# Python Basics

Functions, control, logic

CS101 Lecture #5

2016-10-10

# Administrivia

# *Administrivia*

- Homework #2 was due Oct 3rd.
- Don't send emails for homework deadline extension, except for *Very* special conditions
- Labs this Wednesday

# **Warmup** (review)

# *Function*

```
def f(x):
    y = x ** 2
    area = 0.5 * math.pi * y
    return area
```

# Functions cont.d

# *Example*

```
def greetings():
    print('Bom dia!')
    print('Bonjour!')
    print('Hello!')
    print('Ni Hao!')
    print('Shalom!')
    print('Guten tag!')
    print('Konichiwa!')
    print('As-salamu alaykum!')
```

header

body

# *Example*

```
def pow(a, b):
    y = a ** b
    return y
```

# *Defining a function*

- We define a function with the following
  - Keyword `def`
  - The name of the function
  - A pair of parentheses
  - Arguments inside the parentheses (optional)
  - Return value (optional)
  - A **block** of code

```
def pow(a, b):
  y = a ** b
  return y
```

# *Block*

- A section of code grouped together
- Starts after a :
- Contents of the block are ***indented*** *at the same level*

```
def pow(a, b):
    y = a ** b
    return y
```

# *Example*

```
a = 5
def fun():
   a = 3
   print(a)

fun()
```

# *Example*

```
a = 5
def fun():
   a = 3
print(a)

fun()
```

# *Scope*

- Variables defined inside of a block are *Independent* of variables outside of the block
- Variables inside a block do not exist outside of the block – scope
- The scope of a function is isolated from the rest of the code

```
def pow(a, b):
  y = a ** b
  return y
```

# *Example*

```
def fun():
    a = 3
    b = 4
    a = a + b
fun()
print(a)
```

# *Example*

```
a = 5
def fun():

  b = 4
  a = a + b
fun()
print(a)
```

# *Example*

```
a = 5
def fun():
    a = 3
    b = 4
    a = a + b
fun()
print(a)
```

# *return*

```
a = 5
def fun():
    a = 3
    b = 4
    a = a + b
    return a
a = fun()
print(a)
```

# `return`

- Functions can return values to the *outer* scope with the keyword return
- The returned values can be assigned to a variable after the function call

# *return*

```
a = 5
def fun():
    a = 3
    b = 4
    a = a + b
    return a
fun()
print(a)
```

# *Example*

```
a = 5
def fun():
  a = 3
  return a

b = fun()
print(a)
print(b)
```

# *return*

- Does the code below face an error?
- Does the print statement take effect if invoking the function?

```
def three():
    return 3
    print('3')
```

# *Arguments*

- Functions can accept values as argument (input, parameters)
- These variables are declared in the function header
- Multiple arguments are separated by commas

```
def print_message(msg):
  print(msg)
```

# *Example*

```
def fun(a, b):
    c = (a+' ')*len(b)
    return c

x = fun('ab', 'caa')
```

What is the value of x?

A 'ab ab ab'

B 'Ab Ab Ab'

C 'AB AB AB'

D None of the above

# *Example*

```
def fun(a):
    return a+2

x = fun(2)*fun(3+1)
```

What is the value of x?

# *Return value as argument*

- The returned value of a function call can be passed to another function as argument

```
def pow(a, b):
    y = a ** b
    return y

def three():
    return 3

a = pow(three(), three()+2)
```

# *Example*

```
def fun(a):
    return a+2

x = fun(2)*fun(fun(2))
```

What is the value of x?

# *Summary*

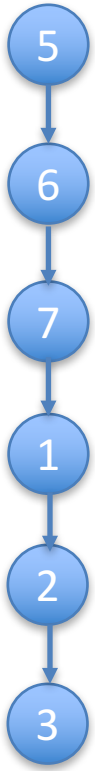
- Header and body
- Code block
- Scope
- Return value
- Argument (input, parameter)

# Conditional Execution

# *Control flow*

- A simple program execution flow

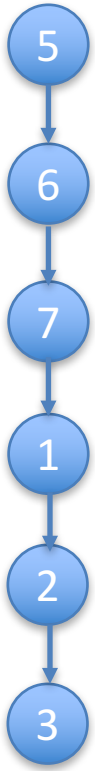
```
1. def pow(a, b):
2.     y = a** b
3.     return y
4.
5. a = 2
6. b = -3
7. print(pow(a, b))
```



# *Control flow*

- We want more flexible control of the program execution flow logic than this!

```
1. def pow(a, b):
2.     y = a** b
3.     return y
4.
5. a = 2
6. b = -3
7. print(pow(a, b))
```

