CSCI 141

Lecture 17
String Manipulation

Happenings

CS Mentors Present: GITHUB Pages Workshop
Tuesday, November 5th 5:00 PM CF 165

Tech Talk: Pacific Northwest National Labs (PNNL)
Tabling Wednesday, Nov 6th 10:00-3:30 PM CF 4th Floor Foyer
Tech Talk Wednesday, Nov 6th 5:00-6:00 PM CF 115

ACM Hosts: Fast Enterprises
Career Prep Presentation Wednesday, Nov 6th 6:00-7:00 PM CF 316

Group Advising Session for CS Premajors
Thursday, November 7th 3:00-4:30 PM

Announcements

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- Midterm grades are out - see Canvas announcement for full details.

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  - Review your exam on Gradescope by Wednesday night for 2 bonus points on your exam score
  - If you do better on the final, it will replace your midterm grade.

Feedback Survey Results

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Lecture Pace

On average, how would you describe the pace of lectures?

Way too slow	3 respondents	2 %	
Somewhat too slow	31 respondents	18 %	
Just right	85 respondents	49 %	
Somewhat too fast	49 respondents	28 %	
Way too fast	4 respondents	2 %	

Feedback Survey Results

QOTD Review

1	Not helpful at all	1 respondents	1 %	
2		17 respondents	10 %	
3		42 respondents	24 %	
4		64 respondents	37 %	
5	Extremely helpful	48 respondents	28 %	

What shouldn't change?

Common themes, approximately in order of frequency:

- QOTDs
- In-class demos
- Socrative

What should change?

Common themes, approximately in order of frequency:

- Reviewing the QOTD is helpful but takes too much time, so new material is rushed.
- A3 was too hard; I gave too little guidance.
- Demos are helpful, often more so than slides.
- You need more in-class practice, especially coding on paper.

What am I doing about it?

Reviewing the QOTD is helpful but takes too much time, so new material is rushed.

- Short term: Spend less time on the QOTD
- Short term experiment: Written explanations of QOTD
- Long term: Video explanations of QOTD

What am I doing about it?

A3 was too hard; I gave too little guidance.

- Short term: Friday's lecture was all about how to approach A4.

- Long term: Adjust A3 difficulty and give more tips for how to approach each problem.

What am I doing about it?

Demos are helpful, often more so than slides.

You need more in-class practice, especially coding on paper.

- Strive to make slides more concise, talk a little less, and allow time for:
  - More frequent demos with more examples per demo.
  - More in-class exercises, including on-paper coding.

Other

- Many people don't like spending class time answering out-of-scope questions.
- Many people do not like taking CS exams on paper.
- Many people would like me to go over assignment solutions.

Goals

- Review what we know already about strings:
  - the `str` type, `+` and `*` operators, `len` function
- Know how to iterate over tuples and strings using `for` loops
- Know how to index into a string
- Know how Python interprets negative indices into strings.
- Know how to use slicing to get substrings

QOTD

```
import math
def square(x):
    return x ** 2
```

Which of the following are local variables belonging to the `discriminant` function?

`x, a, b, c, disc, b2`

```
def quadratic(a, b, c):
    disc = discriminant(a, b, c)
    return (-b + disc) / (2 * a)

def discriminant(a, b, c):
    b2 = square(b)
    return math.sqrt(b2 - 4 * a * c)

print(quadratic(4, 6, 2))
```

Last time: tuples

- A tuple is a sequence of values, optionally enclosed in parens.

(of any types!)

```
(1, 4, “Mufasa”)
```

- You can “pack” and “unpack” them using assignment statements:

```
v = (1, 4, "Mufasa") # "packing"

(a, b, c) = v # "unpacking"
```

QOTD

Run the following code. If a line causes an error, skip it and continue execution. Which lines, if any, cause errors?

```
1    a, b, c = 6, 4, 2
2    (z, x) = c, b
3    print((x, z))
4    v = (x, z, c)
5    print(v)
6    a, b = v
```

QOTD

What does line 5 print?

```
1    a, b, c = 6, 4, 2
2    (z, x) = c, b
3    print((x, z))
4    v = (x, z, c)
5    print(v)
6    a, b = v
```

A. (2, 4, 2)
B. (2, 2, 4)
C. (6, 4, 2)
D. (4, 2, 2)
E. (4, 4, 2)

fun fact:

Tuples are sequences,

so they can be used in `for` loops just like lists and ranges.

