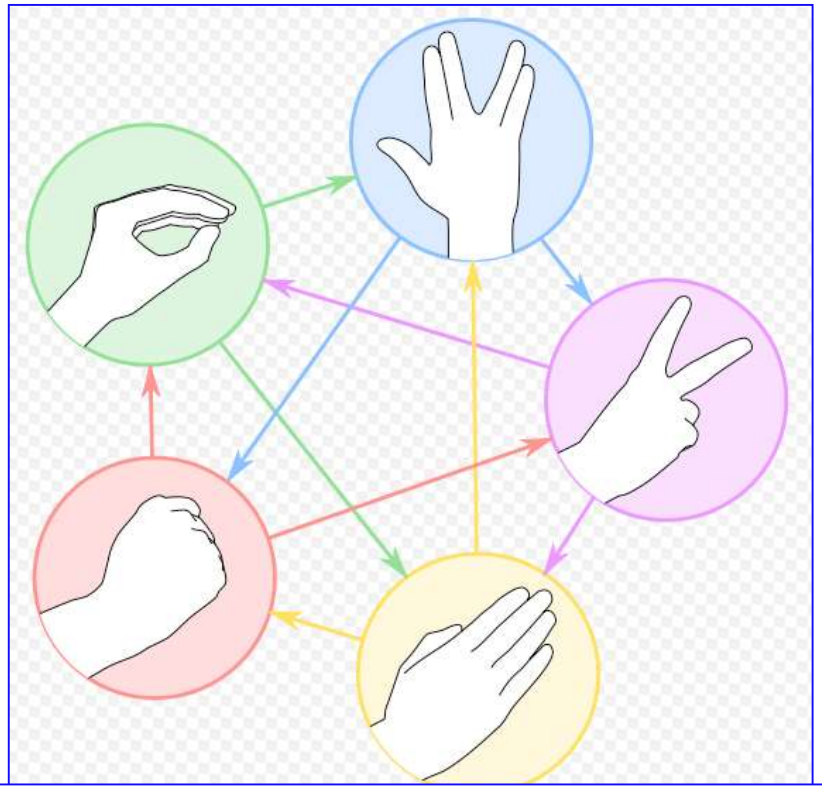
1) What ***is*** CS?

CS is just programming, right?

I'm not so sure…

Whatever it is, it's definitely *alien*!





rock – paper – scissors – lizard – Spock!

Let's play! Maybe two out of three?

Logically, I've got game!

http://www.youtube.com/watch?v=fqlDc2VICZ0 start at about :28

Soundbite Syllabus

Lectures

T and Th: *8:10-9:25 am*

Ke

Ins

y, how)

We'd like to see you! Let me know if you'll be sick…

Come to Lectures!

Lab

recommended by 4 out of 5 CS5 alums!

T or W: *2:45 - 4:45pm or 6-8 pm*

Gu

No

t for lab

Wi

Come to Labs!

Office hrs

F: *3:00-4:00 pm – Linda Activities Center lab*

Lots of help is available!

or, come to any of the ***many*** tutoring hrs!

HW

Monday

Hw is due on Monday nights…

Syllabus, briefly

Lectures

T and Th: *8:10-9:25 am*

Key skills, topics, and their motivation

Insight into the HW problems (what, ***why***, how)

We'd like to see you! Let me know if you'll be sick…

Lab

recommended by 4 out of 5 CS5 alums!

T or W: *2:45 - 4:45pm or 6-8 pm*

Guided progress on the week's hw

Not required, but encouraged: *full credit for lab*

Will ***SAVE*** you time and effort in CS 5

Office hrs

F: *2:30-4:30 pm, Linde Activities Center lab*

feel free to work on HW, to just stop by,

or, come to any of the ***many*** tutoring hrs!

HW

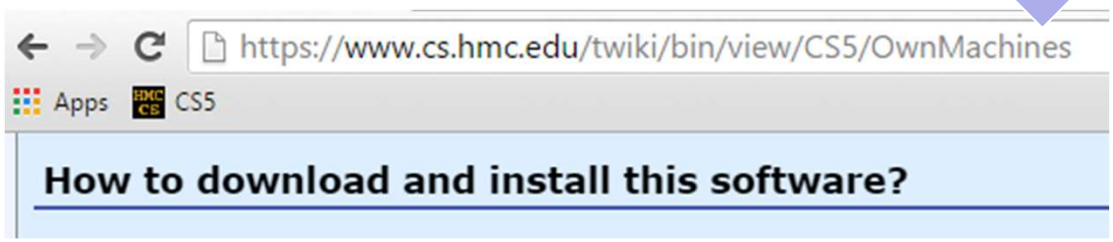
Monday nights: *due by 11:59 pm*

Each week's lab…

0) Find the lab! *Sign in…*

1) Get Python running…

download things ***now***, perhaps!



demo

2) Edit, run, + submit a file…

Encouraged: *bring your laptop*

Each week's lab…

Labs are <u>optional</u>, but *incentivized*.

