Introduction to Programming CS101

Fall 2011

Lecture #3

On-line class review (recorded on Wednesdays)

- site: `http://cyber.kaist.ac.kr`
- id: student id
- password: last 7 digits of your residence/foreign registration number

Review

What we have learned so far:

- function definitions
- function calls
- method calls
- for loops
- while loops
- conditionals

Objects

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The Python Zoo:
Imagine there is a zoo inside your Python interpreter.
Every time you create an object, an animal is born.
What an animal can do depends on the type (kind) of animal:
birds can fly, fish can swim, elephants can lift weights, etc.
When an animal is no longer used, it dies (disappears).

Making objects

You can create objects as follows:

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Numbers: Simply write them:

```
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3.14159265
-5
3 + 6j
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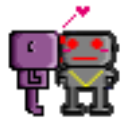
Strings: (a piece of text)

Write text between quotation marks (" and ’ are both okay):

```
"CS101 is wonderful"
’The instructor said: "Well done!" and smiled’
```



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Strings: (a piece of text)

Write text between quotation marks (" and ’ are both okay):

```
"CS101 is wonderful"
’The instructor said: "Well done!" and smiled’
```

Booleans: (truth values)

Write `True` or `False`.

Making more objects

Complicated objects are made by calling functions that create them:

```
from cs1robots import *
Robot()

from cs1media import *
load_picture("photos/geowi.jpg")
```

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```

A tuple object is an object that contains other objects.
To create a tuple, write objects separated by commas (usually in parenthesis):

```
(3, 2.5, 7)
("red", "yellow", "green")
(20100001, "Hong Gildong")
```

Different animals: Types

Every object has a type. The type determines what the object can do, and what you can do with the object. For instance, you can add two numbers, but you cannot add two robots.

Different animals: Types

Every object has a type. The type determines what the object can do, and what you can do with the object. For instance, you can add two numbers, but you cannot add two robots.

The Python interpreter can tell you the type of an object:

```
>>> type(3)
<type 'int'>
>>> type(3.1415)
<type 'float'>
>>> type("CS101 is fantastic")
<type 'str'>
>>> type(3 + 7j)
<type 'complex'>
>>> type(True)
<type 'bool'>
```

Integer number: int

Floating point number: float

String: str

Complex number: complex

Boolean: bool

More types

Types of more complicated objects:

```
>>> type(Robot())
<class 'cs1robots.Robot'>
>>> type( (3, -1.5, 7) )
<type 'tuple'>
>>> type( load_picture("geowi.jpg") )
<class 'cs1media.Picture'>
```

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<class 'cs1robots.Robot'>
>>> type( (3, -1.5, 7) )
<type 'tuple'>
>>> type( load_picture("geowi.jpg") )
<class 'cs1media.Picture'>
```

Some object types are built into the Python language:

`<type 'xxx'>`

Other object types are defined by Python modules:

`<class 'xxx'>`

Names

Objects can be given a name:

```
message = "CS101 is fantastic"
n = 17
hubo = Robot()
pi = 3.1415926535897931
finished = True
img = load_picture("geowi.jpg")
```

Names

Objects can be given a name:

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message = "CS101 is fantastic"
n = 17
hubo = Robot()
pi = 3.14159265358979 31
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We call a statement like `n = 17` an assignment, because the name `n` is assigned to the object `17`.

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We call a statement like `n = 17` an assignment, because the name `n` is assigned to the object `17`.

In the Python zoo, the name is a sign board on the animal's cage.

Variable names

The rules for variable and function names:

- A name consists of letters, digits, and the underscore `_`.
- The first character of a name is a letter.
- The name cannot be a keyword such as `def`, `if`, `else`, or `while`.
- Upper case and lower case are different: `Pi` is not the same as `pi`.

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Good:

```
my_message = "CS101 is fantastic"
a13 = 13.0
```

Bad:

```
more@ = "illegal character"
13a = 13.0
def = "Definition 1"
```

Variables

Names are often called variables, because the meaning of a name is variable: the same name can be assigned to different objects during a program:

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To indicate that a variable is empty, we use the special object `None` (of type `NoneType`):

```
m = None
```

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>>> print img.size()
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width and height in pixels

display the image

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>>> b = "banana"
>>> print b.upper()
BANANA
```

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Operators

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```
>>> 2**16
65536
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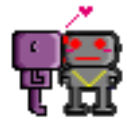
`//` is integer division (division without fractional part):

```
>>> 13.0 // 4.0
3.0
```



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Warning: In Python 2, the division operator `/` works like `//` if both objects are `int` objects. This has been fixed in Python 3:

```
>>> 9 / 7
1
>>> from __future__ import division
>>> 9 / 7
1.2857142857142858
```

Expressions

An expression is a combination of objects, variables, operators, and function calls:

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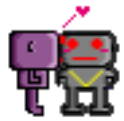
When in doubt, use parentheses!



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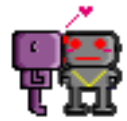

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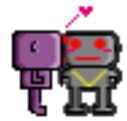

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Use `a/(2*pi)` or `a/2/pi`.

All operators also work for complex numbers.

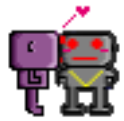
String expressions

The operators + and * can be used for strings:

```
>>> "Hello" + "CS101"
'HelloCS101'
>>> "CS101 " * 8
'CS101 CS101 CS101 CS101 CS101 CS101 CS101 CS101 '
```

Boolean expressions

A boolean expression is an expression whose value has type `bool`. They are used in `if` and `while` statements.



Boolean expressions

A boolean expression is an expression whose value has type `bool`. They are used in `if` and `while` statements.

The operators `==`, `!=`, `>`, `<`, `<=`, and `>=` return boolean values.

