[301] Advanced Iteration

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Learning Objectives Today

Understand "break"

- Syntax
- Control flow
- Use cases

Understand "continue"

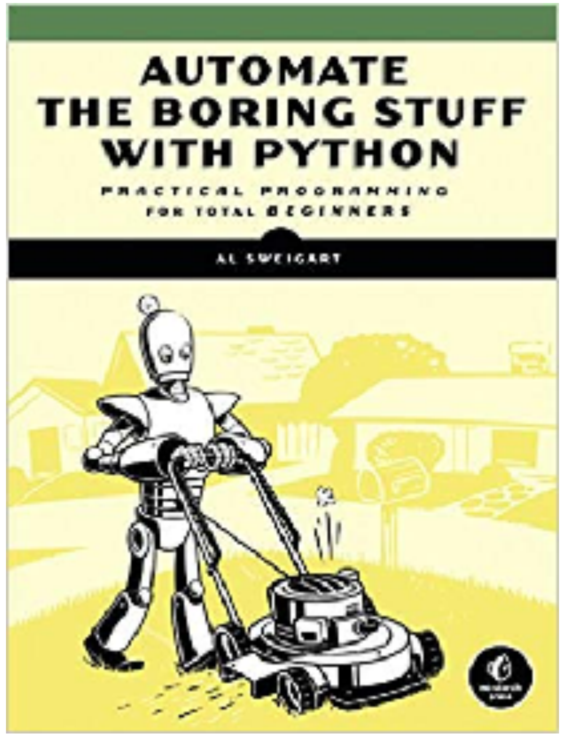
- Syntax
- Control flow
- Use cases

Nested loops

- Interaction with break/continue

Chapter 7 of Think Python

Chapter 2 of Sweigart


AUTOMATE THE BORING STUFF WITH PYTHON
PRACTICAL PROGRAMMING FOR TOTAL BEGINNERS
AL SWEIGART

http://automatetheboringstuff.com/chapter2/

Today's Outline

Design Patterns

Worksheet

Break

Continue

Nesting

Today's Outline

Design Patterns

Worksheet

Break

Don't get too excited,
only the loops get a break!

Continue

Nesting

Design Patterns

```
i = 1
while i <= 30:
  n = i * 2
  print(n)
  i += 1
```

When you ask a programmer what a piece of code does, what do they look at, and in what order?

Design Patterns

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When you ask a programmer what a piece of code does, what do they look at, and in what order?

Way 1: walk through in order (never a bad option)

Design Patterns

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When you ask a programmer what a piece of code does, what do they look at, and in what order?

Way 1: walk through in order (never a bad option)

Design Patterns

Output

2

```
i = 1
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Way 1: walk through in order (never a bad option)

Design Patterns

```
i = 1
while i <= 30:
  n = i * 2
  print(n)
  i += 1
```

Output
```
2
4
```

When you ask a programmer what a piece of code does, what do they look at, and in what order?

Way 1: walk through in order (never a bad option)

Design Patterns

Output

2

4

…

```
i = 1
while i <= 30:
  n = i * 2
  print(n)
  i += 1
```

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while i <= 30:
  n = i * 2
  print(n)
  i += 1
```

When you ask a programmer what a piece of code
does, what do they look at, and in what order?

**Way 2: knowing that certain code is written again
and again, look for common patterns to break it down**

Design Patterns

experienced coders will focus in on everything about "i" first because that is in the loop condition

```
i = 1
while i <= 30:
    n = i * 2
    print(n)
    i += 1
```

When you ask a programmer what a piece of code does, what do they look at, and in what order?

Observation: loop will run with values of i of: 1 to 30

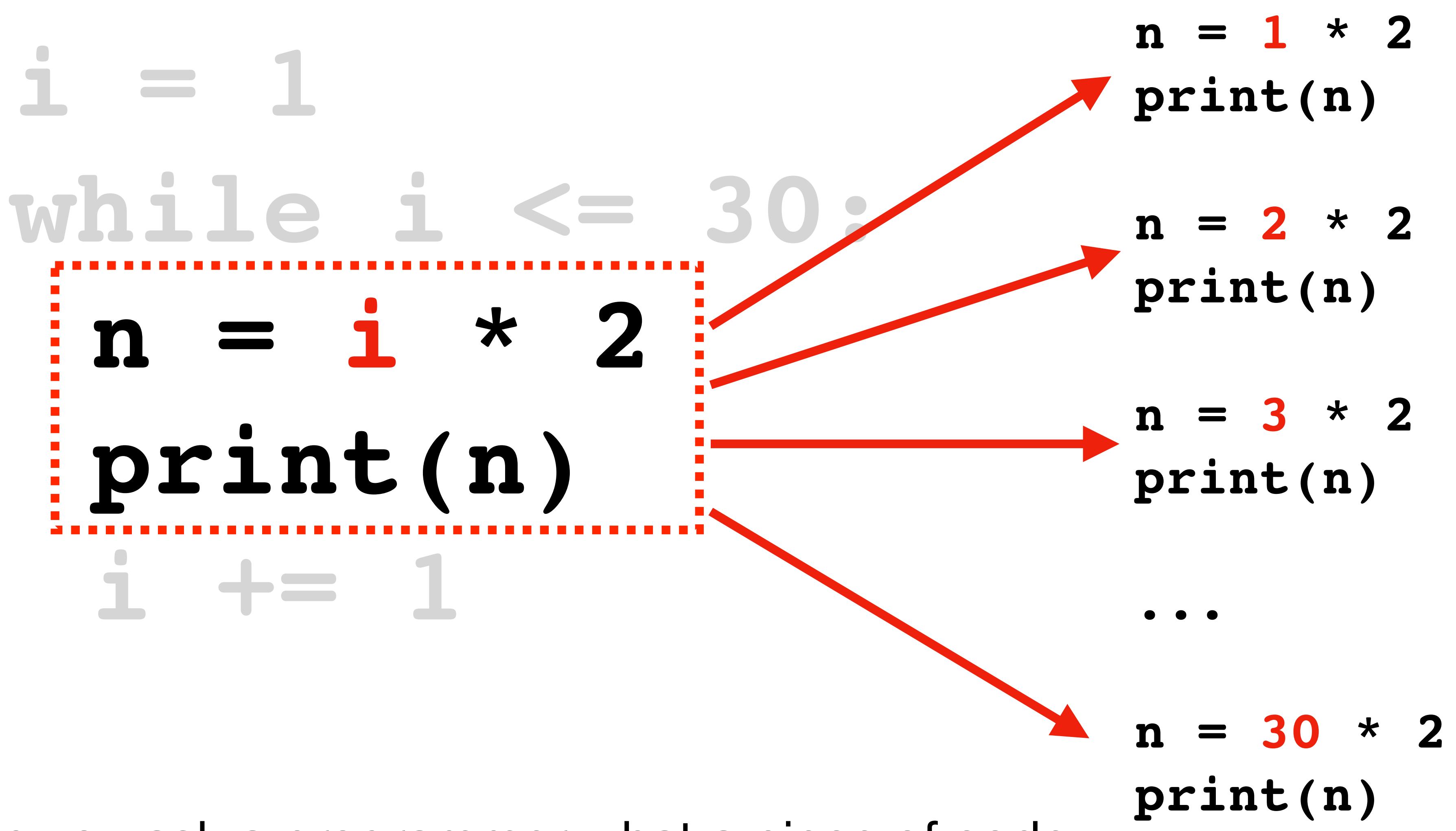
Design Patterns

```
i = 1
while i <= 30:
  n = i * 2
  print(n)
  i += 1
```

When you ask a programmer what a piece of code does, what do they look at, and in what order?

