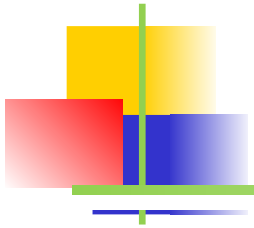

Fundamentos de Programação

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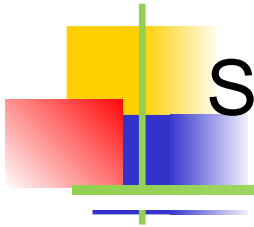
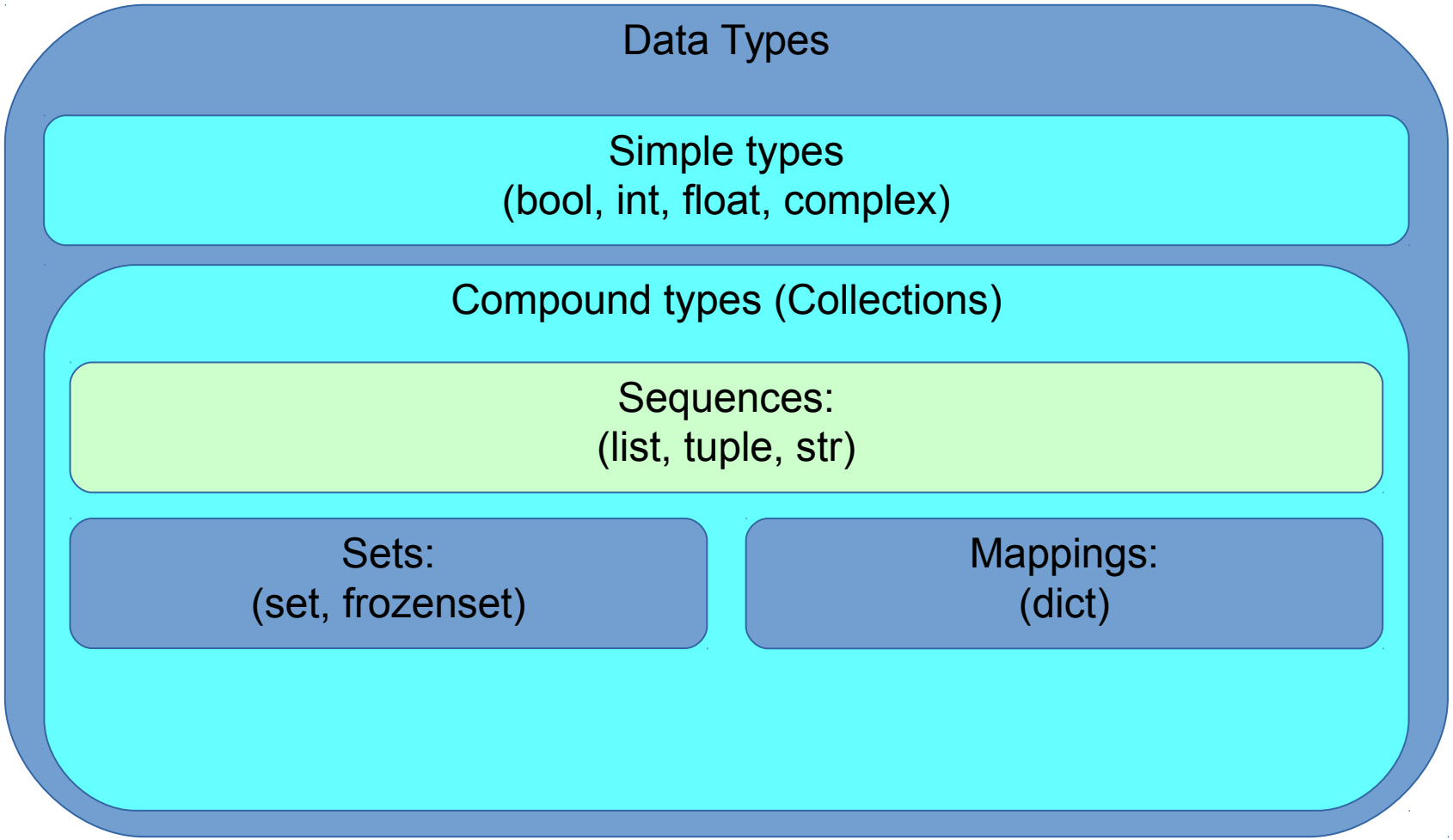


