COMP10001 Foundations of Computing
Conditionals

Semester 2, 2018

Chris Leckie & Nic Geard

THE UNIVERSITY OF MELBOURNE

Lecture Agenda

- Last lecture:
  - String slicing and indexing
- This lecture:
  - String formatting
  - Character encodings
  - Tuples
  - Truth conditions

Strings and Formatting

Often we want our output to be pretty.
Use the `format()` method of a string:

```
>>> "{0} and {1}".format(1,1.0)
'1 and 1.0'
>>> "{0:.2f} and {0}".format(1,1.0)
'1.00 and 1'
>>> "{0:d} {0:x} {0:o} {0:b}".format(42)
'42 2a 52 101010'
>>> "{0[0]} {0[1]}".format('abcdef')
'a b'
```

Method: a function that is a member of an object.
Object: a collection of data and functions. eg `str`

More later in the course - don't panic

Character Representation

- Computers like bits, and so represent characters as (positive) integer codes
- Python3 defaults to UTF-8 encoding: Unicode, with 8 bits for ASCII, where the character `'A'` has a numerical value of 65, `'B'` is 66, ...
- Code↔character conversion:
  - `ord()`: convert an ASCII character into its code
  - `chr()`: convert an `int` code (0–255) into its corresponding ASCII character
- This is important when we sort strings/check for string "precedence"

Tuples I

- Tuples (`tuple`) are very similar to strings, in that they can be of arbitrary length and can be indexed and sliced...
- However, they can contain more than characters.

```
>>> t = (1.2, 'twine', 3)
>>> t[1]
['twine']
>>> t[0:2]
(1.2, 'twine')
```

Tuples II

- The main places where we will use tuples are:
  - as keys to dictionaries (see later ...)
  - as a way of passing/returning multiple values to functions (see later...)
  - in assignments, e.g.:

```
>>> a = 1; b = 2
>>> print(a,b)
(1, 2)
>>> (a,b) = (b,a)
>>> print(a,b)
(2, 1)
```

What do we know so far?

Syntax

- Maths...
- `print()`, `len()`, `abs()`
- `int`, `float`, `complex`, `str`, tuples
- `*`, `+` for strings
- Variables, assignment `=`

Semantics

- Maths expressions are resolved with BODMAS
- Types are important: overloading
- Assignment changes state

In Search of the Truth ...

- Often, we want to check whether a particular value satisfies some condition:
  - does it have four legs?
  - is it over 18?
  - should we add another 'na' to Hey Jude?
- For this, we require:
  - a way of describing whether the test is satisfied or not
  - a series of comparison operators
  - a series of logic operators for combining comparisons
  - a way of conditioning behaviour on the result of a given test

Capturing Truth: The `bool` Type

- We capture truth via the `bool` (short for "Boolean") type, which takes the two values:
  - `True`
  - `False`
- As with other types, we can "cast" to a `bool` via the `bool()` function:

```
>>> bool(3)
True
>>> bool(0)
False
>>> bool("banana")
True
```

Every type has a unique value for which `bool()` evaluates to `False` (what are they?)

Evaluating Truth: Comparison

- We evaluate truth via the following Boolean comparison operators:

`==`	equality; NOT the same as `=`
`>`, `>=`	greater than (or equal to)
`<`, `<=`	less than (or equal to)
`!=`	not equal to
`in`	is an element of

```
>>> 2 == 3
False
>>> 'a' <= 'apple'
True
>>> 2 != 3
True
>>> '3' in '11235'
True
```

Combining Truth

- We combine comparison operators with the following logic operators:
  - `and`, `or`, `not`:

`and`	`True`	`False`
`True`	`True`	`False`
`False`	`False`	`False`

`or`	`True`	`False`
`True`	`True`	`True`
`False`	`True`	`False`

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

- NB: precedence: `not` > `and` > `or`

Combining Truth: Examples I

```
>>> age = 20
>>> age >= 18
True
>>> tall = True; ears = "rabbit"; back = "grey"
>>> whiskers = True; stomach = "cream"
>>> tall and ears == "rabbit" and back == "grey" \
... and whiskers and stomach == "cream"
True
>>> not False or True
True
>>> not (False or True)
False
>>> year = 2015
>>> 2001 < year and year < 2100
True
>>> 2001 < year < 2100
True
```

Combining Truth: Examples II

- The way logic operators are interpreted in Python is by evaluating the truth value of each operand, and combining them, e.g.:

```
>>> tall and ears == "rabbit" and 3
```

is equivalent to:

```
>>> bool(tall) and bool(ears == "rabbit") \
... and bool(3)
```