Observation: highlighted code runs 30 times, with i values of 1 through 30

Design Patterns



```
i = 1
while i <= 30:
    n = i * 2
    print(n)
    i += 1
```

```
n = 1 * 2
print(n)

n = 2 * 2
print(n)

n = 3 * 2
print(n)

...

n = 30 * 2
print(n)
```

When you ask a programmer what a piece of code does, what do they look at, and in what order?

Observation: highlighted code runs 30 times, with i values of 1 through 30

Design Patterns

Output

```
2
4
6
8
…

56
58
60
```

```
i = 1
while i <= 30:
    n = i * 2
    print(n)
    i += 1
```

```
n = 1 * 2
print(n)

n = 2 * 2
print(n)

n = 3 * 2
print(n)

...

n = 30 * 2
print(n)
```

When you ask a programmer what a piece of code does, what do they look at, and in what order?

Conclusion: the code prints 2, 4, 6, …, 58, 60

Design Pattern 1: do something N times

```
i = 1
while i <= N:
    fill in with specifics here
    i += 1
```

Design Pattern 1: do something N times

```
i = 1
while i <= N:
    fill in with specifics here
    i += 1
```

Design Pattern 1: do something N times

Option A

```
i = 1
while i <= N:
    fill in with specifics here
    i += 1
```

Option B

```
i = 0
while i < N:
    fill in with specifics here
    i += 1
```

Design Pattern 1: do something N times

Option A

```
i = 1
while i <= N:
    fill in with specifics here
    i += 1
```

1, 2, 3, …, N

Option B

```
i = 0
while i < N:
    fill in with specifics here
    i += 1
```

0, 1, 2, …, N-1

Design Pattern 2: do something with all data

```
i = 0
while i < N:
```

$$\boxed{\text{fill in with specifics here}}$$

```
    i += 1
```

State	Population	Area
WI	…	…
CA	…	…
MN	…	…
…	…	…

Design Pattern 2: do something with all data

```
i = 0
while i < N:
    fill in with specifics here
    i += 1
```

Functions:
count_rows()
get_population(index)
...

State	Population	Area
WI	...	...
CA	...	...
MN	...	...
...	...	...

Design Pattern 2: do something with all data

```
i = 0
while i < N:
    fill in with specifics here
    i += 1
```

Functions:
count_rows()
get_population(index)
...

index 0

State	Population	Area
WI	...	...
CA	...	...
MN	...	...
...	...	...

Design Pattern 2: do something with all data

```
i = 0
while i < N:
    fill in with specifics here
    i += 1
```

Functions:
count_rows()
get_population(index)
...

index 1

State	Population	Area
WI	...	...
CA	...	...
MN	...	...
...	...	...

Design Pattern 2: do something with all data

```
i = 0
while i < count_rows():
  pop = get_population(i)
  ┌─────────────────────────────┐
  │ fill in with specifics here │
  └─────────────────────────────┘
  i += 1
```

Functions:
count_rows()
get_population(index)
…

State	Population	Area
WI	…	…
CA	…	…
MN	…	…
…	…	…

Design Pattern 2: do something with all data

```
i = 0
while i < count_rows():
    pop = get_population(i)
    ┌──────────────────────────────┐
    │  fill in with specifics here │
    └──────────────────────────────┘
    i += 1
```

assumes we use 0 for first row

Functions:
count_rows()
get_population(index)
...

State	Population	Area
WI	...	...
CA	...	...
MN	...	...
...	...	...

Design Pattern 3: do something until the end

```
while has_more():
  data = get_next()
```

```
fill in with specifics here
```

People creating functions/modules for other programmers to use will often have functions for checking if there is more data and for getting the data one piece at a time

Design Pattern 3: do something until the end

```
while has_more():
    data = get_next()
    fill in with specifics here
```

People creating functions/modules for other programmers to use will often have functions for checking if there is more data and for getting the data one piece at a time

