Introduction to Computation for the Humanities and Social Sciences

CS 3

Chris Tanner

Lecture 4

Python: Variables, Operators, and Casting

Lecture 4

"[People] need to learn code,
man I'm sick with the Python."

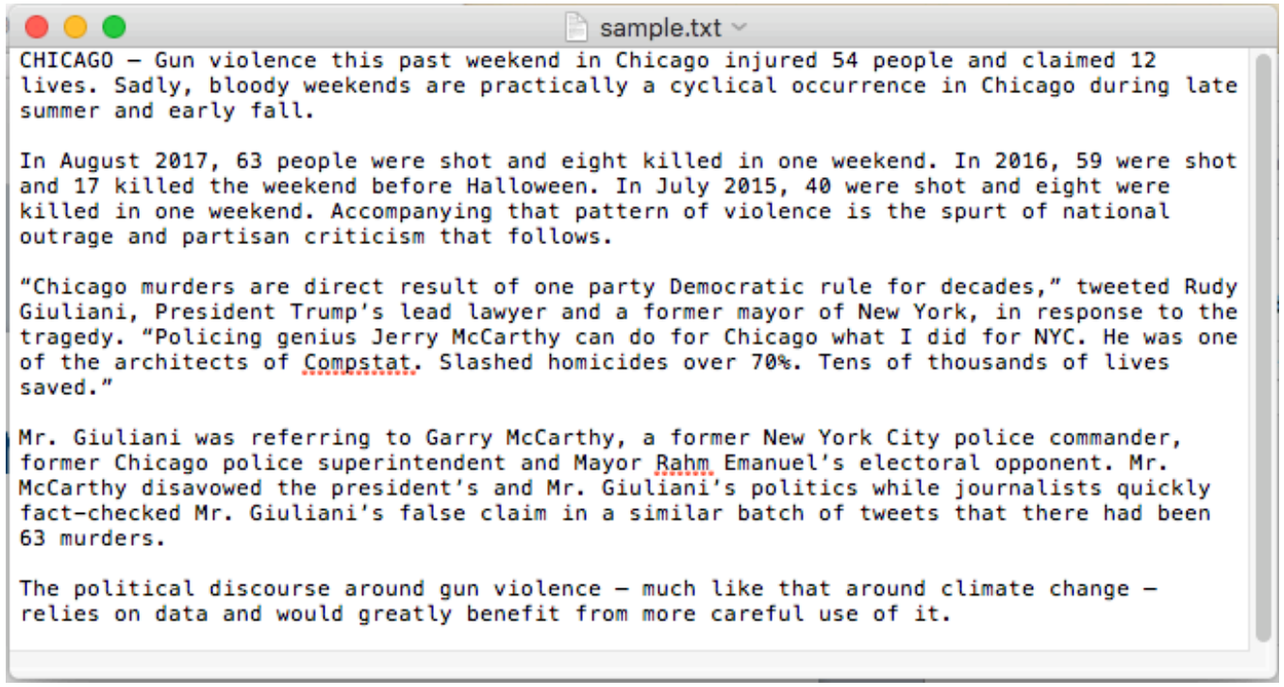
— Childish Gambino

HOT 97 "freestyle", Sept 8, 2014

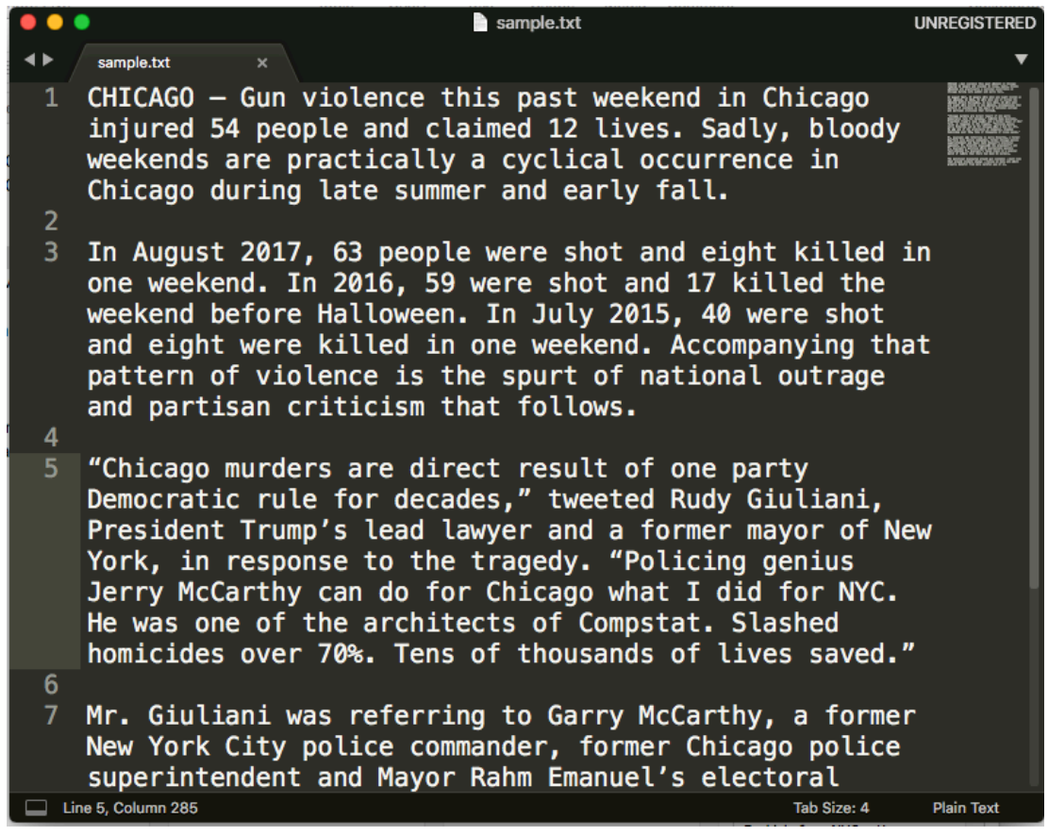
A REFRESHER — IDE (Atom, Sublime, etc)

- Atom, Sublime, etc are **not** Python-specific
- They are programs just like any other on our computer
- They are text editors (like Microsoft Word, Text Edit, Notepad), which allow us to display and edit text
- However, they're catered for the task of **programming**, so they have nifty features like displaying certain words w/ colors to make it easy to read
- Related, we could write Python code in Microsoft Word if we wanted, just that would make our life more difficult

