Discussion 03:
Sequences and Trees

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Agenda

1. Attendance
2. Midterm 1 Thoughts
3. Announcements
4. Check Your Understanding
5. Data Abstraction (fast)
6. Sequences
7. Trees (fast)

Attendance

Sign in at bit.do/jerrydisc

OR

Please put your name, SID, and email on the sign-in sheet.

Midterm 1 Thoughts

I will repeat this before (and after) every exam —

"One test will not define who you are and whether or not you'll be a successful computer scientist."

Please feel free to chat with me (or any other course staff) if you have any questions or concerns!

Announcements

- Midterm 1 on Gradescope: regrade requests by Sunday night

- HW 4 released and due Thursday

- HW 5 released and due next Tuesday

- Maps released and due 9/29, +1 pt. by 9/28

    - Proj party next Wednesday (details on website)

Check Your Understanding

1.

```
[[x for x in range(y)] for y in range(3)]
```

2.

```
def pairs_to_dict(pairs):
    """
    Convert a list of pairs into a dictionary.
    >>> p = [['c', 6], ['s', 1], ['c', 'a']]
    >>> pairs_to_dict(p)
    {'c': 'a', 's': 1}
    """
```

Data Abstraction

Focus on **what happens**, not how it happened

- **Abstract data type (ADT)** - represents an object/ thing in code. Abstract since we (as the user) don't need to know how it was built and how it works!

- **Constructor** - creates an ADT

- **Selector** - retrieve information from an ADT

What's the big deal?

I'll just break a data abstraction. What's the worst that could happen?

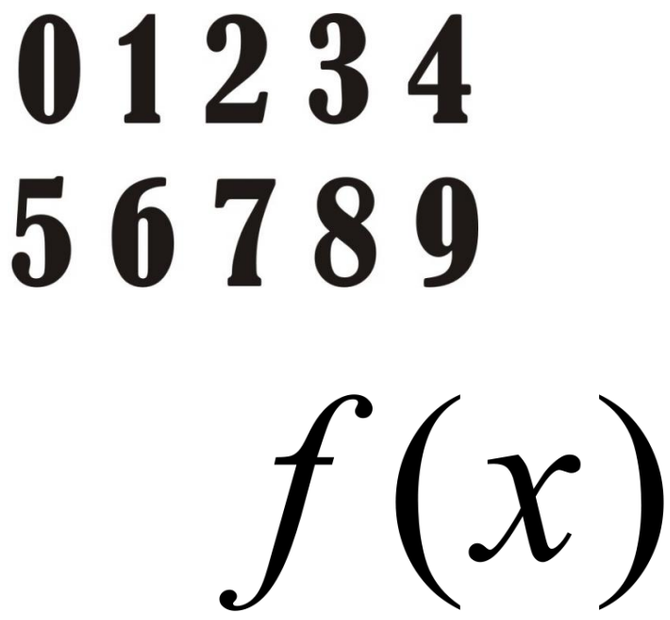
In all seriousness, consistency is important!

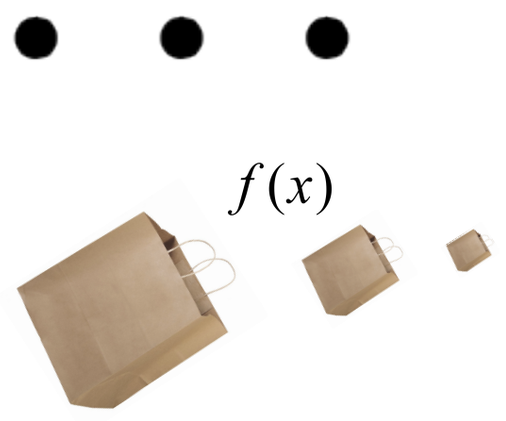
Sequences

Variables (names) generally referred to a single item

A **sequence** is a collection of many items

- Lists: Python's implementation of the abstraction





Lists

Length

Can easily retrieve the length of a list:

```
>>> x = [1, 2, 3]
>>> len(x)
3
>>> y = [x, 4, 5] # Does nesting matter?
>>> len(y)
3
```