These two loops do the same thing:

```
for number in [1, 3]:
    print(number, end=" ")
```

```
for number in (1, 3):
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```
for number in (1, 3):
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```

Exercise: write a `for` loop that uses a `range` to print the same thing.

Today: Strings

Don’t we already know about strings?

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```
type("hello")
```

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```
type("hello")    # => <class ‘str’>
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print("Hello")
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type("hello")    # => <class ‘str’>
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print("Hello")    # prints Hello to the console
```

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```
type("hello")    # => <class ‘str’>

print("Hello")   # prints Hello to the console

"Hello" + “World"
```

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type("hello")    # => <class ‘str’>

print("Hello")   # prints Hello to the console

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```

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len("abc")
```

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```
type("hello")    # => <class ‘str’>

print("Hello")   # prints Hello to the console

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len("abc")         # => 3
```

Today: Strings

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```
type("hello")    # => <class ‘str’>

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"Hello" + “World"  # => “HelloWorld”

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"na" * 16 + " Batman!"
```

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type("hello")    # => <class ‘str’>

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len("abc")         # => 3

"na" * 16 + " Batman!"

# => …
```

Today: Strings

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type("hello")    # => <class ‘str’>

print("Hello")   # prints Hello to the console

"Hello" + “World"  # => “HelloWorld”

len("abc")         # => 3

"na" * 16 + " Batman!"

# => …"nanananananananananananananananana Batman!"
```

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def house_number(address_line):
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        the given address line.
        Examples:
            house_number("1600 Pennsylvania Ave")
            => 1600
```

Strings: What else is there?

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def house_number(address_line):
    """ Return the house number portion of
        the given address line.
        Examples:
            house_number("1600 Pennsylvania Ave")
              => 1600
            house_number("221B Baker St")
              => 221
    """
```

Strings: What else is there?

```
def house_number(address_line):
    """ Return the house number portion of
        the given address line.
        Examples:
            house_number("1600 Pennsylvania Ave")
              => 1600
            house_number("221B Baker St")
              => 221
    """
    # ????
    return result
```

Strings: What else is there?

```
def remove_comments(string):
    """ Return a copy of string, but with
        all characters starting with and following
        the first instance of '#' emoved. If there
        is no # in the string, return input unchanged.
    """
```

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```

fun fact:

Strings are sequences,

so they can be used in for loops just like lists and ranges.

Check this out:

```
for letter in "Bellingham":
    print(letter, "-", sep="", end="")
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Demo?

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Check this out:

```
for letter in "Bellingham":
    print(letter, "-", sep="", end="")
```

What does this print?

A. `Bellingham`
B. `B-e-l-l-i-n-g-h-a-m`
C. `-B-e-l-l-i-n-g-h-a-m`
D. `B-e-l-l-i-n-g-h-a-m-`

Exercise (worksheet #1)

Write a function that **prints** a string with all vowels removed.

```
def remove_vowels(string):
    """ Print string, but with no vowels.
        Don't count y as a vowel. """
```

Exercise (worksheet #1)

Write a function that **prints** a string with all vowels removed.

```
def remove_vowels(string):
    """ Print string, but with no vowels.
        Don't count y as a vowel. """
```

Possible modification: Return the result instead of printing it.

Indexing into Strings

Strings are collections of individual characters.
We can get access to an individual character by index.

```
outlook = “Winter is coming”
```

How is this stored in memory?

Indexing into Strings

(just smaller strings!)

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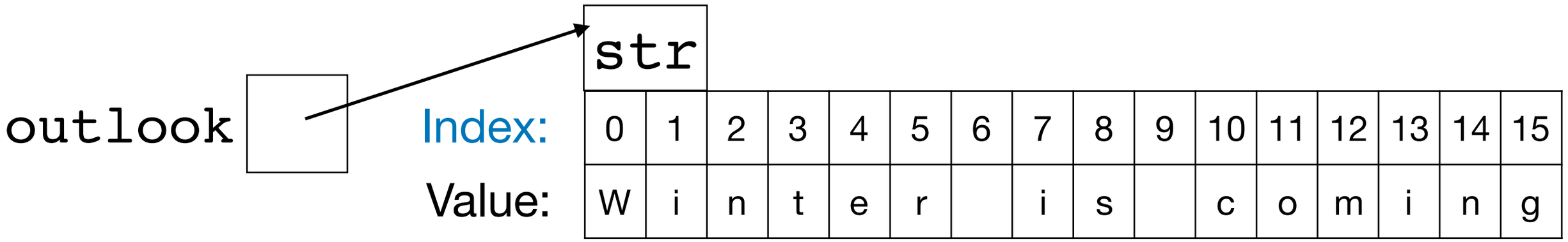

