[301] Strings

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Learning Objectives Today

String Basics
- Comparison
- Common functions

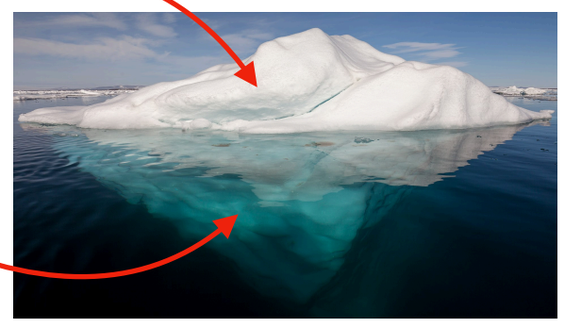
Chapter 8+9 of Think Python

Method Syntax

Sequences (a string is an example of a sequence)
- len
- indexing
- slicing
- for loop

what we've learned about strings so far

what we'll learn today



https://naturalfiberproducers.com/store-3/suri-silk-yarn/

Today's Outline

Comparison

String Methods

Sequences

Slicing

for loop over sequence

for loop over range

Comparison

1 < 2 → True

(because 1 is before 2)

200 < 100 → False

(because 200 is NOT before 100)

Comparison

1 < 2

True

(because 1 is before 2)

200 < 100

False

(because 200 is NOT before 100)

“cat” < “dog”

Python can also compare strings

Comparison

1 < 2 → True

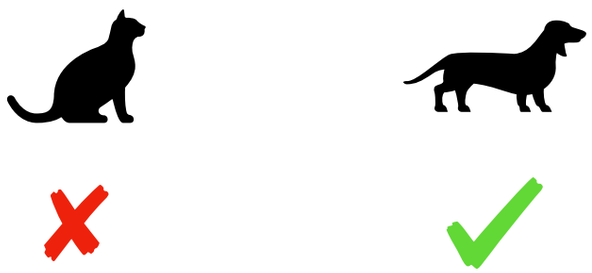
(because 1 is before 2)

200 < 100 → False

(because 200 is NOT before 100)

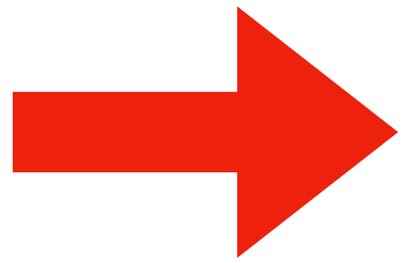
“cat” < “dog” → True

(because “cat” is before “dog” in the dictionary)



Python can also compare strings

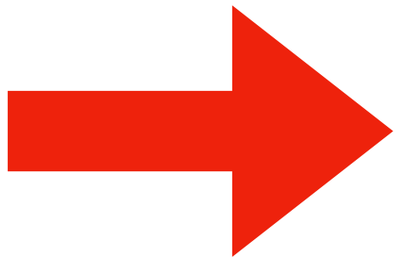
Comparison

“dog” < “doo doo”  ???

What about strings that start with the same letter?

Comparison

“dog” < “doo doo”

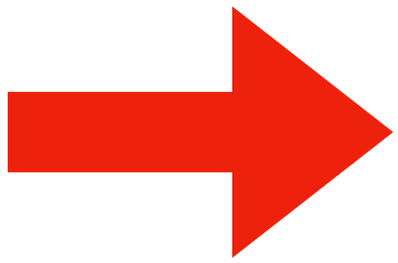


???

What about strings that start with the same letter?

Look for the first letter that’s different, and compare those.

