Variables, Expressions, and Statements

Chapter 2

UMSI

Constants

- Fixed values such as numbers, letters, and strings, are called "constants" because their value does not change

- Numeric constants are as you expect

- String constants use single quotes (')
or double quotes (")

```
>>> print(123)
123
>>> print(98.6)
98.6
>>> print('Hello world')
Hello world
```

Reserved Words

You cannot use reserved words as variable names / identifiers

False	await	else	import	pass
None	break	except	in	raise
True	class	finally	is	return
and	continue	for	lambda	try
as	def	from	nonlocal	while
assert	del	global	not	with
async	elif	if	or	yield

Variables

- A variable is a named place in the memory where a programmer can store data and later retrieve the data using the variable "name"

- Programmers get to choose the names of the variables

- You can change the contents of a variable in a later statement

```
x = 12.2
y = 14
```

x | 12.2 |

y | 14 |

Variables

- A variable is a named place in the memory where a programmer can store data and later retrieve the data using the variable "name"

- Programmers get to choose the names of the variables

- You can change the contents of a variable in a later statement

```
x = 12.2
y = 14
x = 100
```

x ~~12.2~~ 100

y 14

Python Variable Name Rules

- Must start with a letter or underscore _

- Must consist of letters, numbers, and underscores

- Case Sensitive

```
Good:       spam    eggs    spam23      _speed
Bad:       23spam        #sign   var.12
Different:      spam    Spam    SPAM
```

Mnemonic Variable Names

- Since we programmers are given a choice in how we choose our variable names, there is a bit of "best practice"

- We name variables to help us remember what we intend to store in them ("mnemonic" = "memory aid")

- This can confuse beginning students because well-named variables often "sound" so good that they must be keywords

http://en.wikipedia.org/wiki/Mnemonic

```
x1q3z9ocd = 35.0
x1q3z9afd = 12.50
x1q3p9afd = x1q3z9ocd * x1q3z9afd
print(x1q3p9afd)
```

What is this bit of
   code doing?

```
x1q3z9ocd = 35.0                        a = 35.0
x1q3z9afd = 12.50                       b = 12.50
x1q3p9afd = x1q3z9ocd * x1q3z9afd       c = a * b
print(x1q3p9afd)                        print(c)
```

What are these bits
of code doing?

```
x1q3z9ocd = 35.0                    a = 35.0
x1q3z9afd = 12.50                   b = 12.50
x1q3p9afd = x1q3z9ocd * x1q3z9afd   c = a * b
print(x1q3p9afd)                    print(c)
```

What are these bits
of code doing?

```
hours = 35.0
rate = 12.50
pay = hours * rate
print(pay)
```

Sentences or Lines

```
x = 2
```
⟵ Assignment statement

```
x = x + 2
```
⟵ Assignment with expression

```
print(x)
```
⟵ Print statement

