CSE 1061 **Introduction to Computing**

Lecture 5

Fall 2015

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The School of EE & Computing
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OUTLINE

Review: what we have done

Objects: Values and types

Variables

Operators and operands

Expressions

Case study: Photo Processing

Reading assignment

- Chapter 3 of the **textbook**
- The lecture note for **cs1media**

Download two image files, **images and photos**

REVIEW

Characteristics of Python

Instruction set

Arithmetic and logical operations

  +, -, *, /, and **

  and, or, not

for defining expressions

Assignment

Conditionals

Iterations

Input/output

No pointers

No declarations

What we have learned

Through 2D robot control we learned:

- conditionals: `if, if~else, and if~elif~else`
- iterations
  - for-loops
  - while-loops
- assignment, e.g., hubo = Robot()
- functions

Picked up the main constructs for programming.

OBJECTS: VALUES AND TYPES

Programs work with **data**. **Every piece of data** in a Python
program is called an **object** , e.g.,

3, 5.7, “Smith”, True, ... simple
a digital photograph , hubo, ... complex

A **value** itself is an **object**.

Every object has a **type**. The **type** determines **what you can do with an object**.

Python Zoo

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

How to create objects?

Simple objects: by writing them

Numbers

```
integer: 13, -5

float: 3.14159265

complex number: 3 + 6j
```

Strings(a piece of text)

```
“cce20003 is wonderful”
 “cce20003 is great”

 “The instructor said: ‘Well done!’ and smile”
```

Booleans(truth values)

```
True or False
```

Complex objects

User-defined objects: by calling functions that create them

```
from cs1robots import *
hubo = Robot()

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

Data structures (objects composed of another objects):

by writing them

Tuples

(1, 3, 5, 7, 9)

(“red”, “green”, “blue”)

(777, “a lucky number”)

Lists

Dictionary

} to be discussed later

Tuples

```
position = (3.0,  7.2,  5.7)
Instructors = (“Joseph S. Shin”, “Chang B. Choi”)
```

A **tuple** is a **single object** of **type tuple**:

```
>>> print position, type(position)
(3.0, -7.2, 5.7) <type ’tuple’>
```

We can **unpack** tuples:

```
x, y, z = position
```

Object types: The **type** of an object determines **what the object can do** or **what you can do with the object**. For instance, you can add two numbers, but you cannot add two robots.

Type inquires

```
>>>type(3)
<Type ‘int’>
>>>type(3.145)
<Type ‘float’>
>>>type(“Welcome”)
<Type ‘str’>
```

```
>>>type(3 + 5j)
<Type ‘complex’>
>>>type(True)
<Type ‘bool’>
```

```
>>> from cs1robots import *
>>> type(Robot())
<class ’cs1robots.Robot’>

>>>from cs1media import *
>>> type( load_picture(“photos/geowi.jpg") )
<class ’cs1media.Picture’>

>>> type( (3, -1.5, 7) )
>>><type ’tuple’>
```

VARIABLES

A **variable** is a **name** that refers to an **object**(or a **value**).

An **assignment** statement is used to **define** a **variable**:

```
message = “Welcome“
n = 17
from cs1robots import *
create_world()
hubo = Robot()

pi = 3.1415926535897931
finished = True

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

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

Rules for **variables** 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.

Good:

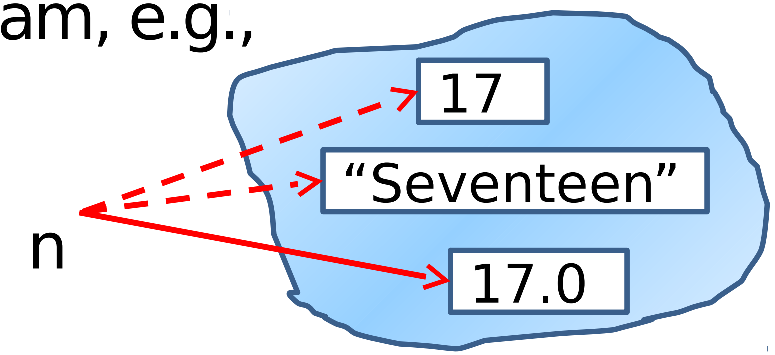
```
msg = “cce20003 is fantastic“
ba13 = 13.0
```