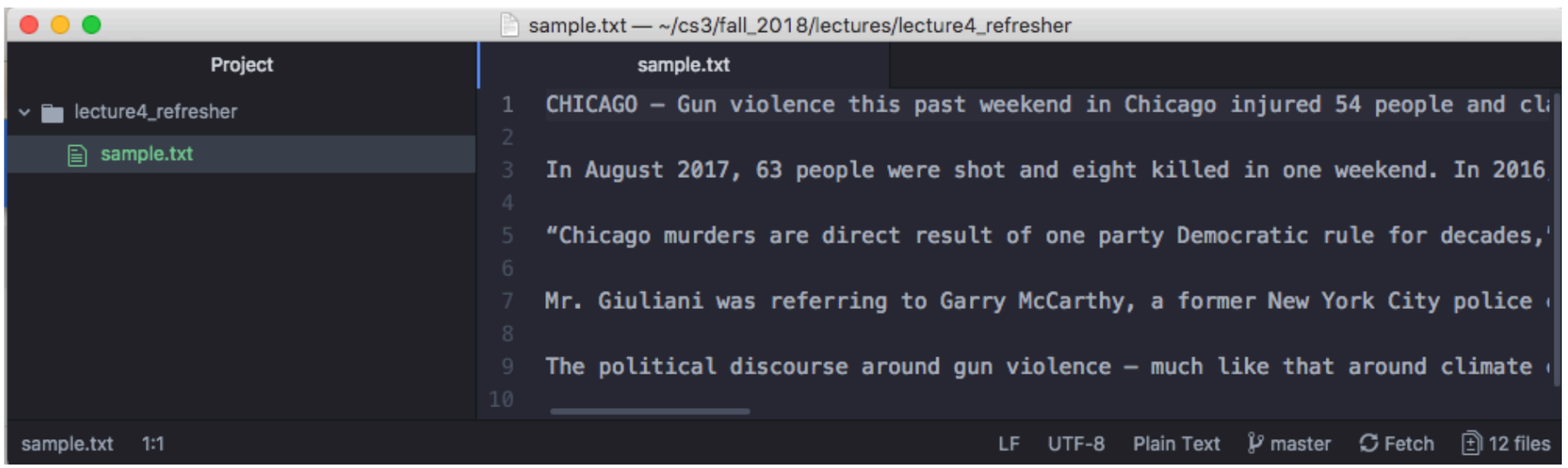
Opening a NY Times article



Text Edit



Sublime



Atom

Opening a file of Python code

```
def parseDir(self, stanOutputDir):
    files = []
    for root, _, filenames in os.walk(stanOutputDir):
        for filename in fnmatch.filter(filenames, '*.x
            files.append(os.path.join(root, filename))
    for f in files:
        doc_id = str(f[f.rfind("/")+1:])
        if doc_id in self.corpus.doc_idToDocs:
            # format: [sentenceNum] -> {[tokenNum] ->
            self.docToSentenceTokens[doc_id] = self.pa

# (1) reads stanford's output, saves it
# (2) aligns it w/ our sentence tokens
def parseFile(self, inputFile):

    sentenceTokens = defaultdict(lambda: defaultdict(i
    tree = ET.ElementTree(file=inputFile)
    root = tree.getroot()

    document = root[0]
    sentences, _ = document
    '''
    print("doc:", inputFile)
    for elem in corefs:
        print("el:",elem)
        for section in elem:
            print("sec:",section)
            for s2 in section:
                print("s2:",s2)
    '''


    self.relationshipTypes = set()
    for elem in sentences:  # tree.iter(tag='sentence'
        sentenceNum = int(elem.attrib["id"])
```

Atom

StanParser.py

```
def parseDir(self, stanOutputDir):
    files = []
    for root, _, filenames in os.walk(stanOutputDir):
        for filename in fnmatch.filter(filenames, '*.xml'):
            files.append(os.path.join(root, filename))
    for f in files:
        doc_id = str(f[f.rfind("/")+1:])
        if doc_id in self.corpus.doc_idToDocs:
            # format: [sentenceNum] -> {[tokenNum] -> StanToken}
            self.docToSentenceTokens[doc_id] = self.parseFile(f)

# (1) reads stanford's output, saves it
# (2) aligns it w/ our sentence tokens
def parseFile(self, inputFile):

    sentenceTokens = defaultdict(lambda: defaultdict(int))
    tree = ET.ElementTree(file=inputFile)
    root = tree.getroot()

    document = root[0]
    sentences, _ = document
    '''
    print("doc:", inputFile)
    for elem in corefs:
        print("el:",elem)
        for section in elem:
            print("sec:",section)
            for s2 in section:
                print("s2:",s2)
    '''


    self.relationshipTypes = set()
    for elem in sentences:  # tree.iter(tag='sentence'):
        sentenceNum = int(elem.attrib["id"])
        for section in elem:
            # process every token for the given sentence
            if section.tag == "tokens":