Comparison

“dog” < “doo doo”  True

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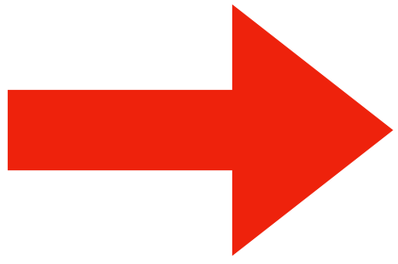


True

There are three gotchas:

1. case (upper vs. lower)
2. digits
3. prefixes

1. Case rules

“A” < “B” < “C” < “D” < … < “X” < “Y” < “Z” **makes sense**

“a” < “b” < “c” < “d” < … < “x” < “y” < “y” **makes sense**

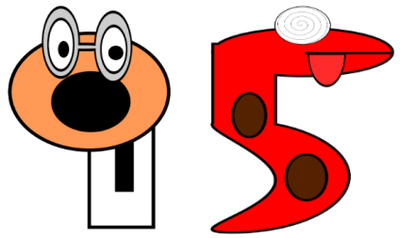
“C” < “b”

“Z” < “a”

(any upper case letter) < (any lower case letter)

less intuitive

2. Pesky digits



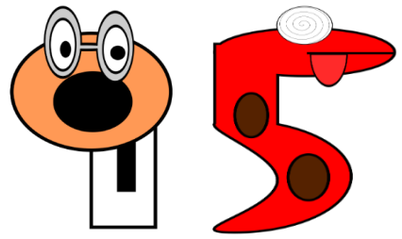
“0” < “1” **makes sense**

“8” < “9” **makes sense**

“11” < “2”
“100” < “15”

less intuitive

2. Pesky digits



“0” < “1” **makes sense**

“8” < “9” **makes sense**

“11” < “2”

“100” < “15”

remember to find the FIRST difference,
and base everything on that

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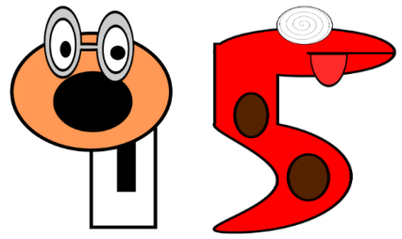

“0” < “1” **makes sense**

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remember to find the FIRST difference,
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3. Prefixes

```
String 1: bat
String 2: batman
```

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3. Prefixes

```
String 1: bat
String 2: batman
```

“” < “m”, so String 1 is first:

“bat” < “batman”

Do problem 1

Today's Outline

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for loop over sequence

for loop over range

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>>
```

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(msg)
```

len is a normal function,
it returns number
of characters in string.

It returns the number of
characters in a string

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(msg)
5
>>>
```

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(msg)
5
>>> msg.isdigit()
```

isdigit is a special function, called a method, that operates on the string in msg.

It returns a bool, whether the string is all digits

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(msg)
5
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```

```
str.isdigit(msg)
```

equivalent

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>>> msg = "hello"
>>> len(msg)
5
>>> msg.isdigit()
```

```
str.isdigit(msg)
```

type of msg

method in str
(similar to mod)

equivalent

isdigit is a special function,
called a method, that operates
on the string in msg.

It returns a bool, whether the
string is all digits

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(msg)
5
>>> msg.isdigit()
False
>>>
```

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(msg)
5
>>> msg.isdigit()
False
>>>
```

Both the regular function (len) and method (isdigit) are answering
a question about the string in msg, but we call them slightly differently

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(msg)
5
>>> msg.isdigit()
False
>>> msg.upper()
```

is upper a regular function or a method?

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(msg)
5
>>> msg.isdigit()
False
>>> msg.upper()
'HELLO'
```

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(msg)
5
>>> msg.isdigit()
False
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methods can be called with literal values as well as with values in variables

What is a method?

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>>> msg.isdigit()
False
>>> msg.upper()
'HELLO'
```

methods can be called with literal values as well as with values in variables

What is a method?