Bad:

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

The **same name** can be assigned to **different objects** (of **different types**) in a program, e.g.,

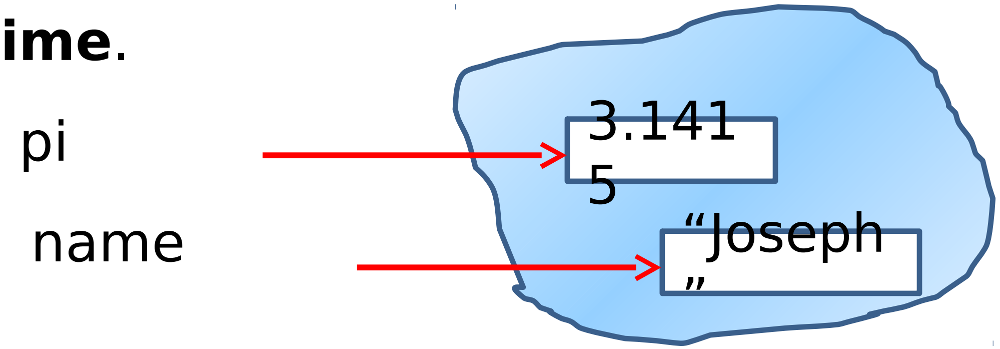
```
n = 17

n = "Seventeen“

n = 17.0
```



In the Python zoo, this means that the sign board is moved from one animal to a different animal.

The **object** binding to a name is called the **value** of the **variable**. The **value** can change over **time**.

```
pi  = 3.1415
name = “Joseph”
```



pi

name

3.141
5

“Joseph
”

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

```
m = None
```

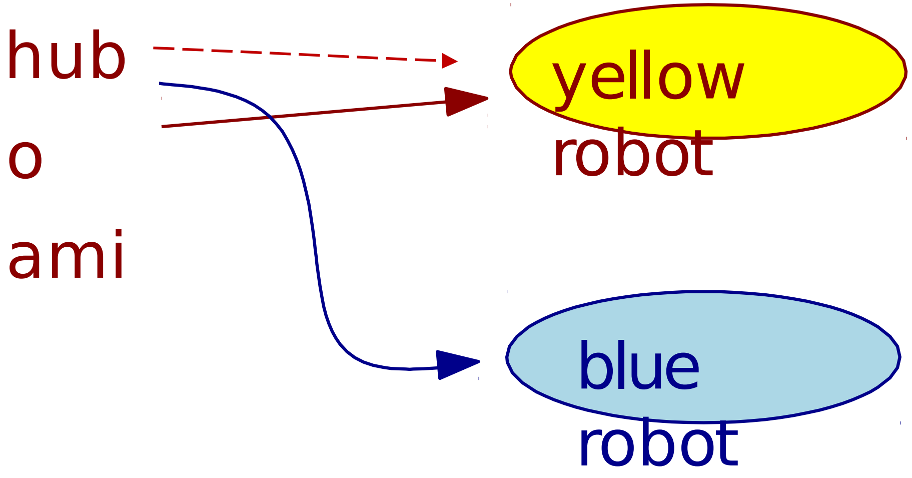
What objects can do depends on the **type of object**: a bird can fly, a fish can swim. Objects provide **methods** to perform these actions. The **methods** of an **object** are used through **dot-syntax:**

```
>>> b = "banana"
>>> print b.upper()
BANANA
>>>from cs1robots import *
>>> hubo = Robot()
>>> hubo.move()
>>> hubo.turn_left()
>>>from cs1media import *
>>>img = load_picture(“photos/yuna1”)
>>> print img.size()
(58, 50)
>>> img.show()
```

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

The same object may have more than one name!