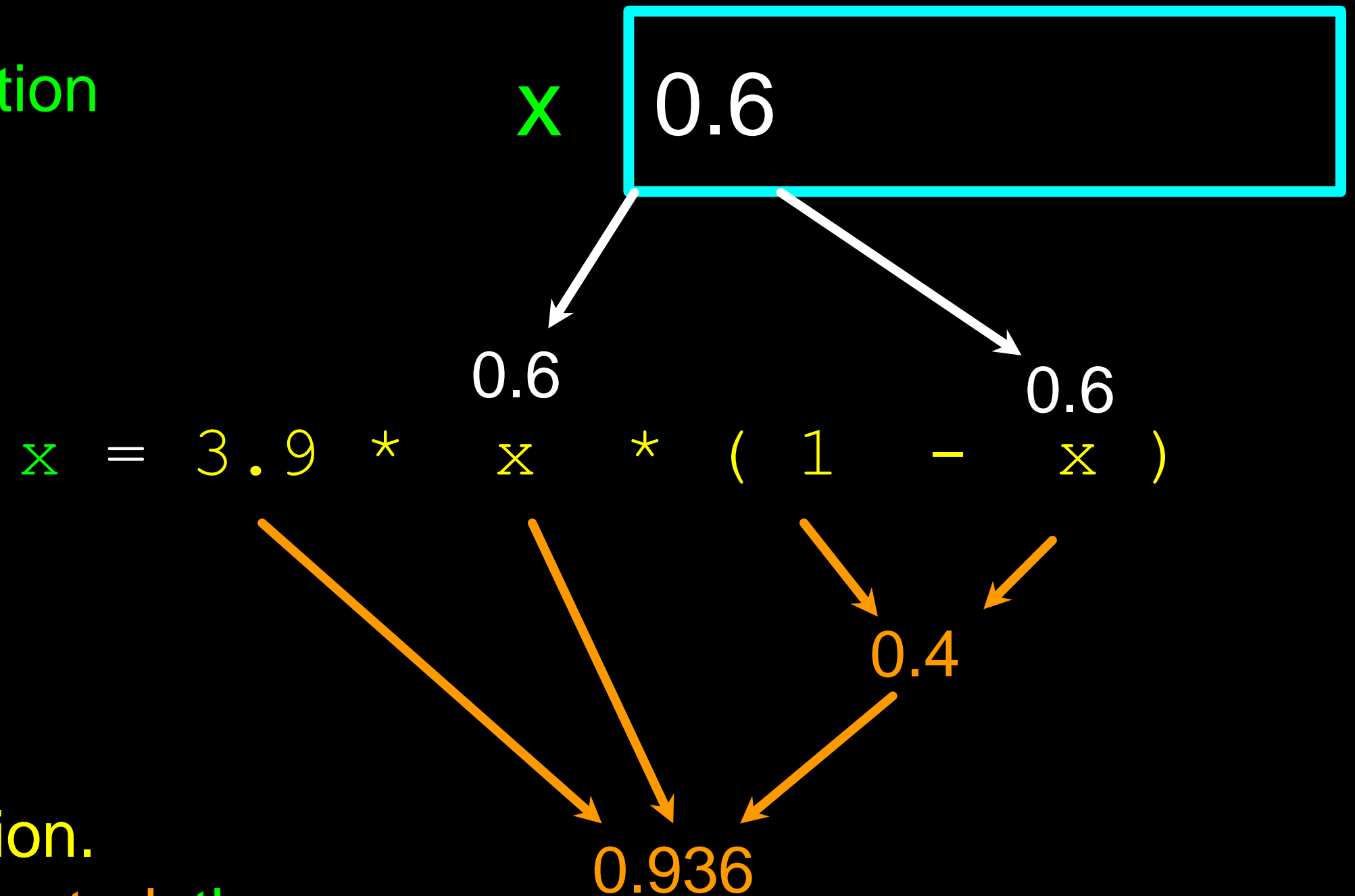Variable   Operator   Constant   Function

Assignment Statements

- We assign a value to a variable using the assignment statement (=)

- An assignment statement consists of an expression on the right-hand side and a variable to store the result

$$x = 3.9 * x * (1 - x)$$

A variable is a memory location
used to store a value (0.6)

x   0.6

0.6   0.6

x = 3.9 * x * (1 - x)

0.4

0.936

The right side is an expression.
Once the expression is evaluated, the
result is placed in (assigned to) x.