A special function associated variable/value

```
>>> msg = "hello"
>>> len(“301”)
3
>>> “301”.isdigit()
True
>>> “Hello World”.upper()
‘HELLO WORLD’
```

methods can be called with literal values as well as with values in variables

String Method	Purpose
s.upper()	change string to all upper case
s.lower()	opposite of upper()
s.strip()	remove whitespace (space, tab, etc) before and after
s.lstrip()	remove whitespace from left side
s.rstrip()	remove whitespace from right side
s.format(args…)	replace instances of “{}” in string with args
s.find(needle)	find index of needle in s
s.startswith(prefix)	does s begin with the given prefix?
s.endswith(suffix)	does s end with the given suffix?
s.replace(a, b)	replace all instances of a in s with b

Quick demos in interactive mode…

Do problem 2

Today's Outline

Comparison

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Sequences

In Python, data is often organized in sequences. A sequence is a series of items, in order

strings are the first example of a sequence we'll consider

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- grab a range of items (e.g., a substring) ← slicing
- use a fancy loop to iterate over every item ← for loops

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- grab an item (e.g., a character) from the middle ← **indexing [demos]**
- grab a range of items (e.g., a substring) ← slicing
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Do problem 3

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- grab a range of items (called a substring) ← **slicing**
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Today's Outline

Comparison

String Methods

Sequences

Slicing

for loop over sequence

for loop over range

Slicing

S: `P I Z Z A`

Code:

S = “PIZZA”

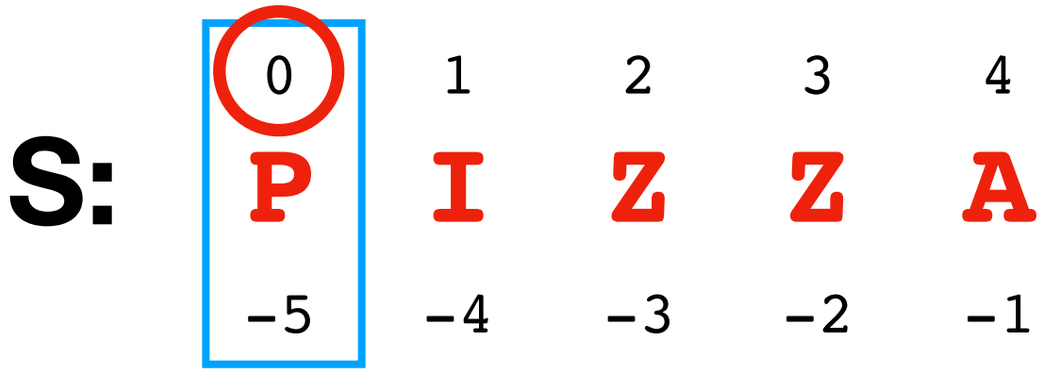
Slicing

	0	1	2	3	4
S:	**P**	**I**	**Z**	**Z**	**A**

Slicing

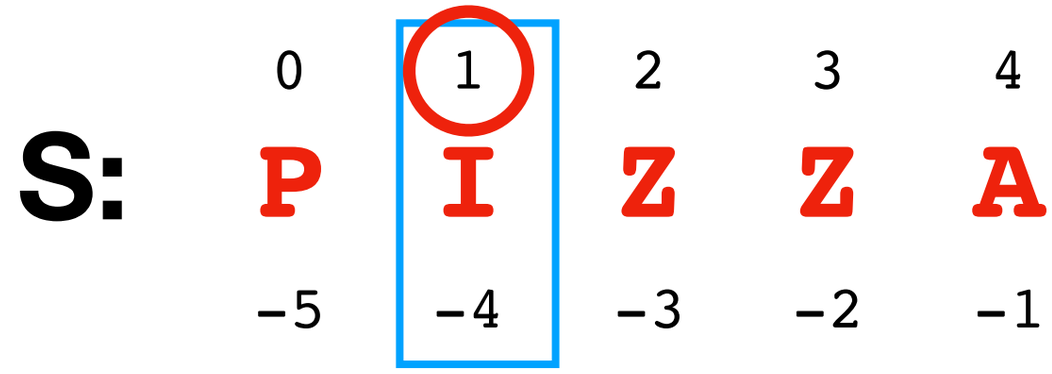
	0	1	2	3	4
S:	**P**	**I**	**Z**	**Z**	**A**
	-5	-4	-3	-2	-1

