

# [30 I] Dictionaries

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# Learning Objectives Today

## Data structures

- definition
- motivation

## Dictionaries in Python

- creation, lookup
- updates, deletes

## When to use dictionaries over lists

- holes in the labels
- non-integer labels



# Today's Outline

Data Structures

Mappings

Dictionaries

Mutations: Updates, Deletes, and Inserts

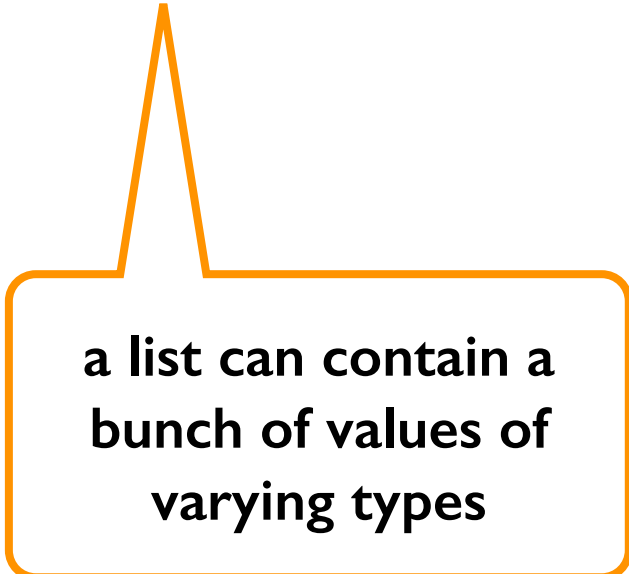
Coding examples

Vocabulary: a list is an example of  
a **data structure**

# Data Structures

Definition (from Wikipedia):

a **data structure** is a **collection of data values**,  
the **relationships** among them,  
and the functions or **operations**  
that can be applied to the data



a list can contain a  
bunch of values of  
varying types

# Data Structures

Definition (from Wikipedia):

a **data structure** is a **collection of data values**,  
the **relationships** among them,  
and the functions or **operations**  
that can be applied to the data

every value has an  
index, representing an  
order within the list

a list can contain a  
bunch of values of  
varying types

`L.sort()`, `len(L)`, `L.pop(0)`, `L.append(x)`,  
update, iterate (for loop), etc

# Data Structures

Definition (from Wikipedia):

a **data structure** is a **collection of data values**,  
the **relationships** among them,  
and the functions or **operations**  
that can be applied to the data

*suggested  
note-taking*

	values	relationships	operations
<b>list</b>	anything	ordered (0,1,...)	indexing, pop, len, index, slicing, in, iteration (for), ...
<b>set</b>	????	no ordering	in, ==
<b>dict</b>			
...			

# Motivation: lots of data

For loops:

- copy/paste is a pain
- don't know how many times to copy/paste before program runs

For data structures:

- creating many variables is a pain  
(imagine your program analyzes ten thousand values)
- don't know how many values you will have before program runs



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# Mappings

Common data structure approach:

- store many values
- give each value a label
- use labels to lookup values

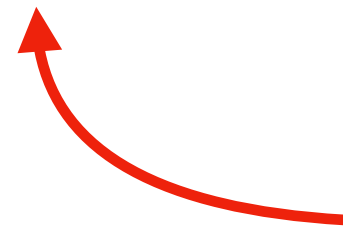
# Mappings

Common data structure approach:

- **store many values**
- give each value a label
- use labels to lookup values

List example:

nums = [300, 200, 400, 100]



we can have many values

# Mappings

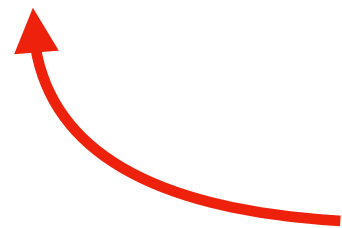
Common data structure approach:

- store many values
- **give each value a label**
- use labels to lookup values

List example:

nums = [300, 200, 400, 100]

**0      1      2      3**



the “labels” are indexes, which  
are implicitly attached to values

# Mappings

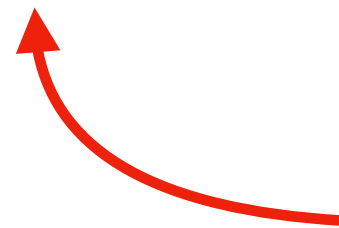
Common data structure approach:

- store many values
- give each value a label
- **use labels to lookup values**

List example:

```
nums = [300, 200, 400, 100]
```

```
x = nums[2]    # x = 400
```



we use the “label” (i.e., the index)  
to lookup the value (here 400)

# Mappings

Common data structure approach:

- store many values
- give each value a **label**
- use **labels** to lookup values

lists are an **inflexible** mapping structure, because we don't have control over **labels**

List example:

```
nums = [300, 200, 400, 100]
```

```
x = nums[2]    # x=400
```

*what if we don't want consecutive integers as labels? E.g., 0, 10, and 20 (but not between)?*

*what if we want to use strings as labels?*

# Today's Outline

Data Structures

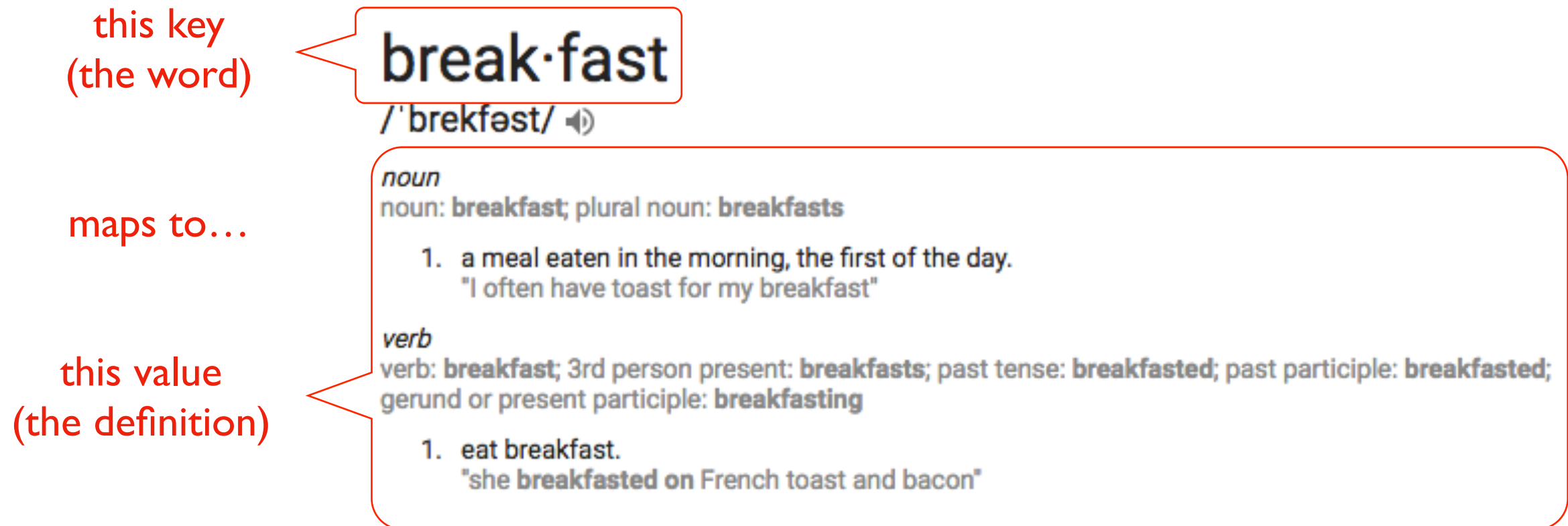
Mappings

Dictionary

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# Why call it a dictionary?



Python 3.6 and before: dicts don't have any order  
Python 3.7 and later: dicts DO have an order



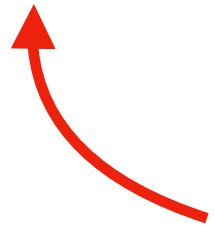
# Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

nums\_list[1] → 700



a dictionary would let us give 700 a label other than its position

# Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

```
nums_list[1] → 700
```



```
nums_dict = {"first":900, "second":700, "third":800}
```

we have the same values



# Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

nums\_list =  [900, 700, 800] 

nums\_list[1]  700

nums\_dict = { "first":900, "second":700, "third":800 }  

we use **curly braces** instead of **square brackets**

careful! curly braces are for both sets and dicts

# Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

0      1      2  
`nums_list = [900, 700, 800]`

`nums_list[1]` ➔ 700

`nums_dict = {"first": 900, "second": 700, "third": 800}`



we choose the label (called a key) for each value.  
Here the keys are the strings “first”, “second”, and “third”

we put a colon between each key and value

# Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

```
nums_list[1] ➔ 700
```

```
nums_dict = {"first":900, "second":700, "third":800}
```

```
nums_dict["second"] ➔ 700
```



lookup for a dict is like indexing for a list (label in brackets).  
Just use a key (that we chose) instead of an index.

# Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

```
nums_list[1] → 700
```

```
nums_dict = {"first":900, "second":700, "third":800}
```

```
nums_dict["first"] → 900
```



lookup for a dict is like indexing for a list (label in brackets).  
Just use a key (that we chose) instead of an index.

# Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

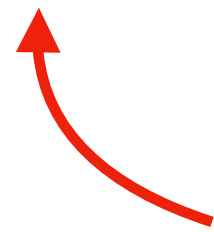
- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

```
nums_list[1] ➔ 700
```

```
nums_dict = {"first":900, "second":700, "third":800}
```

```
nums_dict["third"] ➔ 800
```



lookup for a dict is like indexing for a list (label in brackets).  
Just use a key (that we chose) instead of an index.

# Dictionary

Dictionaries map labels (called keys, rather than indexes) to values

- values can be anything we choose (as with lists)
- keys can be nearly anything we choose (must be immutable)

```
nums_list = [900, 700, 800]
```

```
nums_list[1] ➔ 700
```

```
nums_dict = {"first": 900, "second": 700, "third": 800}
```

```
nums_dict["third"] ➔ 800
```

	index labels	values
ordered ↓	0	900
	1	700
	2	600

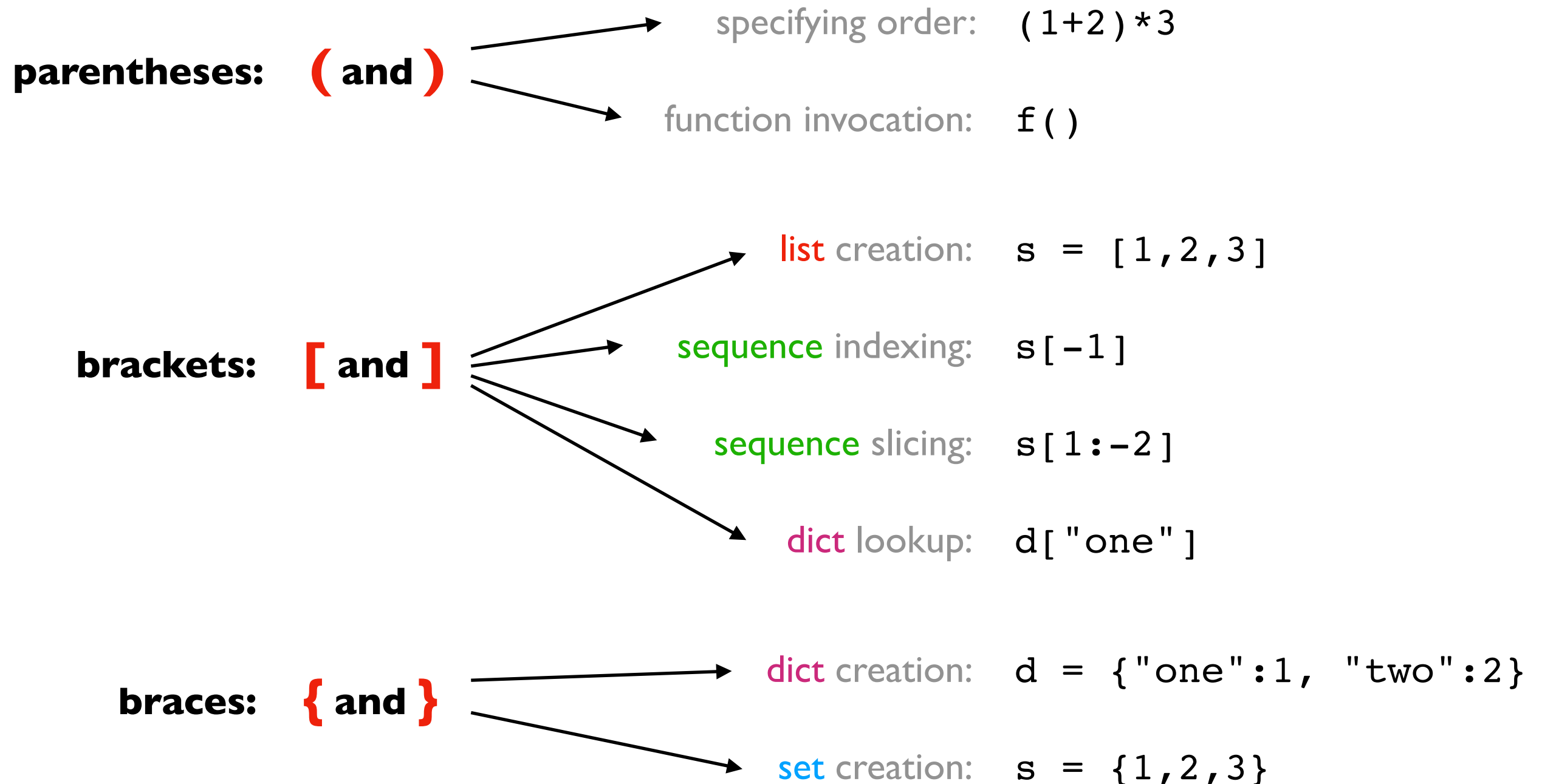
	key labels	values
insert order ↓	"third"	600
	"first"	900
	"second"	700



