

# [220 / 319] Iteration

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- **Exam I next Monday (24-hour period)**
- **Fill out exam I conflict form – by 17<sup>th</sup> Feb**

# Learning Objectives Today

## Reason about loops

- Motivation: need for repetition
- Condition and body of loop
- “while” syntax
- loops inside loops

**Chapter 7 of Think Python**

## Understand common use cases

- Taking input from a user
- Computing over ranges of numbers

## Learn to avoid pitfalls

- Infinite loops (when unintentional)
- Off-by-one mistakes

# Worksheet

State:



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

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

# 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

loop condition

skip past loop body

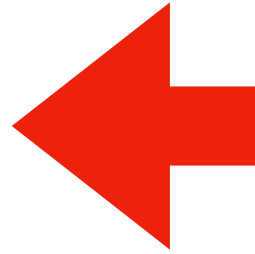
continue to loop body

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

# Today's Outline

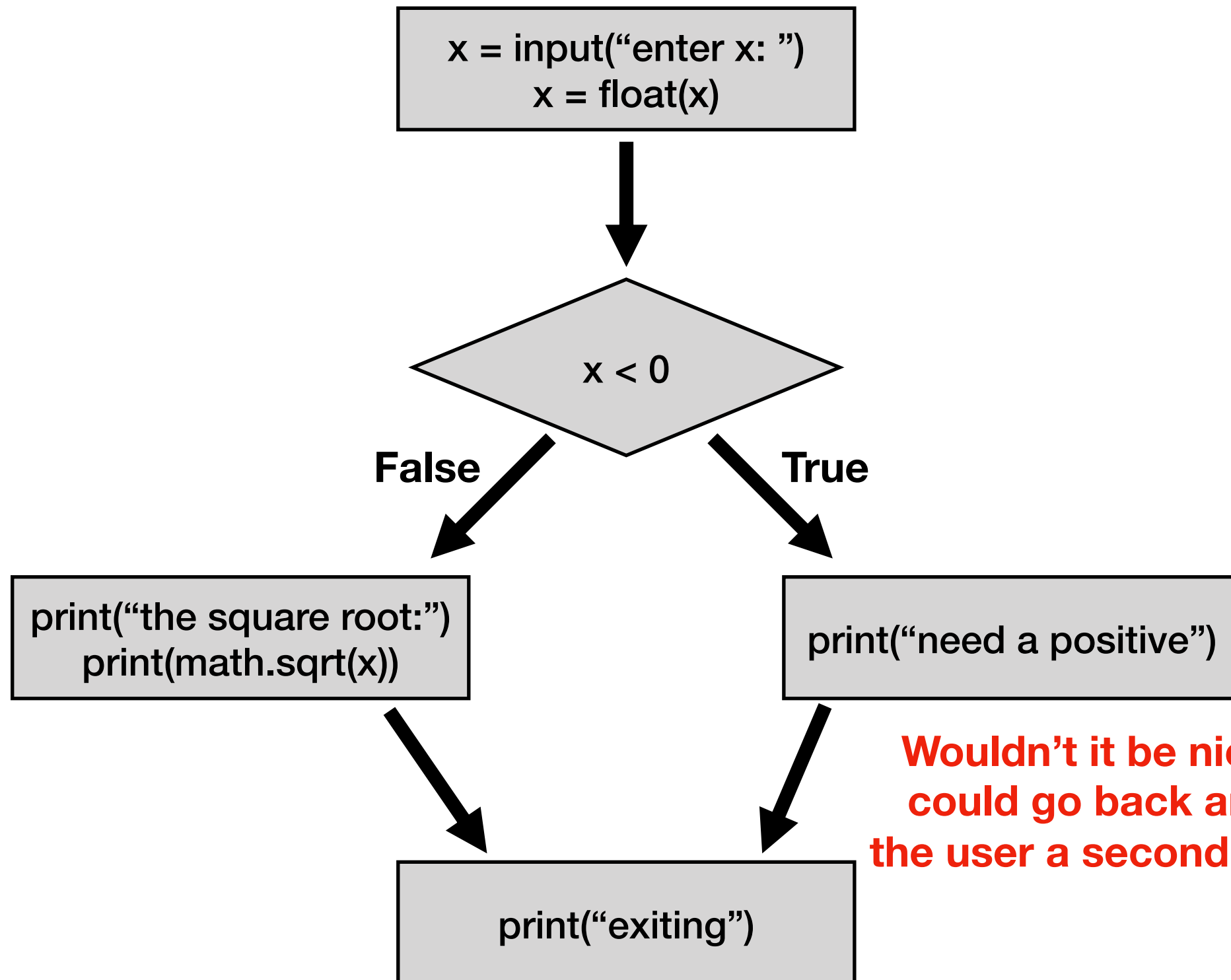
Control Flow Diagrams



Basic syntax for “while”

