Chapter 4
Computing With Strings

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Textbook: Python Programming: An Introduction to Computer Science, John Zelle

String Data Type

- A string is a sequence of characters
- A string literal uses quotes 'Hello' or "Hello"
- For strings, + means "concatenate"
- When a string contains numbers, it is still a string
- We can convert numbers in a string into a number using int()

```
>>> str1 = "Hello“
>>> str2 = 'there‘
>>> bob = str1 + str2
>>> print bobHellothere
>>> str3 = '123‘
>>> str3 = str3 + 1
Traceback (most recent call last):
File "<stdin>", line 1, in
<module>TypeError: cannot
concatenate 'str' and 'int' objects
>>> x = int(str3) + 1
>>> print x
124
>>>
```

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Input() is kind of useless

- When using input("Prompt") it is actually looking for an expression from input
- We use this just to prompt for numbers for simple programs
- We use raw_input("Prompt") for non-trivial programs

```
>>> x = input("Enter ")
Enter hello
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>  File "<string>", line 1, in <module>NameError: name 'hello' is not defined
>>> x = input("Enter ")
Enter 2 + 5
>>> print x
7
>>>
```

Real Programs Use String Input

- We prefer to read data in using strings and then parse and convert the data as we need
- This gives us more control over error situations and/or bad user input
- Raw input numbers must be converted from strings

```
>>> name = raw_input("Enter:")
Enter:Chuck
>>> print name
Chuck
>>> apple = raw_input("Enter:")
Enter:100
>>> x = apple – 10
Traceback (most recent call last):
  File "<stdin>", line 1, in
<module>TypeError: unsupported operand
type(s) for -: 'str' and 'int‘
>>> x = int(apple) – 10
>>> print x
90
```

What Kind of Thing?

- We have a way to see what *kind* of data is in a variable
- We use a special function called type() to look at the kind of data is in a variable

```
>>> x = "Hello"
>>> print x
Hello
>>> print type(x)
<type 'str'>
>>> y = "Bob"
>>> print y
Bob
>>> print type(y)
<type 'str'>
>>> z = 45
>>> print z
45
>>> print type(z)
<type 'int'>
>>>
```

Looking Inside Strings

- We can get at every single character in a string using an index specified in square brackets
- The index value can be an expression that is computed
- The index value must be an integer

