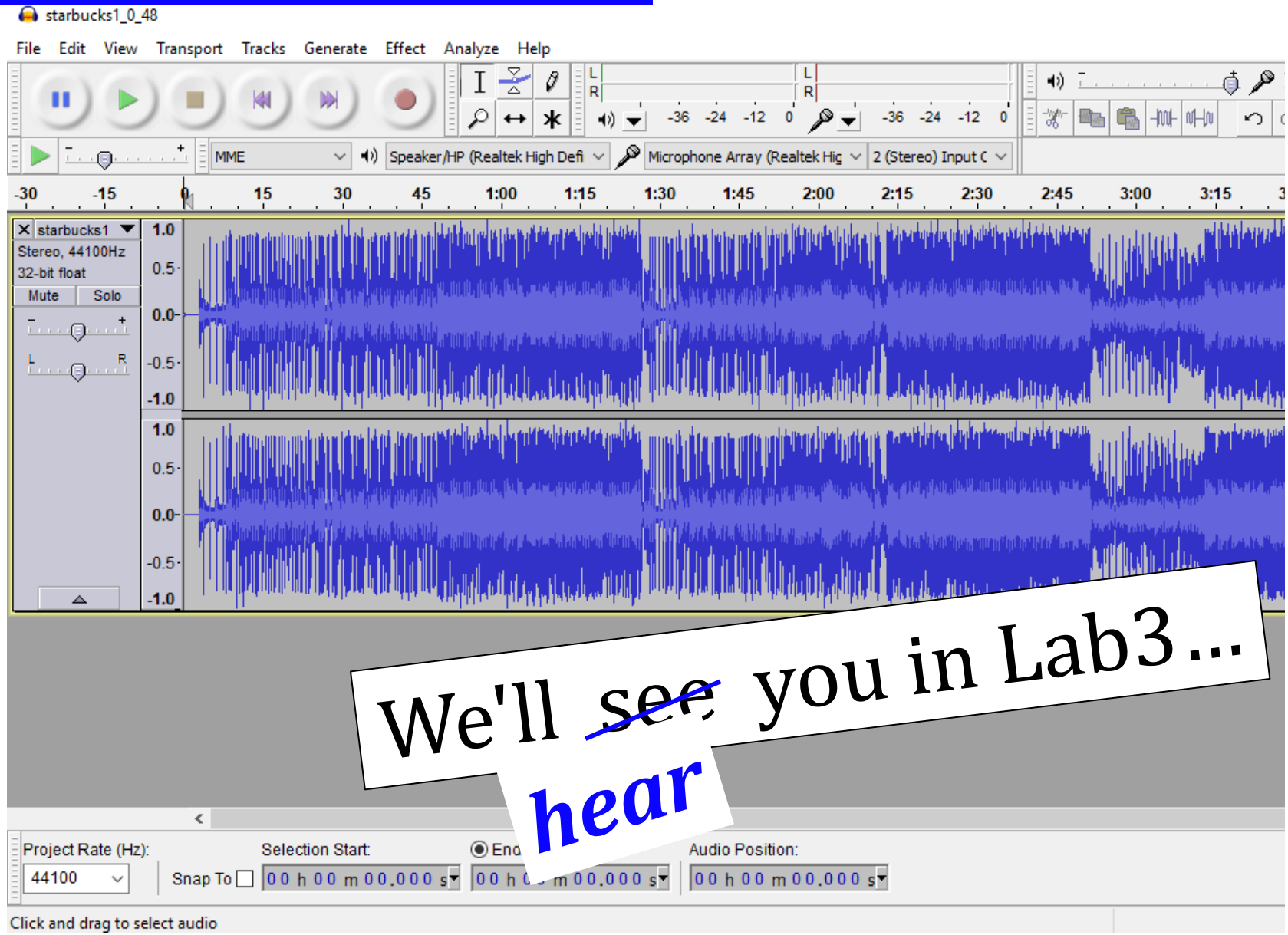
Sound + Starbucks!



Take-away ~ Lab3

```python
def flipflop(filename):
    """ flipflop swaps the halves of an audio file
        input: filename, the name of the original file
        output: no return value, but
                this creates the sound file 'out.wav'
                and plays it
    """
    print( "Playing the original sound...")
    play(filename)

    print( "Reading in the sound data...")
    sound_data = [0,0]
    read_wav(filename,sound_data)
    samps = sound_data[0]
    sr = sound_data[1]

    print( "Computing new sound...")
    # this gets the midpoint and calls it x
    x = len(samps)//2
    newsamps = samps[x:] + samps[:x]
    newsr = sr
    new_sound_data = [ newsamps, newsr ]

    print( "Writing out the new sound data...")
    write_wav( new_sound_data, "out.wav" ) # write data to out.wav

    print( "Playing new sound...")
    play( 'out.wav' )
```

intro stuff – important, but less algorithmic

algorithmic stuff

"outro" stuff

Today in CS5:

chr(9829)

The ♥ of CS (and CSers...)

Algorithms!

https://xkcd.com/2891/

I *feel at home* with recursion now!

BR 5 Snczx

Gesundheit!

powerpoint's English-detection, in action...

Algorithms

Englishness...
Classifying life
Removing/Sorting
and *Jotto!*

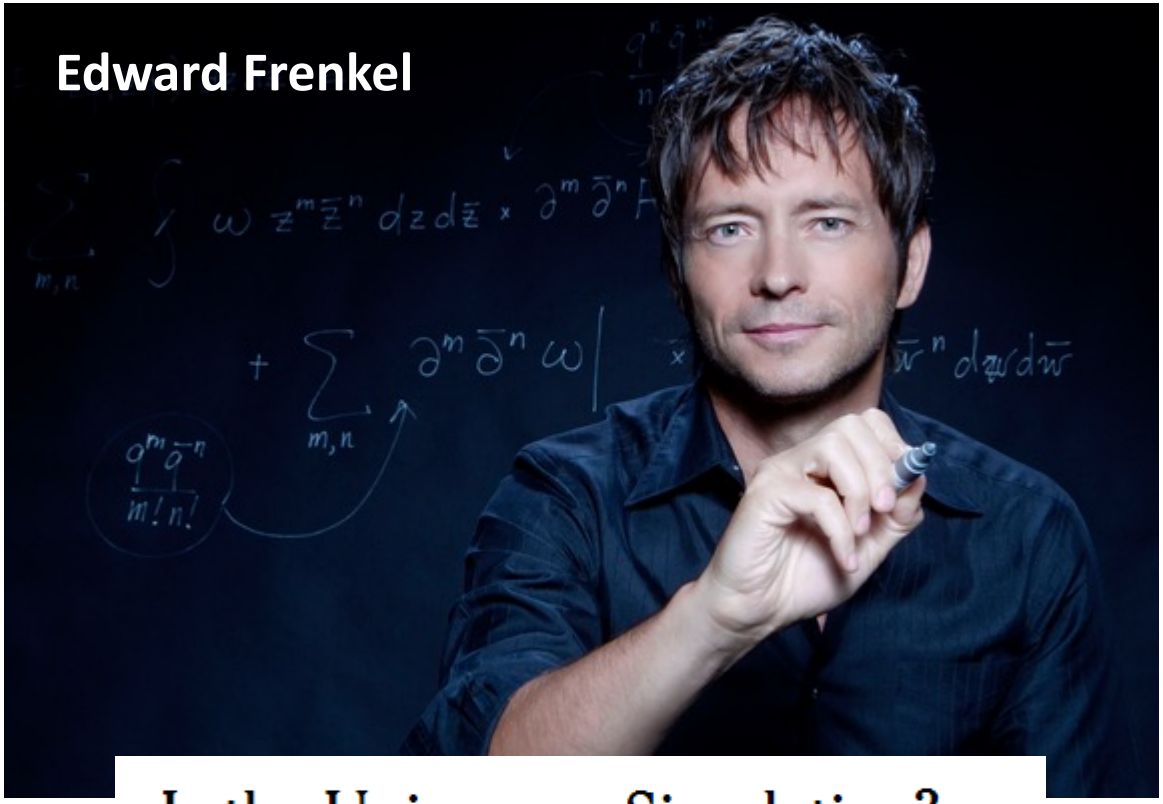
HW 3

Hw #3 due **Tuesday,** 22:22

Several algorithms ...
Reading + response
Sound Lab!

Office Hrs.!

Lots!