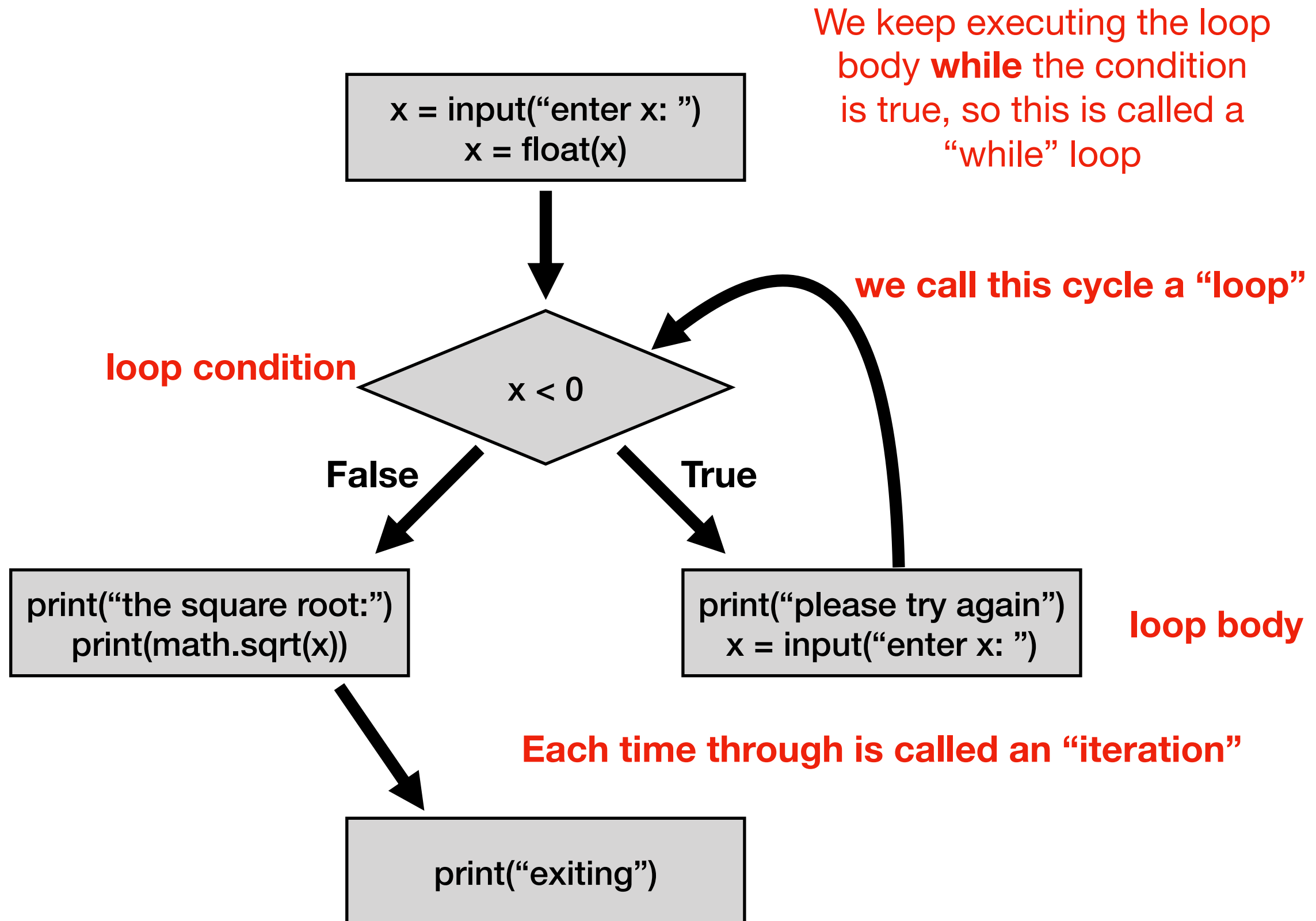
*Demos*

# Control Flow Diagrams: “if”

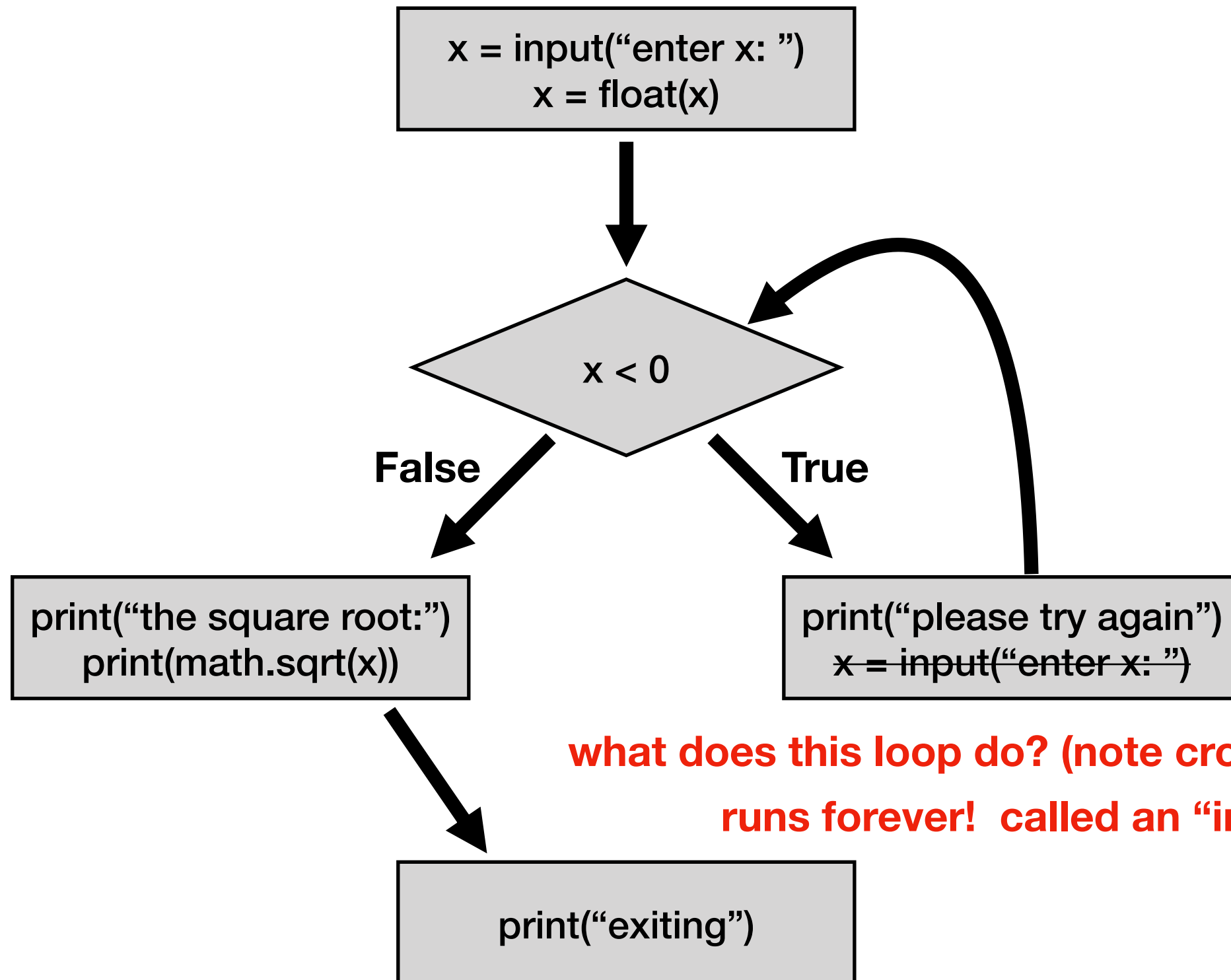


