

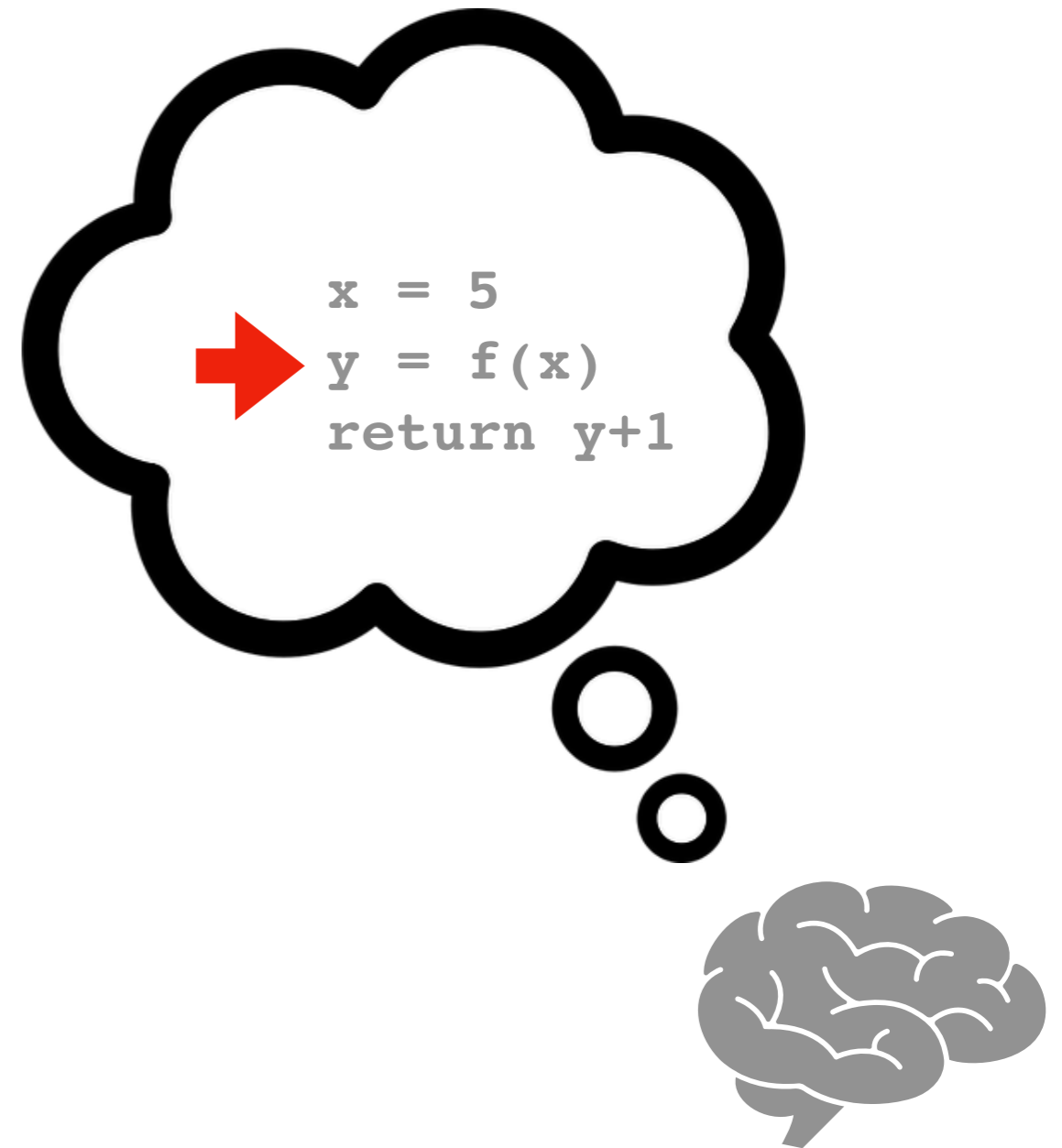
[301] Conditionals

Tyler Caraza-Harter

Mental Model of Control Flow

Code:

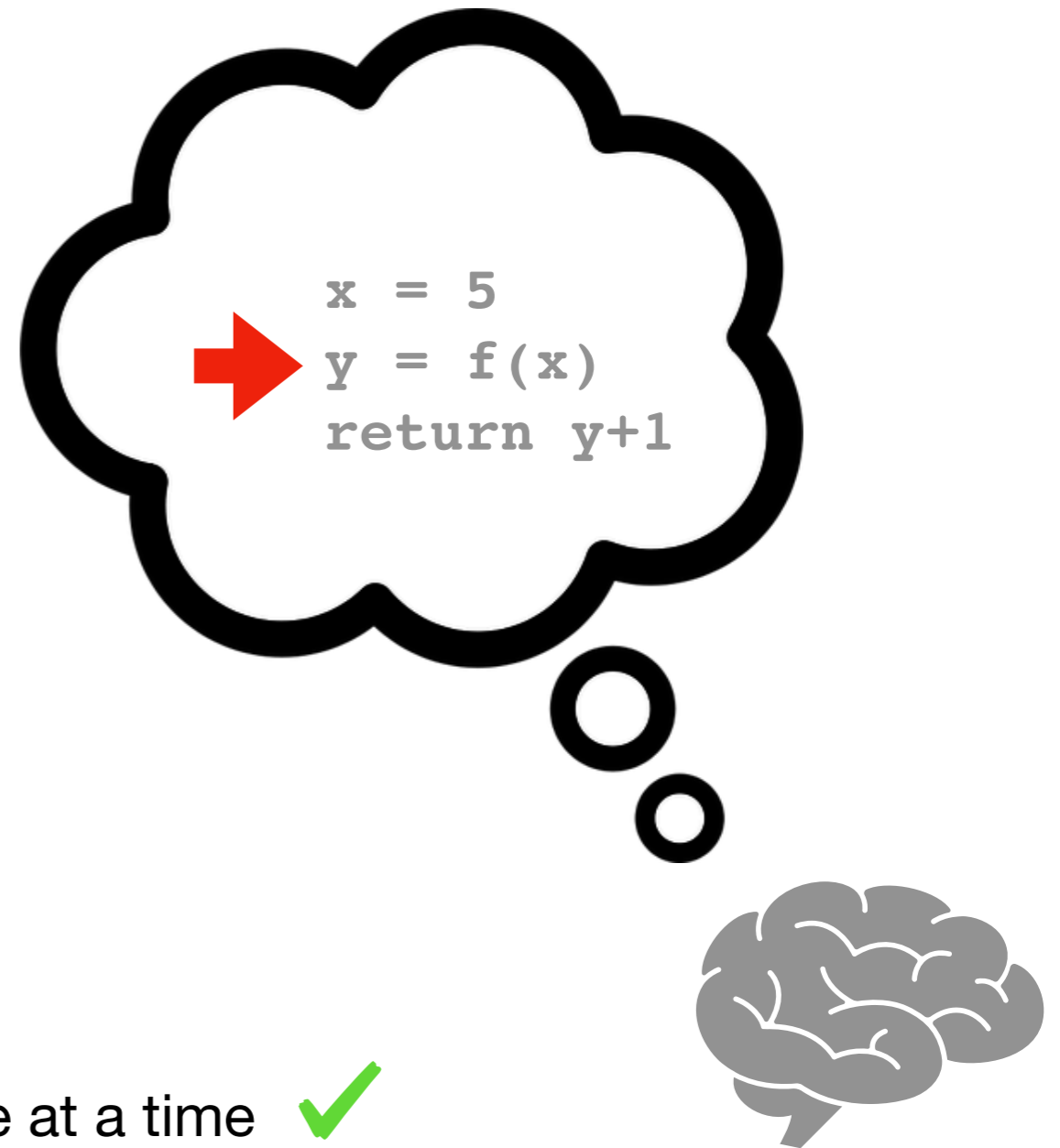
```
...  
x = 5  
y = f(x)  
return y+1  
...
```



Mental Model of Control Flow

Code:

```
...  
x = 5  
y = f(x)  
return y+1  
...
```



three exceptions

1. do statements in order, one at a time ✓
2. **functions**: jump in and out of these ✓
3. **conditionals**: sometimes skip statements ← **TODAY**
4. **loops**: sometimes go back to previous

Learning Objectives Today

Reason about conditionals

- Conditional execution
- Alternate execution
- Chained conditionals
- Nested conditionals

Chapter 5 of Think Python
(skip "Recursion" sections)

Do Python Tutor Practice!
(posted on schedule)

Understand code blocks

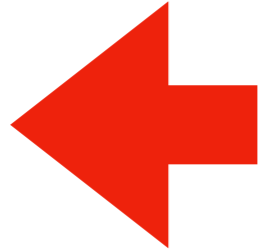
- Be able to identify the lines of code in the same block

Sanity checking

- Recognize errors
- Sanitize bad data automatically

Today's Outline

Review



Control Flow Diagrams

Basic syntax for “if”

Identifying code blocks

Demos

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

```
def print_letters():  
    print("C")  
    print("D")
```

```
print("E")  
print("F")
```

```
print_letters()
```

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

```
def print_letters():  
    print("C")  
    print("D")
```

```
print("E")  
print("F")
```

```
print_letters()
```

A
B
E
F
C
D

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

```
def print_letters():
```

```
    print("C")  
    print("D")
```

*indented, so "inside"
print_letters function*

```
print("E")  
print("F")
```

```
print_letters()
```

A
B
E
F
C
D

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

```
def print_letters():
```

```
    print("C")  
    print("D")
```

indented, so "inside"
print_letters function

```
print("E")  
print("F")
```

printed last because
print_letters is called last

```
print_letters()
```

A
B
E
F
C
D

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

```
def print_letters():
```

```
    print("C")  
    print("D")
```

*indented, so "inside"
print_letters function*

```
print("E")  
print("F")
```

```
print_letters()
```

A
B
E
F
C
D

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

not indented, so
"outside" any function

```
def print_letters():
```

```
    print("C")  
    print("D")
```

indented, so "inside"
print_letters function

```
print("E")  
print("F")
```

```
print_letters()
```

A
B
E
F
C
D

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

not indented, so
"outside" any function

```
def print_letters():
```

```
    print("C")  
    print("D")
```

indented, so "inside"
print_letters function

```
print("E")  
print("F")
```

also not indented, so
"outside" any function.
Runs BEFORE
print_letters is called

```
print_letters()
```

A

B

E

F

C

D

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

not indented, so
"outside" any function

```
def print_letters():
```

```
    print("C")  
    print("D")
```

indented, so **"inside"**
print_letters function

```
print("E")  
print("F")
```

also not indented, so
"outside" any function.
Runs **BEFORE**
print_letters is called

```
print_letters()
```

A
B
E
F
C
D

We use **indenting** to tell Python which code is **inside** or **outside** of a function (or other things we'll learn about soon).

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

not indented, so
"outside" any function

```
def print_letters():
```

```
    print("C")  
    print("D")
```

indented, so **"inside"**
print_letters function

blank lines are **irrelevant**

```
print("E")  
print("F")
```

also not indented, so
"outside" any function.
Runs **BEFORE**
print_letters is called

```
print_letters()
```

A
B
E
F
C
D

We use **indenting** to tell Python which code is **inside** or **outside** of a function (or other things we'll learn about soon).

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

```
def print_letters():
```

```
    print("C")  
    print("D")
```

we'll often call the lines
of code **inside** something
a "**block**" of code

```
print("E")  
print("F")
```

```
print_letters()
```

A
B
E
F
C
D

Review 1: Indentation Example

what does it print?

```
print("A")  
print("B")
```

```
def print_letters():
```

```
    print("C")
```

```
    print("D")
```

```
print("E")  
print("F")
```

```
print_letters()
```

horizontal spaces
identify blocks
(not vertical space)

A
B
E
F
C
D

Review 2: Argument Passing

```
def h(x=1, y=2):  
    print(x, y) # what is printed?
```

```
def g(x, y):  
    print(x, y) # what is printed?  
    h(y)
```

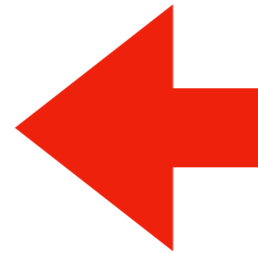
```
def f(x, y):  
    print(x, y) # what is printed?  
    g(x=x, y=y+1)
```

```
x = 10  
y = 20  
f(y, x)
```

Today's Outline

Review

Control Flow Diagrams

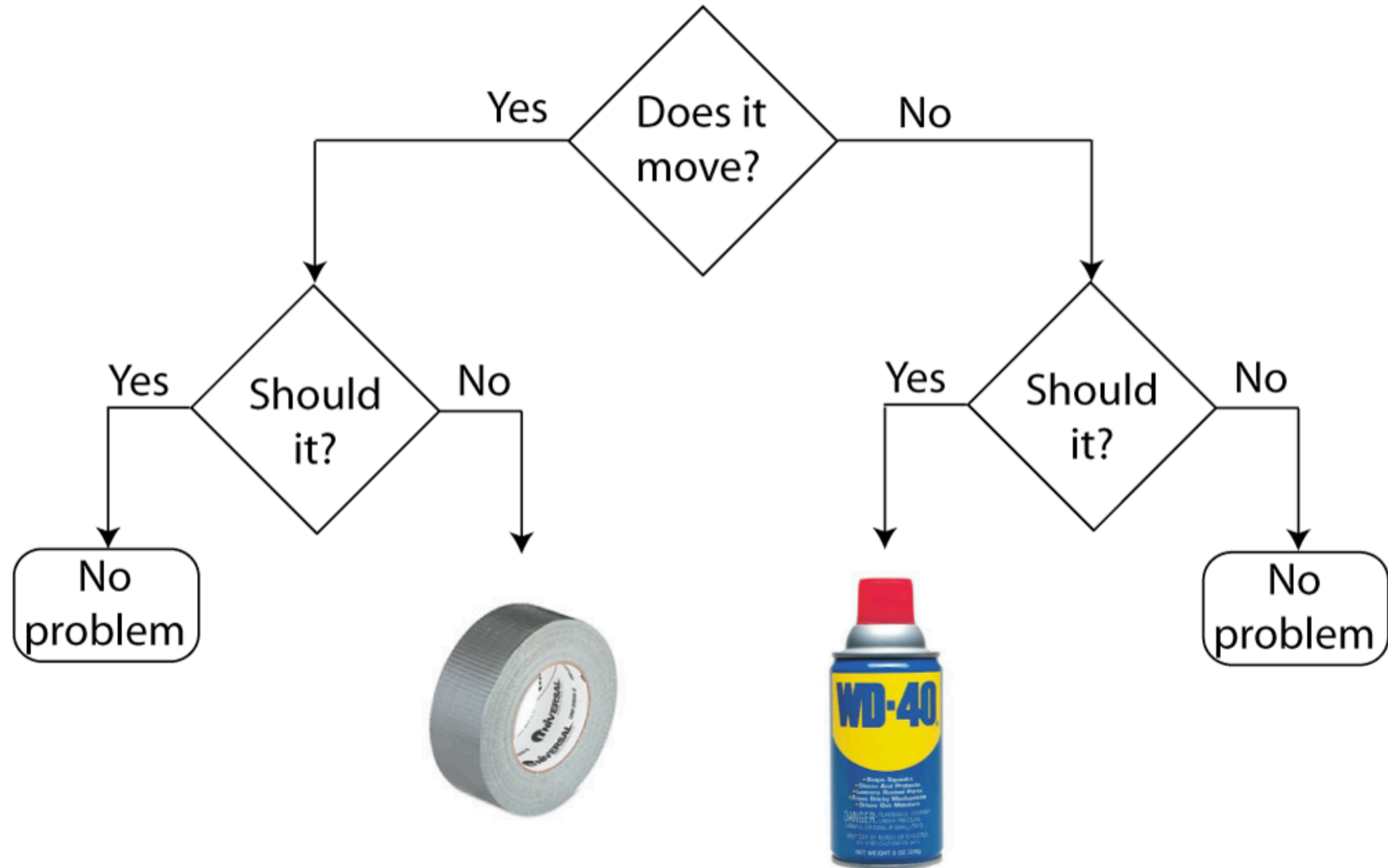


Basic syntax for “if”

