

Variables, Assignments, Expressions

Introduction to Programming and Problem Solving

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Data

- Computer programs work with **data** to accomplish tasks, solve problems, etc.
- Simple data can be of numeric or string types.
- Data is stored in **variables** or presented as **constant** values in programs.

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
```

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  
y = 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	SpaåM

Reserved Words

- You cannot use **reserved words** as variable names / identifiers

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

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

```
a = 35.0  
b = 12.50  
c = a * b  
print(c)
```

What are these bits
of code doing?

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

```
a = 35.0
b = 12.50
c = a * b
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
```

```
x = x + 2
```

```
print(x)
```



Assignment statement

Assignment with expression

Print statement

Variable

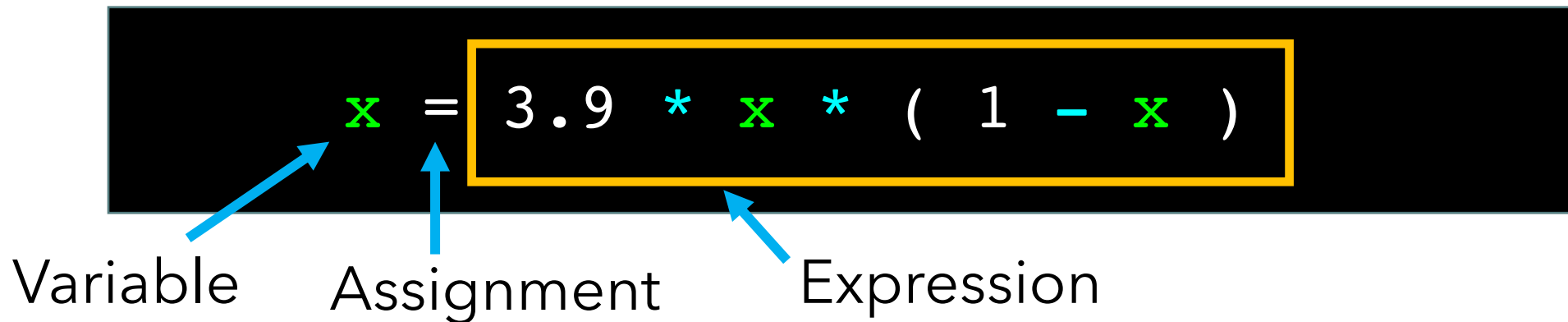
Operator

Constant

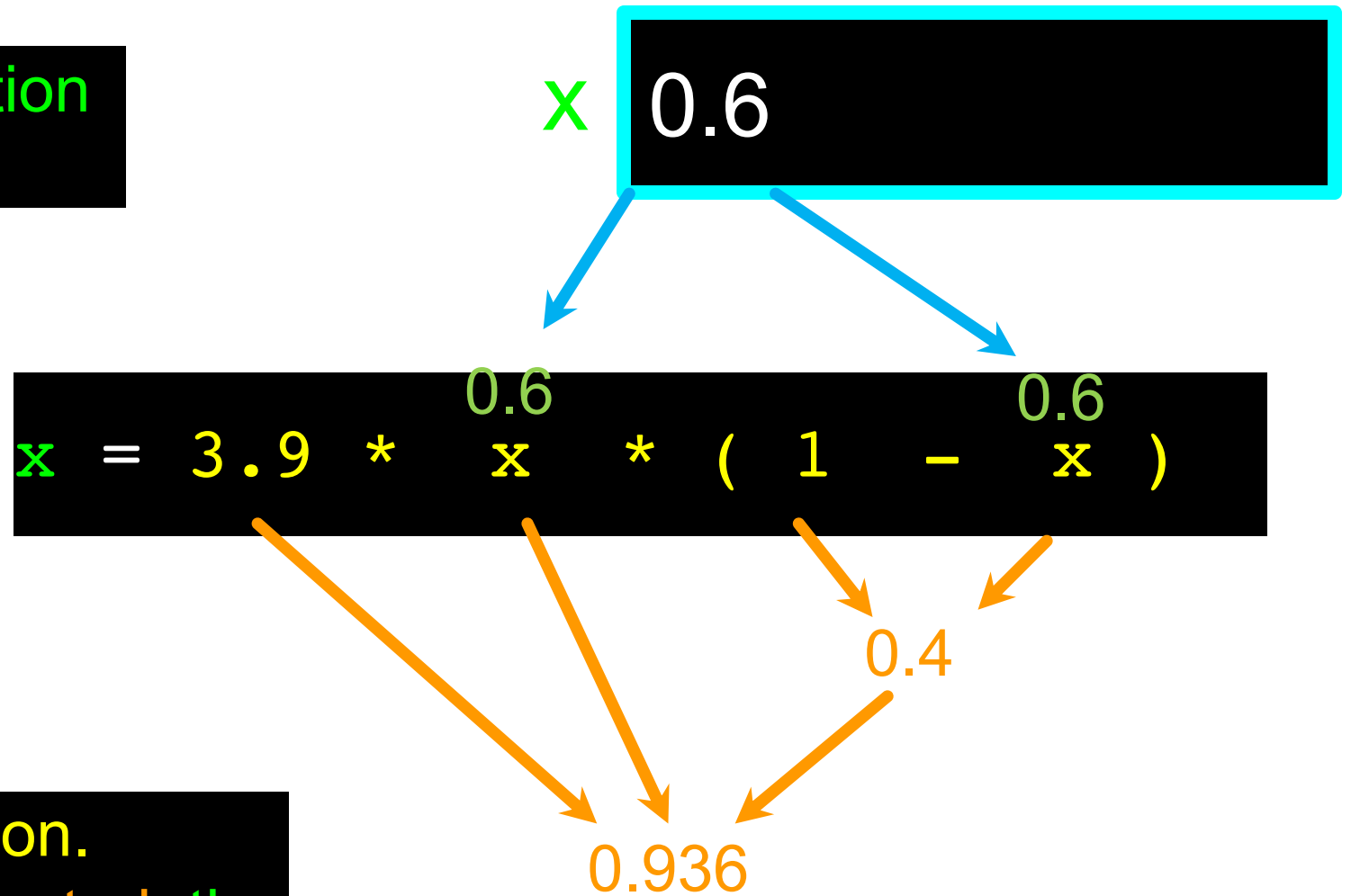
Function

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

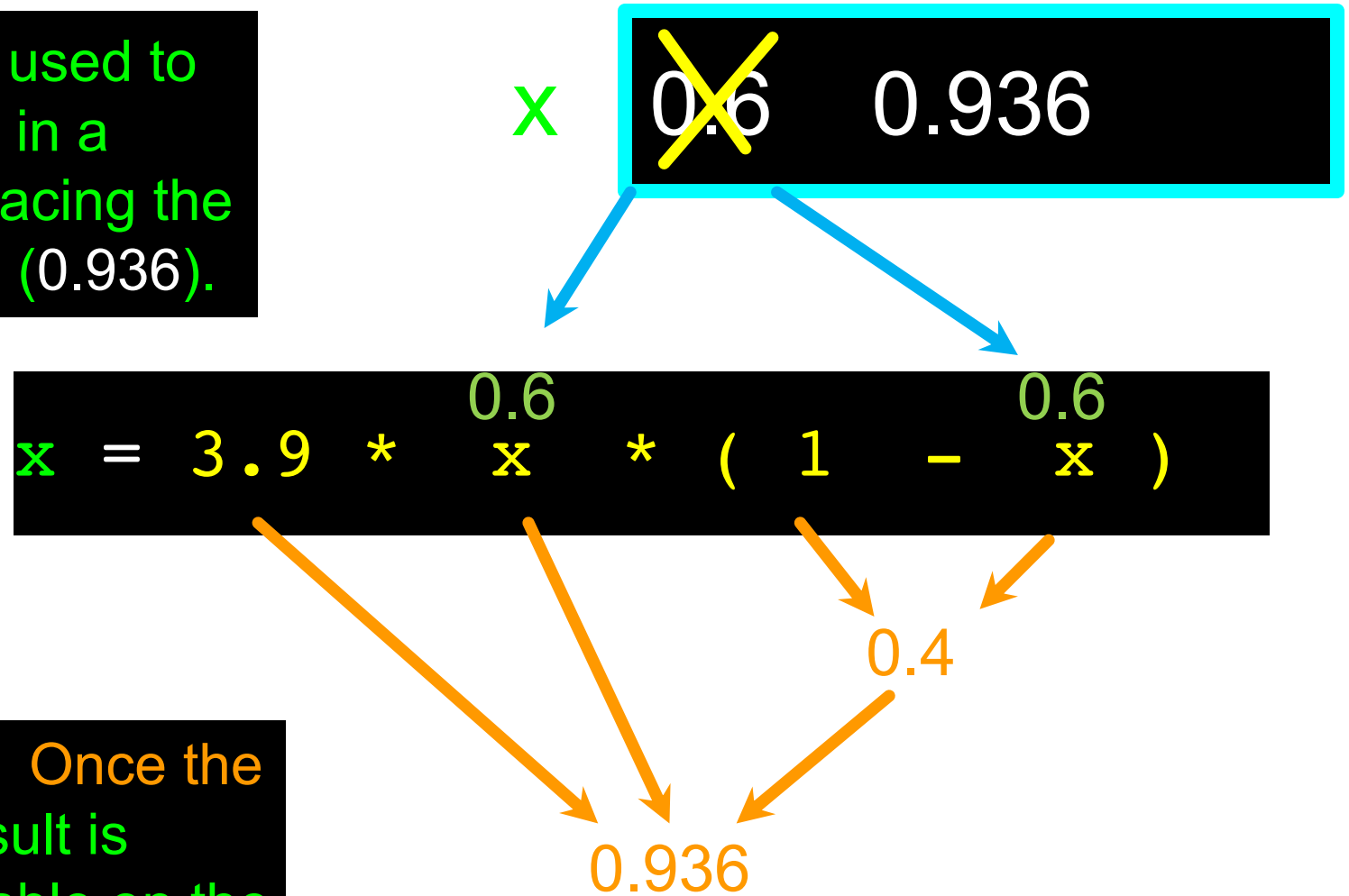


A variable is a memory location used to store a value (0.6)



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).



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
```

$$\begin{array}{r} 4 \text{ R } 3 \\ 5 \overline{) 23} \\ \underline{20} \\ 3 \end{array}$$

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

- Remember the rules top to bottom
- When writing code - use parentheses
 - `x = 1 + 2 ** 3 / 4 * 5`
 - `x = 1 + ((2 ** 3) / 4) * 5` # better
- 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

Parenthesis
Power
Multiplication
Addition
Left to Right



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't convert
'int' object to str implicitly
>>> 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
 - <https://docs.python.org/2.4/lib/typesnumeric.html>

```
>>> 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't convert 'int' object
to str implicitly
>>> ival = int(sval)
>>> type(ival)
<class 'int'>
>>> print(ival + 1)
124
>>> nsval = 'hello bob'
>>> niv = int(nsval)
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? ')\nprint('Welcome', nam)
```

```
Who are you? Chuck\nWelcome 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

```
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

```
# 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 (#)

Exercise

- 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



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