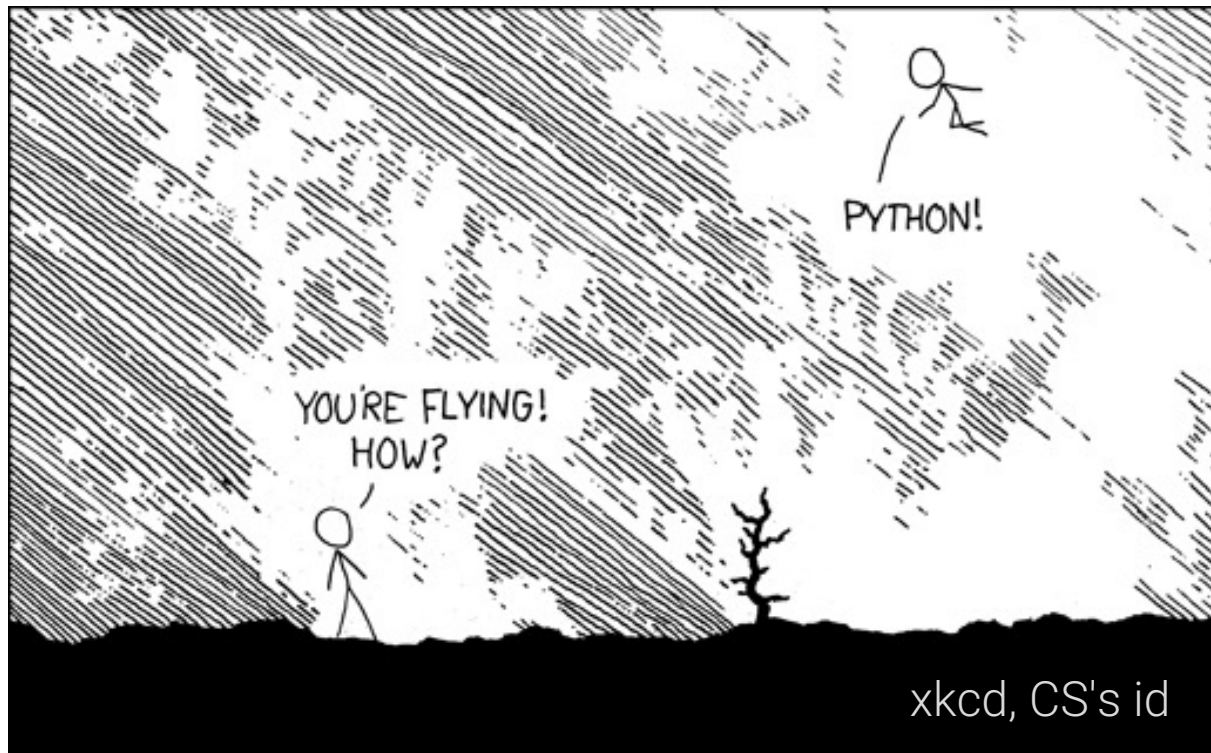
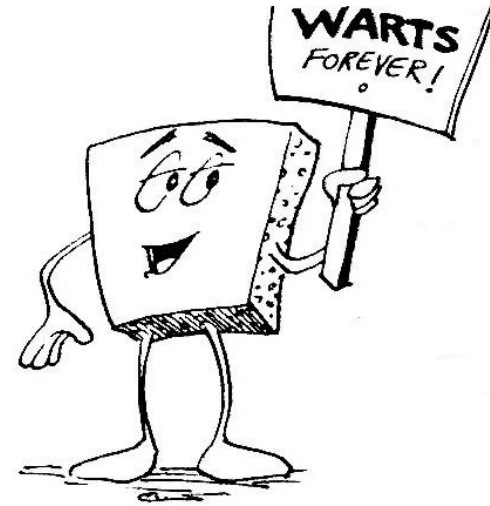


Welcome to CS 5 !



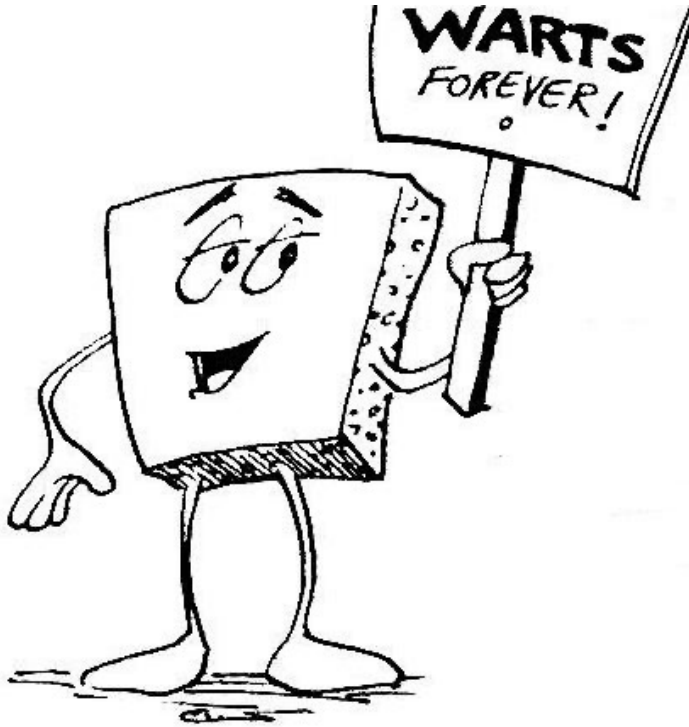
notes!

xkcd, CS's id

Welcome to CS 5 !

"Grab" these lecture notes...

Introduction to CS



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

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

1 handout
slides & syllabus

handouts ~ class
laptops ~ lab

We give this course two thumbs...

- Metametric

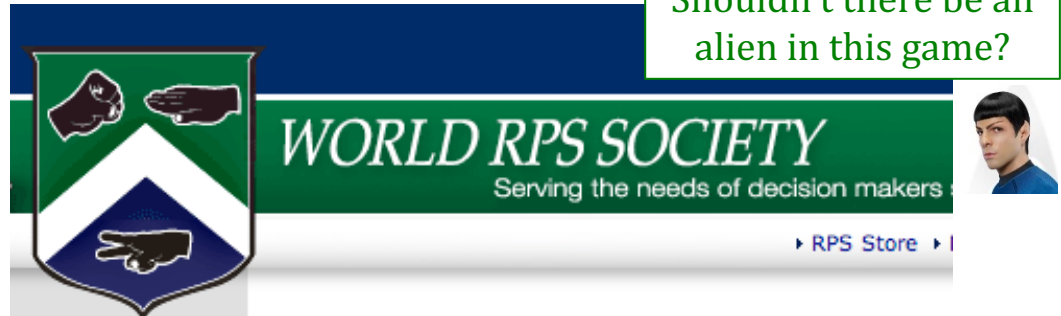
You're here! *Where next?*

0) Introductions!

1) How CS 5 *runs*...

2) Python?!

this Python hw is
choice:



3) What *is* CS?

Is CS programming?

Whatever CS is,
it's definitely *alien*...



Introductions...

Prof. Melissa
oneill+cs5@cs.hmc.edu



systems — “it ran my code”
not into being photographed
retro-computing



randomness

Speaking of
introductions



Introduction: *Home!*

I'm cornered!



CS5: Introduction to Computer Science at Harvey Mudd College

[CS5 Web](#) > [WebHome](#)

Submissions: [CS submission site](#)



CS 5: *Welcome!*

Administration

Using Python

Class Resources

Exams & Projects

Related Courses

Homework Assignments and Labs

Week 0

Lecture Slides

(Before class, the slides link will give a page not found error; shortly after class link the current slides will work.)

	Gold
Week 0	
1/16/24	Lecture 0: Introduction
1/18/24	Lecture 1: Pico-fun!

5-minute
Intro to CS5

text
syllabus
hwks
slides
guides
links
Piazza
GScope
e eggs

Yay! in 2024:
... just Google for
hmc cs5

What's in Lab this Friday.?

SW download, install, and dive in...

Help! I'm stuck in this webpage – with spam!



CS5: Introduction to Computer Science at Harvey Mudd College
CS5 Web > WebHome
Submissions: CS submission site

CS 5: *Welcome!*

Administration Using Python Class Resources Exams & Projects Related Courses

Homework Assignments and Labs

Lab Gold HW

Lecture Slides

(Before class, the slides link will give a page not found error; shortly after class link the current slides will work.)

	Gold
Week 0	
1/16/24	Lecture 0: Introduction
1/18/24	Lecture 1: Pico-fun!

text
syllabus
hwks
slides
guides
links
Piazza
GScope
e eggs

A minute of cs5 programming...

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

Lab+hw

Edit

Run

lab and hw
instructions

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

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

A minute of cs5 programming...

