COSC 1306 - Prog for Non-Majors

Repetition Structures

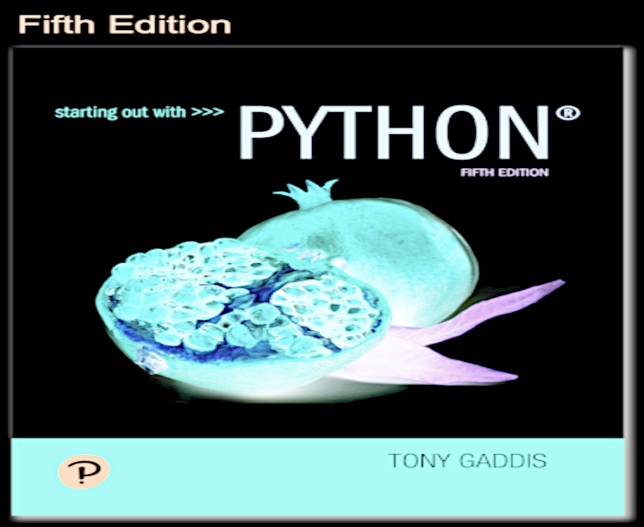
Dr. Mohan

McMurry University

October 3, 2023

Lesson Topics Overview

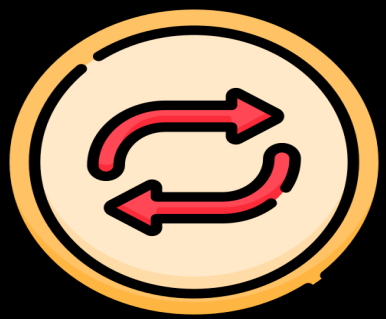
- Introduction to Repetition Structures.
- The while Loop: a Condition-Controlled Loop.
- The for Loop: a Count-Controlled Loop.
- Calculating a Running Total.
- Sentinels.
- Input Validation Loops.
- Nested Loops.



Chapter 4
Repetition Structures

Introduction to Repetition Structures

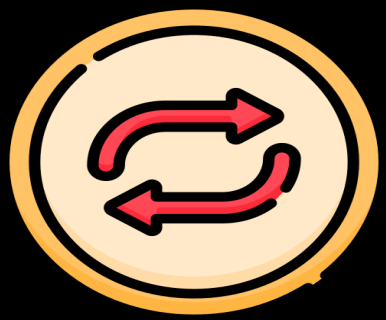
- Often have to write code that performs the same task multiple times.
- Disadvantages to **duplicating** code:
  - Makes program large.
  - Time consuming.
  - May need to be corrected in many places.
- Repetition structure: makes computer **repeat** included code as necessary.
- Includes condition-controlled loops and count-controlled loops.



The while Loop: a Condition-Controlled Loop (1 of 4)

