

Iteration

Department of Computer Sciences
University of Wisconsin-Madison

Readings:

Chapter 7 of Think Python

Chapter 6.1 to 6.3 of Python for Everybody

Learning Objectives

Implement an iterative algorithm using a while loop

- printing /counting
- validating user input
- performing iterative calculation
- printing grids / character art

Trace iterative algorithms and determine their output

Recognize common while loop errors:

- infinite loops (when unintentional)
- off-by-one mistakes in the loop control variable increment / decrement

Worksheet

State:

N

4

total

0

answer

0

6

Code:

1. Put 1 in the “total” box
2. If “N” equals 1, skip to step 6, otherwise continue to step 3
3. Multiply the value in “total” by the value in “N”, and put the result back in “total”
4. Decrease the value in “N” by 1
5. Go to step 2
6. Copy the value in total to the answer box

Worksheet

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Combination of conditionally skipping forward (2) with going back is (5) is called a “while loop”

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loop condition

loop body

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loop condition

loop body

going back will be implicit in Python and will happen right after loop body.
you can identify the loop body because it will be indented

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loop condition

skip past loop body

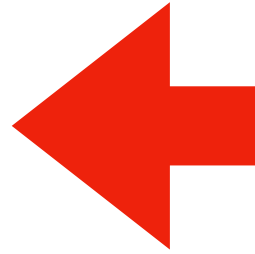
continue to loop body

loop body

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you can identify the loop body because it will be indented

Today's Outline

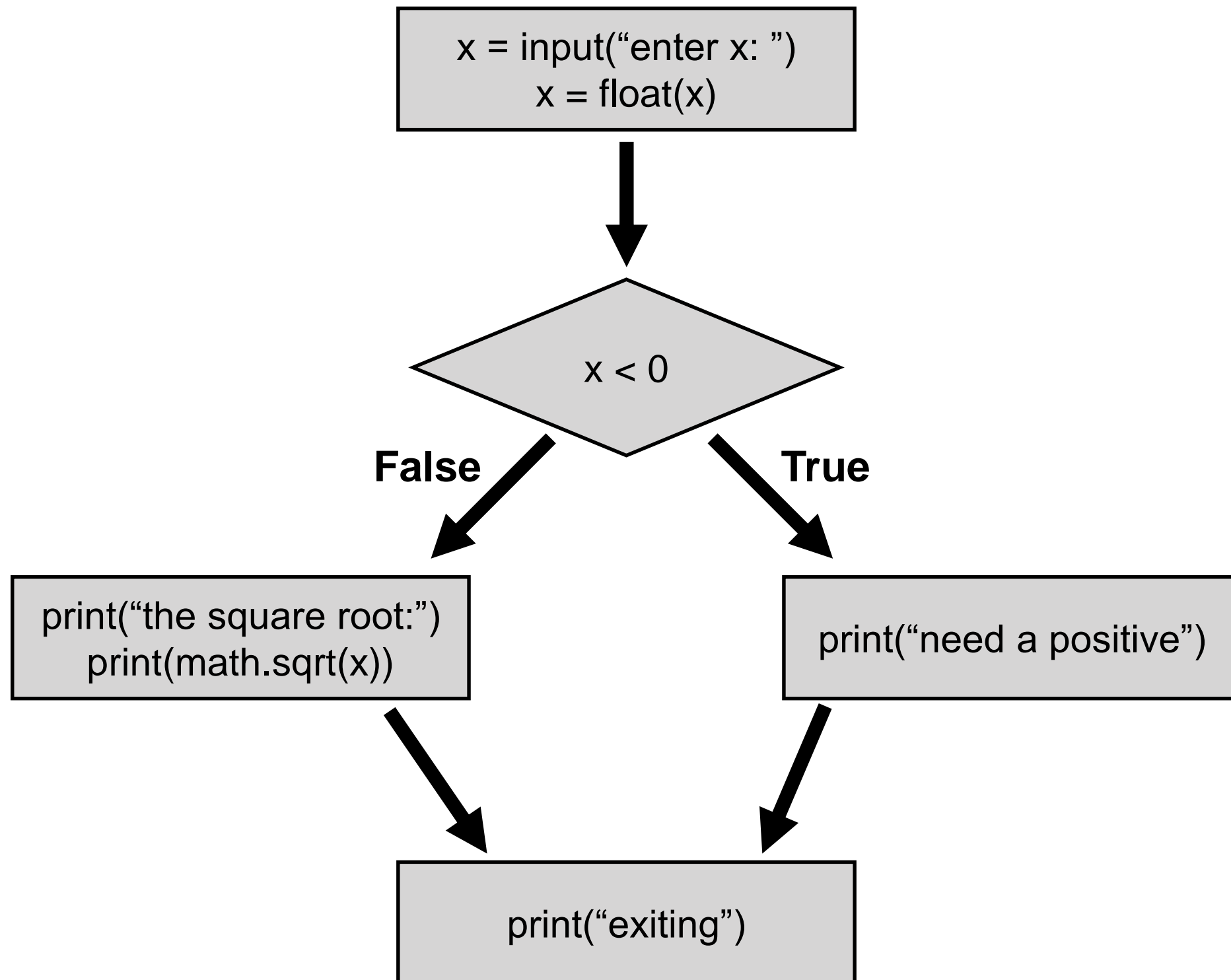
Control Flow Diagrams



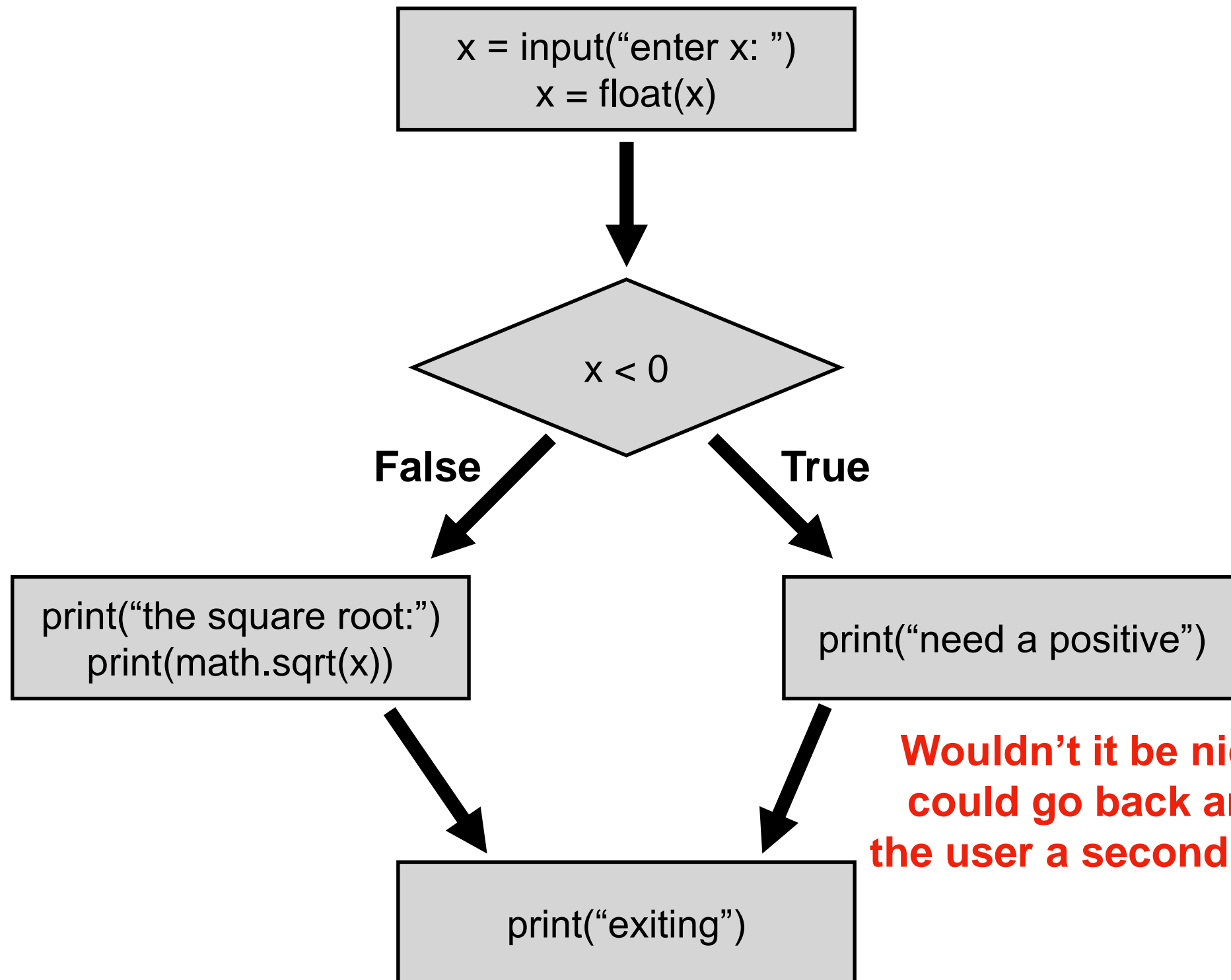
Basic syntax for “while”