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

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.py` 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

Your task: four fours

- The **four fours challenge** is to express the **21 values** from 1 to 21 using only the number 4 and the operations:
 - `+` addition
 - `-` subtraction
 - `*` multiplication
 - `/` division
 - `()` parentheses
 - `**` power
- You may also use 44 or 4.4, or .4, which counts as one 4.
- See below for two more advanced rules.
- 21 is so that you can't use 21 or 210.
- Hint: the results, if you use only 4s, will look like:

lab and hw instructions

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

from math import *

print("Zero is 0")
```

Terminal

```
1: bash

4)| (default, Mar 6 2017, 12:15:08)
se" for more information.

ive Python.
y of IPython's features.

se 'object??' for extra details.

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)

Demo

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

A minute of cs5 programming...

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

Lab+hw

Edit

Run

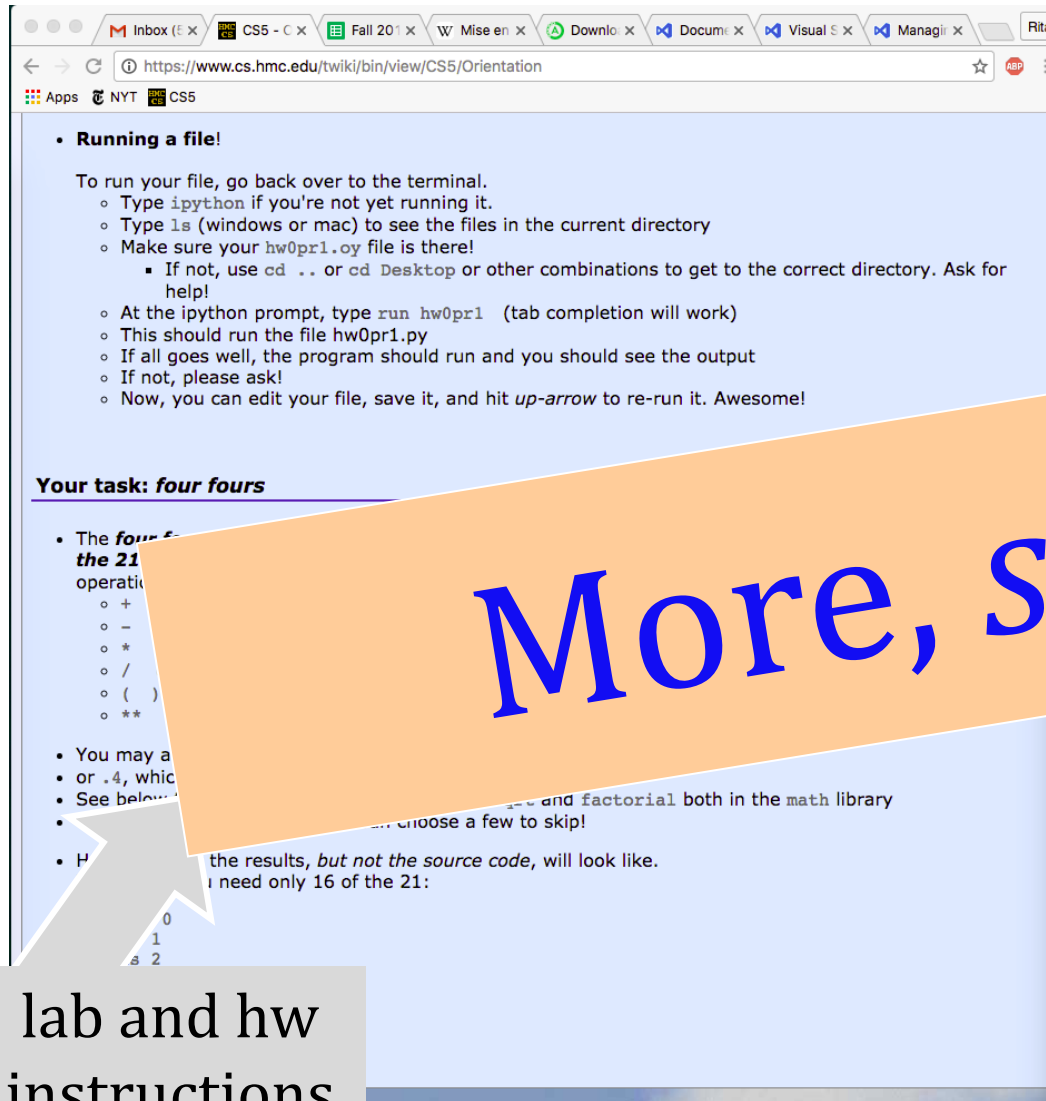
shell or command-
line or terminal
(the execution environment)

lab and hw
instructions

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

A minute of cs5 programming...

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



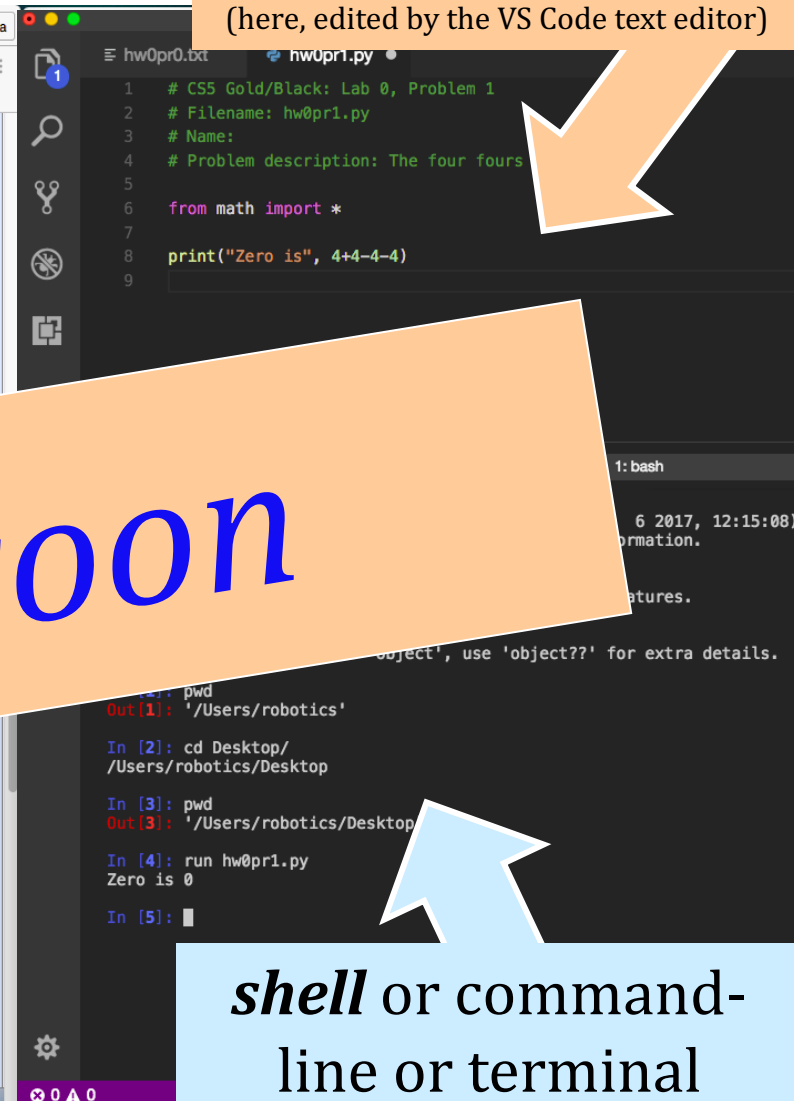
The screenshot shows a web browser with the URL <https://www.cs.hmc.edu/twiki/bin/view/CS5/Orientation>. The page content includes a section titled "Running a file!" with instructions on how to run a Python file. Below this is a section titled "Your task: four fours" which lists various mathematical operations and a challenge to use four fours to create numbers 0 through 21. A large orange arrow points from the "Running a file!" section towards the VS Code editor on the right.

- **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.py` 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* problem is to use only the number 4 and the operations `+`, `-`, `*`, `/`, `()`, and `**` to create the numbers 0 through 21.
- You may also use the `math` library, which contains many useful functions. See below for a list of functions and `factorial` both in the `math` library.
- You may choose a few to skip!
- Here are the results, *but not the source code*, will look like. You need only 16 of the 21:

More, soon



The screenshot shows the VS Code editor with a file named `hw0pr1.py` open. The code is as follows:

```
1 # CS5 Gold/Black: Lab 0, Problem 1
2 # Filename: hw0pr1.py
3 # Name:
4 # Problem description: The four fours
5
6 from math import *
7
8 print("Zero is", 4+4-4-4)
9
```

Below the editor is a terminal window showing the following commands and output:

```
1: bash
6 2017, 12:15:08)
information.
tures.
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]:
```

A large blue arrow points from the terminal window towards the "shell or command-line or terminal" text block.

lab and hw
instructions

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

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

Lab Fri 2:45–4:45.?