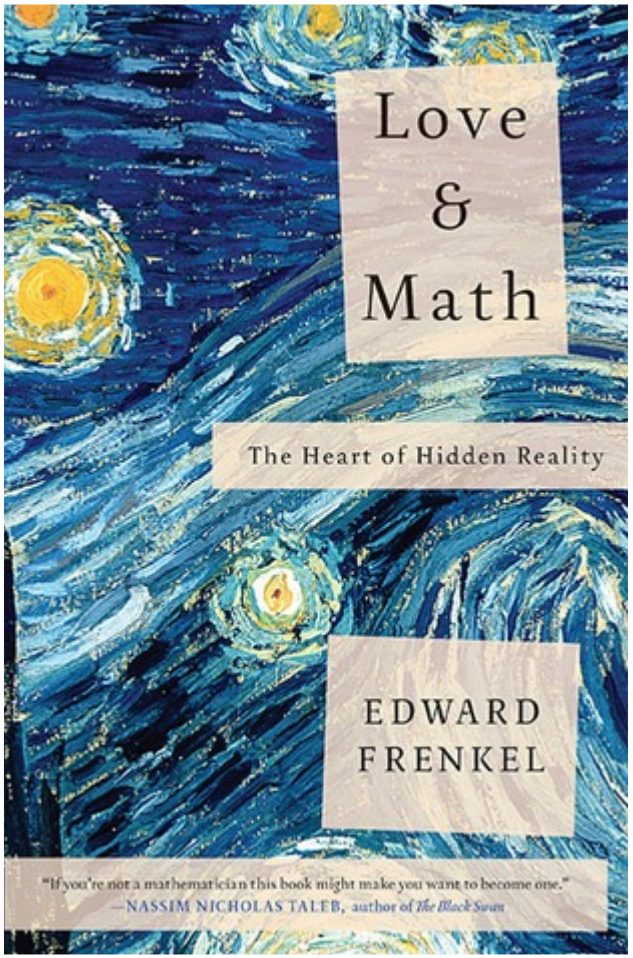
Is the Universe a Simulation?

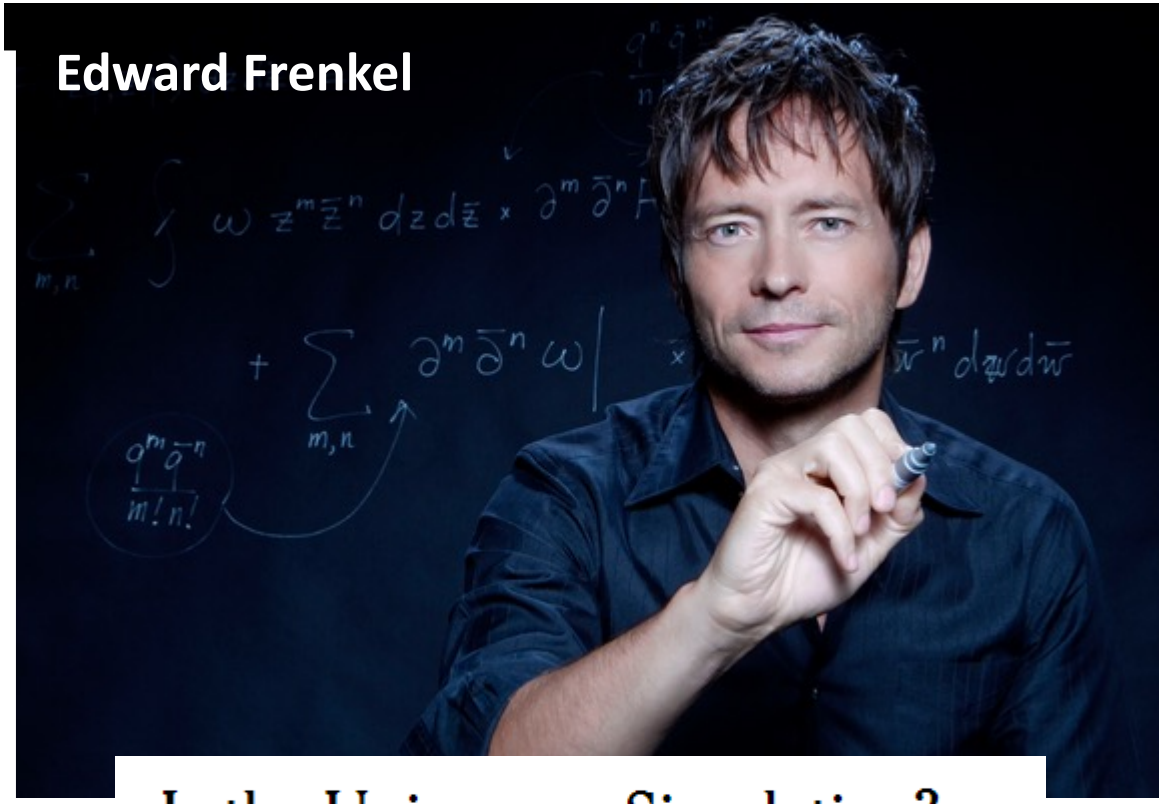
BR 5 Snczx

Gesundheit!

powerpoint's English-detection, in action...

Algorithms





Is the Universe a Simulation?

The Truman Show

MATRIX

Caesar Cipher: `encipher`

`encipher(s,n)` should return the string `s` with each ***alphabetic*** character shifted/wrapped by `n` places in the alphabet

```
encipher( 'I <3 Latin' , 0 )  returns →  'I <3 Latin'
encipher( 'I <3 Latin' , 1 )  returns →  'J <3 Mbujo'
encipher( 'I <3 Latin' , 2 )  returns →  'K <3 Ncvkp'
encipher( 'I <3 Latin' , 3 )  returns →  'L <3 Odwlq'
encipher( 'I <3 Latin' , 4 )  returns →  'M <3 Pexmr'
encipher( 'I <3 Latin' , 5 )  returns →  'N <3 Qfyns'
                    ⋮
encipher( 'I <3 Latin' , 25 )  returns →  'H <3 Kzshm'
```

Algorithm 0

Caesar Cipher: `encipher`

`encipher(s,n)` should return the string `s` with each ***alphabetic*** character shifted/wrapped by `n` places in the alphabet

```
encipher( 'I <3 Latin' , 0 )  returns →  'I <3 Latin'
encipher( 'I <3 Latin' , 1 )  returns →  'J <3 Mbujo'
encipher( 'I <3 Latin' , 2 )  returns →  'K <3 Ncvkp'
```

"…si qua occultius perferenda erant, per notas scripsit, id est sic structo litterarum ordine, ut nullum verbum effici posset; quae si qui investigare et persequi velit, quartam elementorum litteram, **id est D pro A** et perinde reliquas commutet…"

- Suetonius, *De Vitae Caesar*

"…if any were to be conveyed more secretly, he wrote in notes, that is, in such a structured order of letters that no word could be made; that is, he **exchanges D for A** and exchanges the rest in the same manner…"

- Suetonius, *The Life of Caesar*

Design…

*design of **what**?*

The ♥ of CS

(and CSers…)

Algorithms!

Design…

*design of **what**?*

~~*Code?*~~

syntax

*design of **what**?*

The Economist | World politics | Business & finance | Economics | Science & technology | Culture

The Economist explains

Explaining the world, daily

Previous | Next | Latest The Economist explains | All latest updates

The Economist explains

What is code?

Sep 8th 2015, 23:50 BY T.S.

Timekeeper | Like 5k | Tweet 360

```
for i in people.data.users:
    response = client.api.statuses.user_timeline.get(screen_name=i.scre
    print 'Got', len(response.data), 'tweets from', i.screen_name
    if len(response.data) != 0:
        ltdate = response.data[0]['created_at']
        ltdate2 = datetime.strptime(ltdate,'%a %b %d %H:%M:%S +0000 %Y'
        today = datetime.now()
        howlong = (today-ltdate2).days
        if howlong < daywindow:
            print i.screen_name, 'has tweeted in the past' , daywindow,
            totaltweets += len(response.data)
            for j in response.data:
                if j.entities.urls:
                    for k in j.entities.urls:
                        newurl = k['expanded_url']
                        urlset.add((newurl, j.user.screen_name))
        else:
            print i.screen_name, 'has not tweeted in the past', daywind
```

Python!

*design of **what**?*

The Economist | World politics | Business & finance | Economics | Science & technology | Culture

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The Economist explains

What is code?

Sep 8th 2015, 23:50 BY T.S.

FROM lifts to cars to airliners to smartphones, modern civilisation is powered by software, the digital instructions that allow computers, and the devices they control, to perform calculations and respond to their surroundings. How did that software get there? Someone had to write it. But code, the sequences of symbols painstakingly created by programmers, is not quite the same as software, the sequences of instructions that computers execute. So what exactly is it?

syntax

Coding, or programming, is a way of writing instructions for computers that bridges the gap between how humans like to express themselves and how computers actually work. Programming languages, of which there are hundreds, cannot generally be executed by computers directly. Instead, programs written in a particular "high level" language such as C++, Python or Java are translated by a special piece of software (a compiler or an interpreter) into low-level instructions which a computer can actually run. In some cases programmers write software in low-level instructions directly, but this is fiddly. It is usually much easier to use a high-level programming language, because such languages make it

```
for i in people.data.users:
    response = client.api.statuse
    print 'Got', len(response.dat
    if len(response.data) != 0:
        ltdate = response.data[0]
        ltdate2 = datetime.strptime(ltdate,'%a %b %d %H:%M:%S +0000 %Y'
        today = datetime.now()
        howlong = (today-ltdate2).days
        if howlong < daywindow:
            print i.screen_name, 'has tweeted in the past' , daywindow,
            totaltweets += len(response.data)
            for j in response.data:
                if j.entities.urls:
                    for k in j.entities.urls:
                        newurl = k['expanded_url']
                        urlset.add((newurl, j.user.screen_name))
        else:
            print i.screen_name, 'has not tweeted in the past', daywind
```

Python!