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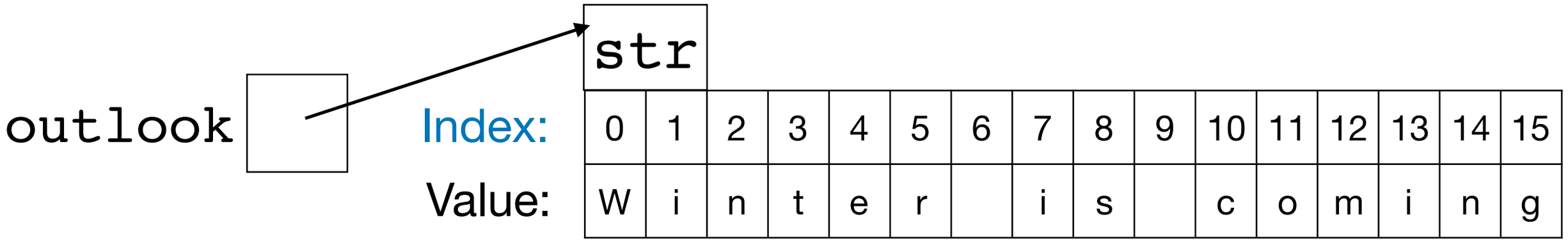

Indices in Python begin at 0.

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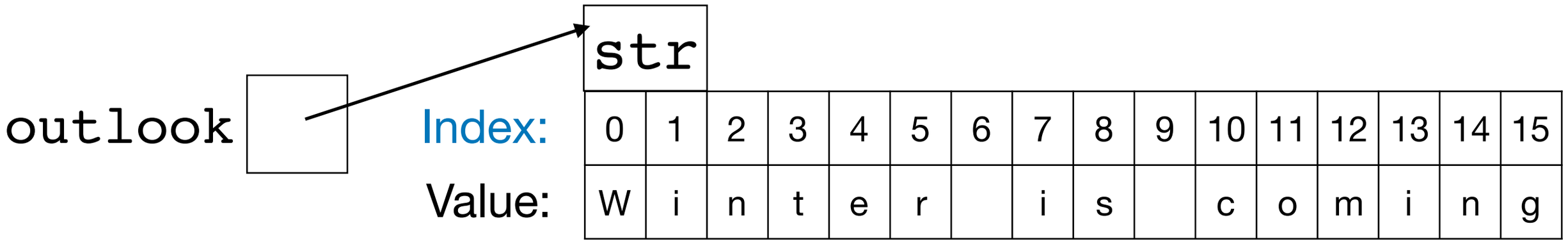

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Syntax:

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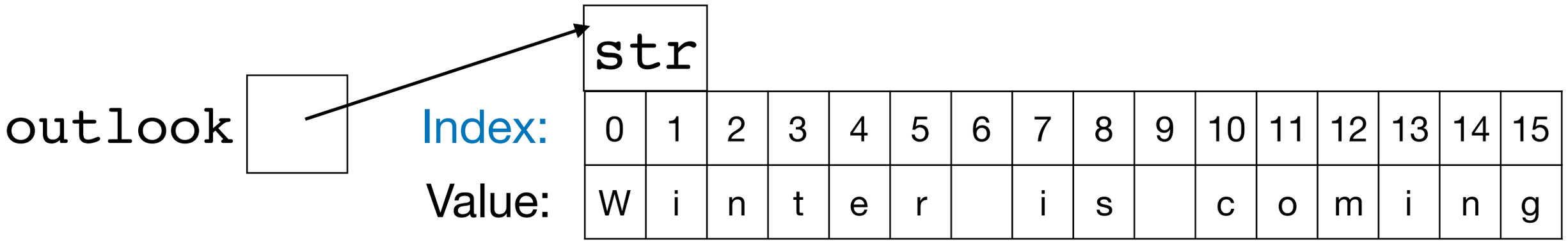

Indices in Python begin at 0.