Examples

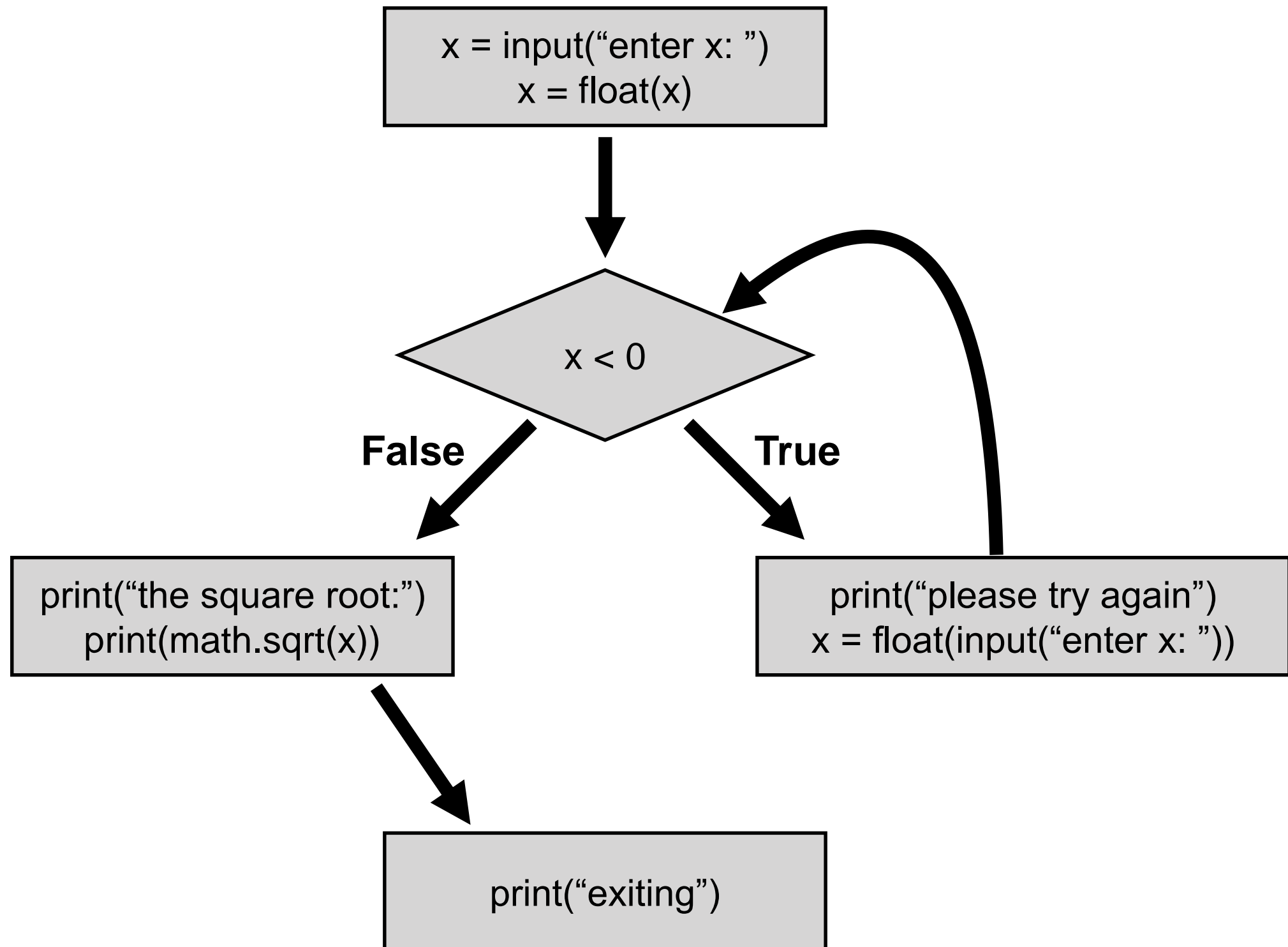
Control Flow Diagrams: “if”



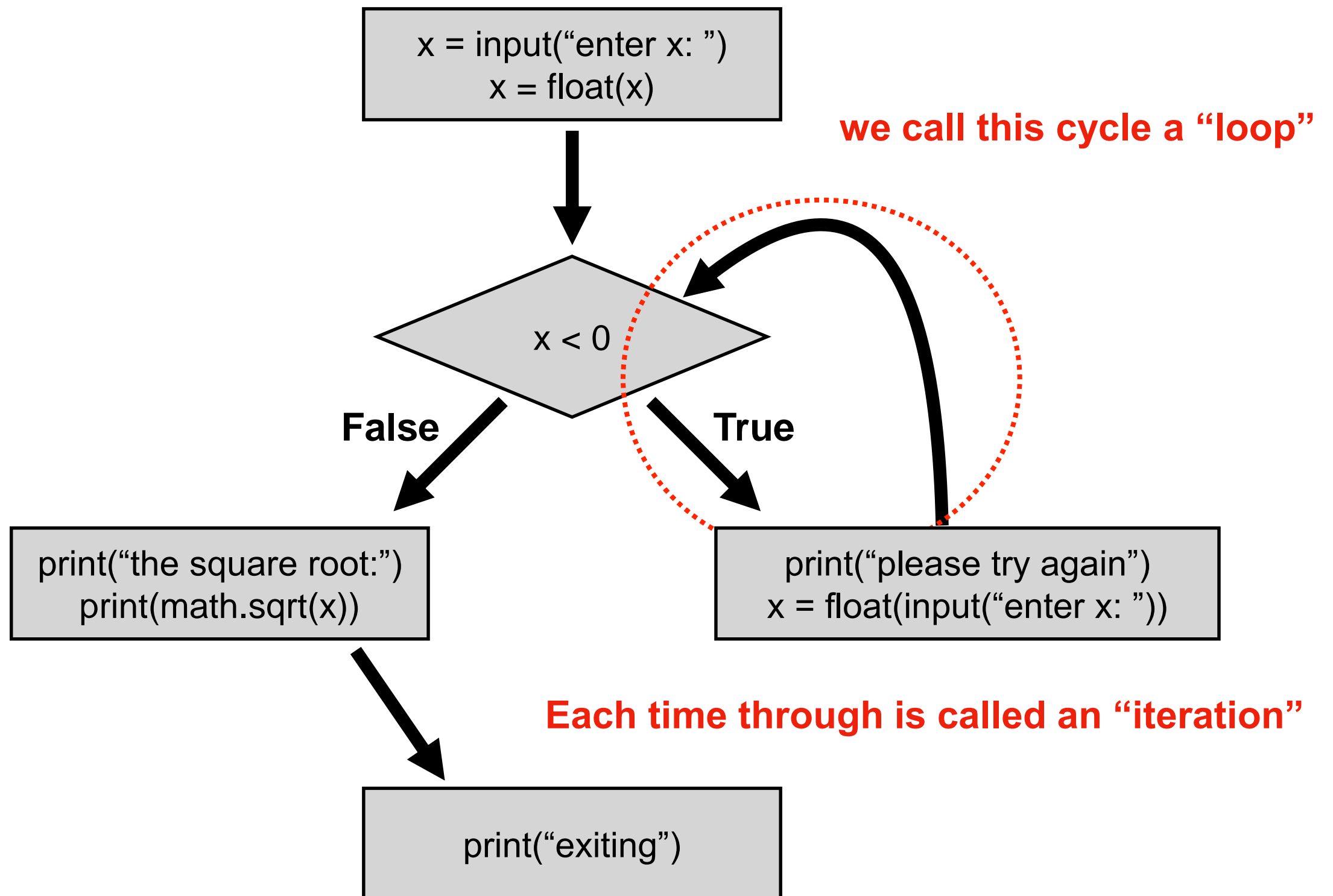
Control Flow Diagrams: “if”