# A note on parenthetical characters

## common structures

## uses



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# Dictionary Updates

```
lst = ["zero", "ten", "not set"]
```

Before

```
lst[2] = "twenty"
```

Operation

```
['zero', 'ten', 'twenty']
```

After

---

```
d = {0: "zero", 10: "ten", 20: "not set"}
```

Before

```
d[20] = "twenty"
```

Operation

```
{0: 'zero', 20: 'twenty', 10: 'ten'}
```

After

dictionary updates look like list updates

# Dictionary Deletes

```
lst = ["zero", "ten", "not set"]
```

Before

```
old = lst.pop(-1)
```

Operation

```
['zero', 'ten'] # lst  
"not set"      # old
```

After

---

```
d = {0: "zero", 10: "ten", 20: "not set"}
```

Before

```
old = d.pop(20)
```

Operation

```
{0: 'zero', 10: 'ten'} # lst  
"not set"            # old
```

After

dictionary deletes look like list deletes

# Dictionary Inserts

```
lst = ["zero", "ten"]
```

Before

```
# doesn't work: lst[2] = ...  
lst.append("twenty")
```

Operation

```
['zero', 'ten', 'twenty']
```

After

---

```
d = {0: "zero", 10: "ten"}
```

Before

```
d[20] = "twenty"
```

Operation

```
{0: 'zero', 10: 'ten', 20: 'twenty'}
```

After

with a dict, if you try to set a value at a key,  
it automatically creates it (doesn't work w/ lists)

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# Demo 1: Score Keeping App

Goal: let users enter scores for various players

## Input:

- Commands: set score, lookup score, get highest

## Output:

- The champion and their score

## Example:

```
prompt> python scores.py
```

```
enter a cmd (type "help" for descriptions): set alice 10
```

```
enter a cmd (type "help" for descriptions): high
```

```
Alice: 10
```

```
enter a cmd (type "help" for descriptions): q
```

```
exiting
```



<https://www.google.com/url?sa=i&source=images&cd=&cad=rja&uact=8&ved=0ahUKEwi37NjD--bgAhUISIMKHUXvAnUQMwhrKAEwAQ&url=https%3A%2F%2Fwww.amazon.com%2FTachikara-Porta-Score-Flip-Scoreboard%2Fdp%2FB006VP8M26&psig=AOvVaw2vUf2TIDoEbyB-Qj9Bi7Ws&ust=1551736624958766&ictx=3&u>

# Demo 2: Print TORNADOS per Year

Goal: given a CSV of tornados,  
print how many occurred per year

## Input:

- A CSV

## Output:

- number per year

## Example:

```
prompt> python tornados.py
```

```
...
```

```
2015: 9
```

```
2016: 2
```

```
2017: 4
```



<https://en.wikipedia.org/wiki/Tornado>



# Demo 3: Wizard of Oz

Goal: count how often each word appears in the Wizard of Oz

## Input:

- Plaintext of book (from Project Gutenberg)

## Output:

- The count of each word



[https://en.wikipedia.org/wiki/The\\_Wizard\\_of\\_Oz\\_\(1939\\_film\)](https://en.wikipedia.org/wiki/The_Wizard_of_Oz_(1939_film))