Design…

*design of **what**?*

~~*Code?*~~

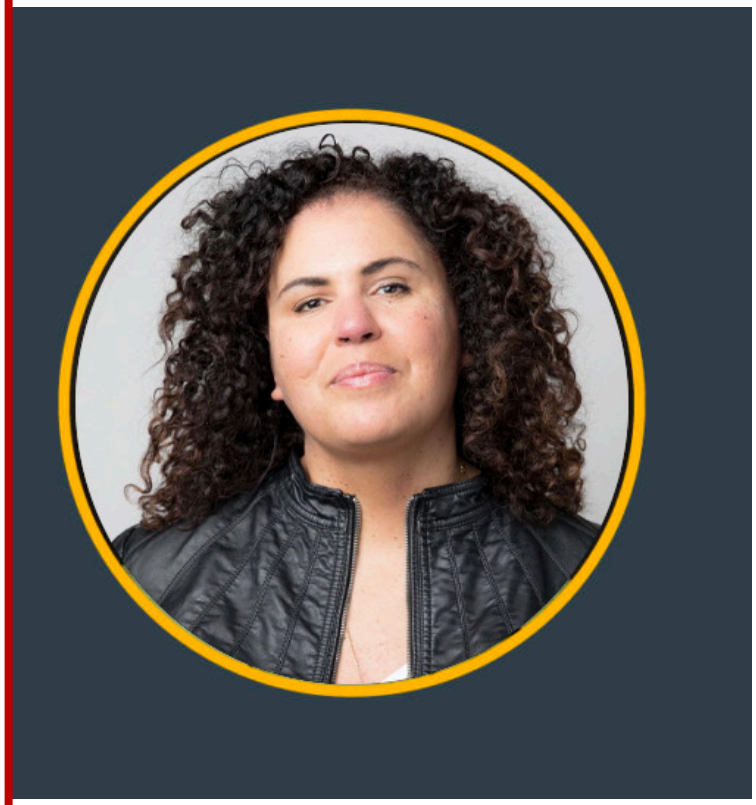
syntax

Algorithms!

ideas!

Design…

*design of **what**?*



Design…

*design of **what**?*

graduation, class of 2021

Algorithm Design…

```
remAll(e,L)
```

remove all e's from L

Design…

`remAll(e,L)`

remove all e's from L

Top-down design

Visualize

Split into parts

Build each part

Combine

Test

L1

```
remAll(42,[5,7,42,8,42])
```

↓

```
[5,7,8]
```

L2

```
remAll('q','qaqqlqqiqqiiqeqqnqs')
```

↓

```
'aliiiens'
```

Design…

remAll(e,L)

remove all e's from L

Top-down design

Visualize

Split into parts

Build each part

Combine

Test

'it'

L[0] and L[1:]

'the rest'

Use it!

it

'the rest'

```
remAll(42,[5,7,42,8,42])
```

```
[5,7,8]
```

it

'the rest'

```
remAll('q','qaqqlqqiqqiiqeqqnqs')
```

```
'aliiiens'
```

Lose it!

Design…

Top-down design

Visualize

Split into parts

Build each part

Combine

Test

`remAll(e,L)`

remove all e's from L

Use it!

it

'the rest'

`remAll(42,[5,7,42,8,42])`

keep L[0]

+ remove e from the rest

`[5,7,8]`

it

'the rest'

`remAll('q','qaqqlqqiqqiiqeqqnqs')`

drop L[0]

+ remove e from the rest

`'aliiiens'`

Lose it!

Design…

Top-down design

- Visualize
- Split into parts
- Build each part
- Combine
- Test

`remAll(e,L)`

remove all e's from L

Use it!

it

`remAll(42`

keep L[0]

+ remove e fr

it

`remAll('q','dagger`

drop L[0]

+ remove e fr

Lose it!

Use it!

- or -

Lose it.

Design ~ *code*

`remAll(e,L)`

remove all e's from L

Top-down design

Re-Visualize *in syntax!?*

If there are no elements or characters in L, we're done – return L itself!

```
def remAll( e, L ):
    """ removes all e from L """
    if len(L) == 0:
        return L
    elif L[0] != e:
        return L[0:1] + remAll(e,L[1:])
    else:
        return remAll(e,L[1:])
```

Design ~ *code*

5 [7,5,42]

remAll(e,L)

remove all e's from L

Top-down design

Re-Visualize *in syntax!?*

```
def remAll( e, L ):
    """ removes all L """
    if len(L) == 0:
        return L
    elif L[0] != e:
        return L[0:1] + remAll(e,L[1:])
    else:
        return remAll(e,L[1:])
```

If **it** is not e,

USE it (keep it in the return value)

AND remove all the e's from the rest of L!

Design ~ *code*

7 [7,5,42]

remAll(e,L)

remove all e's from L

Top-down design

Re-Visualize *in syntax!?*

```
def remAll( e, L ):
    """ removes all e's from L """
    if len(L) == 0:
        return L
    elif L[0] != e:
        return L[0:    +    e,L
    else:
        return                remAll(e,L[1:])
```

If **it** ***is*** e,

LOSE it (don't keep it in the return value)

AND still remove all of the e's from the rest of L!

Design ~ *code*

`remAll(e,L)`

That's it. ***Algorithmic expression*** ~ it's what CSers do.
(think we)

...visualize *in syntax*!?

```
def remAll( e, L ):
    """ removes all e's from L """
    if len(L) == 0:
        return L
    elif L[0] != e:
        return L[0:1] + remAll(e,L[1:])
    else:
        return          remAll(e,L[1:])
```

Try it... Algorithm design

```
def remAll( e, L ):
    """ removes all e's from L """
    if len(L) == 0:
        return L
    elif L[0] != e:
        return L[0:1] + remAll(e,L[1:])
    else:
        return   remAll(e,L[1:])
```

1

Change **remAll** so that it removes only ***one*** **e** from **L**. (We could call it **remOne**.)

remOne(8,[7,8,9,8]) ➡ **[7,9,8]**

Hint: In both 1 + 2, what's needed is *mostly crossing stuff out!* *What stuff?*

2

Make *more* changes to **remAll** so that it removes all of the elements ***up to and including the first*** **e** in **L**. (We could call it **remUpto**.)

remUpto('d','coded') ➡ **'ed'**

If e is not in L, remUpto should remove *everything*...

```
def subseq( s, sbig ):
    """ returns True if s is a subseq. of sbig,
        False otherwise. Both are strings.
    """
    if s == '':
        return True
    elif
```

Challenge...

3 Write the other cases needed for **subseq**...

```
subseq('alg','magical')
False

subseq('alg','twasbrillig')
True
```

remAll insight

syntax

```
def remAll( e, L ):
    """ removes all e's from L """
    if len(L) == 0:
        return L
    elif L[0] != e:
        return L[0:1] + remAll(e,L[1:])
    else:
        return remAll(e,L[1:])
```

```
remAll(8, [7,8,9,8]) ➡ [7,9]
           0 1 2 3
```

sharpening our model for <u>where</u> + <u>how</u> actions happen...

other **rem** examples...

```
remAll(8, [7,8,9,8]) ➡ [7,9]        remAll
remAll('d', 'coded') ➡ 'coe'        remAll

remOne(8, [7,8,9,8]) ➡ [7,9,8]      remOne
remOne('d', 'coded') ➡ 'coed'       remOne

remUpto(8,[7,8,9,8]) ➡ [9,8]        remUpto
remUpto('d','coded') ➡ 'ed'         remUpto
```

Subsequences!

in order, but not necessarily **adjacent**...

```
def subseq( s, sbig )
```

→ True or False?

s is the subsequence to find (or not)

sbig is the bigger string in which we are looking for **s**

```
subseq('', 'cataga')
```

→ **True**

```
subseq('ctg', 'cataga')
```

→ **True**

```
subseq('ctg', 'tacggta')
```

→

```
subseq('aliens', 'always frighten dragons')
```

→

```
subseq('trogdor', 'that dragon is gone for good')
```

→

T or **F**?

Here there be NO dragons!

Why Are these True? or False?

Try it... Algorithm design

Quiz

```
def remAll( e, L ):
    """ removes all e's from L """
    if len(L) == 0:
        return L
    elif L[0] != e:
        return L[0:1]
    else:
        return    remAll(e,L[1:])
```

1

Change **remAll** so that it removes only ***one*** **e** from **L**. (We could call it **remOne**.)

remOne(8,[7,8,9,8]) ➡ **[7,9,8]**

Hint: remove one thing for **remOne**!

what's needed
is mostly crossing stuff out!
What stuff?