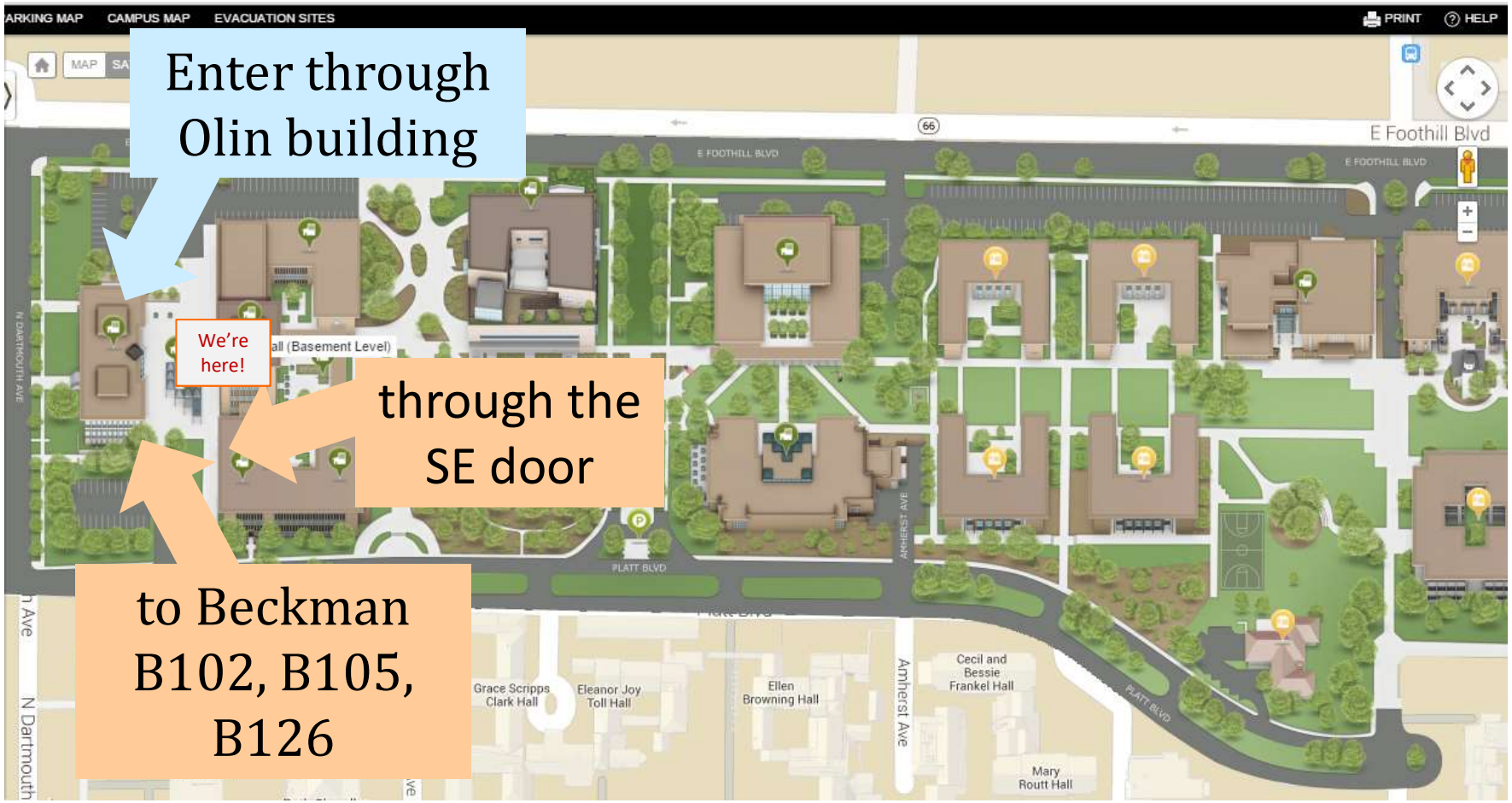
If you come to lab, give a good-faith effort, and sign in, you'll receive **full credit for the lab problems** even if you don't finish

(you <u>do</u> need to submit by the usual hwk due date)