Lists

Element Selection

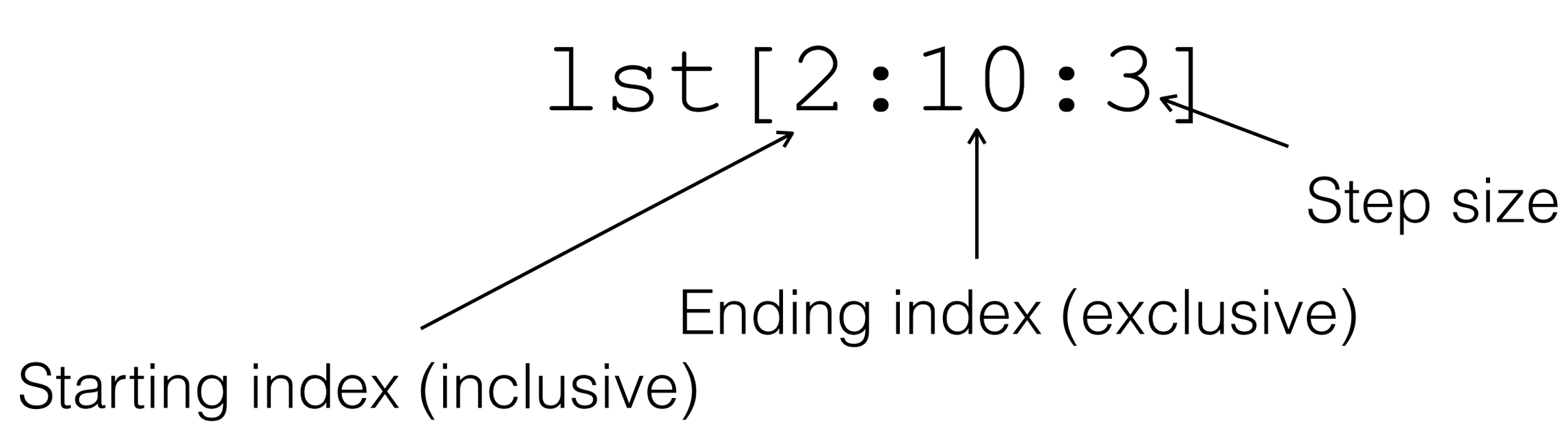
Get an item at an index using bracket notation

```
>>> x = [1, 2, 3]
>>> x[0]
1
>>> x[0] = 10
>>> x
[10, 2, 3]
```

Slicing

Important tool for generating sublists

Anatomy of a slice:



Excluding any part of the slice invokes the default value:
0 for start (positive step), len(lst) for end (positive step), 1 for step

Lists

Slicing Examples

```
>>> x = [1, 2, 3]
>>> x[0:2]
[1, 2]
>>> x[0:2] == x[:2]
True
>>> x[0:2:-1]
[]
>>> x[2:0:-1]
[3, 2]
```

Lists

Odds & Ends

`for` can be used to loop through lists

```
>>> x = [1, 2, 3]
>>> for elem in x: #elem can be any name
...     print(elem)
1
2
3
```

Lists

Odds & Ends

Check membership using `in`

```
>>> x = [1, 2, 3]
>>> 1 in x
True
>>> “bananas” in x
False
>>> 1 in [x]
False
```

Lists

Odds & Ends

`range` is a useful function that returns a sequence

```
>>> x = range(0, 3) # 0, 1, 2
>>> range(0, 3, 1) == range(3) # Like slicing?
True
>>> for n in x:
...   print(n)
0
1
2
```

Lists Questions

WWPD - Page 2, Q1

```
>>> a = [1, 5, 4, [2, 3], 3]
>>> print(a[0], a[-1])
1 3
>>> len(a)
5
>>> 2 in a
False
>>> 4 in a
True
>>> a[3][0]
2
```

Lists Questions

WWPD - Page 3, Q1

```
>>> a = [3, 1, 4, 2, 5, 3]
>>> a[1::2]
[1, 2, 3]
>>> a[:]
[3, 1, 4, 2, 5, 3]
>>> a[4:2]
[]
>>> a[1:-2]
[1, 4, 2]
>>> a[::-1]
[3, 5, 2, 4, 1, 3]
```

Lists

List Comprehension

Quick way of making lists by applying **expressions** to elements in **another sequence**

```
[<map exp> for <name> in <iter> if <filter>]
>>> [x for x in range(4)]
[0, 1, 2, 3]
>>> [x * 2 for x in range(4) if x % 2 == 1]
[2, 6]
```