2

Make *more* changes to **remAll** so that it removes all of the elements ***up to and including the first*** **e** in **L**. (We could call it **remUpto**.)

remUpto('d','coded') ➡ **'ed'**

If e is not in L, remUpto should remove *everything*...

Hint: remove one ***more*** thing for **remUpto**!

```
def subseq( s, sbig ):
    """ returns True if s is a subseq. of sbig,
        False otherwise. Both are strings.
    """
    if s == '':
        return True
    elif
```

Challenge...

3 Write the other cases needed for **subseq**...

subseq('alg','magical')
lse

subseq('alg','twasbrillig')
True

Hint: you'll need 3-4 cases total for **subseq**.

Try it... Algorithm design

Names: _____

```
def remAll( e, L ):
    """ removes all e's from L """
    if len(L) == 0:
        return L
    elif L[0] != e:
        return L[0:1] + remAll(e,L[1:])
    else:
        return   remAll(e,L[1:])
```

1

Change **remAll** so that it removes only ***one*** **e** from **L**. (We could call it **remOne**.)

remOne(8,[7,8,9,8]) ➡ **[7,9,8]**

Hint: In both 1 + 2, what's needed is *mostly crossing stuff out!* *What stuff?*

2

Make *more* changes to **remAll** so that it removes all of the elements ***up to and including the first*** **e** in **L**. (We could call it **remUpto**.)

remUpto('d','coded') ➡ **'ed'**

If e is not in L, remUpto should remove *everything*...

```
def subseq( s, sbig ):
    """ returns True if s is a subseq. of sbig,
        False otherwise. Both are strings.
    """
    if s == '':
        return True
    elif
```

Challenge...

3 Write the other cases needed for **subseq**...

```
subseq('alg','magical')
False

subseq('alg','twasbrillig')
True
```

from **remAll** to **remOne**

Hint: remove one thing for **remOne**!

```
def remAll( e, L ):
    """ returns seq. L with all e's rmovd
    """
    if  len(L) == 0:
        return L

    elif  L[0] != e:
        return  L[0:1] + remAll( e, L[1:] )

    else:
        return  remAll( e, L[1:] )
```

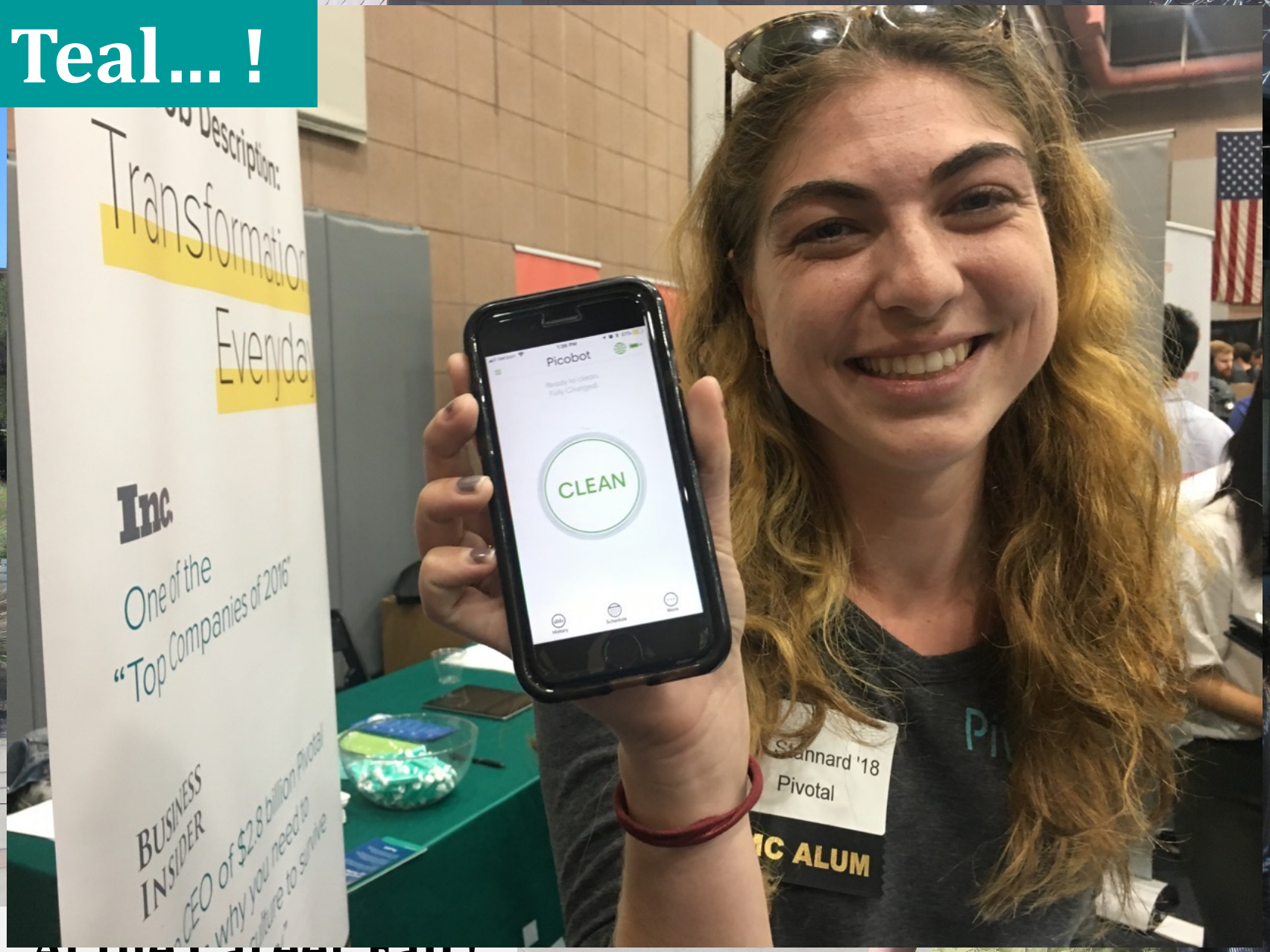
One

Is remAll really "an algorithm"?

Wait! I see **One** more error!

```
remOne(8,[7,8,9,8]) ➡ [7,9,8]          remOne('d','coded') ➡ 'coed'
```

Teal… !



At the career fair!


NO WHEELS
NO
WHEELS

from **remAll** to **remOne**

Hint: remove one thing for **remOne**!

```
        One
def remAll( e, L ):
    """ returns seq. L with all e's rmovd
    """
    if  len(L) == 0:
        return L

    elif  L[0] != e:
        return  L[0:1] + remAll( e, L[1:] )

    else:
        return  remAll( e, L[1:] )
```

Wait! I see **One** more error!

`remOne(8,[7,8,9,8])` ➡ `[7,9,8]` `remOne('d','coded')` ➡ `'coed'`

from **remAll** to **remOne**

Hint: remove one thing for **remOne**!

```
        One
def remAll( e, L ):
    """ returns seq. L with all e's rmovd
    """
    if  len(L) == 0:
        return L

    elif  L[0] != e:
        return  L[0:1] + remAll( e, L[1:] )

    else:
        return  remAll( e, L[1:] )
```

Wait! I see **One** more error!

```
remOne(8,[7,8,9,8]) ➡ [7,9,8]          remOne('d','coded') ➡ 'coed'
```

from **remOne** to **remUpto**

Hint: remove one ***more*** thing for **remUpto**!

```
def remOne( e, L ):
    """ returns seq. L with one e rmoved
    """
    if  len(L) == 0:
        return L

    elif  L[0] != e:
        return  L[0:1] + remOne( e, L[1:] )

    else:
        return  L[1:]
```

Upto

I <3 remSleep!

```
remUpto(8,[7,8,9,8]) ➡ [9,8]          remUpto('d','coded') ➡ 'ed'
```

from **remOne** to **remUpto**

Hint: remove one ***more*** thing for **remUpto**!

```
def remOne( e, L ):
    """ returns seq. L with one e rmoved
    """
    if  len(L) == 0:
        return L

    elif  L[0] != e:
        return  L[0:1] + remOne( e, L[1:] )

    else:
        return  L[1:]
```

Upto

I <3 remSleep!

`remUpto(8,[7,8,9,8])` ➡ `[9,8]`

`remUpto('d','coded')` ➡ `'ed'`

Subseq ~ *coding* it out...

```
def subseq( s, sbig ):
    """ returns True if s is a subseq. of sbig;
        False otherwise. Both are strings.
    """
    if s == '':
        return True

    elif s[0]
```

it

Base case(s)

but first, *algorithms*!

Recursive step(s)

Where are the ***useit*** and ***loseit*** here?

Subseq ~ *thinking* it out...

```
subseq( s, sbig )

subseq('ctg', 'tacggta')

s[0]    sbig[0]
```

What is a small (initial) piece of the problem?

How would we describe it in terms of the inputs?