                # constructs a ROOT StanToken, which represents the NULL R
the DependencyParse
                rootToken = StanToken(True, sentenceNum, 0, "ROOT", "ROOT"
-1, "-", "-")
                sentenceTokens[sentenceNum][0] = rootToken
                for token in section:
                    tokenNum = int(token.attrib["id"])
                    word = ""
                    lemma = ""
                    startIndex = -1
                    endIndex = -1
                    pos = ""
```

Text Edit

A REFRESHER — Python

- We choose to teach programming via the Python language
- Python is just the **language** of the words we choose to type
- We chose Python because:
    - it's incredibly powerful (arguably the most robust language)
    - easy to read and write code
    - extensive set of **libraries** to help w/ doing technical stuff
- The skills you learn in this course (including writing Python code) are completely transferrable to other programming languages; after this course, it would be easy to write code in Java or R (just as Caroline, the TA. She took CS3). The core principles are the same!

A REFRESHER — Anaconda

- In order to run Python code (Python programs) that we write, we need to install software on our computer which knows how to understand and run Python code.
- Anaconda does this for us. Anaconda installs all necessary things so that we can write and run Python code.
- We didn't have to use it; there are other ways to install Python, but it's generally a very easy way to install Python

A REFRESHER — The Terminal (aka Console)

- The terminal/console isn't Python-specific! Inherently, has nothing to do with Python

- It merely provides an alternative way to function w/ our computer, instead of the normal, graphical way with our mouse and clicking on folders and double-clicking programs to open them

- Instead of using your computer via a mouse and clicking on pretty things, one could do most things while just using the Terminal/ Console

- Our Python programs we'll create in this course don't have graphical components that display stuff on the screen (e.g., Spotify), so it makes most sense to execute them from the Terminal

Data Types

- Data Types
- Variables
- Operators
- Casting

Data Types

- all computer programs operate on data
- just like calculators (limited computers) do, but calculators operate only on numerical data
- our computer programs can operate on numerical data, text, and more.

