HA NOI UNIVERSITY OF SCIENCE AND TECHNOLOGY
SCHOOL OF INFORMATION AND COMMUNICATION TECHNOLOGY

Chapter 4: Strings

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- Looping through strings with for and while
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- String library (Searching and Replacing text, Stripping white space)

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(bob)
Hellothere
>>> str3 = '123'
>>> str3 = str3 + 1
Traceback (most recent call
 last):  File "<stdin>", li
ne 1, in <module>TypeError:
 cannot concatenate 'str' a
nd 'int' objects
>>> x = int(str3) + 1
>>> print(x)
124
```

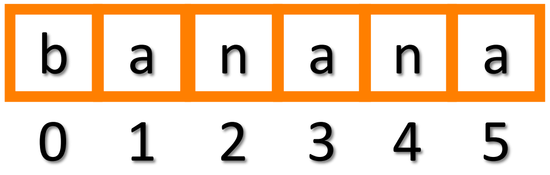
Handling User Input

- 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 las
t):  File "<stdin>", line 1, in
 <module>TypeError: unsupported
 operand type(s) for -
: 'str' and 'int‘
>>> x = int(apple) - 10
>>> print(x)
90
```

Looking Inside Strings

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



```
>>> fruit = 'banana'
>>> letter = fruit[1]
>>> print(letter)
a
>>> n = 3
>>> w = fruit[n - 1]
>>> print(w)
n
```

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
>>>
```

Strings Have Length

- There is a built-in function len that gives us the length of a string

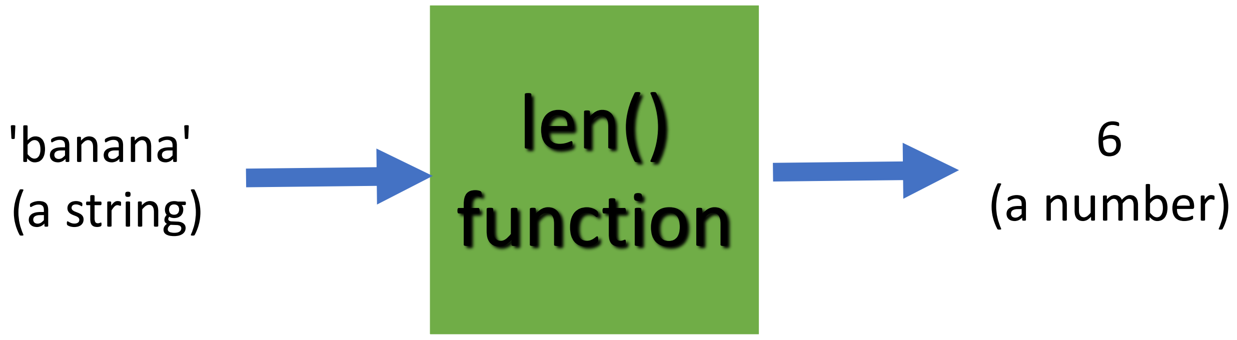
b	a	n	a	n	a
0	1	2	3	4	5

```
>>> fruit = 'banana'
>>> print(len(fruit) )
6
```

len Function

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

```
>>> fruit = 'banana'
>>> x = len(fruit)
>>> print(x)
6
```



Looping Through Strings

- Using a while statement and an iteration variable, and the len function, we can construct a loop to look at each of the letters in a string individually

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

```
0 b
1 a
2 n
3 a
4 n
5 a
```

Looping Through Strings using a "for" statement

- A definite loop using a for statement is much more elegant
- The iteration variable is completely taken care of by the for loop

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

```
b
a
n
a
n
a
```

Looping and Counting

- This is a simple loop that loops through each letter in a string and counts the number of times the loop encounters the 'a' character.

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

Looking deeper into in

- The iteration variable “iterates” though the sequence (ordered set)
- The block (body) of code is executed once for each value in the sequence
- The iteration variable moves through all of the values in the sequence

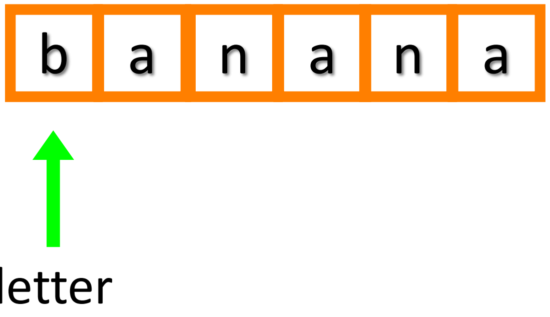
Six-character string

Iteration variable

```
for letter in 'banana':
    print(letter)
```

Looking deeper into in

- The iteration variable "iterates" though the string and the block (body) of code is executed once for each value in the sequence