Like example when we add numbers from nums.txt

Today's Outline

Design Patterns

Worksheet

- Problem 1
- Problem 2

Break

Continue

Nesting

Today's Outline

Design Patterns

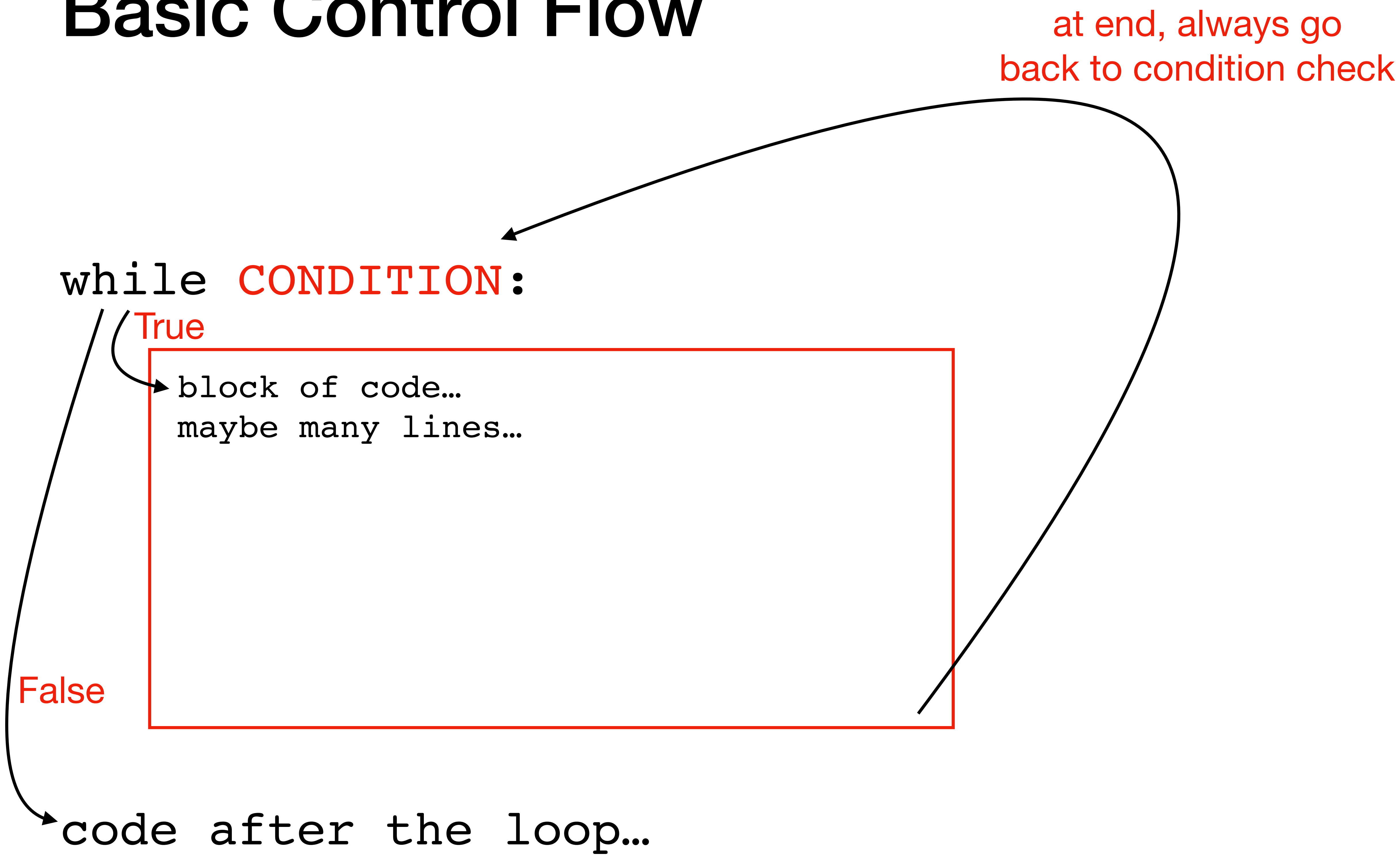
Worksheet

Break

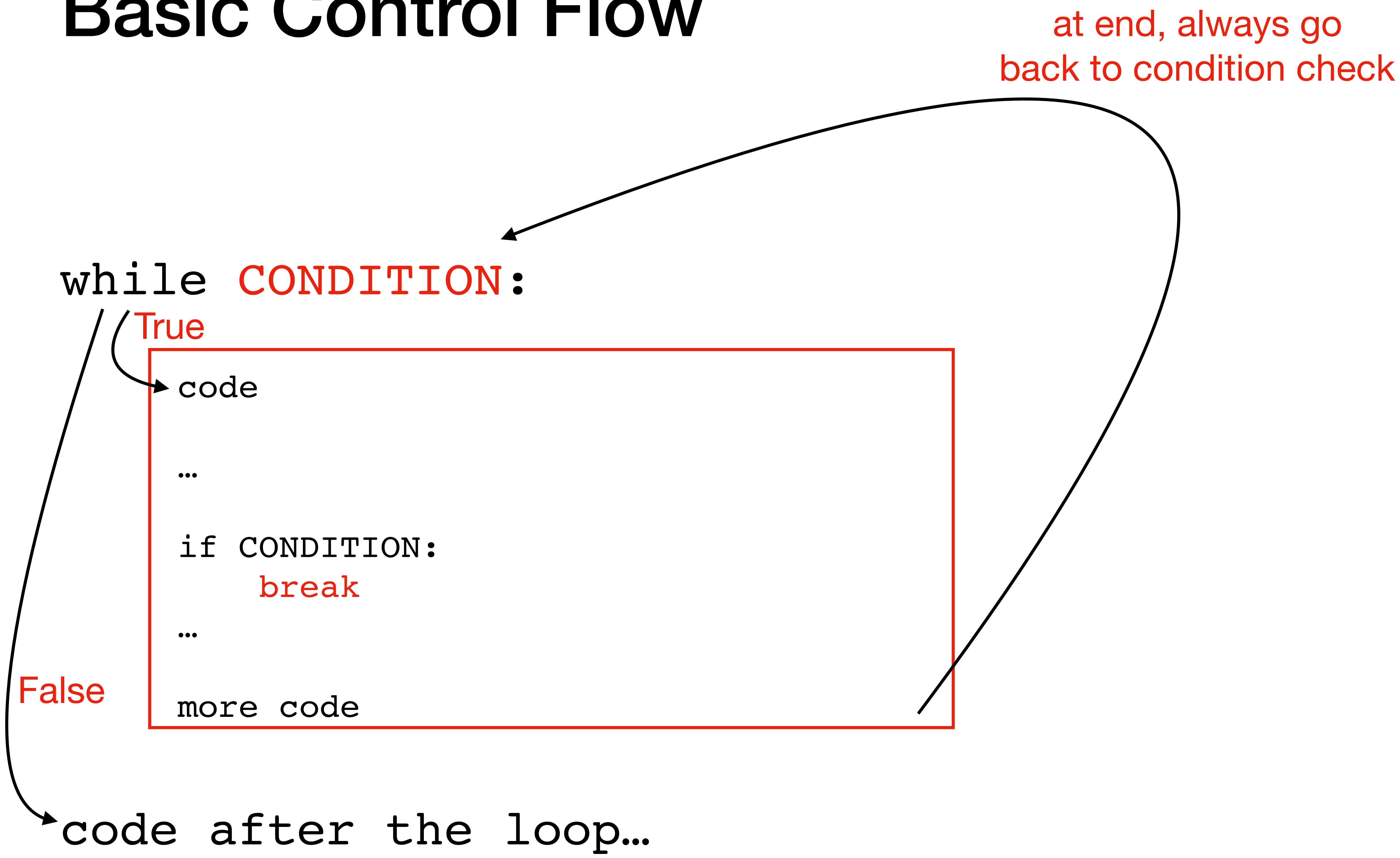