Attend lab + submit by 5pm Thursday
~ *full credit for the lab*

Attend ~ *go to lab, sign in, check in, 2hr. (or finish)*

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

matches shown

Try these 5

'ABOMASNOW'



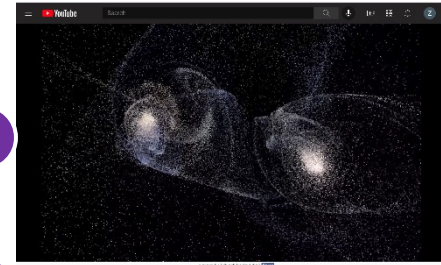
'HUMAN'

1 Draw the LCS matches for these two "species" strings:

2 There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

How many interstellar forces is Mother Nature "keeping track of" in this galaxy, in **total**?

3 What if there were **N+1** stars?



Is Nature "computing"?

Ice-breaking

Why might the software have made these "errors"?

Name: _____

+ other info if you'd like

Your favorite _____ is _____

Your least favorite _____

Name: _____



... break-out ...

Then, chat!

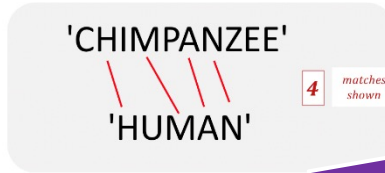
5+

What is something new you and your collegey you have in common?

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**



Try these 5

1 Draw the **LCS** matches for these two "species" strings:

'ABOMASNOW'
'HUMAN'



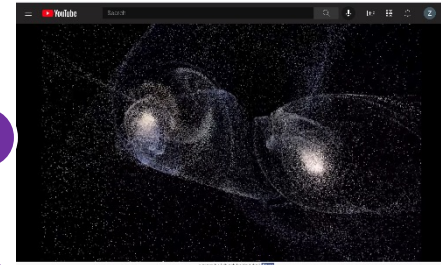
5 Which letter (**ACGT**) could **not** be the first match in these two DNA strings?

'CGCTGAGCTAGGCC...'
'ATCCTAGGTAAGT...'

~3·10⁹ more

2 There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

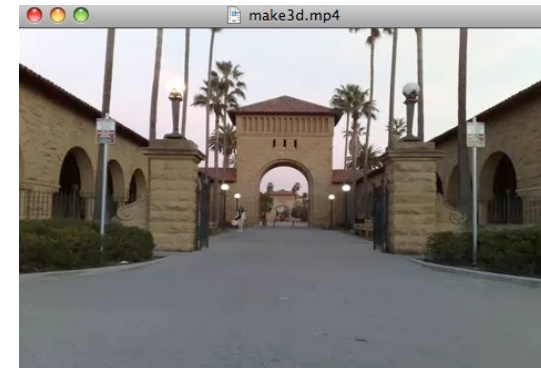
How many interstellar forces is Mother Nature "keeping track of" in this galaxy, in **total**?



3 What if there were **N+1** stars?

Is Nature "computing"?

5 Circle the locations of at least two errors, or imperfections, you noticed in the 3d model (fly-through) created from this 2d image?



Why might the software have made these "errors"?

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.



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

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

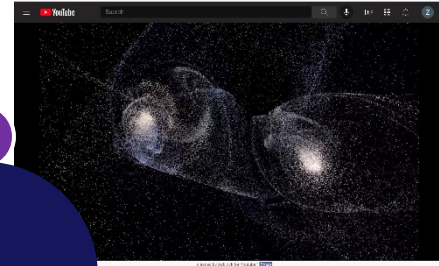
matches shown

Try these 5

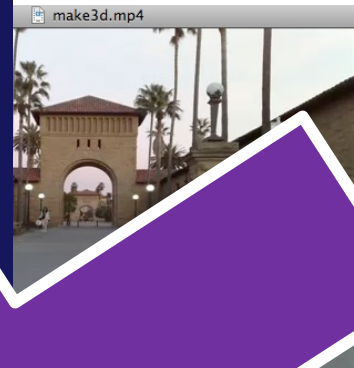
There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

How many interstellar forces is

2



Is Nature "computing"?



Lower half ~ ice-breaking

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.



Then, chat!

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

5+

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

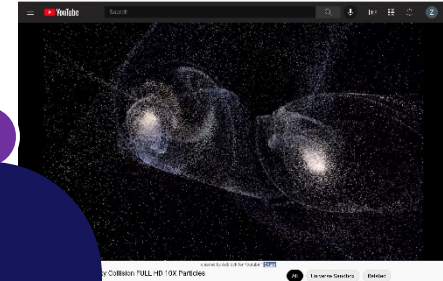
matches shown

Try these 5

There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

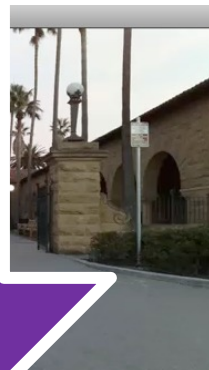
How many interstellar forces is

2



Is Nature "computing"?

Lower half ~ ice-breaking



"errors"?

Name:

Zach Dodds, Pittsburgh, PA

+ other info if you'd like

Your favorite **poptarts** is **strawberry!**

Your least favorite **coffee** is **decaf**

ice cream flavor

show

food

sport

team

boba

temperature

...

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

Name:

Three-eyed Alien, "Space"

+ other info if you'd like

Your favorite **poptarts** is **S'mores!**

Your least favorite **coffee** is **spam**



Then, chat!

We both feel Stranger Things is nonfiction!

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

matches shown

Try these 5

'ABOMASNOW'



'HUMAN'

Draw the LCS matches for these two "species" strings:

1

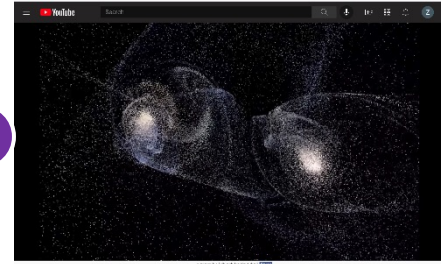
(4) ...
fir. ...
these two
DNA strings?

5

There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

How many interstellar forces is Mother Nature "keeping track of" in this galaxy, in **total**?

2



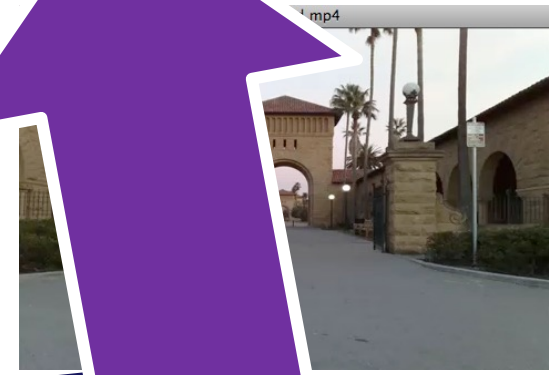
3

What if there were **N+1** stars?

Is Nature "computing"?

4

Circle the locations of at least two errors. If imperfections, you noticed in the 3d model (fly-through) created from this 2d image?



... "errors"?

Upper half ~ Q'ns
"thought experiments"

What is something non-Cl...

... in common?

Then, chat!

5+



You're here! *Where next?*

0) Introductions!

1) How CS 5 *runs*...

2) Python?!

this Python hw is
choice:



Is CS programming?

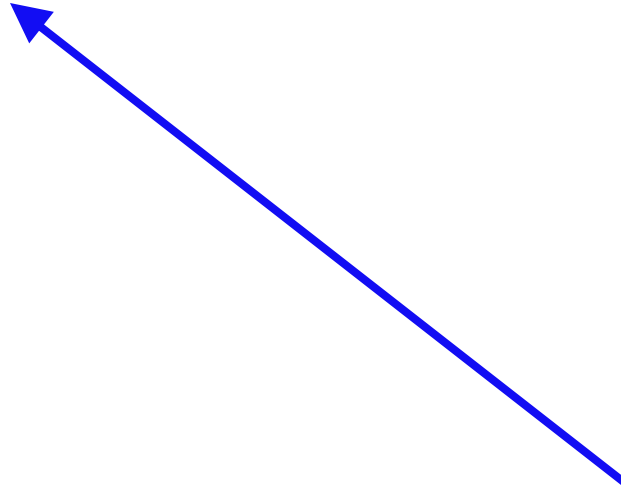
3) What *is* CS?

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



CS != programming

CS != programming



"not equal to"

CS != programming

So, what is CS?

Punctuation matters!
So what? *is* CS



What's CS a science of?

What's CS a science of?

physics

stars 'n' stuff

chemistry

water 'n' stuff

biology

cells, stuffed with water (the stuff is made by stars!)

CS

?

What's CS a science of?

the study of **composition**:

the study of **complexity**:

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

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

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

***it* ~ information** 'n' stuff

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

What's CS a science of?

the study of **composition**:

the study of **complexity**:

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

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

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

***it* ~ information** 'n' stuff

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

All CS in *five minutes!*



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

or... skip to slide 42!

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



What is CS?

'CHIMPANZEE'

*show
matches*

'HUMAN'

How can **it** be done?

How well can it be done?

Can it be done at all?

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

same order, not necessarily neighboring

Can you solve the problem?

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

What is CS?