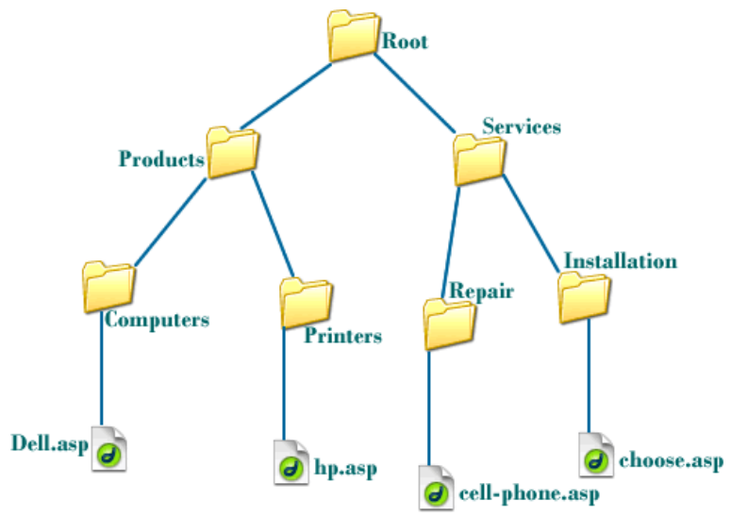
Trees

Trees

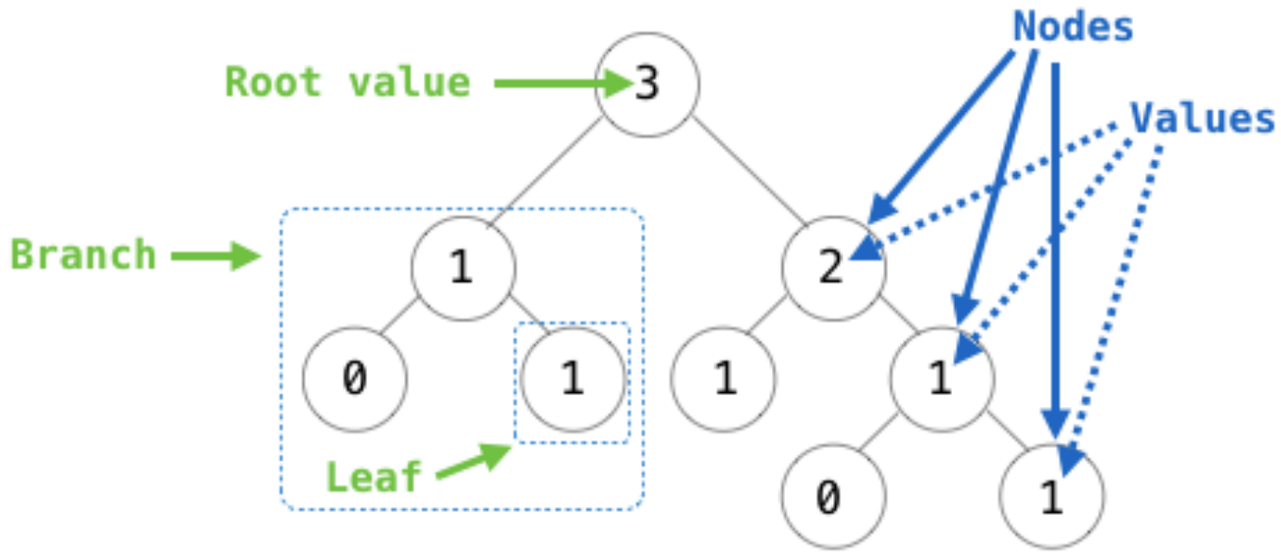
Storing things in order like a list is boring…

In real life, you **see trees everywhere!**

- Taking notes
- Directory structure on your computer
- Nature and stuff, I guess



Trees



Recursive description (**wooden trees**):

A **tree** has a **root** value and a list of **branches**

Each branch is a **tree**

A tree with zero branches is called a **leaf**

Relative description (**family trees**):

Each location in a tree is called a **node**

Each **node** has a **value**

One node can be the **parent**/**child** of another

People often refer to values by their locations: "*each parent is the sum of its children*"