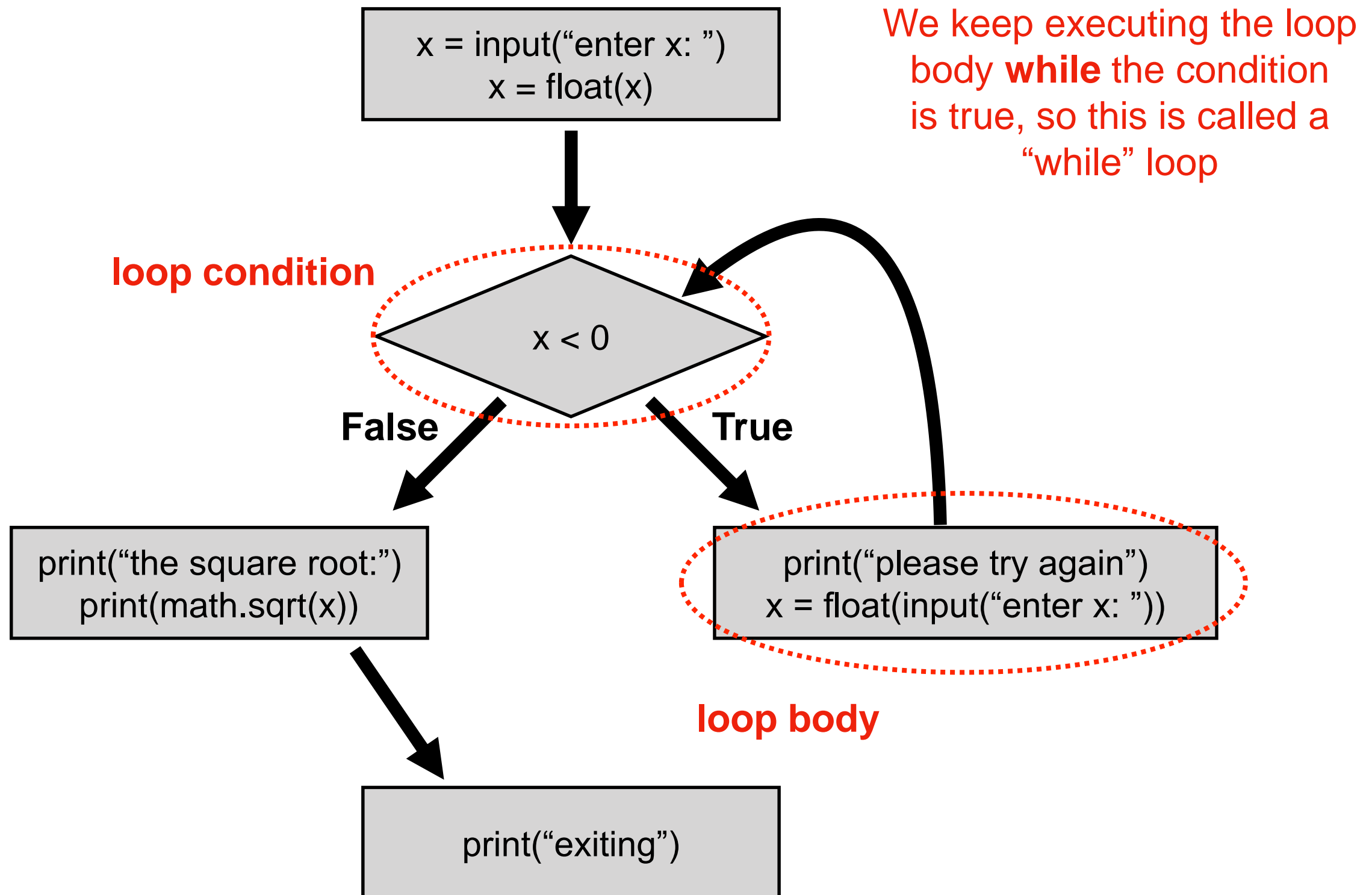
Control Flow Diagrams: “while”



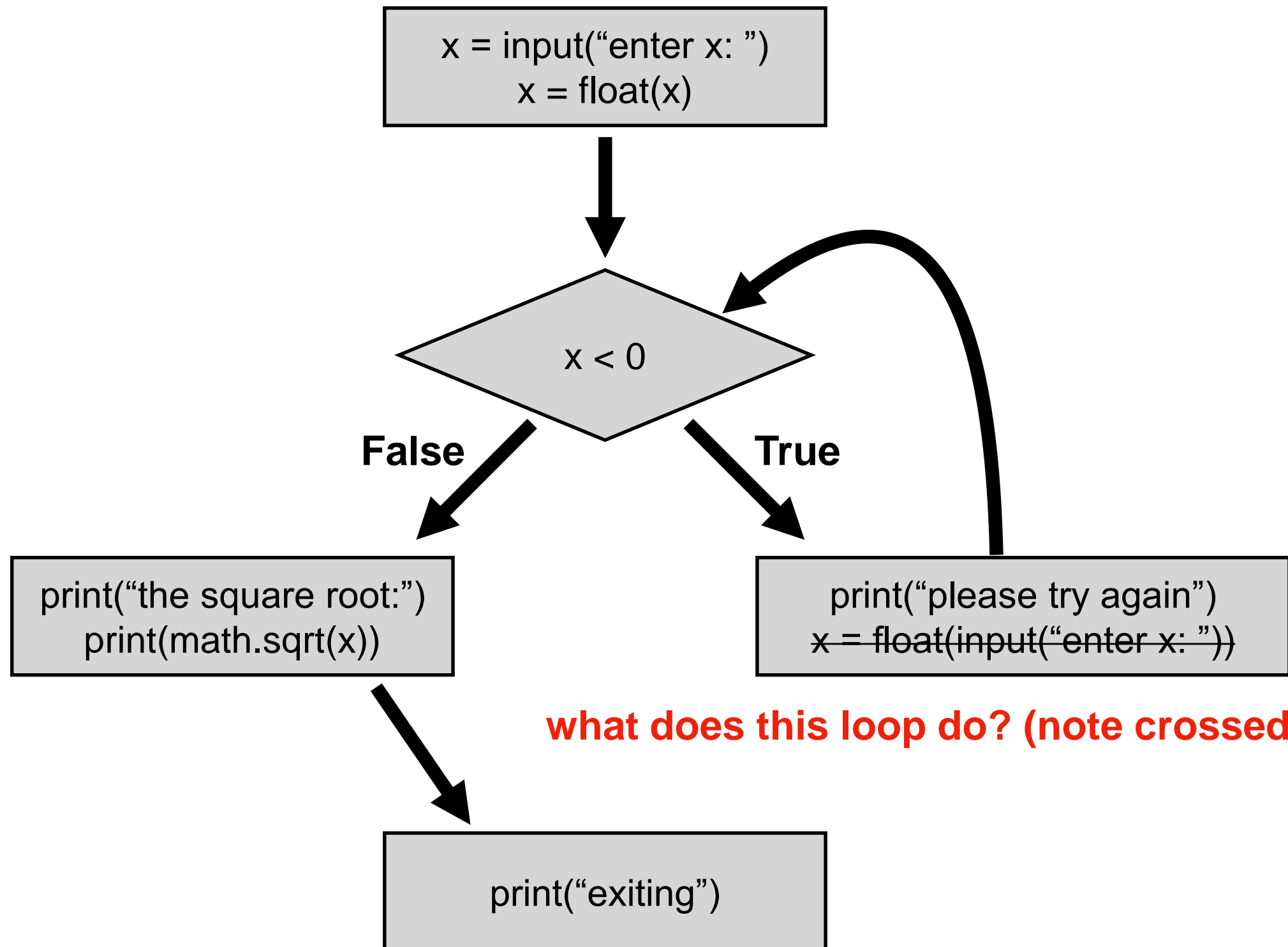
Control Flow Diagrams: “while”