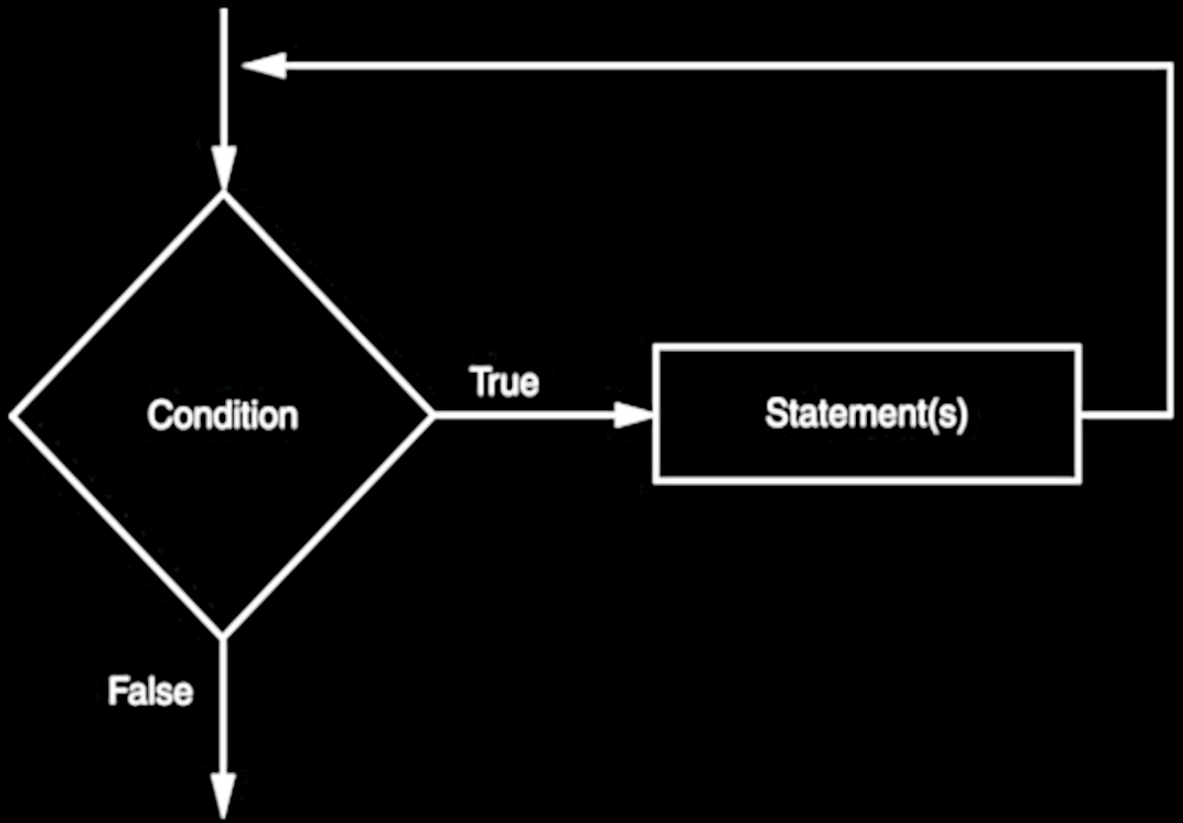
- **while loop:** while condition is true, do something.
- Two parts:
  - Condition tested for true or false value.
  - Statements repeated as long as condition is true.
- In flow chart, line goes back to previous part.
- General format:

```
while condition:
        statements
```



The while Loop: a Condition-Controlled Loop (2 of 4)