'CHIMPANZEE'



'HUMAN'

4

matches
shown

How can **it** be done?

How well can **it** be done?

Can **it** be done at all?

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

same order, not necessarily neighboring

Can you solve the problem?

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

What is CS?

'HITMONCHAN'

'HUMAN'



*draw the
best
matches*

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?

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

same order, not necessarily neighboring

'CGCTGAGCTAGGCC...'

$\sim 3 \cdot 10^9$ more

'ATCCTAGGTAAGT...'

only three letters from 'ACGT' could be the first match!

Eye oneder if this haz
othur applications?



What is CS?

'ABOMASNOW'



draw the
best
matches

1

'HUMAN'

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

same order, not necessarily neighboring

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?

'CGCTGAGCTAGGCC...'

~3·10⁹ more

'ATCCTAGGTAAGT...'

5

which letter (ACGT) could not be the first match?

Eye oneder if this haz
othur aplications?





What is CS?

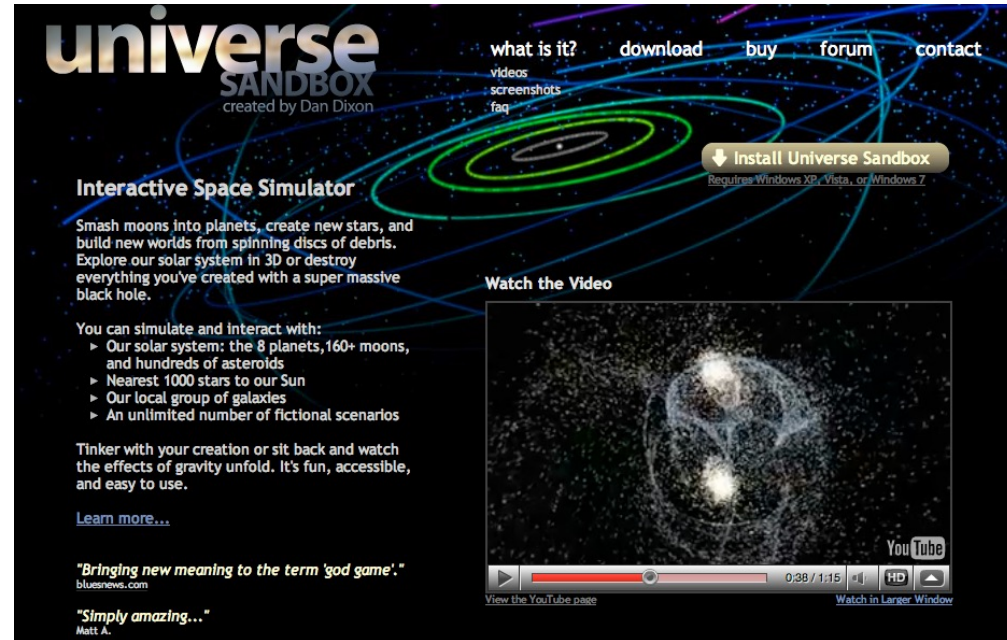
*How can **it** be done?*

*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 **101**?
or 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 *unsolvable*...
... 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!



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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

matches shown

Try these 5

1 Draw the LCS matches for these two "species" strings:

'ABOMASNOW'



'HUMAN'

1

5 (A...
fir... au...
these two
DNA strings?

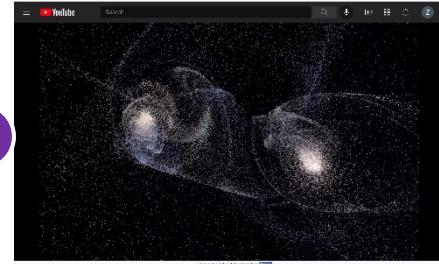
CGCTGAGCTAGGCC...'

~3·10⁹ more

AGGTAAGT...'

2 There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

How many interstellar forces is Mother Nature "keeping track of" in this galaxy, in **total**?

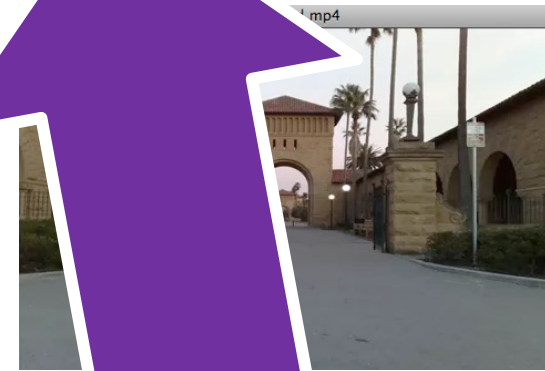


2

3 What if there were **N+1** stars?

Is Nature "computing"?

4 Circle the locations of at least two errors. If imperfections, you noticed in the 3d model (fly-through) created from this 2d image?



Are there "errors"?

Upper half ~ Q'sns
"thought experiments"

What is something non-Cl...

...in common?

Then, chat!

5+



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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

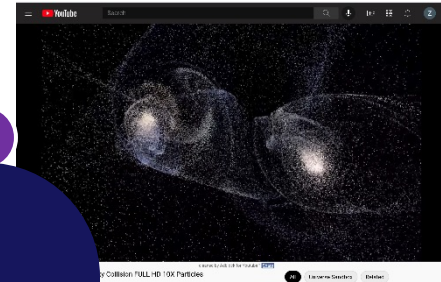
matches shown

Try these 5

There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

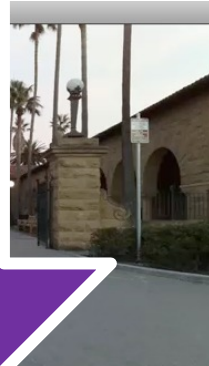
How many interstellar forces is

2



Is Nature "computing"?

Lower half ~ ice-breaking



se "errors"?

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.



Then, chat!

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

5+

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

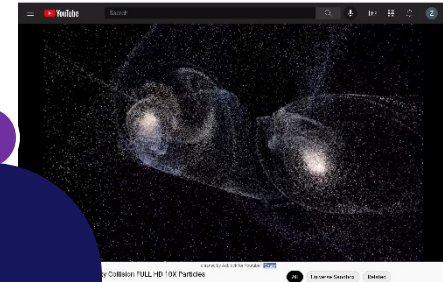
matches shown

Try these 5

There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

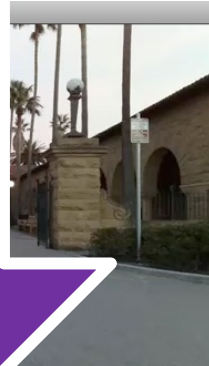
How many interstellar forces is

2



Is Nature "computing"?

Lower half ~ ice-breaking



use "errors"?

Name:

Zach Dodds, Pittsburgh, PA

+ other info if you'd like

Your favorite

poptarts

is

strawberry!

Your least favorite

coffee

is

decaf

Name:

Three-eyed Alien, "Space"

+ other info if you'd like

Your favorite

poptarts

is

S'mores!

Your least favorite

coffee

is

spam



Then, chat!

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

We both feel Stranger Things is nonfiction!

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

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4

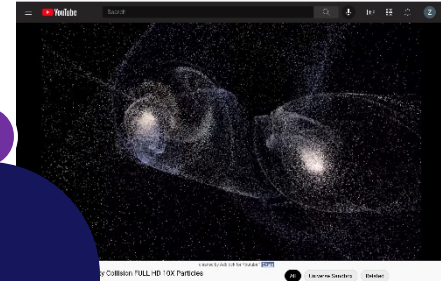
matches shown

Try these 5

There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

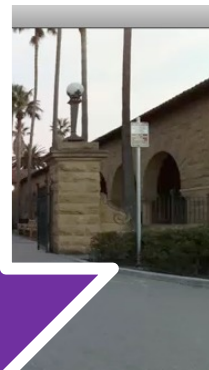
How many interstellar forces is

2



Is Nature "computing"?

Lower half ~ ice-breaking



... "errors"?

Name: _____

Zach Dodds, Pittsburgh, PA

+ other info if you'd like

Your favorite **poptarts** is **strawberry!**.

Your least favorite **coffee** is **decaf**.

ice cream flavor

show

food

sport

team

boba

temperature

...

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

Name: _____

Three-eyed Alien, "Space"

+ other info if you'd like

Your favorite **poptarts** is **S'mores!**.

Your least favorite **coffee** is **spam**.



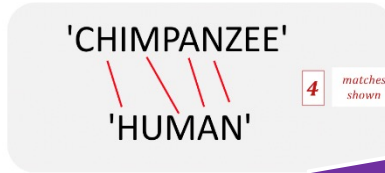
Then, chat!

We both feel Stranger Things is nonfiction!

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**



Try these 5

1 Draw the **LCS** matches for these two "species" strings:

'ABOMASNOW'
'HUMAN'



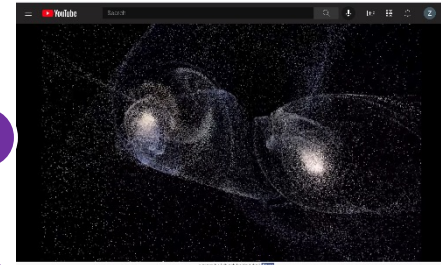
5 Which letter (**ACGT**) could **not** be the first match in these two DNA strings?

