CSCI 141

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Repetition: the `while` statement

Goals

- Understand the syntax and behavior of the `while` statement (also known as `while` loop).
- Know how to use in-place assignment operators: `+=`, `-=`, etc.

Repetition, Repetition

- So far, we’ve seen how to:
    - Print things to the screen and replace your calculator
    - Represent complicated boolean expressions and execute different code based on their truth values.
- So far we *haven’t* seen how to:
    - Do anything that you couldn’t do yourself, given pencil and paper and a few minutes to step through the code.

Motivation

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What is your balance each year for five years?

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balance = 100.00
balance = balance + (0.02 * balance)
print(balance) # year 1
```

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```
balance = 100.00
balance = balance + (0.02 * balance)
print(balance) # year 1
balance = balance + (0.02 * balance)
print(balance) # year 2
```

Motivation

Suppose you have a starting bank account balance of $100.00, and your account earns 2% interest each year.

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balance = 100.00
balance = balance + (0.02 * balance)
print(balance) # year 1
balance = balance + (0.02 * balance)
print(balance) # year 2
balance = balance + (0.02 * balance)
print(balance) # year 3
```

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What is your balance each year for five years?

```
balance = 100.00
balance = balance + (0.02 * balance)
print(balance) # year 1
balance = balance + (0.02 * balance)
print(balance) # year 2
balance = balance + (0.02 * balance)
print(balance) # year 3
balance = balance + (0.02 * balance)
print(balance) # year 4
```

uh oh…
my font is
getting small

Motivation

Suppose you have a starting bank account balance of $100.00, and your account earns 2% interest each year.

What is your balance each year for five years?