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



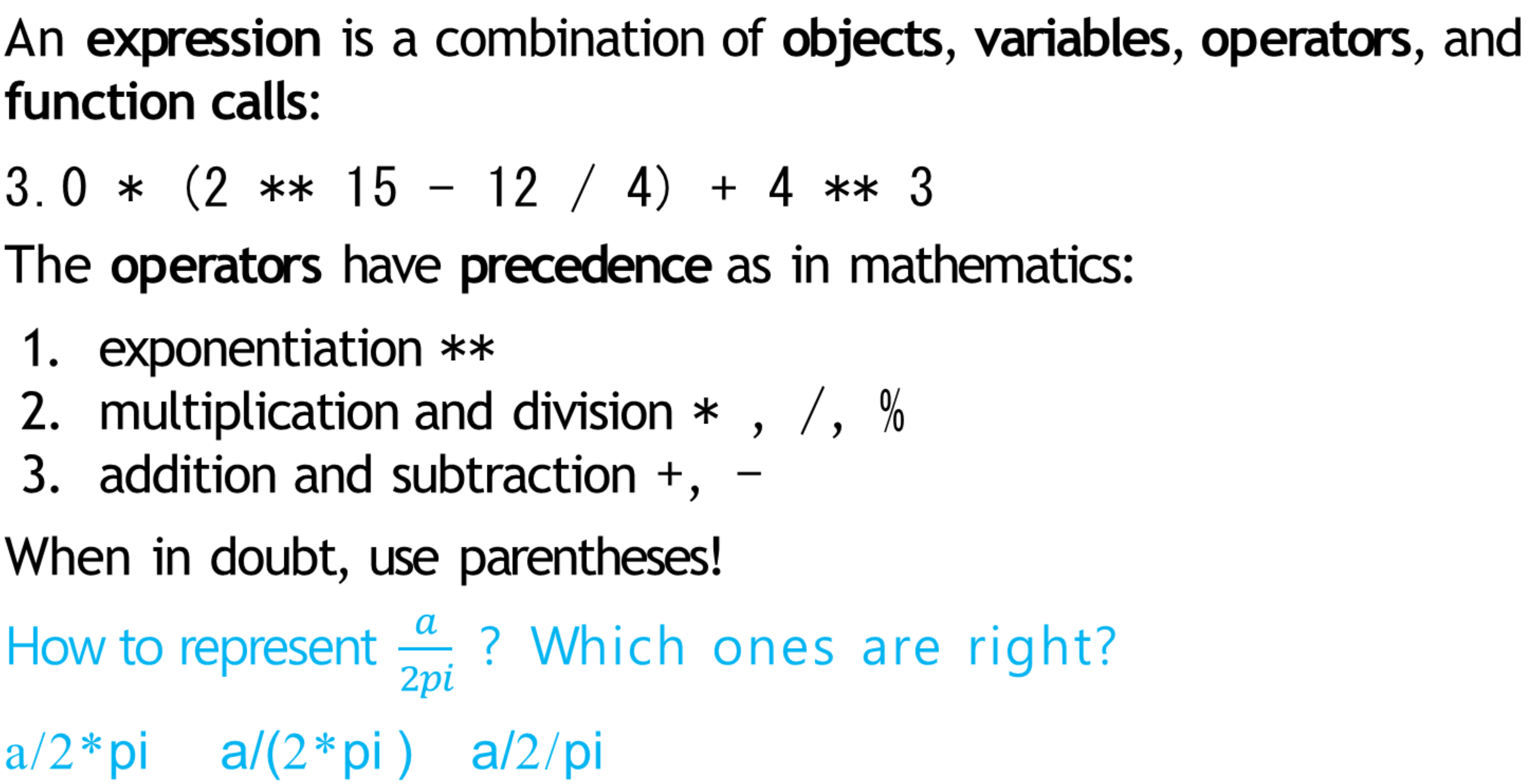
OPERATORS AND OPERANDS

Arithmetic operators are special symbols that represent **computations** such as **+, -, *, /, %,** and ******. **Operands** are the **values** to which an operator is applied.

```
>>> 2 ** 16        a ** b = ab
65536
>>>15.3 + 3.0
18.3
>>>7 % 5
2
>>>7 / 5
1
>>>7.0 / 5
1.4
```

EXPRESSIONS AND STATEMENTS

- Expressions



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

```
3.0 * (2 ** 15 - 12 / 4) + 4 ** 3
```

The **operators** have **precedence** as in mathematics:

1. exponentiation **
2. multiplication and division * , /, %
3. addition and subtraction +, -

When in doubt, use parentheses!