```
>>> 3 < 5
True
>>> 27 == 14
False
>>> 3.14 != 3.14
False
>>> 3.14 >= 3.14
True
>>> "Cheong" < "Choe"
True
>>> "3" == 3
False
```

Equality—don't confuse with `=`

Logical operators

The keywords `not`, `and`, and `or` are logical operators:

```
not True == False
not False == True

False and False == False
False and True == False
True and False == False
True and True == True

False or False == False
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Careful: if the second operand is not needed, Python does not even compute its value.

Tuples

A tuple is an object that contains other objects:

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position = (3.14, -5, 7.5)
profs = ("Yoonjoon Lee", "In-Young Ko",
         "Sukyoung Ryu")
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Packing and unpacking in one line:

```
a, b = b, a
```

Colors

Colors are often represented as a tuple with three elements that specify the intensity of red, green, and blue light:

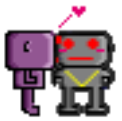
```
red = (255, 0, 0)
blue = (0, 0, 255)
white = (255, 255, 255)
black = (0, 0, 0)
yellow = (255, 255, 0)
purple = (128, 0, 128)

from cs1media import *
img = create_picture(100, 100, purple)
img.show()
img.set_pixels(yellow)
img.show()
```

Digital images

A digital image of width `w` and height `h` is a rectangular matrix with `h` rows and `w` columns:

$0,0$	$1,0$	$2,0$	$3,0$	$4,0$
$0,1$	$1,1$	$2,1$	$3,1$	$4,1$
$0,2$	$1,2$	$2,2$	$3,2$	$4,2$



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$0, 1$	$1, 1$	$2, 1$	$3, 1$	$4, 1$
$0, 2$	$1, 2$	$2, 2$	$3, 2$	$4, 2$

We access pixels using their `x` and `y` coordinates.
`x` is between 0 and `w-1`, `y` is between 0 and `h-1`.

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```
>>> img.get(250, 188)
(101, 104, 51)
>>> img.set(250, 188, (255, 0, 0))
```

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red, green, blue triple

For loops

A for-loop assigns integer values to a variable:

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for i in range(4):
  print i
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```
>>> for i in range(7):
>>>   print "*" * i

*
**
***
****
*****
******
```

Negative of a photo

```
from cs1media import *

img = load_picture("../photos/geowi.jpg")
w, h = img.size()
for y in range(h):
  for x in range(w):
    r, g, b = img.get(x, y)
    r, g, b = 255 - r, 255 - g, 255 - b
    img.set(x, y, (r, g, b))
img.show()
```

Black & white photo

```
from cs1media import *
threshold = 100
white = (255, 255, 255)
black = (0, 0, 0)

img = load_picture("../photos/yuna1.jpg")
w, h = img.size()
for y in range(h):
  for x in range(w):
    r, g, b = img.get(x, y)
    v = (r + g + b) // 3      # average of r,g,b
    if v > threshold:
        img.set(x, y, white)
    else:
        img.set(x, y, black)
img.show()
```

Objects with two names

The same object can have more than one name:

```
hubo = Robot("yellow")
hubo.move()
ami = hubo
ami.turn_left()
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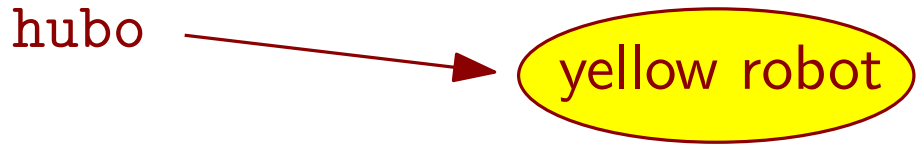

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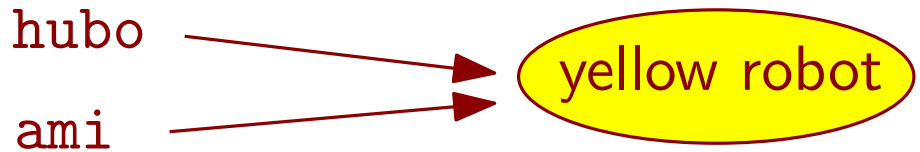

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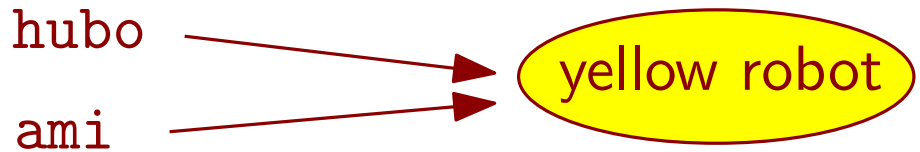


```
hubo = Robot("blue")
hubo.move()
ami.turn_left()
ami.move()
```

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ami = hubo
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hubo.move()

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