Figure 4-1 The logic of a while loop

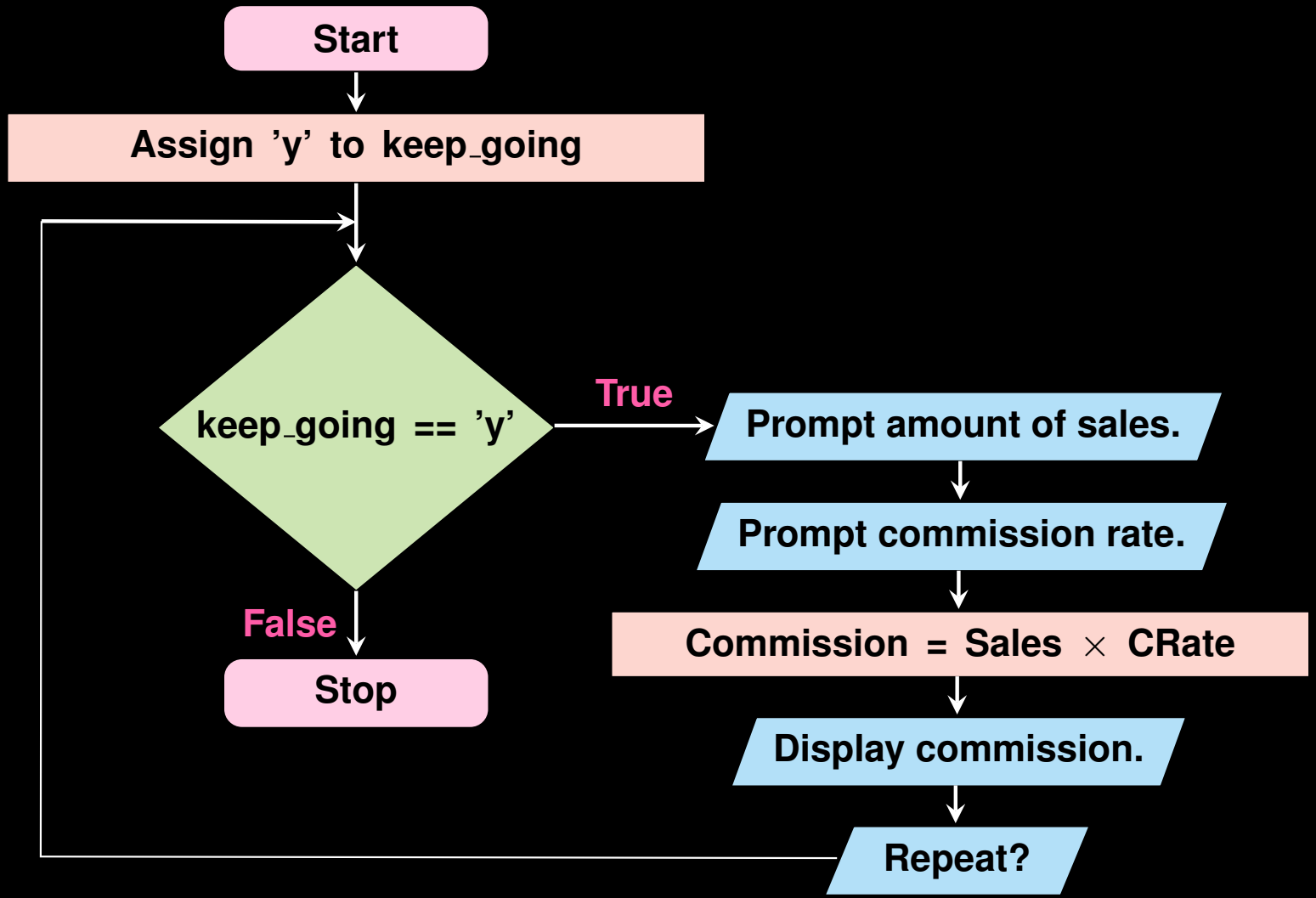


The while Loop: a Condition-Controlled Loop (3 of 4)

- In order for a loop to stop executing, something has to happen inside the loop to make the condition false.
- **Iteration:** one execution of the body of a loop.
- **while loop** is known as a pretest loop.
  - Tests condition before performing an iteration.
  - Will never execute if condition is false to start with.
  - Requires performing some steps prior to the loop.

The while Loop: a Condition-Controlled Loop (4 of 4)

Figure 4-3 Flowchart for Program 4-1



Infinite Loops

- Loops must contain within themselves a way to **terminate**.
- Something inside a while loop must eventually make the condition false.
- **Infinite loop:** loop that does not have a way of stopping.
  - Repeats until program is interrupted.
  - Occurs when programmer forgets to include stopping code in the loop.

The for Loop: a Count-Controlled Loop (1 of 2)

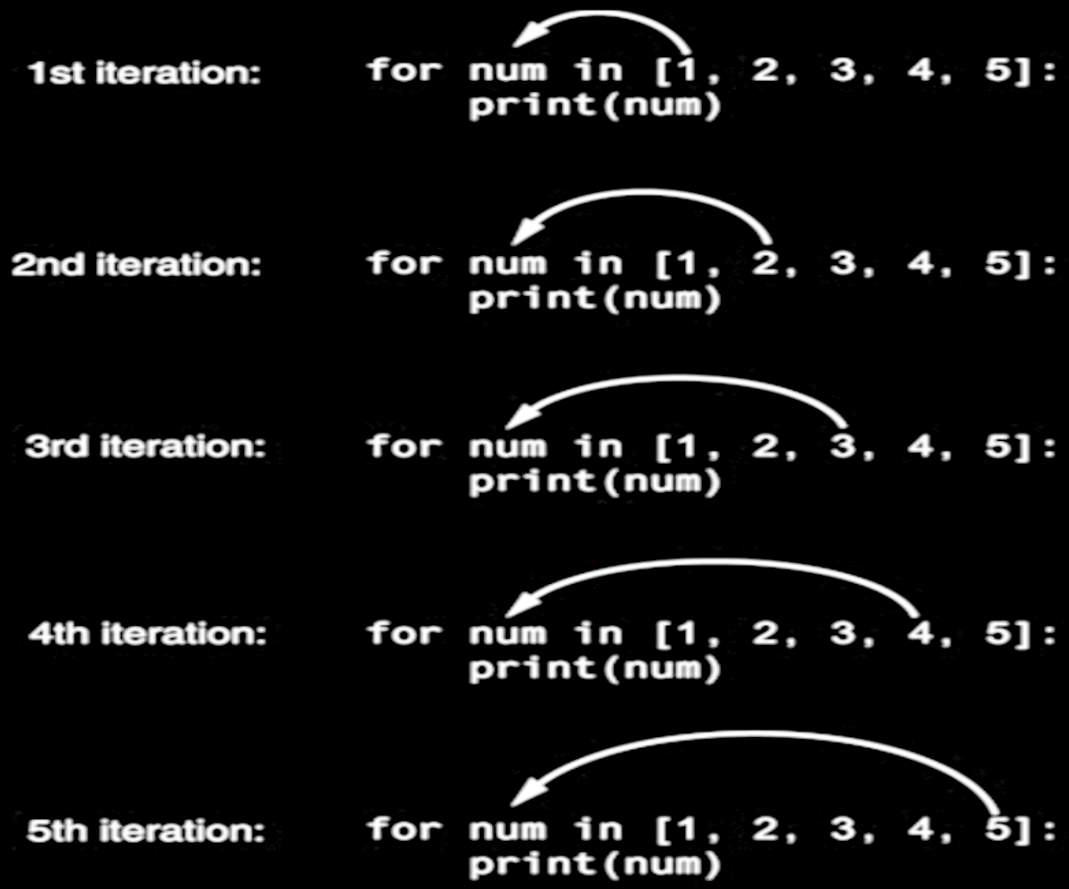
- **Count-Controlled loop:** iterates a specific number of times.
- Use a **for statement** to write count-controlled loop.
- Designed to work with sequence of data items that iterates once for each item in the sequence.
- General format:

```
for variable in [val1, val2, etc]:
    statements
```

