



Introduction to Python and programming

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UW CSE 160

Winter 2022

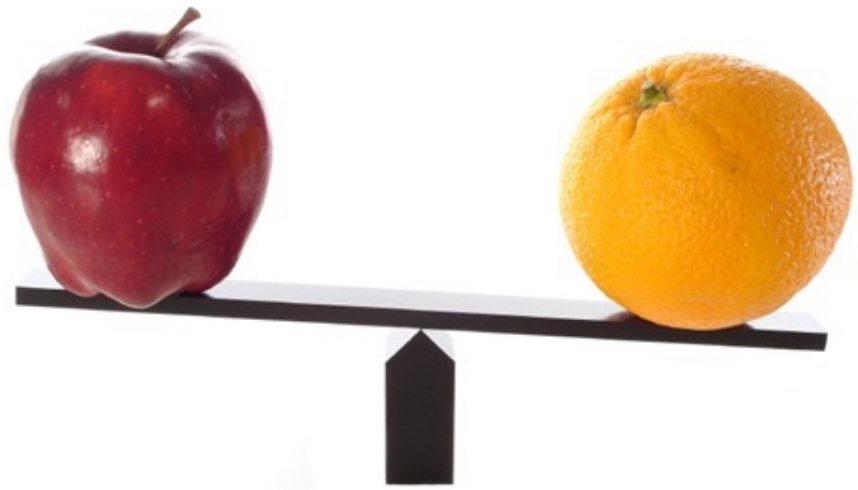
1. Python is a calculator



2. A variable is a container



3. Different types cannot be compared



4. A program is a recipe

CORNBREAD

Colvin Run Mill Corn Bread

- 1 cup cornmeal
- 1 cup flour
- ½ teaspoon salt
- 4 teaspoons baking powder
- 3 tablespoons sugar
- 1 egg
- 1 cup milk
- ¼ cup shortening (soft) or vegetable oil



Mix together the dry ingredients. Beat together the egg, milk and shortening/oil. Add the liquids to the dry ingredients. Mix quickly by hand. Pour into greased 8x8 or 9x9 baking pan. Bake at 425 degrees for 20-25 minutes.

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0. Don't panic!



- CSE 160 is for beginners to programming
 - (If you know how to program, you don't belong)
- You can learn to program in 10 weeks
 - You will work hard
 - We will work hard to help you
- Ask questions!
 - This is the best way to learn

1. Python is a calculator



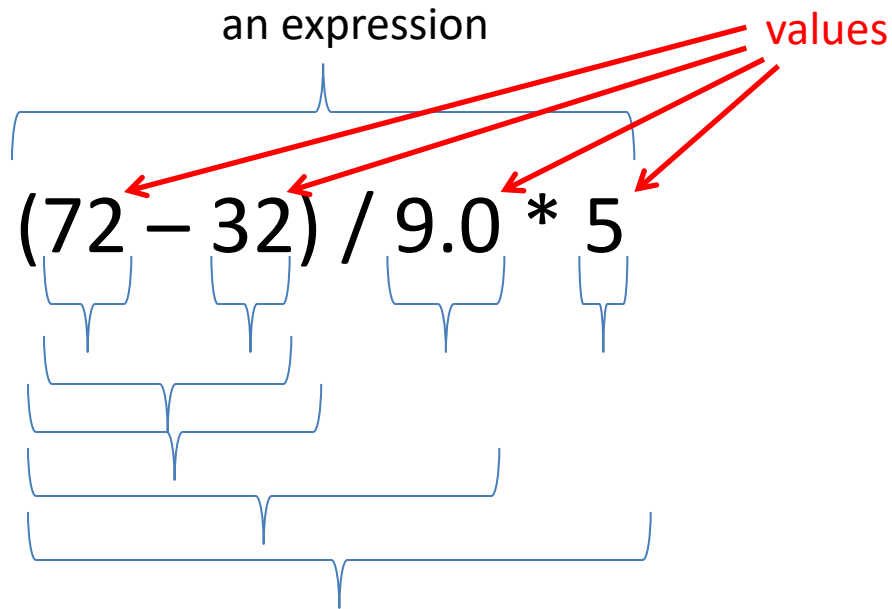
You type *expressions*.

Python computes their *values*.

- 5
- $3 + 4$
- $44 / 2$
- $2 ** 3$
- $3 * 4 + 5 * 6$
 - If precedence is unclear, use parentheses
- $(72 - 32) / 9 * 5$

An expression is evaluated from the inside out

- How many expressions are in this Python code?



$$(72 - 32) / 9.0 * 5$$

$$(40) / 9.0 * 5$$

$$40 / 9.0 * 5$$

$$4.44 * 5$$

$$22.2$$

Another evaluation example

$$(72 - 32) / (9.0 * 5)$$

$$(40) / (9.0 * 5)$$

$$40 / (9.0 * 5)$$

$$40 / (45.0)$$

$$40 / 45.0$$

$$.888$$

2. A variable is a container



Variables hold values

- Recall variables from algebra:

- Let $x = 2$...