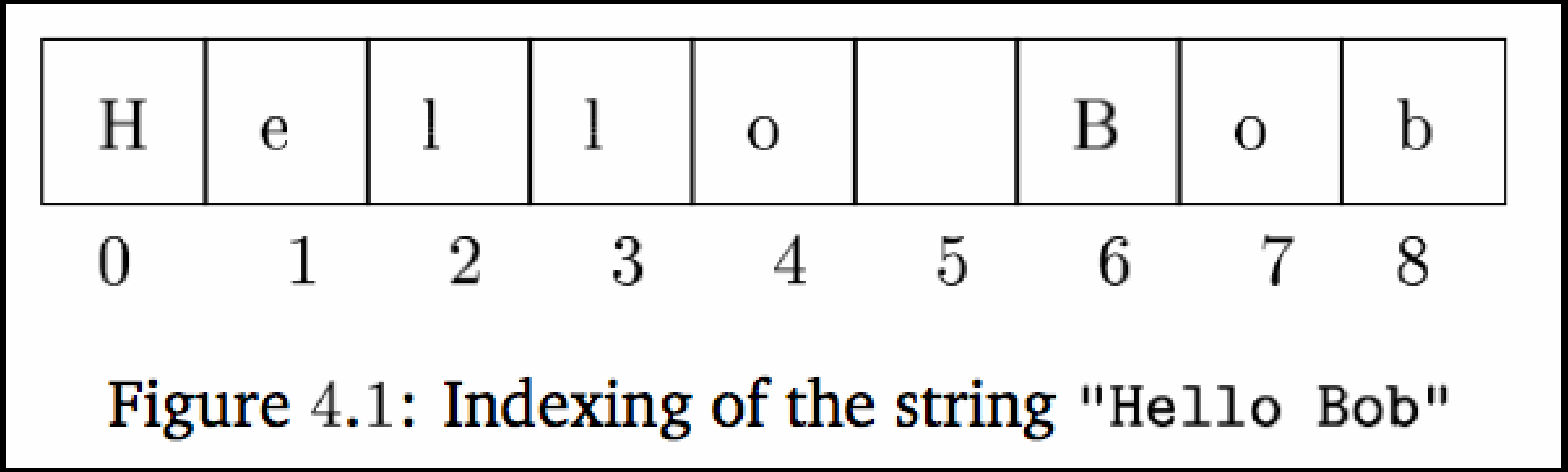
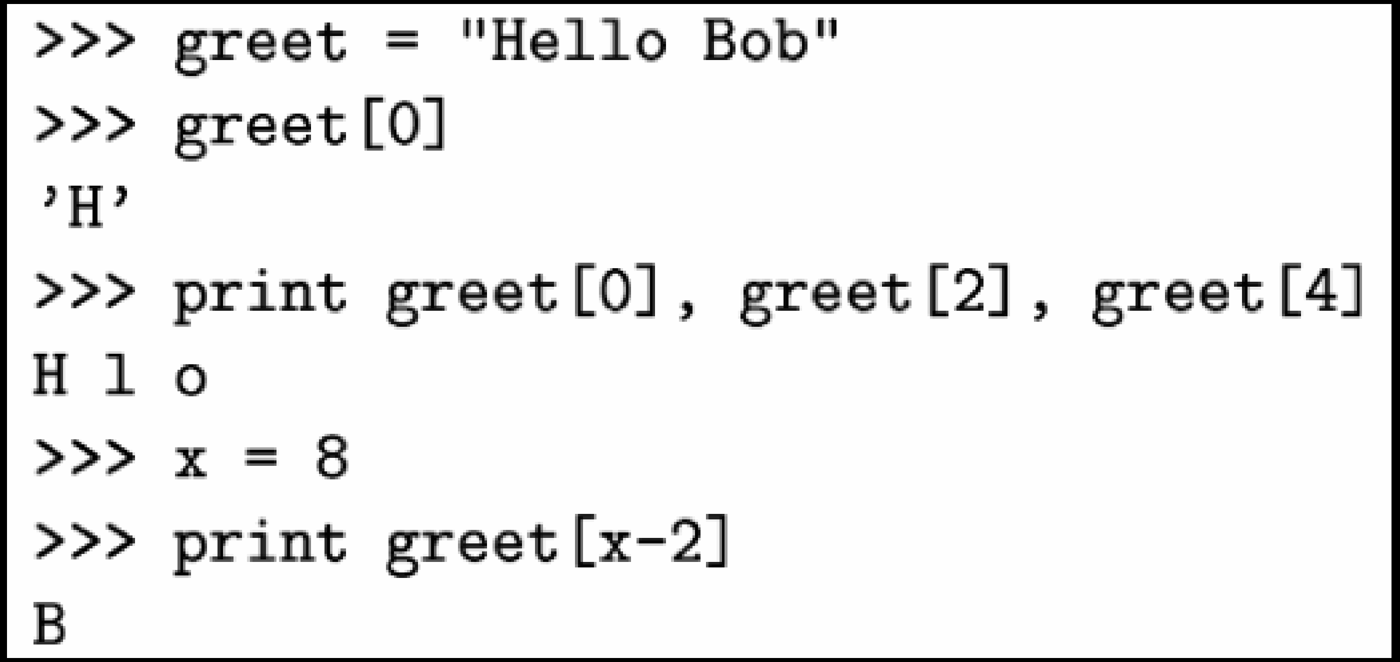


Figure 4.1: Indexing of the string "Hello Bob"



```
>>> greet = "Hello Bob"
>>> greet[0]
'H'
>>> print greet[0], greet[2], greet[4]
H l o
>>> x = 8
>>> print greet[x-2]
B
```