Data Types

Primitive Data Types

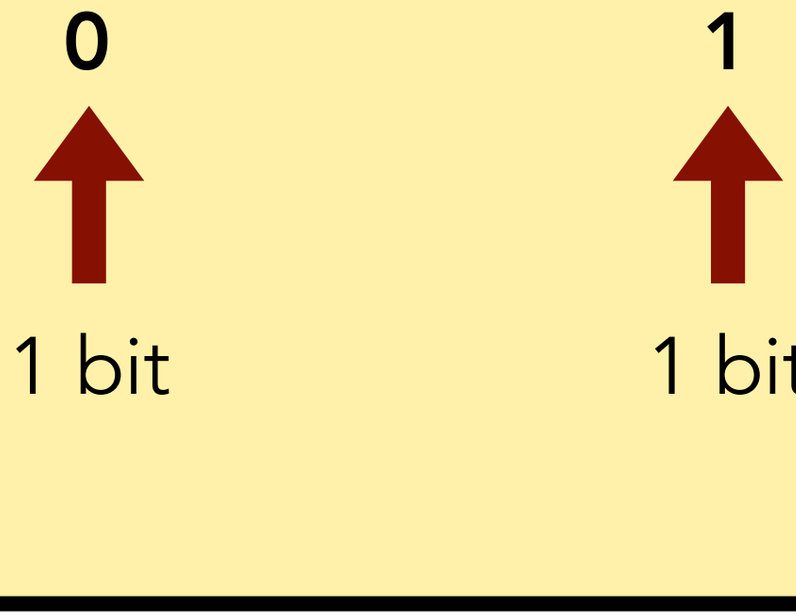
- **Boolean Values:** only `True` or `False`
- **Numeric Values:** `0` `-4` `783910` `33.3333333` `-2.59`
- **Strings** (text): `"Hello"`
  `"Today, we heard from the Senate"`
  `""`
  `"Welcome to CS3"`

Data Types

- **Boolean**
- **Numeric V**
- **Strings** (te

Boolean

- Python's type for booleans is **`bool`**
- Under the hood, your computer uses only 1 bit to store a boolean value



Data Types

- Boolean
- Number
- Strings

Integers

- Python's type for integers is **`int`**
- Whole numbers only
- Calculations with integers are exact, except division
- Calculations with integers are crazy fast
- If your integer value is between ±9,223,372,036,854,775,807
- Under the hood, your computer uses 64 bits (8 bytes) to store an **`int`**

Data Types

- Boole
- Nu
- String

Floating Point (numbers with decimals)

- Python's type for these is called **`float`**
- Used for representing numbers with decimals
- Values are between a huge range: -10^{307} to 10^{308}
- Under the hood, your computer uses 64 bits (8 bytes) to store a **`float`**

Data Types

- Boole
- Nu
- String

Floating Point (numbers with decimals)

- Every calculation with floats is always approximate. Very close to correct, but unreliable after about 15 digits after the decimal. So, never check if two floats are equal.

e.g.,

```
>>> 10/3
3.3333333333333335
```

Probably off

Data Types

- Boole
- Nu
- String

Strings (text)

- Strings are used to represent words
- A **`string`** is just a bunch of characters (a-Z, 0-9, etc)
- Under the hood, the number of bytes your computer uses for a **`string`** depends on how long it is. (Uses 1 byte per character.)

Data Types

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Data Types

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Variables

- for computers programs to access and use any data, they must store the data somewhere, even if it's a single, tiny piece of data (e.g., 1 number) and for a very brief time. Hence, why we have **variables**!

- **Variable** — something that represents a specific, stored piece of data. Each variable has a name (defined by the programmer), and that name is used to later reference/access/use the data.

Variables

- for computers programs to access and use any data, they must store the data somewhere, even if it's a single, tiny piece of data (e.g., 1 number) and for a very brief time. Hence, why we have **variables**!

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variable	**value**
my_age	19

Variables

- for computers programs to access and use any data, they must store the data somewhere, even if it's a single, tiny piece of data (e.g., 1 number) and for a very brief time. Hence, why we have **variables**!