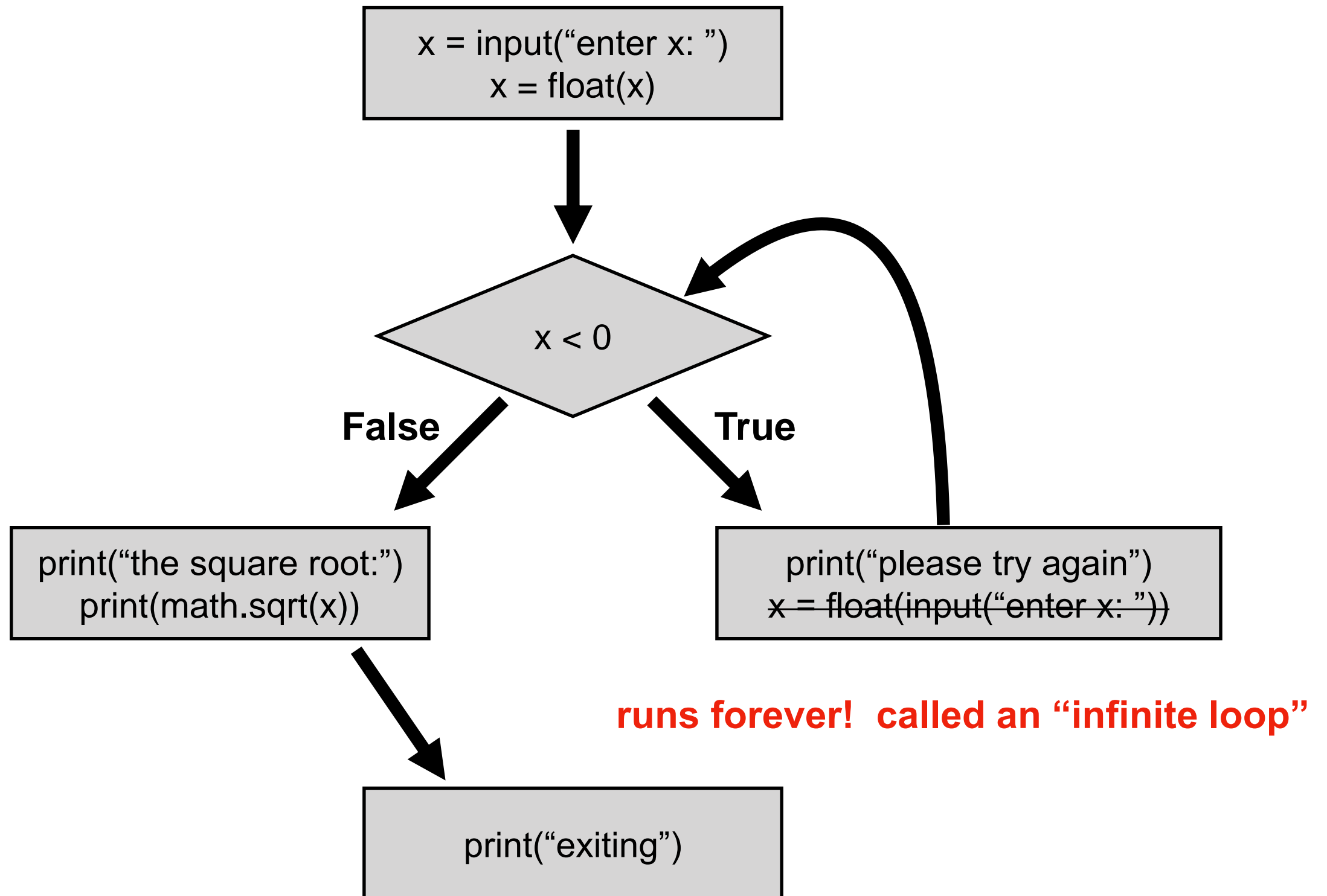
Control Flow Diagrams: “while”



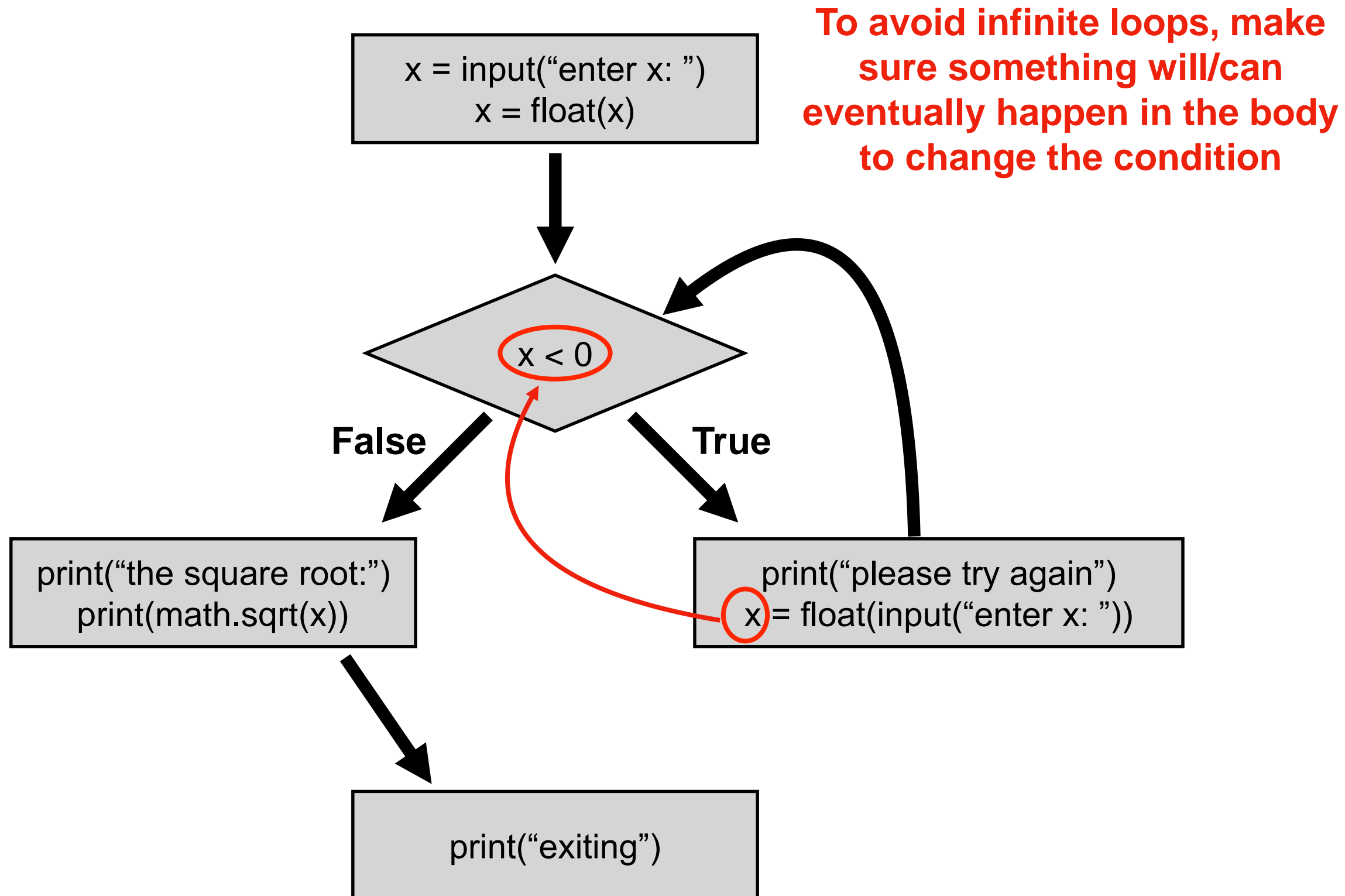
Control Flow Diagrams: “while”