Slicing Strings

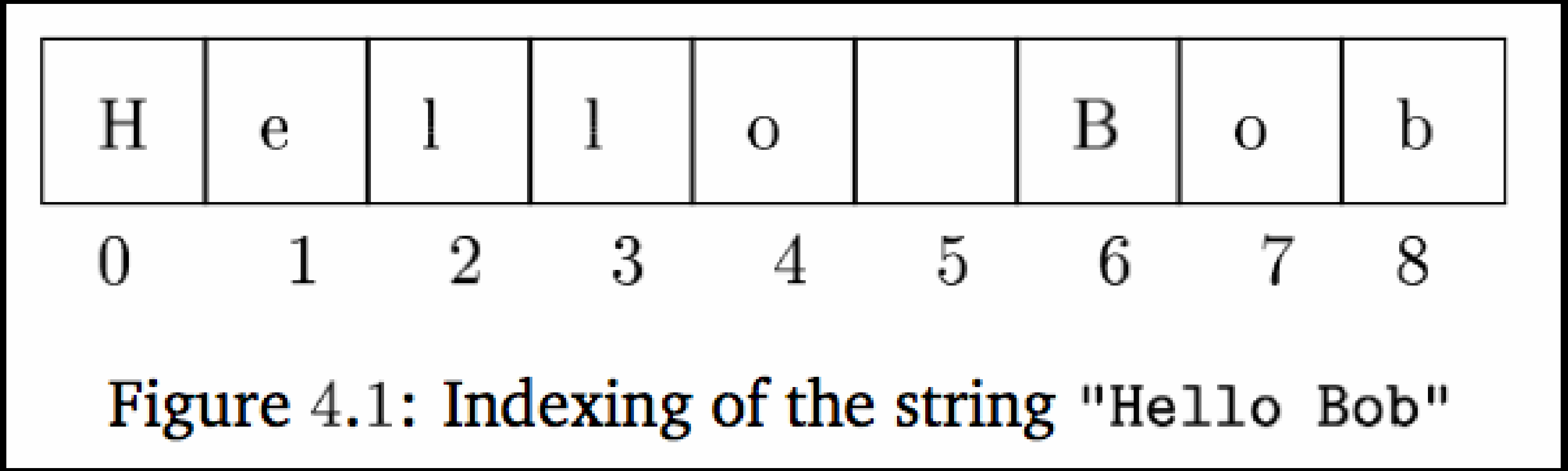


Figure 4.1: Indexing of the string "Hello Bob"

- We can also look at any continuous section of a string using a colon
- The second number is one beyond the end of the slice - “up to but not including”
- If a number is omitted it is assumed to be the the beginning or end

```
>>> greet = "Hello Bob“
>>> greet[0:3]
'Hel‘
>>> greet[5:9]
' Bob‘
>>> greet[:5]
'Hello‘
>>> greet[5:]
' Bob‘
>>> greet[:]
'Hello Bob'
```

String indexes from the right

- Negative index numbers in a string start from the right (or end) of the string and work backwards

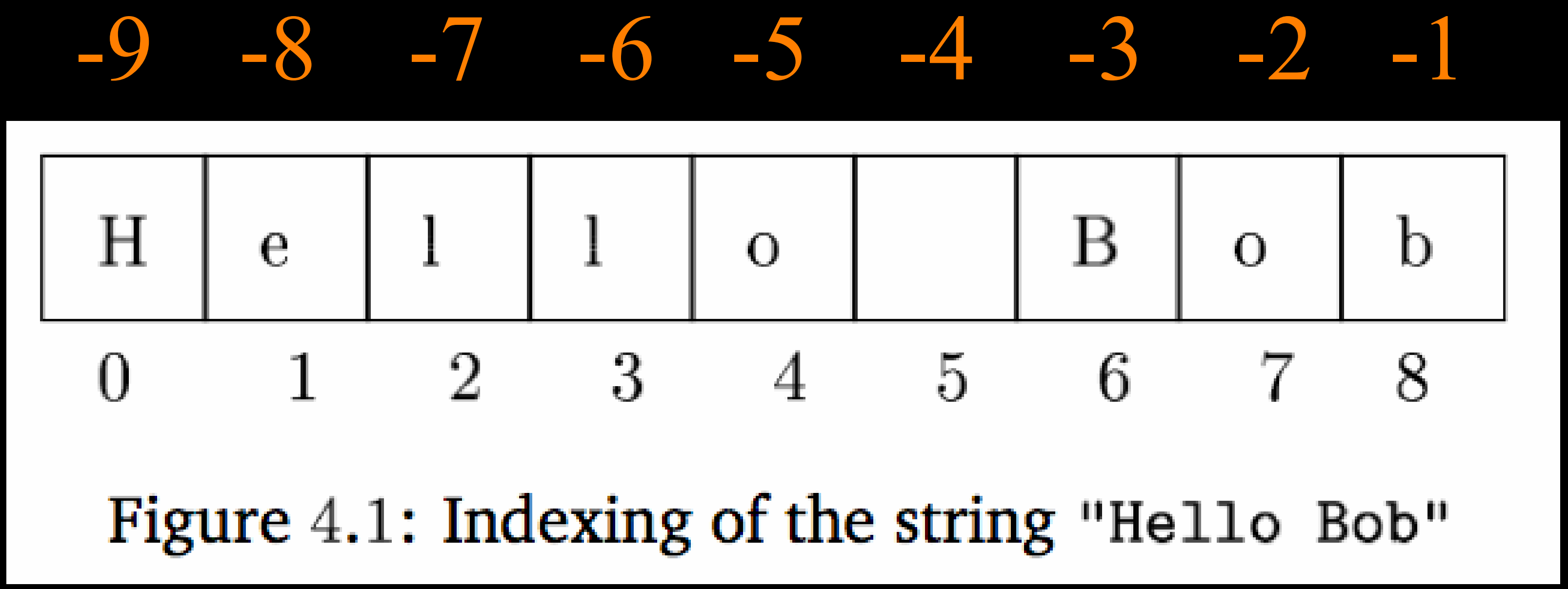


Figure 4.1: Indexing of the string "Hello Bob"

```
>>> greet = "Hello Bob“
>>> greet[-1]
'b‘
>>> greet[-3]
'B'
```