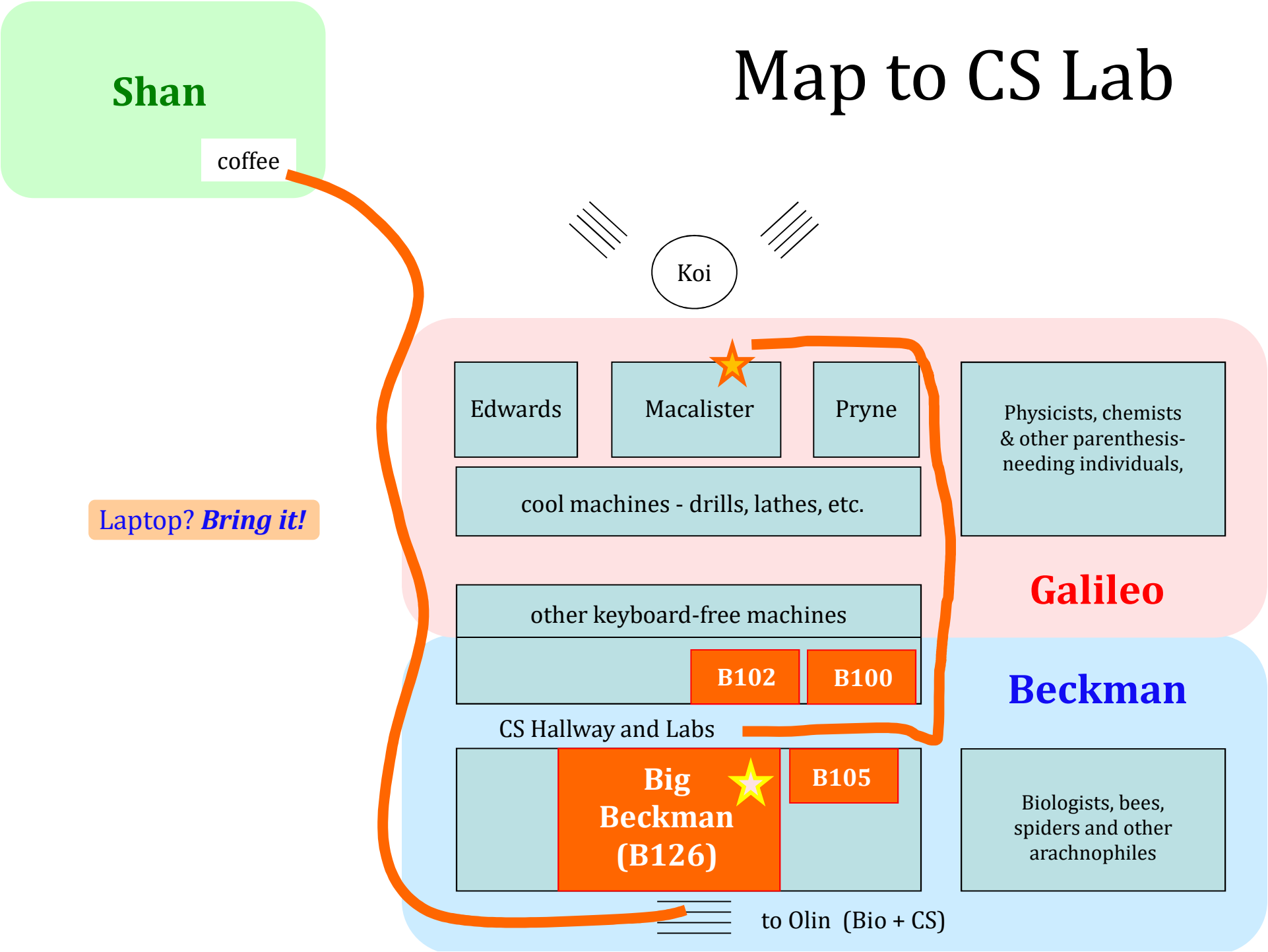
Encouraged: *bring your laptop*

Evening lab?

