Act like a code monkey

Coding Basics

Announcement

- Homework 1 grade is posted
- If you believe there is an error in grading (assignments or quizzes), you may request a regrading within one week of receiving your grade. Requests must be made in writing, explaining clearly to the TA why you think your solution is correct

Base-3 System

Base-3

0, 1, 2

Decimal

100 = 10^2   10 = 10^1   1 = 10^0

1   2   5

1x(10^2) + 2x(10^1) + 5x(10^0) = 125

Decimal

10^2	10^1	10^0
9	7	6

9x(10^2) + 7x(10^1) + 6x(10^0) = 976

Decimal

10^2	10^1	10^0
3	4	5

3x(10^2) + 4x(10^1) + 5x(10^0) = 345

Decimal

10^2	10^1	10^0
2	1	1

2x(10^2) + 1x(10^1) + 1x(10^0) = 211

base-3

9 = 3^2   3 = 3^1   1 = 3^0

2 1 1

2x(3^2) + 1x(3^1) + 1x(3^0) = 22 (decimal)

base-3

9 = 3^2	3 = 3^1	1 = 3^0
2	2	0

2x(3^2) + 2x(3^1) + 0x(3^0) = 24 (decimal)

base-3

3^2	3^1	3^0
1	0	2

1x(3^2) + 0x(3^1) + 2x(3^0) = 11 (decimal)

Base-4 System

Base-4

0, 1, 2,3

base-4

4^2 4^1 4^0

1 0 2

1x(4^2) + 0x(4^1) + 2x(4^0) = 18 (decimal)

Think beyond Binary

Quantum Computing

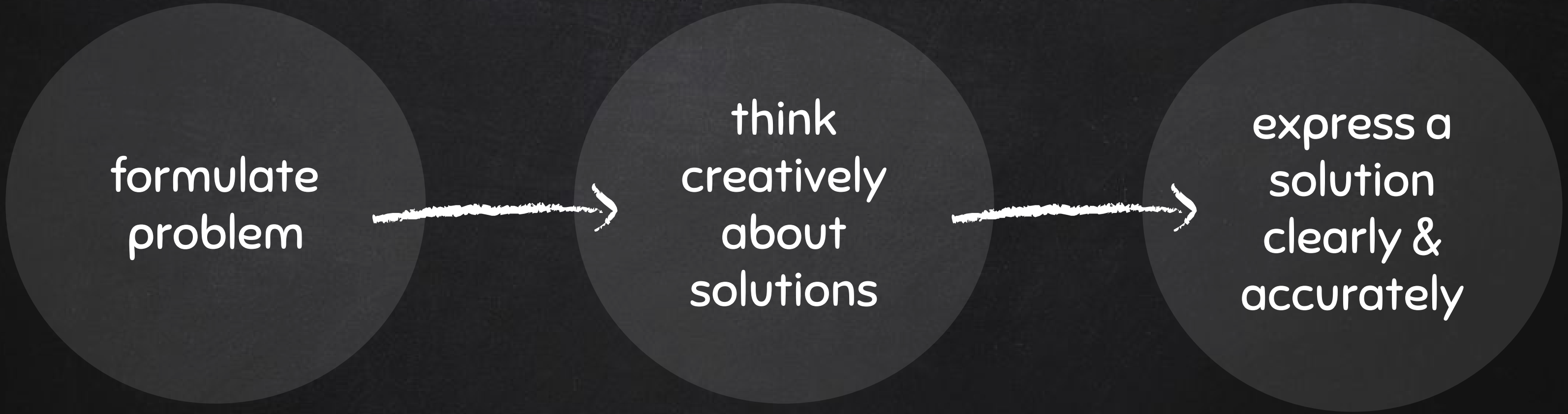
- Quantum computers: use quantum-mechanical phenomena to perform operations on data
- Different from digital electronic computers based on transistors.
- Uses quantum bits (qubits), which can be in superpositions of states: e.g. linear combination of basic states of particles
- Quantum superposition: any 2+ quantum states can be added together and the result will be another valid quantum state
- Quantum Turing machine
- Non-deterministic and probabilistic
- Paul Benioff, Yuri Manin 1980; Richard Feynman 1982; David Deutsch 1985.
- Further reading: https://en.wikipedia.org/wiki/Quantum_computing

Quantum Computing

- A quantum bit corresponds to a single electron in a particular state. Using the trajectories of an electron through two closely spaced channels for encoding.
- In principle, 2 different states are possible: the electron either moves in the upper channel or in the lower channel – a binary system.
- However, a particle can be in several states simultaneously, that is, it can quasi fly through both channels at the same time.
- These overlapping states can form an extensive alphabet of data processing.
- Quantum computer science
- Further reading: http://qist.lanl.gov/qcomp_map.shtml
- http://www.webpronews.com/quantum-computing-beyond-binary-2012-03/

Problem Solving

Problem solving



formulate problem

think creatively about solutions

express a solution clearly & accurately

Learn to program

= Learn to solve problems

Python

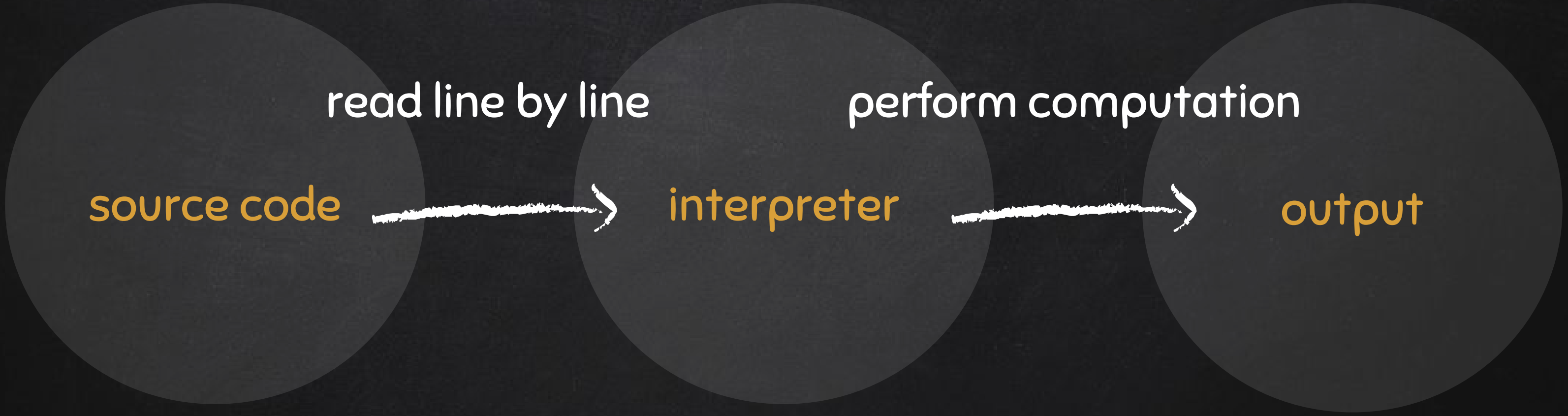
Programming Language

Credit: lecture notes modeled after http://www.openbookproject.net/thinkcs/python/english2e/index.html

Python

- high-level language, like C++, JAVA
- Different from low-level language like assembly language that has strong relation to machine code
- Easier, more efficient to write
- More likely to be correct, portable