Use it!

- or -

Lose it!

What is left after handling this piece?

Are there other functions we will need?

Top-down design

Visualize

Split into parts

Build each part

Combine

Test

Subseq ~ *coding* it out...

```
def subseq( s, sbig ):
    """ returns True if s is a subseq. of sbig;
        False otherwise. Both are strings.
    """
    if s == '':
        return True

    elif s[0]
```

it

Base case(s)

Recursive step(s)

Where are the *useit* and *loseit* here?

Subseq ~ *coding* it out...

```
def subseq( s, sbig ):
    """ returns True if s is a subseq. of sbig;
        False otherwise. Both are strings.
    """
    if s == '':
        return True

    elif s[0] not in sbig:
        return False

    else:
        return subseq(s[1:],remUpto(s[0],sbig))
```

it

Base case(s)

rest of **s**

rest of **sbig** after **s[0]**

Recursive step(s)

Where are the ***useit*** and ***loseit*** here?

Subseq ~ *coding* it out...

```
def subseq( s, sbig ):
    """ returns True if s is a subseq. of sbig;
        False otherwise. Both are strings.
    """
    if s == '':
        return True

    elif s[0] not in sbig:
        return False

    else:
        return subseq(s[1:],remUpto(s[0],sbig))
```

it

Base case(s)

Recursive step(s)

"Use it or lose it"

Where are the *useit* and *loseit* here?

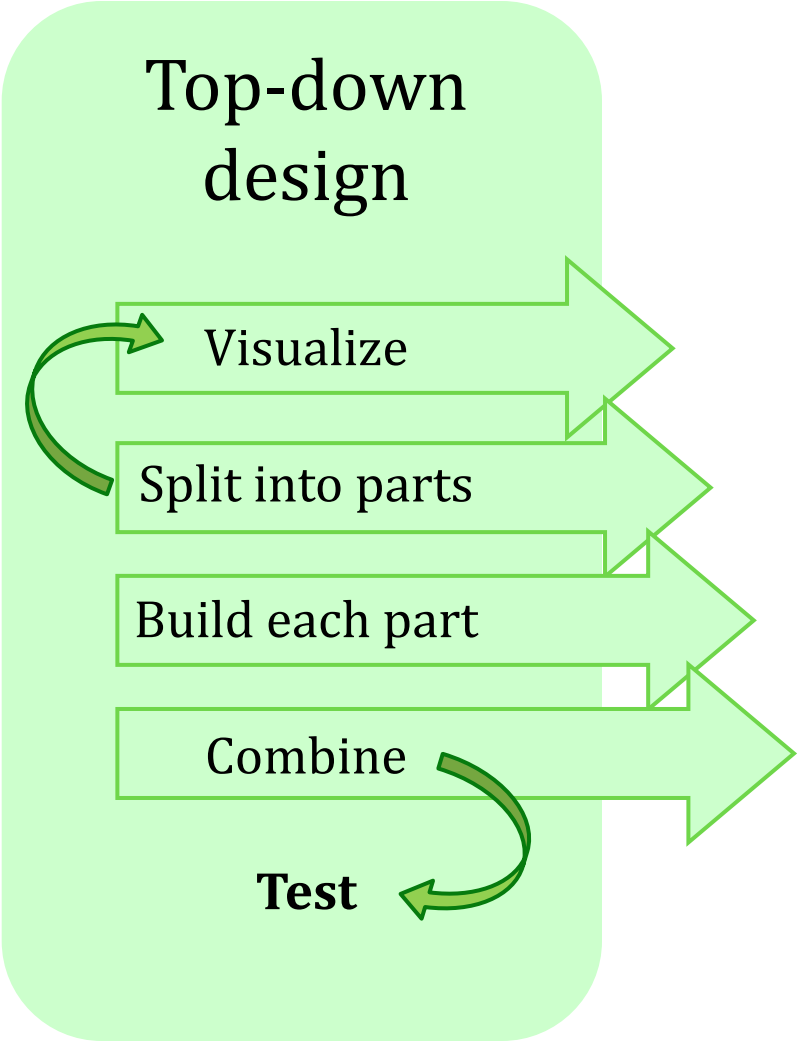
Design ~ *(code)*

That's it. ***Algorithmic expression*** ~
it's what CSers think they do.

... at this moment in a prior CS5 ...

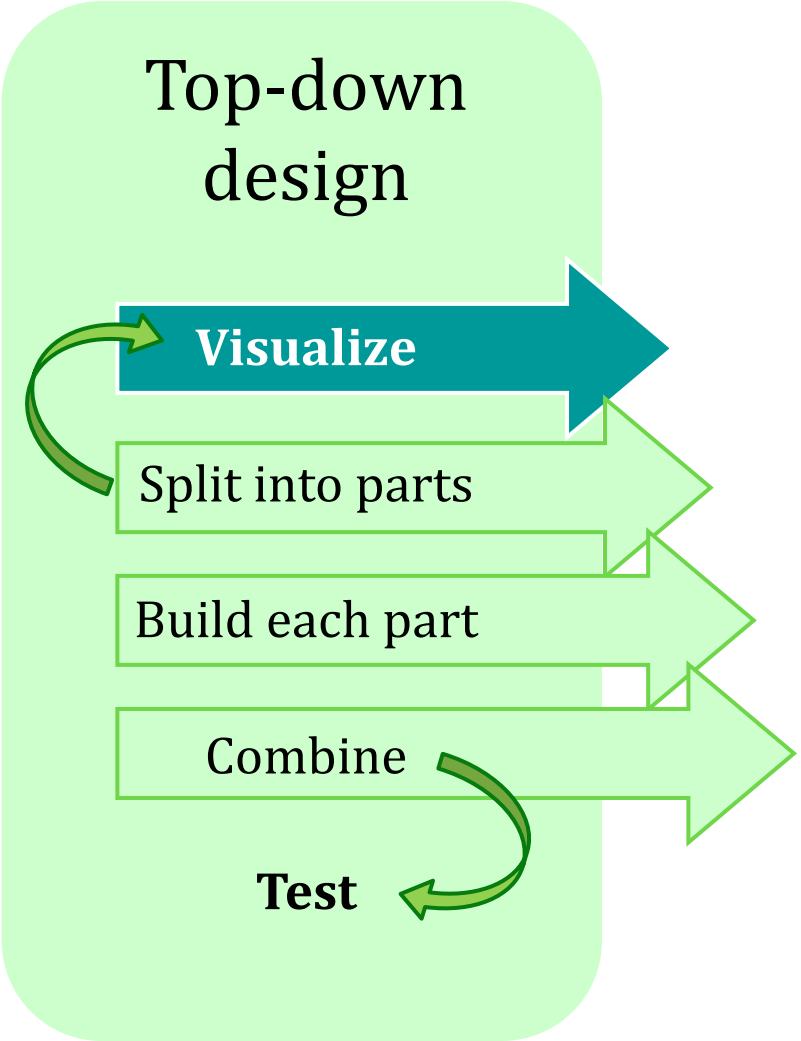
it can take some
"getting used to" ... ?

*What's the **problem**?!*



*Which **one** of these steps is the most important?*

What's the problem?!



understanding *what the problem demands!!*

*I want some **examples**!*

hw3pr2: *use-it-or-lose-it algorithm design*

Longest **C**ommon **S**ubsequence — LCS(S, T)

Jotto **Score** counting — jscore(s1, s2)

binary **l**ist and **gen**eral list **sort**ing — blsort(L), gensort(L)

exact_change making — exact_change(t, L)

hw3pr2: *use it or lose it*

Longest **C**ommon **S**ubsequence

LCS(S, T)

'HUMAN'

'CHIMPANZEE'

'CGCTGAGCTAGGCA...'