Syntax:

```
outlook[0] # => "W"
```

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```

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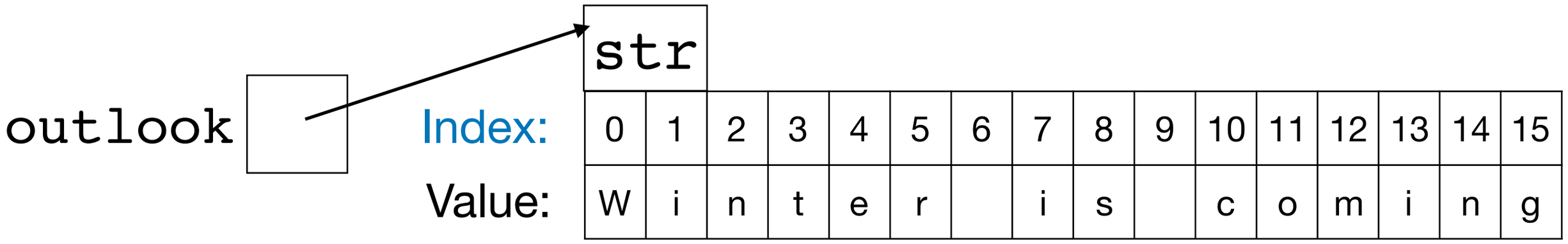

Indices in Python begin at 0.

Syntax:

```
outlook[0] # => "W"
outlook[4] # => "e"
```

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```

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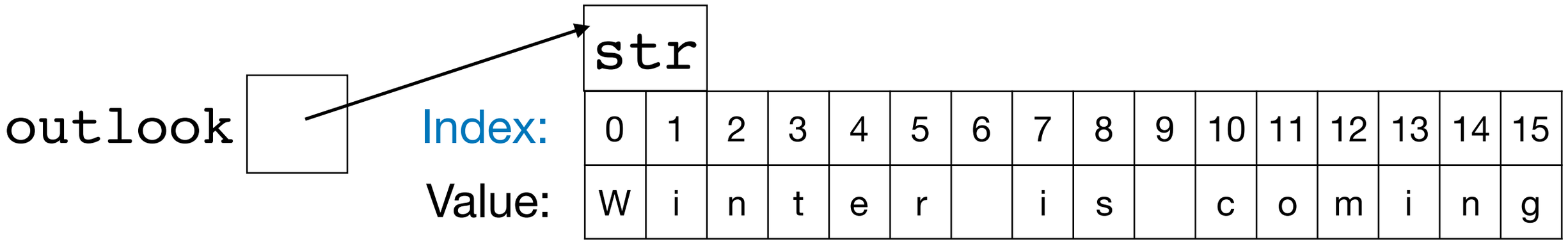

Indices in Python begin at 0.

Spaces are characters too!

Syntax:

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outlook[0] # => "W"
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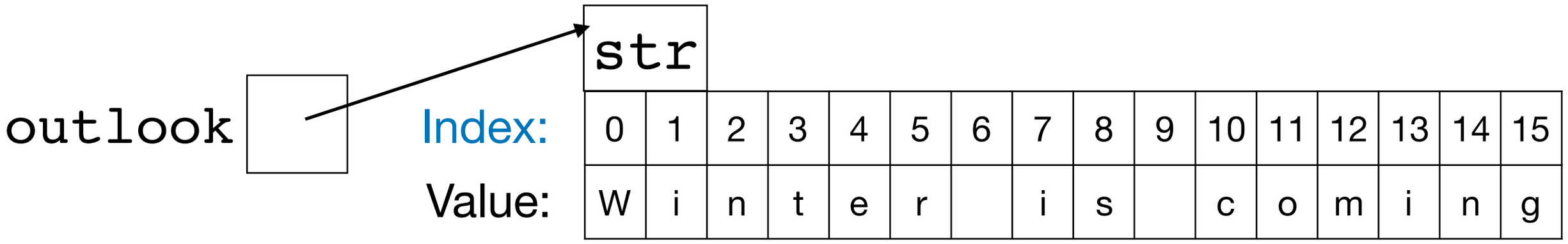

Indices in Python begin at 0.

Spaces are characters too!