Control Flow Diagrams: “while”



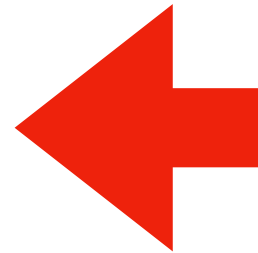
Control Flow Diagrams: “while”



Today's Outline

Control Flow Diagrams

Basic syntax for “while”



Examples

Syntax

```
x = int(input("enter x: "))
```

```
if x < 0:  
    x = int(input("please try again: "))
```

Syntax for “if”

Syntax

```
x = int(input("enter x: "))
```

```
while x < 0:  
    x = int(input("please try again: "))
```

Syntax for “while loop” is just like for “if”, just replace “if” with “while”

**This example gives user an arbitrary number of tries
until they get it right**

Terminology

```
x = int(input("enter x: "))
```

```
while x < 0: ← loop condition  
    x = int(input("please try again: "))
```

loop control variable

loop body

Control Flow

```
while CONDITION:  
    # your code
```

Control Flow

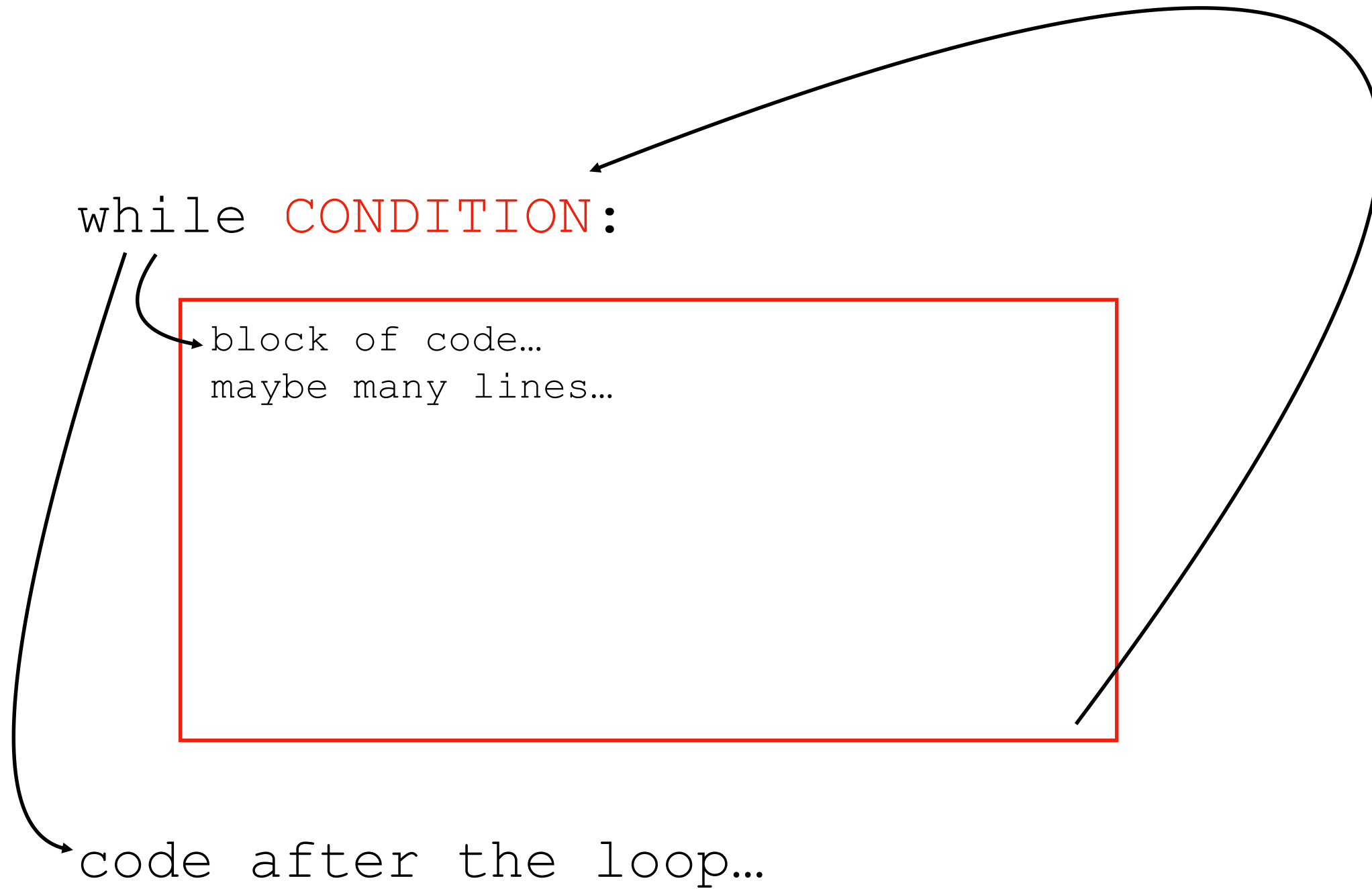
```
while CONDITION:
```



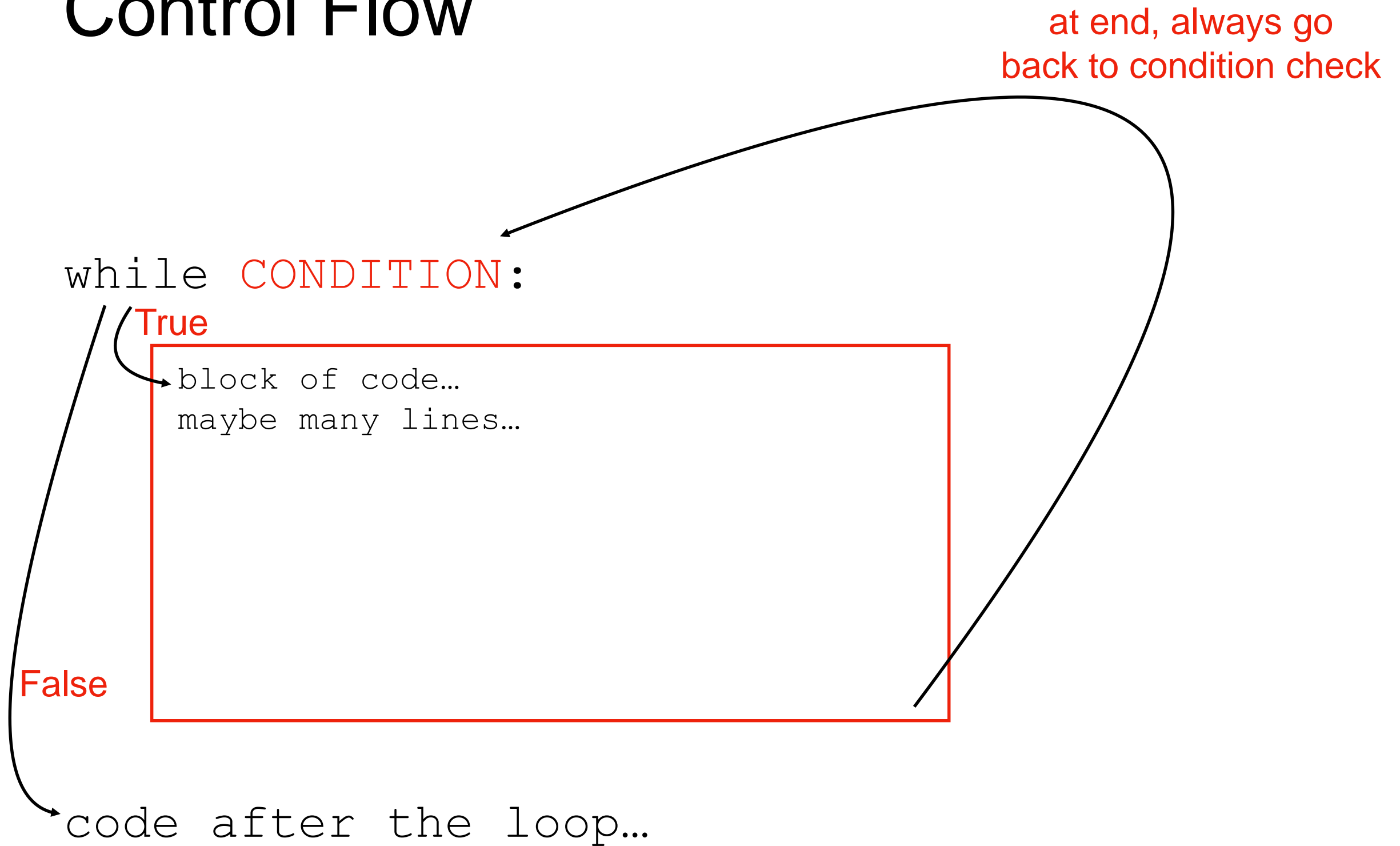
```
    block of code..  
    maybe many lines..
```

```
code after the loop..
```