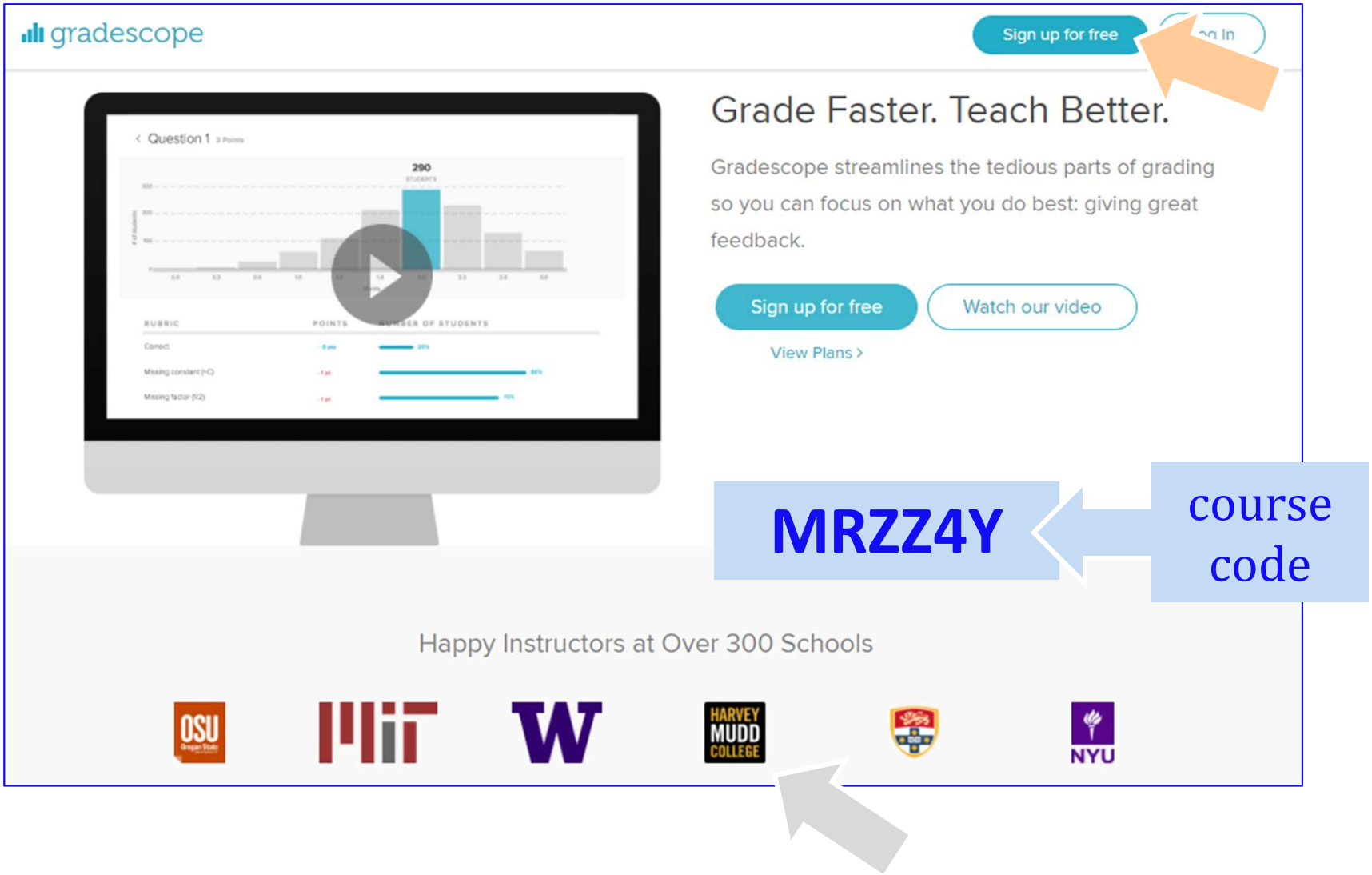
Olin's Southeast door is open!



Map to CS Lab


Shan
coffee
Laptop? Bring it!
Koi
Edwards
Macalister
Pryne
Physicists, chemists & other parenthesis-needing individuals,
cool machines - drills, lathes, etc.
Galileo
other keyboard-free machines
B102
B100
Beckman
CS Hallway and Labs
Big Beckman (B126)
B105
Biologists, bees, spiders and other arachnophiles
to Olin (Bio + CS)

Submissions: *GradeScope*



This week: Lab 0

Python source code, a plain-text file
(here, edited by the VS Code text editor)

https://www.cs.hmc.edu/twiki/bin/view/CS5/Orientation

- **Running a file**!

  To run your file, go back over to the terminal.
  - Type `ipython` if you're not yet running it.
  - Type `ls` (windows or mac) to see the files in the current directory
  - Make sure your `hw0pr1.oy` file is there!
    - If not, use `cd ..` or `cd Desktop` or other combinations to get to the correct directory. Ask for help!
  - At the ipython prompt, type `run hw0pr1` (tab completion will work)
  - This should run the file hw0pr1.py
  - If all goes well, the program should run and you should see the output
  - If not, please ask!
  - Now, you can edit your file, save it, and hit *up-arrow* to re-run it. Awesome!

