

Iteration 2

Department of Computer Sciences
University of Wisconsin-Madison

Readings:

Chapter 2 of Sweigart book
Chapter 6.4 of Python for Everybody

Learning Objectives Today

Nested loops tracing

Chapter 7 of Think Python

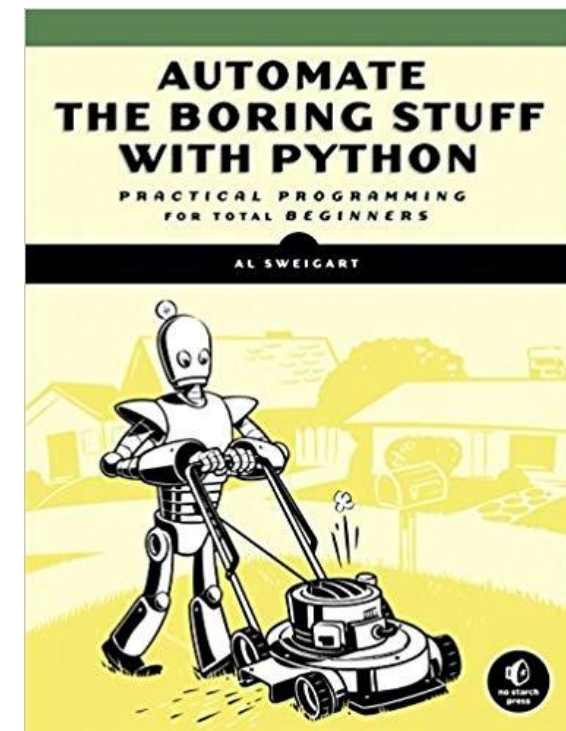
Understanding `break` and `continue`

- Syntax
- Control flow
- Use cases

Chapter 2 of Sweigart
(great recap so far)

Nested loops tracing

- Interaction with `break/continue`



<http://automatetheboringstuff.com/chapter2/>

Today's Outline

Design Patterns

Worksheet

Break

Continue

Nesting

Design Patterns (outside Programming)

Overview [\[edit \]](#)

The **five-paragraph essay** is a form of [essay](#) having five [paragraphs](#):

- one introductory paragraph,
- three body paragraphs with support and development, and
- one concluding paragraph.

[wikipedia]

Design Patterns (outside Programming)

Overview [\[edit\]](#)

The **five-paragraph essay** is a form of [essay](#) having five [paragraphs](#):

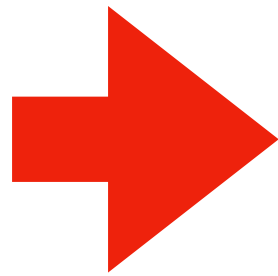
- 1st • one introductory paragraph,
- 3rd • three body paragraphs with support and development, and
- 2nd • one concluding paragraph.

[wikipedia]

somebody familiar with this
structure might skip around

there are many similarities between
reading/writing code and essays

Design Patterns



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

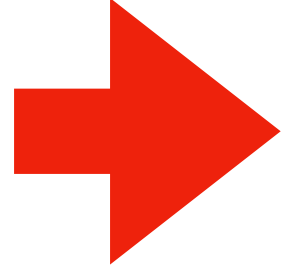
When you ask a programmer what a piece of code does, what do they look at, and in what order?

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

Design Patterns

i

1



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

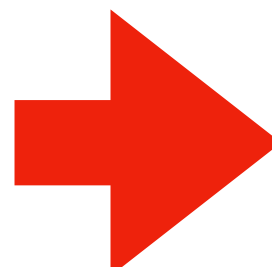
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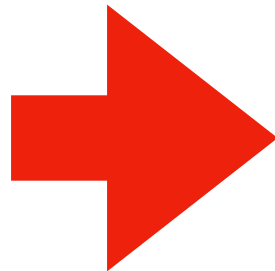
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Way 1: walk through in order (never a bad option)

Design Patterns

i	1
n	2

```
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?

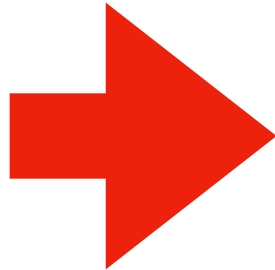
Way 1: walk through in order (never a bad option)

Design Patterns

i	1
n	2

Output
2

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



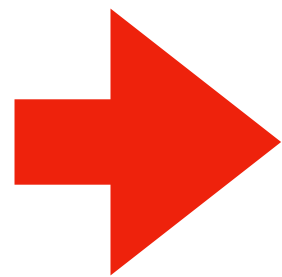
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Way 1: walk through in order (never a bad option)

Design Patterns

i	1 2
n	2

Output
2



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

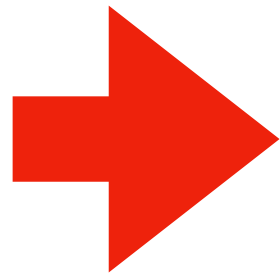
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Way 1: walk through in order (never a bad option)

Design Patterns

i	1 2
n	2

Output
2



```
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?

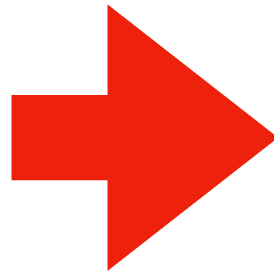
Way 1: walk through in order (never a bad option)

Design Patterns

i	1 2
n	2 4

Output
2

```
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?

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

Design Patterns

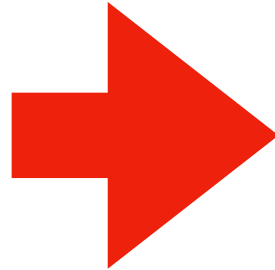
i	1 2
n	2 4

Output

2

4

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

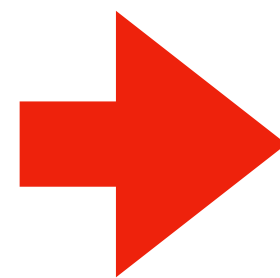


When you ask a programmer what a piece of code does, what do they look at, and in what order?

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

Design Patterns

i	1 3
n	2 4