How to represent $\frac{a}{2pi}$? Which ones are right?

a/2*pi   a/(2*pi)   a/2/pi

The **operators** + and * can be used for **strings**:

```
>>> "Hello " + “cce20003”
‘Hello cce2003’
```

```
>>> “cce20003 " * 8
‘cce20003 cce20003 cce20003 … cce2000’
```

Repeating 8 times!

Relational operators ==, !=, >, <, <=, and >= are used to compare objects. The results are **Boolean values, True** or **False.** A **Boolean expression** is an expression whose **value** is of **type bool**. They are used in if and while statements.

```
>>>27 == 14
False
>>> 3.14 != 3.14
False

>>> 3.14 >= 3.14
True
>>> “Cheong” < “Choe”
True
>>> "3" == 3
False
```

```
x = 9

if x == 3 ** 2 :

    print  “x is a perfect square”


if x % 2 != 0:

  print  “x is odd”
```

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

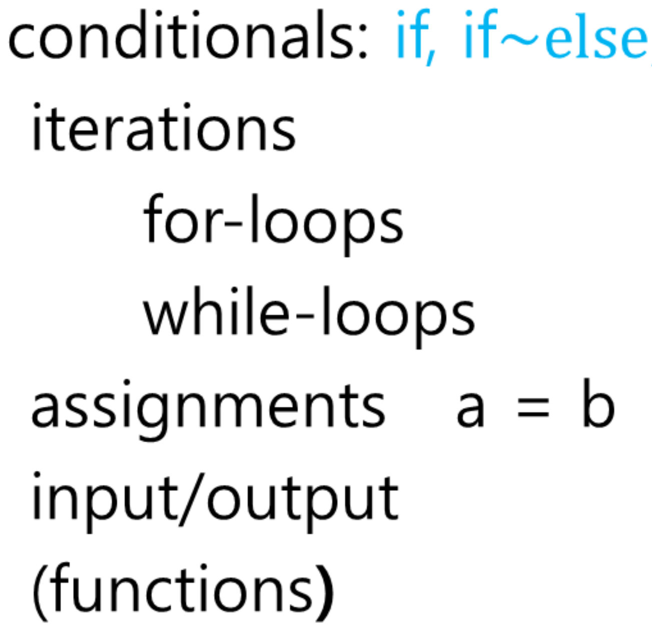
not True → Flase

not False → True

False and False → False		False or False → False	
False and True → False		False or True → True	
True and False → False		True or False → True	
True and True	True	True or True	True

```
x = 5.0
y = 6.0
z = 7.0

if x < y and y < z:
    print “z is the largest one.”
if y < x or y < z:
    print “ y is not the least one.”
if not z >= 6.0:
    print “z is not the largest one.”
```

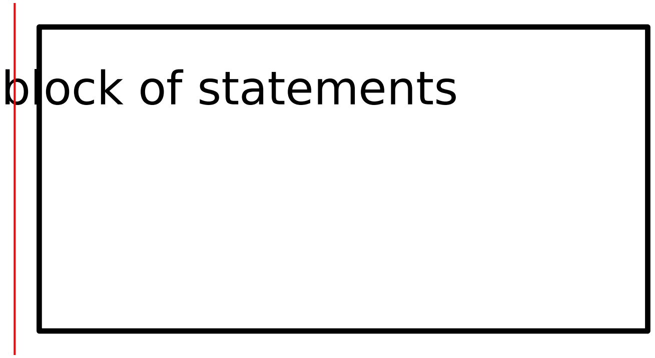
STATEMENTS(INSTRUCTIONS)



- conditionals: if, if~else, and if~elif ~else
- iterations
  - for-loops
  - while-loops
- assignments a = b
- input/output
- (functions)

Review: for-loops

for **variable** in range(n):



block of statements

The **block** of **statements**(instructions) are executed **n times**. While performing the block, **variable** changes **from 0 to n-1**.