Conditioning and Code Blocks

- We can condition the execution of a "block" of code with `if` statements

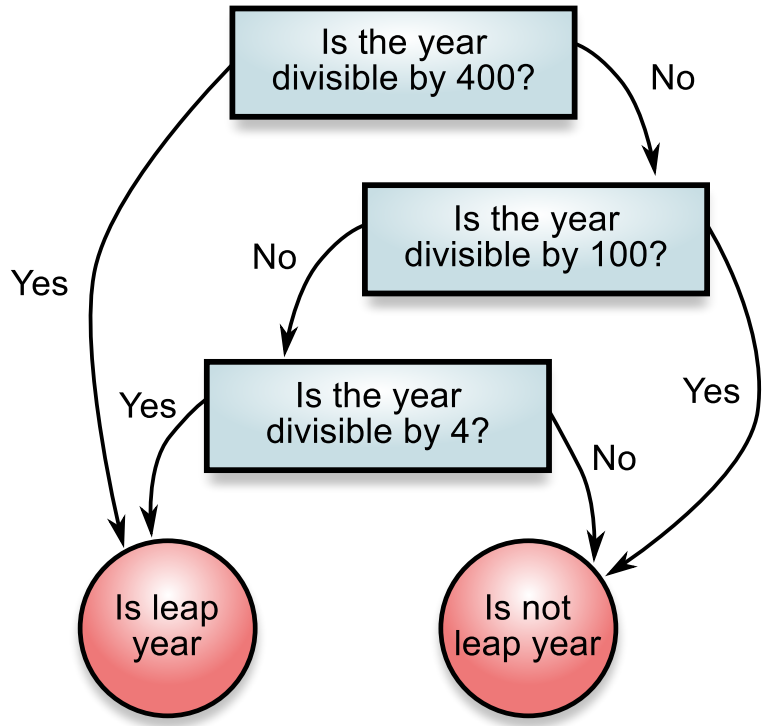
  a "block of code" is a contiguous series of lines of code which are "indented" at (at least) a certain level

```
if␣balance␣-␣withdraw␣>=␣0:
␣␣␣␣balance␣=␣balance␣-␣withdraw
␣␣␣␣print("Withdrawn")
␣␣␣␣if␣balance␣<␣low:
␣␣␣␣␣␣␣␣print("Time␣to␣ring␣mum!")
```

  The block only executes if the condition in the `if` statement evaluates to `True`

Conditional Recap

- Problem: evaluate whether a given year is a leap year (`True`) or not (`False`)
- Flowchart:



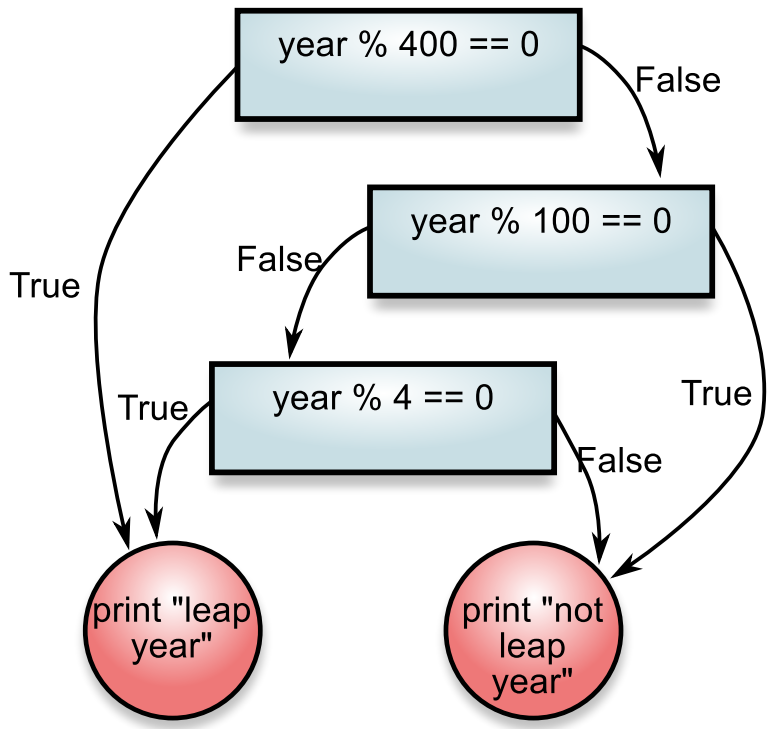
Cascading Conditions

- It is possible to test various **mutually-exclusive** conditions by adding extra conditions with `elif`, and possibly a catch-all final state with `else`

```
if year % 400 == 0:
    print("leap year")
elif year % 100 == 0:
    print("not leap year")
elif year % 4 == 0:
    print("leap year")
else:
    print("not leap year")
```

Conditional Recap

- Problem: evaluate whether a given year is a leap year (`True`) or not (`False`)
- Pythonic flowchart:



Class Exercise

- Simply the preceding code into one `if` statement and one `else` statement (and no `elif` statements)

Lecture Summary

- What is a `tuple`, and how does it relate to a list?
- What is the `bool` type?
- What Boolean comparison operators are commonly used in Python?
- What logic operators are commonly used in Python? What is the operator precedence?
- What are `if` statements and code blocks?
- How can you cascade conditions in Python?