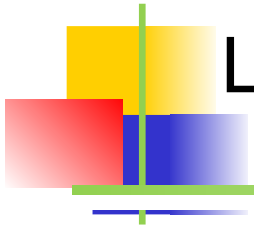
Summary

- Sequence types
  - Lists
  - Tuples
  - Strings

Sequences

- Python data types





Lists

- A **list** is a sequence of values of any type.
- The values in a list are called *elements* or sometimes *items*.
- List literals are written in brackets.

```
numbers = [10, 20, 30, 40]
fruits = ['banana', 'pear', 'orange']
things = ['spam', 2.0, 5, [1, 2]]  # a list inside!
empty = []      # an empty list
```

- Function `len` returns the *length* of a collection.

```
len(numbers)    #-> 4
len(things)     #-> 4
len(empty)      #-> 0
```

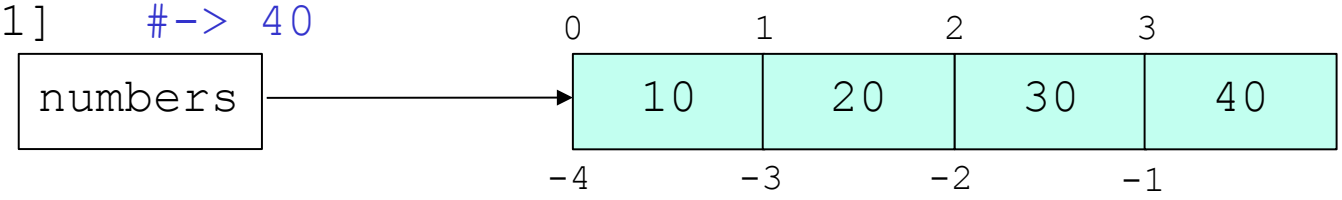
Indexing

- We can access each element of a sequence using the bracket operator and a value – the *index*.

```
numbers[0]      #-> 10          (index starts at 0)
fruits[2]       #-> 'orange'
```

- A negative index counts backward from the end.

```
numbers[-1]     #-> 40
```



- Any integer expression may be used as an index.

```
numbers[(6+1)%4]   #-> 40
```

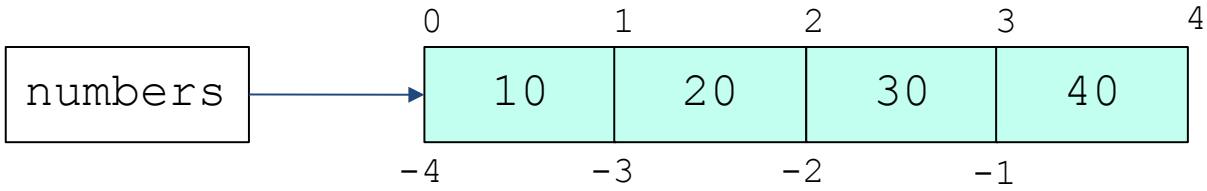
- Using an index outside the list bounds is an error.

```
numbers[4]      #-> IndexError
numbers[-5]     #-> IndexError
```

Slicing

- We can extract a *subsequence* using **slicing**.

```
numbers[1:3]    #-> [20, 30]
numbers[0:4:2]  #-> [10, 30] (step = 2)
numbers[2:2]    #-> []
```



- Negative indices may be used too.

```
numbers[-4:-2]  #-> [10, 20]
numbers[1:-1]   #-> [20, 30]
```