Your task: *four fours*

- The ***four fours challenge***! Now, add several more lines similar to this one so that you compute ***16 of the 21 values*** from `0` through `20` using ***exactly four fours***. You should use Python's arithmetic operations:
  - `+` addition
  - `-` subtraction or negation
  - `*` multiplication
  - `/` division
  - `( )` parentheses for grouping
  - `**` power
- You may also use `44` or `4.4`, which count as two fours,
- or `.4`, which counts as one four.
- See below for two more allowable operations, `sqrt` and `factorial` both in the `math` library
- 21 is so that you can choose a few to skip!
- H the results, *but not the source code*, will look like.
  need only 16 of the 21:

```
0
1
2
```

lab and hw instructions

hw0pr0.txt hw0pr1.py

```
# CS5 Gold/Black: Lab 0, Problem 1
# Filename: hw0pr1.py
# Name:
# Problem description: The four fours

from math import *

print("Zero is", 4+4-4-4)
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL 1: bash

```
sycamore:~ robotics$ ipython
Python 3.5.3 |Anaconda custom (x86_64)| (default, Mar  6 2017, 12:15:08)
Type "copyright", "credits" or "license" for more information.

IPython 4.2.0 -- An enhanced Interactive Python.
?         -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help      -> Python's own help system.
object?   -> Details about 'object', use 'object??' for extra details.

In [1]: pwd
Out[1]: '/Users/robotics'

In [2]: cd Desktop/
/Users/robotics/Desktop

In [3]: pwd
Out[3]: '/Users/robotics/Desktop

In [4]: run hw0pr1.py
Zero is 0

In [5]:
```

shell or command-line or terminal
(the execution environment)

getting everything running ***on your own machine***

Lab 0: ***Happiness Suggestion***

Download the software
BEFORE coming to lab:

https://www.cs.hmc.edu/twiki/bin/view/CS5/OwnMachines

Homework Assignments and Labs

	Labs	Gold	Black
Week 0	Lab 0	Homework 0	Homework 0

Homework

Assignments

~ 5 problems/week

Due **Monday** evenings by 11:59 pm.

Extra credit is usually available…

You have 3 ***CS 5 Euros*** to use…
"Late Days"

Eur-ollowed to use one Euro for up to three hwks.

No need to let us know, even.

Collaborate!

Some problems are specified "individual-only."
Others offer the option of working as pairs/partners:

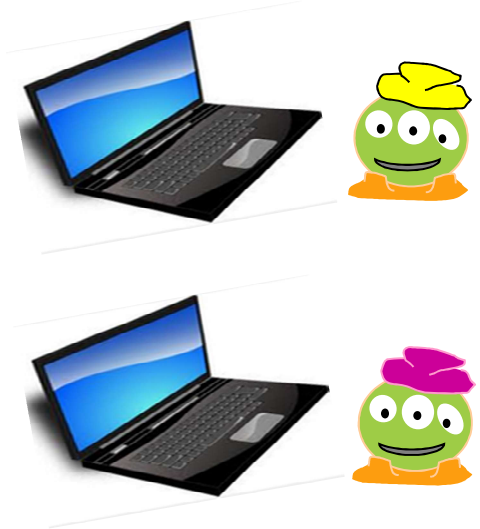
- You don't have to work in pairs/partners (that said, it's fun!)
- If you do, you must share the work equally - typing and coaching
- Be sure to indicate who your partner was at the submission site!

Pairs

one computer

tradeoff typing/debugging ~
about every 20 minutes

Partners



two computers

both partners type/debug ~
provide help as needed

Standard is the same either way: After finishing the hw, (a) *each person has contributed equally* and (b) *both could complete the problems on their own*

Submit with a partner as ***full co-owners*** of the work.

Honor Code

- You're *encouraged* to **discuss** problems with other students – or tutors - or any instructors.

- You may **not** share written, electronic or verbal solutions with other students, present or past:

Please ***do*** use the internet for Python language references.

Pleas ***do*** use other's eyes for finding syntax erorrs.

Even with three eyes, I need to borrow others' to find the syntax errors here!

Do ***not*** use the internet (or intranet) to (try to) find solutions…

If you work as a pair/partners, the rules apply for the duo.

Sign & submit CS's honesty policy ***online*** in this week's lab.

Grading

~ 65% Assignments

~ 30% Exams

~ 5% Participation/“quizzes”

```
if perc > .95:
    print('A')
elif perc > .90:
    print('A-')
elif perc > .70:
    print('Pass')
```

many take cs5 P/NC

see online syllabus for the full grade list...

Midterm? This feels more like a *2/3-term*!

Exams

Midterm	Th, Nov. 8, in-class
Final	Tue. Dec 17th (7pm) or Wed. 18th (9am)

using a page of notes is OK on exams

the exams are *written*, not coded

the problems are modeled on the in-class "quizzes"

Choices, choices!

Let's **set** the value of **perc** to 0.91...