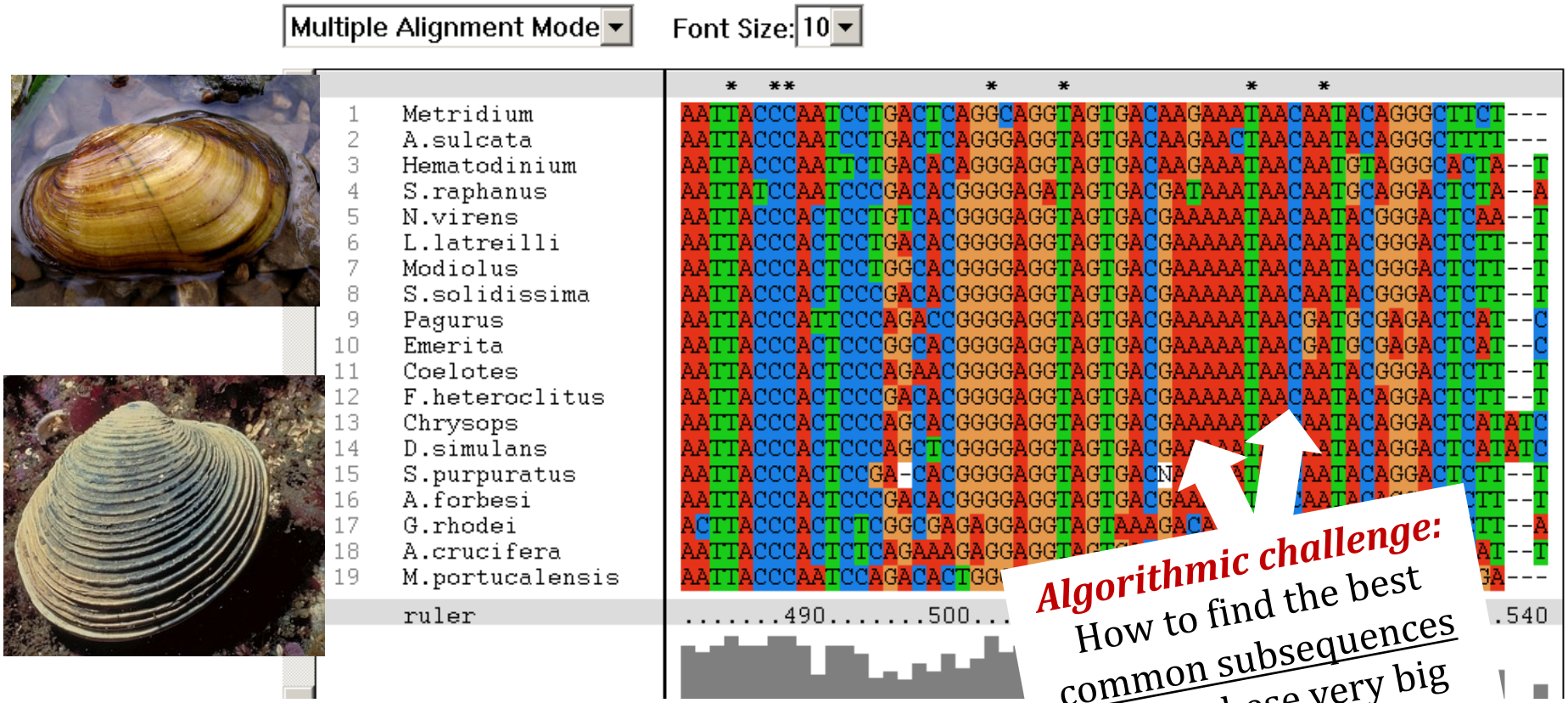
'ATCCTAGGTAACTG...'

+10^9more

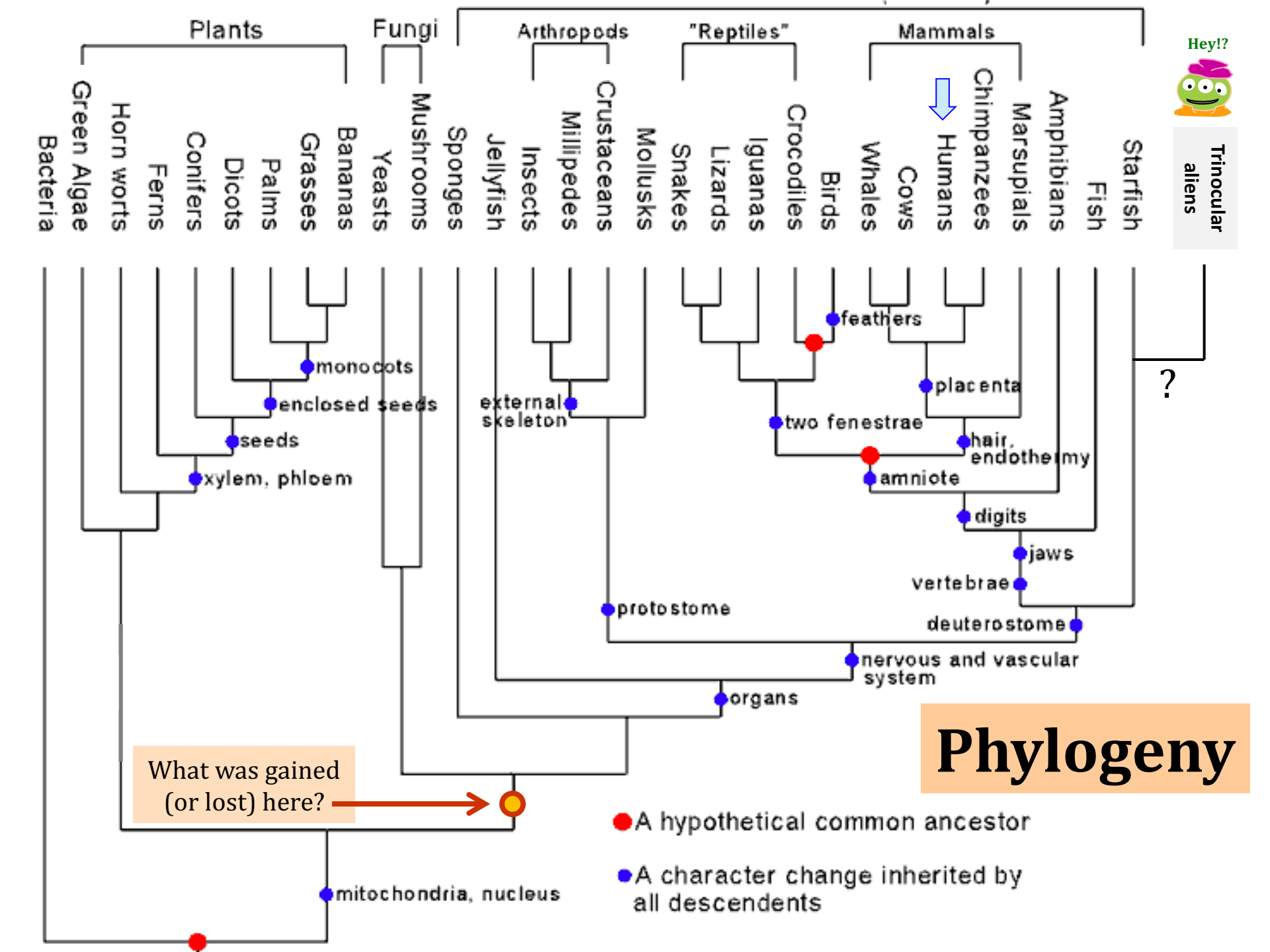
Eye oneder if this haz other aplications?

Why LCS?

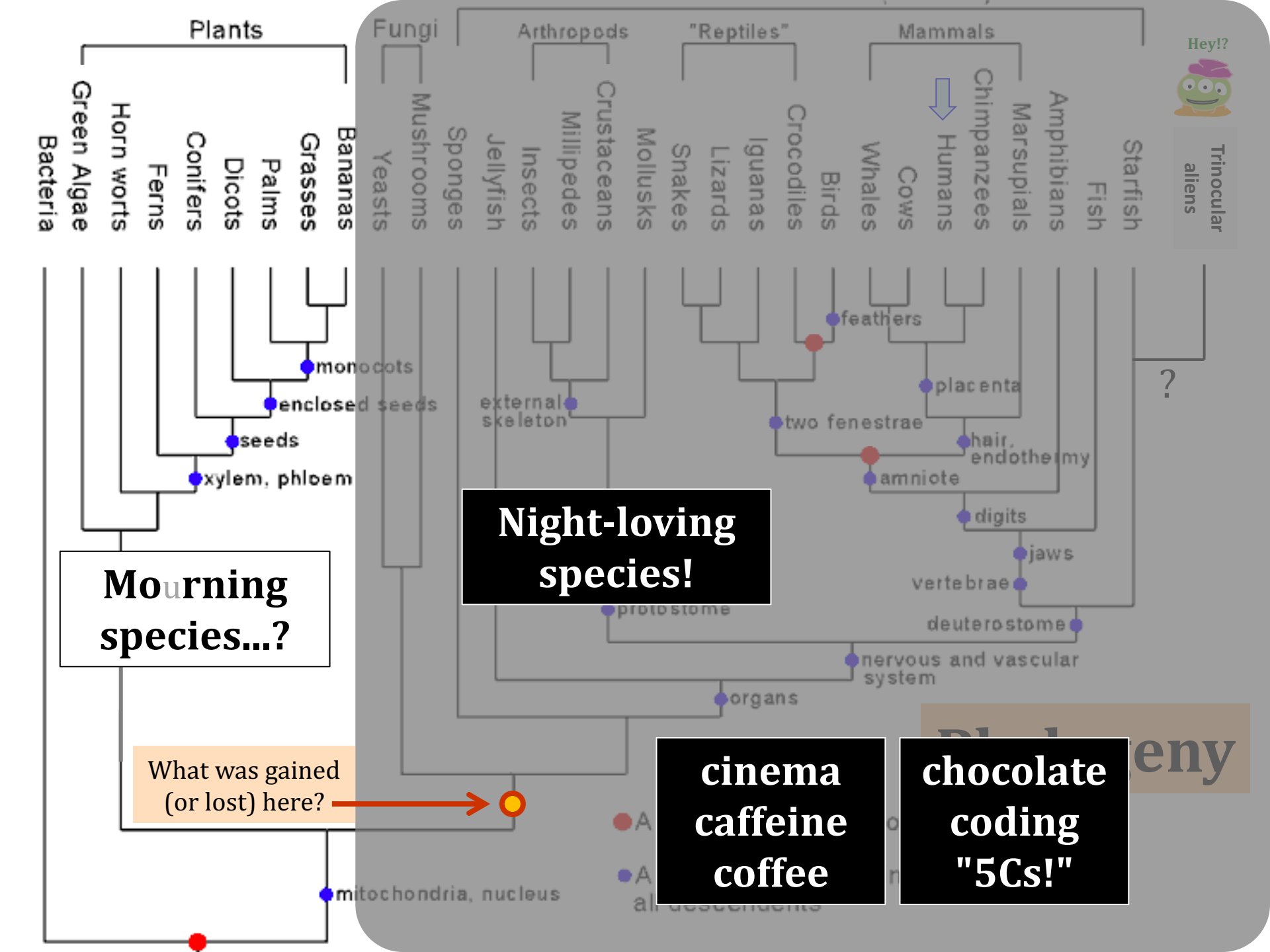
Screenshot from the ClustalX multiple subsequence alignment tool...



