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

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 with 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(a)
```

Example

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

fun(a)
```

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)

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 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?

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))
```

$$\begin{tikzcd}
5 \arrow[d] \\
6 \arrow[d] \\
7 \arrow[d] \\
1 \arrow[d] \\
2 \arrow[d] \\
3
\end{tikzcd}$$

Control flow

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

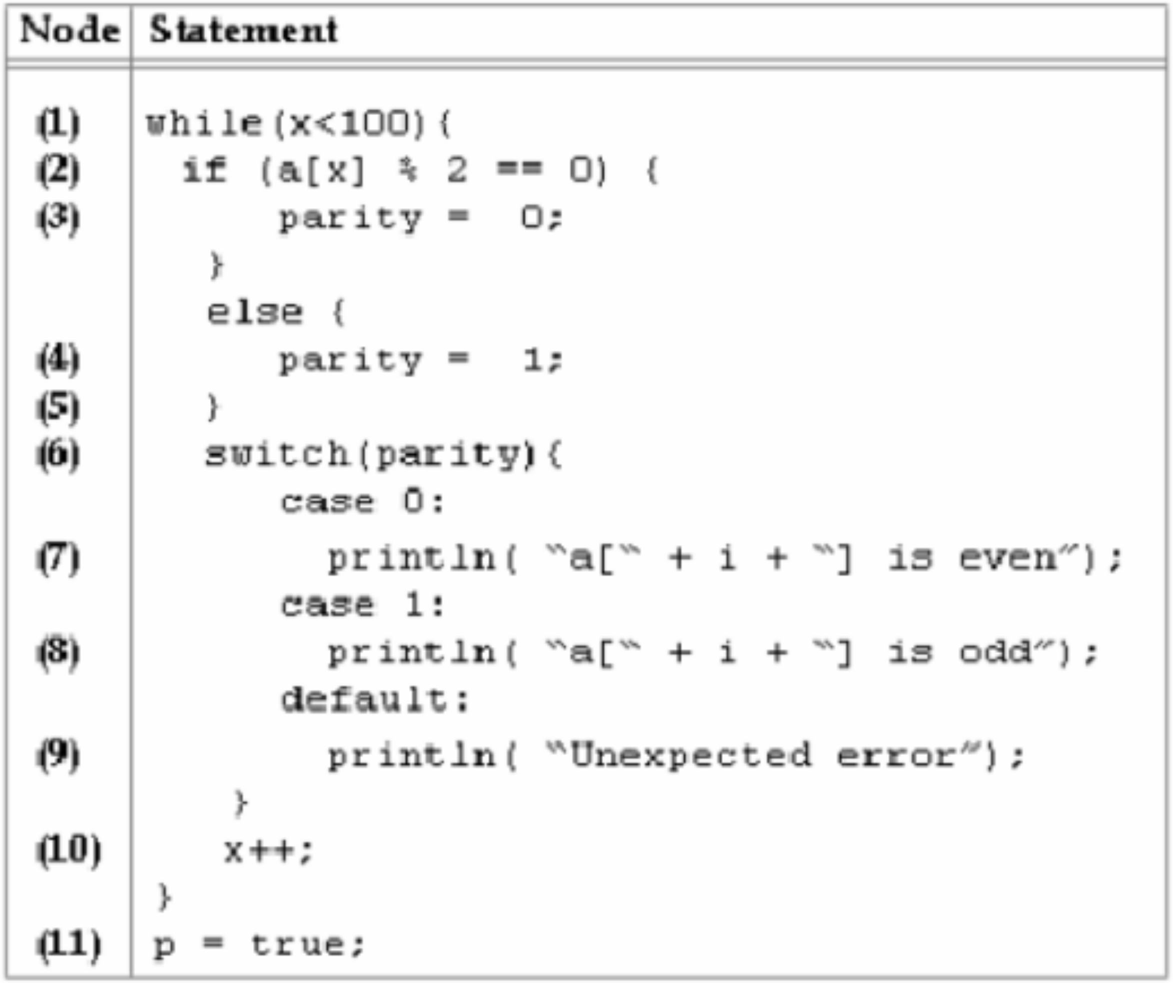
```
1. def pow(a, b):
2.     y = a** b
3.     return y
4.
5. a = 2
6. b = -3