Wouldn't it be nice if we could go back and give the user a second chance?

# Control Flow Diagrams: “while”



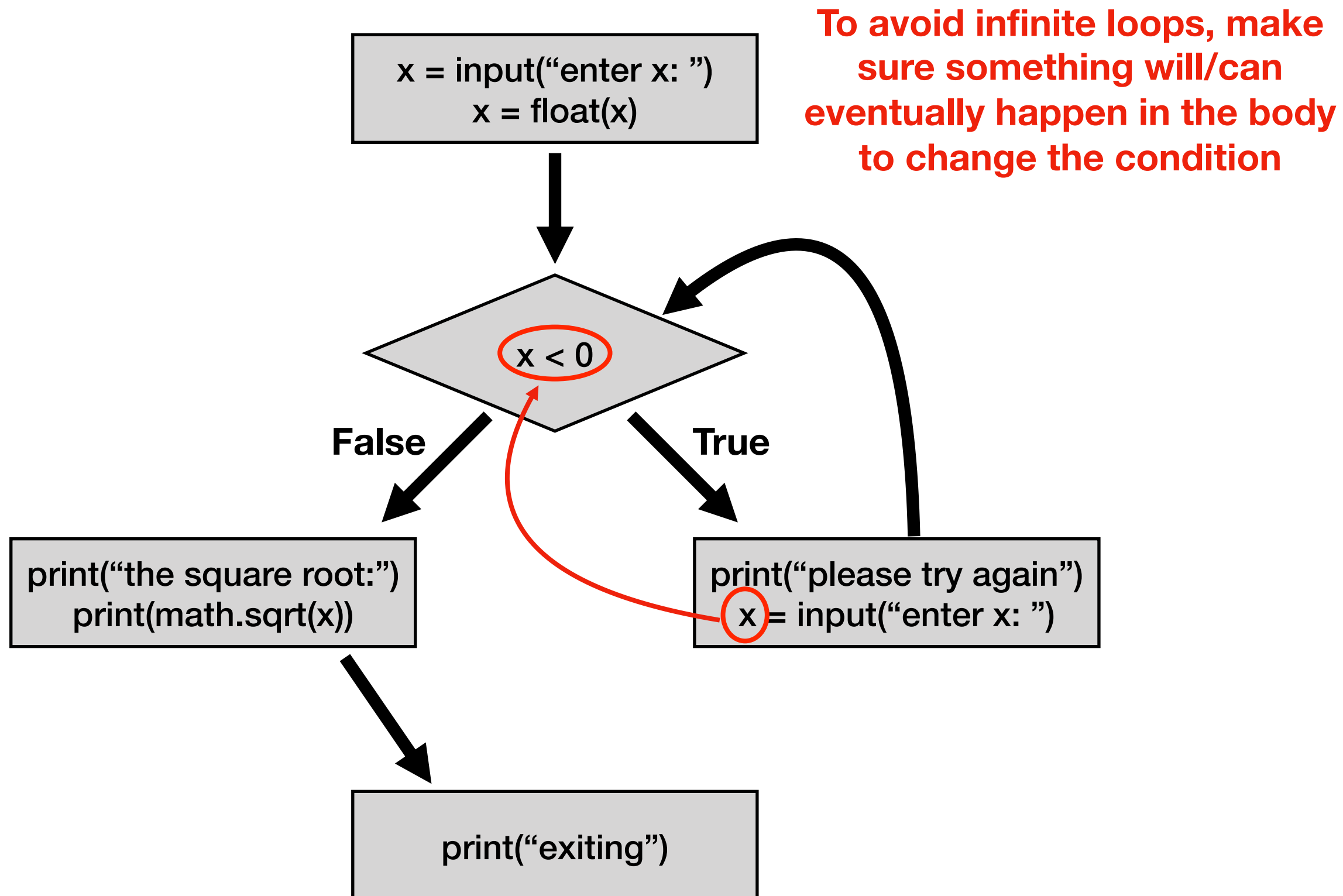
# Control Flow Diagrams: “while”



