CS1110

Lecture 9: Lists and Sequences

Announcements

Assignment 2
…is out! It is very short, on paper, due next class.

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Lists: Sequences of Objects

String

- s = 'abc de'

0	1	2	3	4	5
a	b	c		d	e

- Put characters in quotes
  - Use \' fo
- Access ch
  - s[0] is 'a'
  - s[6] causes an error
  - s[0:2] is 'ab' (excludes c)
  - s[2:] is 'c de'

List

- x = [5, 6, 5, 9, 15, 23]

0	1	2	3	4	5
5	6	8	9	15	23

- e [ ]
  - mmas
- s items with [ ]
  - x[0] is 5
  - x[6] causes an error
  - x[0:2] is [5, 6] (excludes 2nd 5)
  - x[3:] is [9, 15, 23]

Sequence is a name we give to both

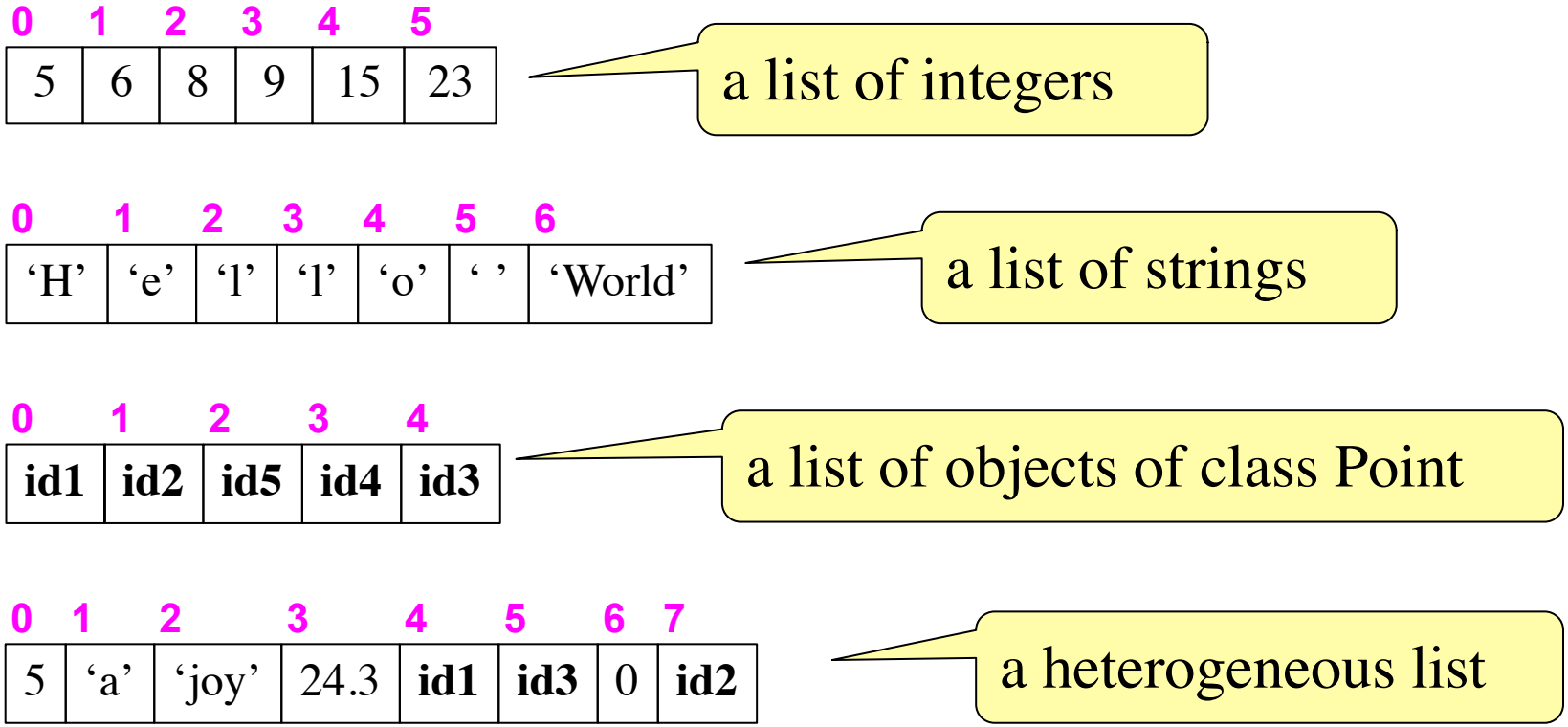
Things that Work for All Sequences

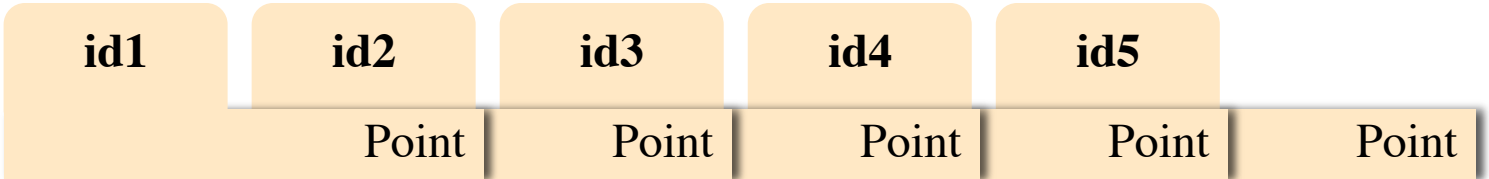
s = 'slithy'		x = [5, 6, 9, 6, 15, 5]
s.index('s') → 0	methods	x.index(5) → 0
s.count('t') → 1		x.count(6) → 2
len(s) → 6	built-in fn.	len(x) → 6
s[4] → "h"	slicing	x[4] → 15