TYPICALLY CONSIDERED AS AN INTERPRETED LANGUAGE



read line by line

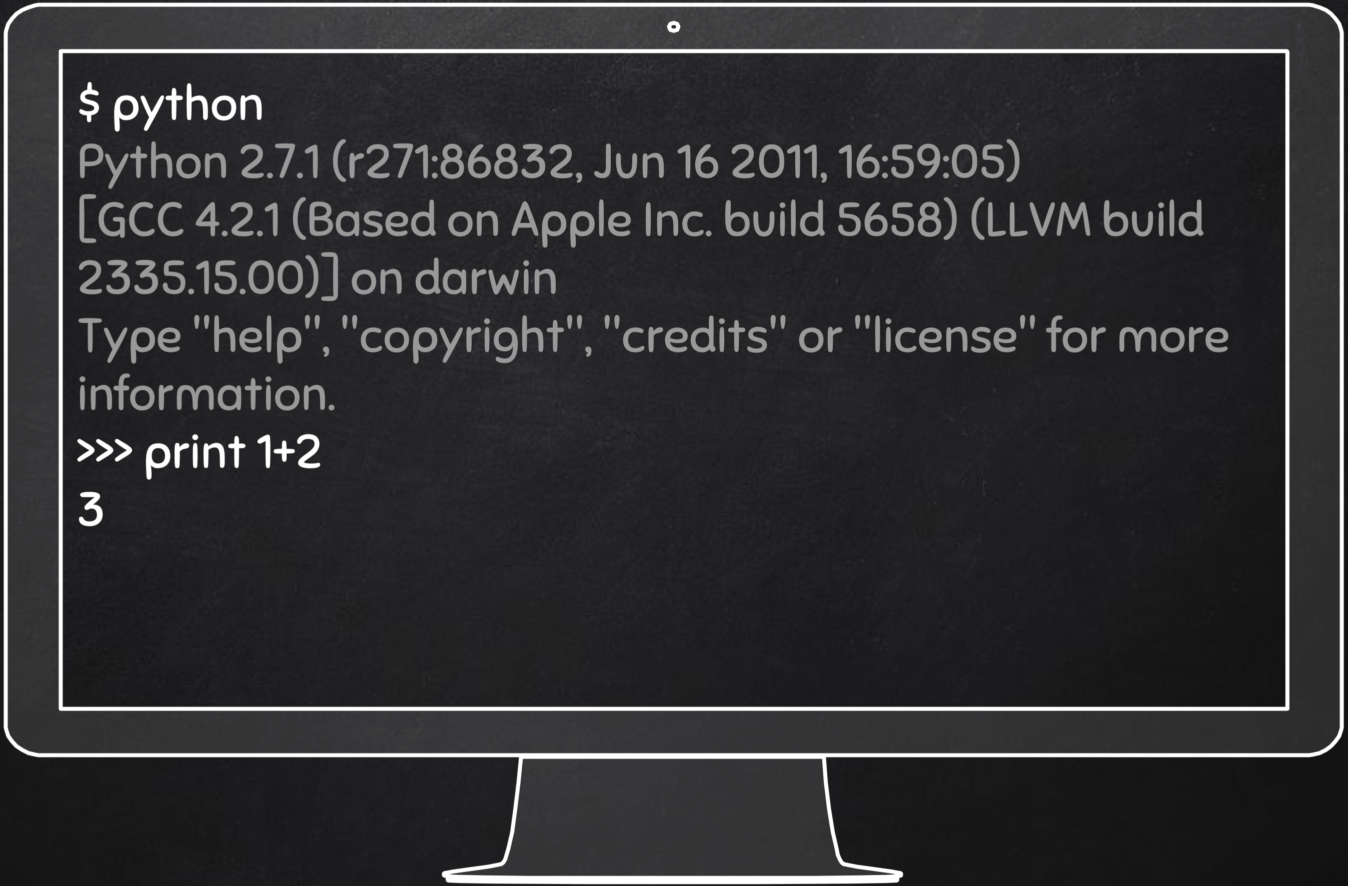
perform computation

source code

interpreter

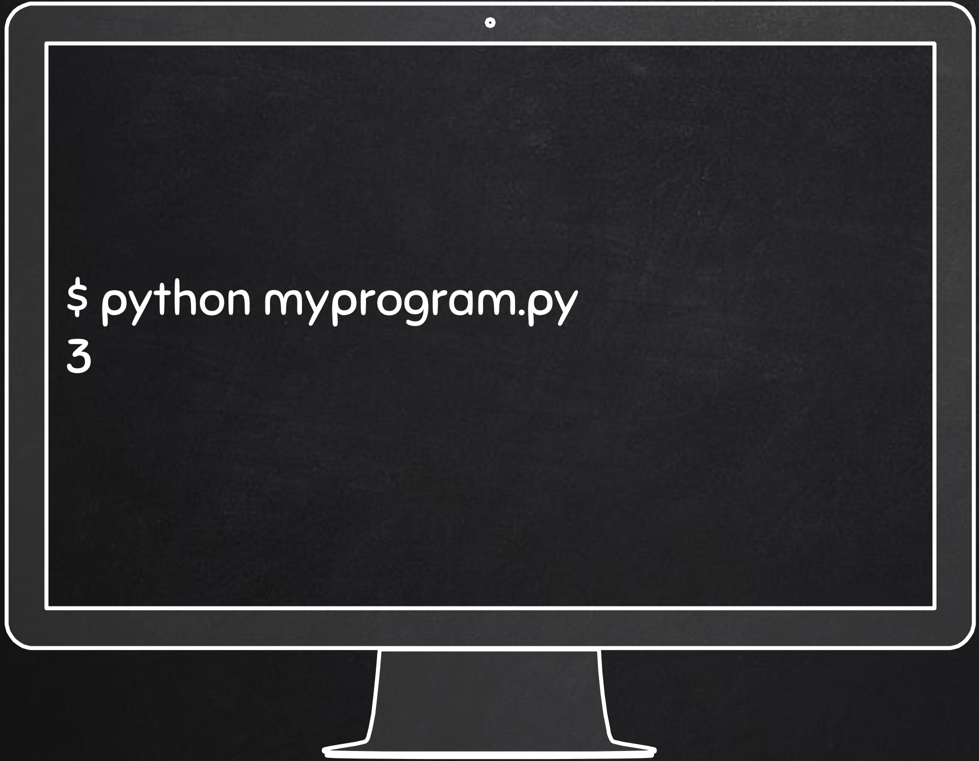
output

Shell Mode in python shell



```
$ python
Python 2.7.1 (r271:86832, Jun 16 2011, 16:59:05)
[GCC 4.2.1 (Based on Apple Inc. build 5658) (LLVM build
2335.15.00)] on darwin
Type "help", "copyright", "credits" or "license" for more
information.
>>> print 1+2
3
```

Script Mode



```
$ python myprogram.py
3
```

Used primarily for this class

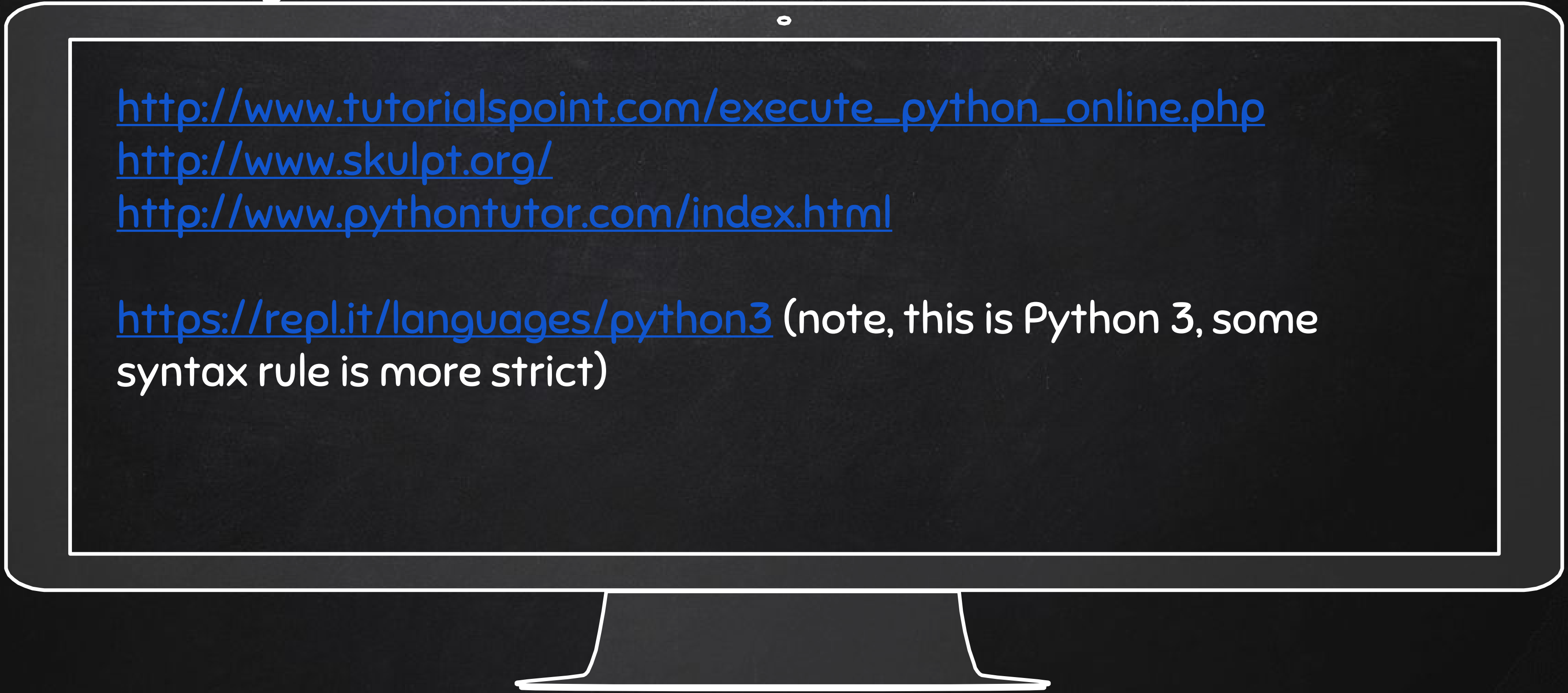
for programs more than a few lines

myprogram.py

```
print 1+2
```

We use online Python interpreters

Making life easier



http://www.tutorialspoint.com/execute_python_online.php
http://www.skulpt.org/
http://www.pythontutor.com/index.html

https://repl.it/languages/python3 (note, this is Python 3, some syntax rule is more strict)

Coding Basics

What is a program?

A sequence of instructions that specifies how to perform a computation

Basic Instructions of a program

Input: get data from the keyboard, a file, or some other device

Output: display data on the screen or send data to a file or other device

Math: perform basic math operations like additions and multiplication

Conditional execution: check for certain conditions and execute the appropriate sequence of statements

Repetition: perform some action repeatedly, usually with some variation

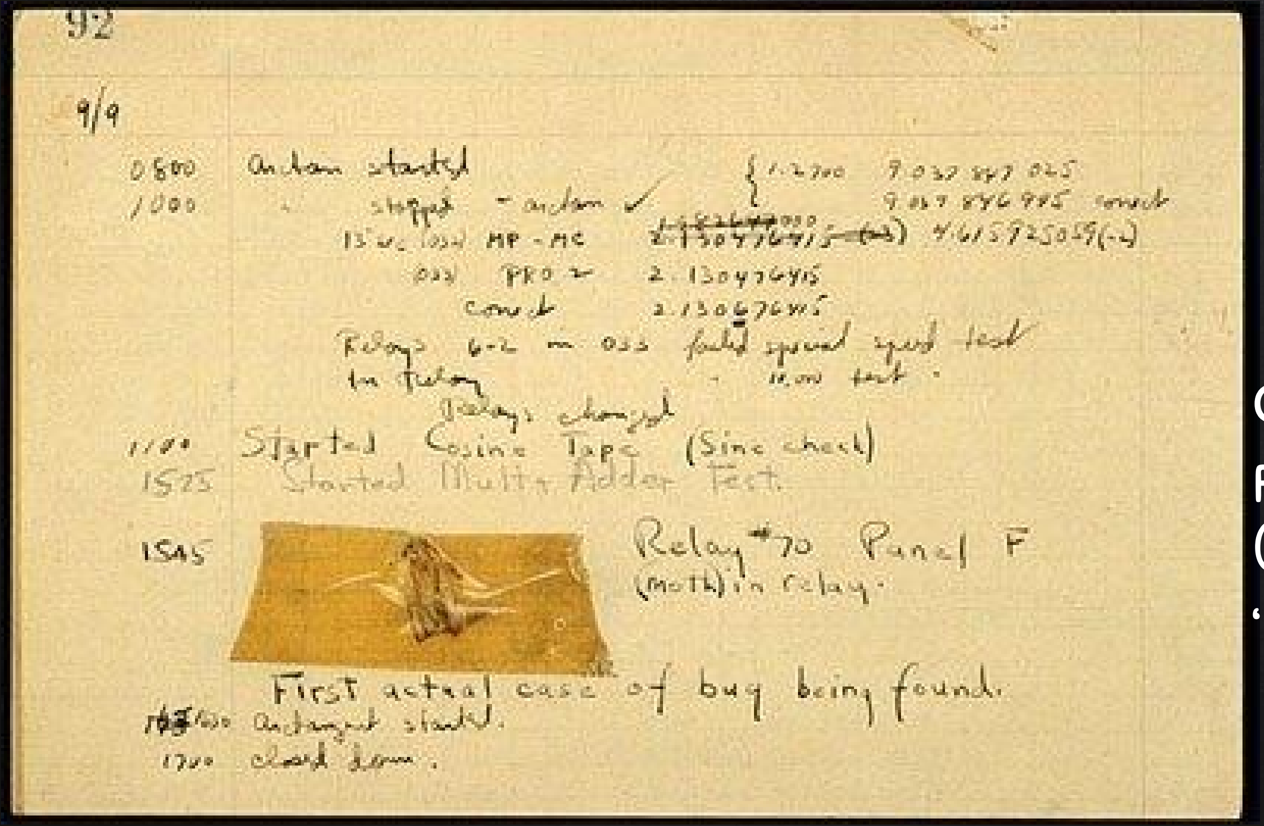
That’s all need to know about a program!

programming

= problem solving

Breaking a large, complex task to smaller and smaller subtasks, until the subtasks are simple enough to be performed by some basic instructions...

What is debugging?



92

9/9

0800 Antan started
1000 " stopped - antan ✓ {1.2700 9.037 847 025
9.037 846 995 correct
13" UC (032) MP - MC 1.982147000 ~~2.130476415~~ (-3) 4.615925059(-2)
(033) PRO 2 2.130476415
correct 2.130676415
Relays 6-2 in 033 failed special speed test
in relay " 10.000 test.
Relays changed
1100 Started Cosine Tape (Sine check)
1525 Started Multy Adder Test.
1545 Relay #70 Panel F
(moth) in relay.
First actual case of bug being found.
1630 Antangent started.
1700 closed down.

Grace Hopper

First actual case of bug (moth)

“Amazing Grace”

Credit: Clip art image by Cliparts.co

bug = programming error
debugging = track down the bugs and fix them

Type of bugs

- Syntax error: violation of rules and structures. For example, a sentence has to start with a capital letter…
- Runtime error: error does not appear until program is executed (rare for now)
- Semantic error: the program is not doing what you tell it to do. Tricky to track down.

programming = experimental debugging, detective work, hypothesis testing, etc.

“

When you have eliminated the impossible, whatever remains, however improbable, must be the truth.

-- Sherlock Holmes

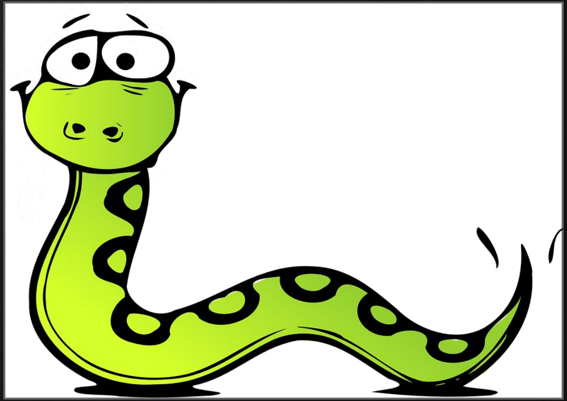
Debugging can be intellectually challenging and rewarding

Python is a formal language used to express computations

Tokens: words, numbers, etc.