Algorithmic challenge:
How to find the best
common subsequences
among these very big
genome strings ?!?


Plants
Fungi
Arthropods
"Reptiles"
Mammals
Hey!?
Trinocular aliens
Green Algae
Bacteria
Horn worts
Ferns
Conifers
Dicots
Palms
Grasses
Bananas
Yeasts
Mushrooms
Sponges
Jellyfish
Insects
Millipedes
Crustaceans
Mollusks
Snakes
Lizards
Iguanas
Crocodiles
Birds
Whales
Cows
Humans
Chimpanzees
Marsupials
Amphibians
Fish
Starfish
?
feathers
monocots
enclosed seeds
seeds
xylem, phloem
external skeleton
placenta
two fenestrae
hair, endothermy
amniote
digits
jaws
vertebrae
protostome
deuterostome
nervous and vascular system
organs
What was gained (or lost) here?
mitochondria, nucleus
A hypothetical common ancestor
A character change inherited by all descendents

Phylogeny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amniote
digits
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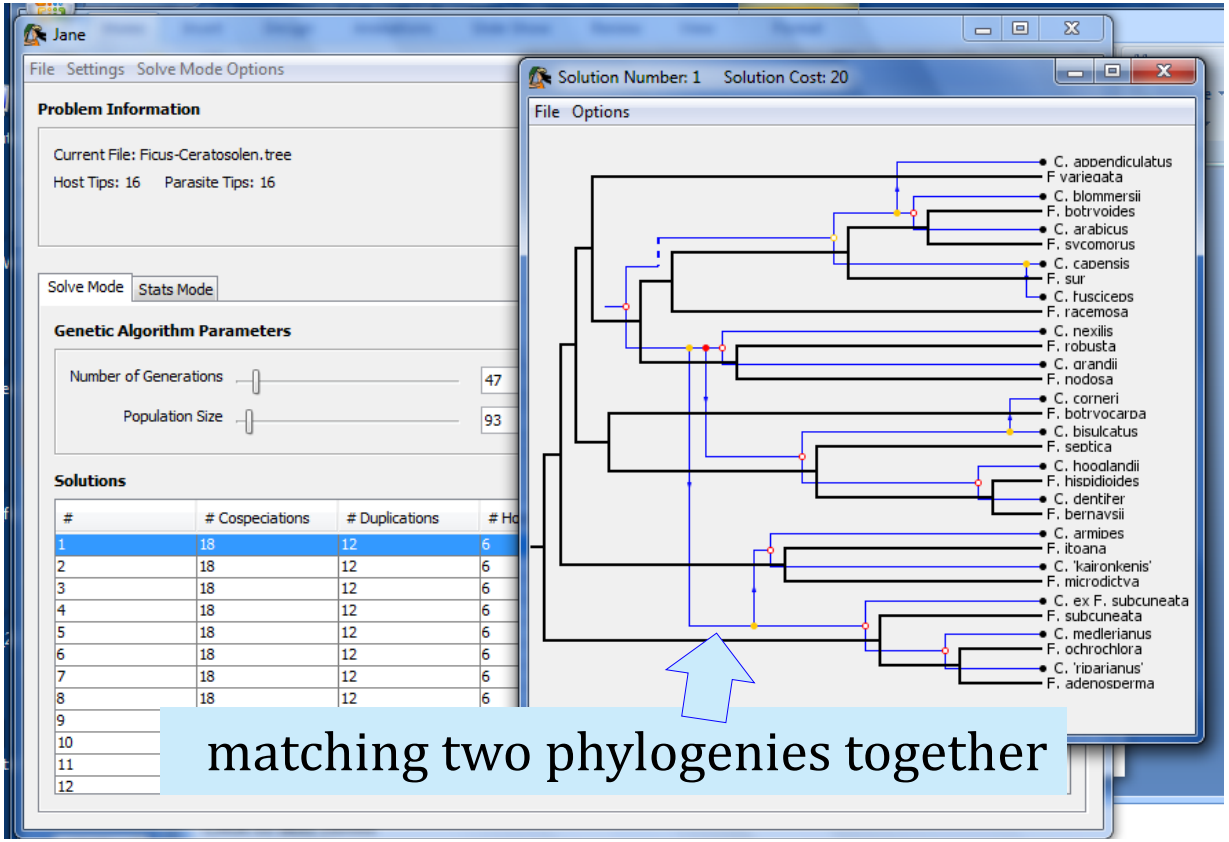
vertebrae
deuterostome
nervous and vascular system
organs
mitochondria, nucleus
?
Night-loving species!
Mourning species...?
What was gained (or lost) here?
cinema
caffeine
coffee
chocolate
coding
"5Cs!"

Subsequences @ 5Cs

host: figs

parasites: wasps

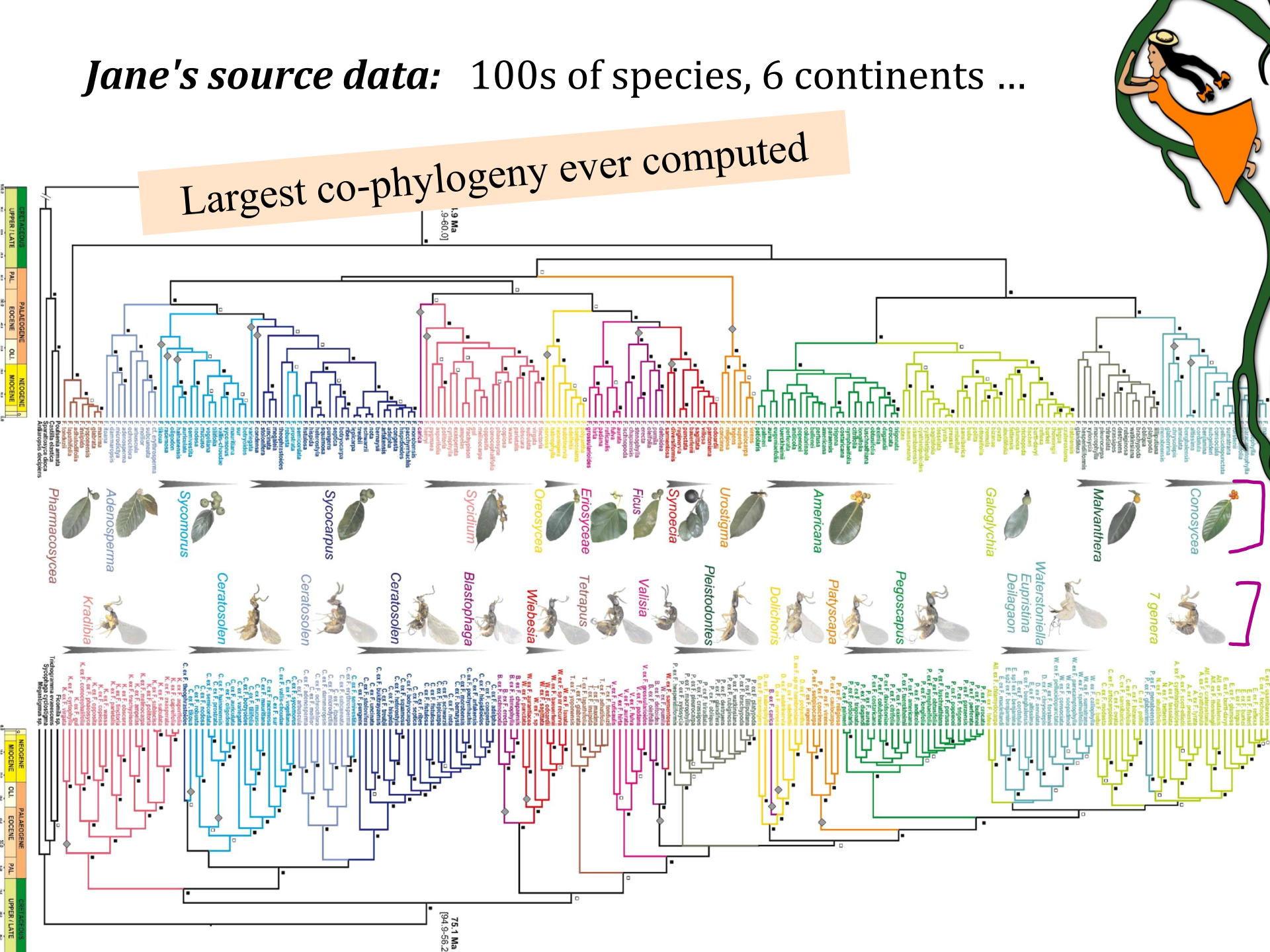
together!