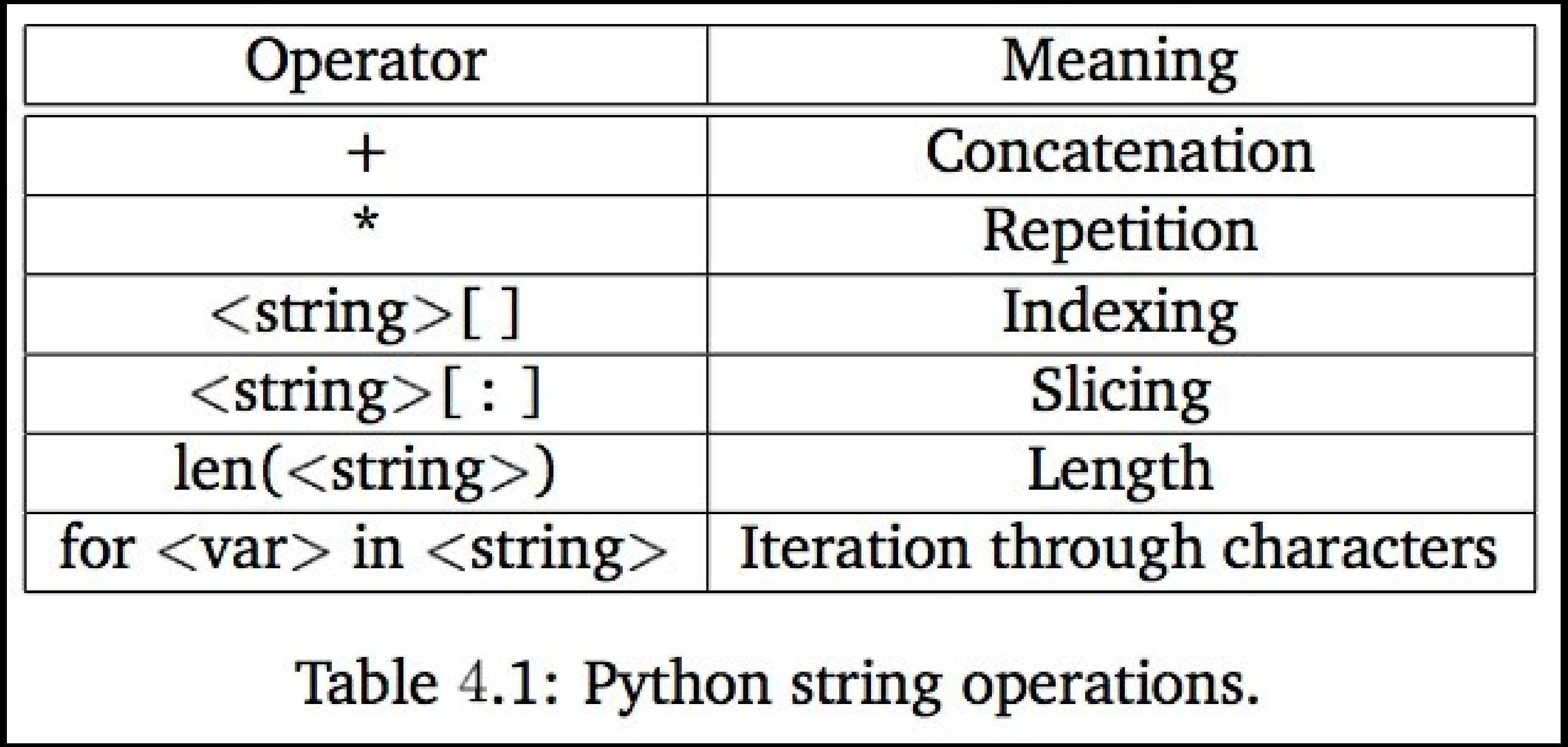
A Character too Far

- You will get a python error if you attempt to index beyond the end of a string.
- So be careful when constructing index values and slices

```
>>> zot = "abc“
>>> print zot[5]
Traceback (most recent call last):
File "<stdin>", line 1, in
<module>IndexError: string index
out of range
>>>
```

String Operators

- We do a lot of work with strings and Python has a lot of support for strings
- With respect to strings, Python is a "smooth operator"



Operator	Meaning
+	Concatenation
*	Repetition
<string>[ ]	Indexing
<string>[:]	Slicing
len(<string>)	Length
for <var> in <string>	Iteration through characters

Table 4.1: Python string operations.