Slicing



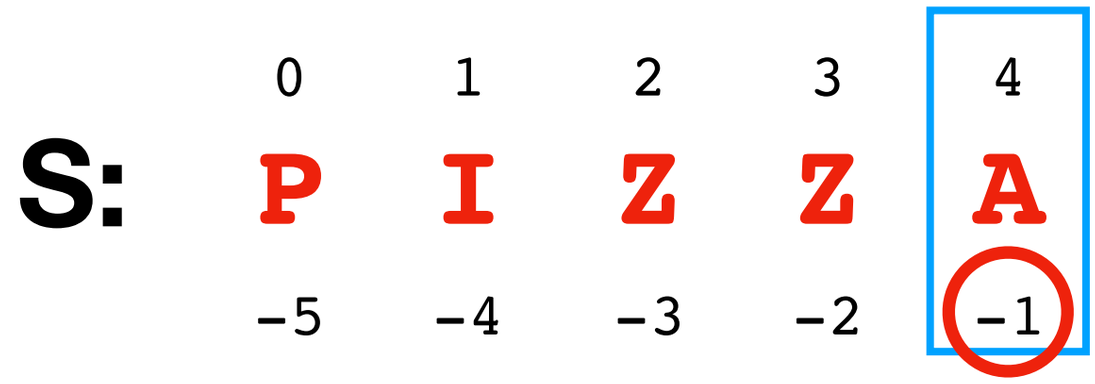
S[0] → **“P”**

Slicing



S[1] → “I”

Slicing



S[-1] → **“A”**

Slicing

	0	1	2	3	4
S:	**P**	**I**	**Z**	**Z**	**A**
	-5	-4	-3	-2	-1

S[???] → **“IZZ”**

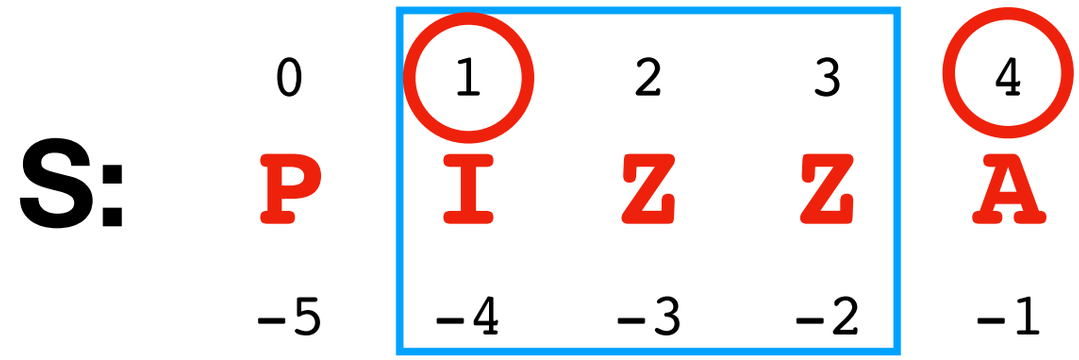
what to put if we want multiple letters, like “IZZ”?