**what does this loop do? (note crossed out line)  
runs forever! called an “infinite loop”**



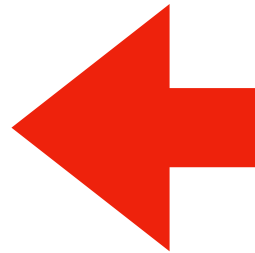
# Control Flow Diagrams: “while”



# Today's Outline

Control Flow Diagrams

Basic syntax for “while”



*Demos*

# Syntax

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

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

**Syntax for “if”**

# Syntax

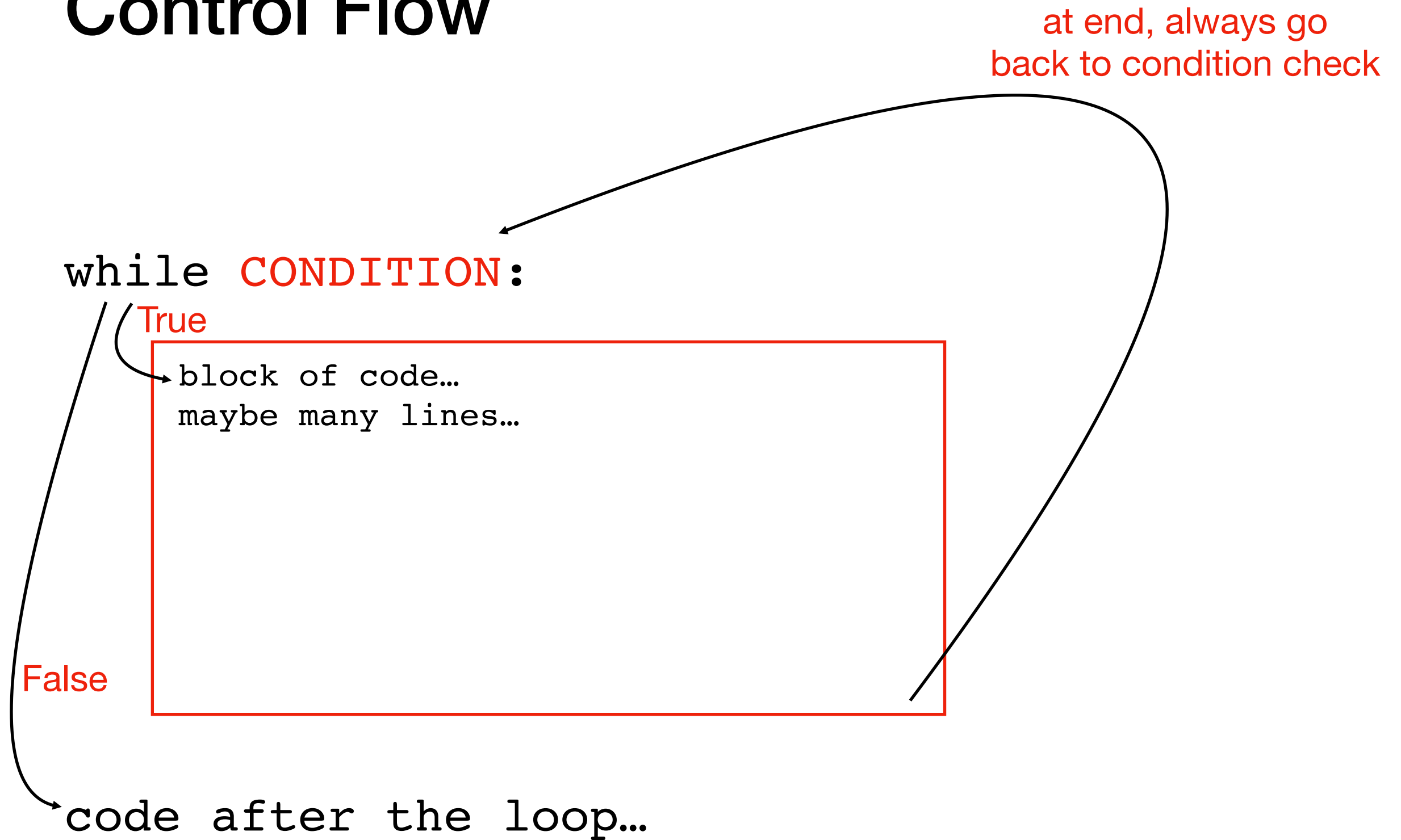
```
x = int(input("enter x: "))
```

```
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**