s[1:3] → "li"		x[1:3] → [6, 9]
s[3:] → "thy"		x[3:] → [6, 15, 5]
s[−2] → "h"		x[−2] → 15
s + ' toves' → "slithy toves"	operators	x + [1, 2] → [5, 6, 9, 6, 15, 5, 1, 2]
s * 2 → "slithyslithy"		x * 2 → [5, 6, 9, 6, 15, 5, 5, 6, 9, 6, 15, 5]
't' in s → True		15 in x → True

the smallest *i* for which x[i] == 5

the number of *i*s for which x[i] == 6

Difference: Lists Hold Any Type





Difference: Lists are mutable

- Their contents **can be altered**
  - by assignment to list items

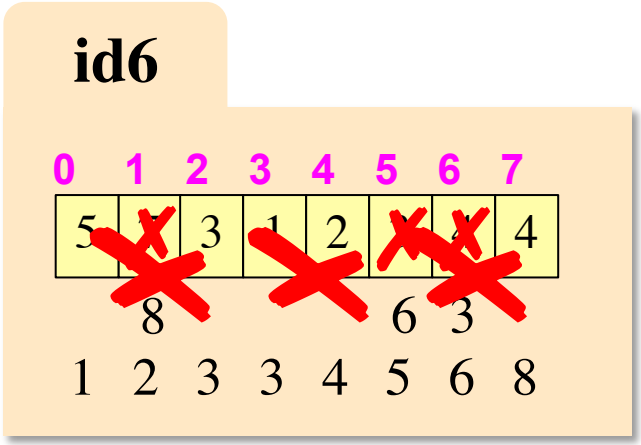
```
x = [5, 7, 3, 1]
x[1] = 8
```

  - using methods

```
x.append(2)
x.extend([3, 4])
x.insert(5, 6)
x.sort()
```

See Python Standard Library for more methods

x **id6**



- Draw lists as folders
  - because they are mutable objects
  - can omit type to save space

Does not work for strings

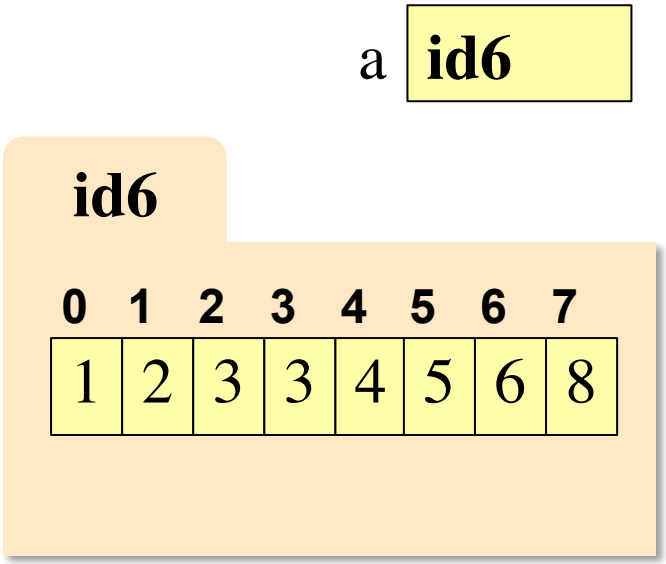
```
s = 'Hello World!'
s[0] = 'J'
```
ERROR

```
s.append('?')
```
ERROR