Slicing

	0	1	2	3	4
S:	**P**	**I**	**Z**	**Z**	**A**
	-5	-4	-3	-2	-1

S[1:4] → **“IZZ”**

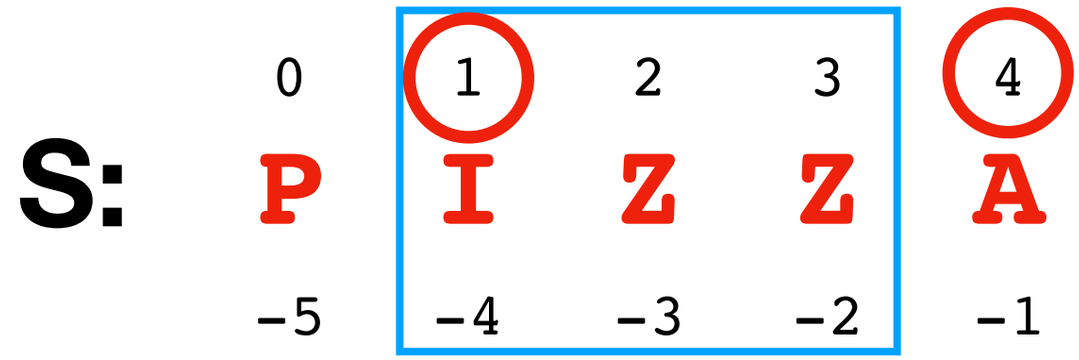
Slicing



S[1:4] → **“IZZ”**

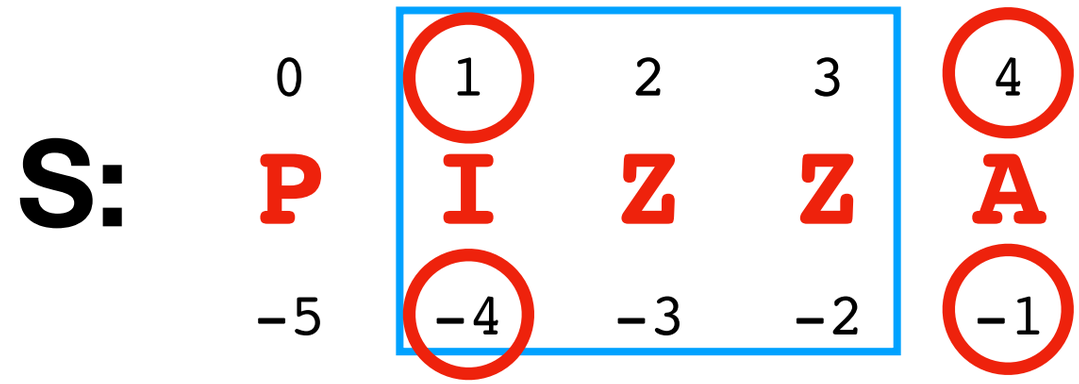
Slicing

start is “inclusive”
end is “exclusive”



S[1:4] → **“IZZ”**

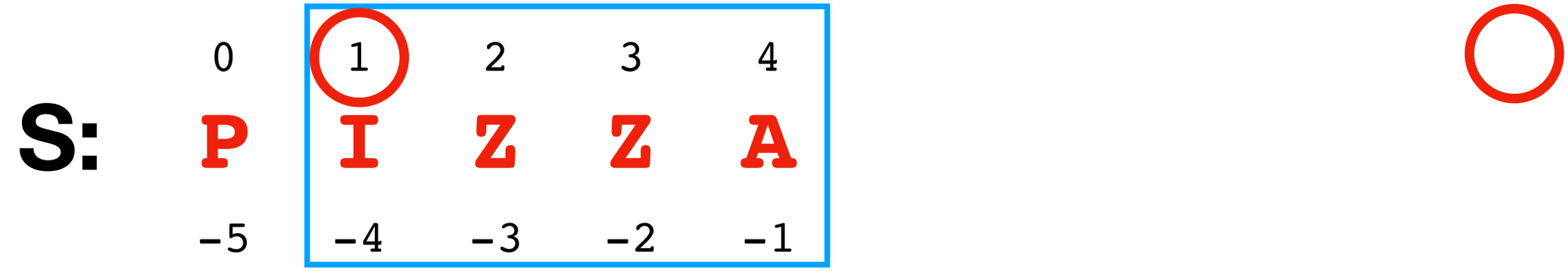
Slicing



S[1:4] → **“IZZ”**

Many different slices give the same result:
S[1:4] == S[1:-1] == S[-4:4] == S[-4:-1]

Slicing



S[1:100] → **“IZZA”**

Slices don’t complain about out-of-range numbers.
You just don’t get data for that part