Control Flow



Control Flow



Steps to follow

Whenever you write a while loop, keep these in mind:

1. **Initialize** your loop condition variable
2. a) **Update** your loop condition variable in loop body
b) Make **progress towards** eventually turning your loop condition to **False**

Congrats!

You now understand the 4 key **Flow of Execution** ideas, in the context of Python.

1. **generally, proceed forward, one step at a time**

2. sometimes go run a “mini program” somewhere else before continuing to the next line

- This is a **function call**

3. sometimes skip forward over some lines of code

- **Conditional** or **while loop**, when the condition is false

4. sometimes go back to a previous line of code

- **while loop**. When at the end of body, always go back to condition

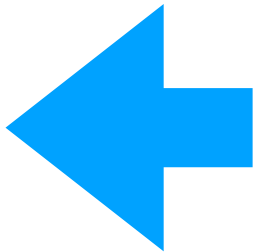
three primary exceptions to the general case (1)

Today's Outline

Control Flow Diagrams

Basic syntax for “while”

Examples



Example: Countdown Timer

use `time.sleep(1)` 

How many seconds? 5

5 seconds left

4 seconds left

3 seconds left

2 seconds left

1 seconds left

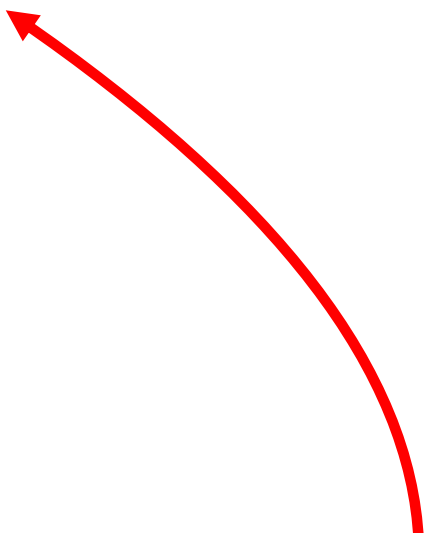
DING DING DING DING DING!

for with range

```
for item in range(5):  
    print(item * 3)
```

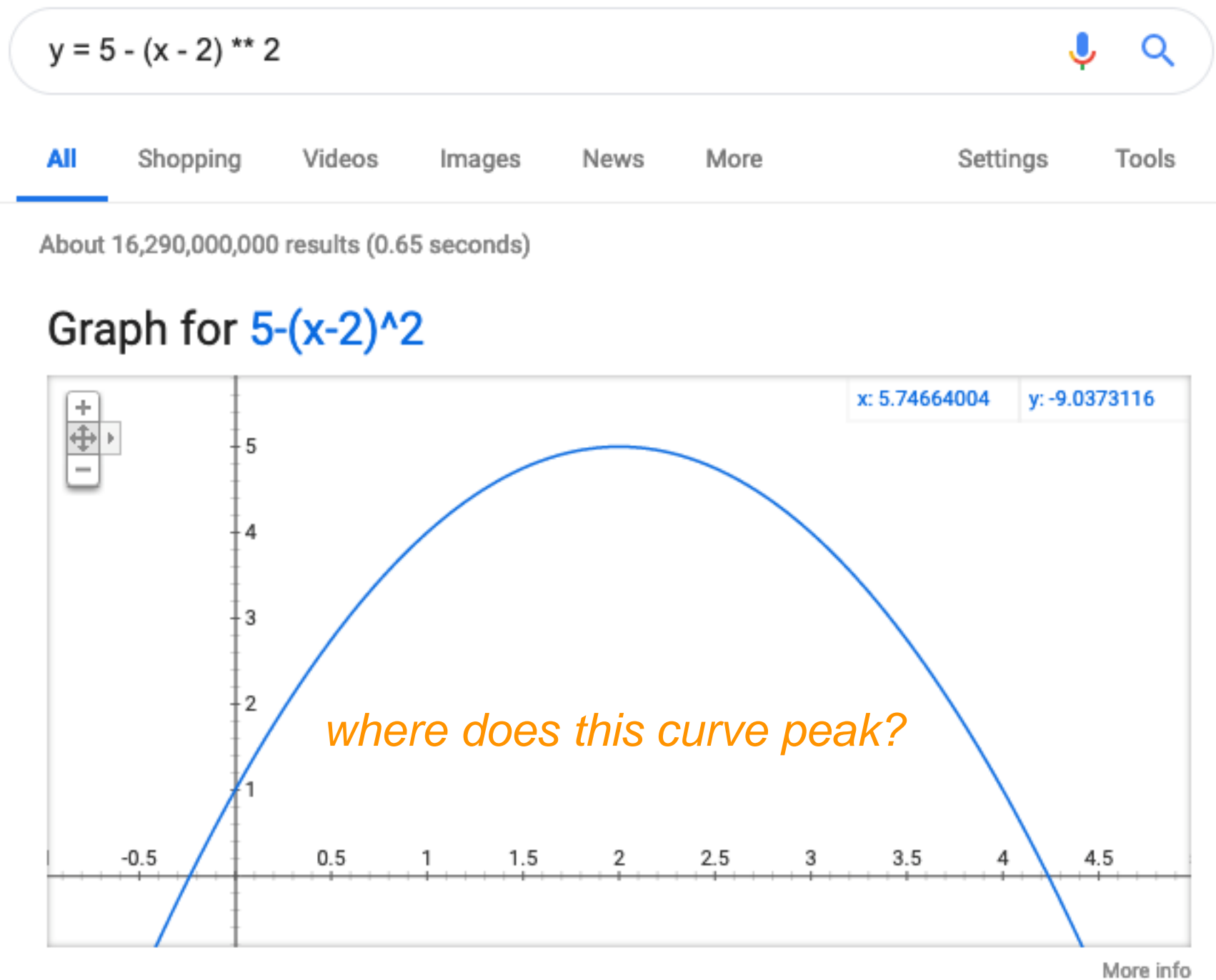
Output:

0
3
6
9
12



using range(N) with a for loop will
iterate with these values for item:
0, 1, 2, ..., N-2, N-1

Example: Maximum (Finding the Peak)