```
perc = 0.91

if perc > 0.95:
    print 'A'
elif perc > 0.90:
    print 'A-'
elif perc > 0.70:
    print 'Pass'
else:
```

What will this program print, if **perc** is 0.91?

First – who sees the ***syntax errors*** here !?

Choices, choices!

Let's **set** the value of **perc** to 0.91...

```
perc = 0.91

if perc > 0.95:
    print('A')
elif perc > 0.90:
    print('A-')
elif perc > 0.70:
    print('Pass')
else:
    print('Aargh!')
```

What will this program print, if **perc** is 0.91?

Lots of Illuminating Solid Parentheses!

Aargh! ;-)

What's here?

of **BLOCKS** here:

of **TESTS** here:

of **CONTROL STRUCTURES** here:

how many tests are **executed?**

Choices, choices!

Let's **set** the value of **perc** to 0.91...

```
perc = 0.91

if perc > 0.95:
    print('A')
elif perc > 0.90:
    print('A-')
elif perc > 0.70:
    print('Pass')
else:
    print('Aargh!')
```

What will this program print, if **perc** is 0.91?

What's here?

of **BLOCKS** here:

of **TESTS** here:

of **CONTROL STRUCTURES** here:

how many tests are **executed?**

Choices, choices!

```
perc = 0.80

if perc > 0.95:
    print('A')
elif perc > 0.90:
    print('A-')
elif perc > 0.70:
    print('Pass')
else:
    print('Aargh!')
```

```
perc = 0.80

if perc > 0.00:
    print('Aargh!')
elif perc > 0.70:
    print('Pass')
elif perc > 0.90:
    print('A-')
else:
    print('A')
```

What does each of these programs print out, if **`perc`** is 0.8?

What value of **`perc`** gives an **`'A-'`** on the right?

How can you get a ***better*** grade on the right than the left?

Exclusive Choices

if ... elif ... else

```
if perc > 0.95:
    print('A')

elif perc > 0.90:
    print('A-')

elif perc > 0.70:
    print('Pass')

else:
    print('Aargh!')
```

***4 mutually exclusive** blocks*

in a single control structure

`elif` and `else` are optional

When using
`if . elif … . else`
at most one block will run:
the first whose test is **True**.
If all fail, the `else` will run

Exclusive Choices

Every **`if`** *starts a new control structure.*

```
if
    print('A')

elif pe  > 0.90:
    p

elif p  > 0.
    p

else:
    p
```

***4 mutually exclusive** blocks*

Every **`elif`** *and* **`else`** *<u>continues</u> an existing control structure.*

`elif` and **`else`** are optional

the first whose test is **True**.
If <u>all</u> fail, the **`else`** will run

What's the difference?

mutually exclusive blocks

```
perc

if perc > .95:
    print('A')

elif perc > .90:
    print('A-')

elif perc > .70:
    print('Pass')
```

nonexclusive blocks

```
perc

if perc > .95:
    print('A')

if perc > .90:
    print('A-')

if perc > .70:
    print('Pass')
```

What if **perc == .99** ? (How would we set it?)

How many separate ***control structures*** does each side have?

What's the difference?

mutually exclusive blocks	***non*exclusive blocks**

perc

```
if perc > .95:
    print('A')

elif perc > .90:
    print('A-')

elif perc > .70:
    print('Pass')
```

1 thing

perc

```
if perc > .95:
    print('A')

if perc > .90:
    print('A-')

if perc > .70:
    print('Pass')
```

3 things

What if **perc == .99** ? (How would we set it?)

How many separate ***control structures*** does each side have?

Nesting

for *decision-making*, we now have it ***all***…

Nesting

for *decision-making*, we now have it ***all***…

Nesting

for *decision-making*, we now have it ***all***...

So, let's catch 'em ***all***...

Nesting

Does this program print the correct RPS result *this time*? *Does it **always**?*

```
comp = 'rock'
user = 'paper'


if comp == 'paper' and user == 'paper':
    print('We tie. Try again?')


elif comp == 'rock':

    if user == 'scissors':
        print('I win! *_*')
    else:
        print('You win. Aargh!')
```

Blocks ?

Tests ?

C. Structures ?

Pair up with someone nearby – answer these questions together...

"Quiz"

Name _____

Your favorite _____ is _____.

Your least favorite _____ is _____.

Name _____

Your favorite _____ is _____.

Your least favorite _____ is _____.

What is something non-Claremont-collegey you have in common?

Then, try these Python q's:

(0) Find the 3 tests and 4 blocks here.

(1) What does this code print?