- **Variable** — something that represents a specific, stored piece of data. Each variable has a name (defined by the programmer), and that name is used to later reference/access/use the data.

variable	**value**
my_age	= 19
my_school	= "Brown University"

Variable Assignment

variable **value**

result = 2 + 2

Variable Assignment

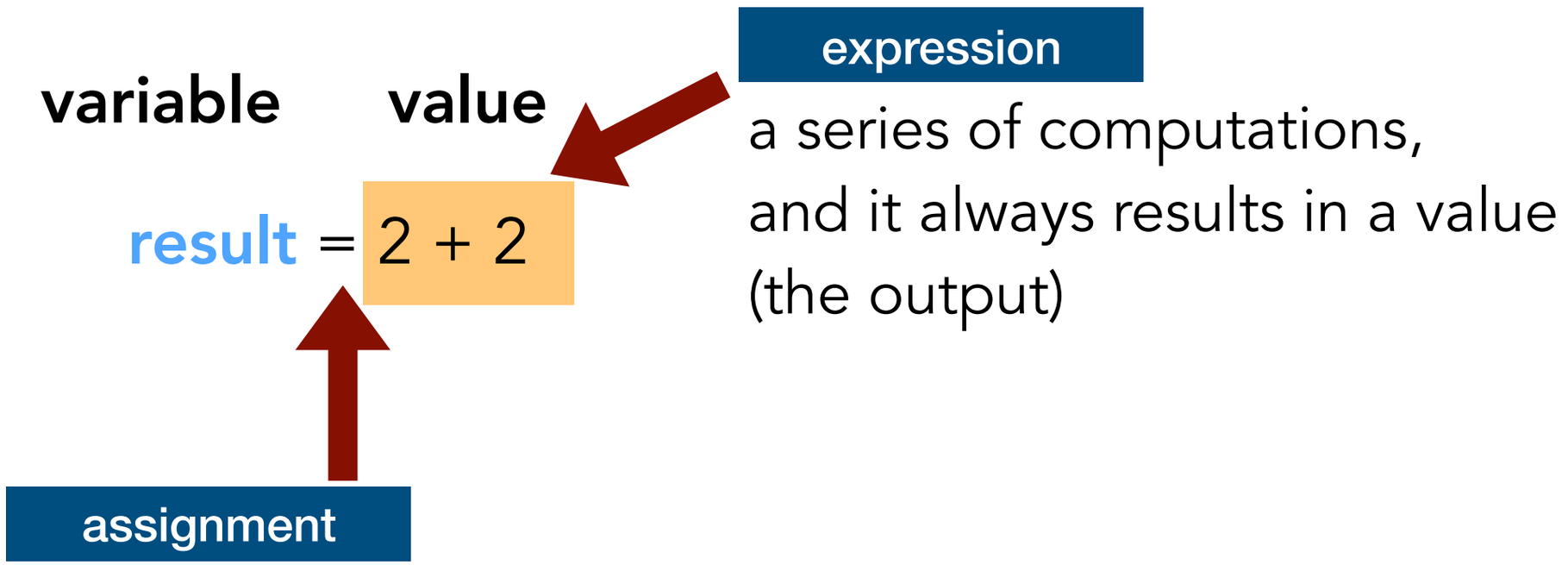
variable **value**

result = 2 + 2

expression

a series of computations,
and it always results in a value
(the output)

Variable Assignment



Variable Assignment

result = 18 * 3 + 2

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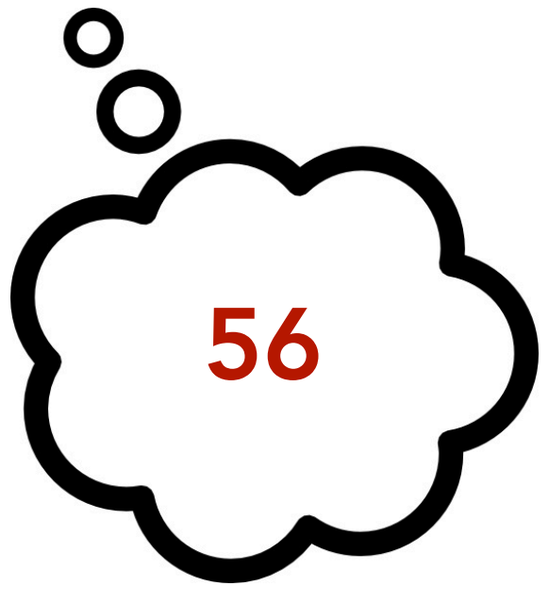
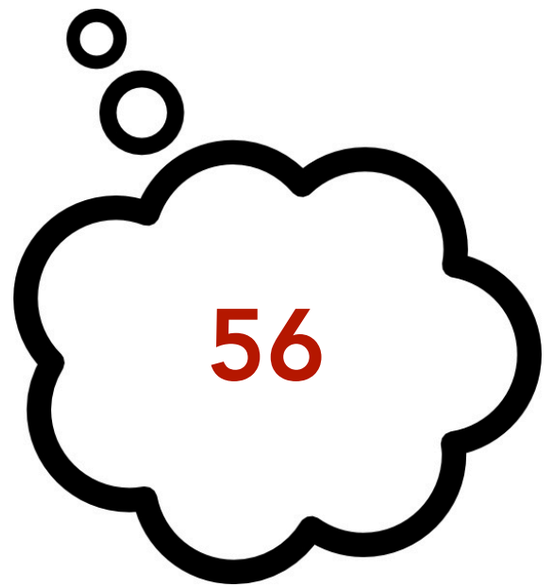


Variable Assignment

result = 18 * 3 + 2

stores **56** (in binary) in the computer's memory somewhere, and you can always access this value via the variable named **result**. you could have named this variable whatever you want.