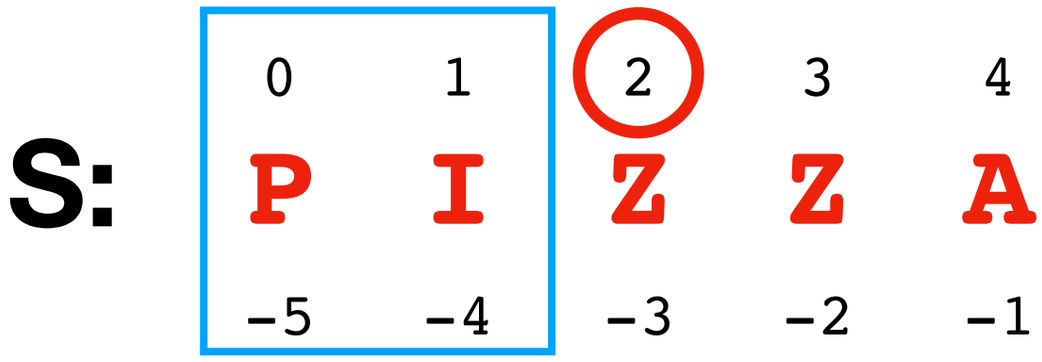
Slicing

	0	1	2	3	4
S:	**P**	**I**	**Z**	**Z**	**A**
	-5	-4	-3	-2	-1

S[50:100] → “”

Slices don’t complain about out-of-range numbers.
You just don’t get data for that part