Continue

Nesting

Basic Control Flow

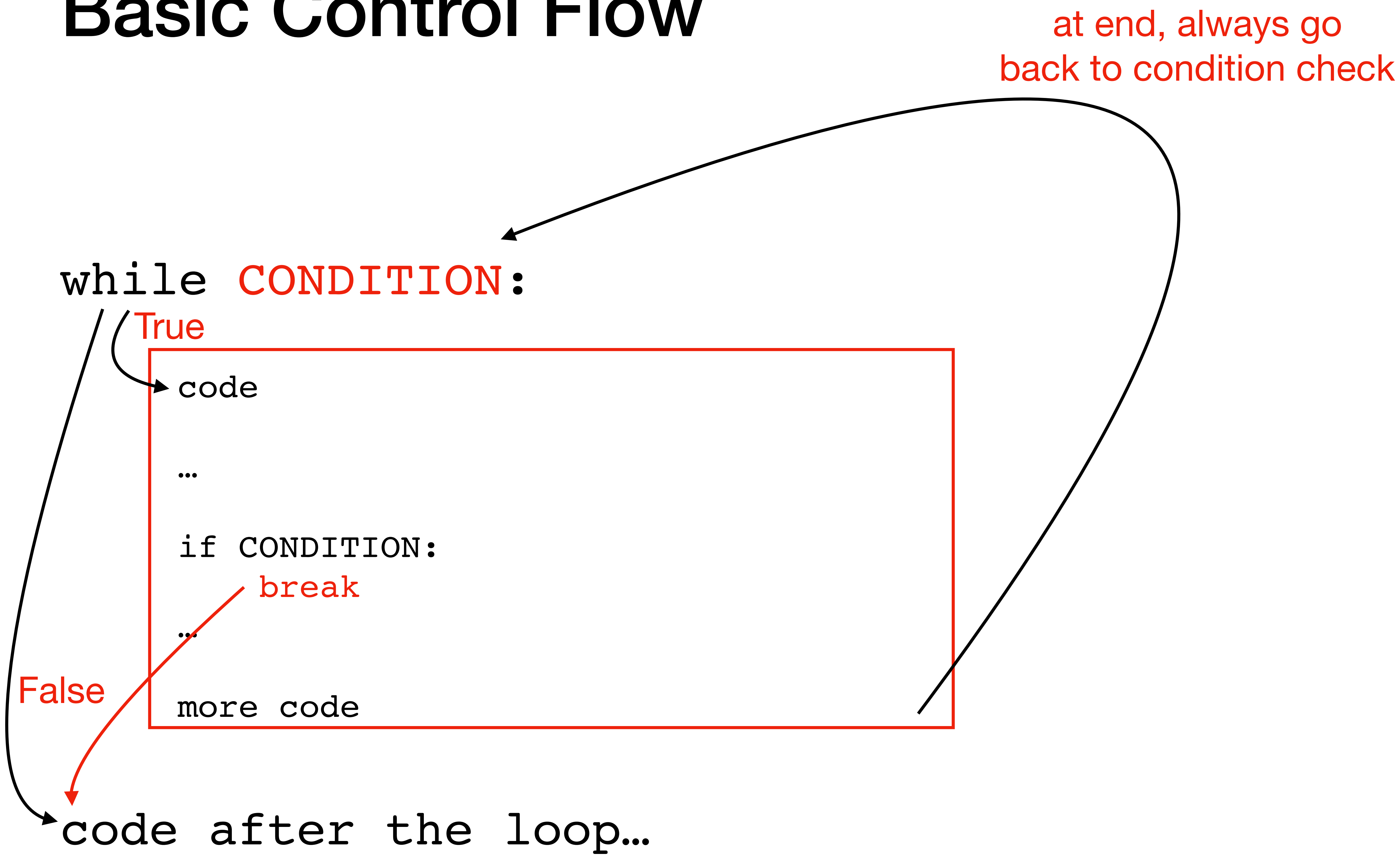


Basic Control Flow

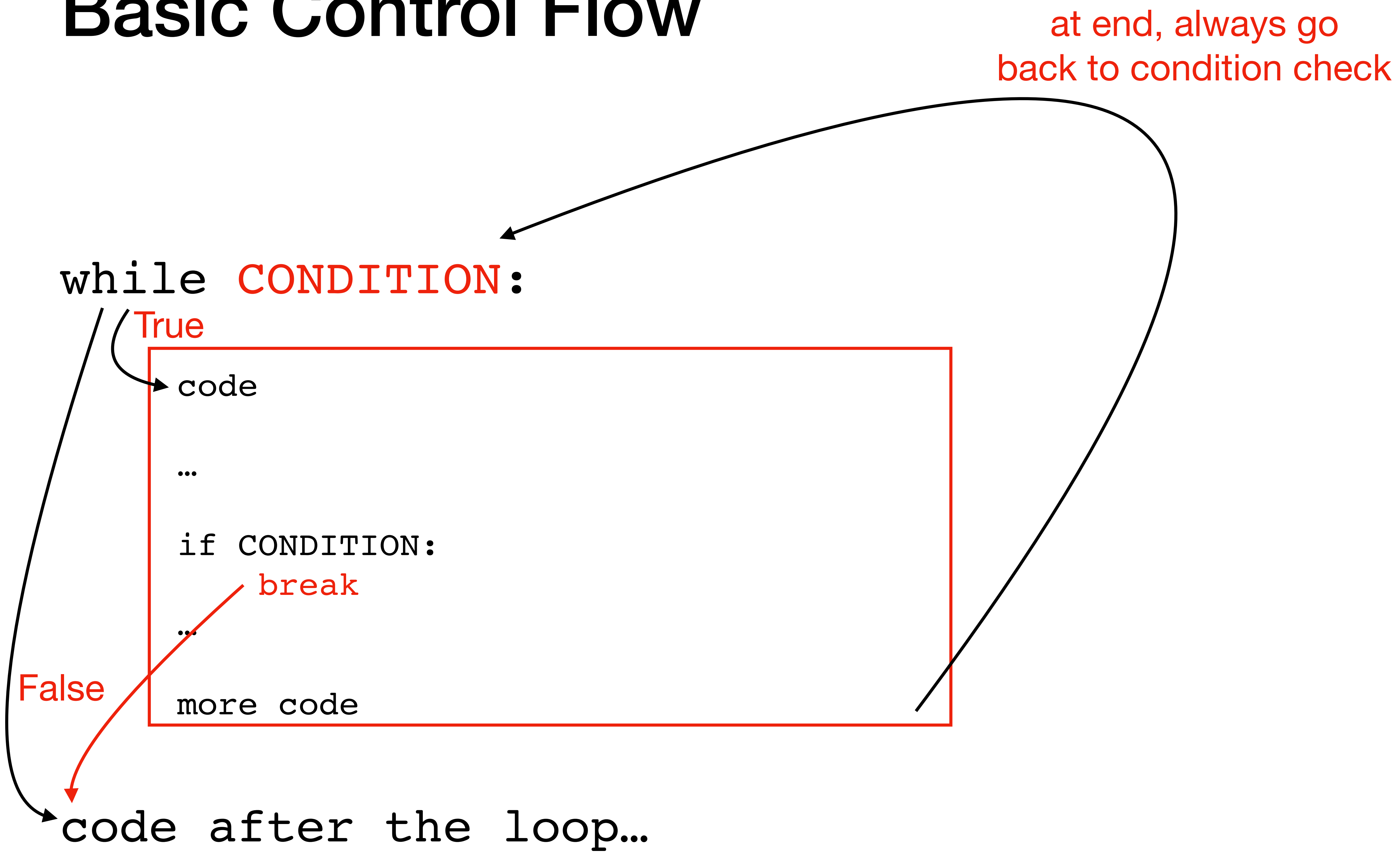


```
while CONDITION:
    code

    …

    if CONDITION:
        break
    …

    more code

code after the loop…
```