"result"

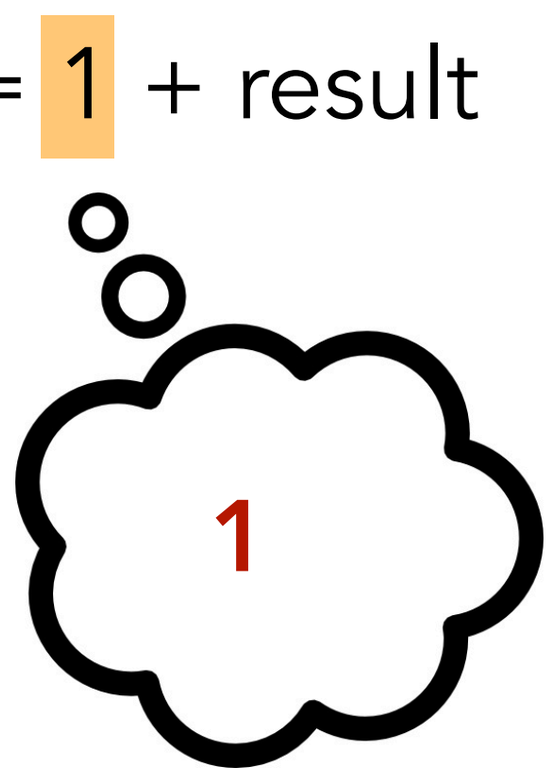
00000000000000000000000000000000000000000000000000000000000111000

Variable Assignment

```
result = 18 * 3 + 2
another_result = 1 + result
```

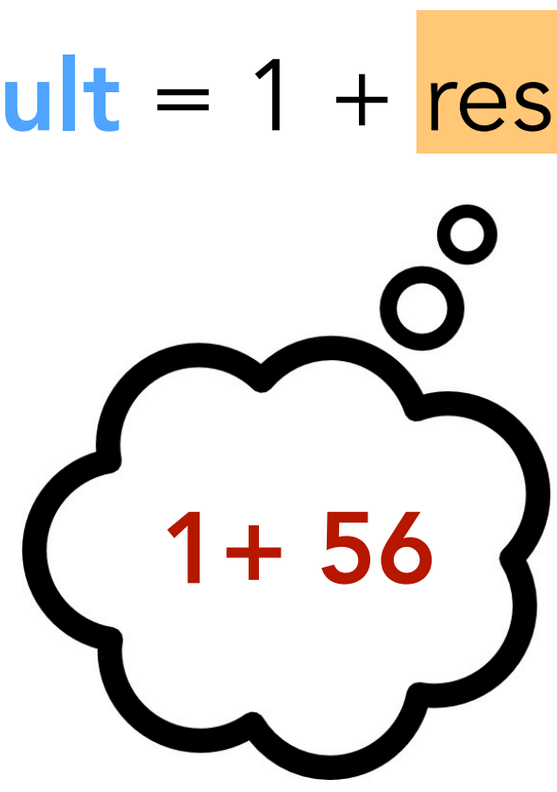
Variable Assignment

```
result = 18 * 3 + 2
another_result = 1 + result
```



Variable Assignment

```
result = 18 * 3 + 2
another_result = 1 + result
```



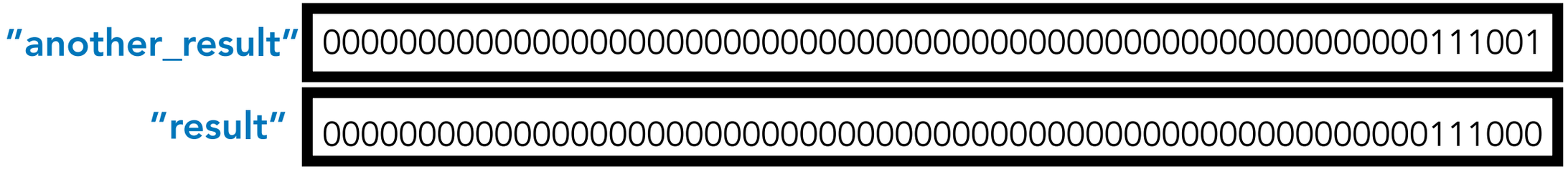
Variable Assignment

```
result = 18 * 3 + 2
another_result = 1 + result
```

Variable Assignment

```
result = 18 * 3 + 2
another_result = 1 + result
```

stores **57** (in binary) in the computer's memory somewhere, and you can always access this value via the variable named **another_result**. you could have named this variable whatever you want.



