A1: less than 1 week

lab1: no paper-based results (yet)

demo1: last-year example to be posted— schedule soon!

CSC148 winter 2018

idiom, abstraction

week 3

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Outline

documentation, special methods for inheritance

abstract data types (ADTs)

implement ADTs with classes, inheritance

balanced parentheses

avoid duplicating documentation

one place will be wrong

don't maintain documentation in two places, e.g. superclass and subclass, unless there's no other choice:

- inherited methods, attributes — no need to document again
- extended methods — document that they are extended and how — e.g. call superclass init
- overridden methods, attributes — document that they are overridden and how

see Shape and Square

Pycharm type hinting, redux

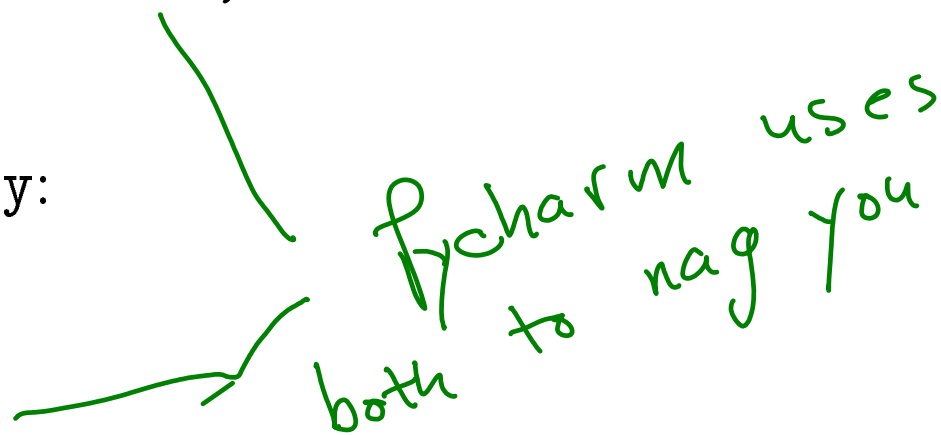
be sure to always include the functional annotation (CSC108) style of annotation:

```
[...]
def __init__(self, num: int, name: str) -> None:
[...]
```

Annotate attributes similarly:

```
x: int
```

see Shape



new lists from old

suppose **L** is a list of the first hundred natural numbers:

```
L = list(range(100))
```

if I want a new list with the squares of all the elements of **L** I *could*

```
new_list = []
for x in L:
    new_list.append(x * x)
```

you probably have to return new_list

or I could use the **equivalent list comprehension**

```
new_list = [x * x for x in L]
```

iterable (e.g. list)

expression

filtering with [...]

I can make sure my new list only uses specific elements of the old list...

```
L = ["one", "two", "three", "four", "five", "six"]
```

by adding a condition...

```
new_list = [s * 3
            for s in L
            if s <= "one"]
```

notice that a comprehension can span several lines, if that makes it easier to understand

general comprehension pattern

[expression **for** name in iterable **if** condition]

Python expressions evaluate to values, **name** refers to each element of **iterable** (list, tuple, dictionary, ...) in turn, and a **condition** evaluates to either **True** or **False**

You should be able to read these, even if you don't write them.

see Code like Pythonista

common ADTs

In CS we recycle our intuition about the outside world as ADTs. We abstract the data and operations, and suppress the implementation

- 

sequences of items; can be added, removed, accessed by position e.g. Python list...

- 
specialized list where we only have access to most recently added item → stack

- 
→ e.g. Python dictionary ...
collection of items accessed by their associated keys

stack class design

We'll use this real-world description of a stack for our design:

> *A stack contains items of various sorts. New items are added on to the top of the stack, items may only be removed from the top of the stack. It's a mistake to try to remove an item from an empty stack, so we need to know if it is empty. We can tell how big a stack is.*

Take a few minutes to identify the main noun, verb, and attributes of the main noun, to guide our class design. Remember to be flexible about alternate names and designs for the same class

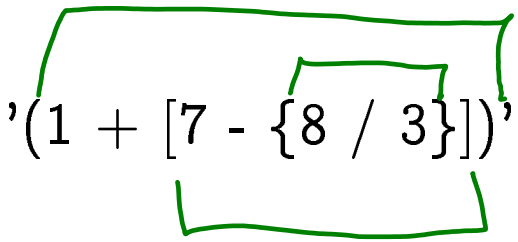
implementation possibilities

The public interface of our Stack ADT should be constant, but inside we could implement it in various ways

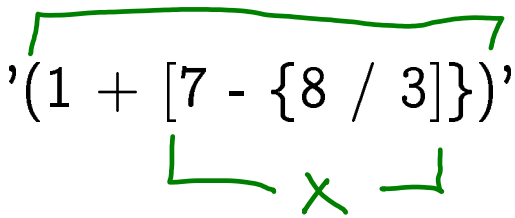
- Use a python list, which already has a pop method and an append method — both from high end of list ...
- Use a python list, but add and remove from position 0
  — some extra work
- Use a python dictionary with integer keys 0, 1, ..., keeping track of the last index used, and which have been removed
  — a little extra work, but fast ...

parenthesization

In some situations it is important that opening and closing parentheses, brackets, braces match.



good



bad

Remember, the computer only "sees" one character at a time.