Basic Control Flow



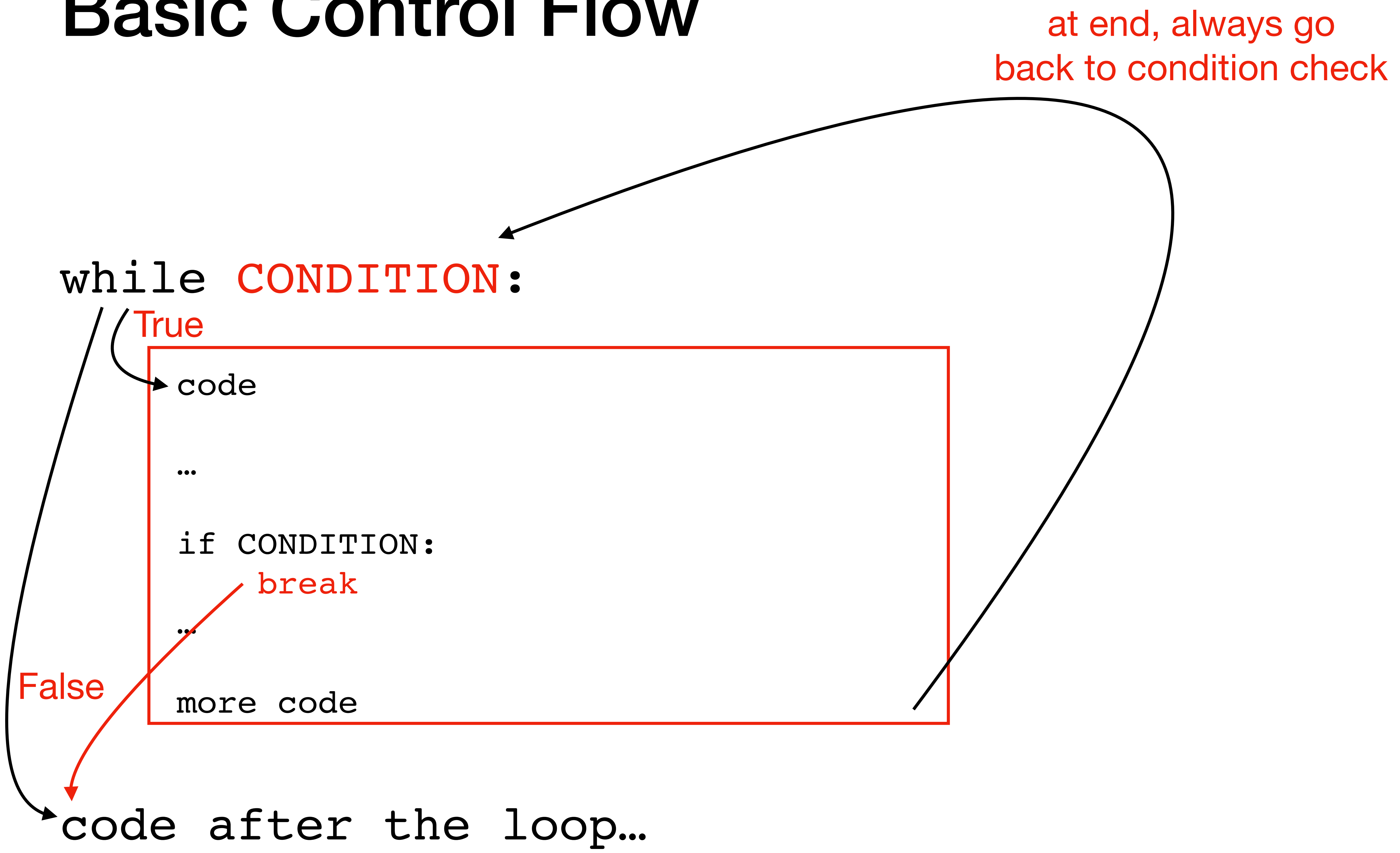
Basic Control Flow



```
while CONDITION:
    code

    …

    if CONDITION:
        break

    …

    more code

code after the loop…
```

Just like “return” immediately exits a function, “break” immediately exits a loop

Basic Control Flow



Commonly used when we're searching through many things. Allows us to stop as soon as we find what we want.

Demo: Prime Search Program

Goal: answer whether a range of numbers contains a prime

Input:

- Start of range
- End of range

Output:

- Yes or no

Note: this is not a good demo to try coding up yourself during lecture (but maybe after)

Examples:

14 to 16 => NO (because 14, 15, and 16 are all not prime)
20 to 28 => YES (because 23 is prime)

Today's Outline

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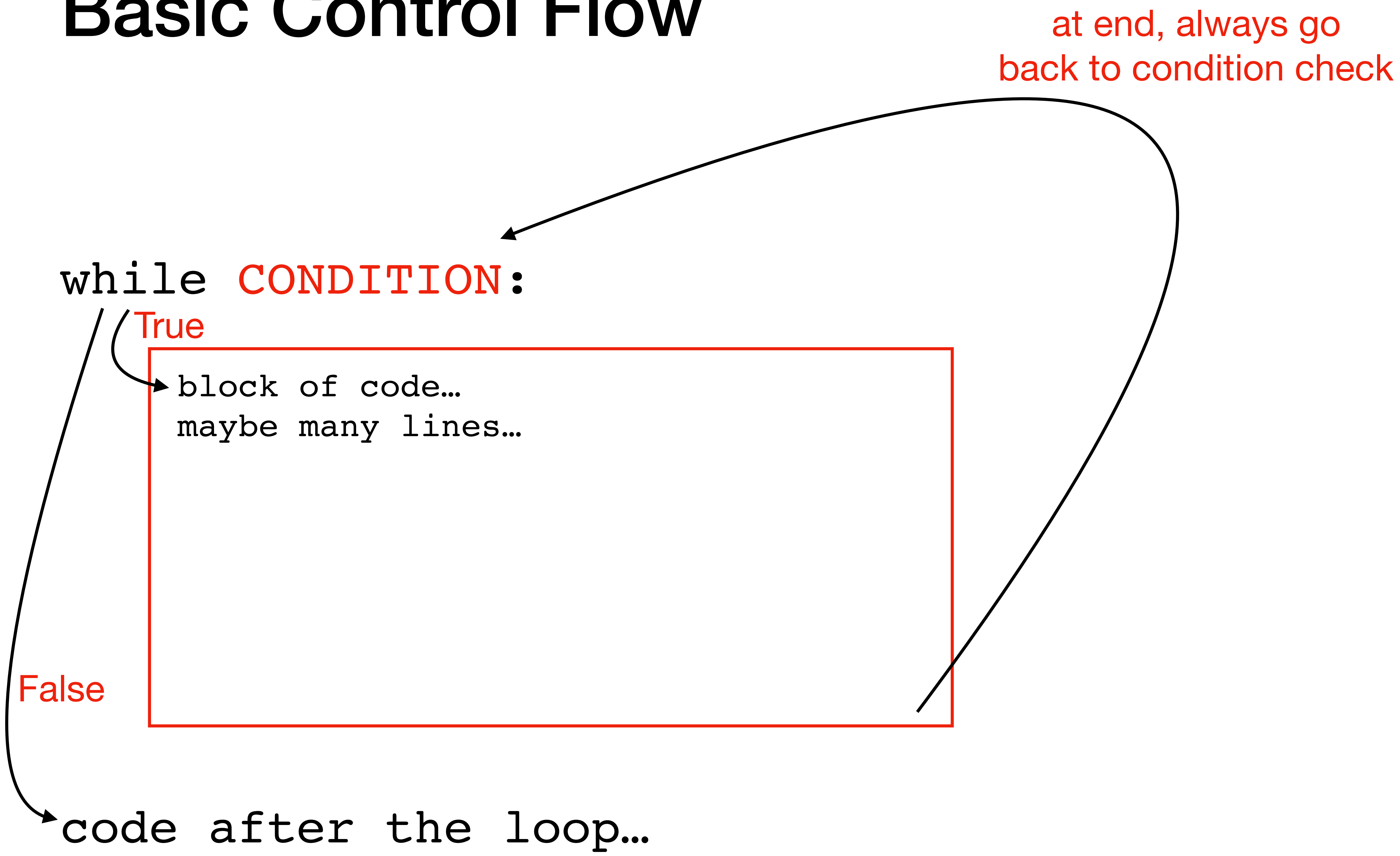
Worksheet