'CGCTGAGCTAGGCC...'
'ATCCTAGGTAAGT...'

~3·10⁹ more

2 There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

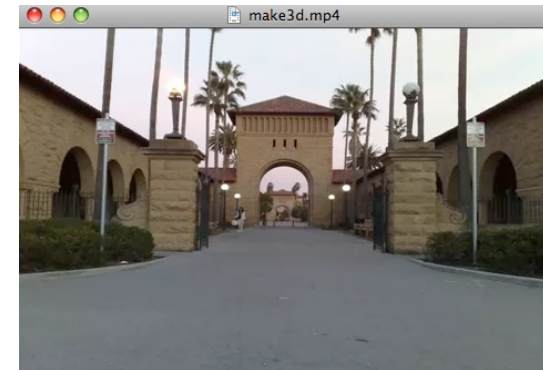
How many interstellar forces is Mother Nature "keeping track of" in this galaxy, in **total**?



3 What if there were **N+1** stars?

Is Nature "computing"?

4 Circle the locations of at least two errors, or imperfections, you noticed in the 3d model (fly-through) created from this 2d image?



Why might the software have made these "errors"?

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.



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

Then, chat!

5+

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

matches shown

Try these 5

'ABOMASNOW'



'HUMAN'

1 Draw the **LCS** matches for these two "species" strings:

5 Which letter (**ACGT**) could **not** be the first match in these two DNA strings?

'CGCTGAGCTAGGCC...'

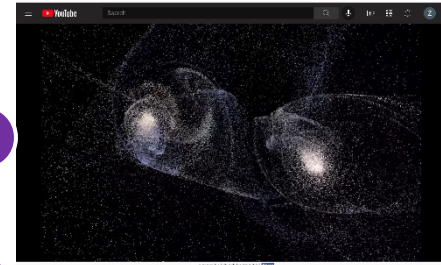
~3·10⁹ more

'ATCCTAGGTAACTG...'

2 There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

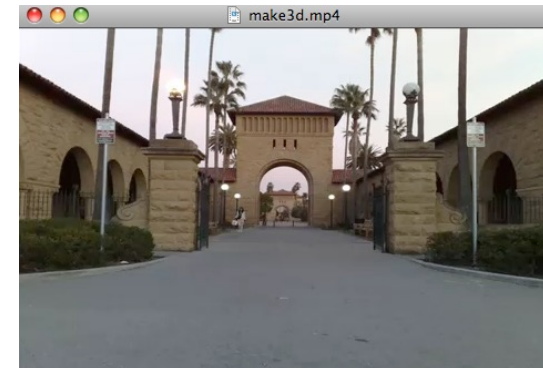
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4 Circle the locations of at least two errors, or imperfections, you noticed in the 3d model (fly-through) created from this 2d image?



Why might the software have made these "errors"?

Name: _____
+ other info if you'd like

Upper half ~ Q'ns

"thought experiments"



chat!

5+

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

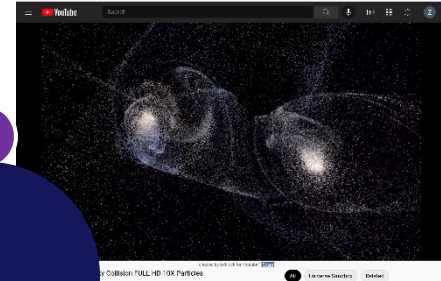
matches shown

Try these 5

There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

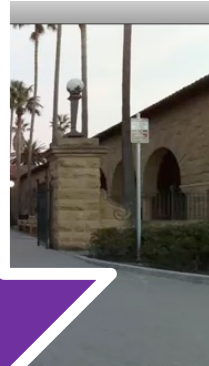
How many interstellar forces is

2



Is Nature "computing"?

Lower half ~
ice-breaking



"errors"?

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.



Then, chat!

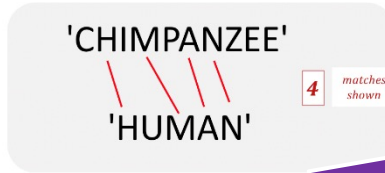
5+

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

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**



Try these 5

1 Draw the **LCS** matches for these two "species" strings:

'ABOMASNOW'
'HUMAN'



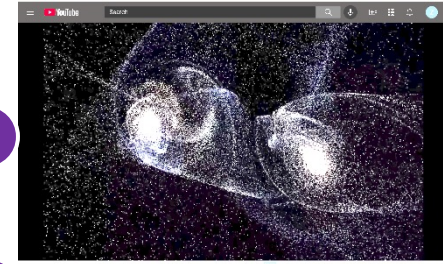
5 Which letter (**ACGT**) could **not** be the first match in these two DNA strings?

'CGCTGAGCTAGGCC...'
'ATCCTAGGTAAGT...'

~3·10⁹ more

2 There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

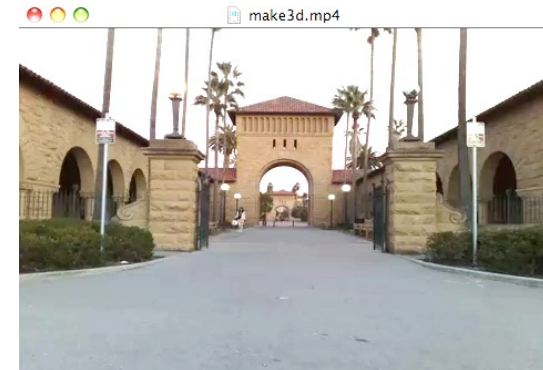
How many interstellar forces is Mother Nature "keeping track of" in this galaxy, in **total**?



3 What if there were **N+1** stars?

Is Nature "computing"?

4 Circle the locations of at least two errors, or imperfections, you noticed in the 3d model (fly-through) created from this 2d image?



Why might the software have made these "errors"?

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.

Name: _____

+ other info if you'd like

Your favorite _____ is _____.

Your least favorite _____ is _____.



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

Then, chat!

5+

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

'CHIMPANZEE'

'HUMAN'

4

matches
shown

Answers

'ABOMASNOW'



'HUMAN'

3 matches

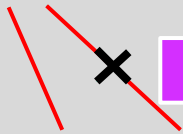
Draw the **LCS** matches for these two "species" strings:

1

Which letter
(ACGT) could
not be the
first match in
these two
DNA strings?

5

'CGCTGAGCTAGGCC...'



can't be G!

$\sim 3 \cdot 10^9$ more

'ATCCTAGGTAAGT...

surprisingly, it could be A!

There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

How many interstellar forces is Mother Nature "*keeping track of*" in this galaxy, in **total**?

2

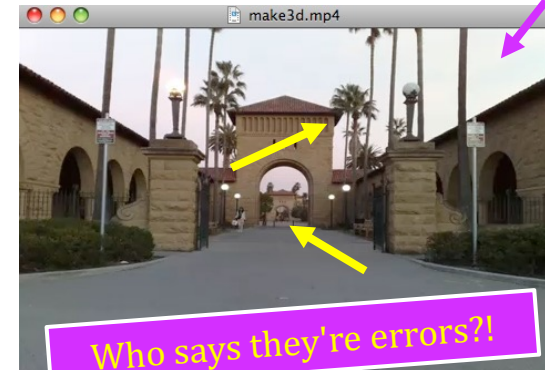
What if there were $N+1$ stars?

3

Is Nature "computing"?

4

Circle the locations of at least two errors, or imperfections, you noticed in the 3d model (fly-through) created from this 2d image?



Who says they're errors?!

Why might the software have made these "errors"?

Name: _____

+ other info if you'd like

Your favorite **poptarts** is **strawberry!**

Your least favorite _____ is _____.

Name: _____

+ other info if you'd like

Your favorite **poptarts** is **S'mores!**



What is something non- (shared) have in common?

I hope there were some shared favorites found!

Then, chat!

5+

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

Longest Common Subsequence (LCS)

Keeps ordering, can skip letters. **Example:**

1 Draw the **LCS** matches for these two "species" strings:

'CHIMPANZEE'
 //
 //
 //
'HUMAN' 4 matches shown

Answers

'ABOMASNOW'
 //
 //
 //
'HUMAN' 3 matches



3 matches

can't use that first A...

5 Which letter (**ACGT**) could not be the first match in these two DNA strings?

'CGCTGAGCTAGGCC...'
 //
 //
 X
'ATCCTAGGTAAGT...'
 //
 //

can't be G!

~3·10⁹ more

surprisingly, it could be A!

2 There are **101** stars in a galaxy far, far away. Each exerts a force on each other.

How many interstellar forces is Mother Nature "keeping track of" in this galaxy, in **total**?