A variable is a memory location used to store a value. The value stored in a variable can be updated by replacing the old value (0.6) with a new value (0.936).
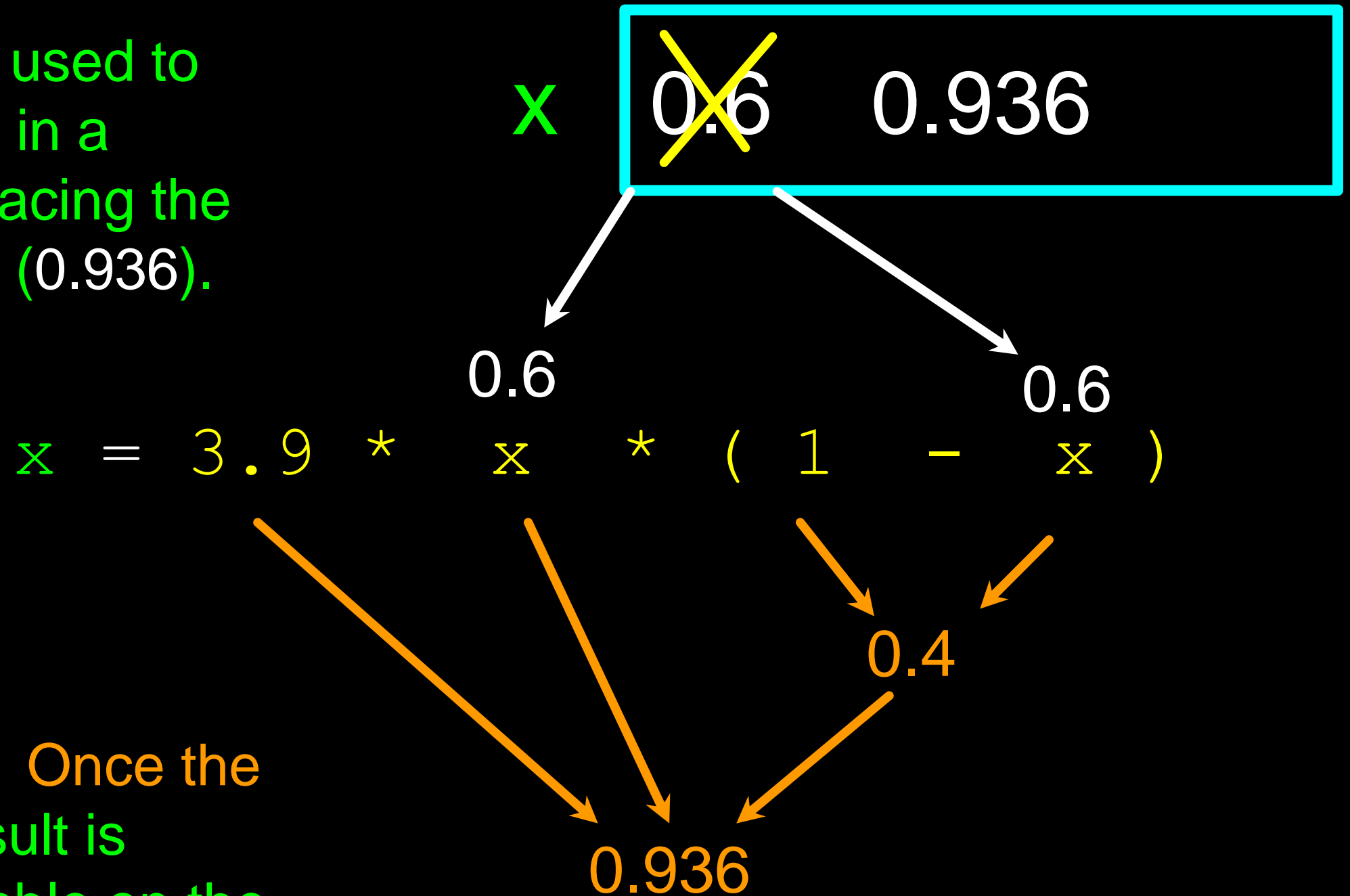
X 0.6 0.936

0.6   0.6

x = 3.9 * x * (1 - x)

0.4

0.936

The right side is an expression. Once the expression is evaluated, the result is placed in (assigned to) the variable on the left side (i.e., x).

Expressions…

Numeric Expressions

- Because of the lack of mathematical symbols on computer keyboards - we use "computer-speak" to express the classic math operations

- Asterisk is multiplication

- Exponentiation (raise to a power) looks different than in math

Operator	Operation
+	Addition
-	Subtraction
*	Multiplication
/	Division
**	Power
%	Remainder

Numeric Expressions

```
>>> xx = 2
>>> xx = xx + 2
>>> print(xx)
4
>>> yy = 440 * 12
>>> print(yy)
5280
>>> zz = yy / 1000
>>> print(zz)
5.28
```

```
>>> jj = 23
>>> kk = jj % 5
>>> print(kk)
3
>>> print(4 ** 3)
64
```

```
    4 R 3
  ┌─────
5 │ 23
    20
    ──
    3
```

Operator	Operation
+	Addition
-	Subtraction
*	Multiplication
/	Division
**	Power
%	Remainder

Order of Evaluation

- When we string operators together - Python must know which one to do first

- This is called "operator precedence"

- Which operator "takes precedence" over the others?

```
x = 1 + 2 * 3 - 4 / 5 ** 6
```

Operator Precedence Rules

Highest precedence rule to lowest precedence rule:

- Parentheses are always respected

- Exponentiation (raise to a power)

- Multiplication, Division, and Remainder

- Addition and Subtraction

- Left to right

Parenthesis
Power
Multiplication
Addition
Left to Right

```
>>> x = 1 + 2 ** 3 / 4 * 5
>>> print(x)
11.0
>>>
```