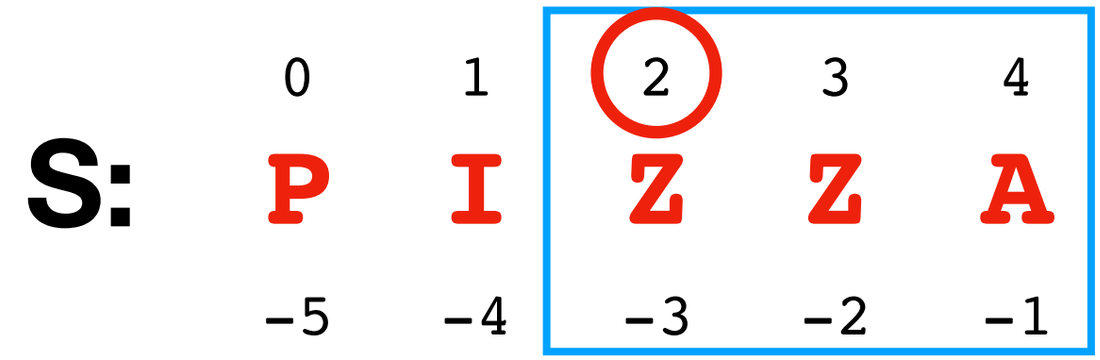
Slicing



S[: 2] → **“PI”**

Feel free to leave out one of the numbers in the slice

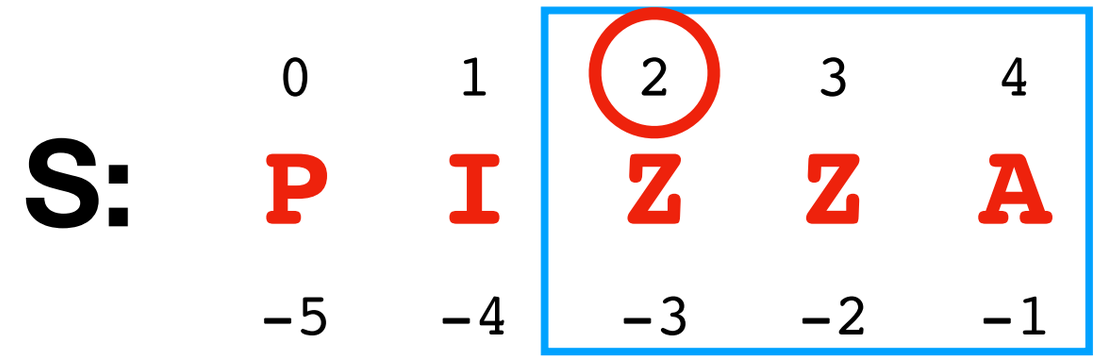
Slicing



S[2 :] → **“ZZA”**

Feel free to leave out one of the numbers in the slice

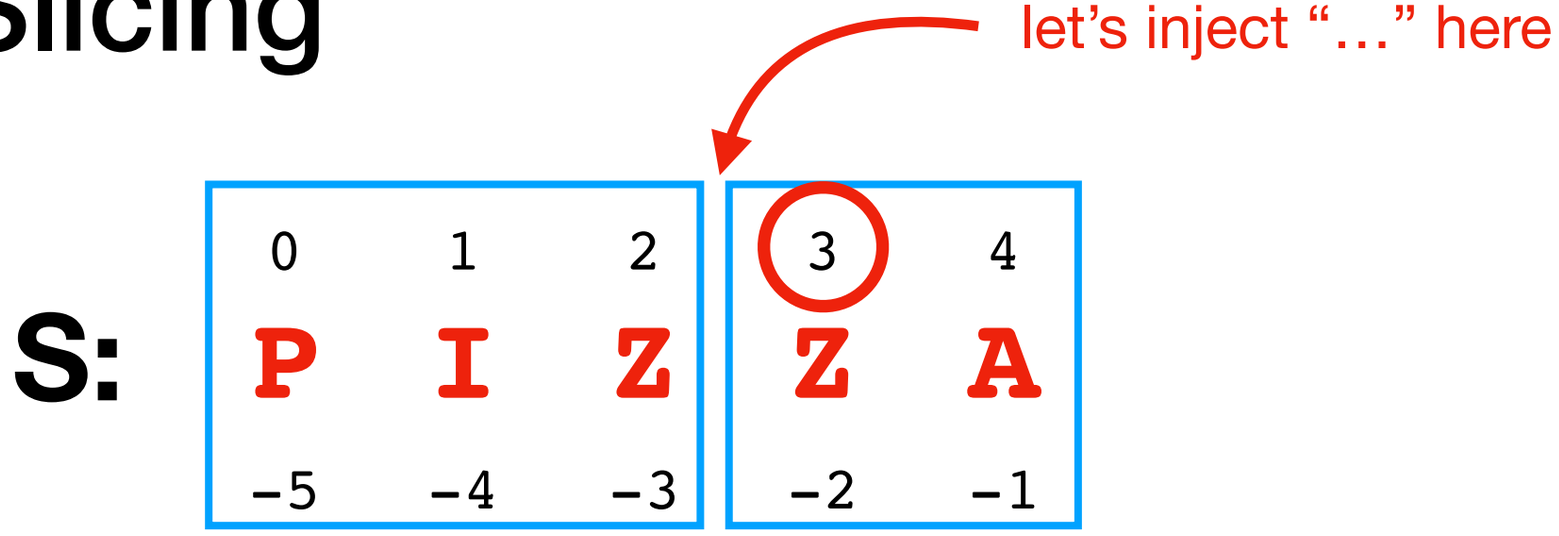
Slicing



S[2 :] → **“ZZA”**

Inclusive start and exclusive end makes it easier to split and inject things

Slicing



mid = 3

S[:3] + “…” + S[3:] → **“PIZ…ZA”**

Inclusive start and exclusive end makes it easier to split and inject things

Do problem 4

Sequences

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Today's Outline

Comparison

String Methods

Sequences

Slicing

for loop over sequence

for loop over range

Motivation

```
msg = "hello"

# let’s say we want to print
# each letter on its own line
```

Motivation

```
msg = "hello"

i = ???
while i < ???:
    ???
    i += ???
```

Motivation

```
msg = "hello"

i = 0
while i < ???:
    ???
    i += ???
```

indexing starts at 0, so msg[0] is ‘h’,
so we want to start i at 0

Motivation

```
msg = "hello"

i = 0
while i < ???:
    ???
    i += 1
```

indexing starts at 0, so msg[0] is ‘h’,
so we want to start i at 0

we don’t want to skip any letters

Motivation

```
msg = "hello"

i = 0
while i < len(msg):
    ???
    i += 1
```

indexing starts at 0, so msg[0] is ‘h’, so we want to start i at 0

last letter (o) has index 4, or len(msg)-1

we don’t want to skip any letters

Motivation

```
msg = "hello"

i = 0
while i < len(msg):
    ???
    i += 1
```

Motivation

```
msg = "hello"

i = 0
while i < len(msg):
    letter = msg[i]
    ???
    i += 1
```

Motivation

```
msg = "hello"

i = 0
while i < len(msg):
    letter = msg[i]
    print(letter)
    i += 1
```

this is the only interesting part
(we just want to print each letter!)