Starting from 0, it is incremented by one at each iteration

to reach n-1.

```
for i in range(4):
   print i
```

What does this short code do?

It prints 0, 1, 2, and 3.

```
For  i  in range(7):
   print "*“   *  i
```

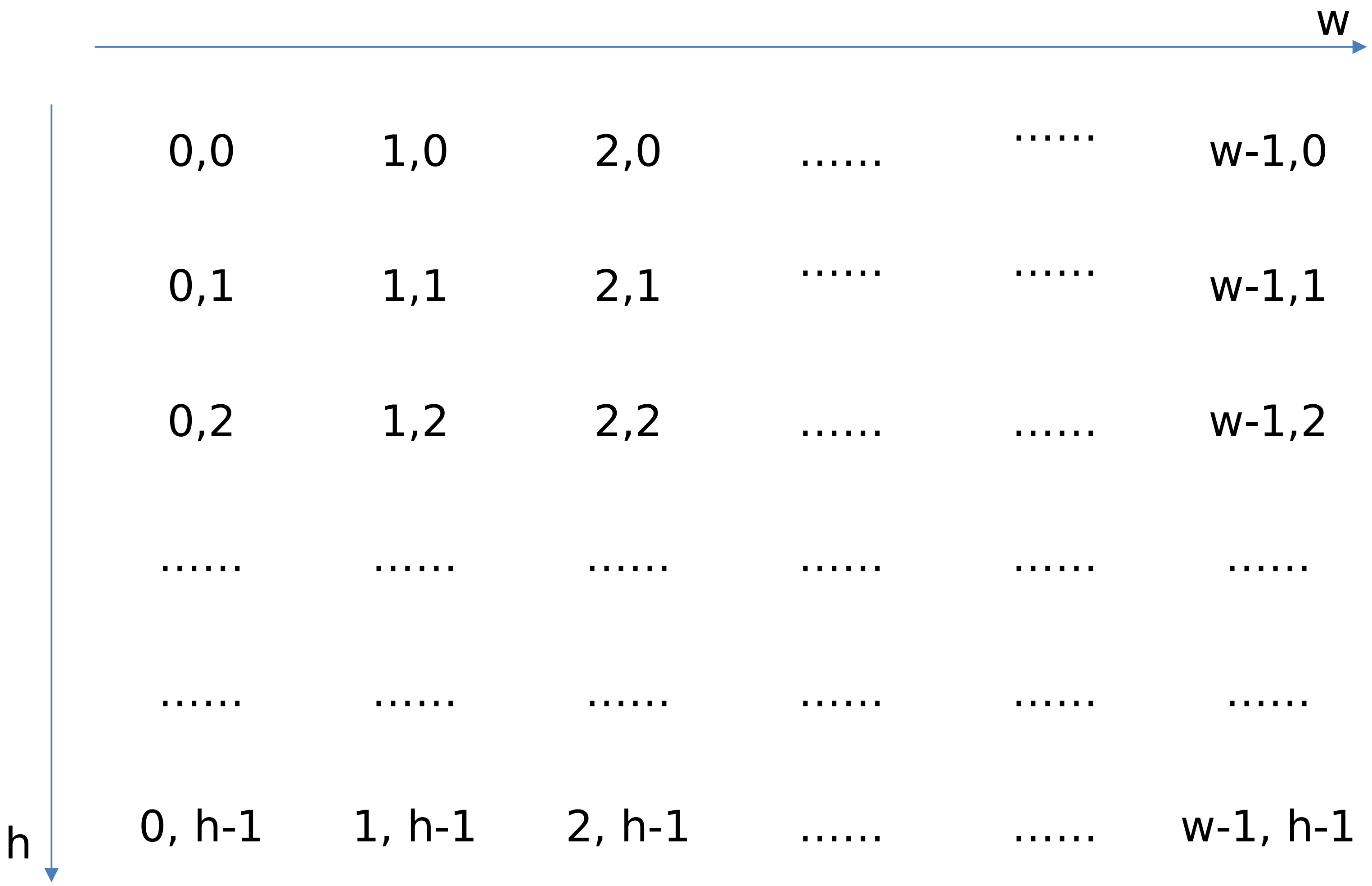
What does this short code do ?