Variable Assignment

```
result = 18 * 3 + 2
another_result = 1 + result
name = "jim"
```

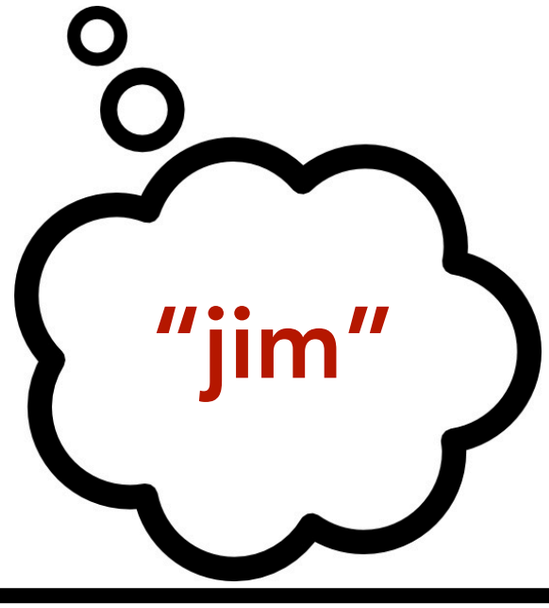
Variable Assignment

result = 18 * 3 + 2

another_result = 1 + result

name = "jim"

stores **jim** (in binary) in the computer's memory somewhere, and you can always access this value via the variable named **name**. you could have named this variable whatever you want.



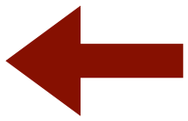
"jim" 01101010 01101001 01101101

Variables

Execution

- a computer executes one line of a code at a time
- optionally assigns the computation's output to a variable (if there's an = sign).

```
1    18 * 3 + 2
```



calculates 56 but doesn't do anything with it

- each line of code should do 1 thing, e.g.

```
1    result = 18 * 3 + 2
2    another_result = 1 + result
```

not

```
1    result = 18 * 3 + 2    another_result = 1 + result
```

Execution

- **Initializing a variable** — the first time you assign something to a variable; this is the *creation* of the variable
- If you try to use a variable that you haven't yet initialize (aka created/defined), your program will crash with an error.

```
1    result = 18 * 3 + 2
2    another_result = 1 + results
```

Variables

Execution

- **Initializing a variable** — the first time you assign something to a variable; this is the *creation* of the variable
- If you try to use a variable that you haven't yet initialize (aka created/defined), your program will crash with an error.

```
1    result = 18 * 3 + 2
2    another_result = 1 + results
```

```
Traceback (most recent call last):
  File "test.py", line 2, in <module>
    print(results)
NameError: name 'results' is not defined
```

Data Types

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Operators

Mathematical Operators

```
result = a + b
```

operator

operators can be:

- Addition: +
- Subtraction: -
- Multiplication: *
- Division: /
- Exponentiation: **
- Whole number result of division: //
- Remainder of division (modulo): %

a and **b** can be:
numerical values (`ints` *or* `floats`)
or
text (`strings`)
but if you mix-and-match them,
then you gotta be careful.

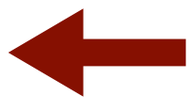
Operators

Mathematical Operators

```
result = 5 + 3
```

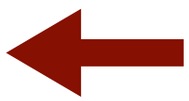
calculates 8

```
result = 5 / 3
```



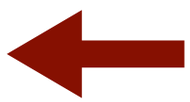
calculates 1.6666666666666667

```
result = 5 ** 3
```



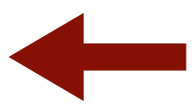
calculates 5^3 which is 125

```
result = 5 // 3
```



calculates 1

```
result = 5 % 3
```

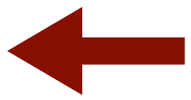


calculates 2

Mathematical Operators

- If an expression contains a `float` anywhere, the result will be a `float`

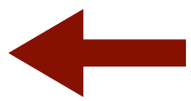
```
result = 5.2 + 3
```



calculates 8.2

- If the result of division of two integers is not an integer, the result will be a float

```
result = 5 / 3
```



calculates 1.6666666666666667

Mathematical Operators

You can operate on any number or variable, including **updating** an existing variable's value:

```
result = result + 1
```

adds 1 to the current value of **result.** standard way to represent a counter of something.