```
for letter in 'banana':
    print(letter)
```

Slicing Strings

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

M	o	n	t	y		P	y	t	h	o	n
0	1	2	3	4	5	6	7	8	9	10	11

```
>>> s = 'Monty Python'
>>> print(s[0:4])
Mont
>>> print ( s[6:7])
P
>>> print(s[6:20])
Python
```

Slicing Strings

- If we leave off the first number or the last number of the slice, it is assumed to be the beginning or end of the string respectively

M	o	n	t	y		P	y	t	h	o	n
0	1	2	3	4	5	6	7	8	9	10	11

```
>>> s = 'Monty Python'
>>> print(s[:2])
Mo
>>> print(s[8:])
thon
>>> print(s[:])
Monty Python
```

String Concatenation

- When the + operator is applied to strings, it means "concatenation"

```
>>> a = 'Hello'
>>> b = a + 'There'
>>> print(b)
HelloThere

>>> c = a + ' ' + 'There'
>>> print(c)
Hello There
```

The String Formatting Operator: %

- Used for math when the operand on the left is a number the % is the modulus operator
- However when the operand to the left of the % operator is a string then % is the string format operator.

```
>>> 32 % 5
 2

>>> b = “Gold”
>>> print(“%s is a metal” % b)
Gold is a metal
```

The String Format Operator: Dissected

$$s = \overbrace{\text{“}\underbrace{\text{%s}}_{\text{string formatting code}}\text{ is a metal”}}^{\text{format string}}\ \underbrace{\%}_{\text{String formatting operator}}\ b$$

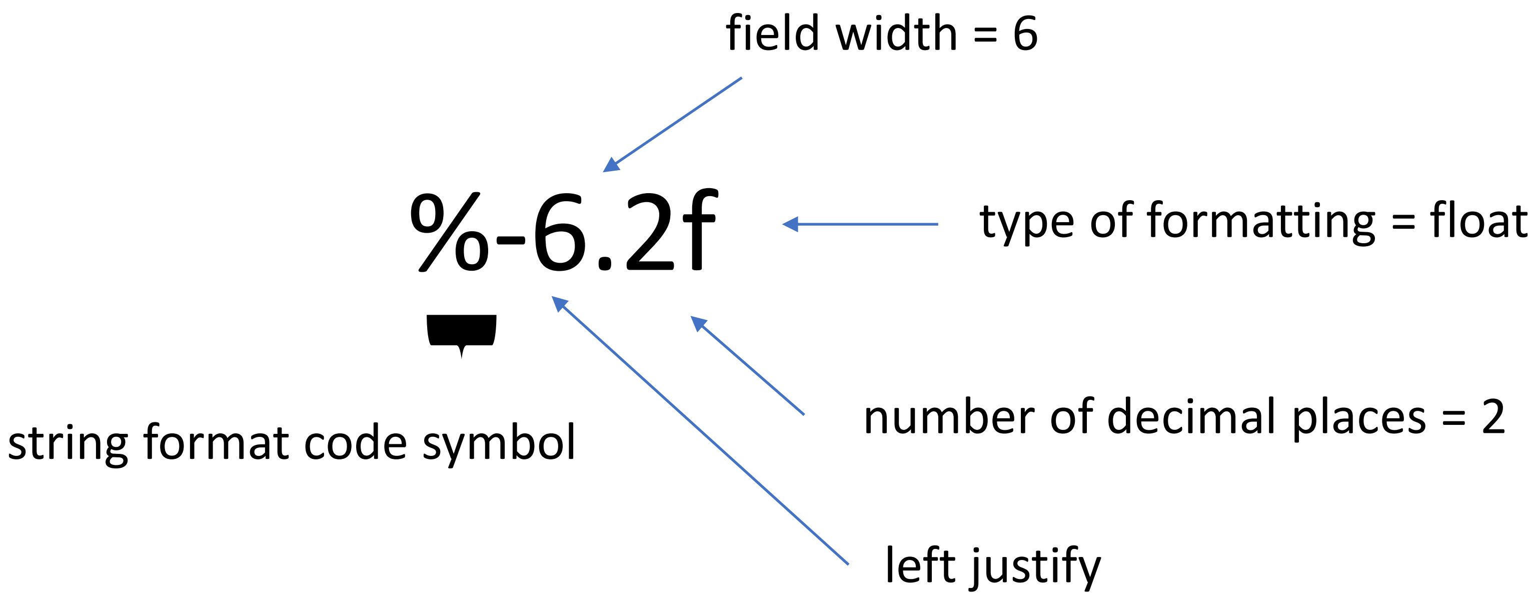
- The string format operator with more than one value being inserted into the format string