```
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

```
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?

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

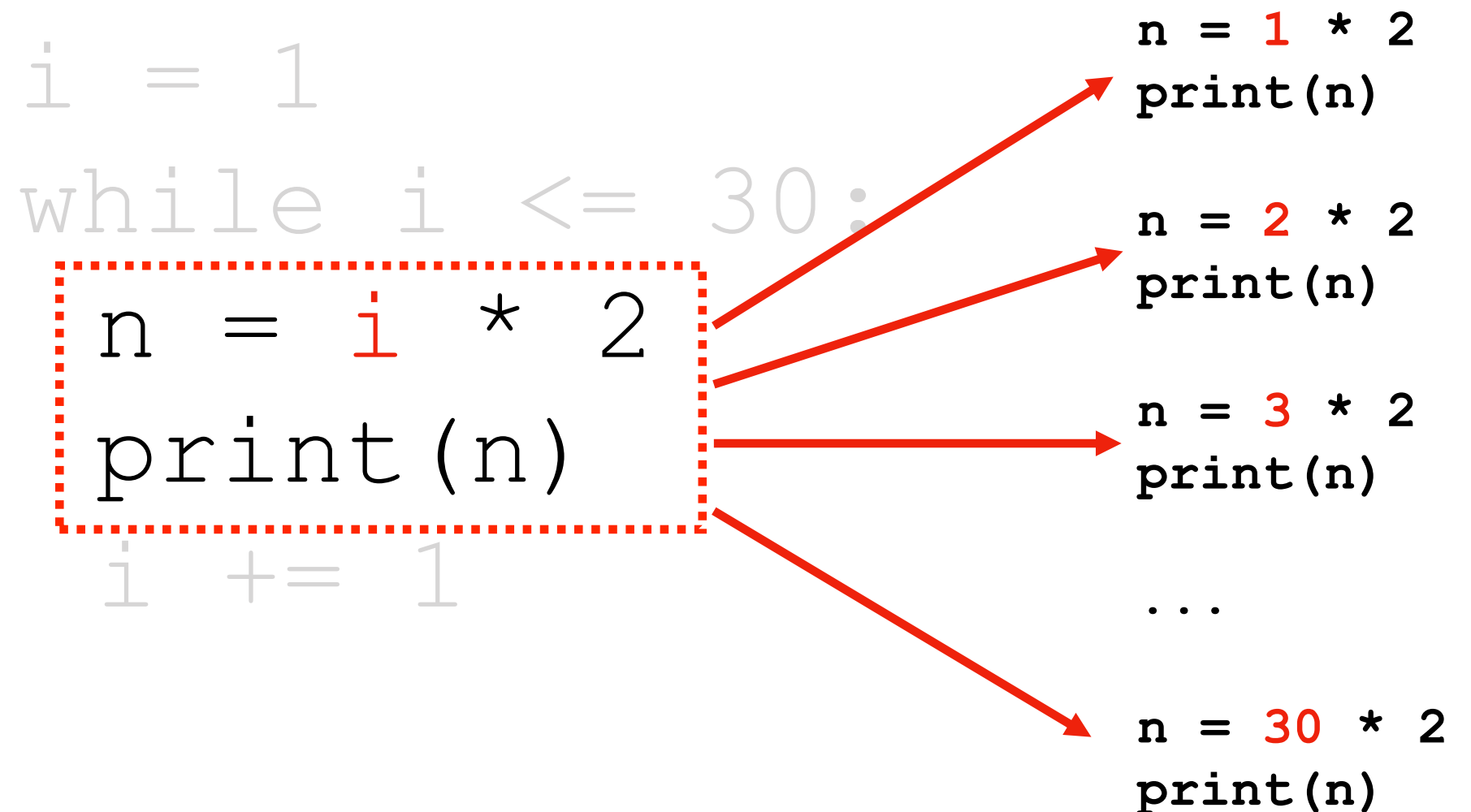
Design Patterns

```
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



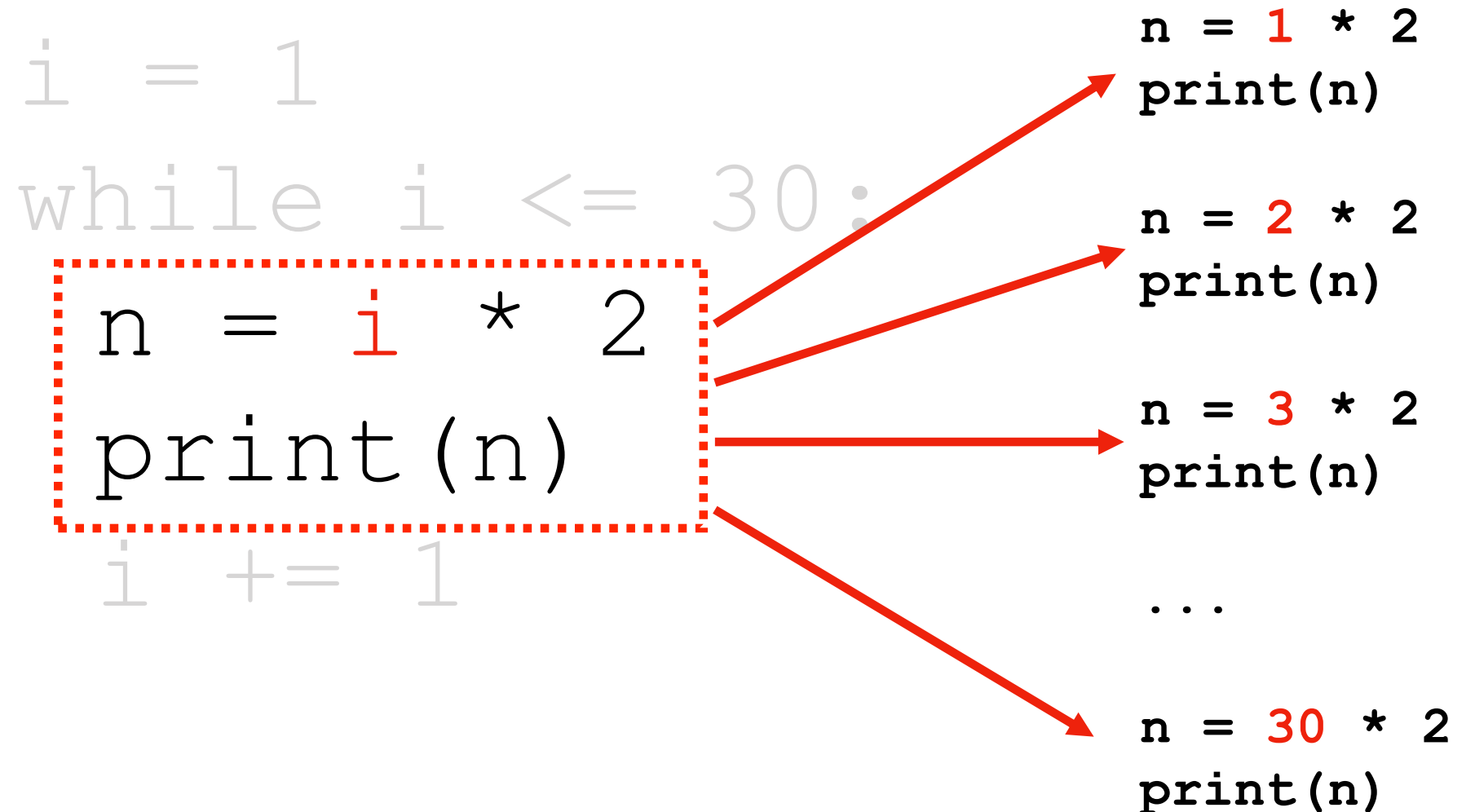
When you ask a programmer what a piece of code does, what do they look at, and in what order?