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

CASE STUDY: PHOTO PROCESSING

Reference : Otfried Cheong, Photo processing with cs1media

pixel coordinates (x, y), $0 \le x < w$, $0 \le y < h$



0,0	1,0	2,0	……	……	w-1,0
0,1	1,1	2,1	……	……	w-1,1
0,2	1,2	2,2	……	……	w-1,2
……	……	……	……	……	……
……	……	……	……	……	……
0, h-1	1, h-1	2, h-1	……	……	w-1, h-1

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

```
red = (255, 0, 0)
green = (0, 255, 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()
```

```
“yellow”: (255, 255, 0)
“purple”: (128, 0, 128)
```

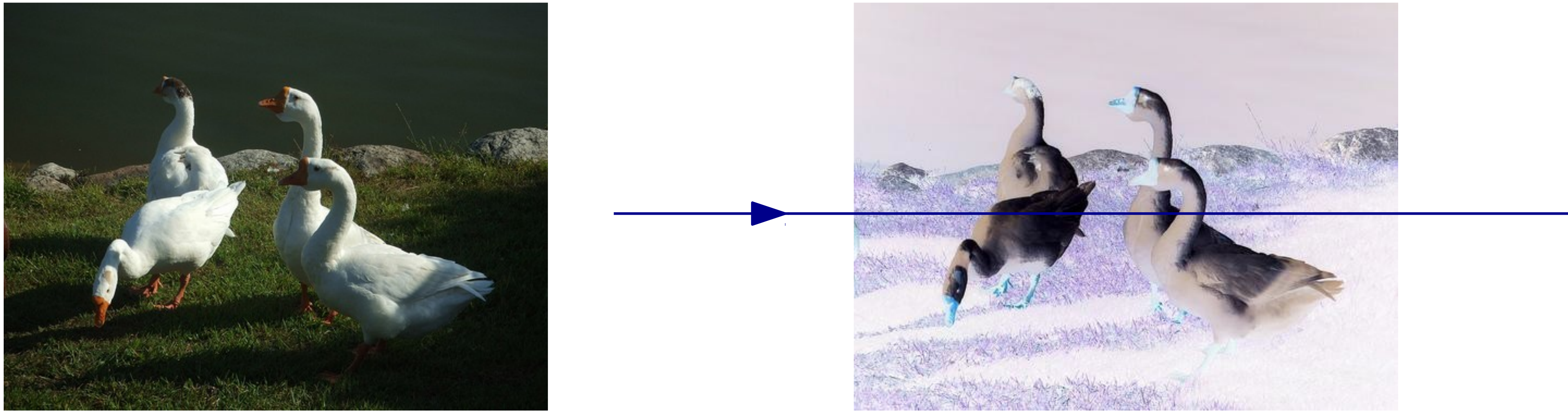
red, green, blue triples

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

Color conversion

(r, g, b)

(255-r, 255-g, 255-b)



```
from cs1media import *
img = load_picture(“./images/yuna.jpg")
w, h = img.size()
for y in range(h):
  for x in range(w):
    r, g, b = img.get(x, y)
```

```
w, h = img.size()
white = 255
black=0
print "imae size: w,h = ", w,h
for y in range(h):
    for x in range(w):
           r, g, b = img.get(x,y)
           v = (r+g+b) / 3.0
           if  v  > 100:
          img.set(x,y, white)
         else:
          img.set(x,y, black)
img.show()
```

threshold
(0 <= v <= 255)