- Target variable: the variable which is the target of the assignment at the beginning of each iteration

The for Loop: a Count-Controlled Loop (2 of 2)

Figure 4-4 The for loop



Using the range Function with the for Loop

- The range function simplifies the process of writing a for loop with range returning an iterable object.
- Iterable: contains a sequence of values that can be iterated over.
- range characteristics:
  - One argument: used as ending limit.
  - Two arguments: starting value and ending limit.
  - Three arguments: third argument is step value.

Using the Target Variable Inside the Loop

- Purpose of target variable is to reference each item in a sequence as the loop iterates.
- Target variable can be used in calculations or tasks in the body of the loop.
- Example: calculate square root of each number in a range.

```
for number in range(1, 11):
    square = number**2
    print(number, '\t', square)
```

Letting the User Control the Loop Iterations

- Sometimes the programmer **does not know** exactly how many times the loop will execute.
- Can receive range inputs from the user, place them in variables, and call the **range function** in the for clause using these variables.
- Be sure to consider the end cases: range does not include the ending limit. Example:

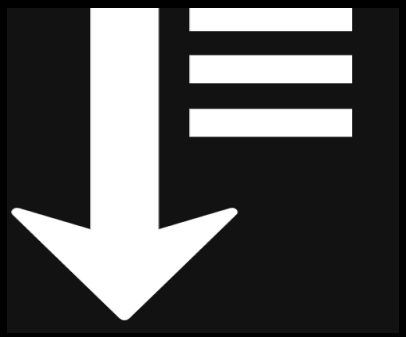
```
nos = int(input("Enter how many numbers:"))
for number in range(1, nos):
    square = number**2
    print(number, '\t', square)
```

Generating an Iterable Sequence that Ranges from Highest to Lowest

- The range function can be used to generate a sequence with numbers in descending order.
- Make sure starting number is larger than end limit, and step value is negative.

Example: range(10, 0, -1)

```
for number in range(10, 0, -1):
    print(number)
```



Calculating a Running Total (1 of 2)