Motivation

```
msg = "hello"

i = 0
while i < len(msg):
    letter = msg[i]
    print(letter)
    i += 1
```

this is the only interesting part
(we just want to print each letter!)

Code like this for sequences is so common
that Python provides an easier way, with the **for loop**

while vs. for

while loop

```
msg = "hello"

i = 0
while i < len(msg):
    letter = msg[i]
    print(letter)
    i += 1
```

while vs. for

while loop

```
msg = "hello"

i = 0
while i < len(msg):
    letter = msg[i]
    print(letter)
    i += 1
```

for loop

```
for letter in msg:
    print(letter)
```

they do the same thing!

for syntax

for loop

```
for letter in msg:
    print(letter)
```

basic syntax always used

for syntax

for loop

```
for letter in msg:
    print(letter)
```

automatically initialized to a different item on each iteration ("h" on 1st, "e" on 2nd, etc)

the sequence (e.g., "hello")

specify a variable name to use inside the loop, and the sequence you want to loop over

for syntax

do PythonTutor example

for loop

```
for letter in msg:
    print(letter)
```

automatically initialized to a different item on each iteration ("h" on 1st, "e" on 2nd, etc)

the sequence (e.g., "hello")

specify a variable name to use inside the loop, and the sequence you want to loop over

Do problem 5

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for loop over sequence

for loop over range

for with range

```
msg = “01234”

for item in msg:
    print(item * 3)
```

Output:

000
111
222
333
444

for with range

```
msg = “01234”

for item in msg:
    print(item * 3)
```

Output:
000
111
222
333
444

what if we want to iterate over the integers
0 to 4 (instead of string digits “0” to “4”)?

for with range

~~msg = “01234”~~

```
for item in msg:
    print(item * 3)
```

Output:

what if we want to iterate over the integers
0 to 4 (instead of string digits “0” to “4”)?

for with range

```
for item in range(5):
    print(item * 3)
```

Output:

```
0
3
6
9
12
```

what if we want to iterate over the integers
0 to 4 (instead of string digits “0” to “4”)?

for with range

```
for item in range(5):
    print(item * 3)
```

Output:

0
3
6
9
12

using range(N) with a for loop will iterate with these values for item:
0, 1, 2, …, N-2, N-1

Example

Hypothetically… Let's say somebody gave you a bunch of hurricanes that are each given an index, and you're searching one with a given name.

Example

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```
N = project.getNumRecords()
```

Example

Hypothetically… Let's say somebody gave you a bunch of hurricanes that are each given an index, and you're searching one with a given name.

```
N = project.getNumRecords()
```

```
for i in range(N):
    print(i)
```

Output:

0
1
2
…
527
528

Example

Hypothetically… Let's say somebody gave you a bunch of hurricanes that are each given an index, and you're searching one with a given name.

```
N = project.getNumRecords()

for i in range(N):
    name = project.getName(i)
    print(name)
```

Output:

HEIDI
OLAF
TINA
…
GAIL
KENNETH

Example

Hypothetically… Let's say somebody gave you a bunch of hurricanes that are each given an index, and you're searching one with a given name.

```
target = "OLAF"
N = project.getNumRecords()

for i in range(N):
    name = project.getName(i)
    print(name)
```

Output:

HEIDI
OLAF
TINA
…
GAIL
KENNETH

Example

Hypothetically… Let's say somebody gave you a bunch of hurricanes that are each given an index, and you're searching one with a given name.

```
target = “OLAF”
N = project.getNumRecords()

for i in range(N):
    name = project.getName(i)
    if name == target:
        print(“found ” + name)
```

Output:
found OLAF

Do problem 6