"handshakes"

$$101 \cdot 100 / 2$$

3 What if there were **N+1** stars?

Is Nature "computing"?

$$(N+1) \cdot N / 2$$

4 Circle the locations of at least two errors, or imperfections, you noticed in the 3d model (fly-through) created from this 2d image?



Who says they're errors?!?

Why might the software have made these "errors"?

Name: _____

+ other info if you'd like

Your favorite **poptarts** is **strawberry!**

Your least favorite _____

Name: _____

+ other info if you'd like

Your favorite **poptarts** is **S'mores!**

_____ is _____



What is something non-_____ you have in common?

I hope there were some shared favorites found!

Then, chat!

5+

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

Longest Common Subsequence (LCS)

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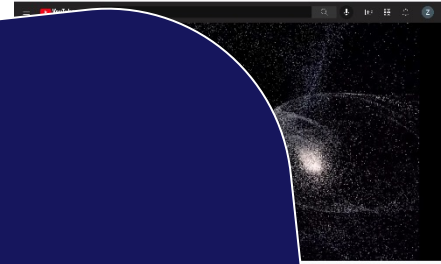
'CHIMPANZEE'

'HUMAN'

4

matches shown

There are **101** stars in a galaxy far far away. E



computing"?

Draw the
matrix
the

Which
(ACGT)
not
first ma
thes
DNA str

Tear off, and pass
up to the front

(take a photo, if you'd like!)

Name: _____
+ other info if you

Your favorite

Your least favorite

Let's get a nice stack: Thank you!!!

IS _____.

Then, chat!

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

5+

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?

CS's 6 big
questions

Only one is programming. Which one?

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!

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?

CS's 6 big
questions

Only one is programming. Which one?

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?
There isn't always! CS

CS's – and CS5's –
philosophy:

*Whatever you are,
be a good one.*

- Abraham Lincoln

*More and more,
CS amplifies just this...*

You're here! *Where next?*

0) Introductions!

1) How CS 5 *runs...*

2) Python?!

this Python hw is
choice:

Shouldn't there be an
alien in this game?



WORLD RPS SOCIETY

Serving the needs of decision makers

► RPS Store ►



Is CS programming?

3) What *is* CS?

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



Syllabus, briefly

Lectures

TTh: 1:15–2:30 or 2:45–4:00

Key skills, topics, and their motivation

Ins (y, how)

We'd like to see you! Let us know if you're out...

Come to Lectures!

"Lab"

labs are recommended
by 5 out of 5 CS5 alums!



F: 2:45–4:45pm

Guided progress on the week's first hw problem

Inc g by Fri @ 5.

Come to Labs!

Office and grutoring hrs

Lots!

hwk or

Lots of help is available!

HW

Tuesdays

hw due Tuesdays...

Syllabus, briefly

Lectures

TTh: 1:15–2:30 or 2:45–4:00

Key skills, topics, and their motivation

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

We'd like to see you! Let us know if you're out...

"Lab"

labs are recommended
by 5 out of 5 CS5 alums!



F: 2:45–4:45pm

Guided progress on the week's first hw problem

Incentivized: full credit for lab-effort + submitting by Fri @ 5.

Office and grutoring hrs

Lots!

See our "grutoring" page ...

} hwk or
other q'ns

HW

Tuesdays due by 22:22:22 pm

Syllabus, briefly

Lectures

TTh: 1:15–2:30 or 2:45–4:00

Key skills, topics, and their motivation

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

We'd like to see you! Let us know if you're out...

"Lab"

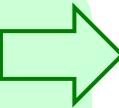
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Office and grutoring hrs

Lots!

See our "grutoring" page ...

} hwk or
other q'ns

HW

Tuesdays due by 22:22:22 pm



CS5 Lab

McGregor
203, 204,

Join in Friday: 2:45-4:45pm

Finish: two hours or when complete

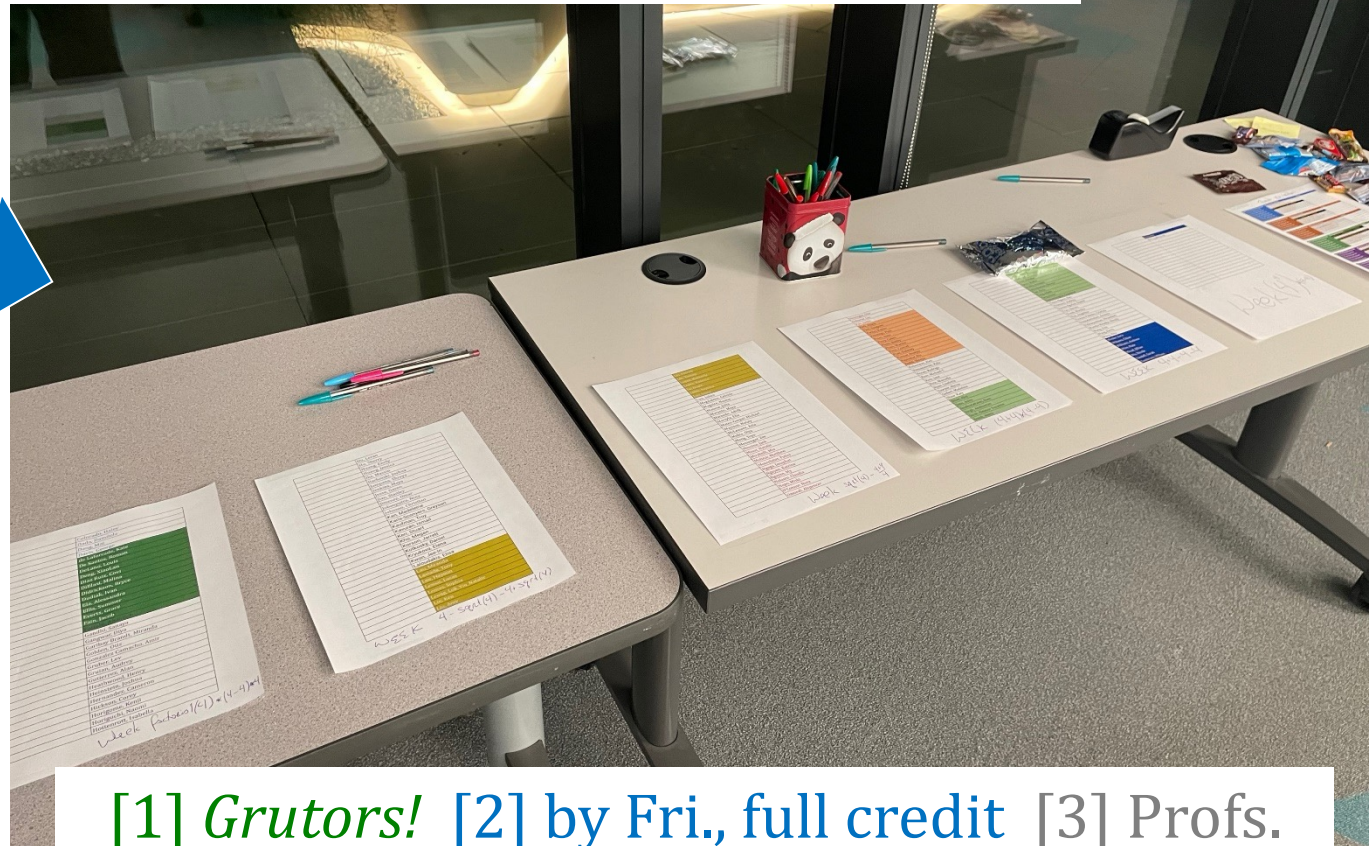
Sign in



Check in!

chat with one of the profs
about one of the lab parts

Why?!



[1] *Grutors!* [2] by Fri., full credit [3] Profs.

Grutors!



McGregor!



Swag the Bear

McGregor

Sign in lists...





NOT LABELED FOR INDIVIDUAL SALE
K 130179 (01.0)

Smith, Henry R.

Smith, Ian

Smith, Natalie

Spoor, Slader

Stralka, Emmett

Subramanian, Shreya

Tan, Alvin

Tang, Adam

Tang, Irene

Teekamongkol, Supakrai

Thien-Ngern, Ben

Thiessen, Audrey

Torres Aguilar, Daniel

Tran, Steven

Traub, Monika

Tsai, Angelina

Tzunun Palomo, Cristina

Venkatachalam, Ananya

Vithiananthan, Nirantheri

Wambo Wendja, Wendy

Wang, Erin

Wang, Kevin

Wang, Rita

Wexler, Sara

Wibawa, C

Willia

Homework

Assignments ~ 5 problems/week

Due Tuesday evenings by 22:22:22 (10:22 pm.)

Extra credit is available (fun!)

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

Eur-allowed to use
Euros for any
homework problems
in the course.