Trees

Constructor:

```
tree(label, branches=[])
```

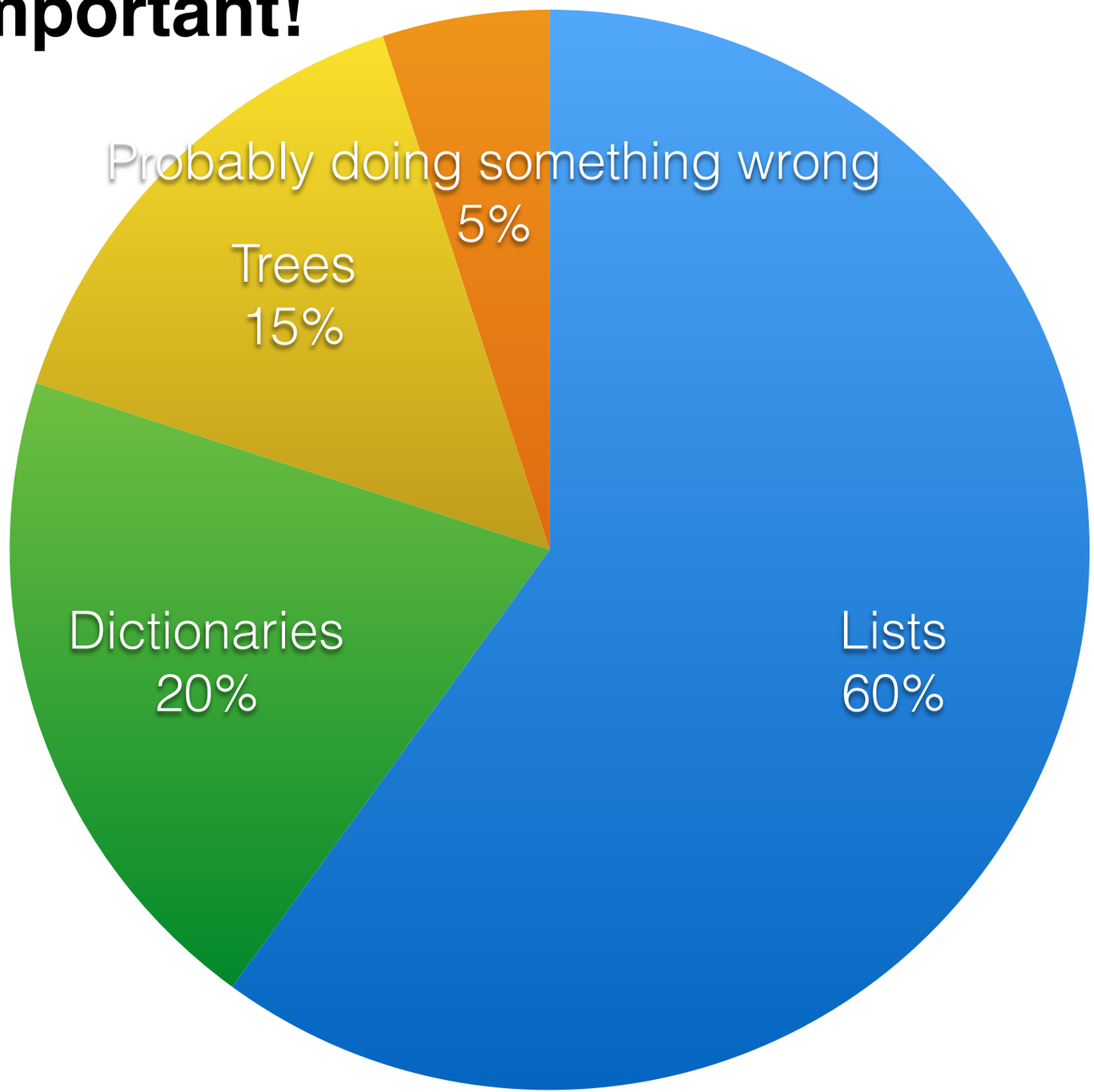
Selectors:

```
root(t), branches(t), is_leaf(t)
```

Why do these matter?

These sequences are important!

Data structures I use:*



*Numbers totally made up (kinda)