Statements: arrangements or structures of tokens

1st Python Lab



Credit: https://pixabay.com/static/uploads/photo/2014/04/02/14/05/snake-306109_960_720.png

```
print “Hello World!!!”
```

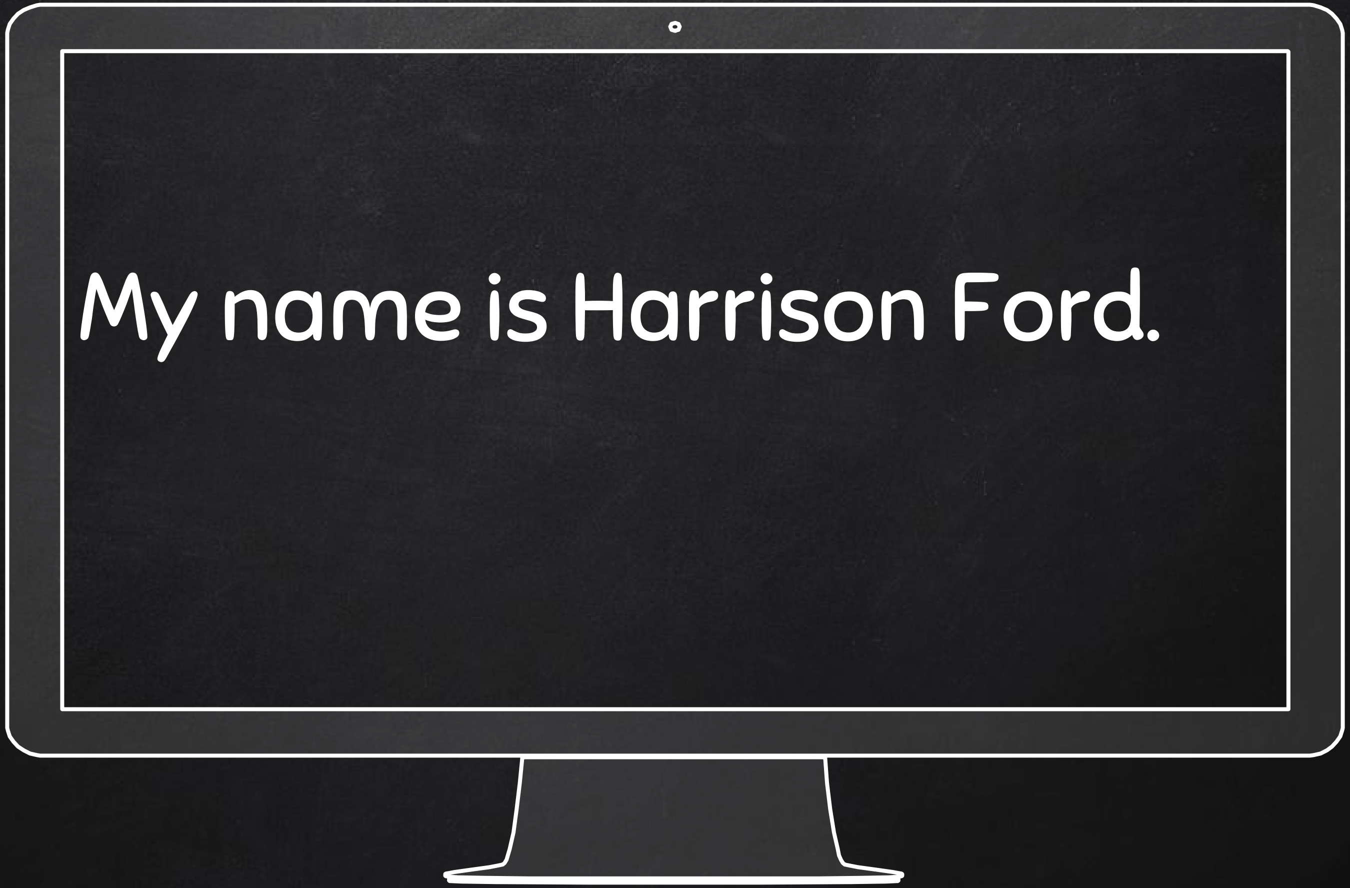
Hello World!!!

```
print “What happened to Han Solo?!”
```

What happened to Han Solo?!

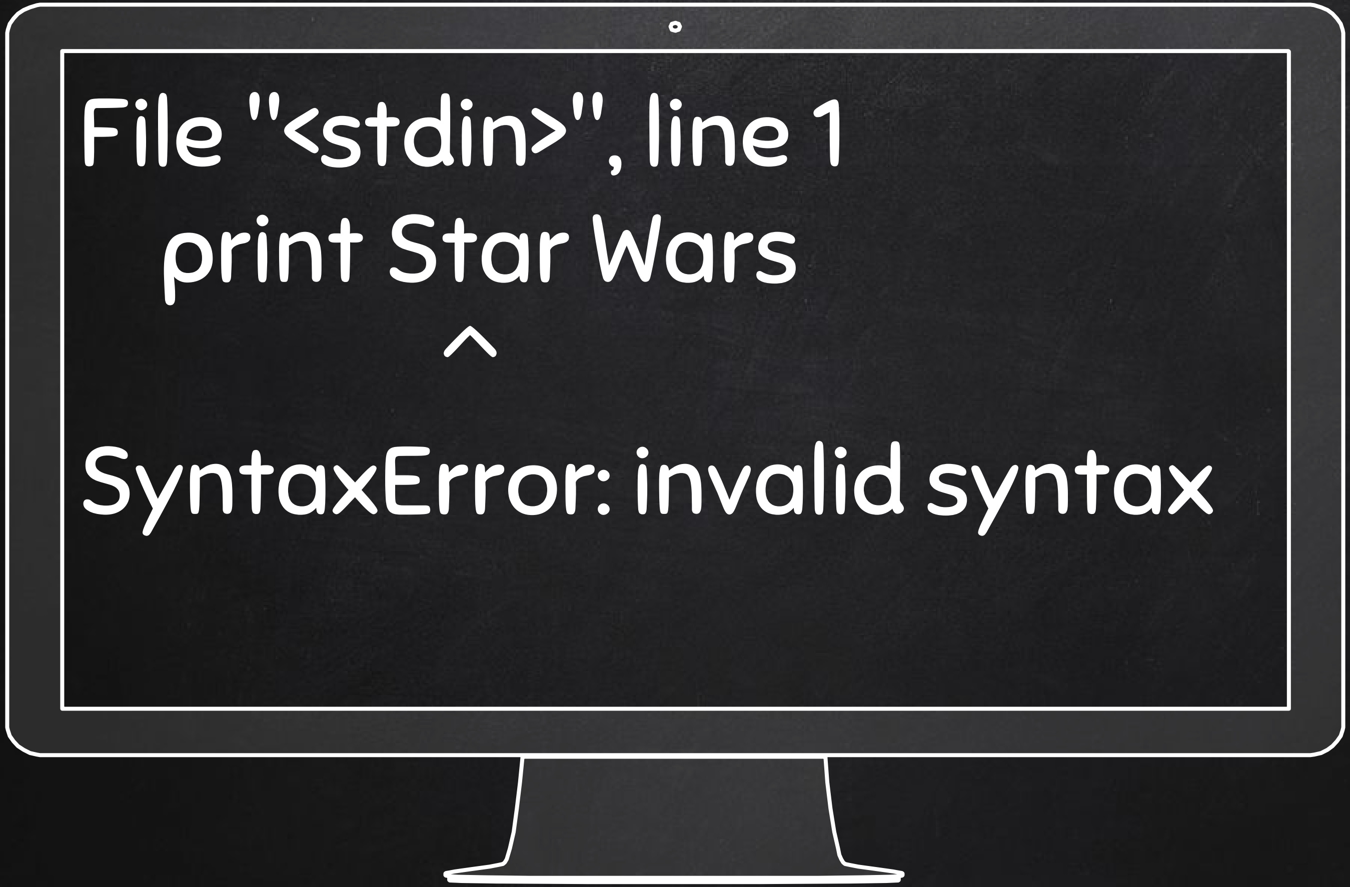
```
print “My name is Harrison Ford.”
```

your name goes here!



My name is Harrison Ford.

print Star Wars



```
File "<stdin>", line 1
  print Star Wars
             ^
SyntaxError: invalid syntax
```

- Runtime Error
- Need quotation marks “ ” or ‘ ’

Values and Data Types

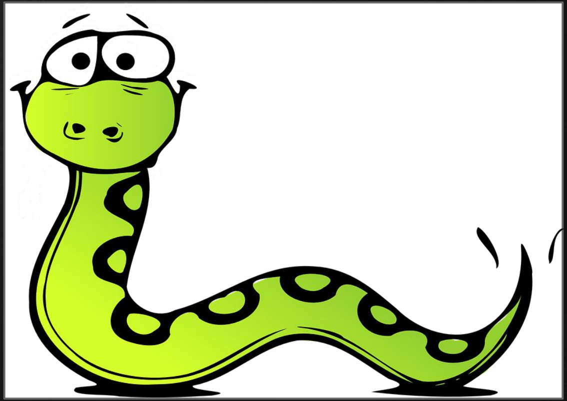
A value is something a program manipulates

- □ a letter “a”
- □ a number 2
- □ a sentence “hello world!”

There are different types of values

- □ 2 is an integer
- □ “Hello World” is a string
- □ 3.1416926 is a floating point (real # or approximation of real #)