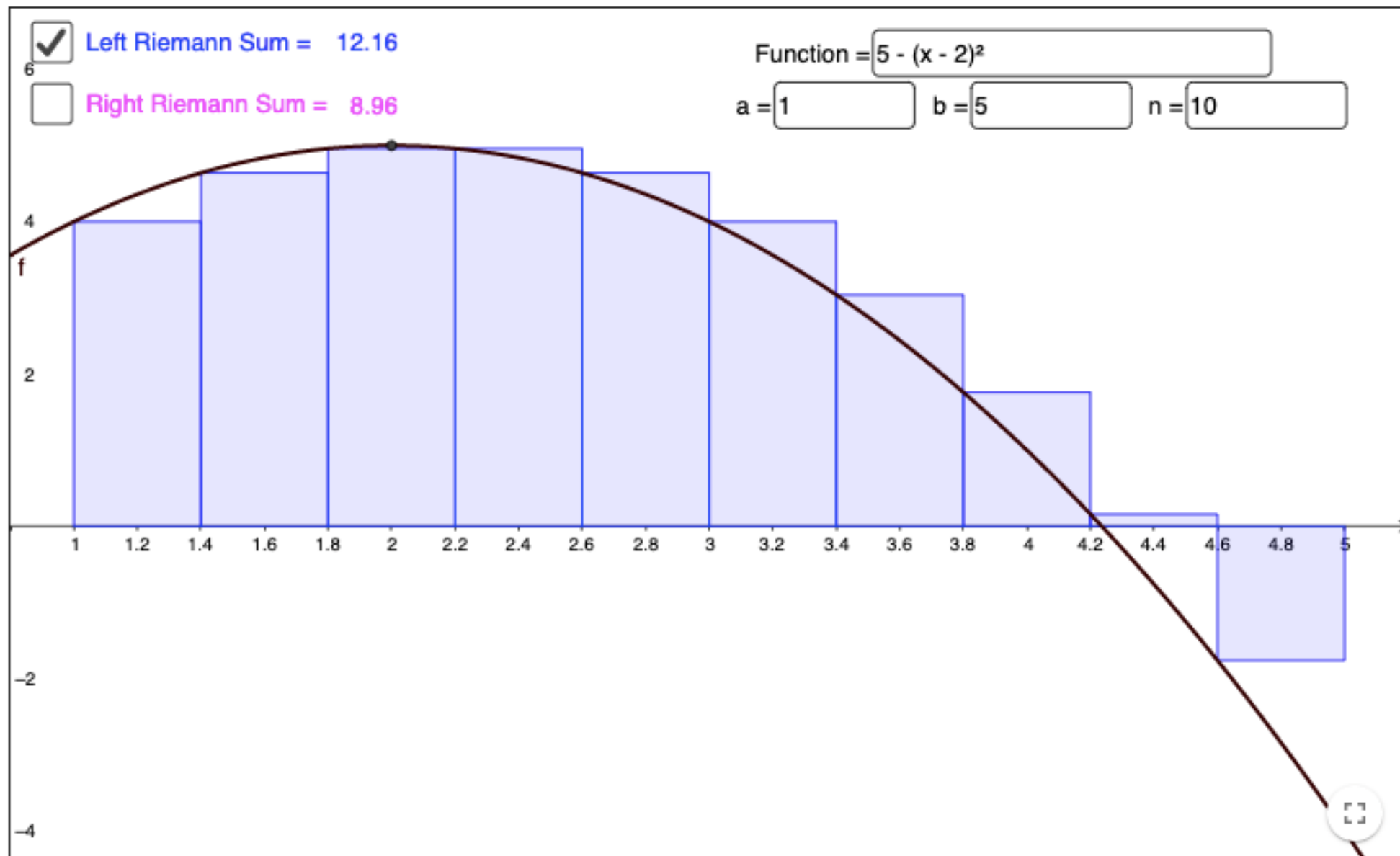
Example: Integration (Riemann Sum)

GeoGebra

Riemann Sum Calculator

Author: [megan.ann.martinez](#)

Topic: [Area](#), [Upper and Lower Sum or Riemann Sum](#)



Example: Prime Finder

Prime numbers:

2 is prime

3 is prime

4 is not prime

5 is prime

6 is not prime

7 is prime

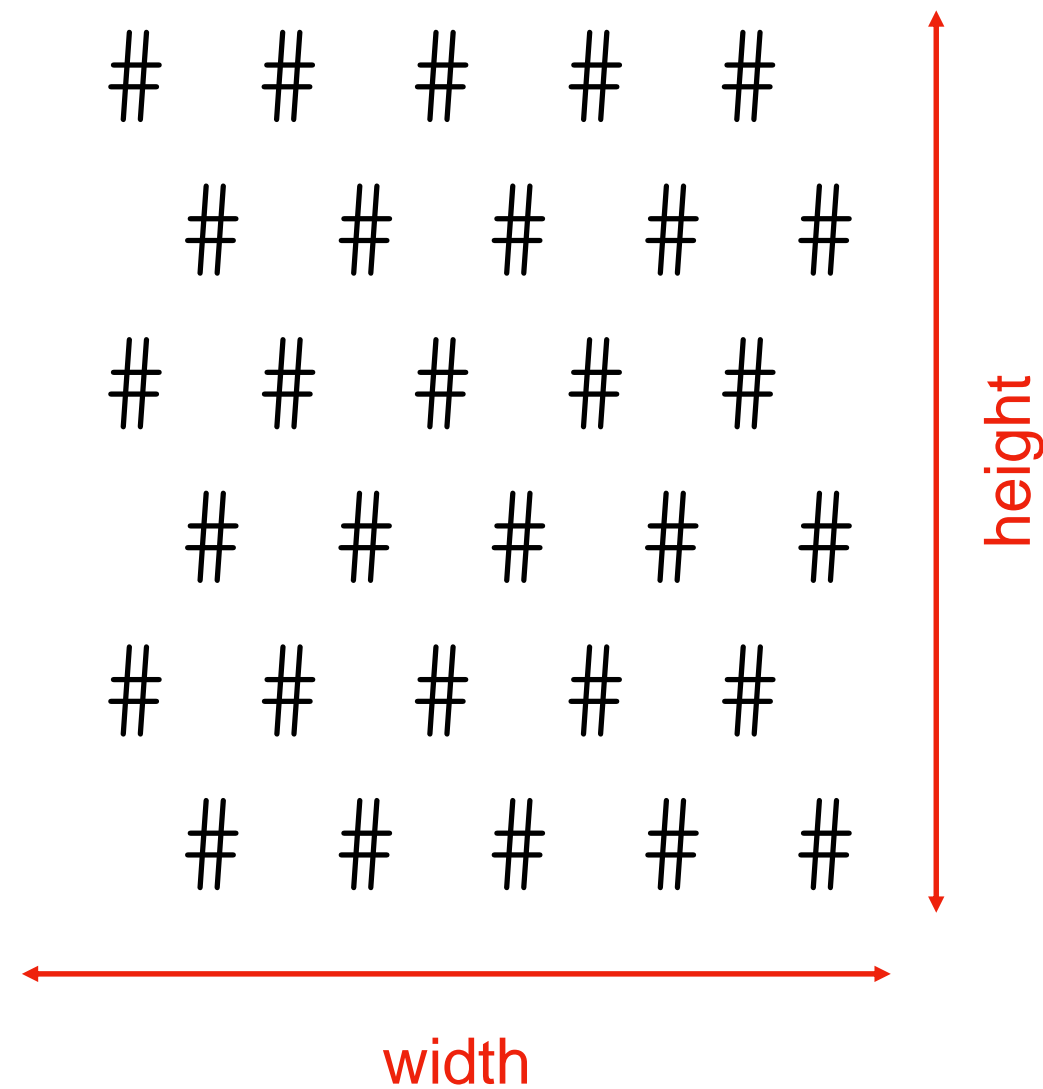
8 is not prime

9 is not prime

...