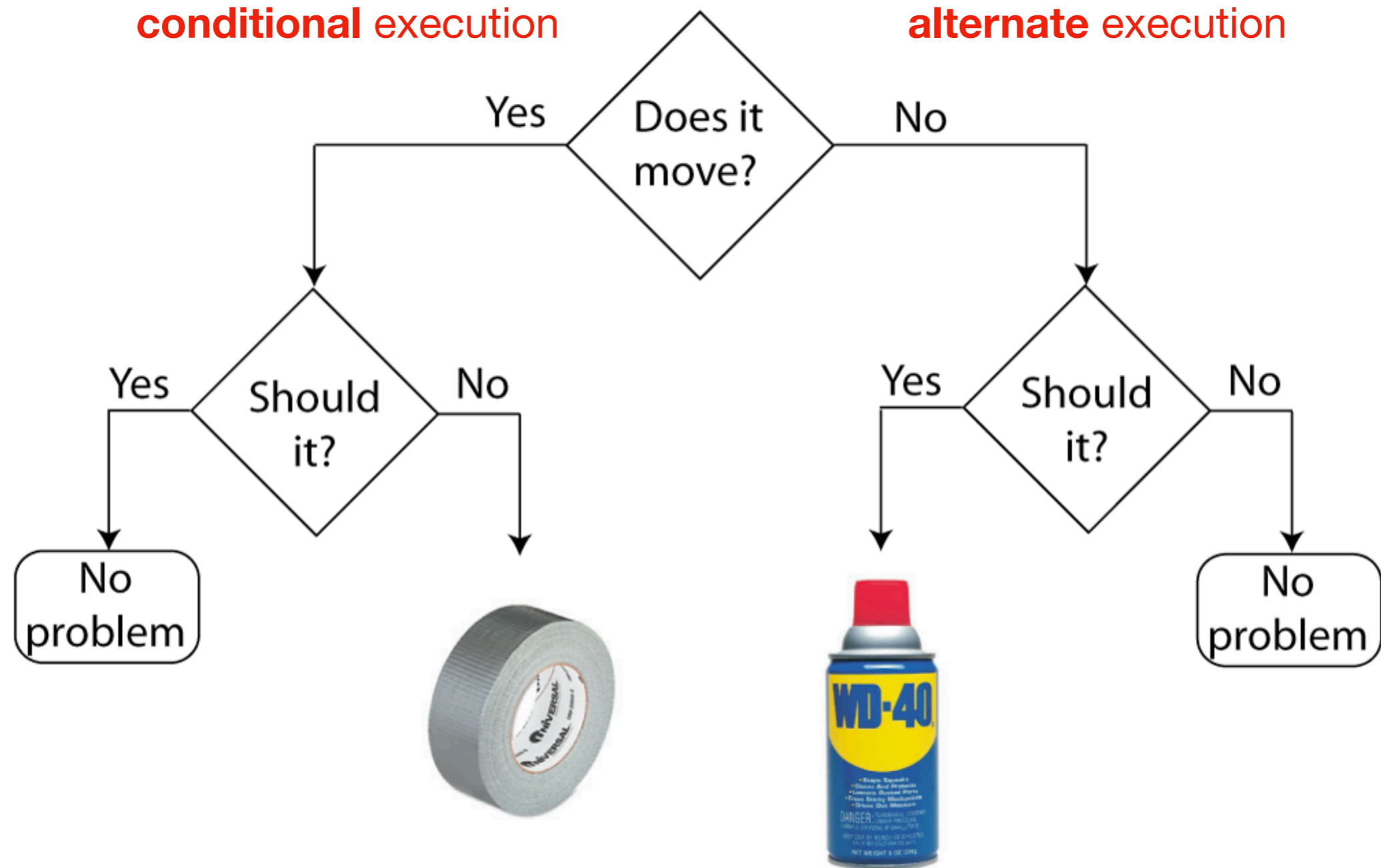
Identifying code blocks

Demos

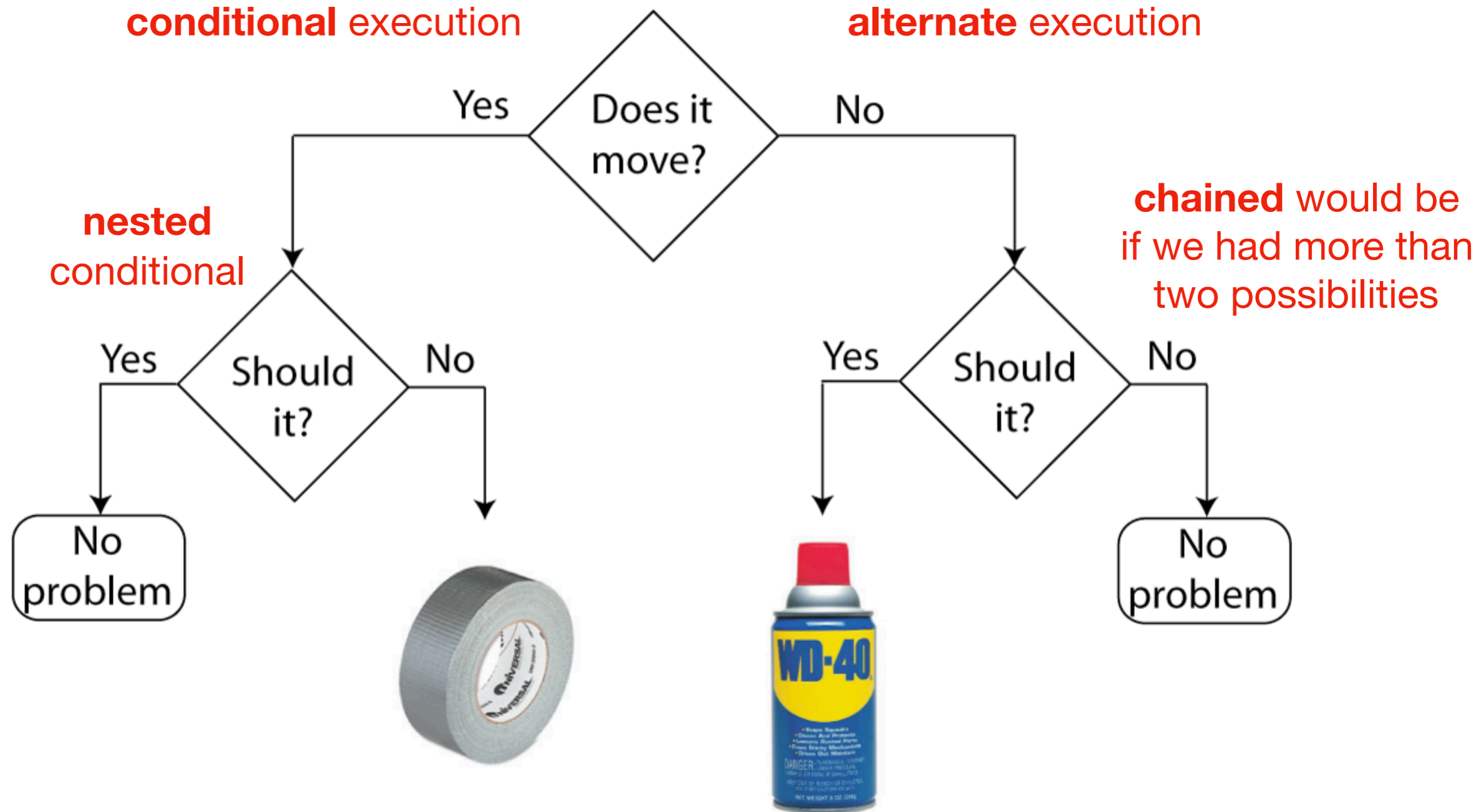
Laboratory Troubleshooting Flowchart



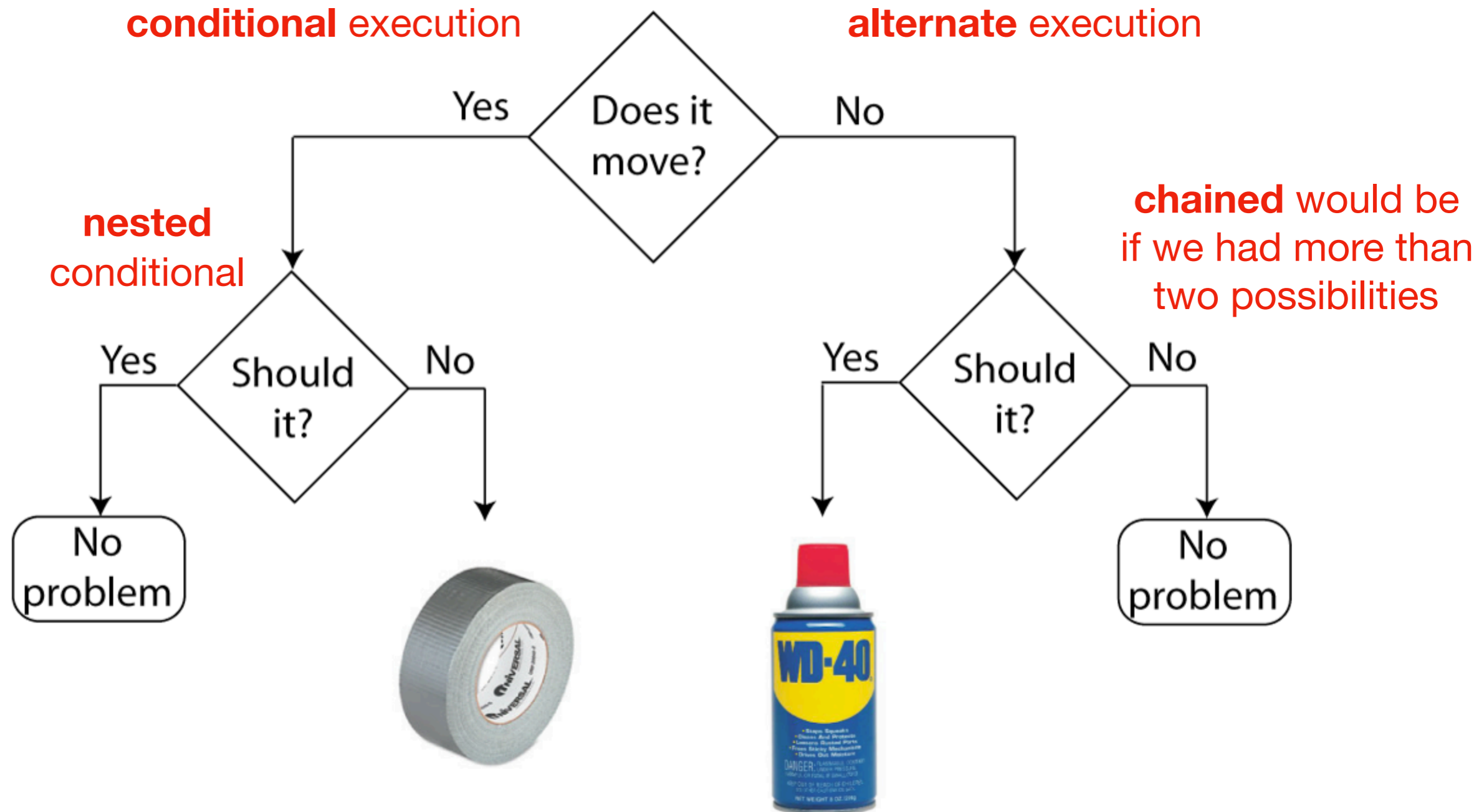
Laboratory Troubleshooting Flowchart



Laboratory Troubleshooting Flowchart



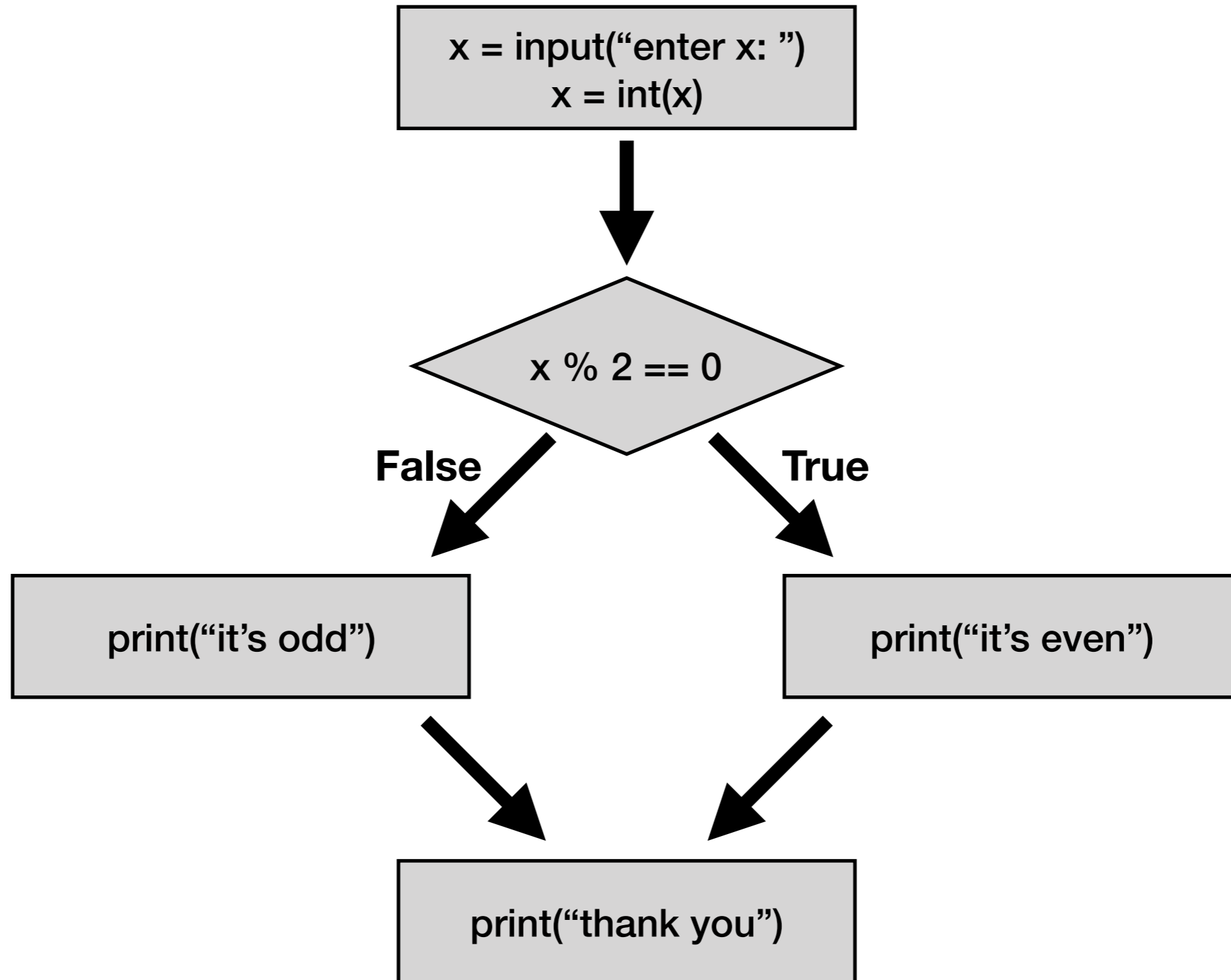
Laboratory Troubleshooting Flowchart



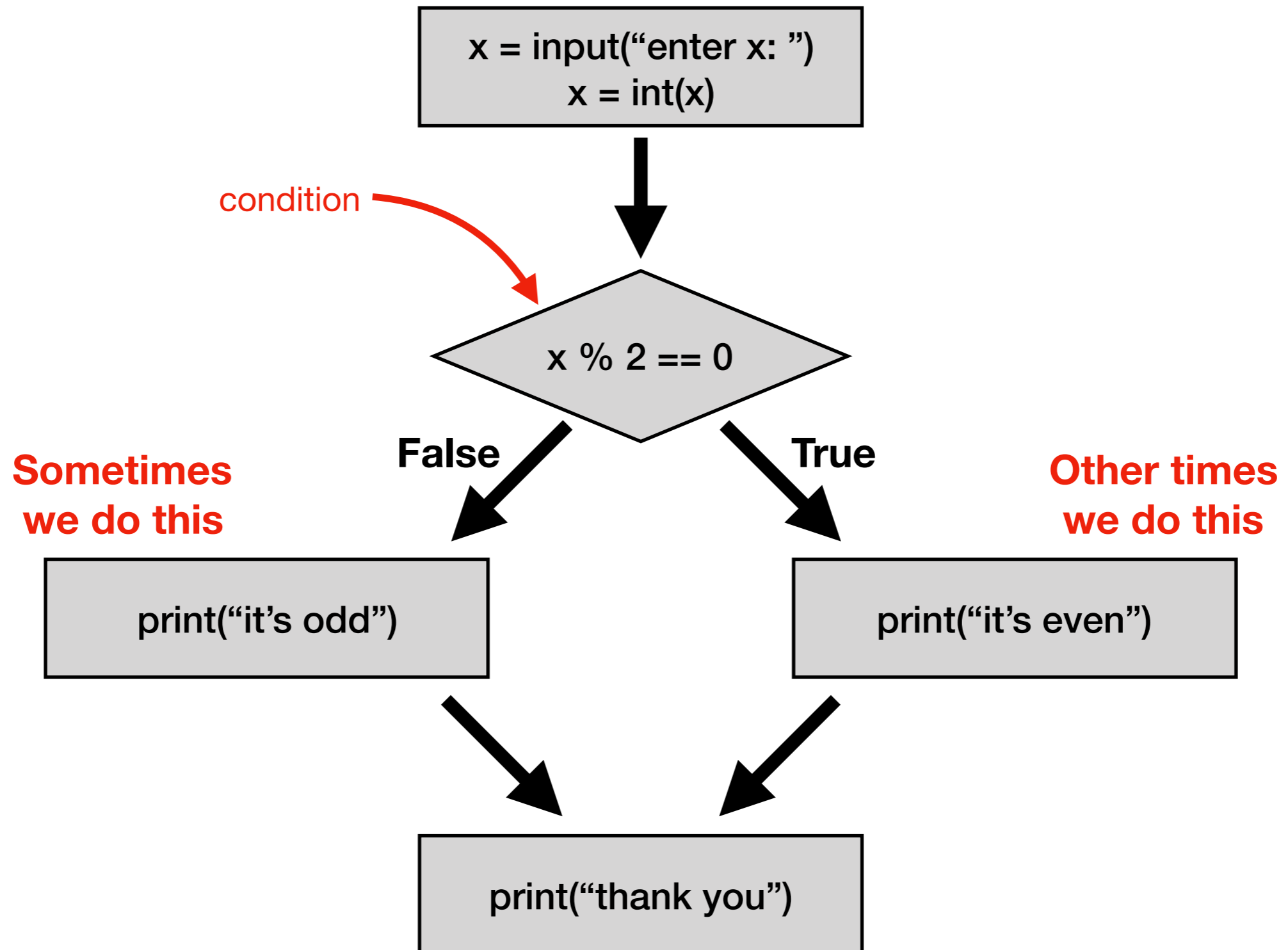
in programming:

- **questions** are phrased as *boolean expressions*
- **actions** are *code/statements*

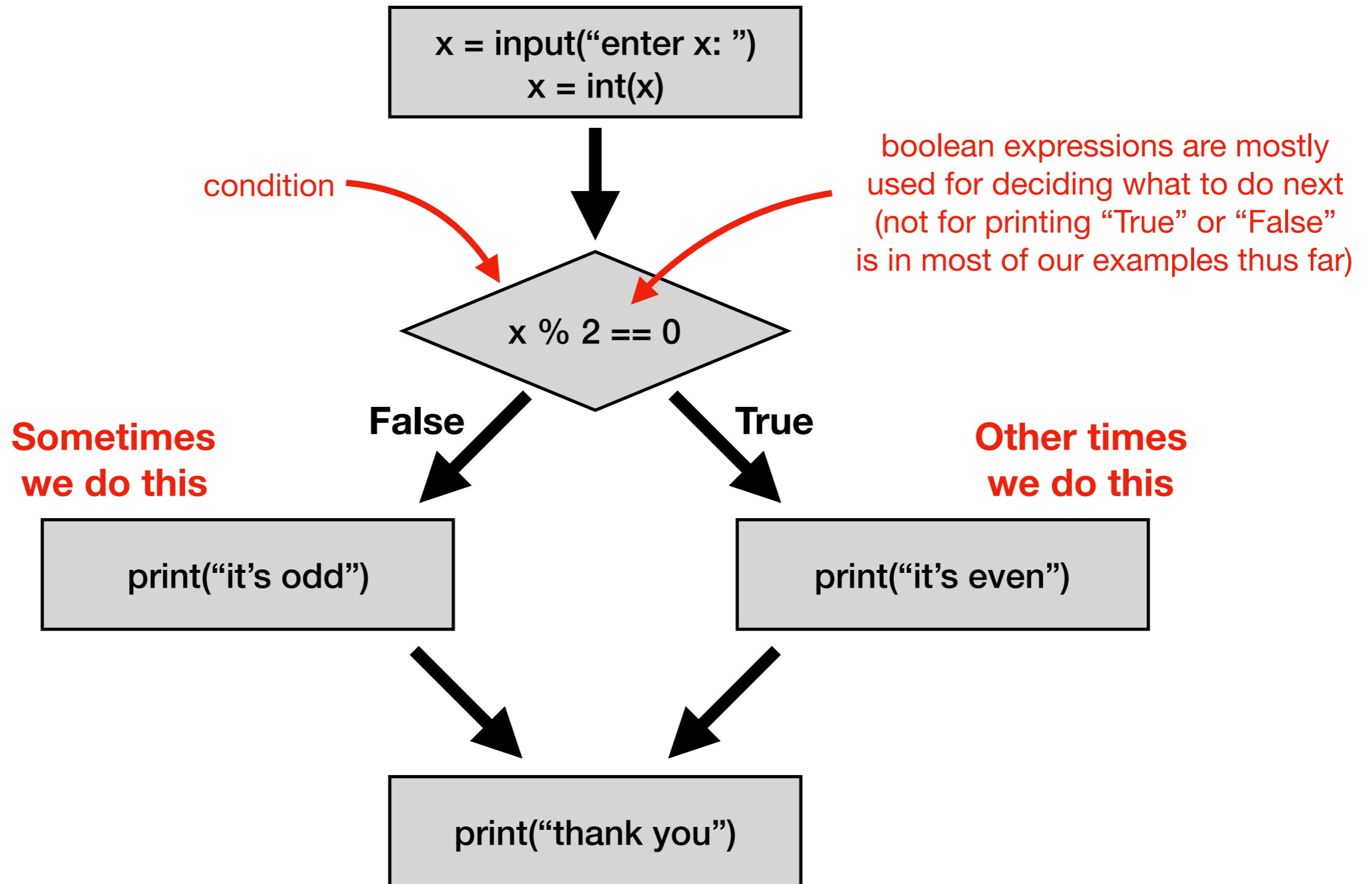
Control Flow Diagrams (Flowcharts for Code)



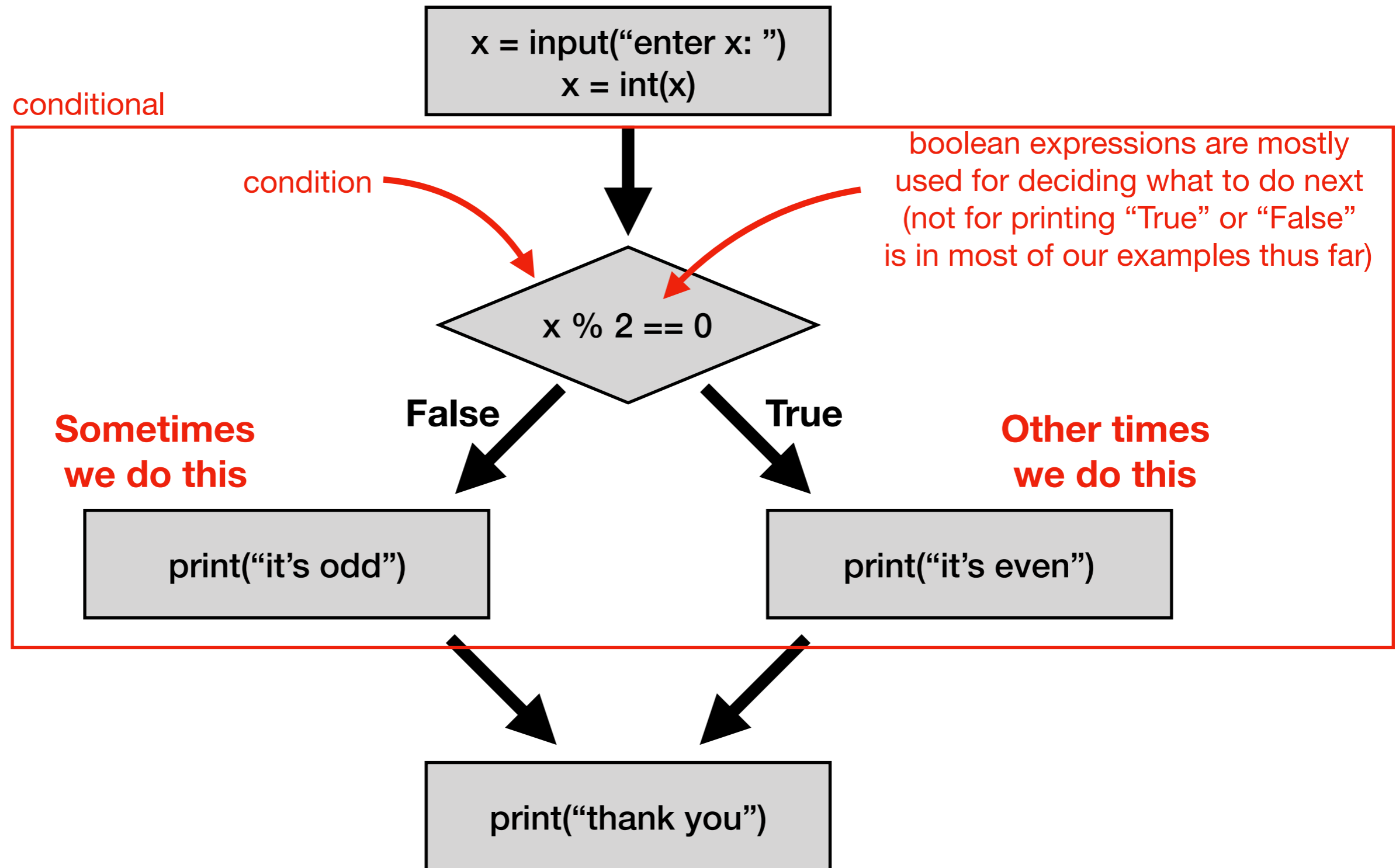
Control Flow Diagrams (Flowcharts for Code)



Control Flow Diagrams (Flowcharts for Code)



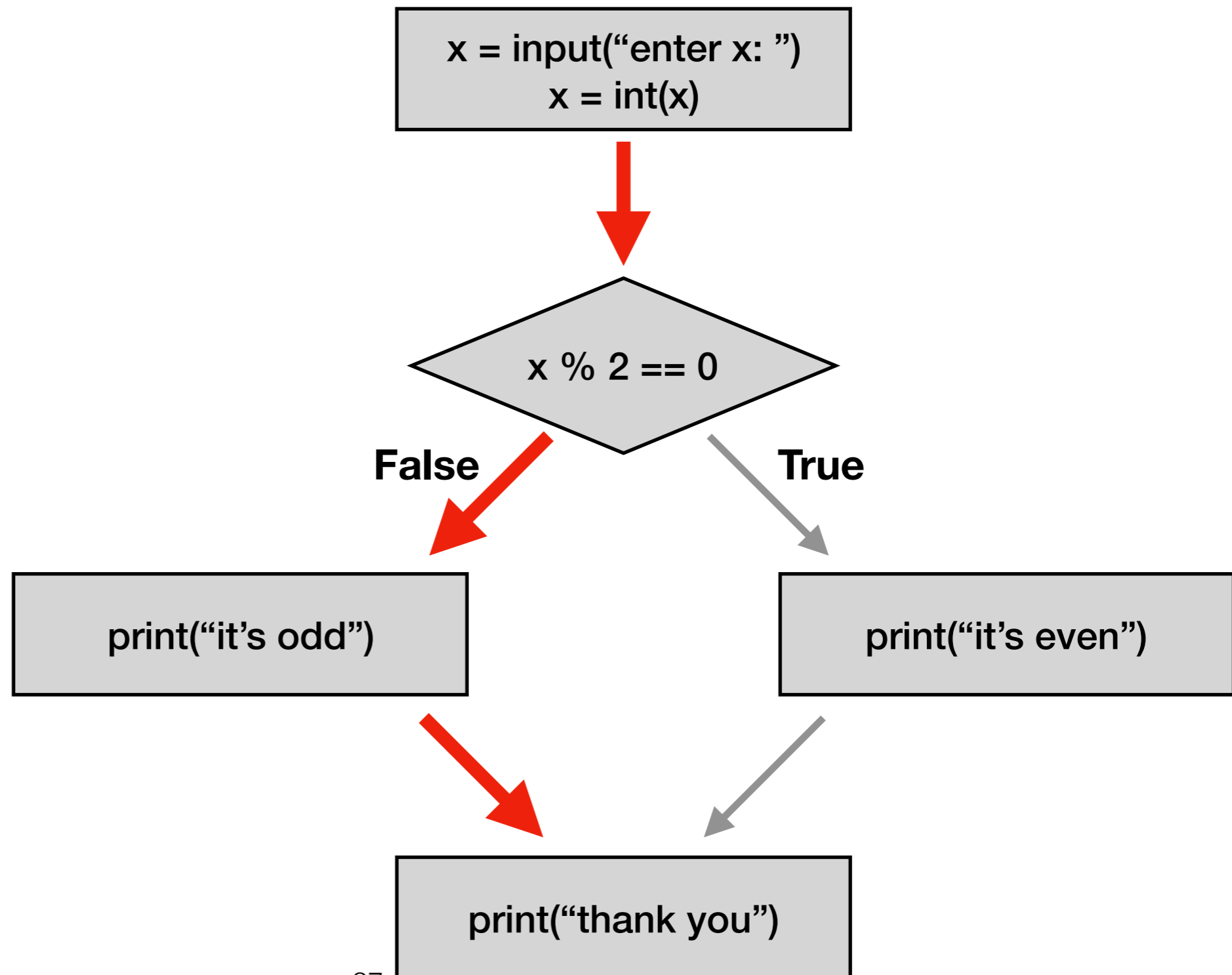
Control Flow Diagrams (Flowcharts for Code)