Lists vs. Objects With Attributes

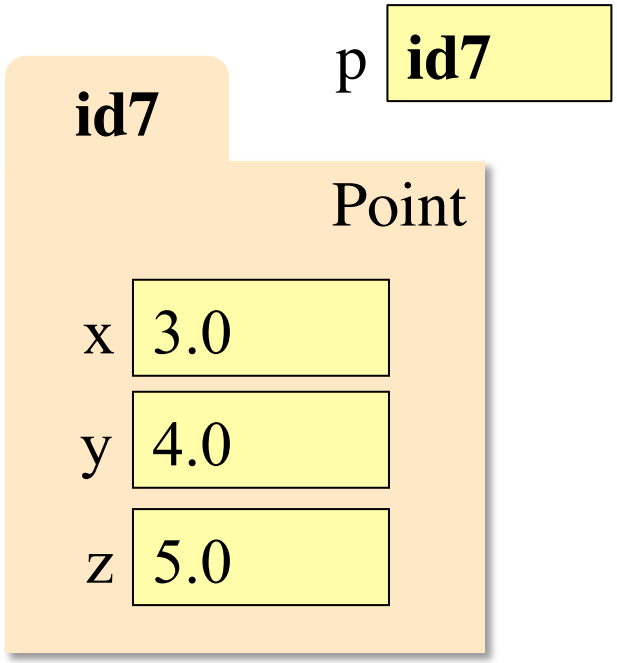
List

- Attributes are indexed
  - Example: `a[2]`



Point

- Attributes are named
  - Example: `p.x`



Clicker Exercise

- Execute the following:

```
>>> x = [5, 6, 5, 9, 10]
>>> x[3] = -1
>>> x.insert(1, 2)
```

- What is x[4]?

A: 10
B: 9
C: -1
D: **ERROR**
E: I don't know

- Execute the following:

```
>>> x = [5, 6, 5, 9, 10]
>>> y = x
>>> y[1] = 7
```

- What is x[1]?

A: 7
B: 5
C: 6
D: **ERROR**
E: I don't know

Lists and Functions: Swap

```
def swap(b, h, k):
    """Procedure swaps b[h] and b[k] in b
       Precondition: b is a mutable list, h
       and k are valid positions in the list"""
1   temp= b[h]
2   b[h]= b[k]
3   b[k]= temp
```

Swaps b[h] and b[k], because parameter b contains name of list.

x **id7**

id7

0	1	2	3	4	5	6	7
3	4	1	~~9~~	~~5~~	3	2	0
			9	5			

swap(x, 3, 4)

