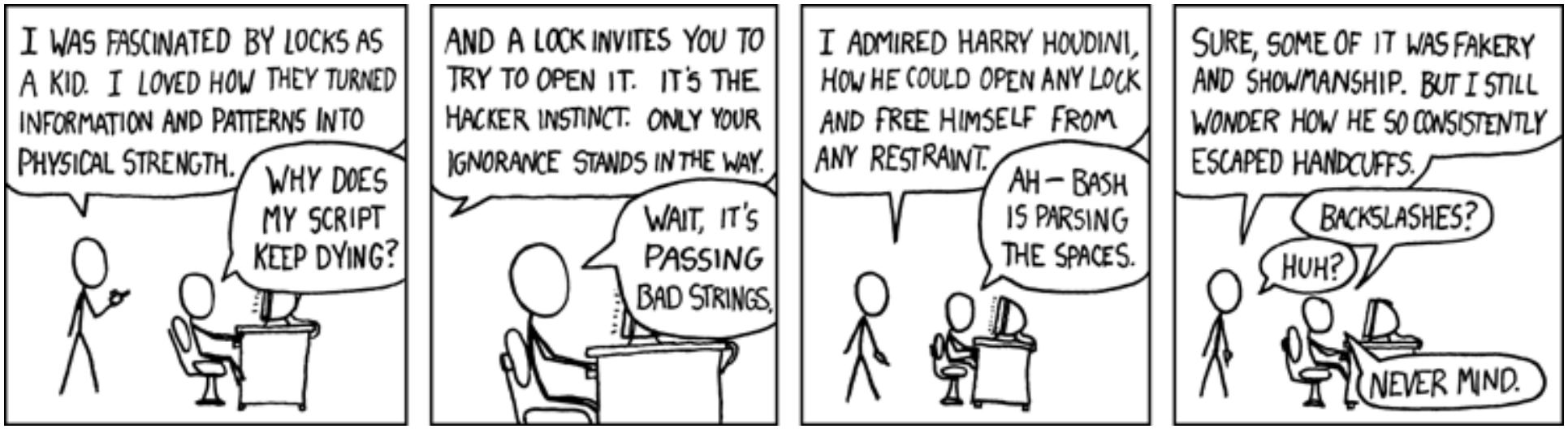
CSc 110, Autumn 2016

Lecture 11: Strings

Adapted from slides by Marty Stepp and Stuart Reges



Strings

- **string**: a type that stores a sequence of text characters.

```
name = "text"
name = expression
```

  - Examples:

```
name = "Daffy Duck"
x = 3
y = 5
point = "(" + str(x) + ", " + str(y) + ")"
```

Indexes

- Characters of a string are numbered with 0-based *indexes*:

```
name = "Ultimate"
```

index	0	1	2	3	4	5	6	7
	-8	-7	-6	-5	-4	-3	-2	-1
character	U	l	t	i	m	a	t	e

  - First character's index : 0
  - Last character's index : 1 less than the string's length

Accessing characters

- You can access a character with **string**`[`**index**`]`:

```
name = "Merlin"
print(name[0])
```

Output: `M`

Accessing substrings

- Syntax:

```
part = string[start:stop]
```

- Example:

```
s = "Merlin"
mid = [1:3]     # er
```

- If you want to start at the beginning you can leave off start

```
mid = [:3]      # Mer
```

- If you want to start at the end you can leave off the stop

```
mid = [1:]      # erlin
```

`String` methods

Method name	Description
`find(`**`str`**`)`	index where the start of the given string appears in this string (-1 if not found)
`substring(`**`index1`**`, `**`index2`**`)` or `substring(`**`index1`**`)`	the characters in this string from *index1* (inclusive) to *index2* (exclusive); if *index2* is omitted, grabs till end of string
`lower()`	a new string with all lowercase letters
`upper()`	a new string with all uppercase letters

- These methods are called using the dot notation below:

```
starz = "Biles & Manuel"
print(starz.lower())    # biles & manuel
```

`String` method examples

```
# index      012345678901
s1 = "Allison Obourn"
s2 = "Merlin The Cat"

print(s1.find("o"))       # 5
print(s2.lower())         # "merlin the cat"
```

- Given the following string:

```
# index  01234567890123456789012345
book =  "Building Python Programs"
```

  - How would you extract the word `"Python"` ?

ALLISON
LLISON
LISON
ISON
SON
ON
N
A
AL
ALL
ALLI
ALLIS
ALLISO
ALLISON
OBOURN
BOURN
OURN
URN
RN
N
O
OB
OBO
OBOU
OBOUR
OBOURN

Name border

- Prompt the user for full name
- Draw out the pattern to the left
- This should be resizable. Size 1 is shown and size 2 would have the first name twice followed by last name twice

Other `String` operations - length

- Syntax:

```
length = len(string)
```

- Example:

```
s = "Merlin"
count = len(s)     # 6
```

Looping through a string

- The `for` loop through a string using range:

```
major = "CSc";
for letter in range(0, len(major)):
    print(major[letter:letter + 1])
```

- You can also use a `for` loop to print or examine each character without range.

```
major = "CSc";
for letter in major:
    print(letter)
```