- Let $y = x$...

- In Python: “*varname = expression*”

```
pi = 3.14
```

Nothing printed from an **assignment statement**

```
pi
```

An **expression** that can be typed into a python interpreter to be evaluated. Not a statement to put into a python program.

```
avogadro = 6 * 10 ** 23
```

```
avogadro
```

```
22 = x # Error!
```

- Not all variable names are permitted

Changing existing variables ("re-binding" or "re-assigning")

```
x = 2
```

Nothing printed from an assignment **statement**

```
x
```

```
y = 2
```

```
y
```

```
x = 5
```

```
x
```

```
y
```

An **expression** that can be typed into a python interpreter to be evaluated. Not a statement to put into a python program.

- “=” in an assignment is **not** a promise of eternal equality
 - This is **different** than the mathematical meaning of “=”
- Evaluating an expression gives a new (copy of a) number, rather than changing an existing one

How an assignment is executed

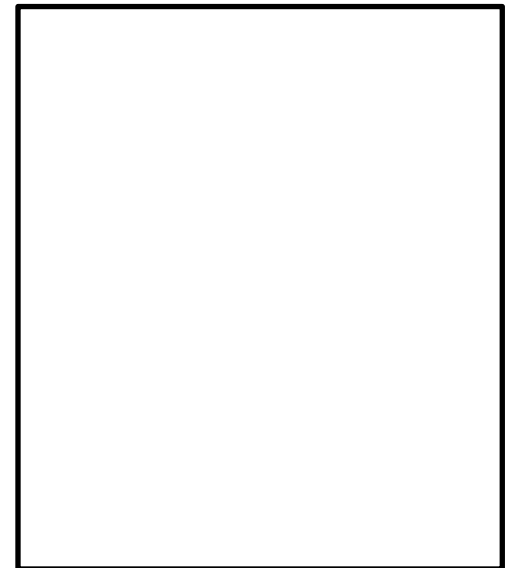
1. Evaluate the right-hand side to a value
2. Store that value in the variable

```
x = 2
print(x)
y = x
print(y)
z = x + 1
print(z)
x = 5
print(x)
print(y)
print(z)
```

State of the computer:



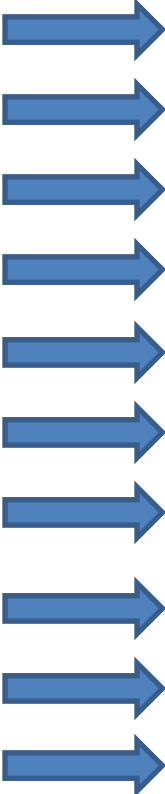
Printed output:



To visualize a program's execution: <http://pythontutor.com>
A custom link to this program is [here](#)

How an assignment is executed

1. Evaluate the right-hand side to a value
2. Store that value in the variable



```
x = 2
print(x)
y = x
print(y)
z = x + 1
print(z)
x = 5
print(x)
print(y)
print(z)
```

State of the computer:

```
x: 2
y: 2
z: 3
```

Printed output:

```
2
2
3
5
2
3
```

To visualize a program's execution: <http://pythontutor.com>
A custom link to this program is [here](#)

Boolean Expressions

(value is True or False)

```
22 > 4
```

```
22 < 4
```

```
22 == 4
```

```
x = 100
```

```
22 = 4
```

```
x >= 5
```

```
x >= 100
```

```
x >= 200
```

```
not True
```

```
not (x >= 200)
```

```
3 < 4 and 5 < 6
```

```
4 < 3 or 5 < 6
```

```
temp = 72
```

```
water_is_liquid = temp > 32 and temp < 2123
```

Also: see a [program printing these expressions in python tutor](#)

Assignment, *not* conditional!

Error!

Order of Precedence:

Numeric operators: +, *, **

Mixed operators: <, >=, ==

Boolean operators: not, and, or

What do you think?

What is printed out by the following Python code:

1) `print(2 < 7 or 3 > 12)`

2) `print(not ((2 < 3) and (4 > 100)))`

3)

```
temp = 72
```

```
is_liquid = temp > 32 and temp < 212
```

```
print(is_liquid)
```

```
temp = 300
```

```
print(is_liquid)
```