Branches (aka "Paths of Execution")

Input/Output:

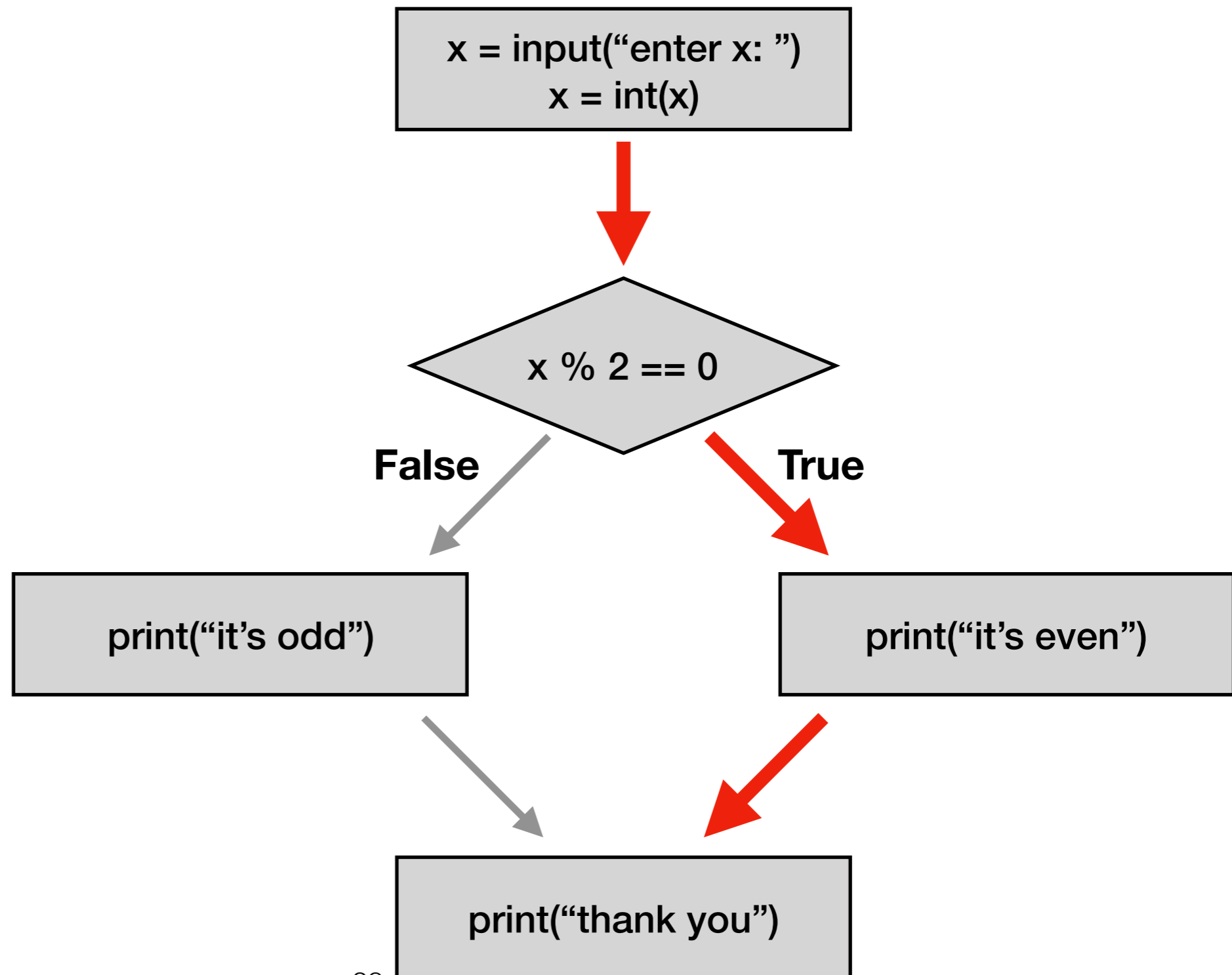
```
enter x: 7  
it's odd  
thank you
```



Branches (aka "Paths of Execution")

Input/Output:

```
enter x: 8  
it's even  
thank you
```

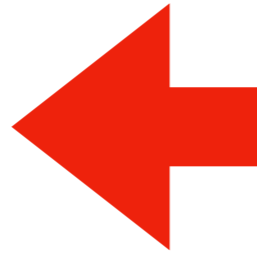


Today's Outline

Review

Control Flow Diagrams

Basic syntax for “if”

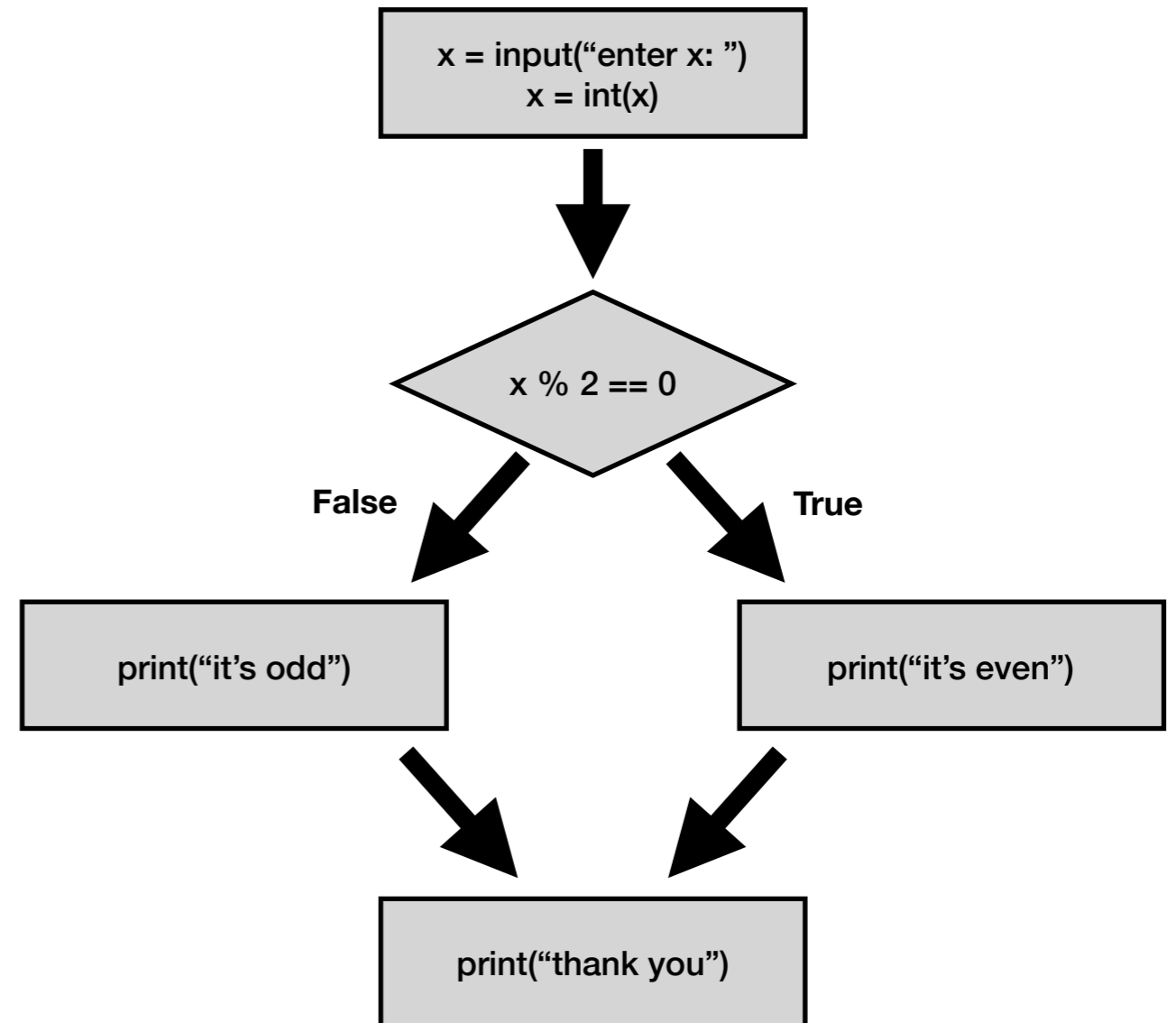


Identifying code blocks

Demos

Writing conditions in Python

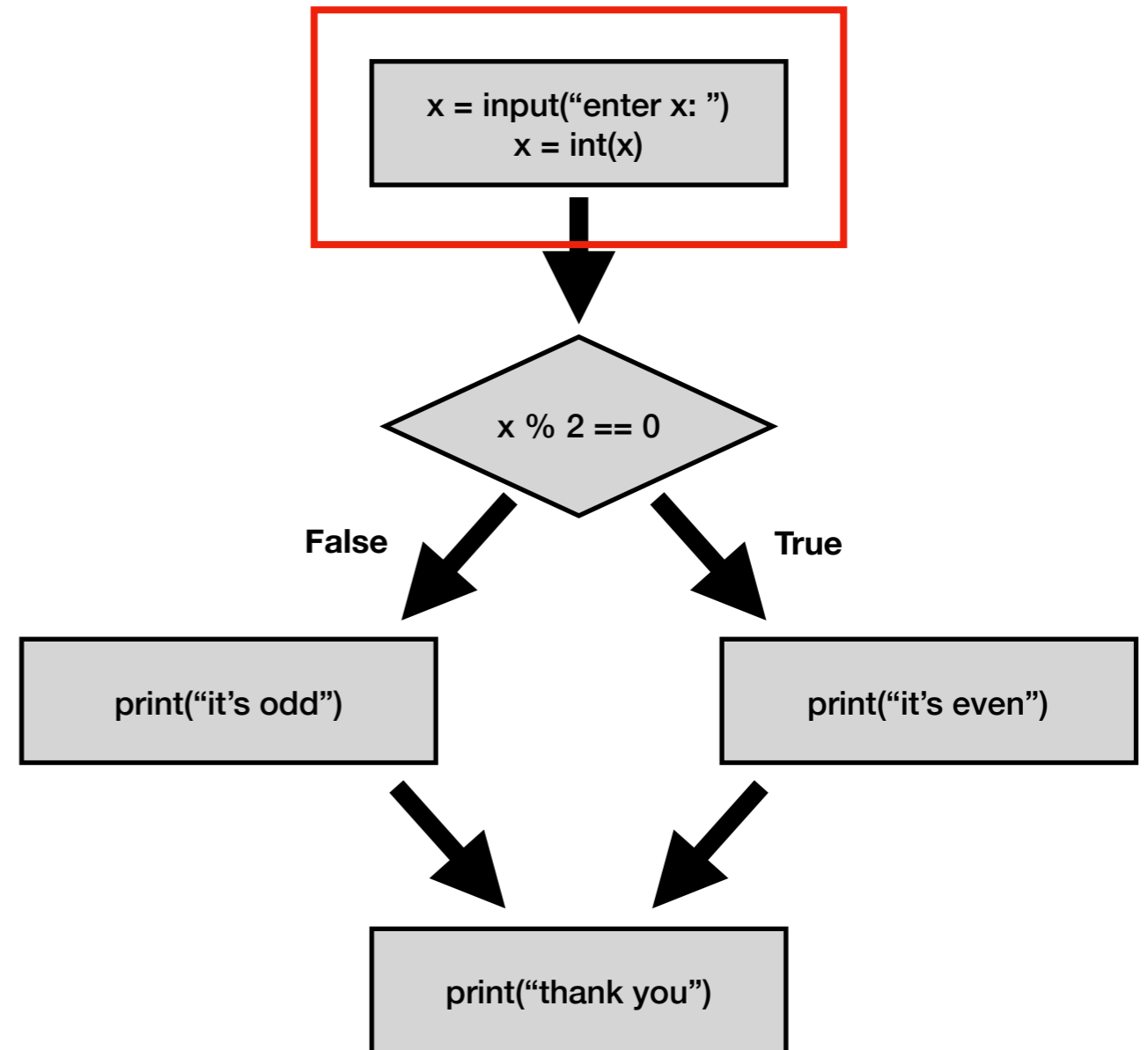
Code:



Writing conditions in Python

Code:

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

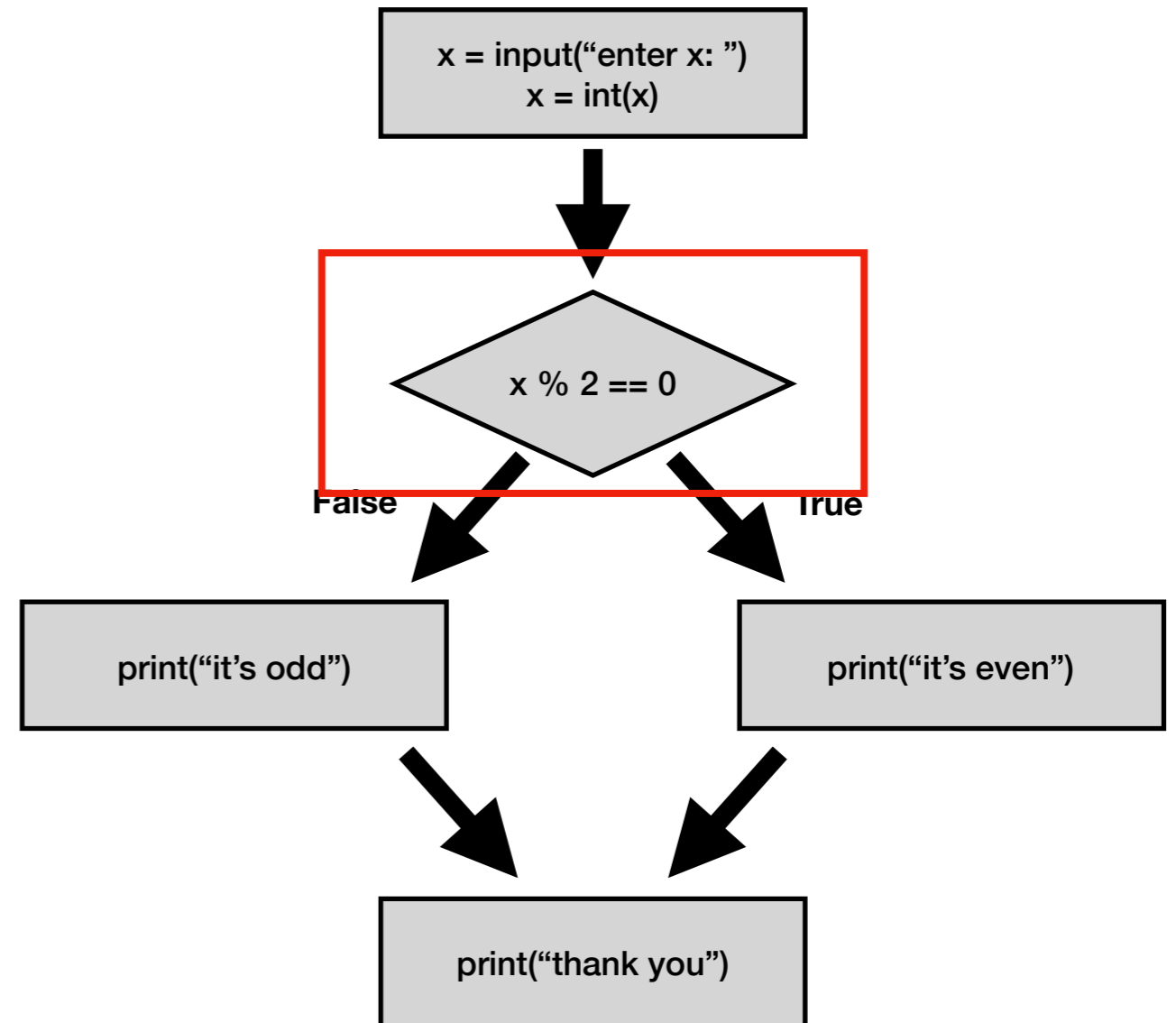


Writing conditions in Python

Code:

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

```
if x % 2 == 0:
```



Writing conditions in Python

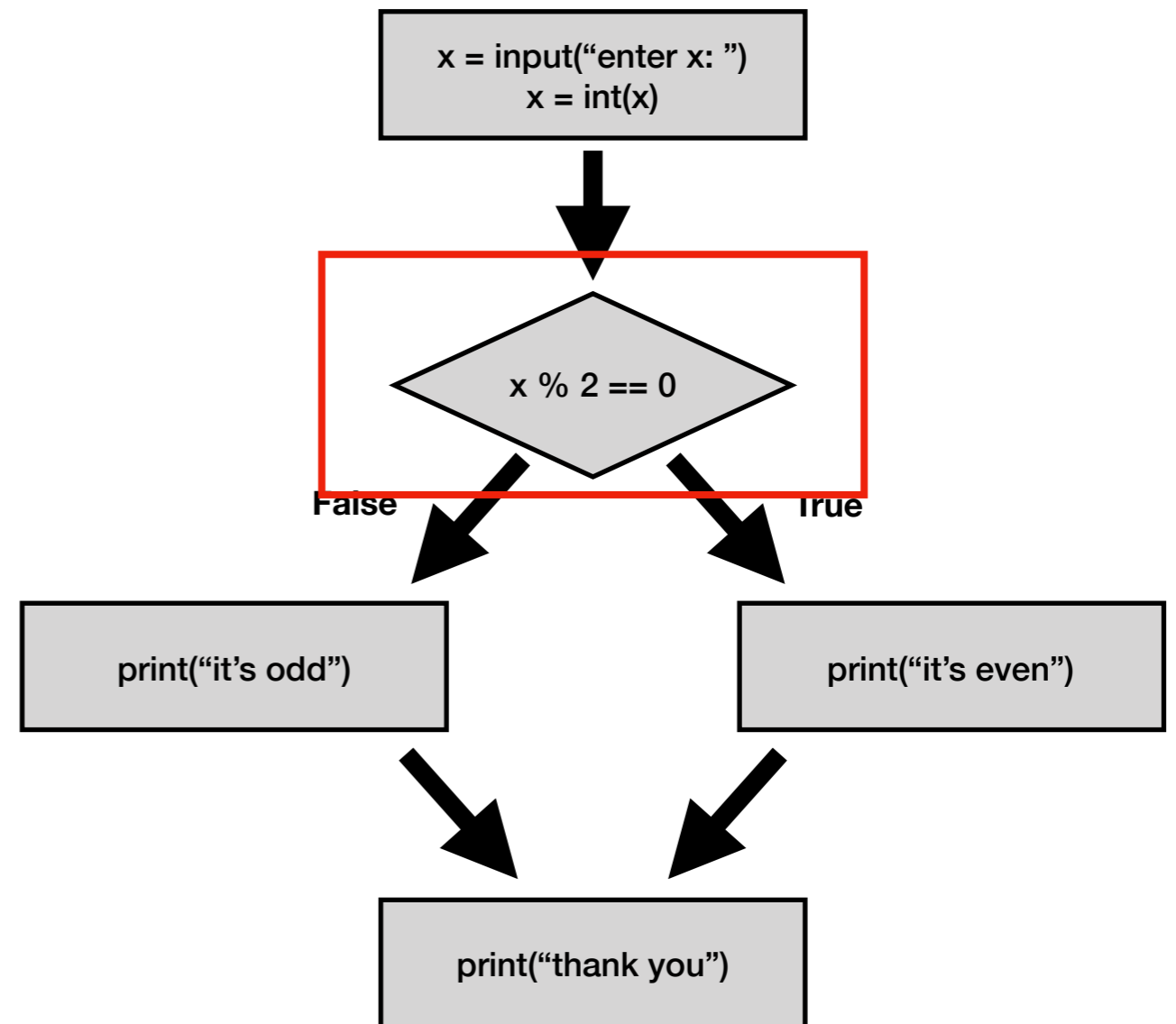
Code:

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

```
if x % 2 == 0:
```



boolean expression

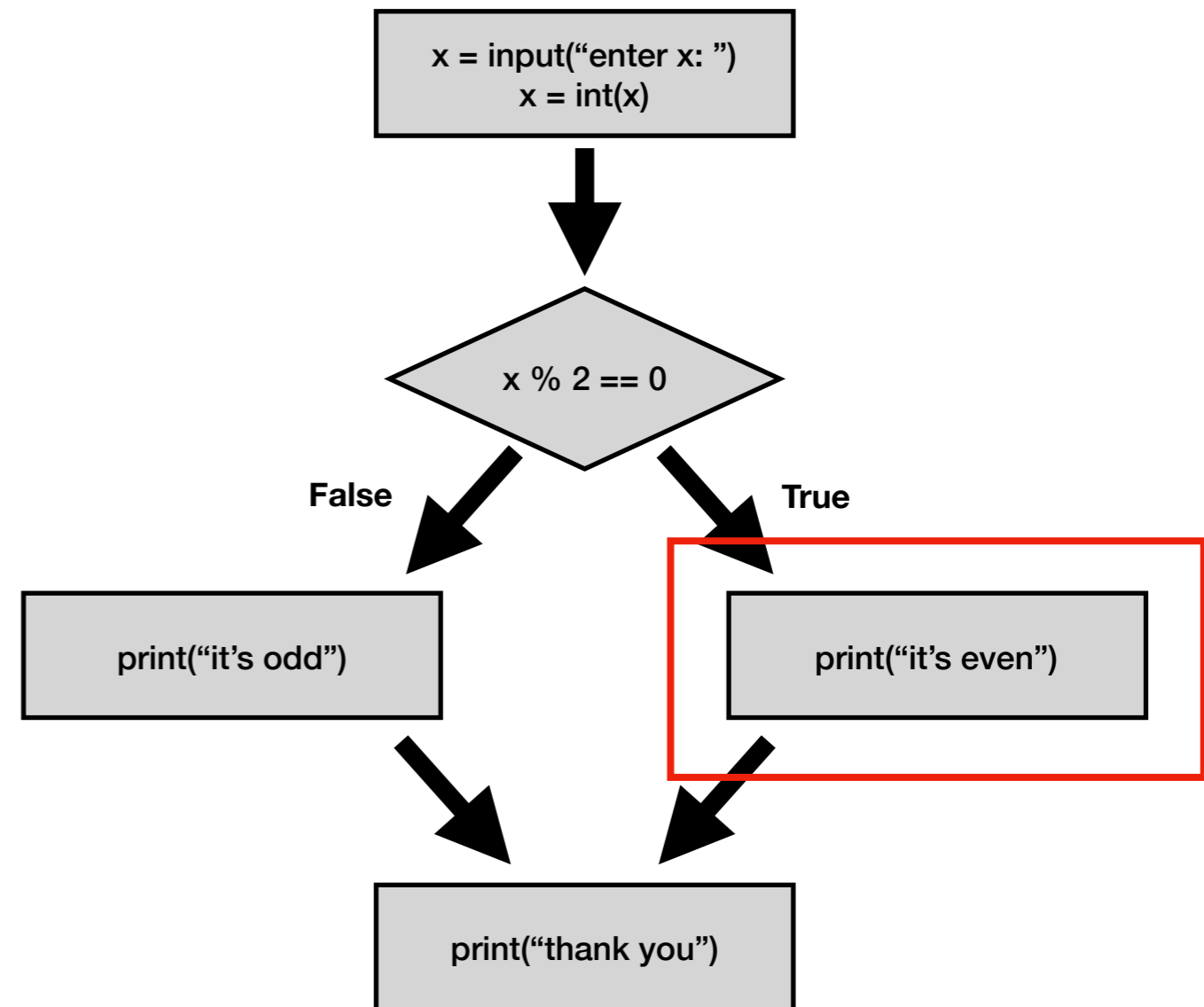


Writing conditions in Python

Code:

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x = input("enter x: ")  
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if x % 2 == 0:  
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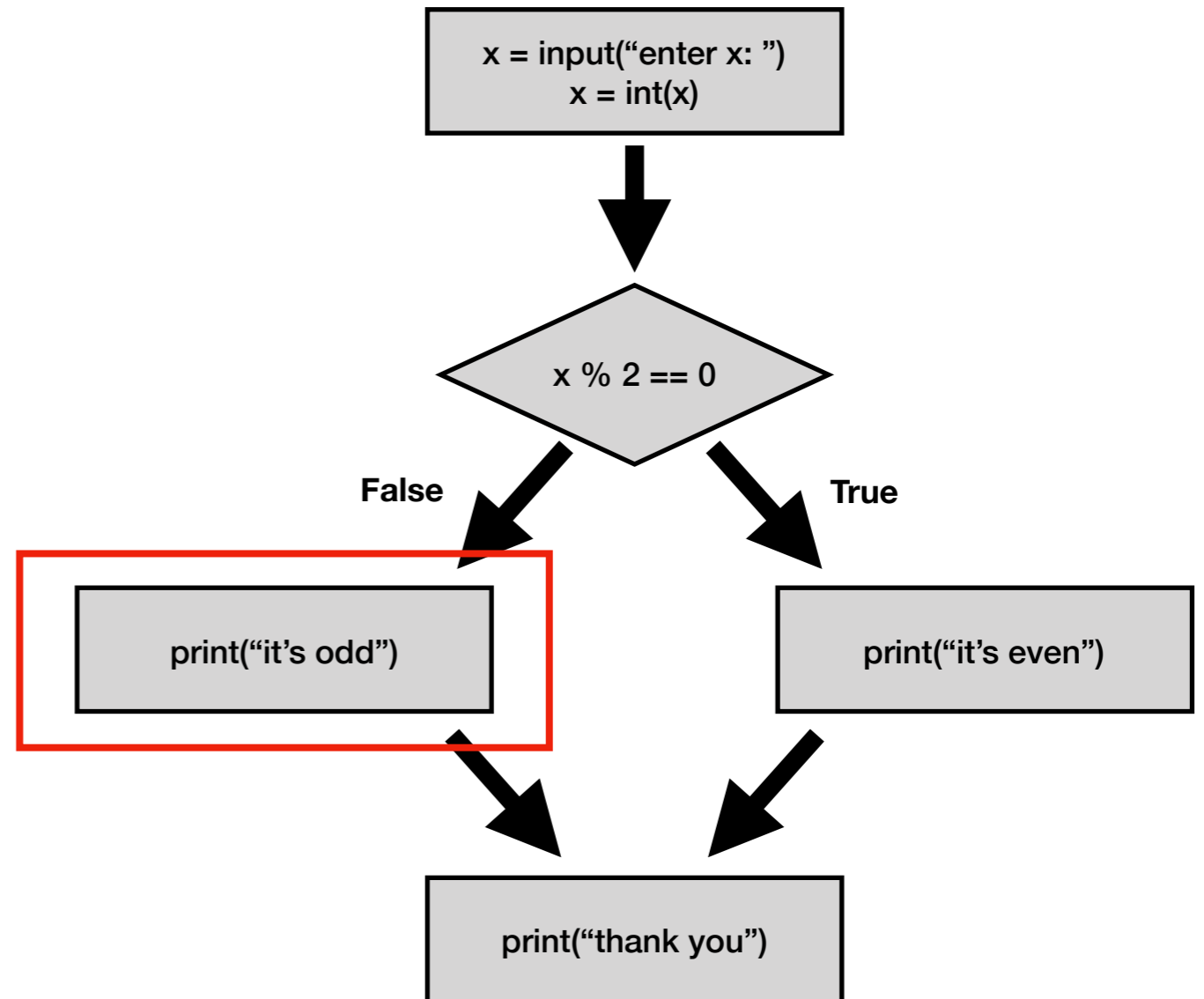


Writing conditions in Python

Code:

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

```
if x % 2 == 0:  
    print("it's even")  
else:  
    print("it's odd")
```