- Indices may be omitted for the start or end.

```
numbers[:2]  #-> [10, 20]
numbers[3:]  #-> [40]
numbers[:]   # a full copy of numbers
```

Traversing

- The most common way to traverse the elements of a sequence is with a **`for`** loop.

```
for f in fruits:
    print(f)
```

```
banana
pear
orange
```

- But sometimes we use the indices, e.g., when updating.

```
for i in range(len(numbers)):
    numbers[i] = numbers[i] * 2
```

- In this case, we could have used a **`while`** loop instead.

```
i = 0
while i < len(numbers):
    numbers[i] = numbers[i] * 2
    i += 1
```

Sequence operations and methods

- The + operator concatenates and * repeats sequences.

```
s = [1, 2, 3] + [7, 7]   #-> [1, 2, 3, 7, 7]
z = [0]*3                #-> [0, 0, 0]
```

- Operator **in** checks if an element is included in the sequence. Operator **not in** means the opposite.

```
7 in s        #-> True
4 not in s    #-> True
```

- Some methods allow finding and counting elements.

```
s.index(7)    #-> 3
s.count(7)    #-> 2
```

- Some built-in functions apply to sequences.

```
sum(s)    #-> 20
min(s), max(s)    #-> 1, 7
```

Lists are mutable

- Lists are **mutable**, i.e., we can change their contents.

```
numbers[1] = 99
numbers       #-> [10, 99, 20, 40]
```

- We can even change a sublist.

```
numbers[2:3] = [98, 97]
numbers       #-> [10, 99, 98, 97, 40]
```

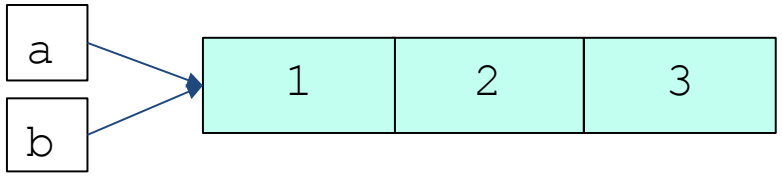
- Lists have several methods to change their contents.

```
z = [1, 2]
z.append(3)  # appends 3 to end of z → [1, 2, 3]
x = z.pop()  # z → [1, 2], x → 3
z.extend([4, 5])  # z → [1, 2, 4, 5]
z.insert(1, 6)  # z → [1, 6, 2, 4, 5]
x = z.pop(0)  # z → [6, 2, 4, 5], x → 1
```

Mutability and aliasing

- In Python, variables store ***references*** to objects.

```
a = [1, 2, 3]
b = a
# a and b refer to the same object!
# In other words, a and b are aliases.
```



- Object contents may change, but the object **is the same**!

```
b[0] = 9        # object referenced by b is modified
b               #-> [9, 2, 3]   (of course!)
a               #-> [9, 2, 3]   (do you get it?)
# This effect is known as aliasing (in computing).
```

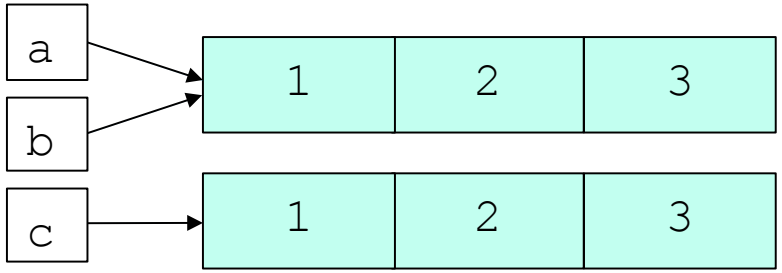
- We can confirm that `a` and `b` refer to the same object.

```
a is b      #-> True
```

Equality *versus* identity

- Objects may be *equal* without being *the same*!

```
a = [1, 2, 3]
b = a
c = a[:]
```



- We test **equality** with **==** (or **!=**).

```
a == b   #-> True        a != b   #-> False
a == c   #-> True        a != c   #-> False
```

- We test **identity** with **is** (or **is not**).

```
a is b   #-> True        a is not b   #-> False
a is c   #-> False       a is not c   #-> True
```

- Identity *implies* equality!
- Equality *does not imply* identity.