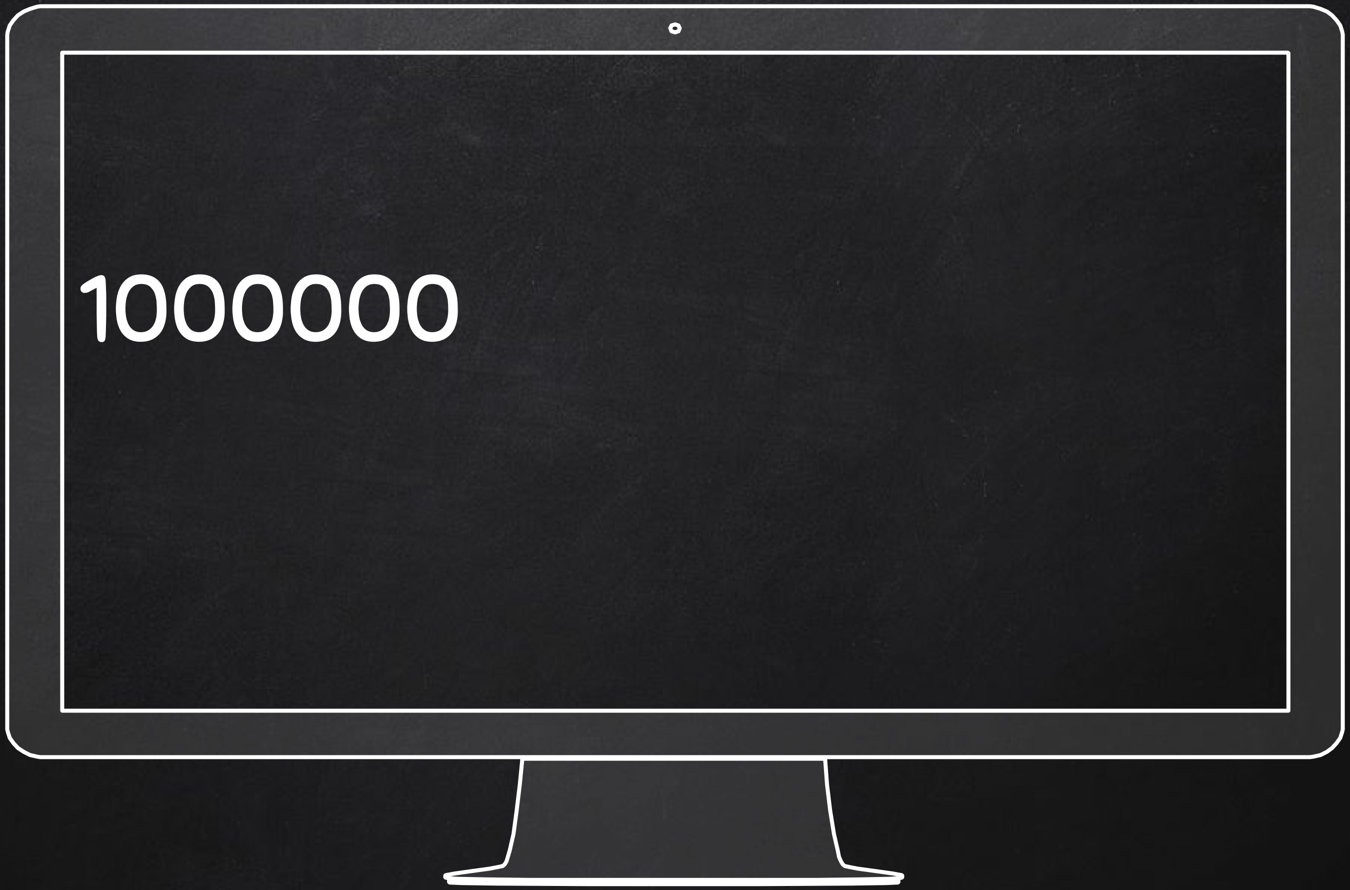
2nd Python Lab



print 5

5

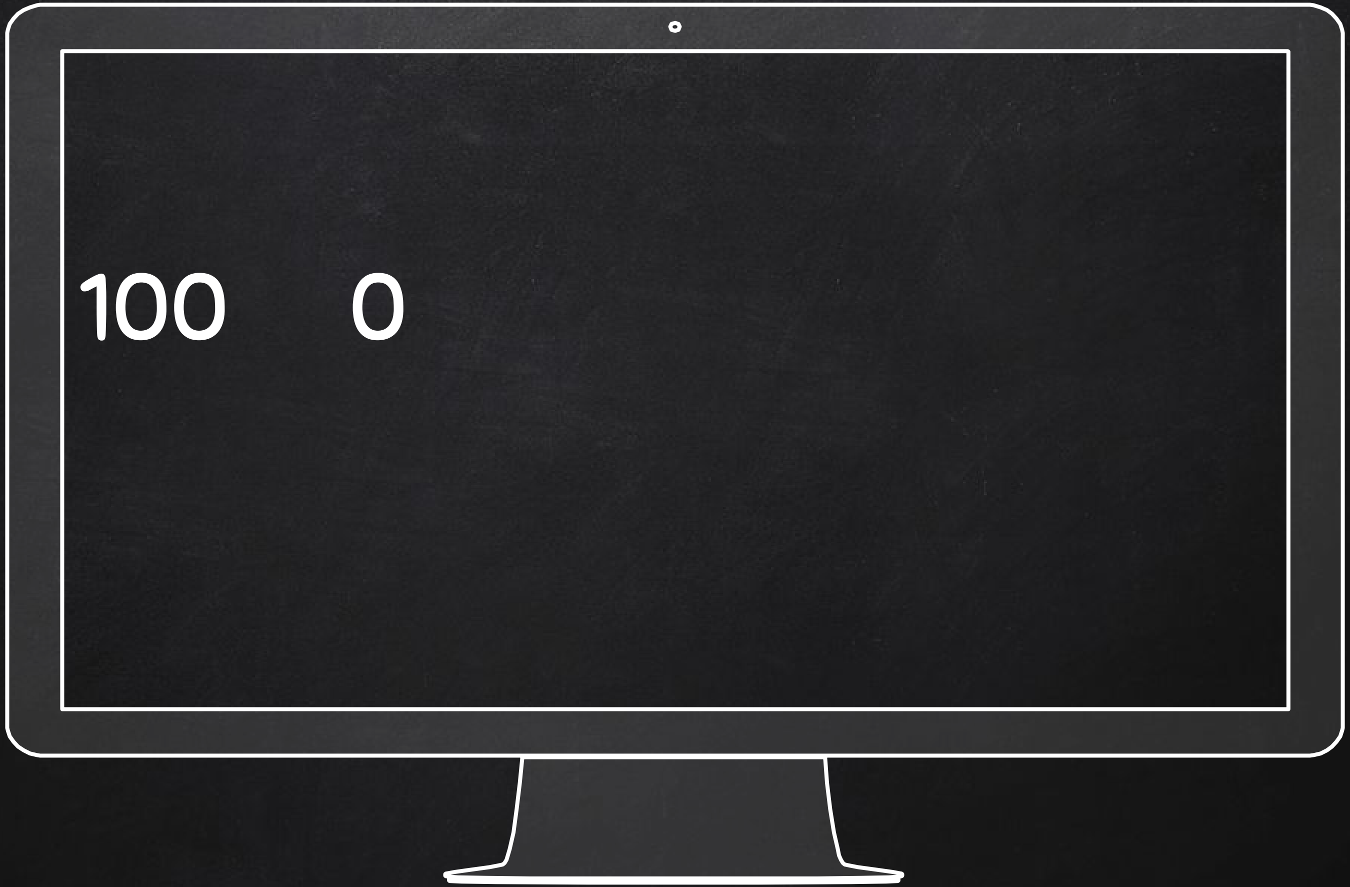
print 100000



1000000

print 100,000

Treating 100,000 as a list of 2 items



100 0

```
type(“hello world!”)
```

```
<type 'str'>
```

```
type(2)
```

```
<type 'int'>
```

```
type(“2”)
```

```
<type 'str'>
```

```
type(3.1415926)
```

```
<type 'float'>
```

What is a variable?

A name that refers to a value

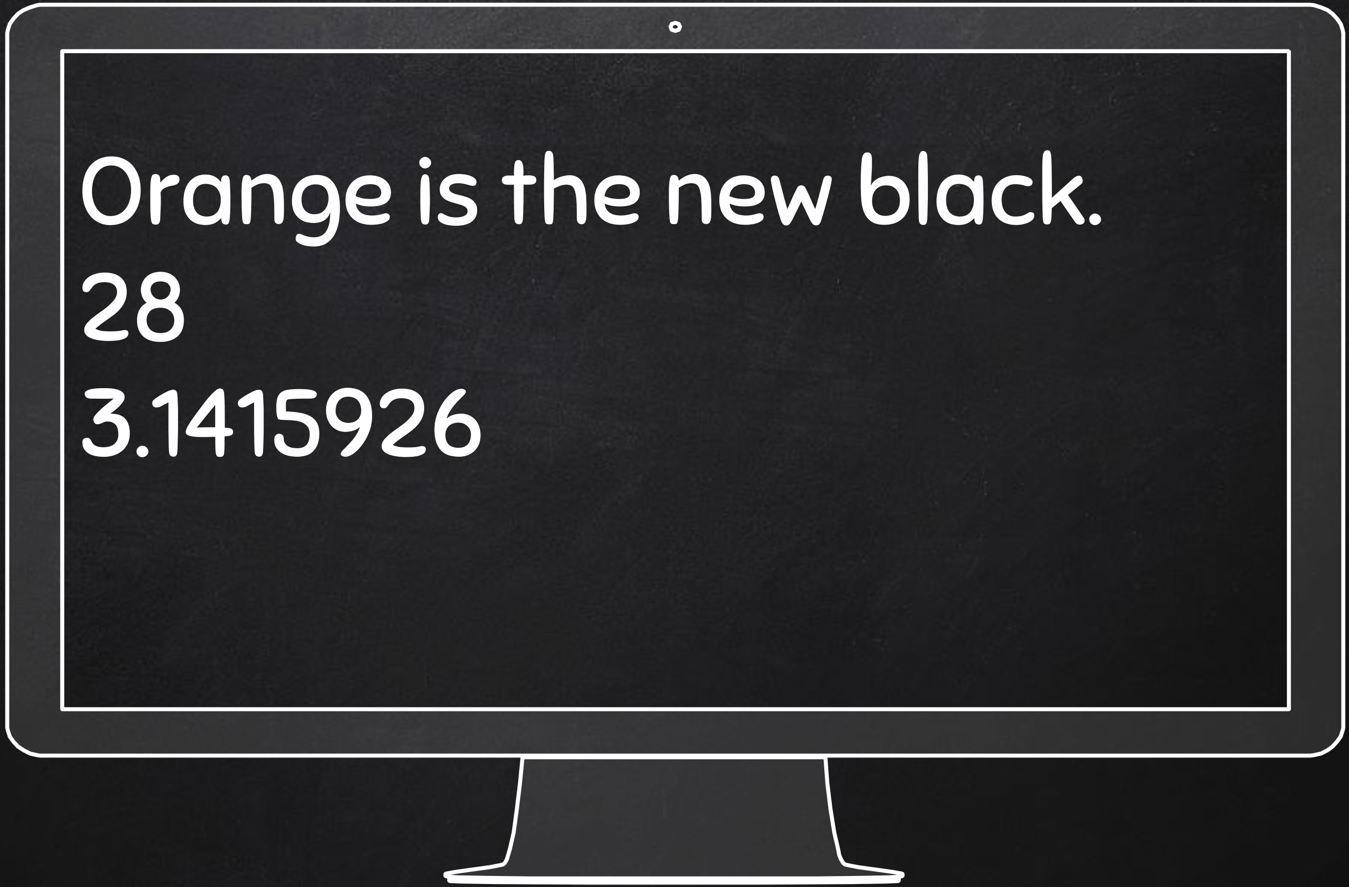
Assignment statement: creates new variables and gives them values

```
message = “Orange is the new black.”
```

$n = 28$

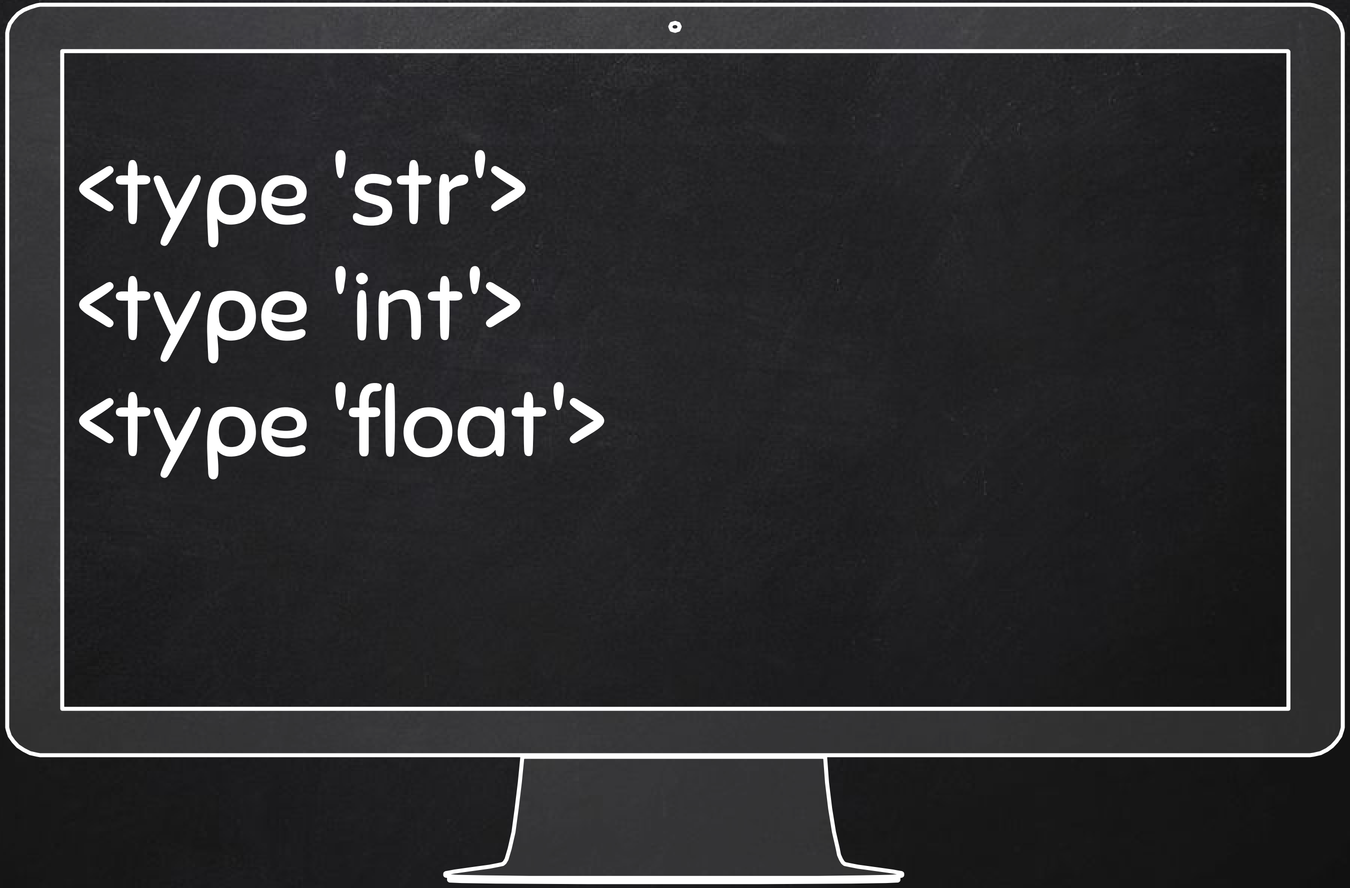
pi = 3.1416926

```
print message
print n
print pi
```