Parenthesis
Power
Multiplication
Addition
Left to Right

```
1 + 2 ** 3 / 4 * 5

1 + 8 / 4 * 5

1 + 2 * 5

1 + 10

11
```

Operator Precedence

Parenthesis
Power
Multiplication
Addition
Left to Right
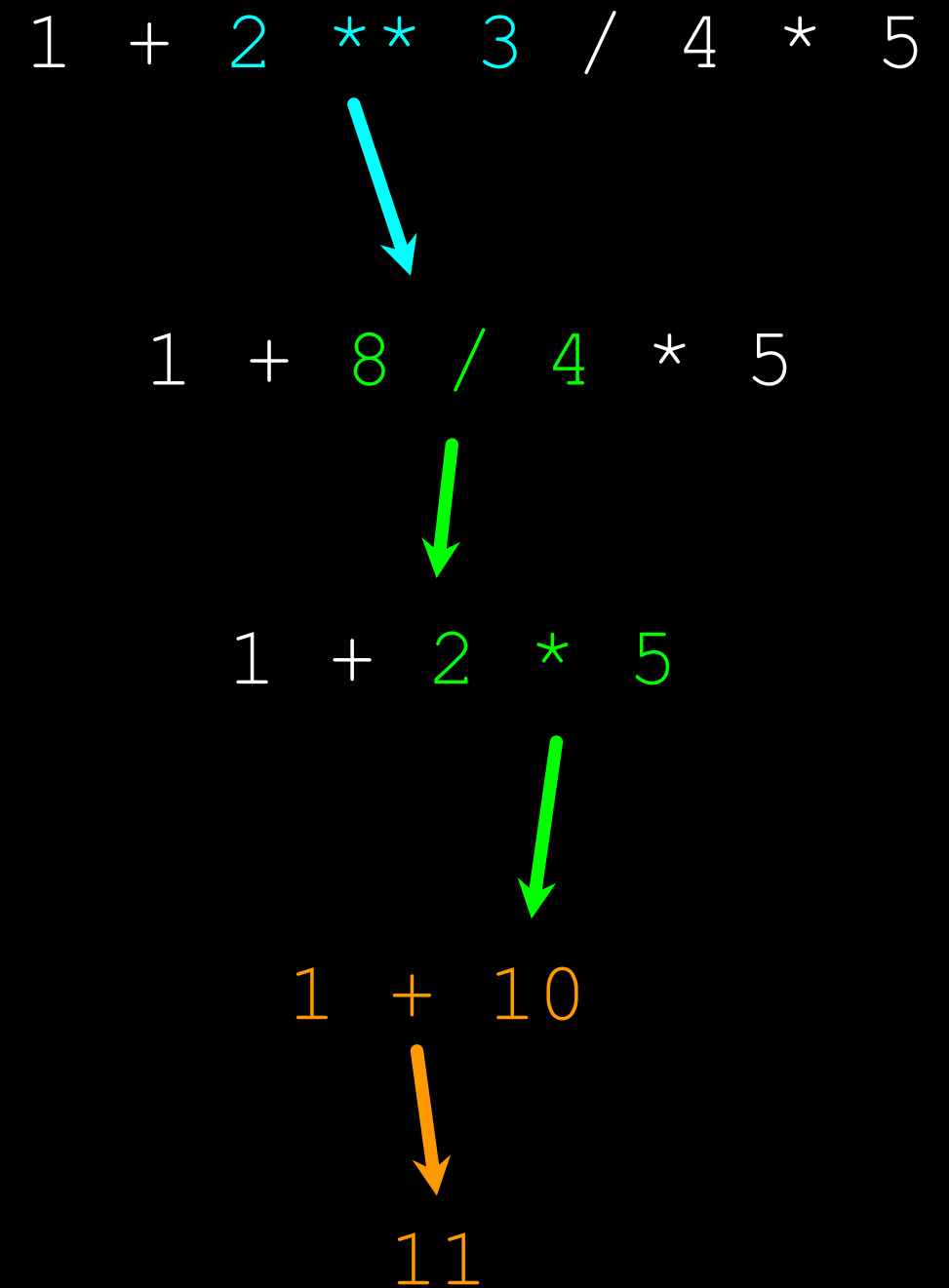
- Remember the rules top to bottom

- When writing code - use parentheses

- When writing code - keep mathematical expressions simple enough that they are easy to understand

- Break long series of mathematical operations up to make them more clear

What Does "Type" Mean?