```
comp = 'rock'
user = 'rock'

if comp == 'rock':
    if user == 'paper':
        print('I win *_*!')
    elif user == 'scissors':
        print('You win.')
else:
    print('Tie.')
```

(2) As written, what output does this print?

```
comp = 'rock'
user = 'rock'

if comp == 'rock':
    print('I win *_*!')
if user == 'paper':
    print('You win.')
else:
    print('Tie.')
```

(3) ***Change*** these inputs to produce a completely correct RPS output here.

(4) How many of the 9 RPS **input cases** are *fully correctly* handled here?

user \ comp	'rock'	'paper'	'scissors'
'rock'			
'paper'			
'scissors'			

(5) What is the ***smallest*** number of **blocks** and **tests** you'd need for a full game of RPS?

(**Extra**) What if it were RPS-5, which includes Lizard and Spock? How about RPS-101?

Pair up with someone nearby – answer these questions together...

"Quiz"

Name _____

Your favo

Your least f ___.

Name _____

Your favorite _____ is _____.

Your least favorite _____ .

People

Paper

What is sonething non-Claremont-collegey you have in common?

Then, try these Python q's:

(0) Find the 3 tests and 4 blocks here.

(1) What does this code print?

```
comp = 'rock'
user = 'rock'

if comp == 'roc
    if user == 'l
        print('I w  _*!')
    elif user == 'scissors':
        print('You win.')
else:
    print('Tie.')
```

Python

(2) As written, what output does this print?

```
comp = 'rock'
user = ck'

 'rock':
 win *_*!')
 paper':
 You win.')
else:
    print('Tie.')
```

(3) ***Change*** these inputs to produce a completely correct RPS output here.

(4) How many of the 9 RPS **input cases** are *fully correctly* handled here?

user \ comp	'rock'	'paper'	'scissors'
'rock'			
'paper'			
'scissors'			

(5) What is the ***smallest*** number of **blocks** and **tests** you'd need for a full game of RPS?

(**Extra**) What if it were RPS-5, which includes Lizard and Spock? How about RPS-101?

Pair up with someone nearby – answer these questions together...

"Quiz"

Name _____

Your favorite _____ is _____.

Your least favorite _____ is _____.

Name _____

Your favorite _____ is _____.

Your least favorite _____ is _____.

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```
comp = 'rock'
user = 'rock'

if comp == 'rock':
    if user == 'paper':
        print('I win *_*!')
    elif user == 'scissors':
        print('You win.')
else:
    print('Tie.')
```

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if user == 'paper':
    print('You win.')
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```

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'rock'			
'paper'			
'scissors'			

(5) What is the ***smallest*** number of **blocks** and **tests** you'd need for a full game of RPS?

(**Extra**) What if it were RPS-5, which includes Lizard and Spock? How about RPS-101?

"Quiz"

- Name Zach Dodds
- Your favorite tv show is Modern Family + Dr. Who
- Your least favorite coffee is decaffeinated

- Name T. E. Alien
- Your favorite canned-meat food product is spam
- Your least favorite # is 41.999 so close!

Something in common?

Our taste in hats!

Pair up with someone nearby – answer these questions togethe

Quiz"

Name _____

Your favorite ___ ___.

You ___.

Wha

Th

(0) Find t

(1) What c

```
comp = '
user = '

if comp =
    if use
        prin
    elif us
        print
else:
    print('T
```

inputs
letely
here.

9
ully
e?

sors'

'scissors' 'paper' '

s the ***smallest*** number of **blocks** and **tests** you'd need for a full game of RPS?

(**Extra**) What if it were RPS-5, which includes Lizard and Spock? How about RPS-101?

Please pass these up the aisles...

(take a picture, if you'd like)

... then, turn back to the notes

"Quiz" ~ problems 1+2

```
comp = 'rock'
user = 'rock'

if comp == 'rock':

    if user == 'paper':
        print('I win *_*!')
    elif user == 'scissors':
        print('You win.')

else:
    print('Tie.')
    print('Ties go to the runner.')
    print(' - and I am running!')
```

... what if this **else** block were indented?

"Quiz" ~ problems 3-5

```
comp = 'rock'
user = 'rock'

if comp == 'rock':
   print('I win *_*!')

if user == 'paper':
   print('You win.')

else:
   print('An awful tie')
```

What does this program print?