How Long is a String?

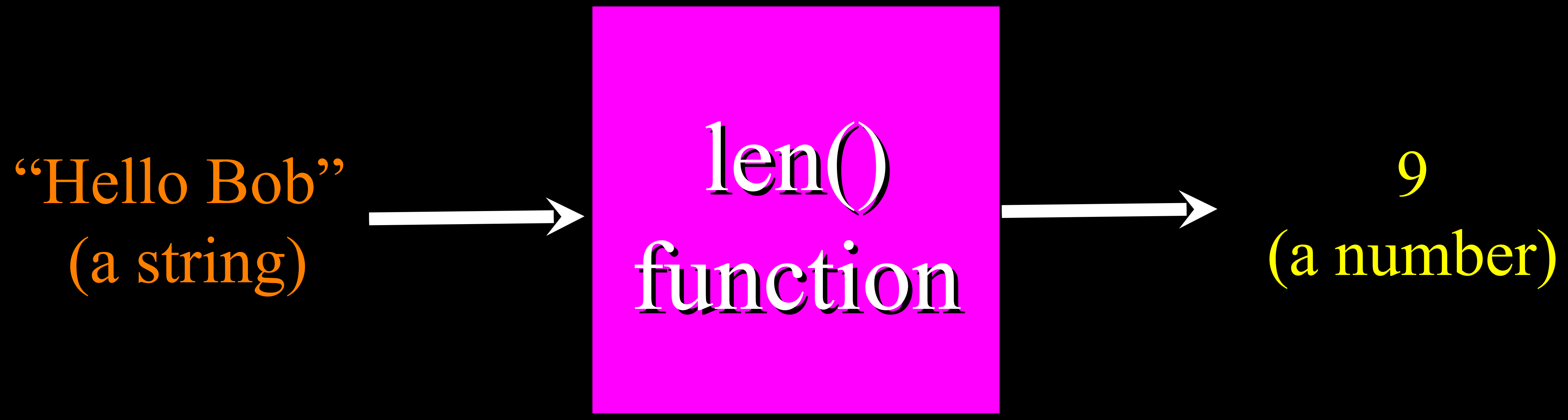
- The len() function takes a string as a parameter and returns the number of characters in the string
- Actually len() tells us the number of elements of any set or sequence

```
>>> greet = "Hello Bob“
>>> print len(greet)
9
>>> x = [ 1, 2, "fred", 99]
>>> print len(x)
4
>>>
```

Len Function

```
>>> greet = "Hello Bob“
>>> x = len(greet)
>>> print x
9
```

A function is some stored code that we use. A function takes some input and produces an output.