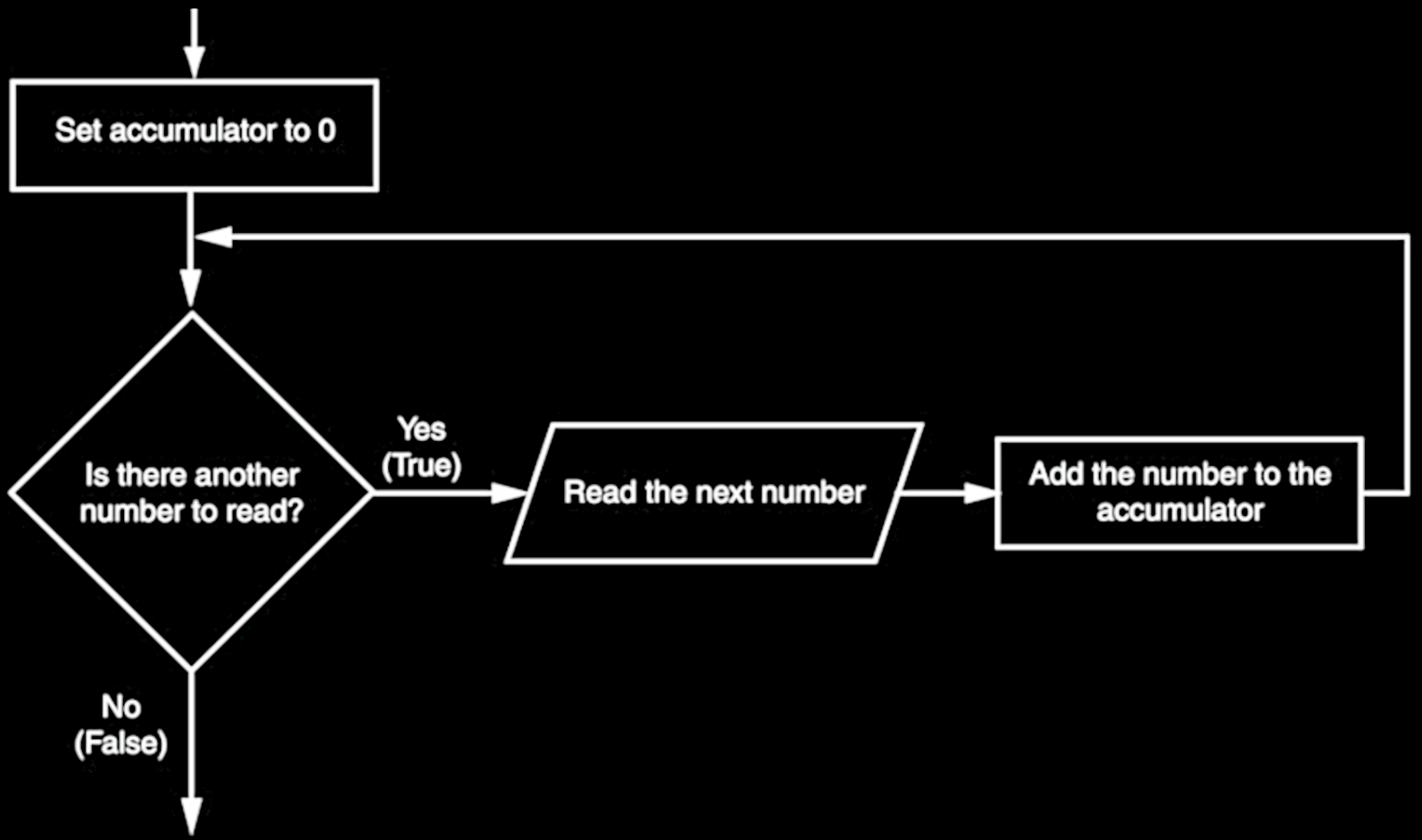
- Programs often need to calculate a total of a series of numbers. This typically include two elements:
  - A loop that reads each number in series.
  - An accumulator variable,
- Known as program that keeps a running total: accumulates total and reads in series.
- At end of loop, accumulator will reference the total.

Example:

```
nums = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]
accum = 0
for numbers in nums:
    accum = accum + w
print(accum)
```

Calculating a Running Total (2 of 2)

Figure 4-6 Logic for calculating a running total



The Augmented Assignment Operators (1 of 2)

- In many assignment statements, the variable on the left side of the $=$ operator also appears on the right side of the $=$ operator.
- **Augmented assignment operators:** special set of operators designed for this type of job. Also known as, Shorthand operators.

The Augmented Assignment Operators (2 of 2)

Table 4-2 Augmented assignment operators Operator

Operator	Example Usage	Equivalent To
+=	x += 5	x = x + 5
-=	y -= 2	y = y - 2
*=	z *= 10	z = z * 10
/=	a /= b	a = a / b
%=	c %= 3	c = c % 3
//=	x //= 3	x = x // 3
**=	y **= 2	y = y**2

Sentinels

- **Sentinel:** special value that marks the end of a sequence of items.
- When program reaches a sentinel, it knows that the end of the sequence of items was reached, and the **loop terminates**.
- Must be distinctive enough so as not to be mistaken for a regular value in the sequence.
- **Example:** when reading an input file, empty line can be used as a sentinel.