Break

Continue

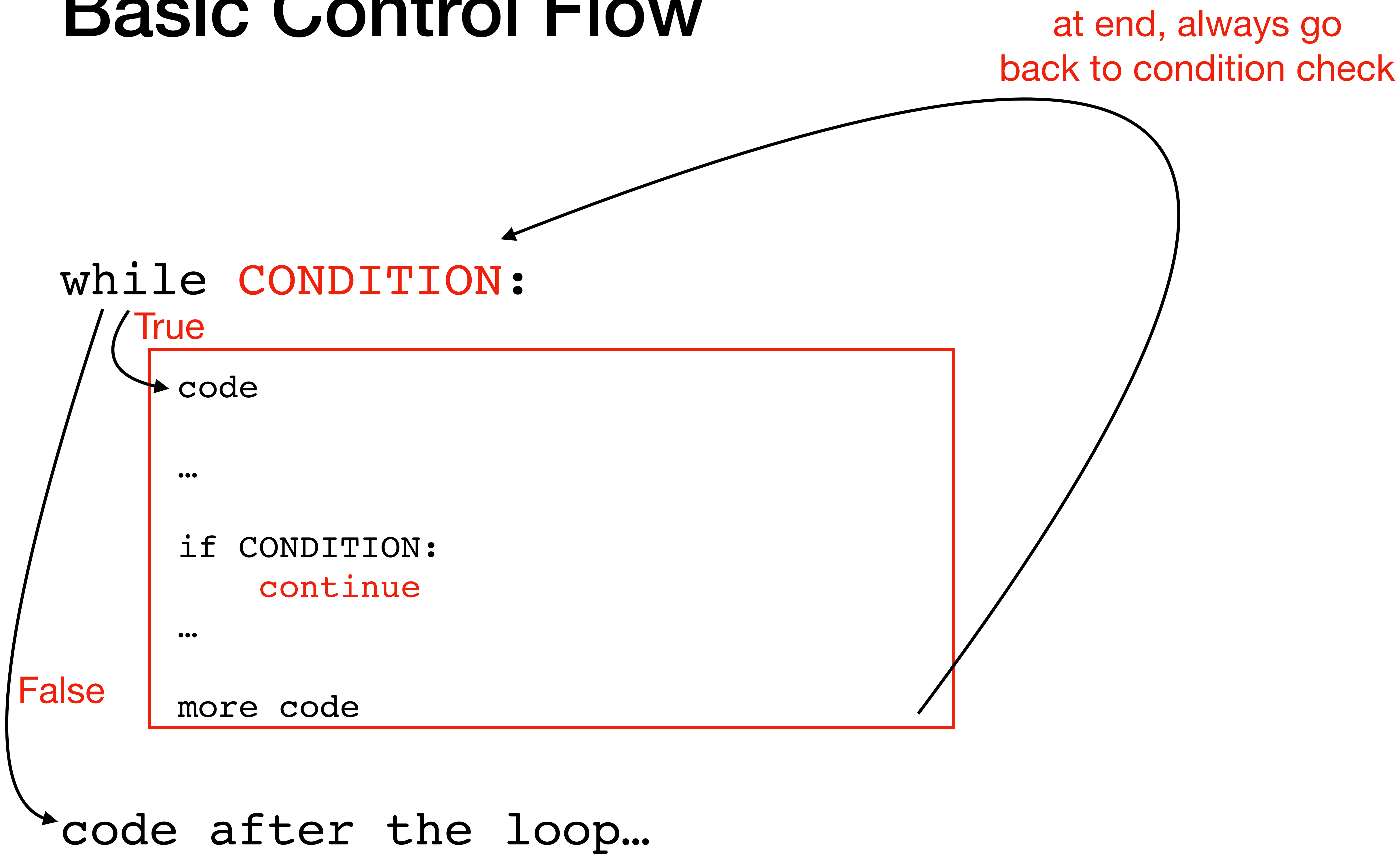
Nesting

Basic Control Flow



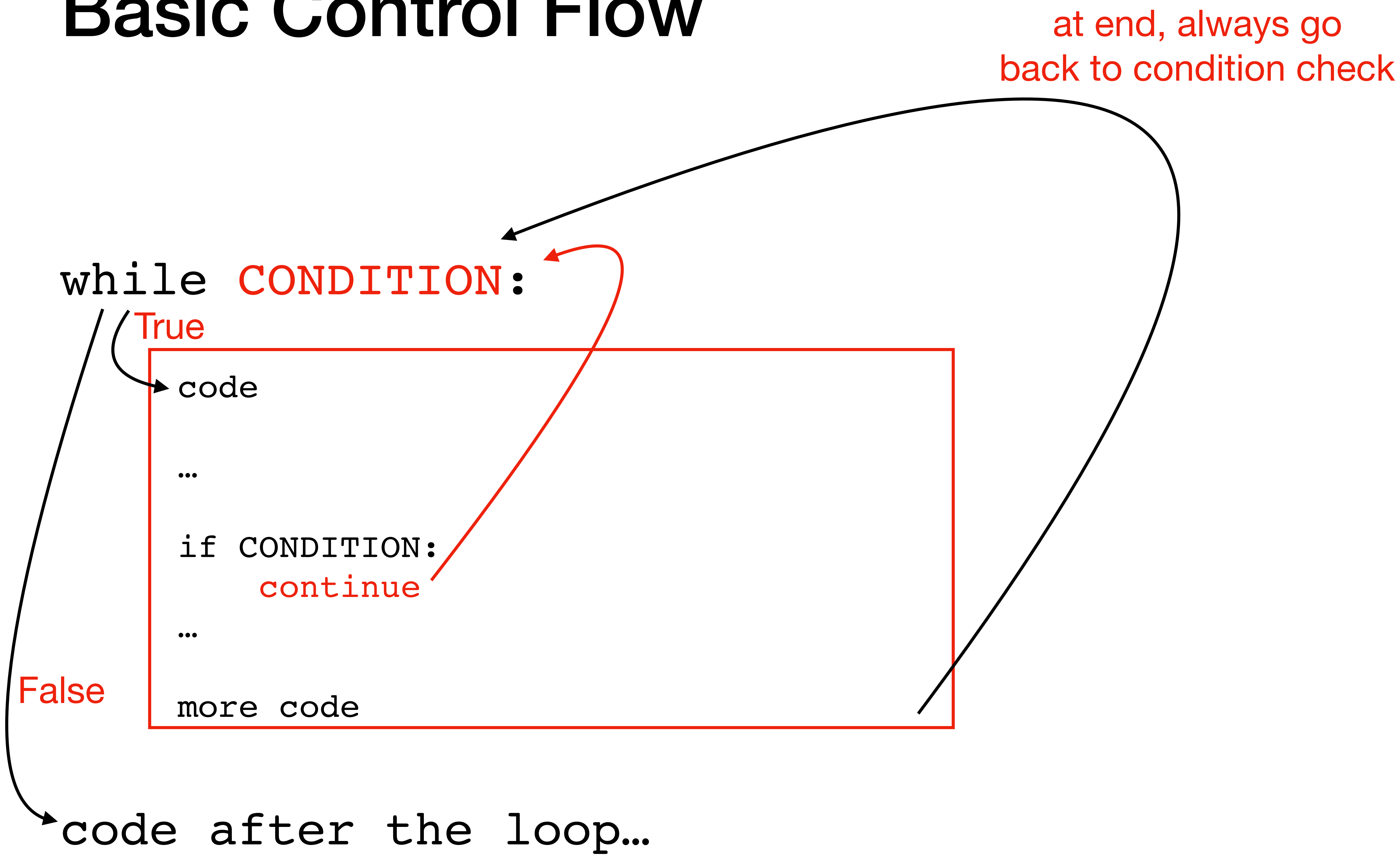
```
while CONDITION:
    block of code…
    maybe many lines…

code after the loop…
```