7. print(pow(a, b))
```

$$\begin{tikzcd}
5 \arrow[d] \\
6 \arrow[d] \\
7 \arrow[d] \\
1 \arrow[d] \\
2 \arrow[d] \\
3
\end{tikzcd}$$

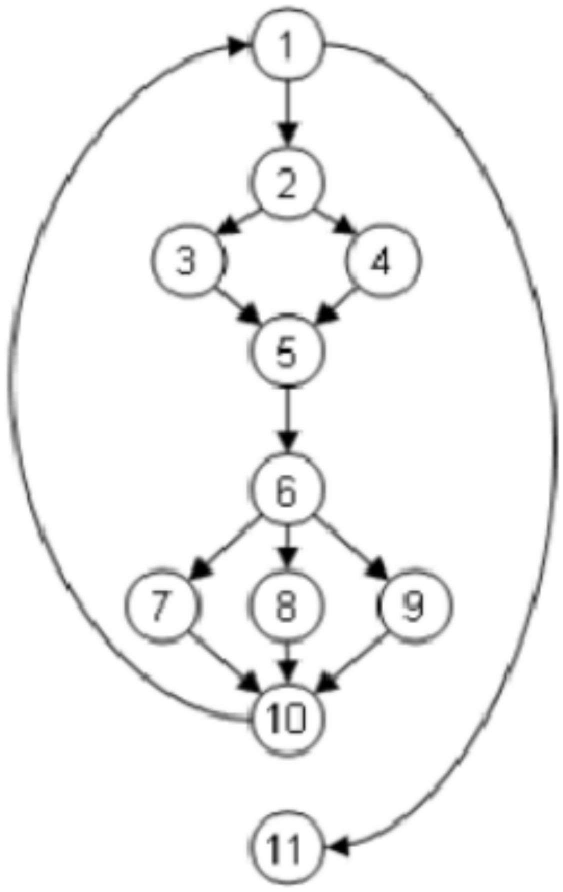
Control flow

- 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"

Control flow

- More control flow syntaxes to come!

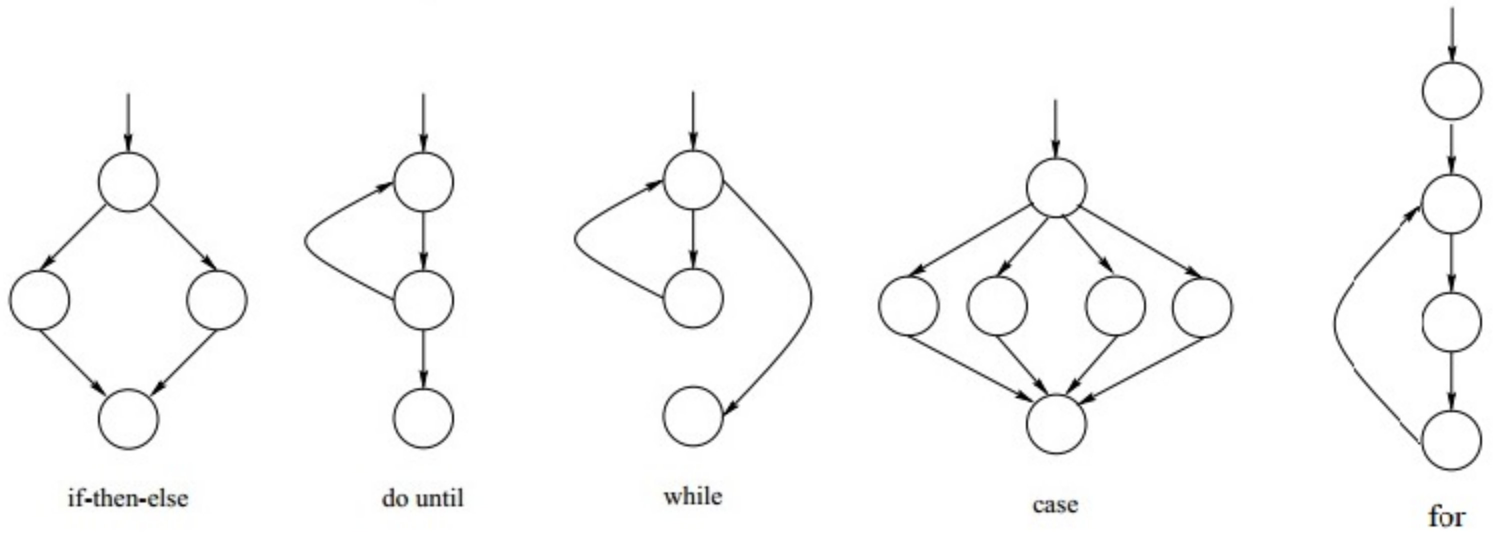


Figure 1: Flow graph representation.

Control flow

If they have eggs, get six!

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

Boolean Logic

Boolean

- `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`

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() and 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

Try this out..

```
a = 5
b = ‘hello world!’

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