```
balance = 100.00
balance = balance + (0.02 * balance)
print(balance) # year 1
balance = balance + (0.02 * balance)
print(balance) # year 2
balance = balance + (0.02 * balance)
print(balance) # year 3
balance = balance + (0.02 * balance)
print(balance) # year 4
balance = balance + (0.02 * balance)
print(balance) # year 5
```

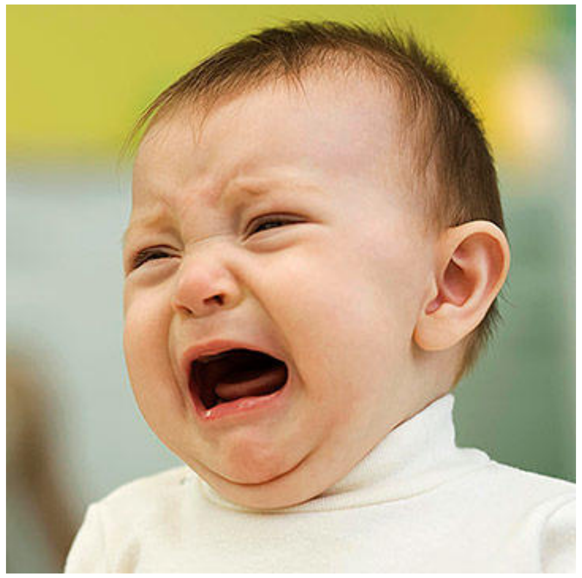
argh, ok, done.

Motivation

Suppose you have a starting bank account balance of $100.00, and your account earns 2% interest each year.

What is your balance each year for **500** years?

…

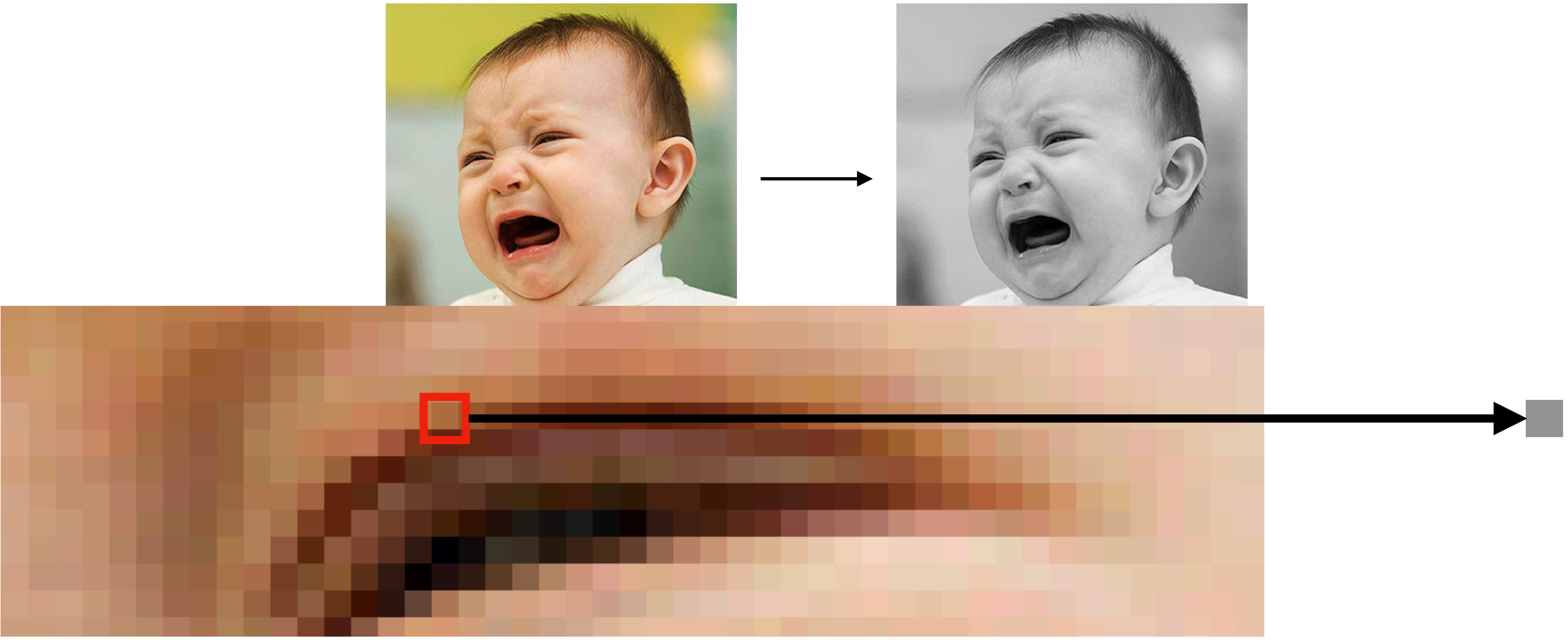


An extremely common task: do the same thing over and over again.

Or: do the same thing to many different pieces of data.

Motivation

Example: Convert this 100x100 pixel image to grayscale (“black-and-white”).

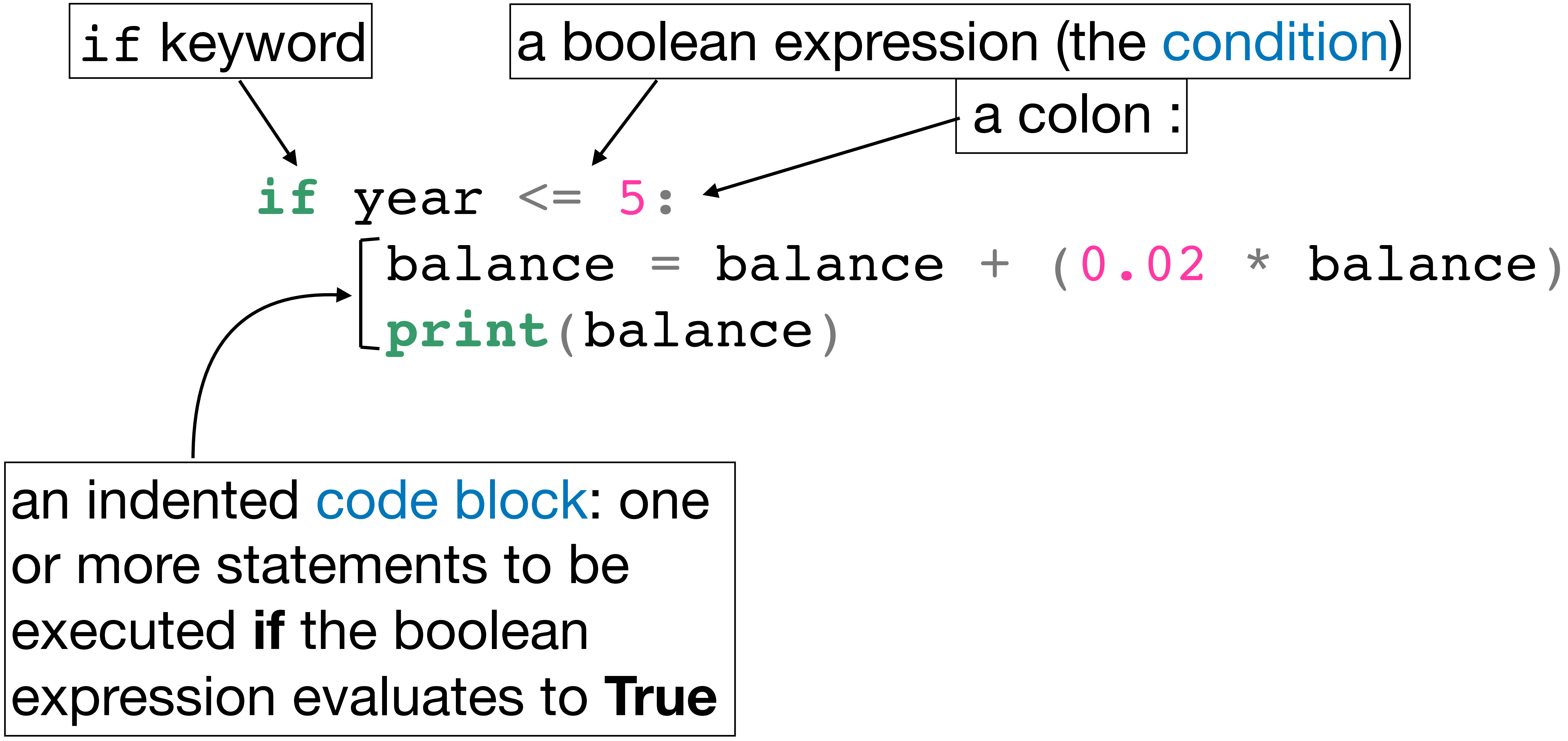


10,000 pixels, same calculation:

```
grey = 0.29 * red + 0.59 * green + 0.12 * blue
```

Python to the rescue: the `while` statement

Not so different from an `if` statement:



if keyword

a boolean expression (the condition)

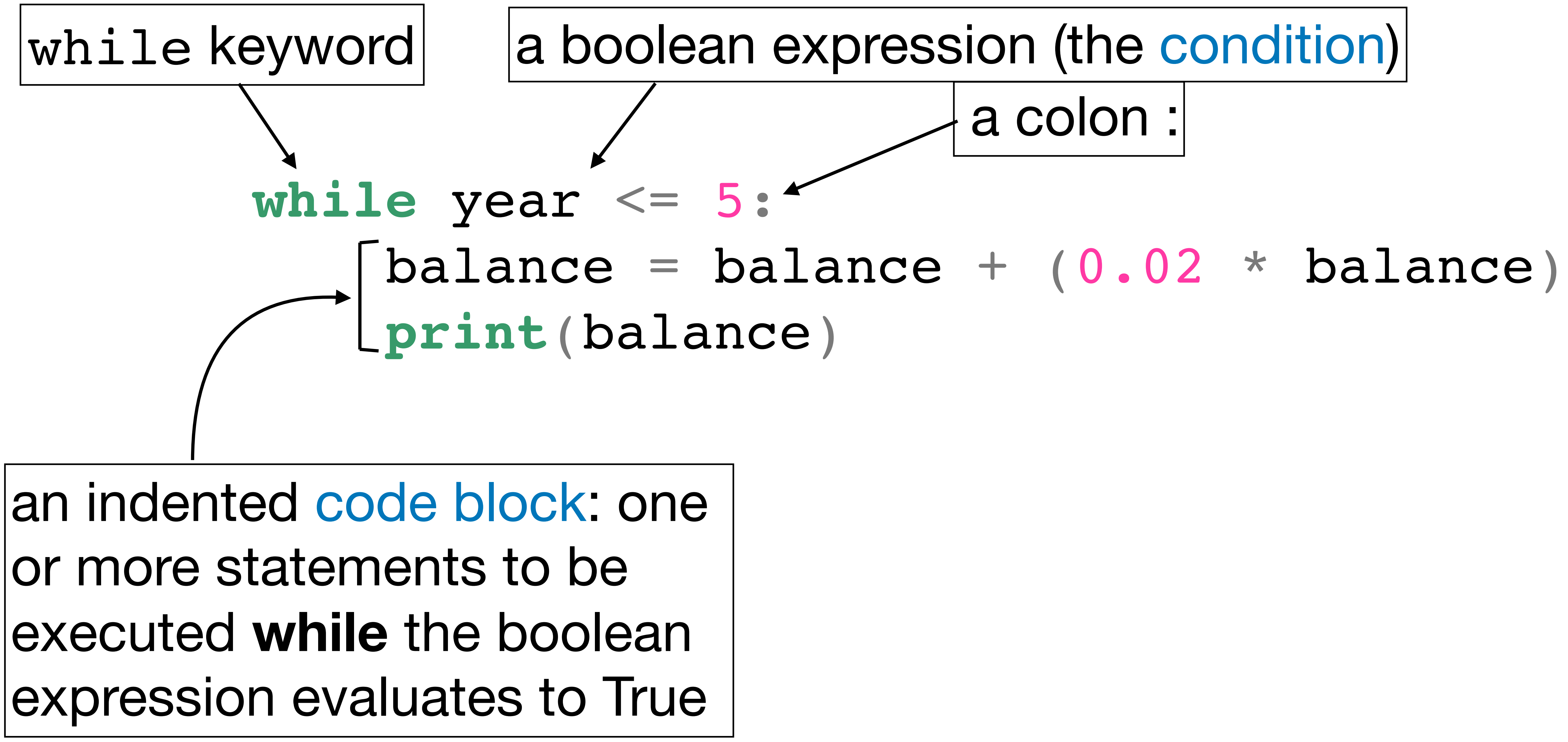
a colon :