Syntax:

```
outlook[0] # => "W"
outlook[4] # => "e"
outlook[6] # => " "
```

Indexing into Strings

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value:	W	i	n	t	e	r		i	s		c	o	m	i	n	g

Assume `s` is a variable that refers to the above string object.
How would I access the letter `'r'`?

```
A. s[5]
B. s(5)
C. s[6]
D. s(6)
```

Indexing into Strings

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Value:	W	i	n	t	e	r		i	s		c	o	m	i	n	g

What is the index of the last character of a string `s`?
(not the specific string above - this should work for **any** string)

```
A. len(s) - 1
B. len(s)
C. len(s) + 1
D. 42
```

A consequence of indexing - Another way to loop through strings:

```
for letter in a_string:
    print(letter, "-", sep="", end="")
```

is equivalent to

```
for i in range(len(a_string)):
    print(a_string[i], "-", sep="", end="")
```

Nifty Python Feature: Negative Indices

Negative indices count backwards from len(s):

Index:

Also Index:

Nifty Python Feature: Negative Indices

Negative indices count backwards from len(s):

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	W	i	n	t	e	r		i	s		c	o	m	i	n	g
Also Index:	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1

Nifty Python Feature: Negative Indices

Negative indices count backwards from len(s):

Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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Two possible ways to remember how this works:

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Two possible ways to remember how this works:

```
a_string[-5]
```

is equivalent to

```
a_string[len(a_string)-5]
```

Nifty Python Feature: Negative Indices

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Index:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
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Also Index:	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1

Two possible ways to remember how this works:

-1 is always the last character, and indices count backwards from there.

```
a_string[-5]
```

is equivalent to

```
a_string[len(a_string)-5]
```

Negative Indices!

For which assignment of `a` and `b` does the above **not** print `True`?

A.
```
a = 1
b = 5
```

B.
```
a = 1
b = 7
```

C.
```
a = -8
b = -4
```

D.
```
a = -2
b =  6
```

Negative Indices!

```
last_name = "wehrwein"
```

For which assignment of `a` and `b` does the above **not** print `True`?

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```

D.
```
a = -2
b =  6
```

Negative Indices!

```
last_name = "wehrwein"

print(last_name[a] == last_name[b])
```

For which assignment of `a` and `b` does the above **not** print `True`?

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a = 1
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```

C.
```
a = -8
b = -4
```

D.
```
a = -2
b =  6
```

Indexing

gives us other ways to loop through strings:

```
for letter in a_string:
    print(letter, end="")
```

is equivalent to

```
for i in range(len(a_string)):
    print(a_string[i], end="")
```

and also

```
i = 0
while i < len(a_string):
    print(a_string[i], end="")
    i += 1
```

Exercise (worksheet #2)

```
def remove_comments(string):
    """ Return a copy of string, but with
        all characters starting with and following
        the first instance of '#' emoved. If there
        is no # in the string, return input unchanged.
    """


# Example:

remove_comments("a = b # assign b to a"))
# => "a = b "
```

Exercise (worksheet #2)

```
def remove_comments(string):
    """ Return a copy of string, but with
        all characters starting with and following
        the first instance of '#' emoved. If there
        is no # in the string, return input unchanged.
    """
```

Hint: use a `while` loop!

```
# Example:

remove_comments("a = b # assign b to a"))
# => "a = b "
```

Slicing: indexing substrings

```
alph = "abcdefghij"
alph[0] # => "a"
alph[4] # => "e"
```

	str									
Ind	0	1	2	3	4	5	6	7	8	9
Val	a	b	c	d	e	f	g	h	i	j

Slicing syntax: `string[start:end]`

just like the `range` function:
the end index is **not** included

Slicing: indexing substrings

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alph = "abcdefghij"
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index of first character → `start`

1 + index of last character → `end`

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Slicing: indexing substrings

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index of first character — 1 + index of last character

Slicing syntax: `string[start:end]`

just like the `range` function:
the end index is **not** included

```
alph[0:5] # => “abcde"
```

Slicing: indexing substrings

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alph = "abcdefghij"
alph[0] # => "a"
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	str									
Ind	0	1	2	3	4	5	6	7	8	9
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index of first character — 1 + index of last character

Slicing syntax: `string[start:end]`

just like the `range` function:
the end index is **not** included

```
alph[0:5] # => “abcde"

alph[0:10] # => "abcdefghij"
```