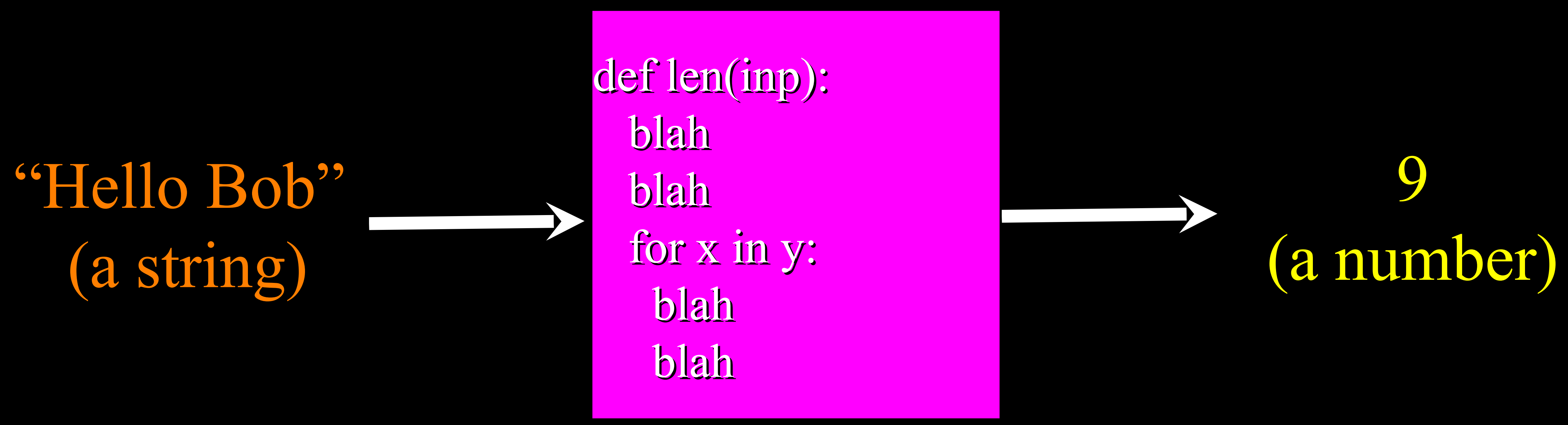


Guido wrote this code

Len Function

```
>>> greet = "Hello Bob“
>>> x = len(greet)
>>> print x
9
```

A function is some stored code that we use. A function takes some input and produces an output.



```
def len(inp):
  blah
  blah
  for x in y:
    blah
    blah
```

Multiplying Strings?

- While it is seldom useful, the asterisk operator applies to strings

```
>>> zig = "Hi"
>>> zag = zig * 3
>>> print zag
HiHiHi
>>> x = " "*80
```

Looping Through a String

- A string is a sequence (ordered set) of characters
- The for loop iterates through a sequence, with the iteration variable taking successive values from the sequence each time the loop body is run

```
>>> zap = "Fred“
>>> for xyz in zap:
...         print xyz
...
F
r
e
d
>>>
```

String Library

String Library

- Python has a number of string operations which are in the string library
- We use these library operations quite often when we are pulling apart input data
- To use these, we import the string library

```
import string

zap =string.lower(greet)
```

What is a Library?

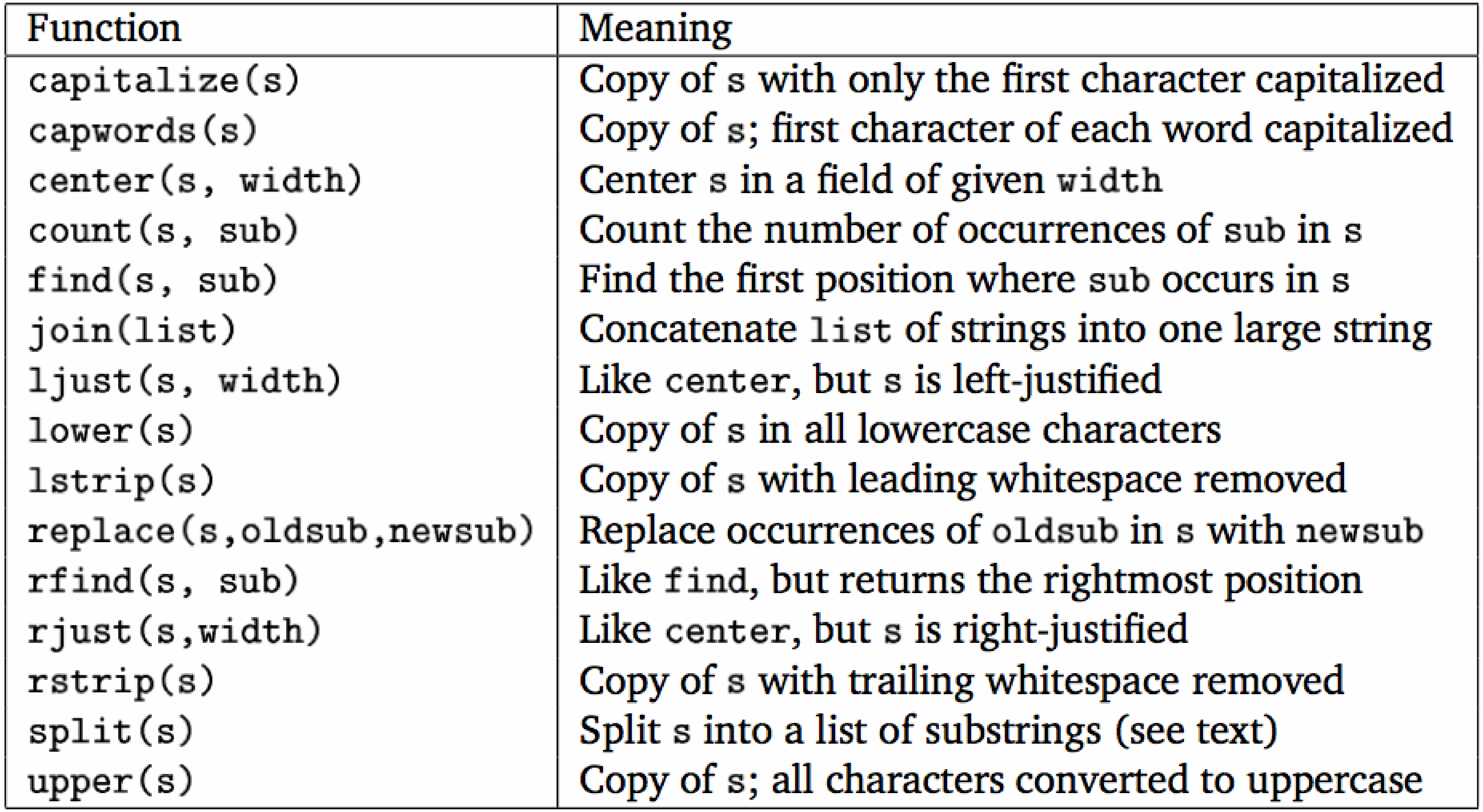
- Some super developers in the Python world write the libraries for us to use
- import string
- Somewhere there is a file string.py with a bunch of def statements