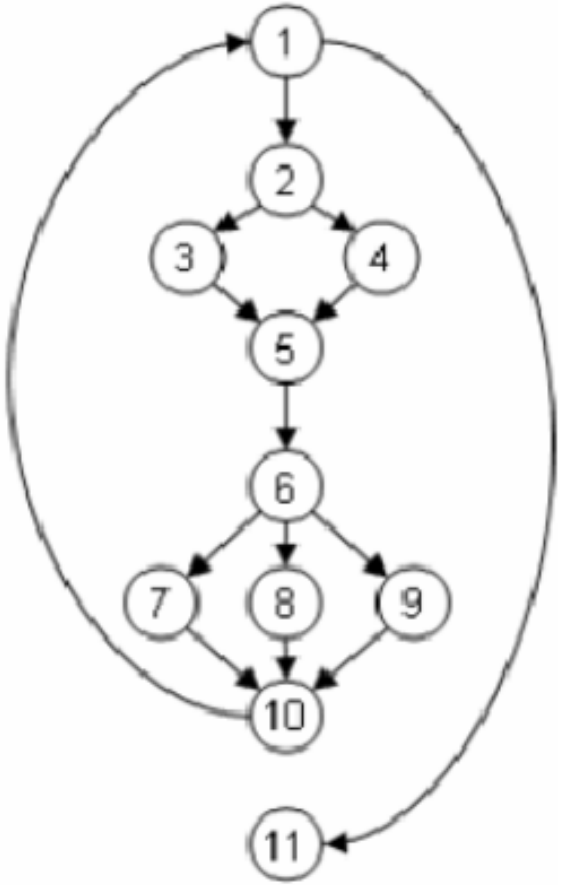


# *Control flow*

- We want more flexible control of the program execution flow logic than this!
- ***Control flow*** allows us to define it

# Control flow

| Node | Statement |
|---|---|
| (1) | `while(x<100){` |
| (2) | `  if (a[x] % 2 == 0) {` |
| (3) | `      parity =  0;` |
| | `   }` |
| | `   else {` |
| (4) | `      parity =  1;` |
| (5) | `   }` |
| (6) | `   switch(parity){` |
| | `      case 0:` |
| (7) | `        println( "a[" + i + "] is even");` |
| | `      case 1:` |
| (8) | `        println( "a[" + i + "] is odd");` |
| | `      default:` |
| (9) | `        println( "Unexpected error");` |
| | `    }` |
| (10) | `   x++;` |
| | `}` |
| (11) | `p = true;` |




A more expressive control flow graph (Code in C language; not required)

# *Conditional flow: `if` statement*

- Conditional flow allows you to execute (or not) a block of code based on logical comparison

# *Example: `if` statement*

```
ans = input('Enter a number: ')
if float(ans) < 0:
    print('the input number is negative.')
```

# *`if` statement*

- A `if` statement has the following:
  - The keyword `if`
  - A logical comparison (result in a **boolean** type)
  - A block of code (starts with a `:` )

# *if statement*

- Allows us to make decisions during the program execution
- Change program behavior based on different conditions during program execution

# *Example: `if` statement*

```
ans = input('Enter a number: ')
if float(ans) < 0:
    print('the input number is negative.')
if float(ans) >= 0:
    print('the input number is positive or zero.')
```

# *Example: `if-else` statement*

```
ans = input('Enter a number: ')
if float(ans) < 0:
    print('the input number is negative.')
else:
    print('the input number is positive or zero.')
```

- For two conditional branches that are logically complementary

# Example: `if-else` statement

```
ans = input('Enter a number: ')
if float(ans) < 0:
    print('the input number is negative.')
if float(ans) > 0:
    print('the input number is positive.')
if float(ans) == 0:
    print('the input number is zero.')
```

# *Example: `if-else` statement*

```
ans = input('Enter a number: ')
if float(ans) < 0:
    print('the input number is negative.')
elif float(ans) > 0:
    print('the input number is positive.')
else:
    print('the input number is zero.')
```

- For multiple conditional branches that are logically complementary
- `elif` means "else if"

# Example: `if-else` statement

```
def printNumber():
    ans = input('Enter a number: ')
    if float(ans) < 0:
        print('the input number is negative.')
    elif float(ans) > 0:
        print('the input number is positive.')
    else:
        print('the input number is zero.')
```

If they have eggs, get six!

http://www.dslreports.com/forum/r25743814-Wife-of-a-computer-programmer

# Boolean Logic

# `bool` Data type

- `Bool` is a data type with two possible values
  - `True`
  - `False`
- We use these to make decisions
- Their logic is based on Boolean algebra
- Operators
  - `and (&)`
  - `or  (|)`
  - `not`

# `bool` Data type

- `bool` vs. bit
  - A bool is not equal to a bit!
  - Data representation in computer is always byte-based

# *Boolean operators (review)*

| `and` | True | False |
|---|---|---|
| True | True | False |
| False | False | False |

True when BOTH inputs are true

| `or` | True | False |
|---|---|---|
| True | True | True |
| False | True | False |

True when EITHER input is true

# *Boolean operators*

| **not** | result |
| --- | --- |
| True | False |
| False | True |

Inverts input value

# *Comparison operators*

- Comparison operators produces **`bool`** type
  - Less than, <
  - Greater than, >
  - Less than or equal to, <=
  - Greater than or equal to, >=
  - Equal to, ==
  - Not equal to, !=

# *Examples: `Boolean` logic*

```
x > 0

(x > 0) or (x < -10)

(x > 0) and (x <= 10)

0 < x <= 10
```

# *Boolean logic*

- Assign a boolean type to a variable

```
x = 5
y = (x < 0) or (x > -2)
type (x)
type (y)
print(y)

x = 3 > 5
type(x)
```

# *Example*

```
def fun():
    return True and False

x = fun() or not (True or False)
```

What is the value of x?

A True

B False

# *Example*

```
a = 5
b = 3

x = (a < 5) or ((b <= 3) and (a != b))
```

What is the value of x?

A True

B False

# *Example*

```
a = 5
b = ‘hello world!’

x = (a < 5) or  (b[len(b)] == ‘!’)
```

What is the value of x?

A True

B False

# *Example*

```
a = 5
b = ‘hello world!’

x = (a < 5) and (b[len(b)] == ‘!’)
```

What is the value of x?

A True

B False