Input Validation Loops (1 of 3)

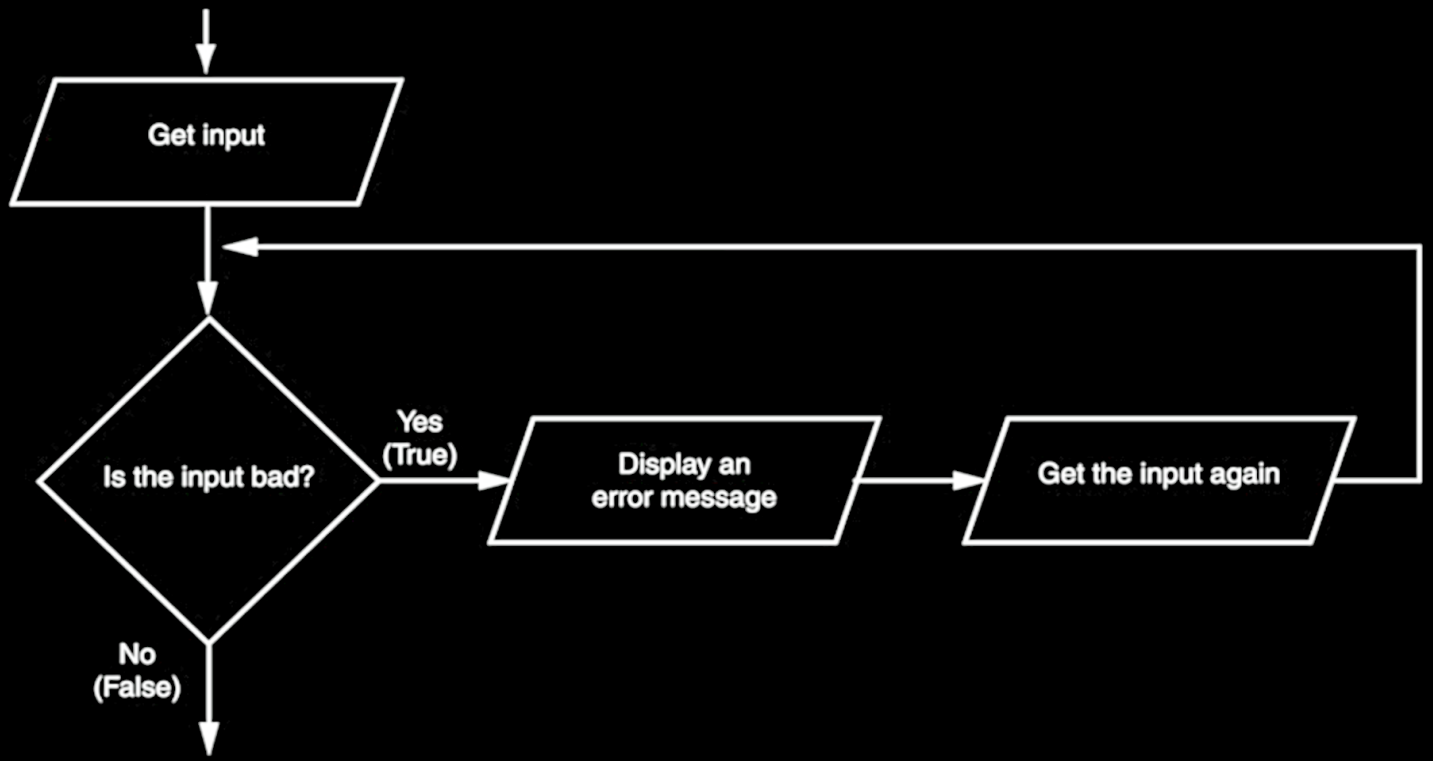
- Computer cannot tell the **difference** between good data and bad data.
  - If user provides bad input, program will produce bad output.
  - GIGO: garbage in, garbage out.
  - It is important to design program such that bad input is never accepted.

Input Validation Loops (2 of 3)

- **Input validation:** inspecting input before it is processed by the program.
- If input is invalid, prompt user to enter correct data.
- Commonly accomplished using a while loop which repeats as long as the input is bad.
- If input is bad, display error message and receive another set of data.
- If input is good, continue to process the input.