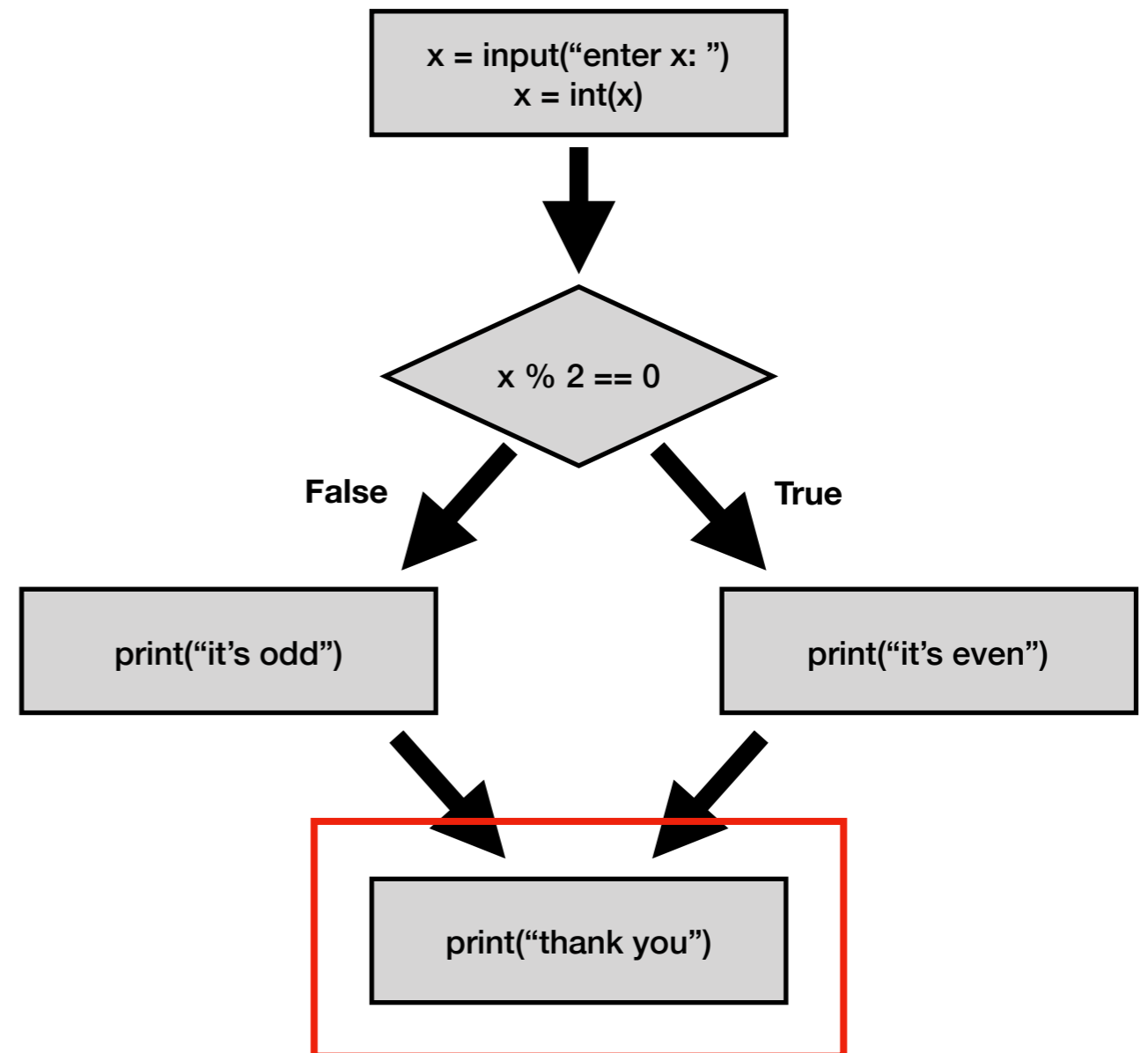
Writing conditions in Python

Code:

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

```
if x % 2 == 0:  
    print("it's even")  
else:  
    print("it's odd")
```

```
print("thank you")
```



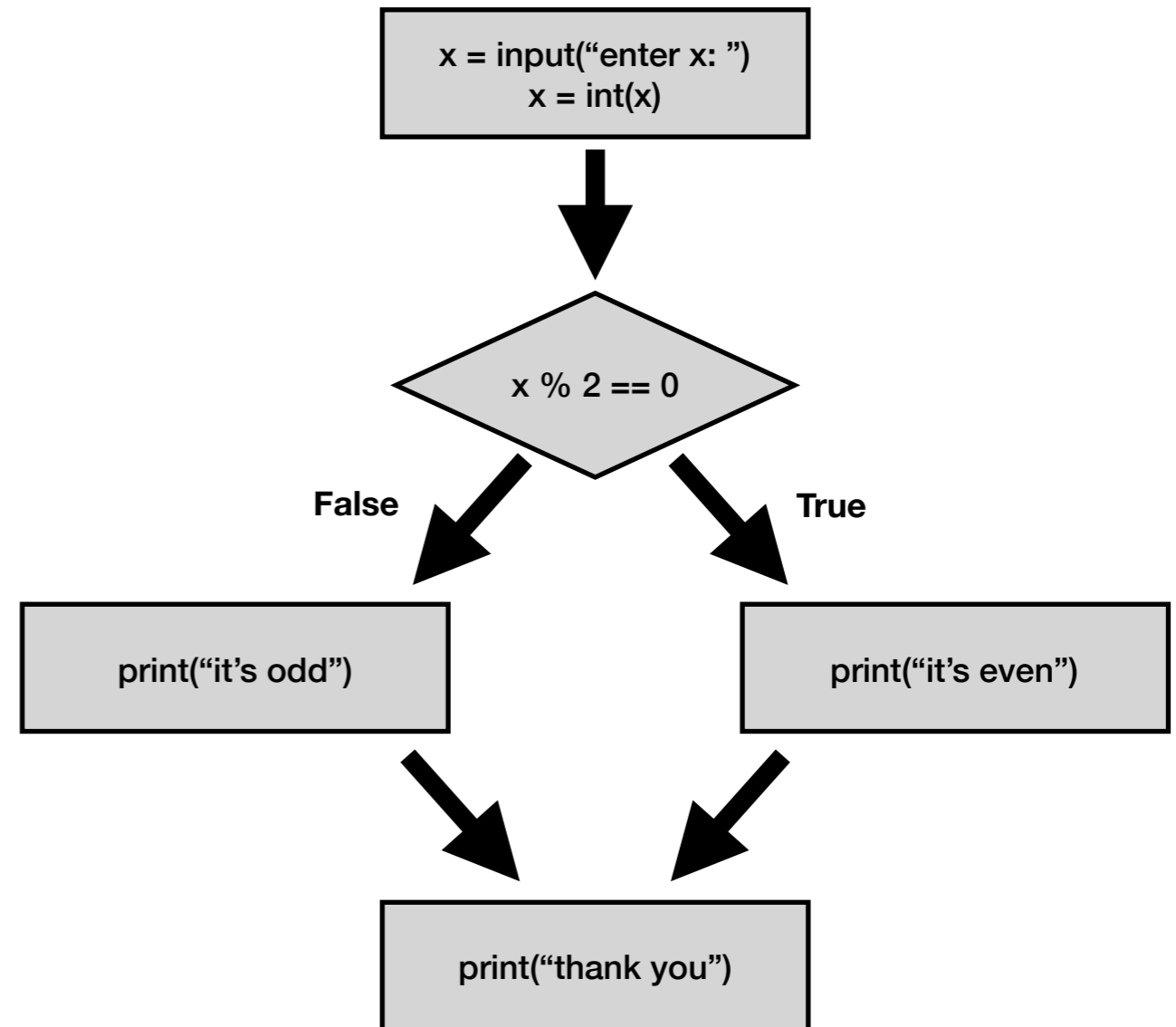
Writing conditions in Python

Code:

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

if x % 2 == 0:
    print("it's even")
else:
    print("it's odd")

print("thank you")
```



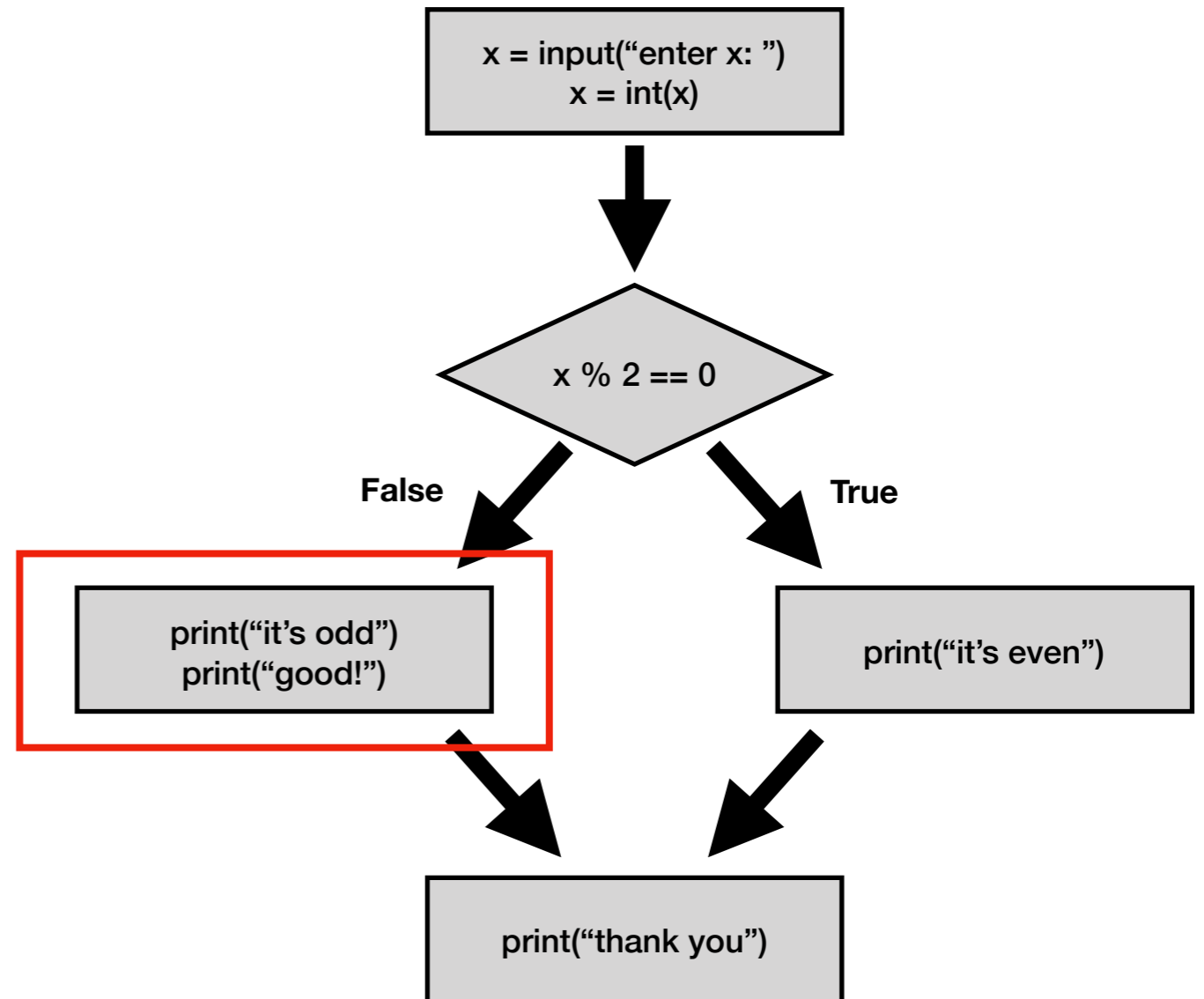
Writing conditions in Python

Code:

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

```
if x % 2 == 0:  
    print("it's even")  
else:  
    print("it's odd")  
    print("good!")
```

```
print("thank you")
```



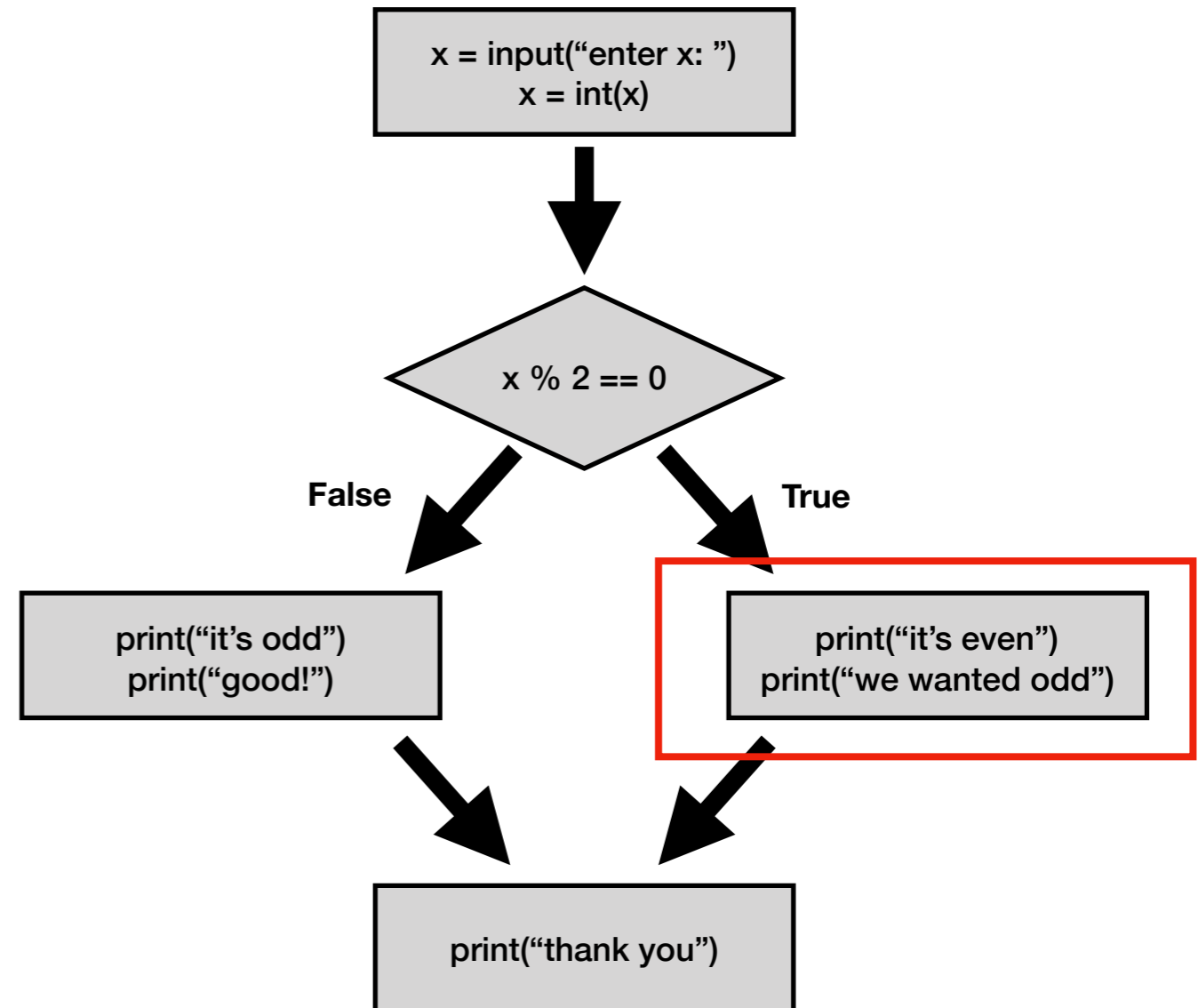
Writing conditions in Python

Code:

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

if x % 2 == 0:
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    print("we wanted odd")
else:
    print("it's odd")
    print("good!")

print("thank you")
```