Basic Control Flow



```
while CONDITION:
    code

    …

    if CONDITION:
        continue
    …

    more code

code after the loop…
```

Basic Control Flow



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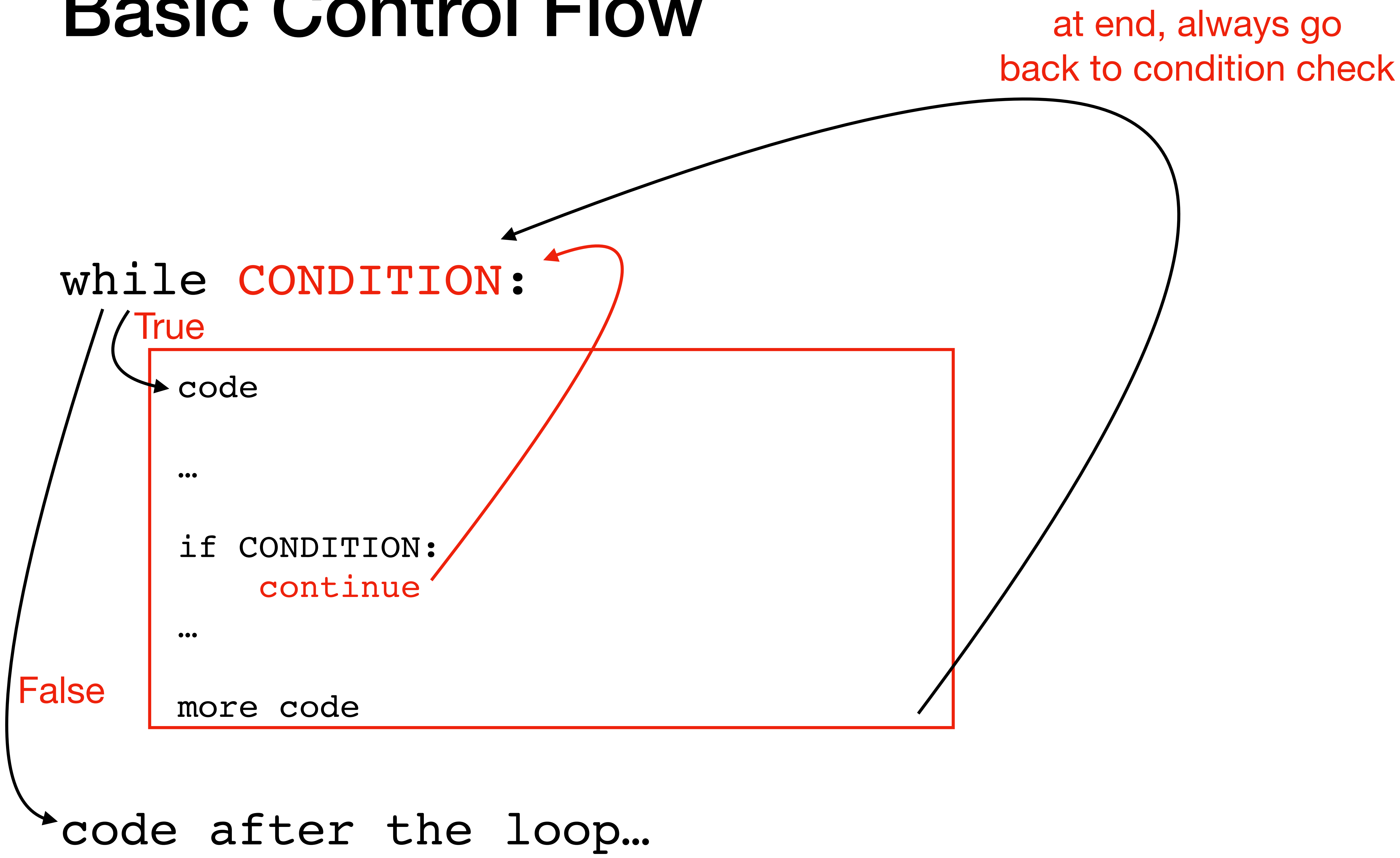


"continue" immediately stops current iteration and goes back to the condition, potentially to start another iteration

Demo: Average Score

Goal: keep a running average of user-provided scores

Input:

- "q" for quit (keep running until this)
- a score in the 0 to 100 range

Output:

- Recompute average and print after each new number

Example:

```
enter a score (or q for exit): 50
avg is 50
enter a score (or q for exit): 70
avg is 60
enter a score (or q for exit): q
exiting
```