Identity and immutable types

- Don't use **`is`** when you mean ==!

```
[1, 2] == [1, 2]    #-> True
[1, 2] is [1, 2]    #-> False
"abx"[:2] == "ab"       #-> True
"abx"[:2] is "ab"       #-> False (probably...)
1000+1 is 1001          #-> False (probably...)
```

- For some immutable types, Python can sometimes detect equal values and share the same object to save space.

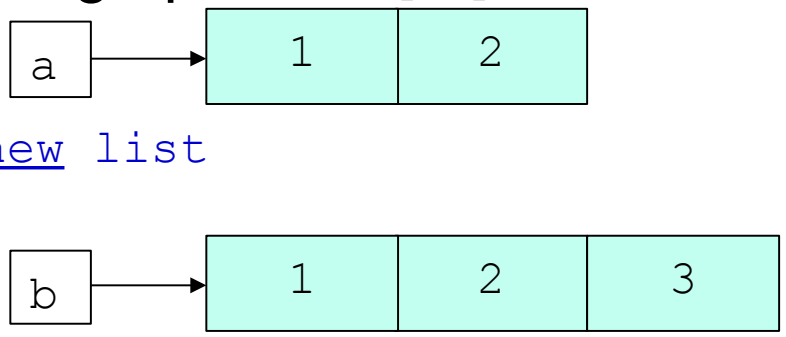
```
"ab" is "ab" #-> probably True, but ...
10+1 is 11   #-> probably True, but ...
```

- This is implementation-dependent, so do not rely on it!

Cloning

- Sometimes, we need to make a copy of an object, so we can change it without changing the original.
- To clone lists, we may use the slicing operator `[:]`.

```
a = [1, 2]
b = a[:]    # slicing creates a new list
b is a      #-> False
b.append(3)
```

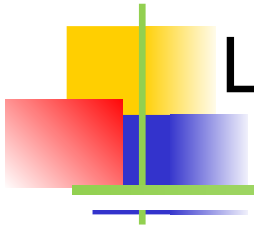


- We could also use the more general **`copy`** method.

```
b = a.copy() # clone a
b is a       #-> False
```

- Other mutable types (such as sets and dictionaries) also have a `copy` method.
- Immutable types (tuples, strings) don't need one.

Lists – more operations



- If we know the index of the element to delete, we can use `pop` - it modifies the list and returns the element that was removed.
- If we don't need the removed value, we can use the **`del`** operator.
- If we know the element to remove (but not the index), we can use `remove`.
- To remove more than one element, we can use **`del`** with a slice index.
- `sort` arranges the elements of the list from low to high.

Strings

- Strings are sequences of characters.
- String literals are delimited by single or double quotes.

```
fruit = 'orange'
```

- Like other sequences, we can use indexing and slicing.

```
letter = fruit[0] #-> 'o' (1st character)
len(fruit)        #-> 6   (length of string)
fruit[1:4]        #-> 'ran'
fruit[:-1]        #-> 'orang'
fruit[::-1]       #-> 'egnaro'
```

- We can also concatenate and repeat strings.

```
name = 'tom' + 'cat'  #-> 'tomcat'
gps = 2 * 'tom'       #-> 'tomtom'
```

Strings are immutable

- Unlike lists, strings in *Python* are **immutable**. Once a string is created it can't be modified.

```
fruit[0] = 'a'          #-> TypeError
```

- But we can create new strings by combining existing ones.

```
ape = fruit[:-1]+'utan'    #-> 'orangutan'
```