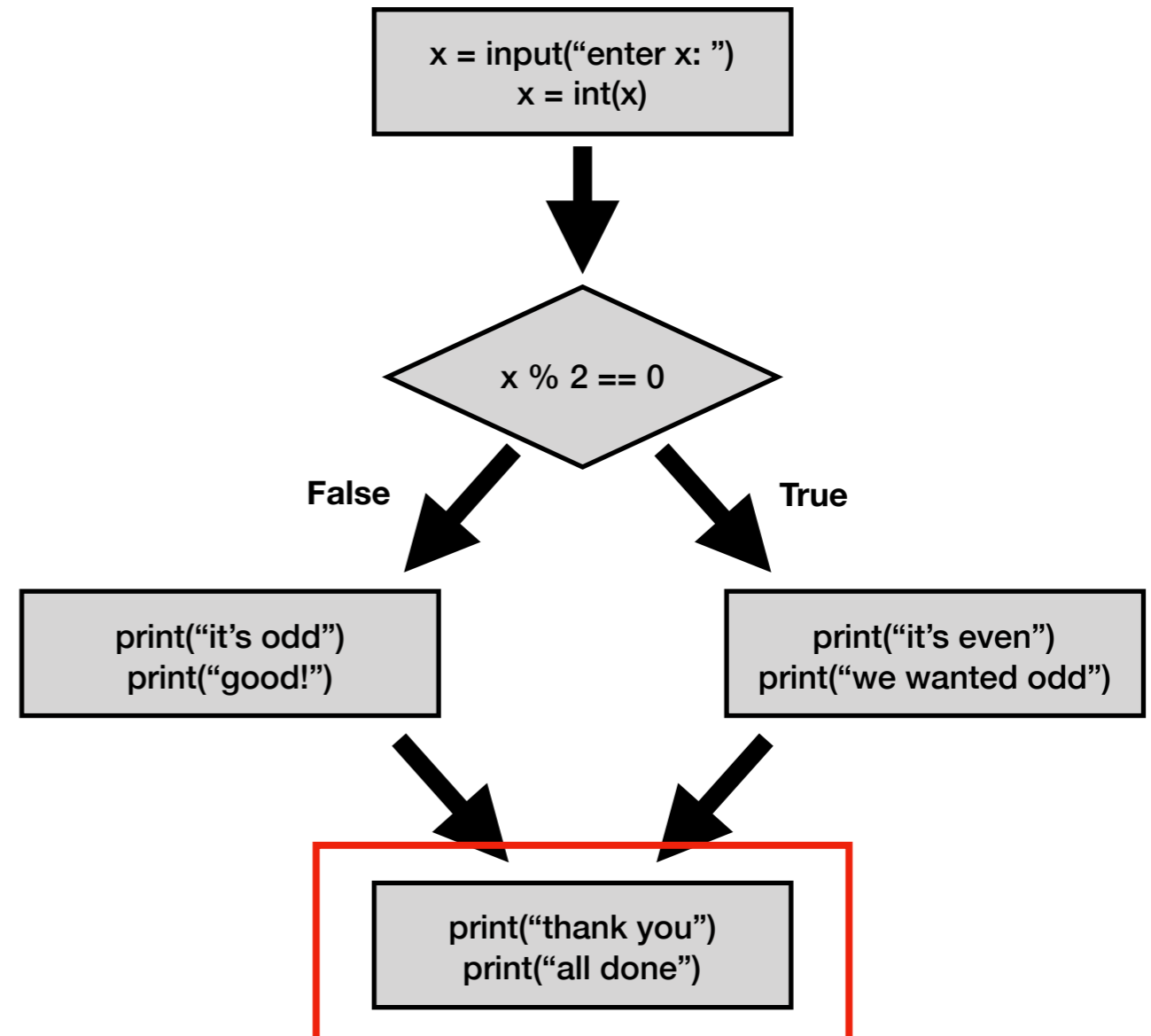
Writing conditions in Python

Code:

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

if x % 2 == 0:
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    print("we wanted odd")
else:
    print("it's odd")
    print("good!")

print("thank you")
print("all done")
```



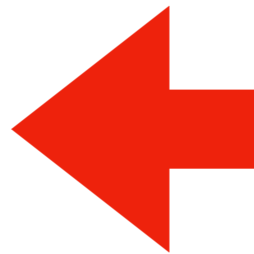
Today's Outline

Review

Control Flow Diagrams

Basic syntax for “if”

Identifying code blocks



Demos

Code Blocks

Code:

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

if x % 2 == 0:
    print("it's even")
    print("we wanted odd")
else:
    print("it's odd")
    print("good!")

print("thank you")
print("all done")
```

Code Blocks

Code:

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

```
if x % 2 == 0:
```

```
    print("it's even")  
    print("we wanted odd")
```

block of code
inside "if"

```
else:
```

```
    print("it's odd")  
    print("good!")
```

```
print("thank you")  
print("all done")
```

Code Blocks

Code:

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

```
if x % 2 == 0:
```

```
    print("it's even")  
    print("we wanted odd")
```

**block of code
inside "if"**

```
else:
```

```
    print("it's odd")  
    print("good!")
```

**block of code
inside "else"**

```
print("thank you")  
print("all done")
```

Code Blocks

Code:

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

```
if x % 2 == 0:
```

```
    print("it's even")  
    print("we wanted odd")
```

**block of code
inside "if"**

```
else:
```

```
    print("it's odd")  
    print("good!")
```

**block of code
inside "else"**

```
print("thank you")  
print("all done")
```

What if all this were inside a function?

Code Blocks

Code:

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

```
    if x % 2 == 0:
```

```
        print("it's even")  
        print("we wanted odd")
```

**block of code
inside "if"**

```
    else:
```

```
        print("it's odd")  
        print("good!")
```

**block of code
inside "else"**

```
        print("thank you")  
        print("all done")
```

```
check_oddness()
```

Code Blocks

Code:

```
def check_oddness():
```

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

```
    if x % 2 == 0:
```

```
        print("it's even")  
        print("we wanted odd")
```

**block of code
inside "if"**

```
    else:
```

```
        print("it's odd")  
        print("good!")
```

**block of code
inside "else"**

```
    print("thank you")  
    print("all done")
```

**block of code in
check_oddness**

```
check_oddness()
```

Code Blocks

You need to get good at “seeing” code blocks in Python code.

Code:

```
def check_oddness():
```

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

```
    if x % 2 == 0:
```

```
        print("it's even")  
        print("we wanted odd")
```

block of code
inside “if”

```
    else:
```

```
        print("it's odd")  
        print("good!")
```

block of code
inside “else”

```
    print("thank you")  
    print("all done")
```

block of code in
check_oddness

```
check_oddness()
```


Code Blocks

You need to get good at “seeing” code blocks in Python code.
Even blocks inside blocks inside blocks...

Code:

```
def check_oddness():
```

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

```
    if x % 2 == 0:
```

```
        print("it's even")  
        print("we wanted odd")
```

block of code
inside “if”

```
    else:
```

```
        print("it's odd")  
        print("good!")
```

block of code
inside “else”

```
    print("thank you")  
    print("all done")
```

block of code in
check_oddness

```
check_oddness()
```

Identifying Code Blocks

Code:

```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")  
  
check_oddness()
```

Identifying Code Blocks


Code:

```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")  
  
check_oddness()
```

**Step 1: look for a colon at
end of a line**

Identifying Code Blocks

Code:




```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")  
  
check_oddness()
```

Step 2: start drawing a line on next code line, indented in

Identifying Code Blocks

Code:

```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")  
  
check_oddness()
```



Step 3: continue down until you hit code that is less indented

Identifying Code Blocks

Code:

```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")
```

`check_oddness()`

Step 4: box off the code



Identifying Code Blocks

Code:

```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")
```

```
check_oddness()
```

Step 4: box off the code

Identifying Code Blocks

Code:

```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")
```

```
check_oddness()
```

to find more boxes,
look for the next colon
and repeat

Identifying Code Blocks

Code:

```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")  
  
check_oddness()
```

to find more boxes,
look for the next colon
and repeat

Identifying Code Blocks

Code:

```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")  
  
check_oddness()
```

to find more boxes,
look for the next colon
and repeat

Identifying Code Blocks

Code:

```
def check_oddness():
```

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

```
    if x % 2 == 0:
```

```
        print("it's even")  
        print("we wanted odd")
```

```
    else:
```

```
        print("it's odd")  
        print("good!")
```

```
    print("thank you")  
    print("all done")
```

```
check_oddness()
```

to find more boxes,
look for the next colon
and repeat

Identifying Code Blocks

Code:

Do problem 1 on worksheet

```
def check_oddness():  
    x = input("enter x: ")  
    x = int(x)  
  
    if x % 2 == 0:  
        print("it's even")  
        print("we wanted odd")  
    else:  
        print("it's odd")  
        print("good!")  
  
    print("thank you")  
    print("all done")  
  
check_oddness()
```

to find more boxes,
look for the next colon
and repeat

Today's Outline

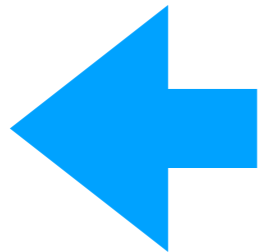
Review

Control Flow Diagrams

Basic syntax for “if”

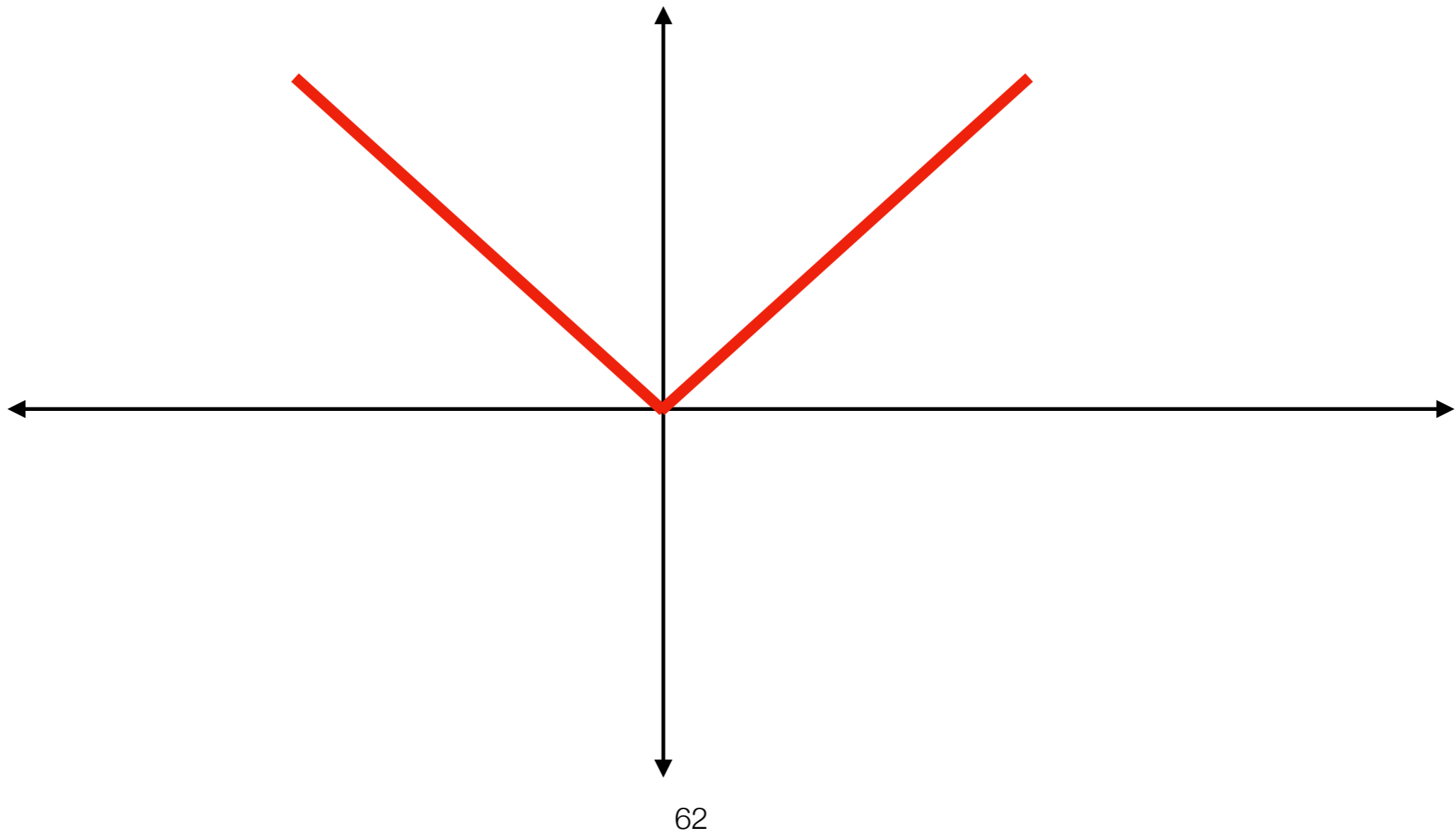
Identifying code blocks

Demos

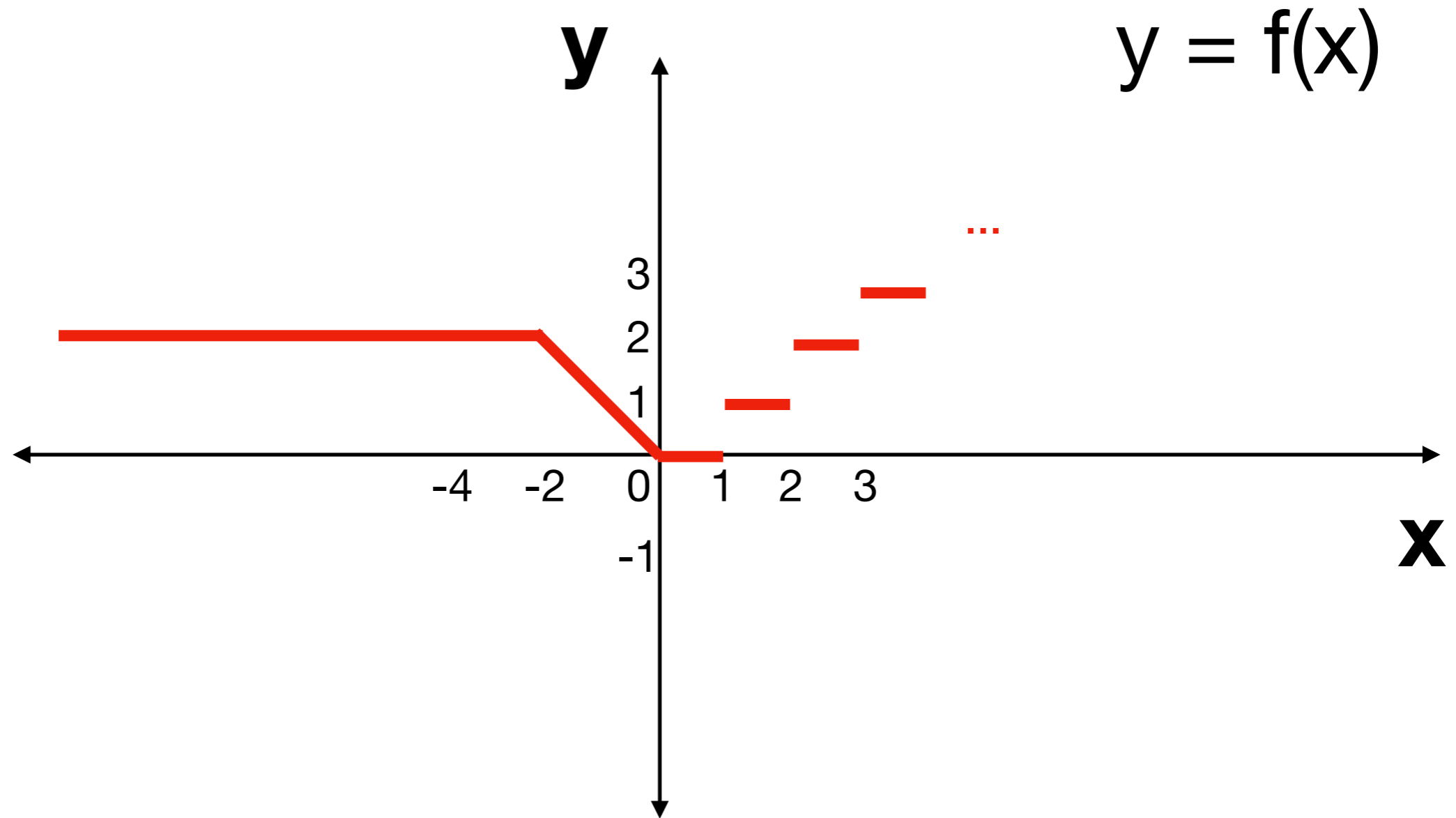


Demo: Absolute

compare 4 ways to compute the absolute of a number
(step through in **Interactive Exercises**)