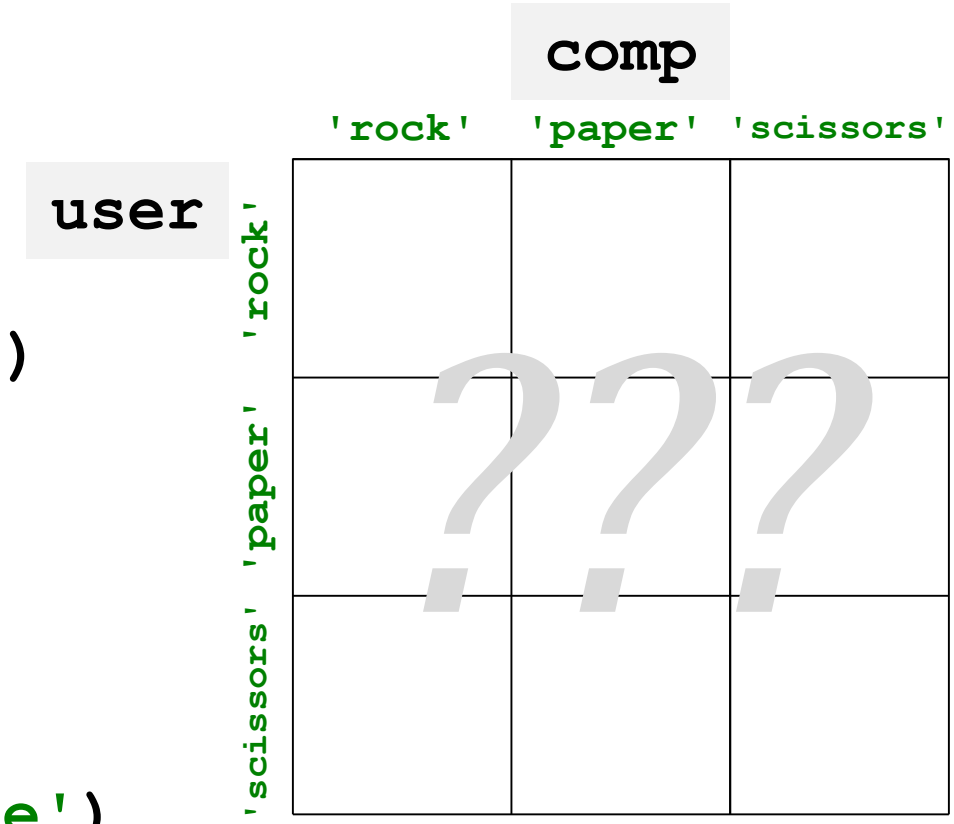
"Quiz" ~ problems 3-5

```
comp = 'rock'
user = 'rock'

if comp == 'rock':
    print('I win *_*!')

if user == 'paper':
    print('You win.')

else:
    print('An awful tie')
```



How many possible "input cases" are there?

For how many is <u>this</u> program correct?

*How **efficient** can we be?*

For RPS-3? RPS-5? RPS-101?

"Quiz" ~ problems 3-5

```
comp = 'rock'
user = 'rock'

if comp == 'rock':
    print('I win *_*!')

if user == 'paper':
    print('You win.')

else:
    print('An awful tie')
```

user \ comp	'rock'	'paper'	'scissors'
'rock'	*not quite*	*not quite*	*not quite*
'paper'	*not quite*	*not quite*	*not quite*
'scissors'	*not quite*	*not quite*	★ *correct!*

How many possible "input cases" are there?

For how many is <u>this</u> program correct?

*How **efficient** can we be?*

For RPS-3? RPS-5? RPS-101?

"Quiz" ~ problems 3-5

```
comp = 'rock'
user = 'rock'

if comp == 'rock':
    print 'I win *_*!'

if use
    pr

else:
    pr
```

user \ comp	'rock'	'paper'	'scissors'
'rock'			

A correct RPS is possible with <u>only</u>

`if` … `elif` … `else` *!*

How many possible "input cases" are the

For how many is <u>this</u> program correct?

*How **efficient** can we be?*

or RPS-3? RPS-5? RPS-101?

*Remember ~ **Lab** this week*

Tue. or Wed. ~ afternoon or evening

Bring your laptop to Beckman B126 (here)

- *or* use one of the CS machines in B105/B102

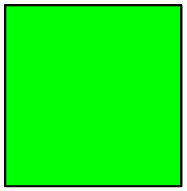
Get started with Python/text editor/cmdline…

See you in lab!

(perhaps at 2:44:44 today…?)

though it's more than a few bits early!

Alien defeats everything –
even Alien



How about a sneak peek at this week's HW… ?

… you must mean sneak *Pic* !