Slicing: indexing substrings

```
alph = "abcdefghij"
alph[0] # => "a"
alph[4] # => "e"
```

	str									
Ind	0	1	2	3	4	5	6	7	8	9
Val	a	b	c	d	e	f	g	h	i	j

index of first character — 1 + index of last character

Slicing syntax: `string[start:end]`

just like the `range` function:
the end index is **not** included

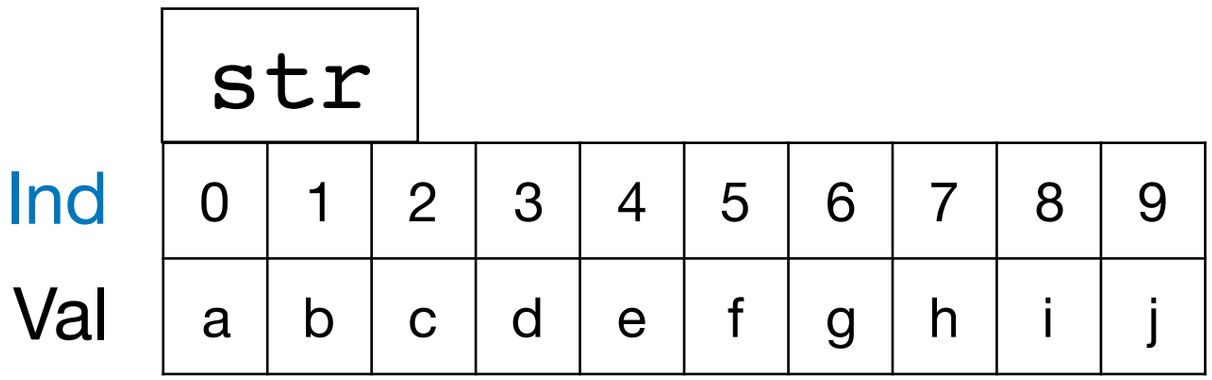
```
alph[0:5] # => “abcde"

alph[0:10] # => "abcdefghij"

alph[5:-2]
```

Slicing: indexing substrings

```
alph = "abcdefghij"
alph[0] # => "a"
alph[4] # => "e"
```



index of first character — 1 + index of last character

Slicing syntax: `string[start:end]`

just like the `range` function:
the end index is **not** included

```
alph[0:5] # => “abcde"

alph[0:10] # => "abcdefghij"

alph[5:-2] # => "fgh"
```

Slicing: indexing substrings

```
alph = "abcdefghij"
```

	str									
Ind	0	1	2	3	4	5	6	7	8	9
Val	a	b	c	d	e	f	g	h	i	j

index of first character → `start`

1 + index of last character → `end`

Slicing syntax: `string[start:end]`

Slicing: indexing substrings

```
alph = "abcdefghij"
```

	str									
Ind	0	1	2	3	4	5	6	7	8	9
Val	a	b	c	d	e	f	g	h	i	j

index of first character — 1 + index of last character

Slicing syntax: `string[start:end]`

If omitted, *`start`* defaults to `0`

Slicing: indexing substrings

```
alph = "abcdefghij"
```

	str									
Ind	0	1	2	3	4	5	6	7	8	9
Val	a	b	c	d	e	f	g	h	i	j

Slicing syntax: `string[start:end]`

`start`: index of first character

`end`: 1 + index of last character

If omitted, `start` defaults to `0`

If omitted, `end` defaults to `len(string)`

Slicing: indexing substrings

```
alph = "abcdefghij"
```

	str									
Ind	0	1	2	3	4	5	6	7	8	9
Val	a	b	c	d	e	f	g	h	i	j

Slicing syntax: `string[start:end]`

`start`: index of first character

`end`: 1 + index of last character

If omitted, `start` defaults to `0`

If omitted, `end` defaults to `len(string)`

```
alph[:4] # => “abcd"
```

Slicing: indexing substrings

```
alph = "abcdefghij"
```

	str									
Ind	0	1	2	3	4	5	6	7	8	9
Val	a	b	c	d	e	f	g	h	i	j

Slicing syntax: `string[start:end]`

- `start`: index of first character
- `end`: 1 + index of last character

If omitted, `start` defaults to `0`

If omitted, `end` defaults to `len(string)`

```
alph[:4] # => “abcd"
alph[5:] # => "fghij"
```

String Slicing: Exercise

	str							
Ind	0	1	2	3	4	5	6	7
Val	W	e	h	r	w	e	i	n

Which of these evaluates to `"in"`?

A. `last_name[7:8]`
B. `last_name[6:-1]`
C. `last_name[-3:]`
D. `last_name[-2:8]`

String Slicing: Exercise

```
last_name = "Wehrwein"
```

	str							
Ind	0	1	2	3	4	5	6	7
Val	W	e	h	r	w	e	i	n

Which of these evaluates to `"in"`?

A. `last_name[7:8]`
B. `last_name[6:-1]`
C. `last_name[-3:]`
D. `last_name[-2:8]`