string

def

def

def



Function	Meaning
`capitalize(s)`	Copy of `s` with only the first character capitalized
`capwords(s)`	Copy of `s`; first character of each word capitalized
`center(s, width)`	Center `s` in a field of given `width`
`count(s, sub)`	Count the number of occurrences of `sub` in `s`
`find(s, sub)`	Find the first position where `sub` occurs in `s`
`join(list)`	Concatenate `list` of strings into one large string
`ljust(s, width)`	Like `center`, but `s` is left-justified
`lower(s)`	Copy of `s` in all lowercase characters
`lstrip(s)`	Copy of `s` with leading whitespace removed
`replace(s,oldsub,newsub)`	Replace occurrences of `oldsub` in `s` with `newsub`
`rfind(s, sub)`	Like `find`, but returns the rightmost position
`rjust(s,width)`	Like `center`, but `s` is right-justified
`rstrip(s)`	Copy of `s` with trailing whitespace removed
`split(s)`	Split `s` into a list of substrings (see text)
`upper(s)`	Copy of `s`; all characters converted to uppercase

Table 4.2: Some components of the Python string library

http://docs.python.org/lib/string-methods.html

Searching a String

- We use the find() function to search for a substring within another string
- find() finds the first occurance of the substring
- If the substring is not found, find() returns -1
- Remember that string position starts at zero

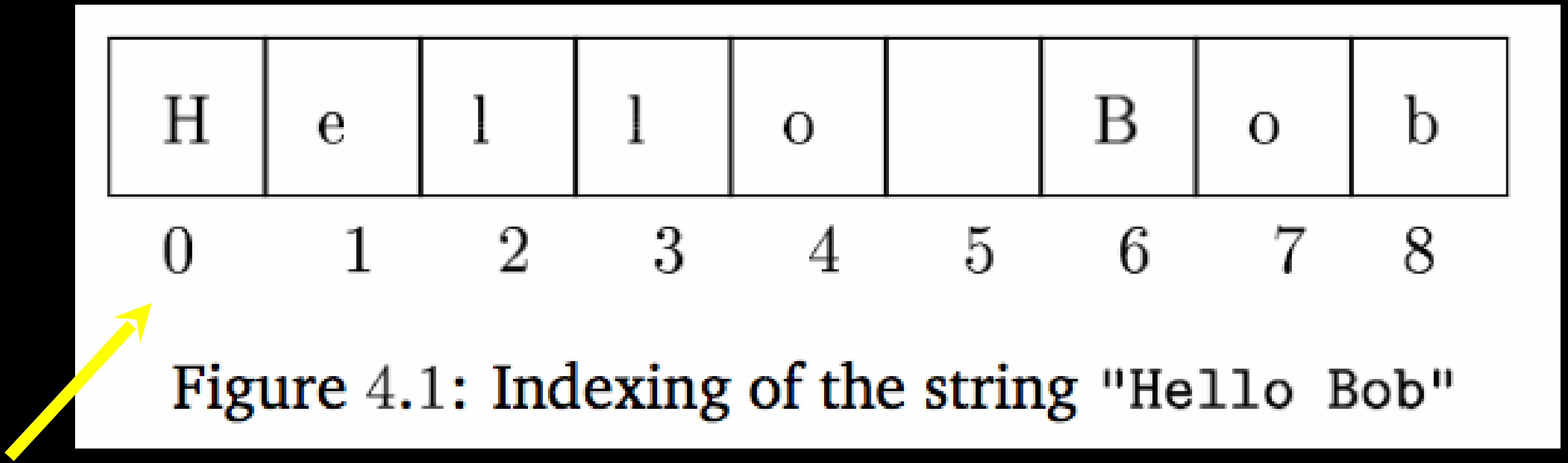


Figure 4.1: Indexing of the string "Hello Bob"

```
>>> import string
>>> greet = "Hello Bob"
>>> pos = string.find(greet,"o")
>>> print pos
4
>>> aa = string.find(greet,"z")
>>> print aa
-1
```