matching two phylogenies together

Jane's source data: 100s of species, 6 continents …

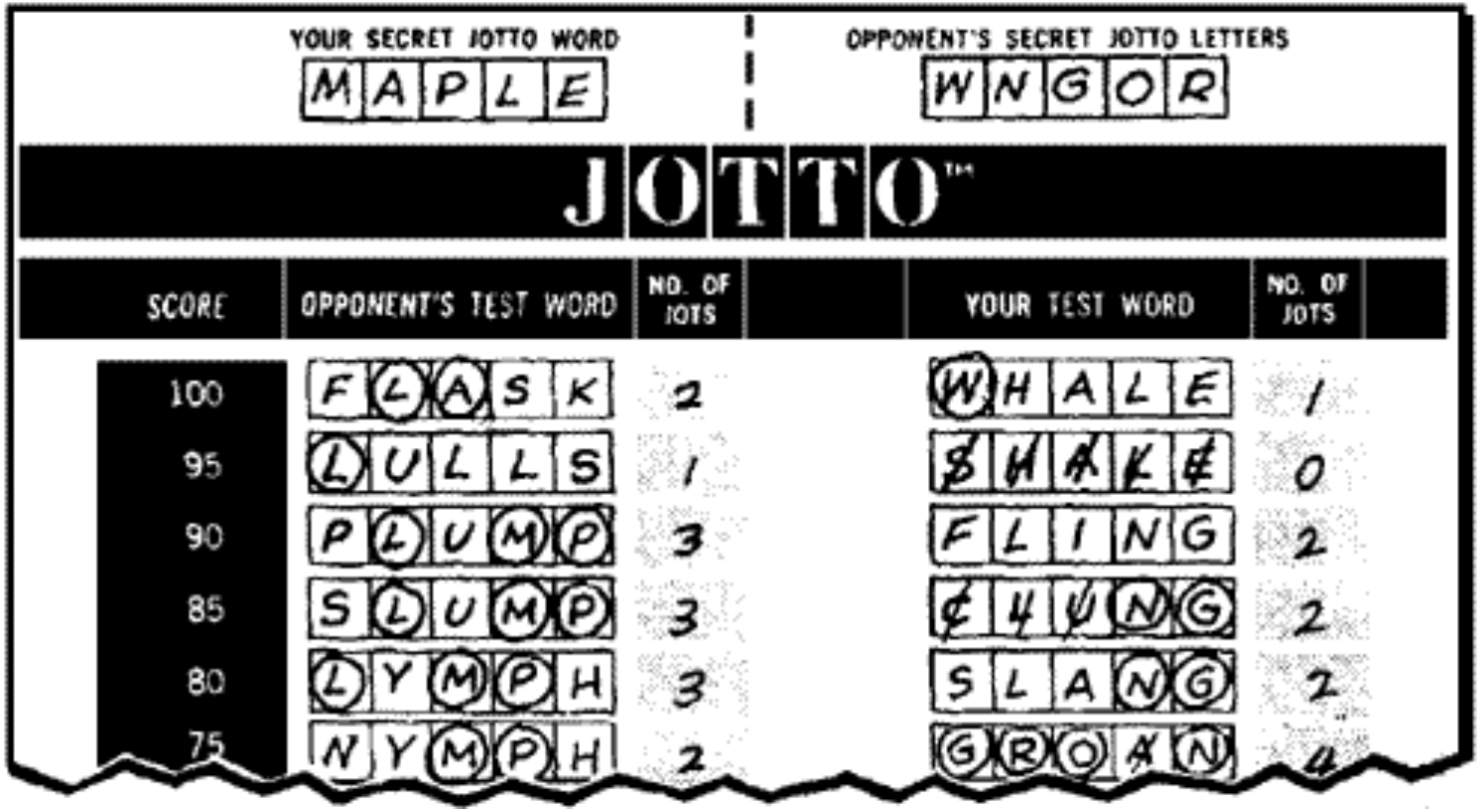
Largest co-phylogeny ever computed



also in hw3pr2: *Jotto* !

a word-guessing game…

jscore(S, T)



jscore

"Jotto scoring"

These are two cute

'robot'

'otter'

```
jscore( 'robot', 'otter' ) ⟶
```

```
jscore( S, T )
```

Let's try it!

also in hw3pr2: **`sort`** + **`exact_change`**

sort(**[42,5,7]**) → **[5,7,42]**

sort(**[42,7]**) → **[7,42]**

sort(**[42]**) → **[42]**

returns an ascending list

---

exact_change(42, **[25,30,2,5]**) → `False`

exact_change(42, **[25,30,2,15]**) → `True`

returns `True` or `False`

should return the jotto score for any strings **S** and **T**

jscore(S,T)

jscore('robot', 'otter') → **3**

jscore('geese', 'seems') → **3**

jscore('fluff', 'lulls') → **2**

jscore('pears', 'diner') →

jscore('xylyl', 'slyly') →

Extra! Which of these 10 is the *cruellest* hidden jotto word?

should return a new list that is the sorted version of the input **L**

sort(L)

sort([42,5,7]) → **[5,7,42]**

sort([42,7]) → **[7,42]**

sort([42]) → **[42]**

sort([ ]) →

blsort([1,0,1]) →

binary-list sort: same as sort, but all of the #s are 0 or 1

should return the Longest Common Subsequence of strings **S** and **T**

LCS(S,T)

LCS('ctga', 'tagca') → 'tga'

LCS('tga', 'taacg') → 'ta' (or 'tg')

LCS('tga', 'a') →

LCS('gattaca', 'ctctgcgat') →

Use it! *Lose it!*

remOne

how is remOne used?

don't write any code for these...

min

remOne

how are min and remOne used?

do answer examples + *brainstorm*

Use it! *Lose it!* *Lose it!*

only recursion here...

this is eerily like svTree

Brainstorm algorithms for these problems. What **helper functions???** might help for each...

returns True if ***any*** subset of elements in L add up to t; returns False otherwise

exact_change(t,L)

exact_change(42, [25,30,2,5]) → **False**

exact_change(42, [22,16,3,2,17]) →

exact_change(42, [18,21,22]) →

exact_change(42, [40,17,1,7]) →

exact_change(20, [16,3,2,17]) →

Use it! *Lose it!*

... and here

should return the jotto score for any strings **s1** and **s2**

jscore(s1,s2)

jscore('robot', 'otter') → **3**

jscore('geese', 'seems') → **3**

jscore('fluff', 'lulls') → **2**

jscore('pears', 'diner') → **2**

jscore('xylyl', 'slyly') → **4**

Extra! Which of these 10 is the *cruellest* hidden jotto word?

should return a new list that is the sorted version of the input **L**

sort(L)

sort([42,5,7]) → **[5,7,42]**

sort([42,7]) → **[7,42]**

sort([42]) → **[42]**

sort([ ]) → **[ ]**

blsort([1,0,1]) → **[0,1,1]**

binary-list sort: same as sort, but all of the #s are 0 or 1

should return the Longest Common Subsequence of strings **S** and **T**

LCS(S,T)

LCS('ctga', 'tagca') → 'tga'

LCS('tga', 'taacg') → 'ta' (or 'tg')

LCS('tga', 'a') → **'a'**

LCS('gattaca', 'ctctgcgat') → **'ttca'**

4 chars

Use it! *Lose it!* **remOne**

how is remOne used?

don't write any code for these...

min **remOne**

how are min and remOne used?

do answer examples + *brainstorm*

Use it! *Lose it!* *Lose it!*

only recursion here...

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Brainstorm algorithms for these problems. What **helper functions???** might help for each...

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exact_change(42, [40,17,1,7]) → **False**

exact_change(20, [16,3,2,17]) → **True**

Use it! *Lose it!*

... and here

decipher('Weet bksa ed xecumeha 3!')

kxn rkfo k qbokd goouoxn ...

decipher('Weet bksa ed xecumeha 3!')

Good luck on homework 3!

kxn rkfo k qbokd goouoxn ...

and have a great weekend ...