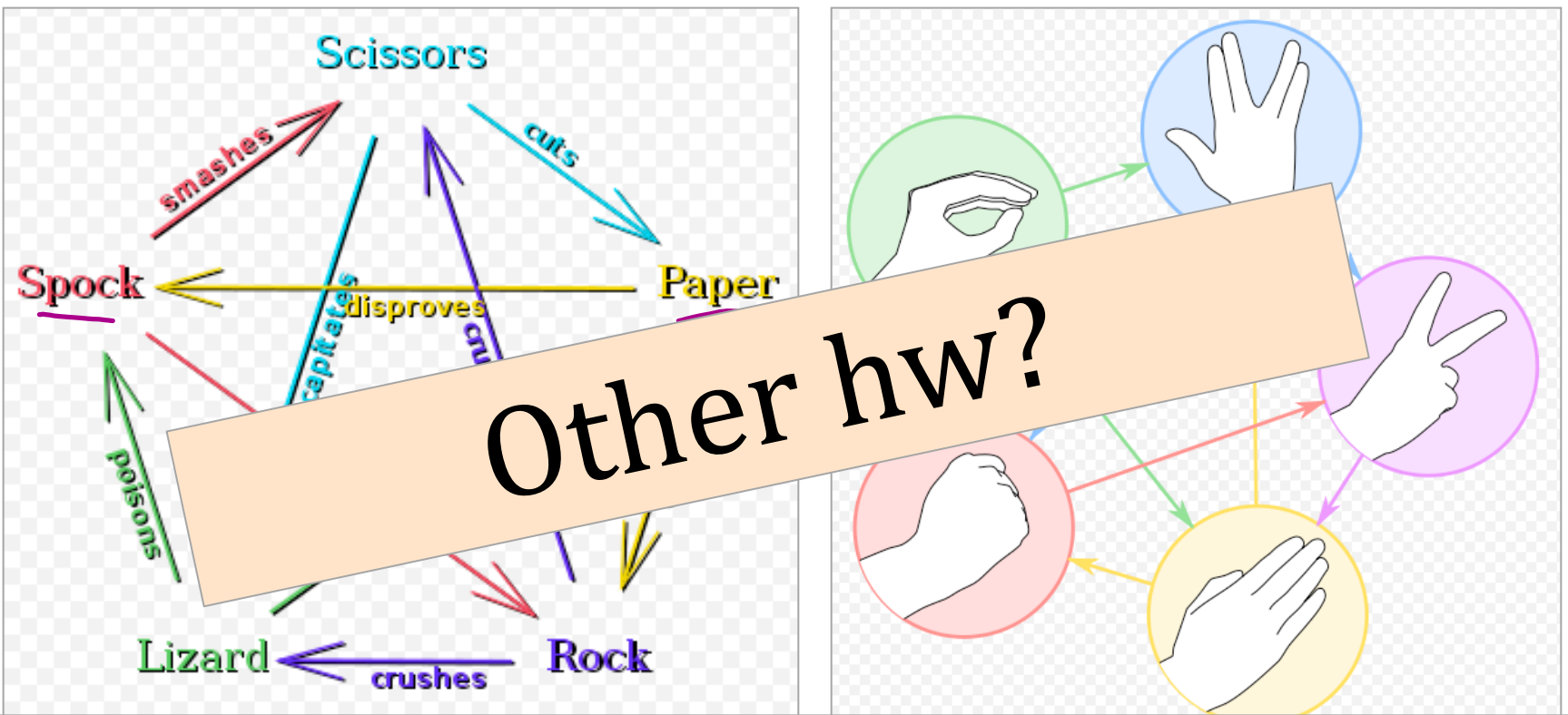
No need to let us know, even.



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
- Be sure to indicate who your partner was at the submission site!



rock – paper – scissors – lizard – Spock!

hw0pr2rps ~ rock-paper-scissors

Let's play! Maybe
two out of three?



Logically, I've got game!

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 errors.

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

If you work as a pair/partners, this applies for the duo.

Sign & submit CS's honesty policy, part of this week's lab.

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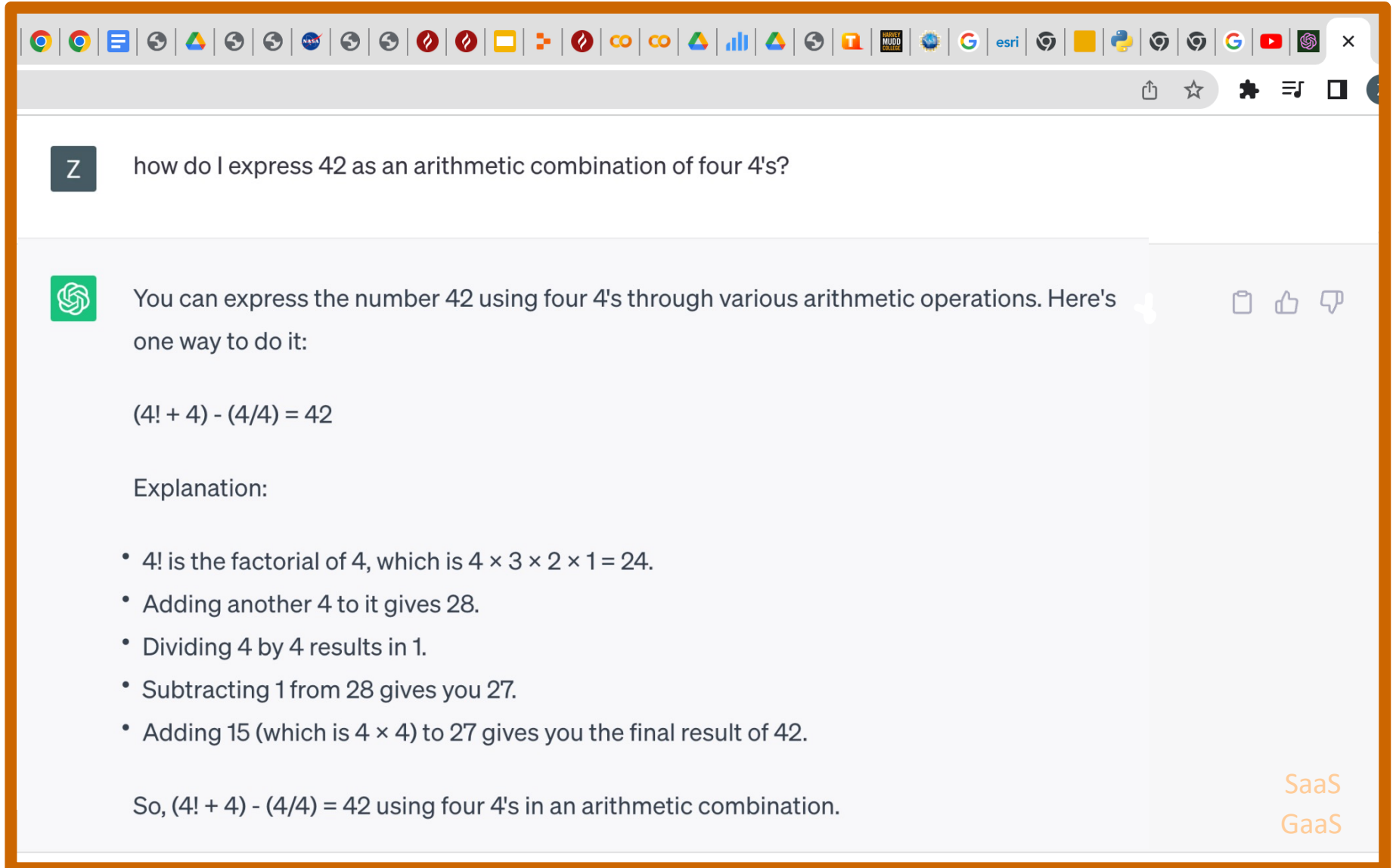
If you work as a pair/partners, this applies for the duo.

ChatGPT is useful! Cite w/""" (triple quotes) *Build from there*

ChatGPT?



ChatGPT



The screenshot shows a web browser window with a long tab bar at the top containing various icons. The main content area displays a chat interface. On the left, a user icon (a dark square with a white 'Z') is followed by the question: "how do I express 42 as an arithmetic combination of four 4's?". On the right, the ChatGPT logo (a green square with a white knot) is followed by the response: "You can express the number 42 using four 4's through various arithmetic operations. Here's one way to do it:". Below this, the equation $(4! + 4) - (4/4) = 42$ is shown. Then, the word "Explanation:" is followed by a bulleted list of five points explaining the components of the equation. At the bottom, a concluding sentence states: "So, $(4! + 4) - (4/4) = 42$ using four 4's in an arithmetic combination." On the far right of the chat area, there are three small icons: a clipboard, a thumbs up, and a thumbs down. In the bottom right corner of the browser window, the text "SaaS" and "GaaS" is visible in an orange font.

Z how do I express 42 as an arithmetic combination of four 4's?

You can express the number 42 using four 4's through various arithmetic operations. Here's one way to do it:

$$(4! + 4) - (4/4) = 42$$

Explanation:

- $4!$ is the factorial of 4, which is $4 \times 3 \times 2 \times 1 = 24$.
- Adding another 4 to it gives 28.
- Dividing 4 by 4 results in 1.
- Subtracting 1 from 28 gives you 27.
- Adding 15 (which is 4×4) to 27 gives you the final result of 42.