```
if year <= 5:
    balance = balance + (0.02 * balance)
    print(balance)
```

an indented code block: one or more statements to be executed **if** the boolean expression evaluates to **True**

Python to the rescue: the `while` statement

Not so different from an `if` statement:



```
while year <= 5:
    balance = balance + (0.02 * balance)
    print(balance)
```

`while` keyword

a boolean expression (the condition)

a colon :

an indented code block: one or more statements to be executed **while** the boolean expression evaluates to True

The `while` statement: A Working Example

```
# print account balance after each
# of five years:
balance = 100.0 # starting balance
year = 1
while year <= 5:
    balance = balance + (0.02 * balance)
    print(balance)
    year = year + 1
```

Terminology notes:

- the line with `while` and the condition is the loop header
- the code block is the loop body
- the entire construct (header and body) is a `while` statement
- usually people call them while loops instead

The `while` statement: Semantics (Behavior)

If statement:

1. Evaluate the condition
2. If true, execute body (code block), then continue on.

While statement:

1. Evaluate the condition
2. If true, execute body, otherwise skip step 3 and continue on.
3. Go back to step 1

Code Examples

- balance1.py: the tedious way
- balance2.py: the loopy way

Aside: In-Place Operators

When writing loops (and code in general), you'll find yourself doing things like this often:

```
count = count - 1
total = total + n
```

Python has a nice shorthand for this:

```
count -= 1
total += n
```

Many math operators have an in-place version:

```
+=      -=      /=      //=      %=
```

[**No**, Python doesn't have increment and decrement operators ++ and --]

Demo

Demo

- double.py
  - Count how many times you need to double 1 before it exceeds 100
- count.py:
  - Counting up, counting down by an interval
- never.py:
  - Condition never True
  - Condition never False