

TRACING

An Introduction to Computer Science



Let's learn about Tracing.

Syntax Examples

Writing

```
my_int_variable = 5  
  
my_str_variable = "hello"  
  
my_bool_variable = True
```

Reading

```
print(my_int_variable)  
new_variable = old_variable + 1
```

This is being written

This is being read



To write to a variable, you put its name on the left side of an "assignment statement".
To read from a variable, you simply use its name.

= VS. ==

Assignment

```
new_boolean_variable = (5 == 4)
```

Equals
operator



Notice that assignment statements use a single equal sign, and the equality operator uses two.

Lifetime

```
football_score = 0
```

Variable
changes to 0

```
football_score = 10
```

Variable
changes to 10

```
football_score = 27
```

Variable
changes to 27



Variables have a lifetime.

At some point in the program, they are initialized, and then later on they are used.

At any given time, you can ask what the value of a variable is, and change it.

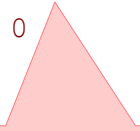
Read after Write

Good

```
age = 0  
print(age)
```

Bad

```
print(age)  
age = 0
```



```
Traceback (most recent call last):  
  File "<stdin>", line 1  
NameError: name 'age' is not defined
```



A variable cannot be read until it has been written.
If you attempt to read an unwritten variable, an error will occur.

Update

count = 0

The count variable is replaced by 0

count = count + 1

count = count + 1

The second time, the count variable is replaced by 1



We often want to increase or decrease a variable by a variable.

For instance, when we're counting the number of things in a list, we need to add one to a variable.

We could do: $x = x + 1$

This really highlights the difference between math and computing.

In algebra, it would have been impossible to write that statement, because you were solving for x .

But in computing, you are ASSIGNING to x .

You are overwriting whatever was there before.

That's why you should read this statement starting from the right side.

It literally means, "Take the expression on the right and replace the variable on the left with it"

Tracing

```
count = 0
count = count + 5
count = count + 2
```

Trace Table

Line	Value of count
1	0
2	5
3	7



It is often useful to track the value of variables over time.

We call this "tracing" a variable.

We often put these traces into a Trace Table.

Although the computer only keeps track of the latest state of the variables, we humans want to think about the entire lifetime of the variables.

Initializing and Updating

count = 0

Initialization

count = count + 5

count = count + 2

Updates



The first time a variable is written to, we say that that variable has been "initialized" or "created".

Any time after that, writing to the variable is referred to as being "updated" or "changed".

Terminology

Write	Initialize	Update	Read
Set	Define	Change	Use
Store	Create	Increment	Load



Besides "reading" and "writing", there are many other words.
You should get a sense of the different ways we refer to variables.