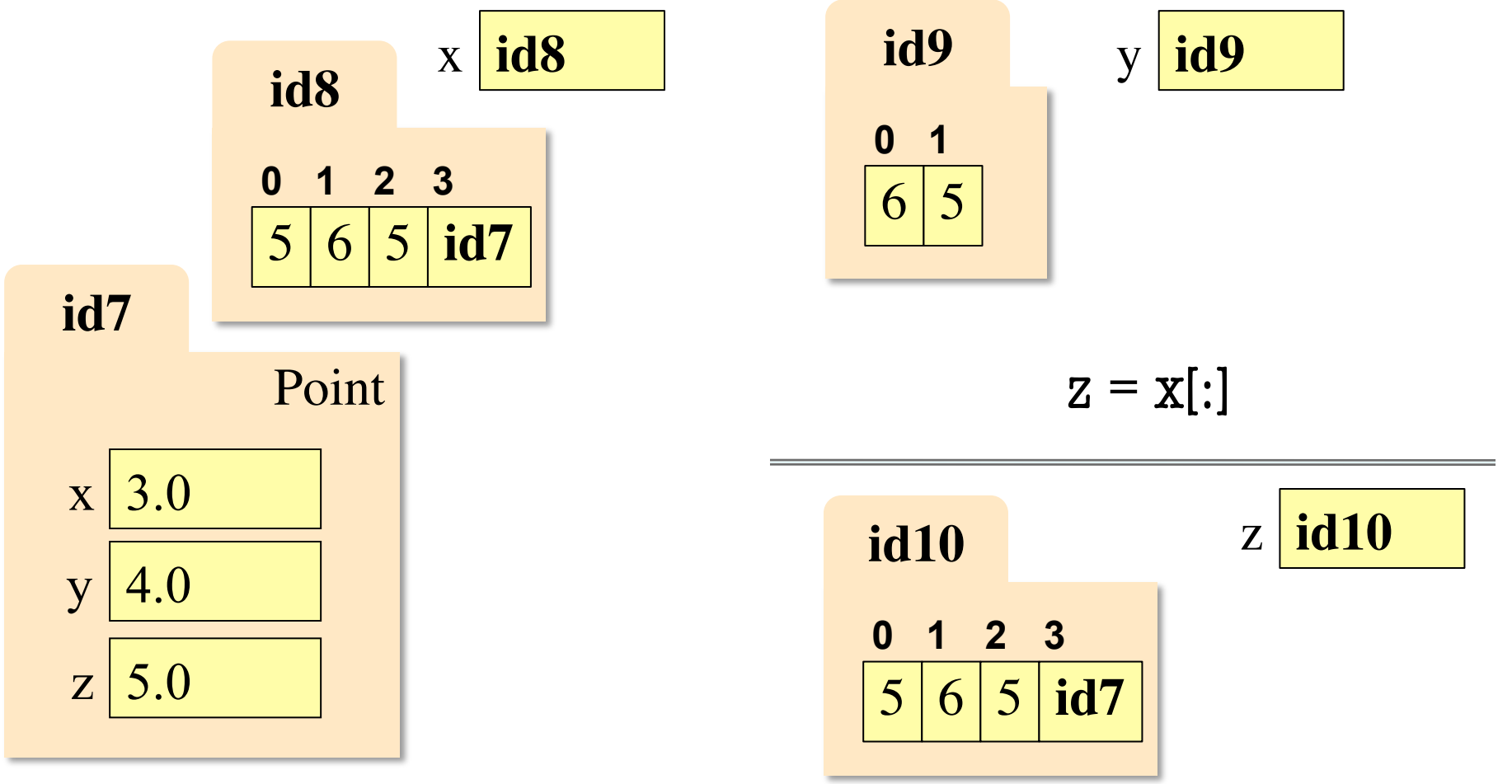
swap: ~~x~~ ✗✗✗

b **id7** h 3 k 4

Slicing Lists Makes Copies

`x = [5, 6, 5, Point(3,4,5)]`

`y = x[1:3]`



`z = x[:]`

Clicker Exercise

- Execute the following:

```
>>> x = [5, 6, 5, 9, 10]
>>> y = x[1:]
>>> y[0] = 7
```

- What is x[1]?

A: 7
B: 5
C: 6
D: **ERROR**
E: I don't know

- Execute the following:

```
>>> x = [5, Point(1, 2, 3), 6]
>>> y = x[1:]
>>> y[0].x = 7
```

- What is x[1].x?

A: 1
B: 5
C: 7
D: **ERROR**
E: I don't know

Lists and Strings: They go together like…

text.split(sep): return a list of the words in text (separated by sep, or whitespace by default)

sep.join(words): concatenate the items in the list of strings words, separated by sep.

```
text = 'Rama lama lama\nke ding a de ding a dong'
words = text.split()
lines = text.split('\n')
sep = '-'
print sep.join(words)
s = (sep.join(lines[0].split()) + ' ' + sep.join(lines[1].split()))
```

returns a list of two strings

[‘Rama’, ‘lama’, ‘lama’, ‘ke’, …]

‘Rama-lama-lama-ke…’

‘Rama-lama-lama ke-ding-a-de-ding-a-dong’

…a horse and carriage? Bread and butter?

Foreshadowing: Iteration

- To process a list, you often want to do the same thing to each item in the list. Two ways to do this:
  - The `map` function:

    `map(`⟨*function*⟩`,` ⟨*list*⟩`)`

    Call the function once for each item in the list, with the list item as the argument, and put the return values into a list.

  - The `for` statement:

    `for` ⟨*variable*⟩ `in` ⟨*list*⟩`:`
    ⟨*statements*⟩

    Execute the statements once for each item in the list, with the value of the variable set to the list item.

Tuples

strings:
immutable sequences of **characters**

lists:
mutable sequences of **any objects**

"tuple" generalizes "pair," "triple," "quadruple," …

tuples:
immutable sequences of **any objects**

- Tuples fall between strings and lists
  - write them with just commas: `42, 4.0, 'x'`
  - often enclosed in parentheses: `(42, 4.0, 'x')`

length 1: `(42,)`
length 0: `()`

Conventionally use lists for:
- long sequences
- homogeneous sequences
- variable length sequences

Conventionally use tuples for:
- short sequences
- heterogeneous sequences
- fixed length sequences