- Even methods that imply modification actually only return a new string object.

```
fruit.upper()              #-> 'ORANGE'
fruit.replace('a', 'A')    #-> 'orAnge'
fruit                      #-> 'orange' (not changed)
```

String - traversal

- One way to traverse strings is with a `for` loop:

```
fruit = 'banana'
for char in fruit:
    print(char)
```

- Another way:

```
index = 0
while index < len(fruit):
    letter = fruit[index]
    print(letter)
    index = index + 1
```

- Another example:

```
prefixes = 'JKLMNOPQ'
suffix = 'ack'
for letter in prefixes:
    print(letter + suffix)
```

Examples

- The following program counts the number of times the letter `'a'` appears in a string:

```
word = 'banana'; count = 0
for letter in word:
    if letter == 'a':
        count = count + 1
print(count)
```

- For strings, the **`in`** operator returns `True` iff the first string appears as a substring in the second:

```
for letter in word1:
    if letter in word2:
        print(letter)
```

More on strings

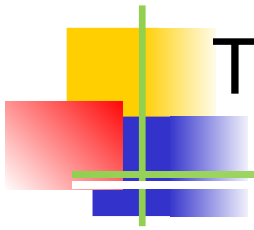
- The relational operators work on strings and other sequences.

```
if word < 'banana':
  print(word, 'comes before banana.')

elif word > 'banana':
  print(word, 'comes after banana.')

else:
  print ('the same’)
```

- Characters (letters, digits, punctuation) are stored as numeric codes (according to Unicode in python3).
  - `ord(c)` - returns the code of the character.
  - `chr(n)` - returns character represented by code `n`.
- String class has various built-in methods which allows to check for different classes of characters (`isalpha`, …).



Tuples

- A **tuple** is an immutable sequence of values of any type.
- The values are indexed by integers, like in lists. The important difference is that **tuples are immutable**.
- Syntactically, a tuple is a comma-separated list of values.

```
>>> t = 'a', 'b', 'c', 'd', 'e'
```

- It is common (and sometimes necessary) to enclose tuples in parentheses.

```
>>> t = ('a', 'b', 'c', 'd', 'e')
```

- To create a tuple with a single element, you have to include a final comma:

```
>>> t1 = ('a',)
>>> type(t1)     #->  <type 'tuple'>
```

Tuples (2)

- Another way to create a tuple is the built-in function `tuple`. With no argument, it creates an empty tuple:

```
t = tuple()          # t → ()
```

- If the argument is a sequence (string, list or tuple), the result is a tuple with the elements of the sequence:

```
t = tuple('ape')     # t → ('a', 'p', 'e')
t = tuple([1, 2])        # t → (1, 2)
```

- Most list operators also work on tuples.
- We can't modify the elements in a tuple, but we can replace one tuple with another.

```
t = t + (3, 4)           # t → (1, 2, 3, 4)
```

Lists and tuples

- The built-in function `zip` takes two or more sequences and generates a sequence of tuples, each containing one element from each sequence.

```
s = 'abc'
t = [4, 3, 2]
list(zip(s, t))  # → [('a', 4), ('b', 3), ('c', 2)]
```

- `enumerate` generates a sequence of (index, item) pairs.

```
enumerate('abc') # → (0, 'a'), (1, 'b'), (2, 'c')
```

- You can use tuple assignment in a `for` loop to traverse a sequence of tuples:

```
s = 'somestuff'
for i, c in enumerate(s):
    print(i, c)
```

Tuples – some more issues

- Tuples may be used as keys in dictionaries

```
directory[last, first] = number

for last, first in directory:

    print(first, last, directory[last,first])
```

- The **relational operators** work with tuples and other sequences.
- Python starts by comparing the first element from each sequence. If they are equal, it goes on to the next elements, and so on, until it finds elements that differ.

```
(0, 1, 2) < (0, 3, 4)     #-> True
```

- The `sorted` function and `sort` method work the same way. They sort primarily by first element, but in the case of a tie, they sort by second element, and so on.