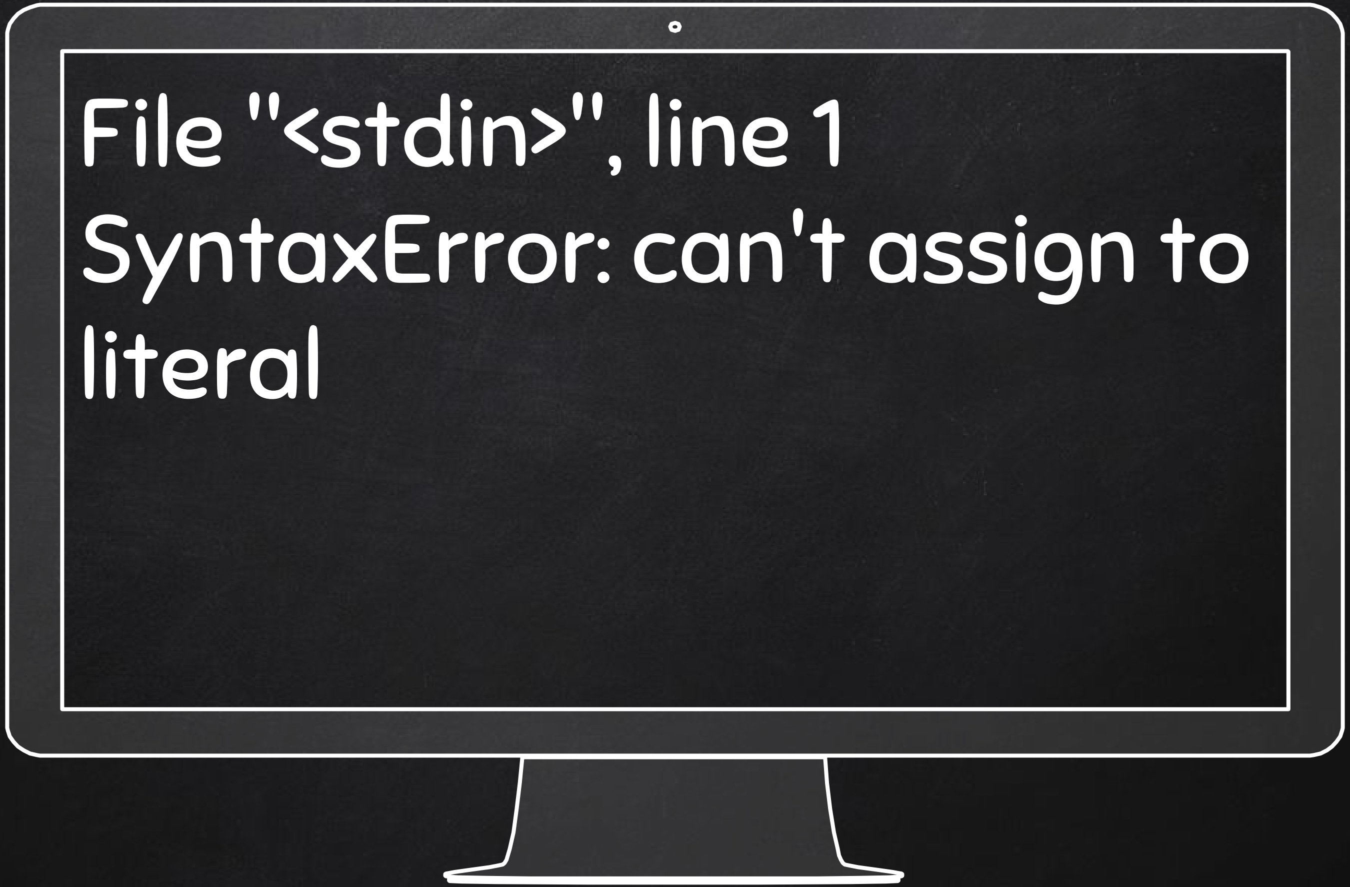
```
Orange is the new black.
28
3.1415926
```

```
type(message)
type(n)
type(pi)
```



```
<type 'str'>
<type 'int'>
<type 'float'>
```

$28 = n$

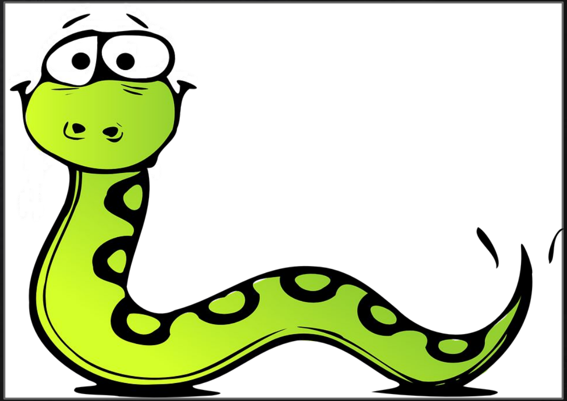


```
File "<stdin>", line 1
SyntaxError: can't assign to
literal
```

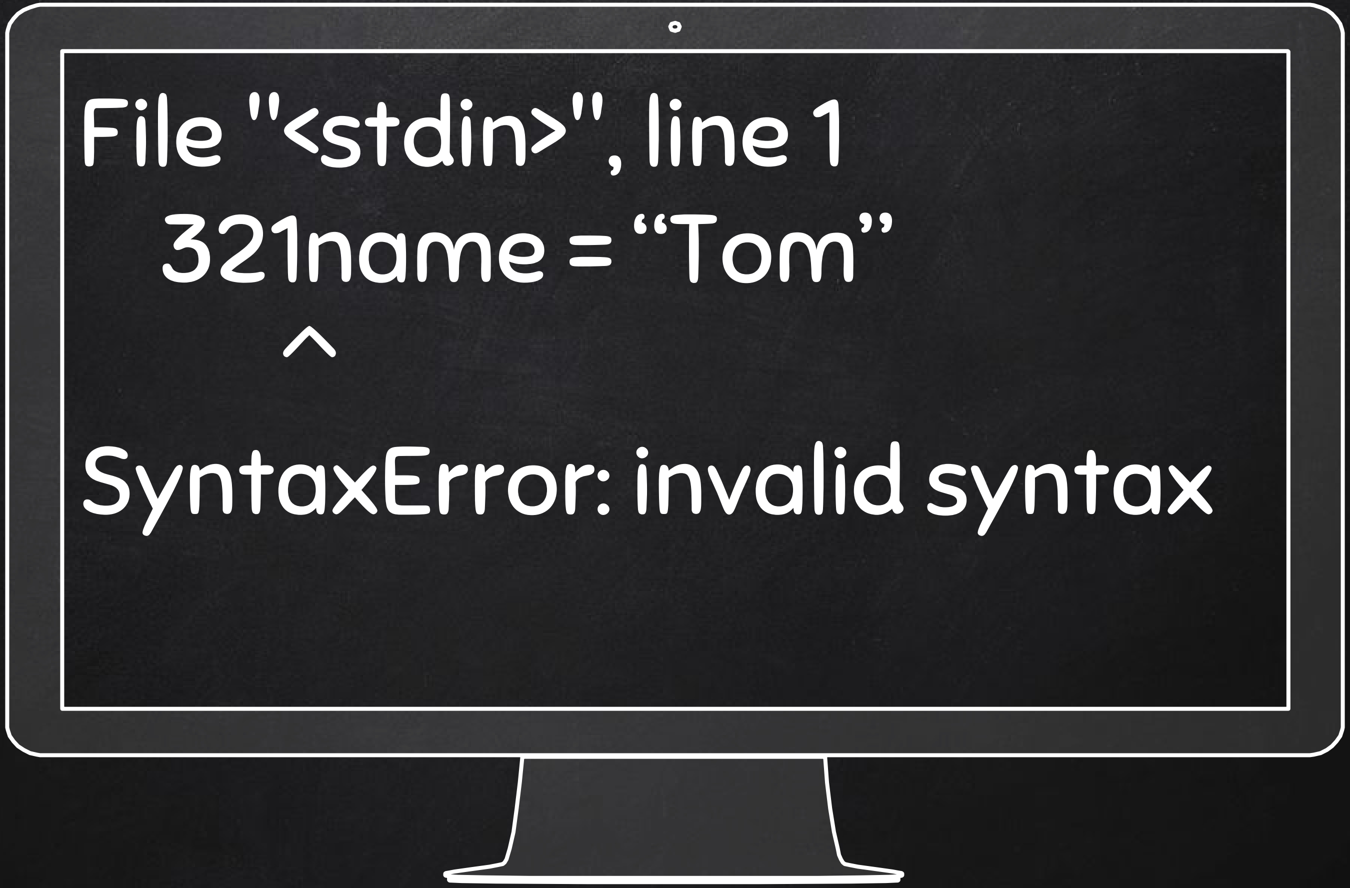
Choose meaningful variable names

- What = “hello” (not so good)
- Begin with letters, contain letters and numbers and “_”
- Typically use lowercase letters
- Python keywords (describe rules and structures) can’t be variables