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

Design Patterns

Output

2
4
6
8
...
56
58
60



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:
```

Option A

fill in with specifics here

```
i += 1
```

Option B

Design Pattern 1: do something N times

```
i = 1  
while i <= N:
```

Option A

fill in with specifics here

```
i += 1
```

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

Option B

fill in with specifics here

```
i += 1
```

Design Pattern 1: do something N times

```
i = 1  
while i <= N:
```

Option A

fill in with specifics here

```
i += 1
```

1, 2, 3, ..., N

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

Option B

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:
```

fill in with specifics here

```
i += 1
```

State	Population	Area
WI	5.795	...
CA	39.54	...
MN	5.577	...
...

Design Pattern 2: do something with all data

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

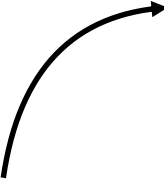
fill in with specifics here

```
i += 1
```

Functions:

count_rows()
get_population(index)
...

index 0



State	Population	Area
WI	5.795	...
CA	39.54	...
MN	5.577	...
...

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	5.795	...
CA	39.54	...
MN	5.577	...
...

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	5.795	...
CA	39.54	...
MN	5.577	...
...

Design Pattern 2: do something with all data

```
i = 0
while i < count_rows():
    pop = get_population(i)
```

assumes we
use 0 for first row

fill in with specifics here

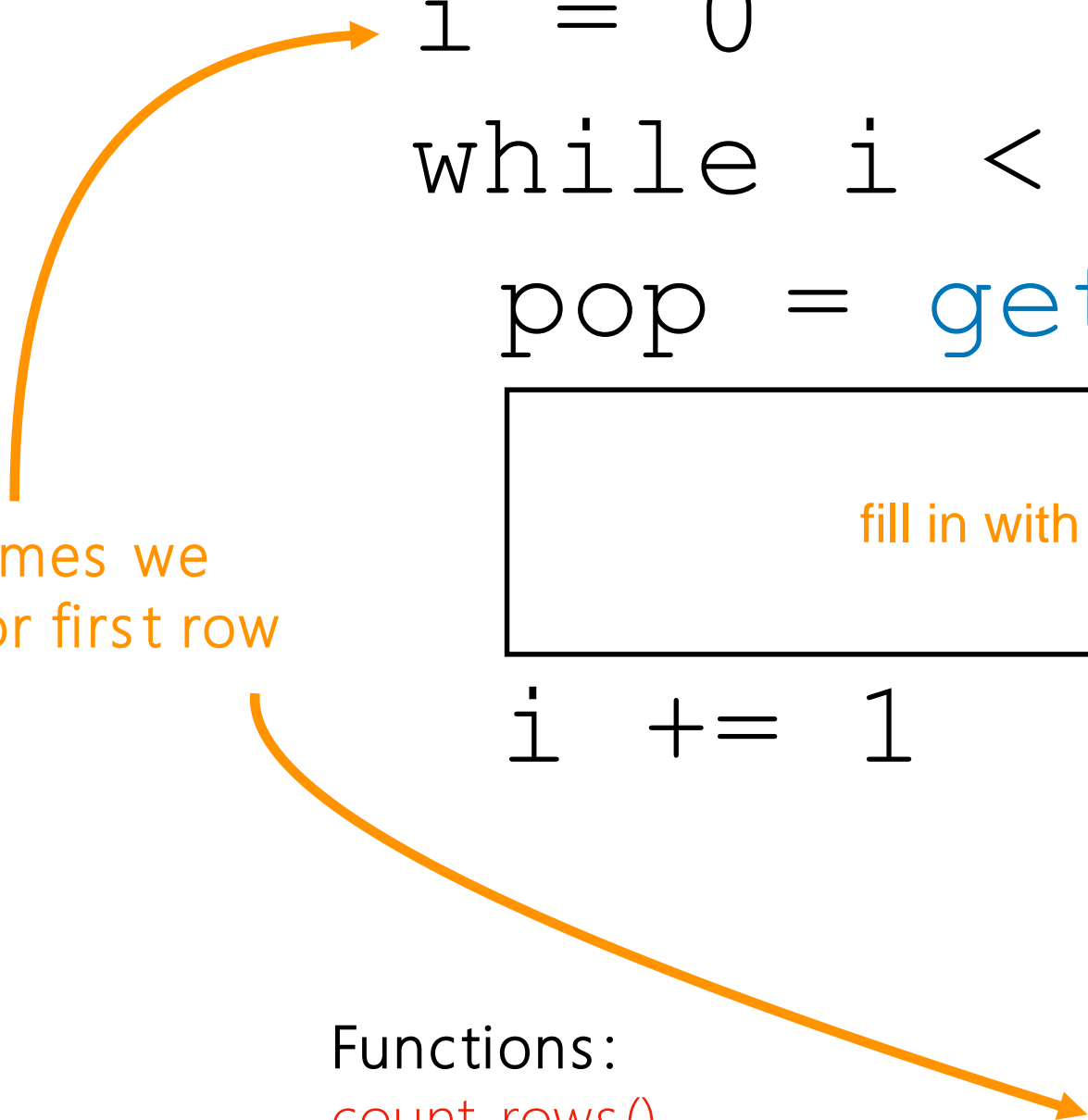
```
i += 1
```

Functions:

`count_rows()`

`get_population(index)`

...



State	Population	Area
WI	5.795	...
CA	39.54	...
MN	5.577	...
...

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

Today's Outline

Design Patterns

Worksheet

- Problem 1
- Problem 2

Break

Continue

Nesting

Problem 1: counting

```
countdown = 5
while countdown > 1:
    print(countdown)
    countdown -= 1
```

Problem 1: counting

```
countdown = 5
while countdown > 1:
    print(countdown)
    countdown -= 1
```

countdown

5

4

3

2

Problem 1: counting

```
countdown = 5
while countdown > 1:
    print(countdown)
    countdown -= 1
```

countdown

5

4

3

2

output

5

4

3

2

Problem 2: loops inside loops

```
i = 1
while i <= 3:
    j = 1
    while j <= i:
        print(i)
        j += 1
    print( 'END' )
    i += 1
```

Problem 2: loops inside loops

```
i = 1
while i <= 3:
    j = 1
    while j <= i:
        print(i)
        j += 1
    print( 'END' )
    i += 1
```

i
1
2
3

Problem 2: loops inside loops

```
i = 1
while i <= 3:
    j = 1
    while j <= i:
        print(i)
        j += 1
    print( 'END' )
    i += 1
```

i	j
1	1
2	1
2	2
3	1
3	2
3	3

Problem 2: loops inside loops

```
i = 1
while i <= 3:
    j = 1
    while j <= i:
        print(i)
        j += 1
    print( 'END' )
    i += 1
```