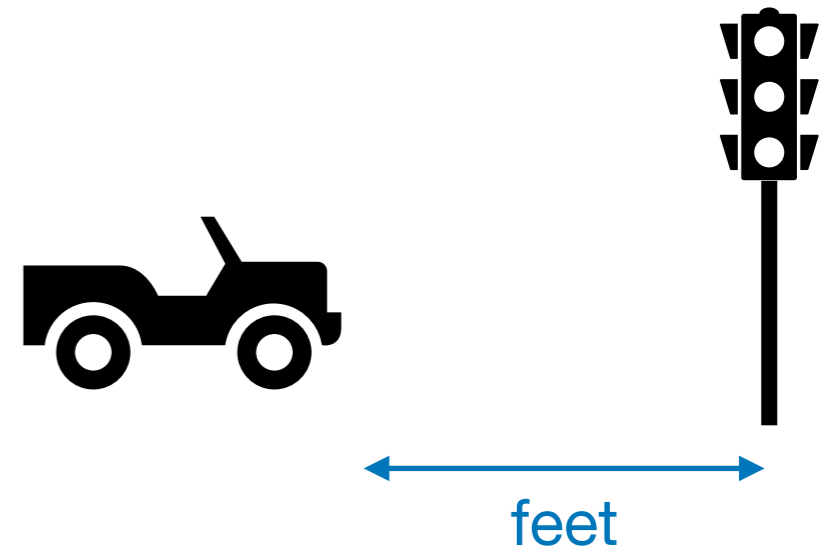
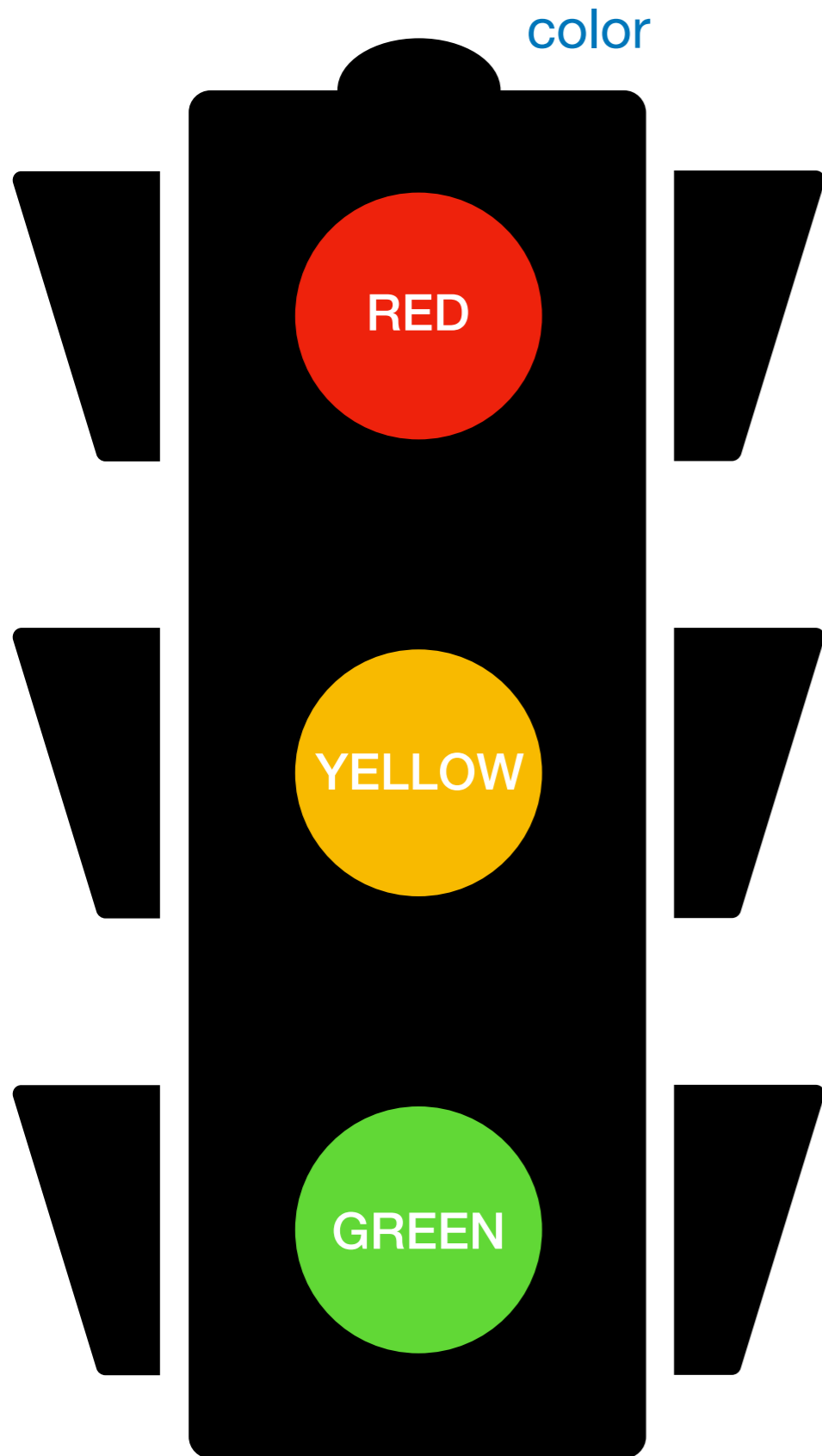


Demo: Piecewise Function



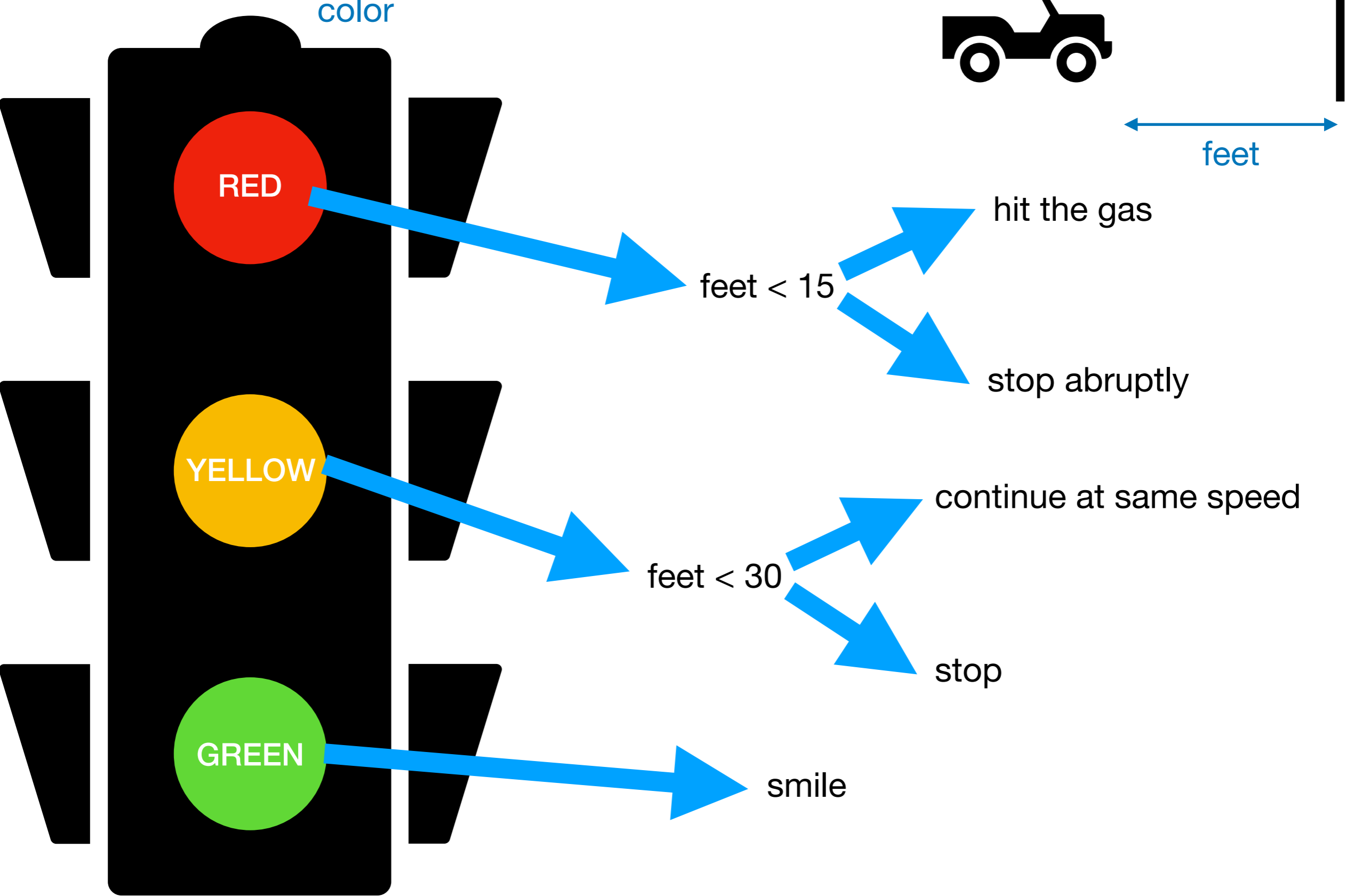
Implement the f function in Python

Demo: Stoplight



what should the driver do?

Demo: Stoplight



Demo: Date Printer

```
please enter a year: (YYYY): 18  
please enter a month (1-12): 2  
please enter a day (1-31): 3  
the date is: Feb 3rd, 2018
```

convert month num to name

add 2000 when needed

e.g., 1st, 2nd, 3rd, etc

Demo: Addition Tester

what is 3+5? 5 ← 1 point
what is 9+2? 10 ← 0.5 points (close answer)
what is 9+5? 2 ← 0 points

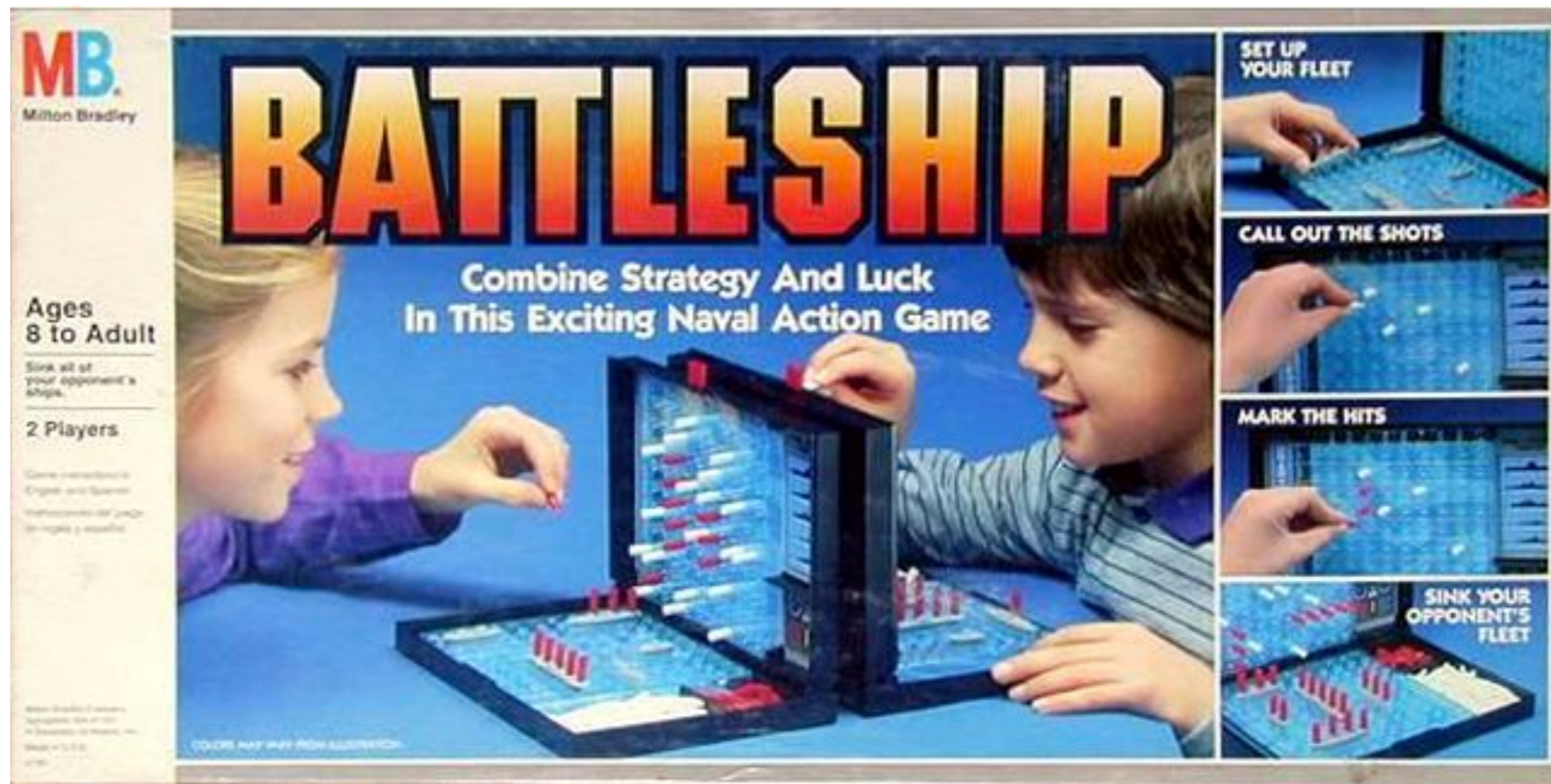
...

Your score is 6.5 of 10

We can get random number by using the random module:

```
random.randint(1, 10)
```

Demo: Better Battleship



Improvements

- give more meaningful feedback (not "True" or "False")
- check that user guessed in a reasonable range
- choose random placement for two ships, not overlapping
- show different symbols depending on which ship was hit
- give user up to 3 guesses (or until they get a hit)