Output:

```
C
S
c
```

Strings question

- Write a program that reads two people's first names and suggests a name for their child

Example Output:

```
Parent 1 first name? Danielle
Parent 2 first name? John
Child Gender? f
Suggested baby name: JODANI

Parent 1 first name? Danielle
Parent 2 first name? John
Child Gender? Male
Suggested baby name: DANIJO
```

`String` tests

Method	Description
`startswith(`**`str`**`)`	whether one contains other's characters at start
`endswith(`**`str`**`)`	whether one contains other's characters at end

```
name = "Voldermort"
if(name.startswith("Vol")):
    print("He who must not be named")
```

- The `in` keyword can be used to test if a string contains another string.

  example: `"er" in name` `# true`

`String` question

- A *Caesar cipher* is a simple encryption where a message is encoded by shifting each letter by a given amount.
  - e.g. with a shift of 3, A → D, H → K, X → A, and Z → C

- Write a program that reads a message from the user and performs a Caesar cipher on its letters:

```
Your secret message: Brad thinks Angelina is cute
Your secret key: 3
The encoded message: eudg wklqnv dqjholqd lv fxwh
```

`Strings` and `ints`

- All `char` values are assigned numbers internally by the computer, called *ASCII* values.
  - Examples:
    `'A'` is 65, `'B'` is 66, `' '` is 32
    `'a'` is 97, `'b'` is 98, `'*'` is 42
  - One character long `Strings` and `ints` can be converted to each other
    `ord('a')` is 97, `chr(103)` is 'g'
  - This is useful because you can do the following:
    `chr(ord('a' + 2))` is `'c'`

Strings answer

```
# This program reads a message and a secret key from the user and
# encrypts the message using a Caesar cipher, shifting each letter.
def main():
    message = input("Your secret message: ")
    message = message.lower()
    key = int(input("Your secret key: "))
    encode(message, key)

# This method encodes the given text string using a Caesar
# cipher, shifting each letter by the given number of places.
def encode(text, shift):
    print("The encoded message: ")
    for letter in text:
        # shift only letters (leave other characters alone)
        if (letter >= 'a' and letter <= 'z'):
            letter = chr(ord(letter) + shift)
            # may need to wrap around
            if (letter > 'z'):
                letter = chr(ord(letter) - 26)
            elif (letter < 'a'):
                letter = chr(ord(letter) + 26)
        print(letter, end='')
    print()
```

format

Formatting text with `format`

```
print("format string".format(parameters))
```

- A format string can contain *placeholders* to insert parameters:
  - `{:d}` integer
  - `{:f}` real number
  - `{:s}` string
    - these placeholders are used instead of + concatenation

  - Example:

```
x = 3;
y = -17;
print("x is {:d} and y is {:d}!".format(x, y))
      # x is 3 and y is -17!
```

format width

- `{:Wd}` integer, **W** characters wide
- ...

```
for i in range(1, 4):
    for j in range(1, 11):
        print("{:4d}".format(i * j), end='')
    print()   # to end the line
```

Output:

```
   1   2   3   4   5   6   7   8   9  10
   2   4   6   8  10  12  14  16  18  20
   3   6   9  12  15  18  21  24  27  30
```

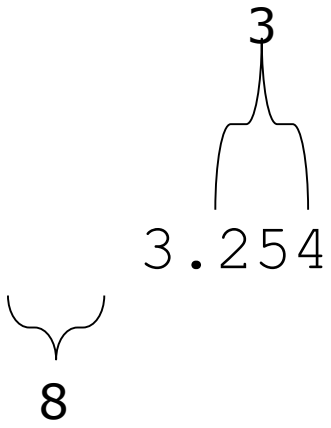
format precision

- {:.**D**f} real number, rounded to **D** digits after decimal
- {:**W**.**D**f} real number, **W** chars wide, **D** digits after decimal

```
gpa = 3.253764
print("your GPA is {:.1f}".format(gpa))
print("more precisely: {:8.3f}".format(gpa))
```

Output:

```
your GPA is 3.3
more precisely:    3.254
```



`format` question

- Modify our `Receipt` program to better format its output.
  - Display results in the format below, with 2 digits after `.`

- Example log of execution:

```
How many people ate? 4
Person #1: How much did your dinner cost? 20.00
Person #2: How much did your dinner cost? 15
Person #3: How much did your dinner cost? 25.0
Person #4: How much did your dinner cost? 10.00

Subtotal:  $70.00
Tax:       $5.60
Tip:       $10.50
Total:     $86.10
```

format answer (partial)

```
...

# Calculates total owed, assuming 8% tax and 15% tip
def results(subtotal):
    tax = subtotal * .08
    tip = subtotal * .15
    total = subtotal + tax + tip

    # print("Subtotal: $" + str(subtotal))
    # print("Tax: $" + str(tax))
    # print("Tip: $" + str(tip))
    # print("Total: $" + str(total))

    print("Subtotal: ${:.2f}".format(subtotal))
    print("Tax:      ${:.2f}".format(tax))
    print("Tip:      ${:.2f}".format(tip)}
    print("Total:    ${:.2f}".format(total))
```