i	j
1	1
2	1
2	2
3	1
3	2
3	3

Output

1
END
2
2
END
3
3
3
END

Today's Outline

Design Patterns

Worksheet

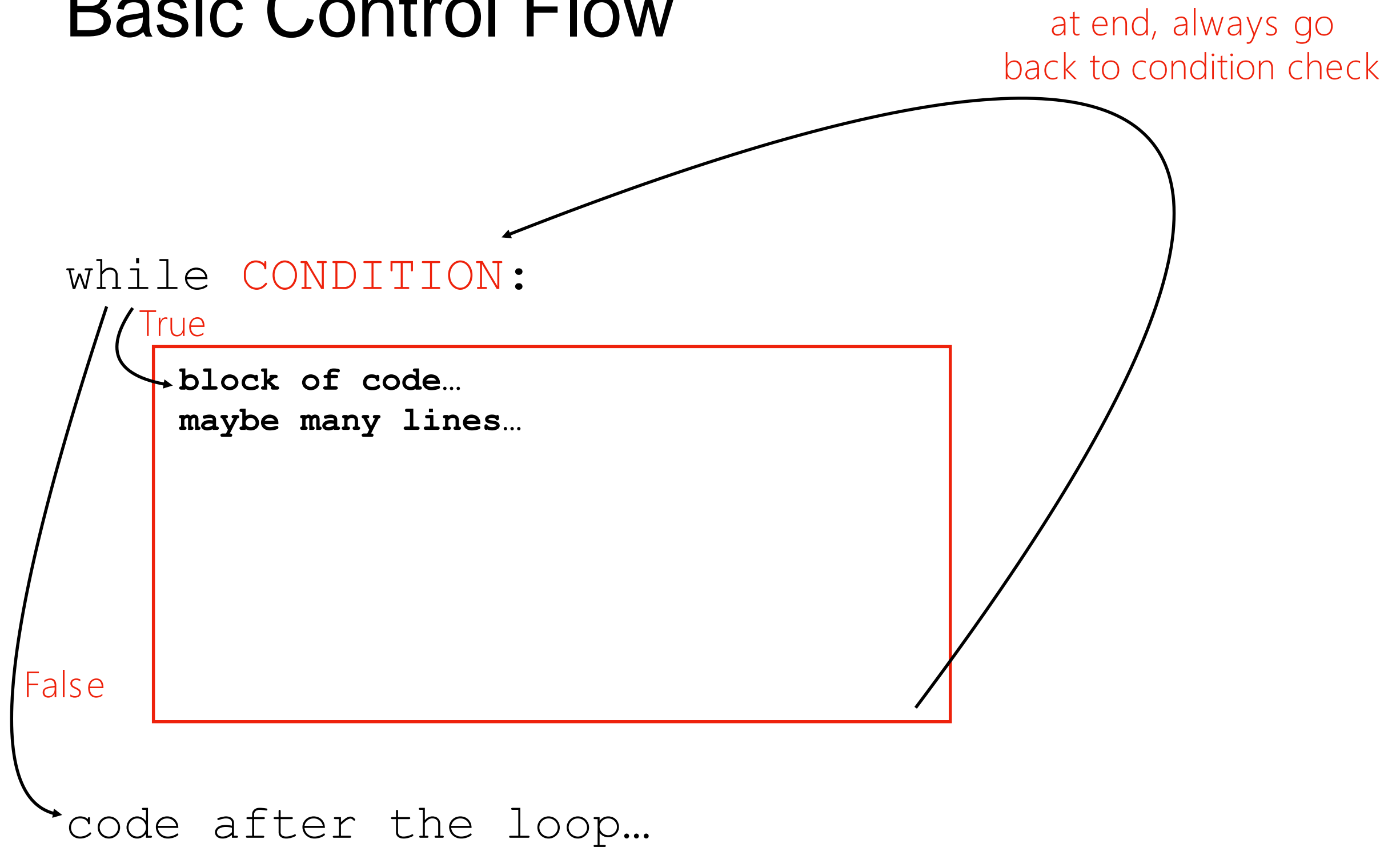
Break

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

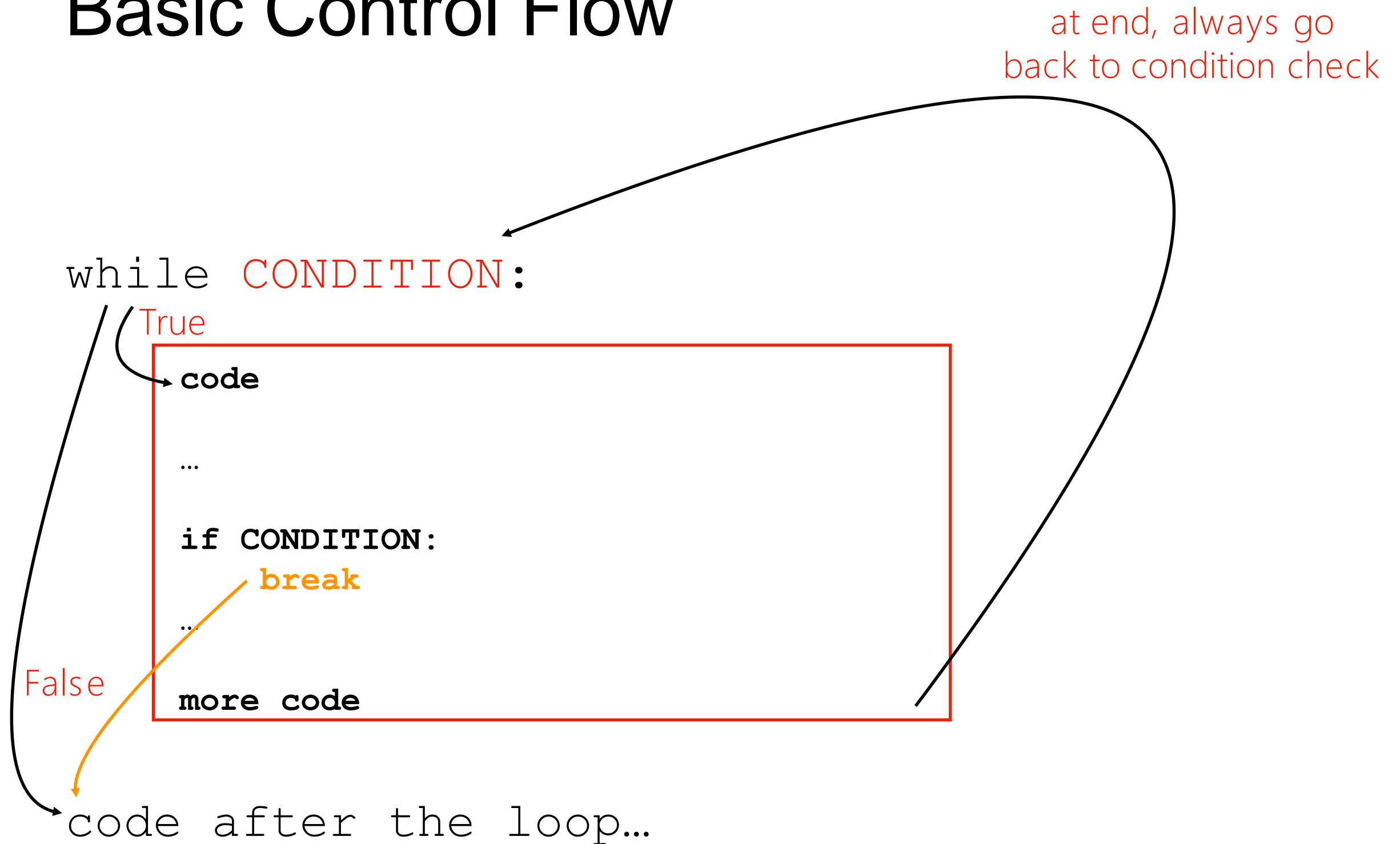
Continue

Nesting

Basic Control Flow

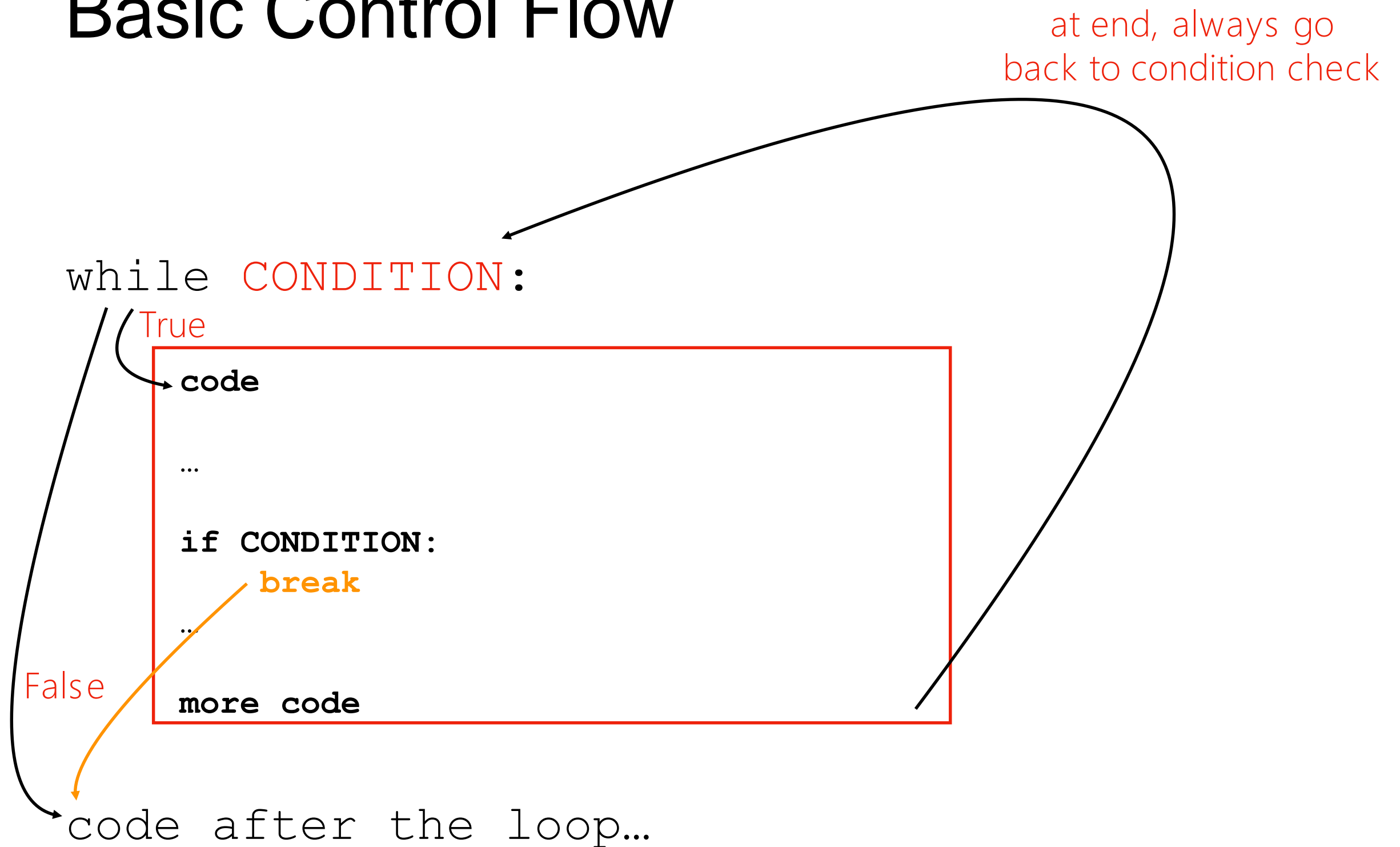


Basic Control Flow



Just like `return` immediately exits a function,
`break` immediately exits a loop

Basic Control Flow



Usage: 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

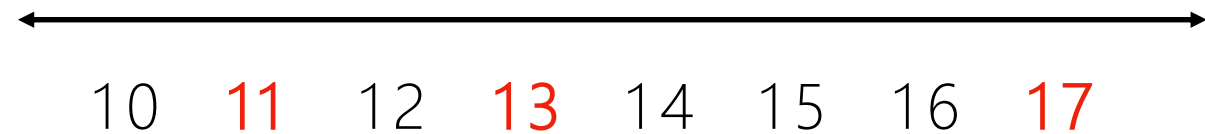
Goal: answer whether a range of numbers contains a prime

Input:

- Start of range
- End of range

Output:

- Yes or no



Examples:

14 to 16 => NO (because 14, 15, and 16 are all not prime)

10 to 12 => YES (because 11 is prime)

Problem 3: can we have a *break*, please?

```
num = 0
while num < 500:
    num += 100
    print(str(num) + "?")
    if num == 300:
        break
    print('YES')
```

Problem 3: can we have a *break*, please?

```
num = 0
while num < 500:
    num += 100
    print(str(num) + "?")
    if num == 300:
        break
    print('YES')
```

num
0
100
200
300
400

Problem 3: can we have a *break*, please?

```
num = 0
while num < 500:
    num += 100
    print(str(num) + "?")
    if num == 300:
        break
    print('YES')
```

num	inside sandwich
0	100
100	200
200	300
300	400
400	500

Problem 3: can we have a *break*, please?

```
num = 0
while num < 500:
    num += 100
    print(str(num) + "?")
    if num == 300:
        break
    print('YES')
```

num	inside sandwich
0	100
100	200
200	300
300	400
400	500

output

100?
YES
200?
YES
300?