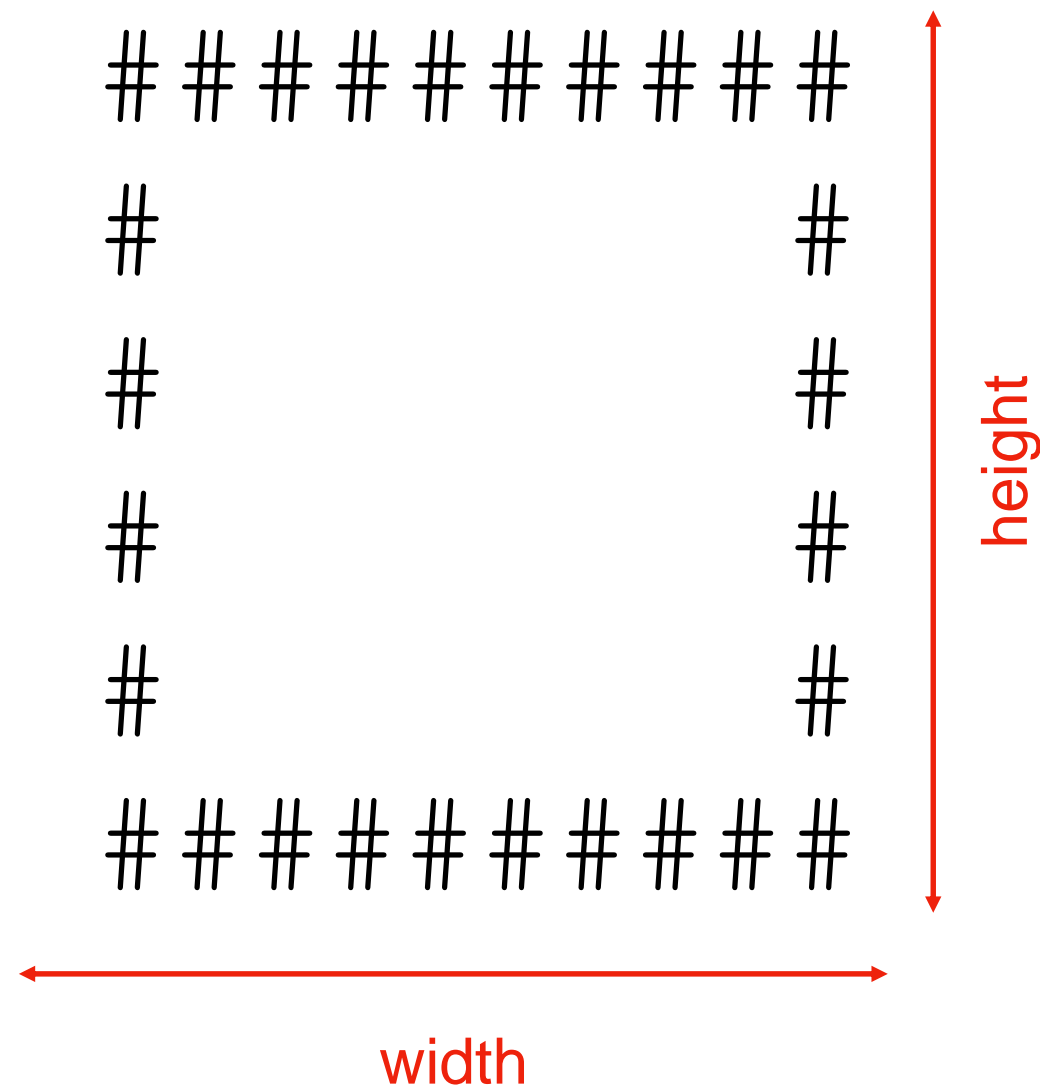
Practice: Checkers

write a loop to draw the following:



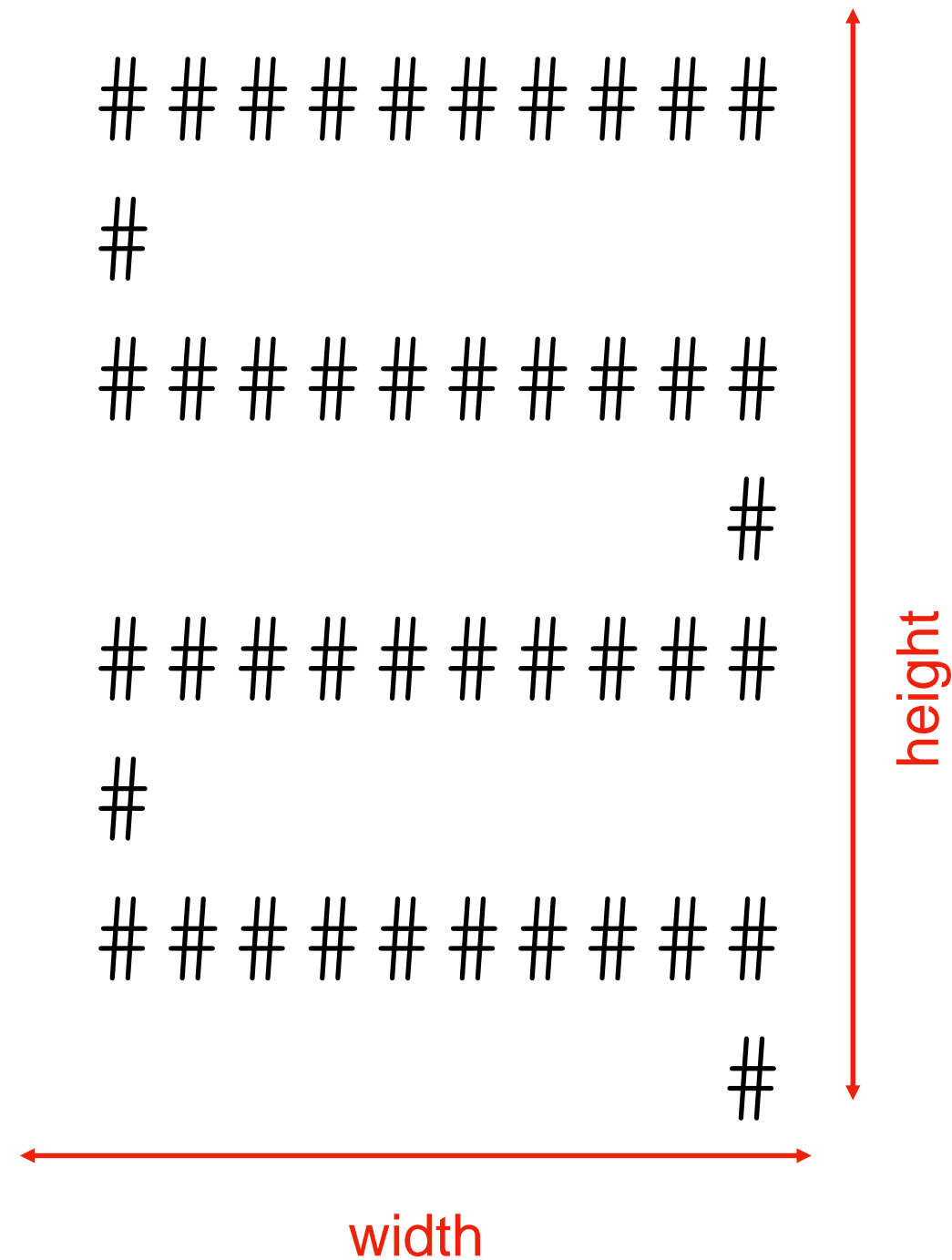
Practice: Border

write a loop to draw the following:



Practice: Snake

write a loop to draw the following:



Challenge: Countdown Timer

use `time.sleep(1)`



how many seconds? 5

5

4

3

2

1

DING DING DING DING DING!

how many seconds? 2

2

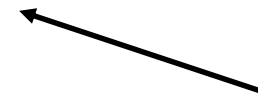
1

0

DING DING DING DING DING!

how many seconds? q

good bye!



exit program

this program should involve a nested loop!!!