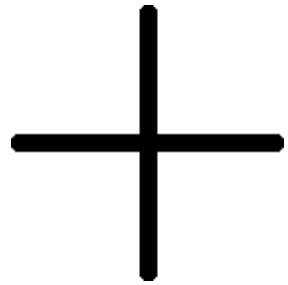
define balanced parentheses:

(a recursive definition)

- a string with no parentheses is balanced
- a string that begins with a left parenthesis "(", ends with a right parenthesis ")", and in between has balanced parentheses is balanced. Same for brackets '"[...]" and braces "..."
- the concatenation of two strings with balanced parentheses is also balanced

Stack →

1



Stack →

7

stack → { [(

8

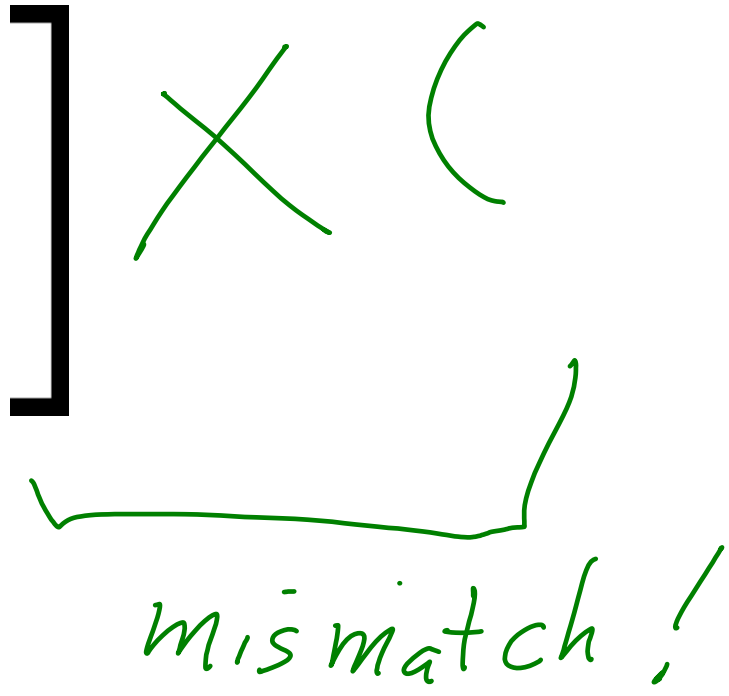
3

Stack → [
(

✓ ok!

stack → (

✓ ok


mismatch!

sack ADT

Here's a description of a **sack**, which has similar features to a stack:

> *A sack contains items of various sorts. New items are added on to a random place in the sack, so the order items are removed from the sack is completely unpredictable. It's a mistake to try to remove an item from an empty sack, so we need to know if it is empty. We can tell how big a sack is.*

Take a few minutes to identify the main noun, verb, and attributes of the main noun, to guide our class design. Remember to be flexible about alternate names and designs for the same class

generalize stack, sack as Container

stacks and sacks can have different implementations: using python lists, dictionaries, ... so it doesn't make sense to have the implementation in a superclass. However, it is nice to have a common API between the two, so we can write client code that works with any stack, sack, or other... Containers

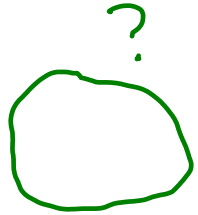
```
# suppose L is list[Container]

for c in L:
    for i in range(1000):
        c.add(i)
    while not c.is_empty():
        print(c.remove())
```

Pycharm + other tools know c has a add method, so they chill...

... so we'll make Stack, Sack subclasses of Container!

hand-rolled Exception

- what happens when you remove something from an empty Container? Error, but message depends on implementation ('list, dict ...)
- the contract is honoured, but can we do better?
  Give the client more clues...
- easy class implementation: EmptyContainerException



declare this!

testing

Use your `docstring` for testing as you develop, but use unit testing to make sure that your particular implementation remains consistent with your ADT's interface. Be sure to:

- import the module `unittest`
- subclass `unittest.Testcase` for your tests, and begin each method that carries out a test with the string `test`

```
def test.... ( ) :
```

- compose tests **before** and **during** implementation

chosing test cases

since you can't test every input, try to think of **representative** cases:

- smallest argument(s): 0, empty list or string, ...
- boundary case: moving from 0 to 1, empty to non-empty, ...
- "typical" case

if your function had a str and an int argument, that would mean 3x3 tests (minimum)!

isolate units

- test classes separately
- test (related) methods separately

why?

Pinpoint problem code!