Twist: use "continue" to skip over inputs not in the 0 to 100 range

Today's Outline

Design Patterns

Worksheet

Break

Continue

Nesting

Nested loops

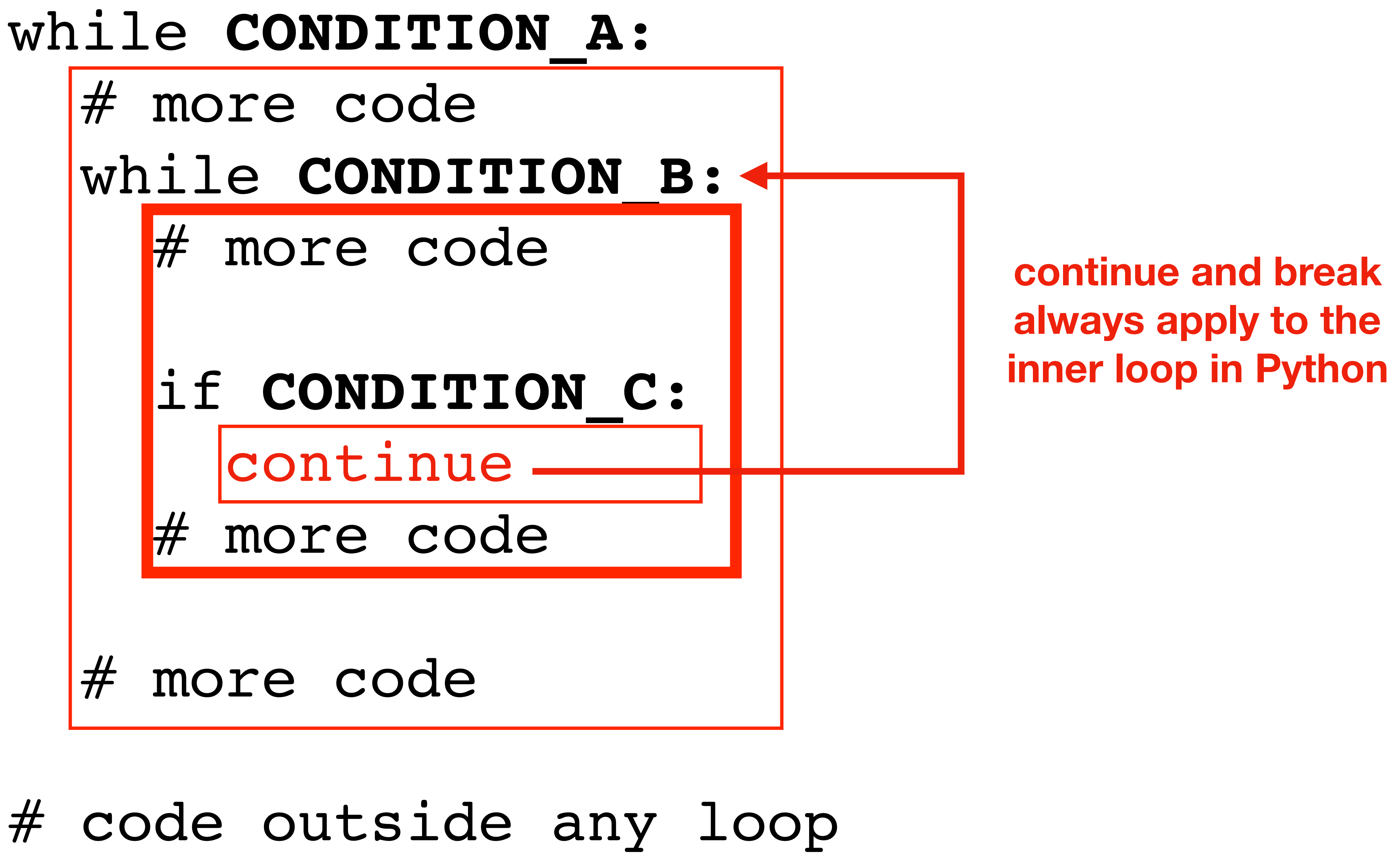
```
while CONDITION_A:
    # more code
    while CONDITION_B:
        # more code

        if CONDITION_C:
            continue
        # more code

    # more code

# code outside any loop
```

Nested loops

```
while CONDITION_A:
  # more code
  while CONDITION_B:
    # more code

    if CONDITION_C:
      continue
    # more code

  # more code

# code outside any loop
```

where does this jump back to?

Nested loops



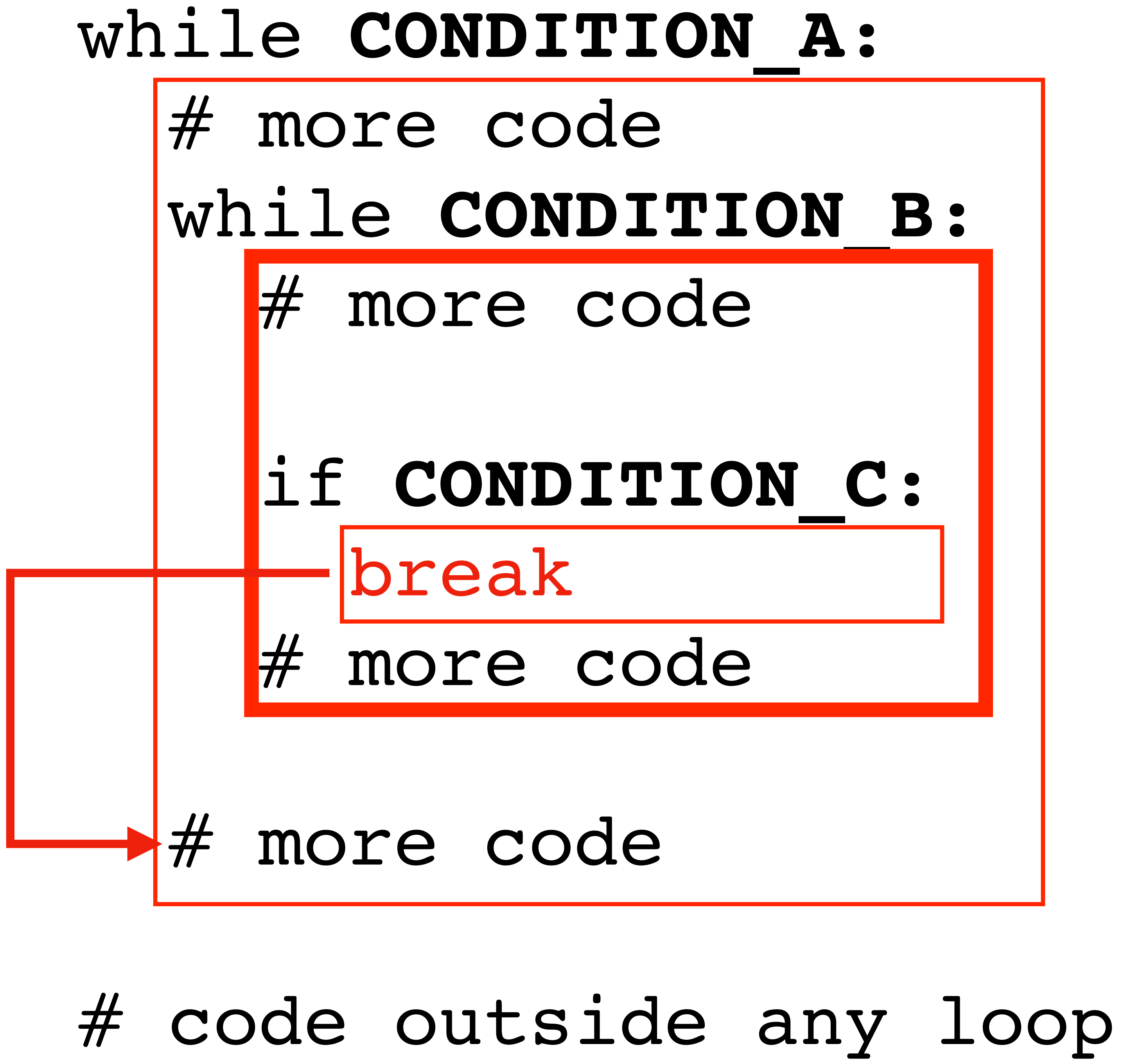
```
while CONDITION_A:
    # more code
    while CONDITION_B:
        # more code

        if CONDITION_C:
            continue
        # more code

    # more code

# code outside any loop
```

continue and break always apply to the inner loop in Python

Nested loops

```
while CONDITION_A:
    # more code
    while CONDITION_B:
        # more code

        if CONDITION_C:
            break
        # more code

    # more code

# code outside any loop
```

Nested loops



```
while CONDITION_A:
    # more code
    while CONDITION_B:
        # more code

        if CONDITION_C:
            break
        # more code

    # more code

# code outside any loop
```

Worksheet Problems