- In Python variables, literals, and constants have a "type"

- Python knows the difference between an integer number and a string

- For example "+" means "addition" if something is a number and "concatenate" if something is a string

```
>>> ddd = 1 + 4
>>> print(ddd)
5
>>> eee = 'hello ' + 'there'
>>> print(eee)
hello there
```

concatenate = put together

Type Matters

- Python knows what "type" everything is

- Some operations are prohibited

- You cannot "add 1" to a string

- We can ask Python what type something is by using the type() function

```
>>> eee = 'hello ' + 'there'
>>> eee = eee + 1
Traceback (most recent call last):
File "<stdin>", line 1, in
<module>
TypeError: can only concatenate
str (not "int") to str
>>> type(eee)
<class'str'>
>>> type('hello')
<class'str'>
>>> type(1)
<class'int'>
>>>
```

Several Types of Numbers

- Numbers have two main types

  - Integers are whole numbers:
    -14, -2, 0, 1, 100, 401233

  - Floating Point Numbers have
    decimal parts: -2.5 , 0.0, 98.6, 14.0

- There are other number types - they
  are variations on float and integer

```
>>> xx = 1
>>> type (xx)
<class 'int'>
>>> temp = 98.6
>>> type(temp)
<class'float'>
>>> type(1)
<class 'int'>
>>> type(1.0)
<class'float'>
>>>
```

Type Conversions

- When you put an integer and floating point in an expression, the integer is implicitly converted to a float

- You can control this with the built-in functions int() and float()

```
>>> print(float(99) + 100)
199.0
>>> i = 42
>>> type(i)
<class'int'>
>>> f = float(i)
>>> print(f)
42.0
>>> type(f)
<class'float'>
>>>
```

Integer Division

Integer division produces a floating point result

This was different in Python 2.x

```
>>> print(10 / 2)
5.0
>>> print(9 / 2)
4.5
>>> print(99 / 100)
0.99
>>> print(10.0 / 2.0)
5.0
>>> print(99.0 / 100.0)
0.99
```

String Conversions

- You can also use int() and float() to convert between strings and integers

- You will get an error if the string does not contain numeric characters

```
>>> sval = '123'
>>> type(sval)
<class 'str'>
>>> print(sval + 1)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: can only concatenate str
(not "int") to str
>>> ival = int(sval)
>>> type(ival)
<class 'int'>
>>> print(ival + 1)
124
>>> nsv = 'hello bob'
>>> niv = int(nsv)
Traceback (most recent call last):
File "<stdin>", line 1, in <module>
ValueError: invalid literal for int()
with base 10: 'x'
```

User Input

- We can instruct Python to pause and read data from the user using the input() function

- The input() function returns a string

```
nam = input('Who are you? ')
print('Welcome', nam)
```

Who are you? Chuck
Welcome Chuck

Converting User Input

- If we want to read a number from the user, we must convert it from a string to a number using a type conversion function

- Later we will deal with bad input data

```python
inp = input('Europe floor?')
usf = int(inp) + 1
print('US floor', usf)
```

Europe floor? 0
US floor 1

Comments in Python

- Anything after a **#** is ignored by Python

- Why comment?

    - Describe what is going to happen in a sequence of code

    - Document who wrote the code or other ancillary information

    - Turn off a line of code - perhaps temporarily

```python
# Get the name of the file and open it
name = input('Enter file:')
handle = open(name, 'r')

# Count word frequency
counts = dict()
for line in handle:
    words = line.split()
    for word in words:
        counts[word] = counts.get(word,0) + 1

# Find the most common word
bigcount = None
bigword = None
for word,count in counts.items():
    if bigcount is None or count > bigcount:
        bigword = word
        bigcount = count

# All done
print(bigword, bigcount)
```

Summary

- Type

- Reserved words

- Variables (mnemonic)

- Operators

- Operator precedence

- Integer Division

- Conversion between types

- User input

- Comments (#)

Write a program to prompt the user for hours and rate per hour to compute gross pay.

```
Enter Hours: 35
Enter Rate: 2.75

Pay: 96.25
```

Acknowledgements / Contributions

...