# 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

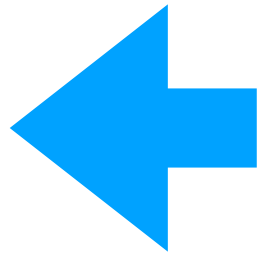
three primary exceptions to the general case (1)

# Today's Outline

Control Flow Diagrams

Basic syntax for “while”

*Demos*





# Demo: 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

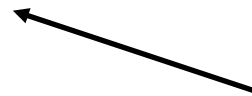
1

0

DING DING DING DING DING!

how many seconds? q

good bye!



exit program

this program will involve a nested loop!!!

# Demo: Maximum (Finding the Peak)

$y = 5 - (x - 2)^{**} 2$   

All

Shopping

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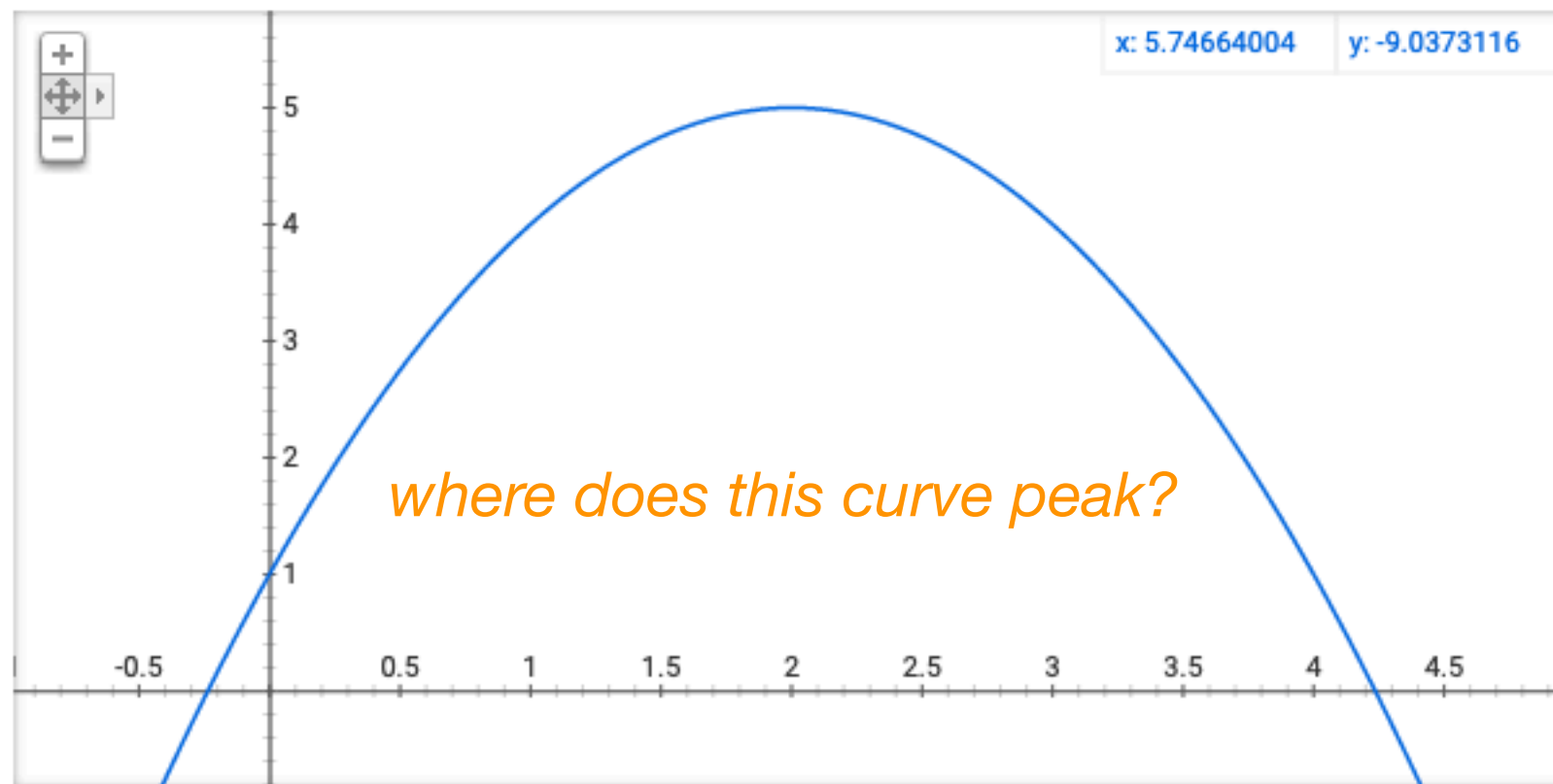
More

Settings

Tools

About 16,290,000,000 results (0.65 seconds)

Graph for  $5-(x-2)^2$

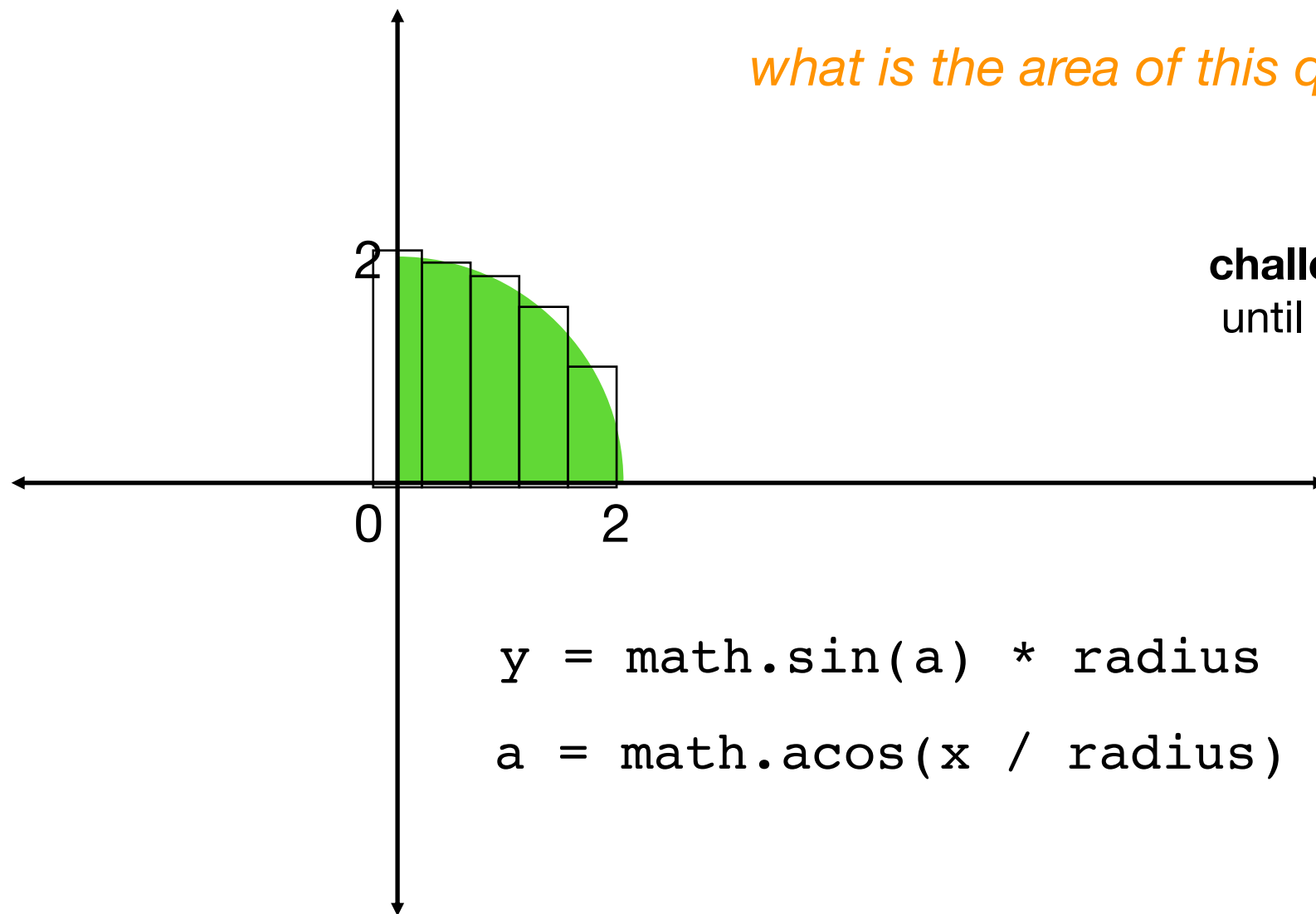


[More info](#)

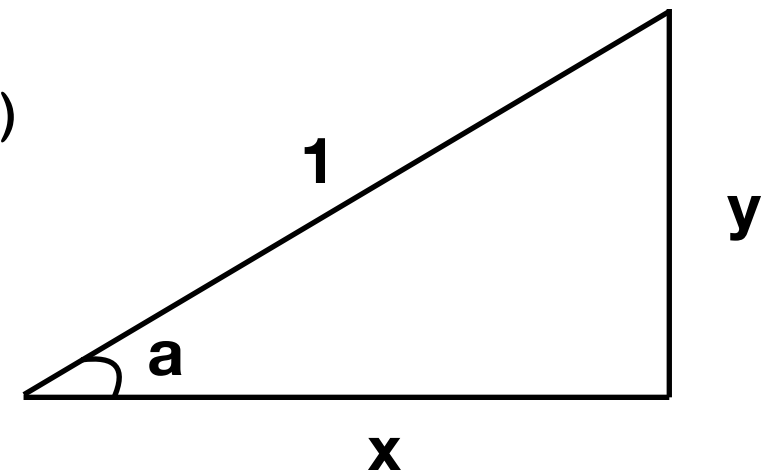
# Demo: Integration (Finding the area)

*what is the area of this quarter circle?*

**challenge:** keep using narrower slices until it doesn't make much difference



```
y = math.sin(a) * radius  
a = math.acos(x / radius)
```



# Demo: Prime Finder

Here are a "few" primes:

2

3

5

7

11

13

... runs forever ...

# Demo: Battleship

columns

rows

•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	*	+	*	*	*	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	*	•
•	•	•	•	•	•	•	•	*	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	*	•	•	•	•	•
•	•	•	•	*	•	•	•	•	•
•	•	•	•	*	•	•	•	•	•

show where ship(s) are after guess

guess and ship: +  
just ship: \*  
guess and miss: -  
blank spot: •