3nd Python Lab

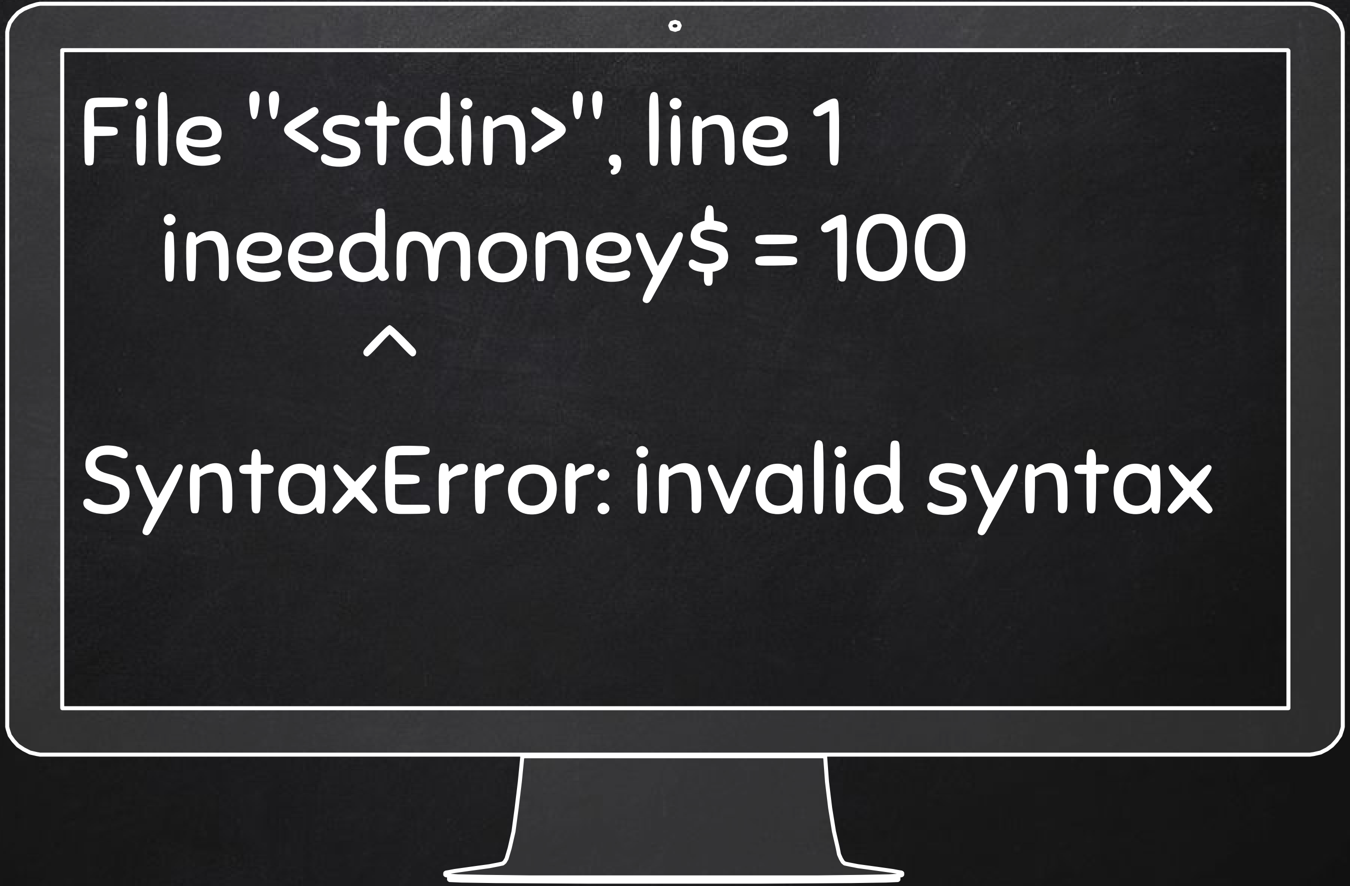


```
321name = “Tom”
```



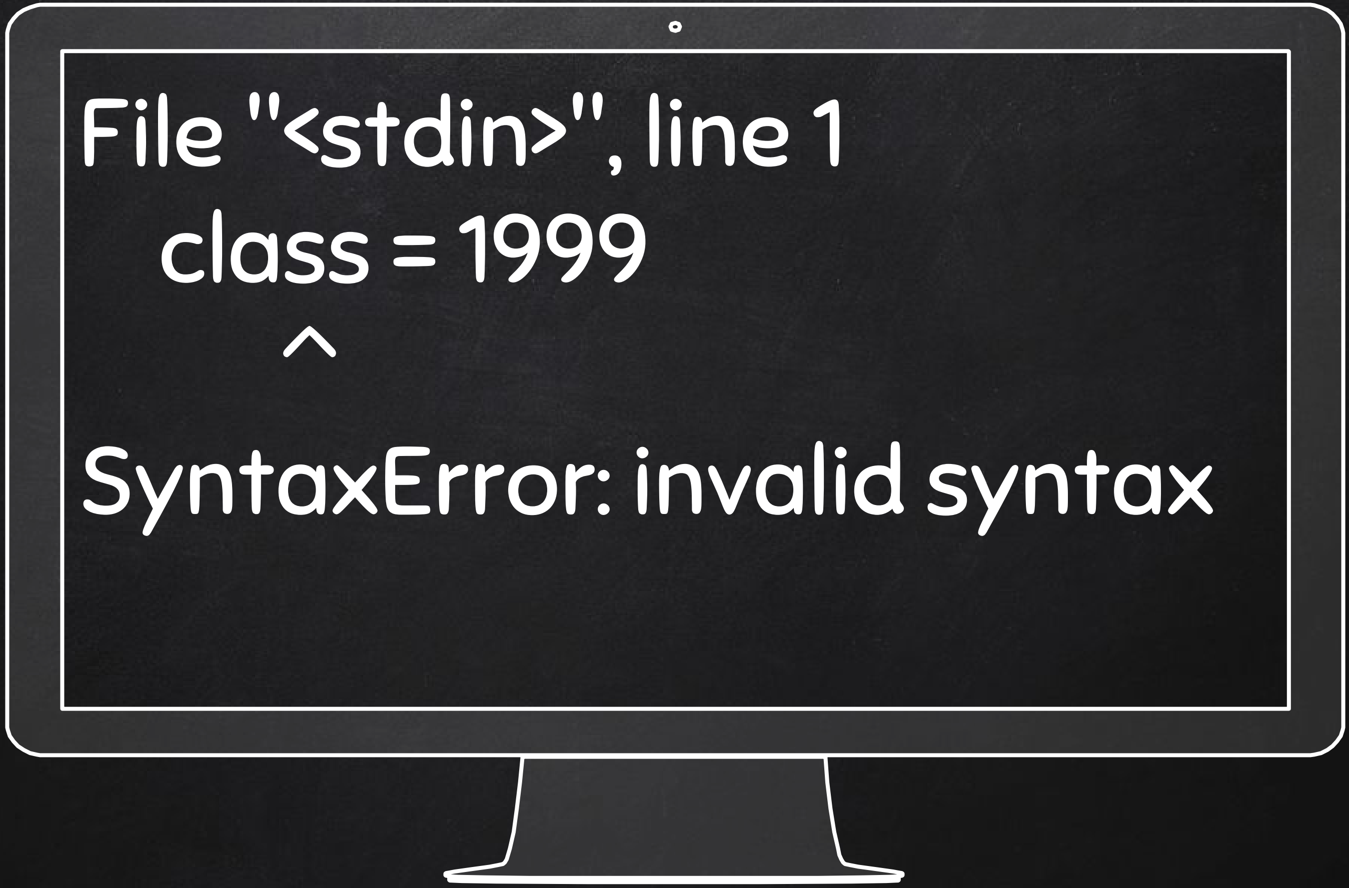
```
File "<stdin>", line 1
    321name = “Tom”
       ^
SyntaxError: invalid syntax
```

```
ineedmoney$ = 100
```



```
File "<stdin>", line 1
  ineedmoney$ = 100
       ^
SyntaxError: invalid syntax
```

class = 1999



```
File "<stdin>", line 1
    class = 1999
       ^
SyntaxError: invalid syntax
```

What is a statement?

An instruction that the Python interpreter can execute

Examples:
print statement
assignment statement

Python executes a statement and display the results (if any)

Result of a print statement is a value
Assignment statement produces no output

A script/program contains a set of statements, results appear one at a time

```
print “a”
x = 28
print x
```

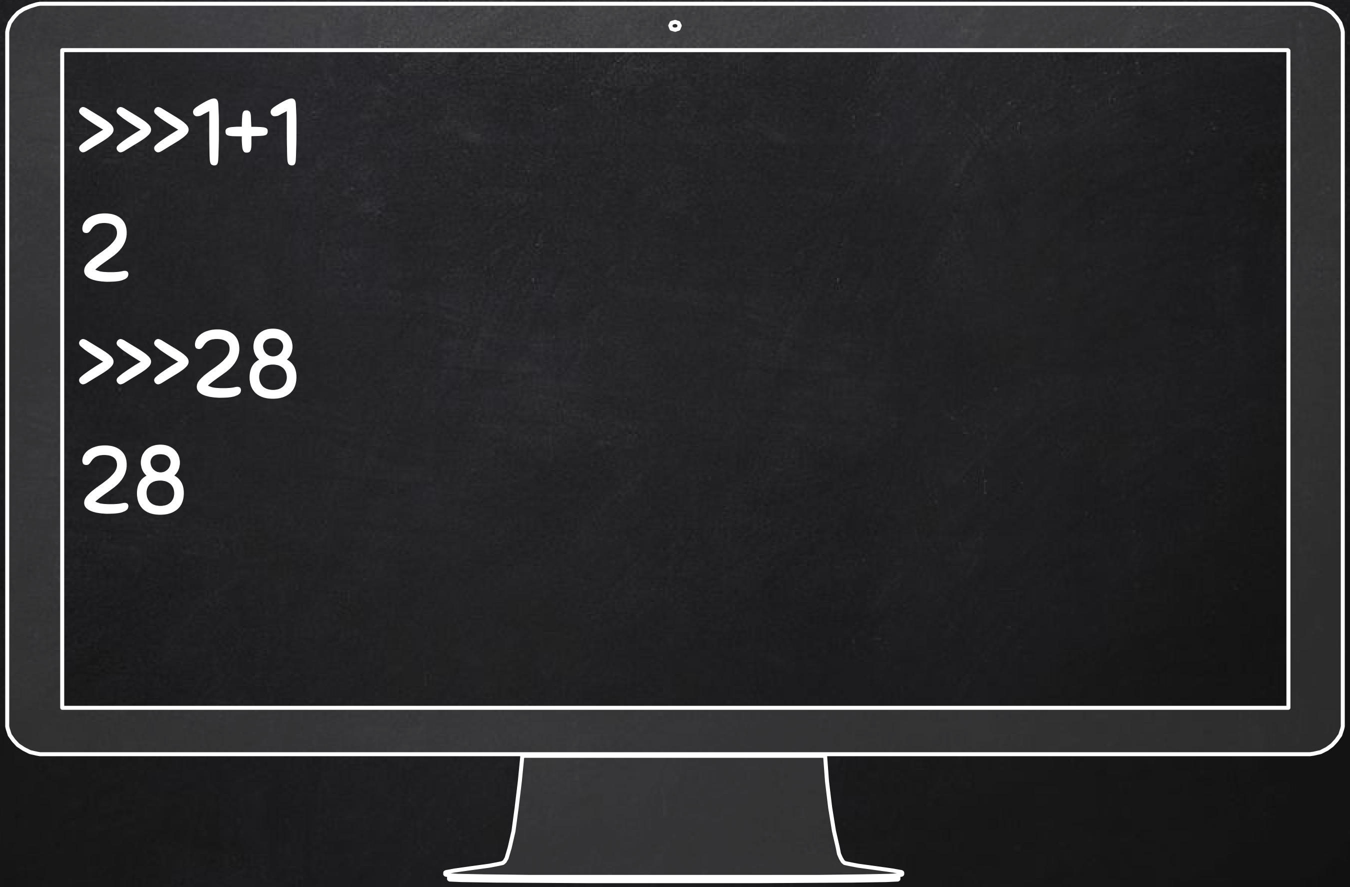
```
a
28
```

What is an expression?