Today's Outline

Design Patterns

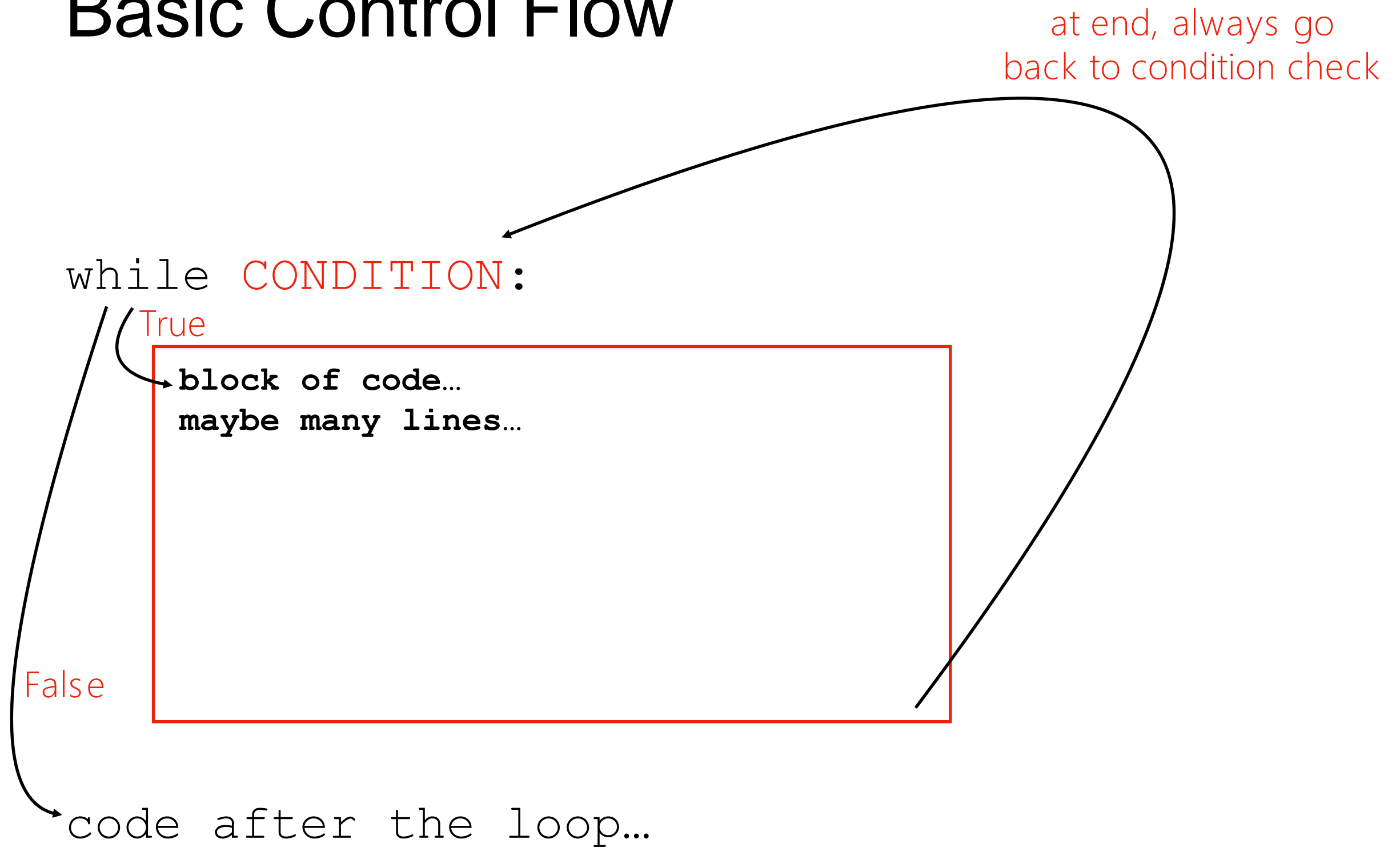
Worksheet

Break

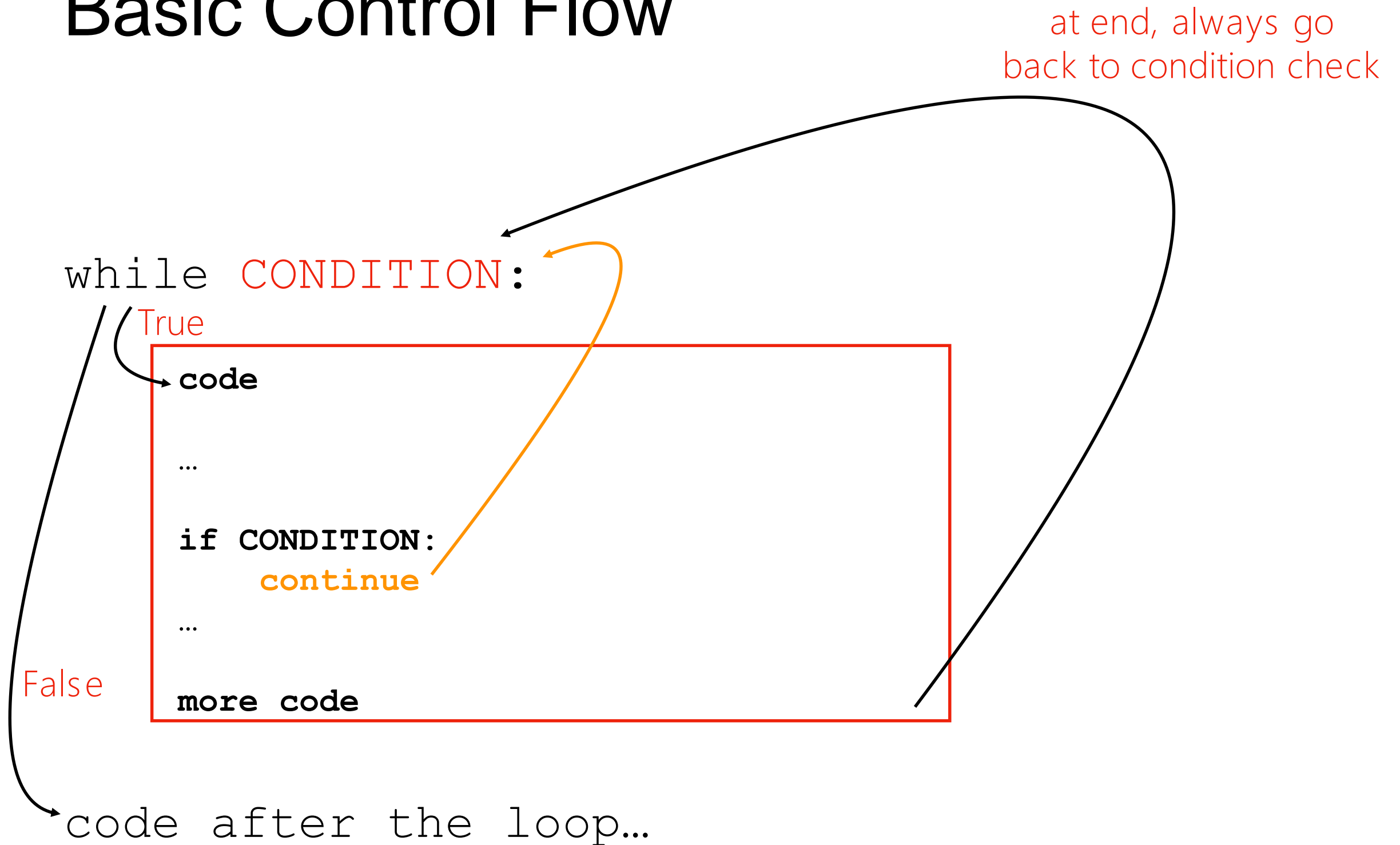
Continue

Nesting

Basic Control Flow

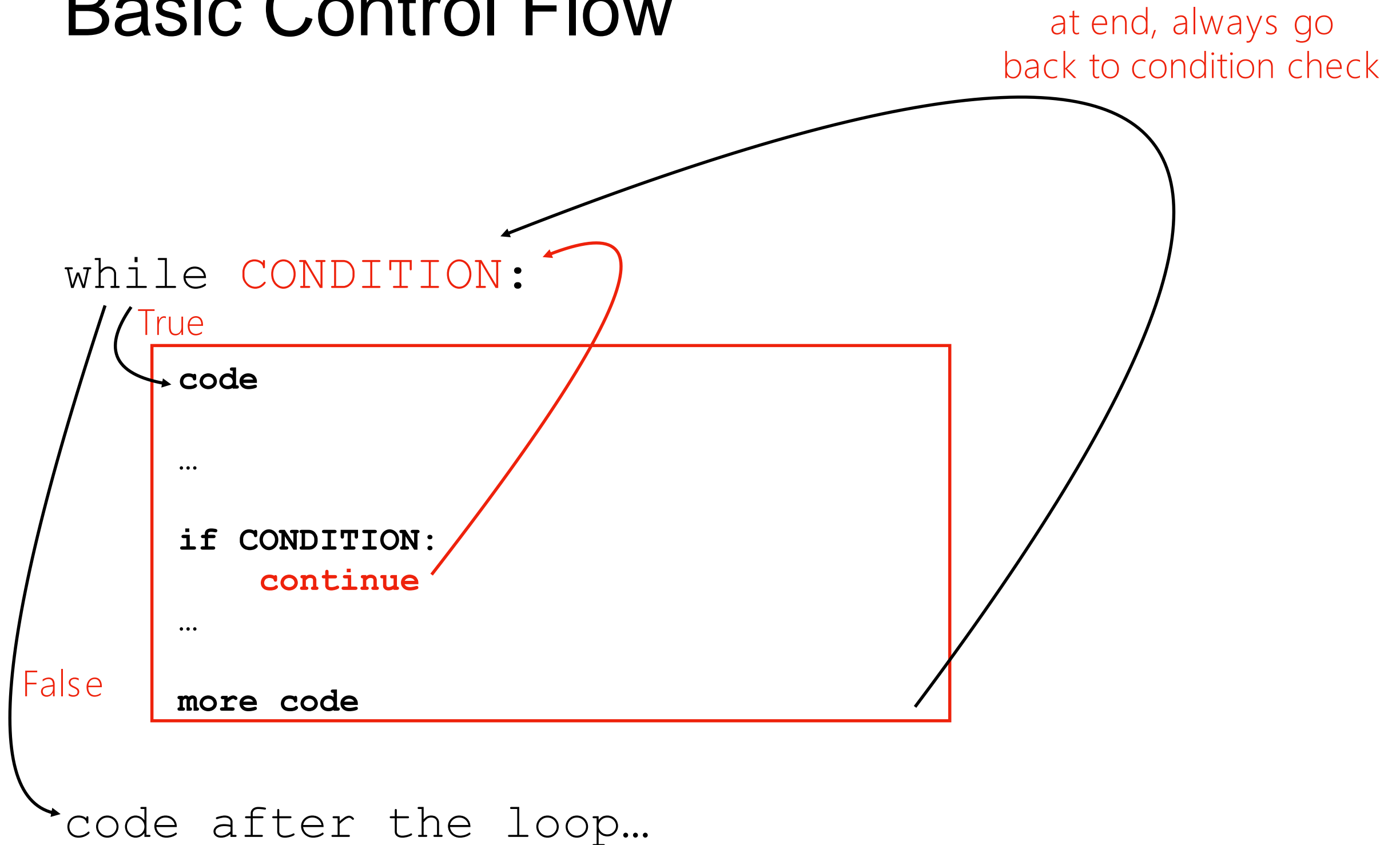


Basic Control Flow



`continue` immediately stops current iteration and goes back to the condition, without executing the "more code part, potentially to start another iteration

Basic Control Flow



Usage: commonly used to skip over values we want to ignore

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): 110
bad input, skipping!
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

Problem 4: we must *continue* practicing loops!

```