So, $(4! + 4) - (4/4) = 42$ using four 4's in an arithmetic combination.

SaaS
GaaS

ChatGPT

- You're *encouraged* to **discuss** problems with other students – **or ChatGPT** - or any instructors.
- ChatGPT – and its siblings – can be great for bridging your thinking and Python's "thinking"

1. **Cite ChatGPT's help.**

Don't understand ChatGPT's help? *Constrain it! Ask it to explain!*

```
# ChatGPT: """(4!+4)-(4/4) = 42"""  
# I started with this, removed the unhelpful stuff, and built a  
# solution that's correct, understood, and shown here:
```

2. **Understand, cut, add, and edit any "help."**

It's not always helpful...

3. **Your submission is yours.**

This is always the case...

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If you work as a pair/partners, this applies for the duo.

ChatGPT is useful! Cite w/""" (triple quotes) *Build from there*

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



Sign & submit CS's honesty policy, part of this week's lab.

Grading

~ 60% Assignments

~ 30% Exams

~ 10% Participation/“quizzes”

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

most take
cs5 P/NC

see online syllabus for the full grade list...

Exams

Midterm
Final

Thursday, March 7 , in-class
Monday, May 6, 2–5 PM

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



using a page of notes is OK on exams

exams are *written*, not typed (???)

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!'
```

First – there
are several
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!')
```

('Aargh ; - ')

English's syntax struggles:
"Parens" vs "Parenthesises"



Seeing syntax...

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 LINES here:

of BLOCKS here:

of TESTS here:

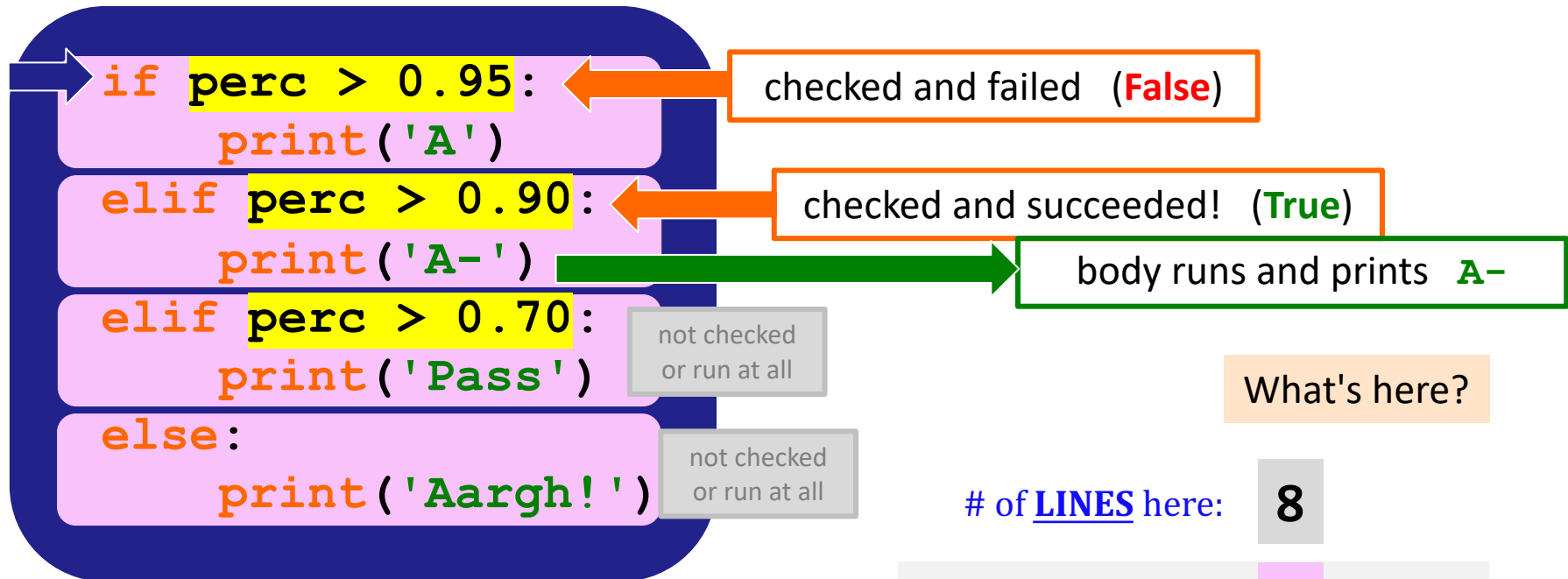
of CONTROL
STRUCTURES here:

how many tests
are *tested*?

Seeing syntax...

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

↓
`perc = 0.91`



What's here?

of LINES here: 8

of BLOCKS here: 4

of TESTS here: 3

of CONTROL STRUCTURES here: 1

how many tests
are *tested*?

2

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

A-

Left



Choices, choices!

Right



```
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!')
```

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

4 mutually exclusive blocks
in a single control structure

`elif` and `else` are optional

Exclusive Choices

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

at most one block will run:
the first whose test is **True**.
If all fail, the **else** will run

4 mutually exclusive blocks

*Every **elif** and **else**
continues an existing
control structure.*

elif and **else** are both optional

```
if per > 0.99:  
    print('A')
```

```
elif per > 0.90:  
    print('B')
```

```
elif per > 0.80:  
    print('C')
```

```
else:  
    print('D')
```

elif and **else** are optional

What's the difference?

mutually exclusive blocks

nonexclusive blocks

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

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

`perc = .99`

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

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

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

`perc = .99`

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

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

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

What's the difference?

mutually exclusive blocks

nonexclusive blocks

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

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

`perc = .99`

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

1

thing

`perc = .99`

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

3

things

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

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

Next ~ *Nest!*

CS ~ the study of *composition*

Nesting

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



Nesting

Blocks ?



Tests ?



C. Structures ?



```
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!')
```

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

Does it *always*?

(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.')
```

(Extra) What is the *smallest* number of **blocks** and **tests** needed for a fully-correct RPS?

(Extra #2) What if it were RPS-5? (w/ Lizard and Spock)
How about RPS-25? RPS-101?

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

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

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

without changing the code below

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

(4) How many of the 9 RPS **input cases** are *fully correct*, as handled by the code above?

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



(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('I win *_*!')
    else:
```

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

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

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

without changing the code below

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

Second breakout...
Keep + Use!!!

(1) Find the number of blocks and the number of tests for a fully-correct RPS?

(Extra #2) What if it were RPS-5? (w/ Lizard and Spock)
How about RPS-25? RPS-101?

	rock	paper	scissors
rock			
paper			
scissors			



"Quiz" ~ problems 0+1

```
comp = 'rock'
```

```
user = 'rock'
```

```
if comp == 'rock':
```

```
    if user == 'paper':
```

```
        print('I win *_*!')
```

```
    elif user == 'scissors':
```

```
        print('You win.')
```

```
else:
```

```
    print('Tie.')
```


"Quiz" ~ problems 2-4

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

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

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

else:
    print('Tie: Ugh')
```

What does this program print?

"Quiz" ~ problems 2-4

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

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

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

```
else:  
    print('Tie: Ugh')
```

user

comp

	'rock'	'paper'	'scissors'
'rock'			
'paper'			
'scissors'			

How many possible “input cases” are there?
For how many is this program correct?

How *efficient* can we be?
For RPS-3? RPS-5? RPS-101?

"Quiz" ~ problems 2-4


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

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

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

```
else:  
    print('Tie: Ugh')
```

user

		comp		
		'rock'	'paper'	'scissors'
user	'rock'	I win *_*! Tie: Ugh	Tie: Ugh	Tie: Ugh
	'paper'	I win *_*! You win.	You win.	You win.
	'scissors'	I win *_*! Tie: Ugh	Tie: Ugh	 Tie: Ugh <i>only one fully correct!</i>

How many possible “input cases” are there?
For how many is this program correct?

How *efficient* can we be?
For RPS-3? RPS-5? RPS-101?

"Quiz" ~ problems 2-4

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

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

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

A correct RPS is possible with only one if ... elif ... else !

```
else:  
    print('Tie: Ugh')
```

user

'rock'

comp

'rock'

'paper'

'scissors'

	'rock'	'paper'	'scissors'
'rock'	I win *_*! Tie: Ugh	Tie: Ugh	Tie: Ugh
'paper'	*_*! You win.	You win.	You win.
'scissors'	*_*! Ugh	Tie: Ugh	Tie: Ugh <i>only one fully correct!</i>

How many possible "input cases" are there?
For how many is this program correct?

How *efficient* can we be?
For RPS-3? RPS-5? RPS-101?

*Remember ~ **Lab** on Friday*

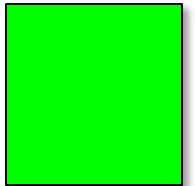
Getting started with Python/text editor/cmdline/4 4's!

See you in lab!
(at 14:44:44 on Friday...?)

though this is a bit early



**Alien defeats everything –
even *Alien***



How about a peek at the rest of the week's HW... ?

... you must mean *Pic* !