```
b = “platinum”
a = 5
s = “%s is one of %d shiny metals” % (b, a)
print(s)
platinum is one of 5 shiny metals
```

String Formatting Codes

%s	String
%c	Character
%d	Decimal (int)
%i	Integer
%f	Float

String Formatting Codes Advanced Usage


field width = 6
%-6.2f
type of formatting = float
number of decimal places = 2
string format code symbol
left justify

Using in as an Operator

- The in keyword can also be used to check to see if one string is "in" another string
- The in expression is a logical expression and returns True or False and can be used in an if statement

```
>>> fruit = 'banana'
>>> 'n' in fruit
True
>>> 'm' in fruit
False
>>> 'nan' in fruit
True
>>> if 'a' in fruit :
        print('Found it!')
Found it!
```

String Comparison

```python
word = 'blueberry'

if word == 'banana':
    print('All right, bananas.')

if word < 'banana':
    print('Your word,' + word + ', comes before banana.')
elif word > 'banana':
    print('Your word,' + word + ', comes after banana.')
else:
    print('All right, bananas.')
```

String Library

- Python has a number of string functions which are in the string library
- These functions are already built into every string - we invoke them by appending the function to the string variable
- These functions do not modify the original string, instead they return a new string that has been altered

```
>>> greet = 'Hello Bob'
>>> zap = greet.lower()
>>> print(zap)
hello bob
>>> print(greet)
Hello Bob
>>> print('Hi There'.lo
wer())
hi there
>>>
```

The Directory Function – dir()

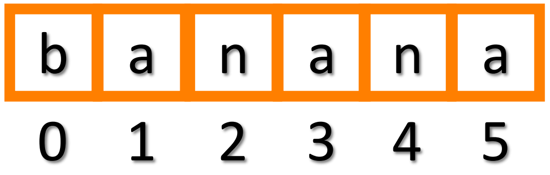
```
>>> stuff = 'Hello world'
>>> type(stuff)
<type 'str'>
>>>> dir(stuff)
['capitalize', 'center', 'count', 'decode', 'enco
de', 'endswith’,'expandtabs', 'find’,'format’,
'index','isalnum','isalpha','isdigit’, 'islower',
 'isspace', 'istitle', 'isupper', 'join’,
'ljust','lower', 'lstrip', 'partition','replace',
'rfind', 'rindex', 'rjust', 'rpartition’,
'rsplit', 'rstrip', 'split', 'splitlines', 'start
swith', 'strip', 'swapcase', 'title’,'translate',
'upper', 'zfill']
```

String Library

```
str.capitalize()
str.center(width[, fillchar])
str.endswith(suffix[, start[, end]])
str.find(sub[, start[, end]])
str.lstrip([chars])
str.join(x [, sep])
str.replace(old, new[, count])
str.lower()
str.rstrip([chars])
str.strip([chars])
str.upper()
```

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



```
>>> fruit = 'banana'
>>> pos = fruit.find('na')
>>> print(pos)
2

>>> aa = fruit.find('z')
>>> print(aa)
-1
```

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 search a string regardless of case

```
>>> greet = 'Hello Bob'
>>> nnn = greet.upper()
>>> print(nnn)
HELLO BOB

>>> www = greet.lower()
>>> print(www)
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

```
>>> greet = 'Hello Bob'
>>> nstr = greet.replace('Bob','
Jane')
>>> print(nstr)
Hello Jane

>>> greet = 'Hello Bob'
>>> nstr = greet.replace('o','X'
)
>>> print(nstr)
HellX 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 beginning and ending whitespace

```
>>> greet = '   Hello Bob  '
>>> greet.lstrip()
'Hello Bob  '

>>> greet.rstrip()
'   Hello Bob'

>>> greet.strip()
'Hello Bob'
>>>
```

Prefixes

```
>>> line = 'Please have a nice day'
>>> line.startswith('Please')
True

>>> line.startswith('p')
False
```

21 31

From stephen.marquard@uct.ac.za Sat Jan 5 09:14:16 2008

```
>>> data = 'From stephen.marquard@uct.ac.za Sat Jan  5 09:14:16 2008'
>>> atpos = data.find('@')
>>> print(atpos)
21
>>> sppos = data.find(' ',atpos)
>>> print(sppos)
31
>>> host = data[atpos + 1: sppos]
>>> print(host)
uct.ac.za
```

References

1. MIT Introduction to Computer Science and Programming in Python
2. Think Python: How to Think Like a Computer Scientist: https://greenteapress.com/thinkpython2/html/index.html

VIỆN CÔNG NGHỆ THÔNG TIN VÀ TRUYỀN THÔNG
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Thank you for your attention!

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