A combination of values, variables and operators

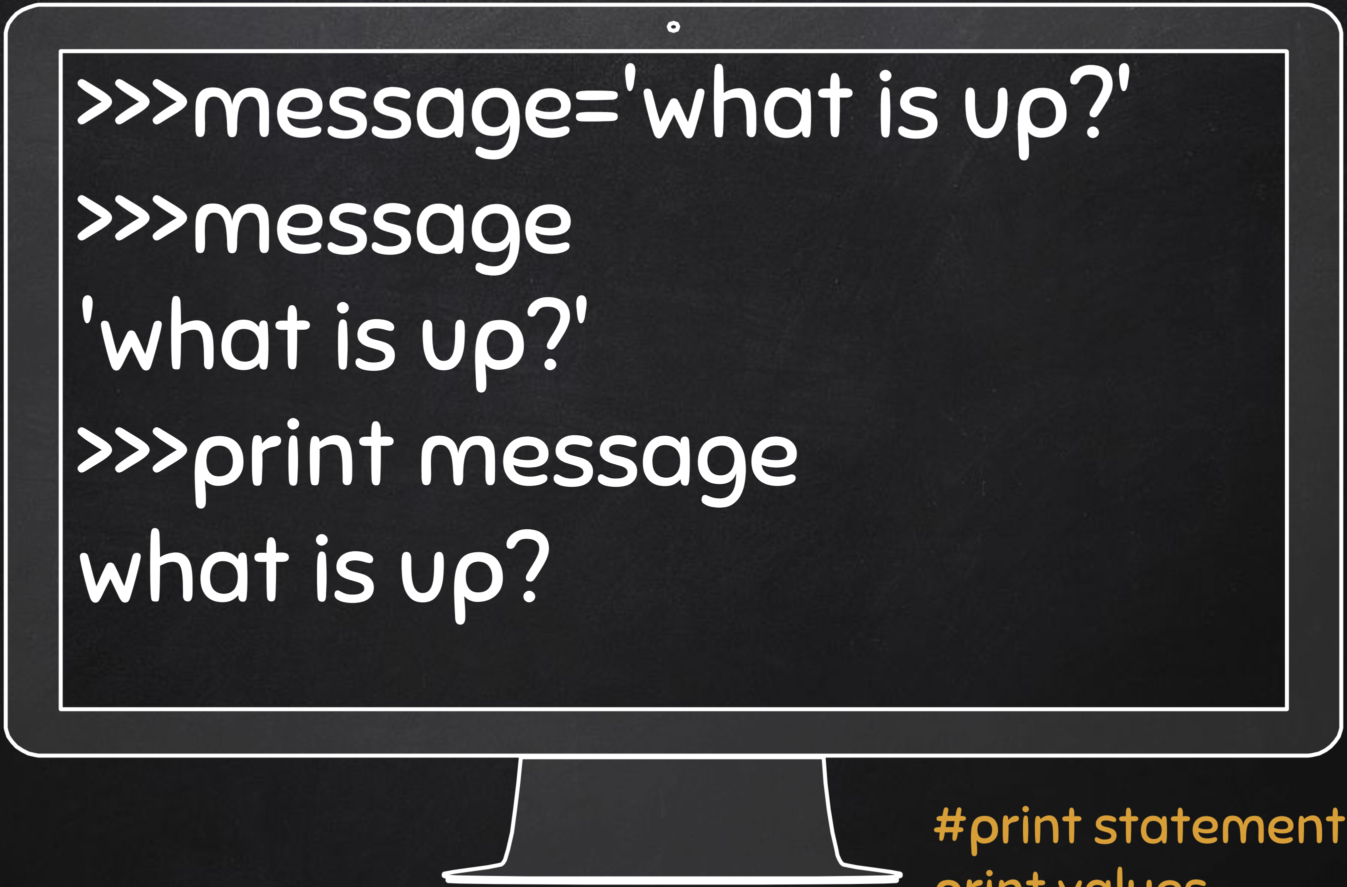
Evaluating an expression by an interpreter produces a value

Shell Mode (command line)



```
>>>1+1
2
>>>28
28
```

Shell Mode (command line)



```
>>>message='what is up?'
>>>message
'what is up?'
>>>print message
what is up?
```

#print statement
print values

What is an operator?

Operators are special symbols representing computations, such as addition and multiplication

Operators use operands

+, -, *, / (integer division)

** exponentiation

```
11+22
hour*60+minute
minute/60
3**2+3**1
(3**2)+(3**1)
```

Order of operations

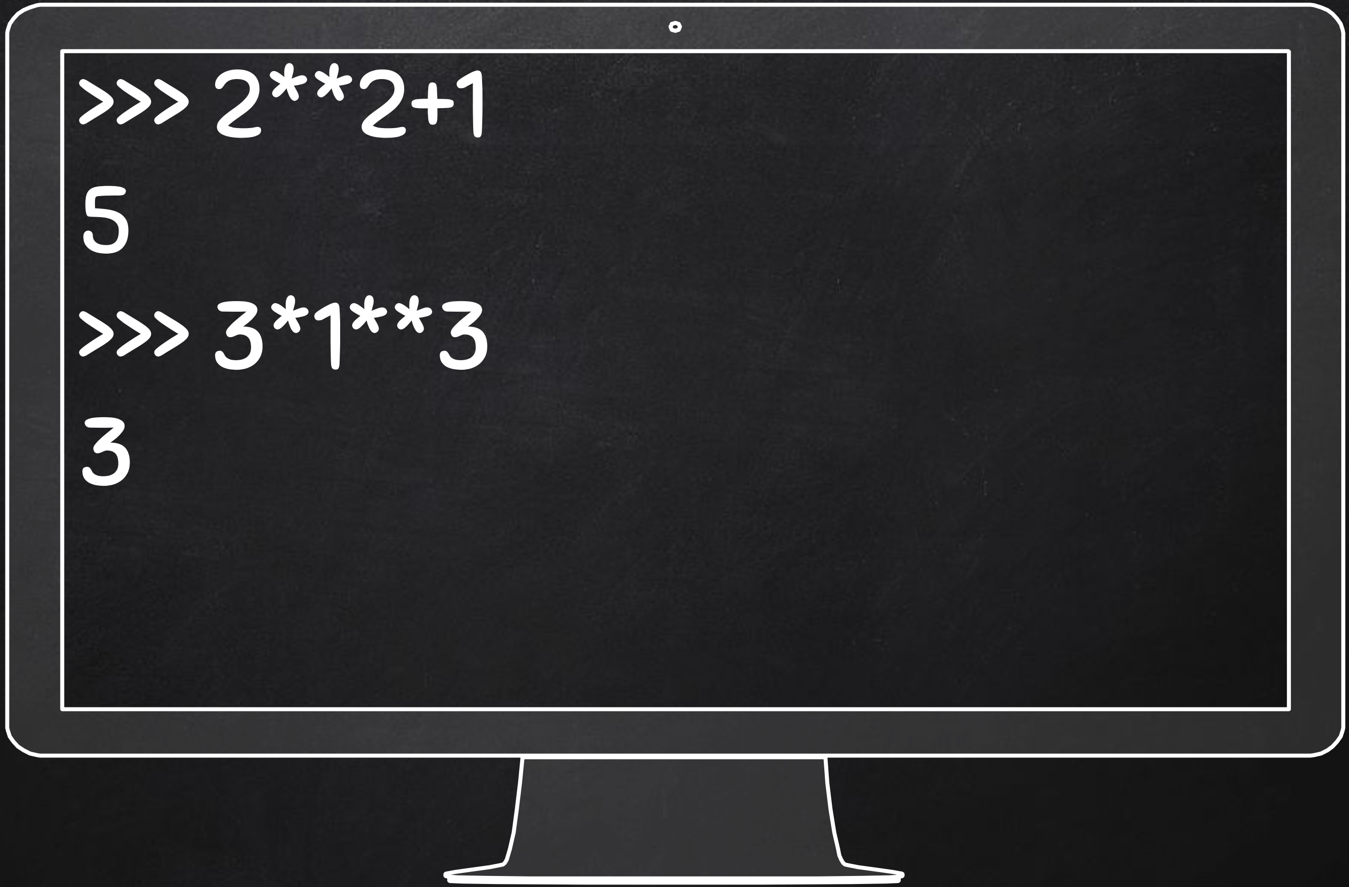
( )

**

*, /

```
2**2+1  #(2**2)+1
3*1**3 #3*(1**3)
#comments
```

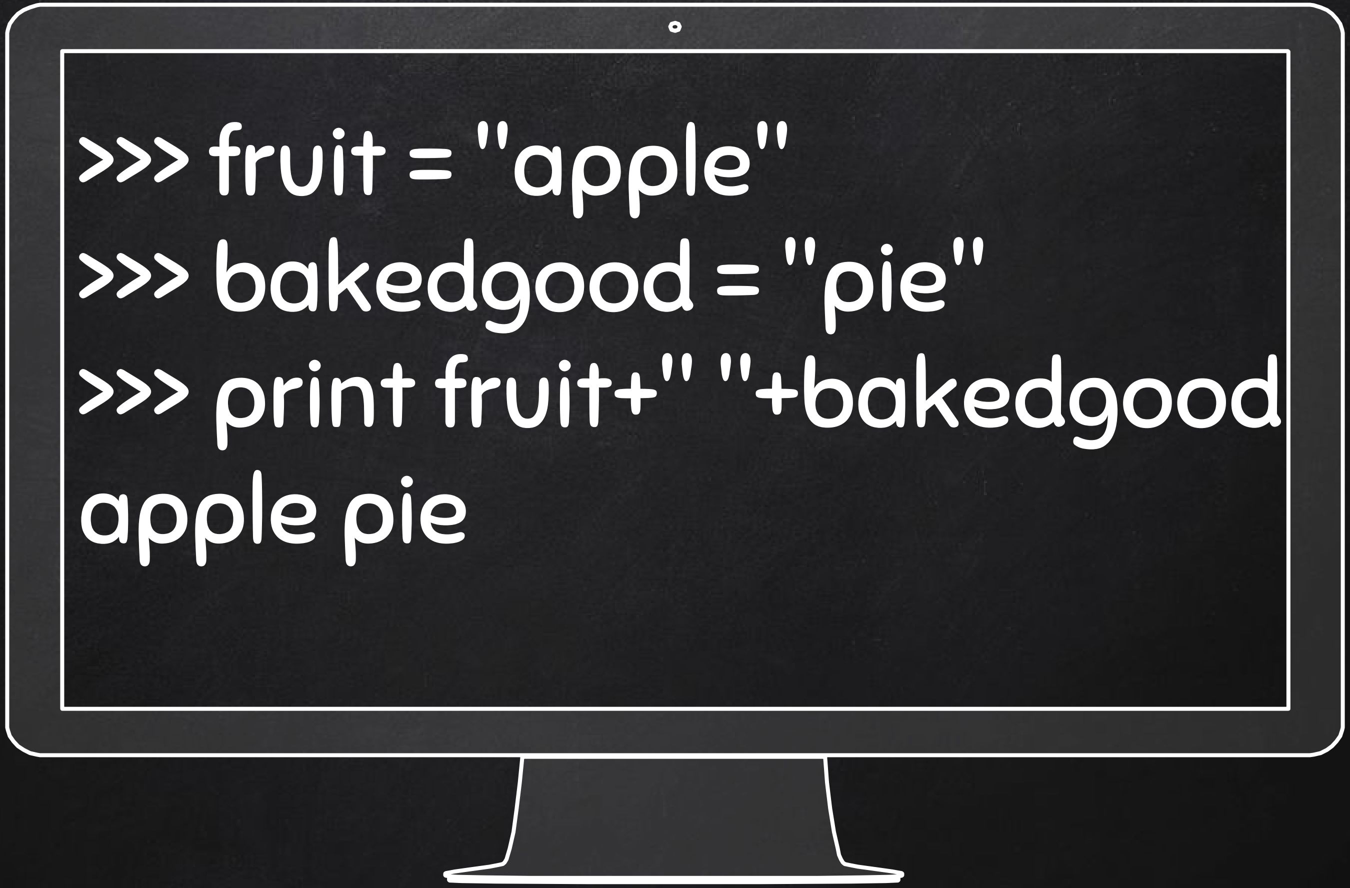
Shell Mode (command line)



```
>>> 2**2+1
5
>>> 3*1**3
3
```