Mathematical Operators

You can operate on any number or variable, including **updating** an existing variable's value:

```
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```
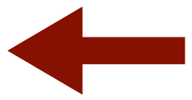
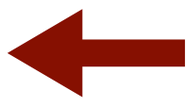



adds 1 to the current value of **result.** standard way to represent a counter of something.

For succinctness, you could alternatively type:

```
result += 1
```



same as above

Mathematical Operators

This nifty alternate version of writing can be used for all operations, e.g.,:

```
result = result * 2
```

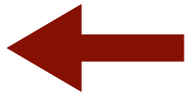
is equivalent to

```
result *= 2
```

String Operators

- String concatenation (aka combining words together):

```
result = “Red” + “Sox”
```



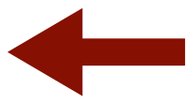
calculates “RedSox”

Mainly useful to concatenate when you’re combining text with numerical data (e.g., answers you care about) and you want to display it to the user

String Operators

For example:

```
1   result = 6 / 3
2   message = “The answer is ” + result
```



calculates 2.0. Remember division always yields a **`float`**

Operators

String Operators

For example:

```
1   result = 6 / 3
2   message = “The answer is ” + result
```

calculates 2.0. Remember division always yields a **`float`**

Although, UH-OH. We get an error.

```
>>> result = 6/3
>>> message = "The answer is " + result
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: Can't convert 'float' object to str implicitly
```

String Operators

TypeError: The computation expects a value of a specific type, but received a different one instead

```
  Fil "<stdin>", line 1, in <module>
TypeError: Can't convert 'float' object to str implicitly
```

What value does “result” contain?

```
1  result = 6 / 3
2  age = 20
3  result = result + age
4  result /= 2
```

What value does “result” contain?

```
1   result = 6 / 3
2   age = 20
3   result = result + age
4   result /= 2
```

11.0

Data Types

- Data Types
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Casting

```
>>> result = 6/3
>>> message = "The answer is " + result
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: Can't convert 'float' object to str implicitly
```

- Remember, mixing-and-matching numeric data (**`int`**s or **`float`**s) with text (**`string`**s) requires us to be careful

- The computer doesn't know what to do with these different data types, so it tells us that we must fix it.

- When trying to use different *types* of data together, which by default are incompatible, we must **cast** (convert) them (when possible).

Casting

Casting — to change a particular data's **type** of value(s)

```
1   result = 6 / 3
2   message = “The answer is ” + str(result)
```

converts the `float` to a `string`!

```
>>> result = 6/3
>>> message = "The answer is " + str(result)
>>> print(message)
The answer is 2.0
```

Casting

Casting — to change a particular data's **type** of value(s)

```
1   result = 6 / 3
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```

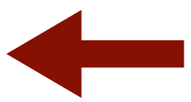
converts the `float` to a `string`!

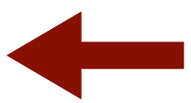
```
>>> result = 6/3
>>> message = "The answer is " + str(result)
>>> print(message)
The answer is 2.0
```

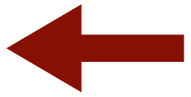
btw, **`print()`** allows us to display to the screen the value of whatever is in the **`()`**

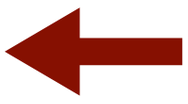
Casting Examples

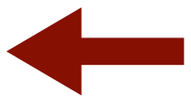
- We need to use `int()`, `float()`, `str()`, and `bool()`

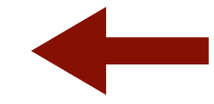
```
result = int("5")
```

5

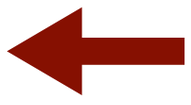
```
result = float("5")
```

5.0

```
result = str(5)
```

"5"

```
result = str(5.0)
```

"5.0"

```
result = int("5.2")
```

ValueError

```
result = int(float("5.2"))
```

5

```
result = float("h")
```

ValueError

Casting Examples

ValueError: The computation expected a value with specific properties, but the value it received as input differed

```
result = float("h")
```

ValueError

Data Types

- Data Types
- Variables
- Operators
- Casting

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Lab Time