More expressions: strings

A string represents **text**

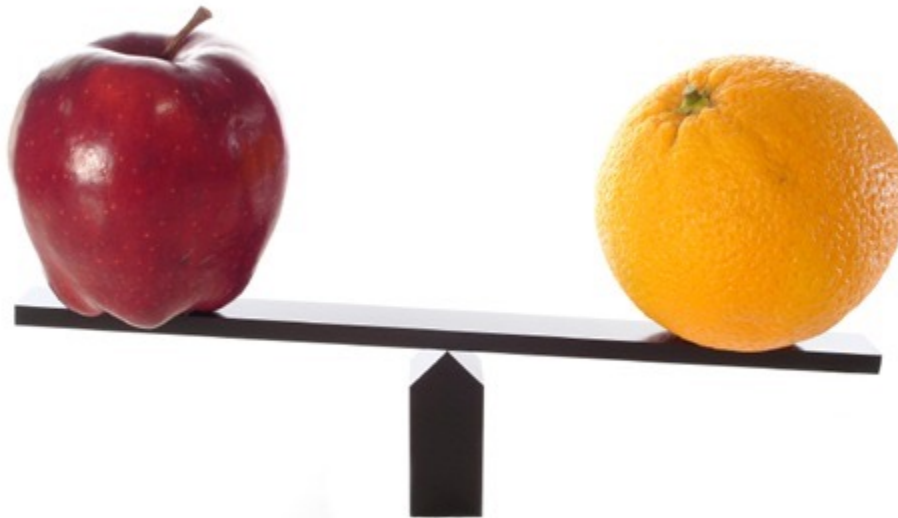
```
'Python'  
this_class = "CSE 160"  
""
```

Empty string is not the same as an unbound variable

Operations on strings:

- Length:
`len(this_class)`
- Concatenation:
`"Andrew" + "S" + 'Fitz' + "Gibbon"`
- Containment/searching:
`'0' in this_class`
`"0" in this_class`

3. Different types cannot be compared



Types of values

- Integers (**int**): -22, 0, 44
 - Arithmetic is **exact**
- Real numbers (**float**) : 2.718, 3.1415
 - **float**, for “floating point”
 - Arithmetic is **approximate**
- Strings (**str**): "I love Python", ""
- Truth values (**bool**): True, False
 - **bool**, for “Boolean”

Operations behave differently on different types

[Also: see a program printing these expressions in python tutor](#)

`3.0 + 4.0`

`3 + 4`

`3 + 4.0`

`"3" + "4"`

`3 + "4"` # Error

`3 + True` # Don't do this.

Moral: Python *sometimes* tells you when you do something that does not make sense.

Operations behave differently on different types

```
15.0 / 4.0
```

```
15 / 4      # Would have been truncated in Python 2.
```

```
15.0 / 4
```

```
15 / 4.0
```

[See a **program** printing these expressions in python tutor](#)

Type conversion:

```
float(15)
```

```
int(15.0)
```

```
int(15.5)
```

```
int("15")
```

```
str(15.5)
```

```
float(15) / 4
```

4. A program is a recipe

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What is a program?

[See this program in python tutor](#)

- A program is a sequence of instructions
- The computer executes one after the other, as if they had been typed to the interpreter
- Saving your work as a program is better than re-typing from scratch

```
x = 1
y = 2
x + y
print(x + y)
print("The sum of", x, "and", y, "is", x + y)
```

Interlude: The `print` statement

[See this program in python tutor](#)

- The `print` statement always prints one line
 - The next print statement prints below that one
- Write 0 or more expressions inside the parentheses, separated by commas
 - In the output, the values are separated by spaces

- Examples:

```
print(3.1415)
```

```
print(2.718, 1.618)
```

```
print()
```

```
print(20 + 2, 7 * 3, 4 * 5)
```

```
print("The sum of", x, "and", y, "is", x + y)
```

Expressions, statements, and programs

- An **expression** evaluates to a value

```
3 + 4
```

```
pi * r ** 2
```

- A **statement** causes an effect

```
pi = 3.14159
```

```
print(pi)
```

- **Expressions** appear within other **expressions** and within **statements**

```
(fahr - 32) * (5.0 / 9)
```

```
print(pi * r ** 2)
```

- A **statement** may *not* appear within an **expression**

```
3 + print(pi)           # Error!
```

- A **program** is made up of **statements**

- A program should do something or communicate information
- Just evaluating an expression does not accomplish either goal

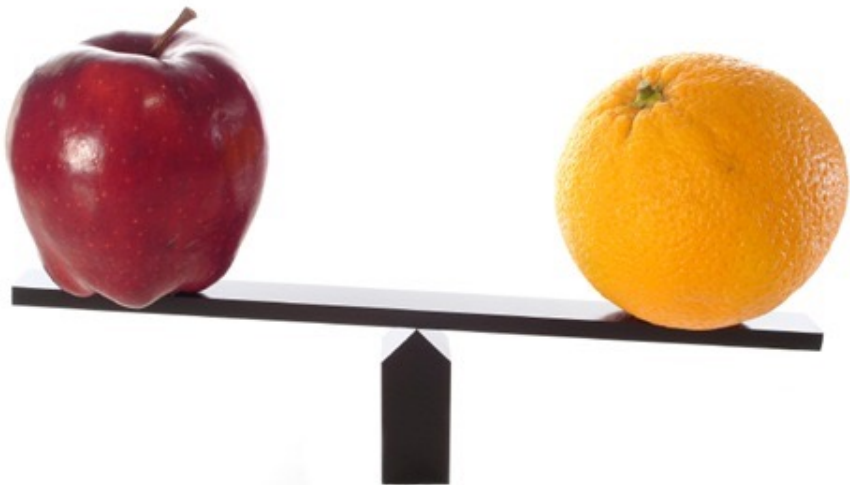
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