num = 0
while num < 500:
    num += 100
    print(str(num) + "?")
    if num == 300:
        continue
    print('YES')
```

Problem 4: we must *continue* practicing loops!

```
num = 0
while num < 500:
    num += 100
    print(str(num) + "?")
    if num == 300:
        continue
    print('YES')
```

num
0
100
200
300
400

Problem 4: we must *continue* practicing loops!

```
num = 0
while num < 500:
    num += 100
    print(str(num) + "?")
    if num == 300:
        continue
    print('YES')
```

num	inside
0	100
100	200
200	300
300	400
400	500

Problem 4: we must *continue* practicing loops!

```
num = 0
while num < 500:
    num += 100
    print(str(num) + "?")
    if num == 300:
        continue
    print('YES')
```

num	inside sandwich
0	100
100	200
200	300
300	400
400	500

output

100?
YES
200?
YES
300?
400?
YES
500?
YES

Nested loops

```
while CONDITION_A:
```

```
    # more code
```

```
    while CONDITION_B:
```

```
        # more code
```

```
        if CONDITION_C:
```

```
            continue
```

```
        # more code
```

```
    # more code
```

```
# code outside any loop
```

how many blocks are there?

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:
```

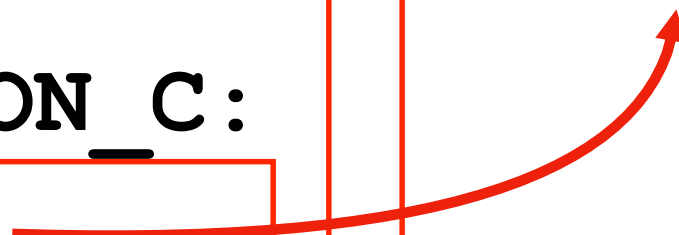
```
continue
```

```
# 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
```

Worksheet Problems