Operations on Strings

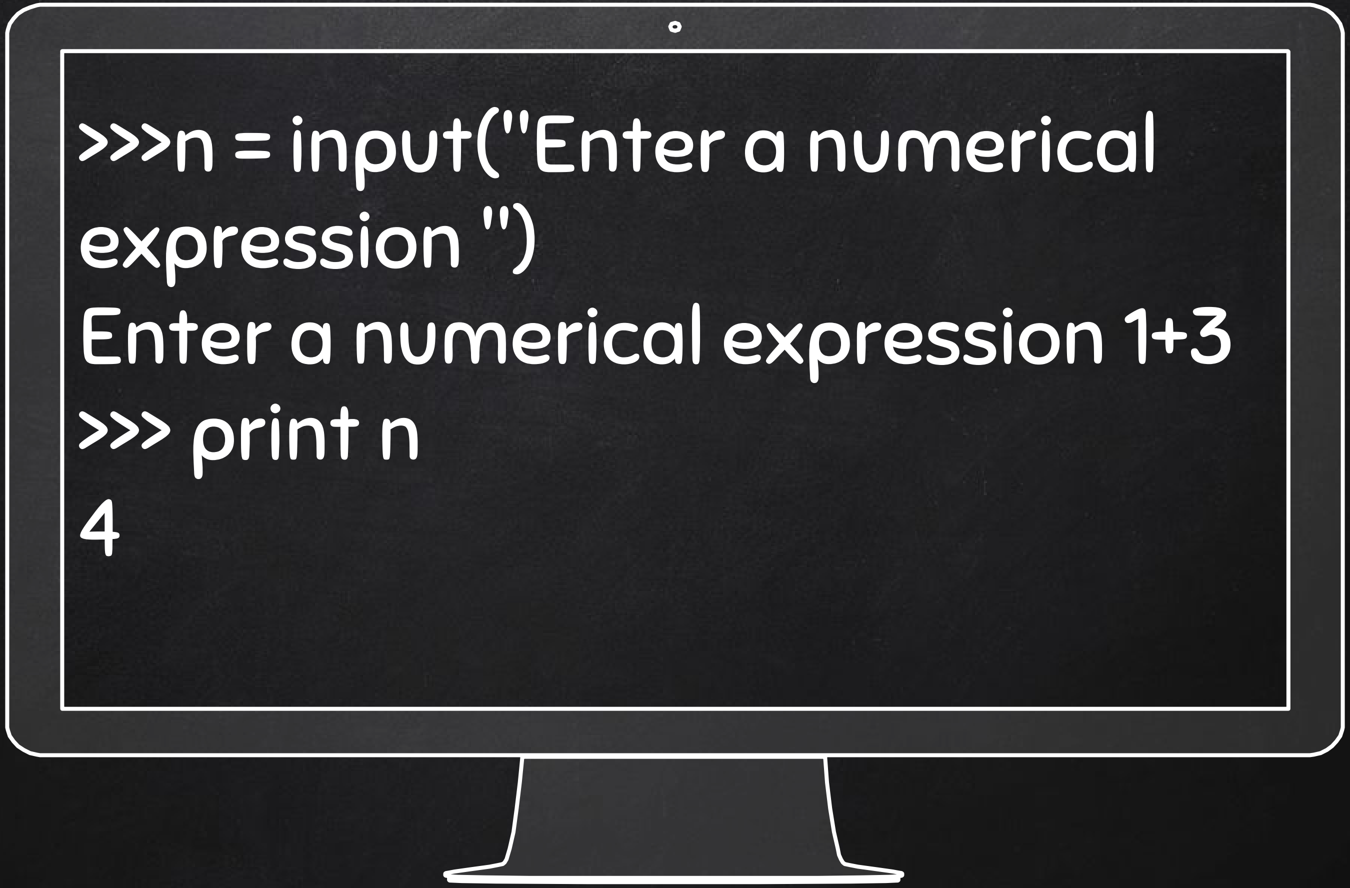
Shell Mode (command line)



```
>>> fruit = "apple"
>>> bakedgood = "pie"
>>> print fruit+" "+bakedgood
apple pie
```

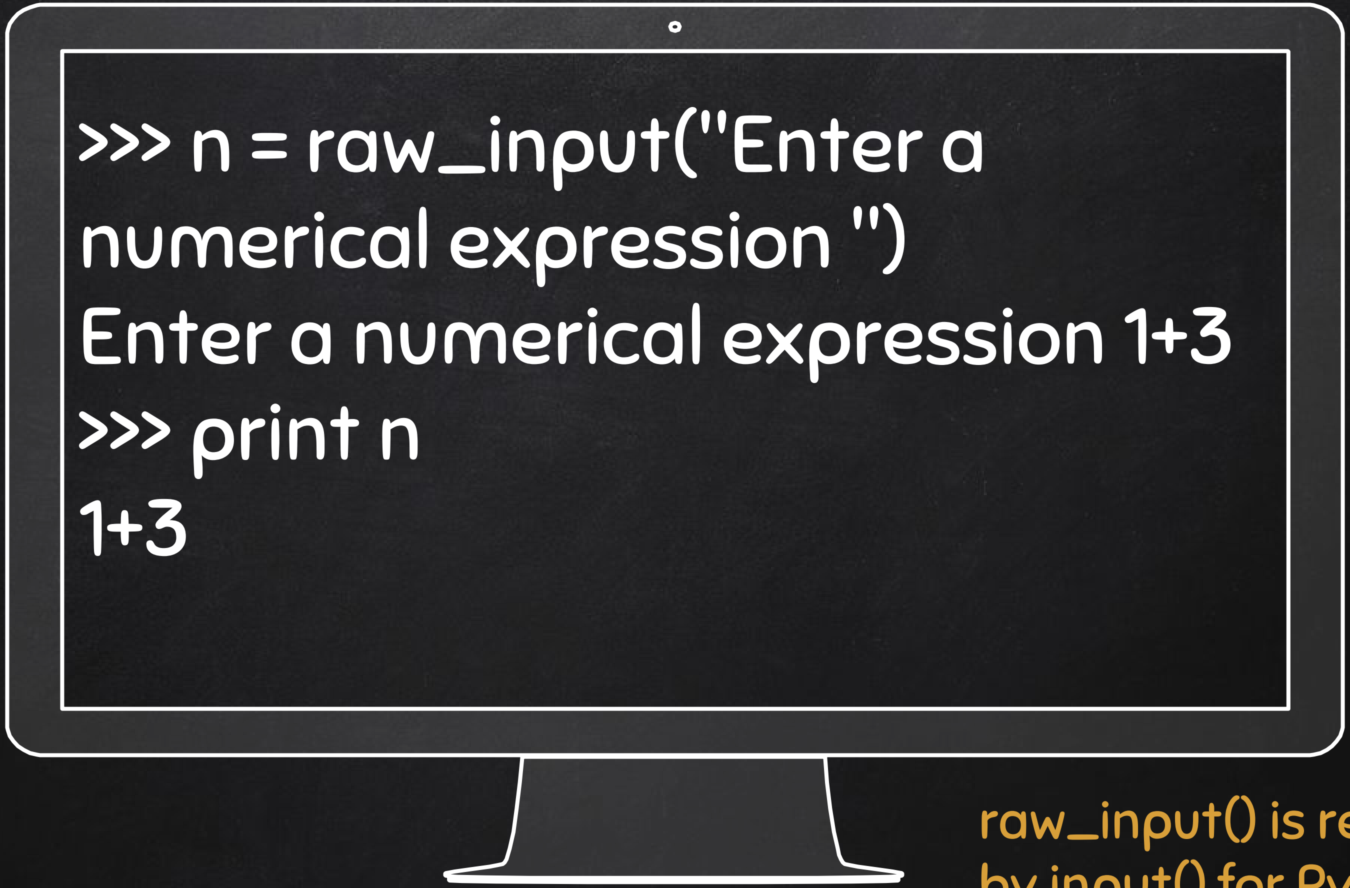
Input

Shell Mode (command line)



```
>>>n = input("Enter a numerical
expression ")
Enter a numerical expression 1+3
>>> print n
4
```

Shell Mode (command line)

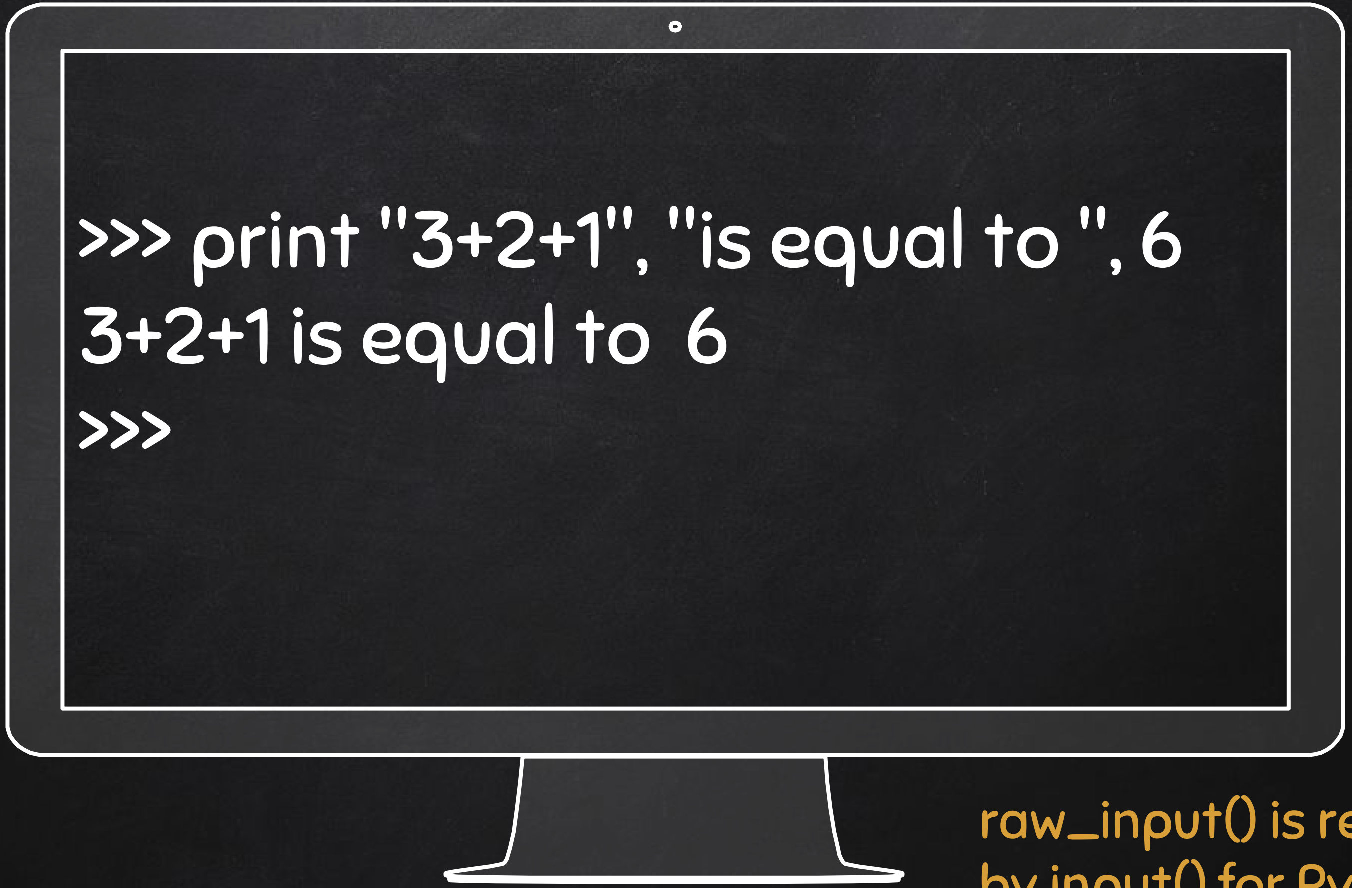


```
>>> n = raw_input("Enter a
numerical expression ")
Enter a numerical expression 1+3
>>> print n
1+3
```

raw_input() is replaced by input() for Python 3.*

Combination of statements

Shell Mode (command line)



```
>>> print "3+2+1", "is equal to ", 6
3+2+1 is equal to  6
>>>
```

raw_input() is replaced
by input() for Python 3.*

Play with Python labs on your own!

THANKS!

Any questions?

You can find me at
beiwang@sci.utah.edu

http://www.sci.utah.edu/~beiwang/teaching/cs1060.html

Credits

Special thanks to all the people who made and released these awesome resources for free:

- Presentation template by SlidesCarnival
- Photographs by Unsplash