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Making everything UPPER CASE

- You can make a copy of a string in lower case or upper case
- Often when we are searching for a string using find() - we first convert the string to lower case so we can find a string regardless of case

```
>>> import string
>>> greet = "Hello Bob"
>>> nnn = string.upper(greet)
>>> print nnn
HELLO BOB
>>> lll = string.lower(greet)
>>> print lll
hello bob
>>>
```

Search and Replace

- The replace() function is like a "search and replace" operation in a word processor
- It replaces all occurrences of the search string with the replacement string

```
>>> import string
>>> greet = "Hello Bob"
>>> nstr = string.replace(greet,"Bob","Jane")
>>> print nstr
Hello Jane
>>> greet = "Hello Bob“
>>> nstr = string.replace(greet,"o","X")
>>> print nstrHellX BXb
>>>
```

Stripping Whitespace

- Sometimes we want to take a string and remove whitespace at the beginning and/or end
- lstrip() and rstrip() to the left and right only
- strip() Removes both begin and ending whitespace

```
>>> import string
>>> greet = "   Hello Bob  "
>>> string.lstrip(greet)
'Hello Bob  '
>>> string.rstrip(greet)
'   Hello Bob'
>>> string.strip(greet)
'Hello Bob'
>>>
```

Breaking Strings into Parts

- We are often presented with input that we need to break into pieces
- We use the split() function to break a string into a sequence of strings

```
>>> import string
>>> abc = "With three words“
>>> stuff = string.split(abc)
>>> print stuff
['With', 'three', 'words']
>>>
```

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```
>>> import string
>>> abc = "With three words“
>>> stuff = string.split(abc)
>>> print stuff
['With', 'three', 'words']
>>> print len(stuff)
3
>>> print stuff[1]
three
```

```
>>> print stuff
['With', 'three', 'words']
>>> for w in stuff:
...         print w
...
With
three
words
>>>
```

Split breaks a string into parts produces a list of strings. We think of these as words. We can access a particular word or loop through all the words.

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```
>>> import string
>>> line = "first,second,third“
>>> thing = string.split(line)
>>> print thing
['first,second,third']
>>> print len(thing)
1
>>> thing = string.split(line,",")
>>> print thing
['first', 'second', 'third']
>>>
```

```
>>> line = "A lot              of spaces“
>>> etc = line.split()
>>> print etc
['A', 'lot', 'of', 'spaces']
>>>
```

You can specify what delimiter character to use in the splitting. Also when you do not specify a delimiter, multiple spaces is thought of as “one” delimiter.
You can also just add .split() to the end of a string variable.

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File Processing

File Processing

- A text file can be thought of as a sequence of lines

```
From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008
Return-Path: <postmaster@collab.sakaiproject.org>
Date: Sat, 5 Jan 2008 09:12:18 -0500To: source@collab.sakaiproject.orgFrom:
stephen.marquard@uct.ac.zaSubject: [sakai] svn commit: r39772 -
content/branches/Details: http://source.sakaiproject.org/viewsvn/?
view=rev&rev=39772
```

Opening a File

- Before we can read the contents of the file we must tell Python which file we are going to work with and what we will be doing with the file
- This is done with the open() function
- open() returns a "file handle" - a variable used to perform operations on the file
- Kind of like "File -> Open" in a Word Processor

Using open()

- handle = open(filename, mode)

```
fhand = open("mbox.txt", "r")
```

  - returns a handle use to manipulate the file
  - filename is a string
  - mode is "r" if we are planning reading the file and "w" if we are going to write to the file.

http://docs.python.org/lib/built-in-funcs.html

File Handle as a Sequence

- A file handle open for read can be treated as a sequence of strings where each line in the file is a string in the sequence
- We can use the for statement to iterate through a sequence
- Remember - a sequence is an ordered set

```
xfile = open("mbox.txt", "r")

for cheese in xfile:
    print cheese
```

Counting Lines in a File

- Open a file read-only
- Use a for loop to read each line
- Count the lines and print out the number of lines

```
pizza = open("mbox.txt", "r")

howmany = 0
for slice in pizza:
    howmany = howmany + 1

print howmany
```

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Summary

- String Data Type
- input() and raw_input()
- Indexing strings
- Slicing strings
- String operators
- String len() function
- Looping through a string
- String Library

- Searching strings
- Changing Case
- Removing Whitespace
- Splitting a string into parts
- File Processing
- Opening a File
- Looping through a file