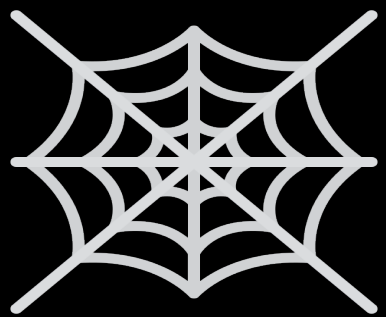
Input Validation Loops (3 of 3)

Figure 4-7 Logic containing an input validation loop



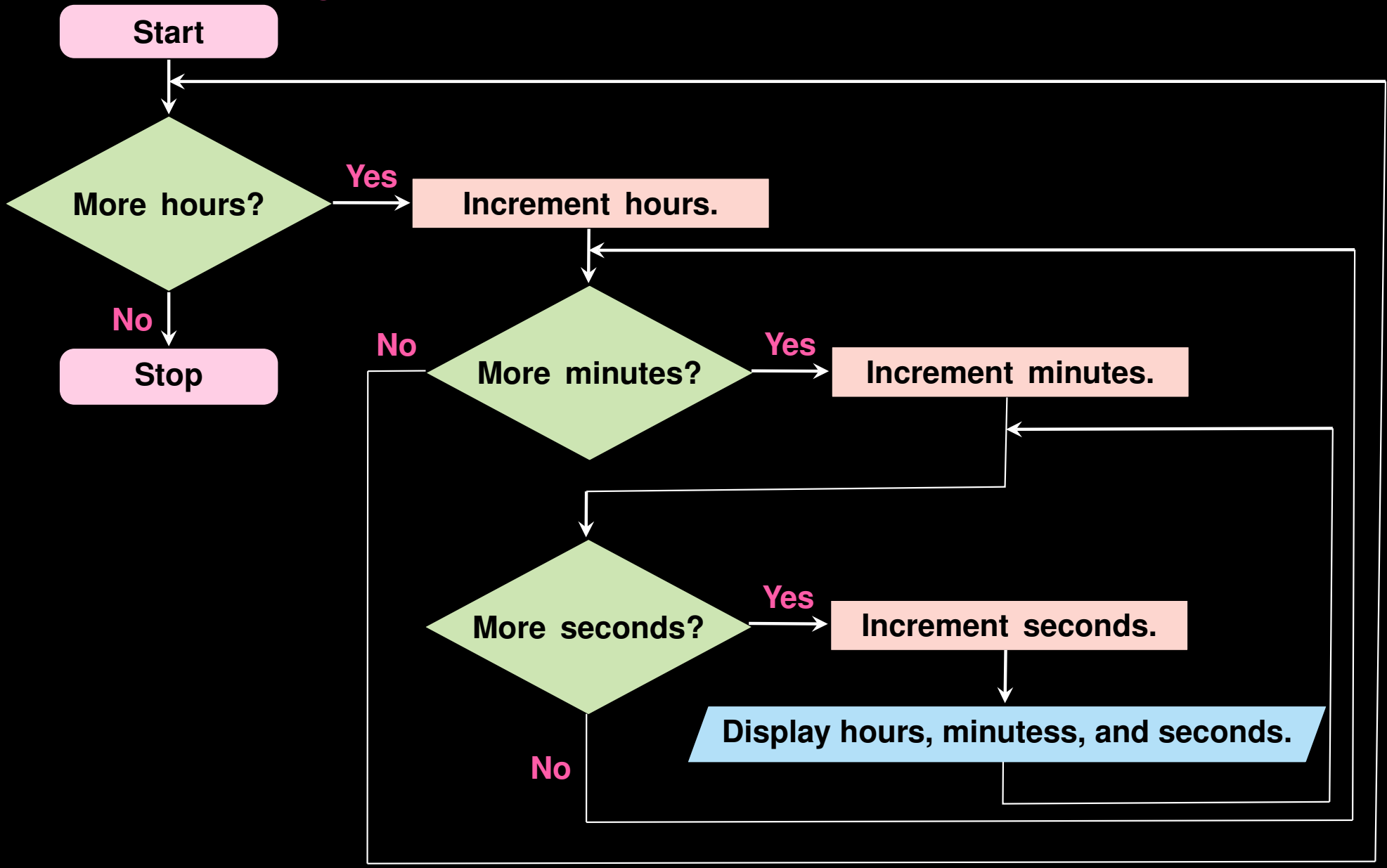
Nested Loops (1 of 3)

- **Nested loop:** loop that is contained inside another loop.
- Example: analog clock works like a nested loop.
  - **Hours hand** moves once for every twelve movements of the **minutes hand**: for each iteration of the ”hours,”” do twelve iterations of ”minutes”.
  - **Seconds hand** moves 60 times for each movement of the **minutes hand**: for each iteration of ”minutes,” do 60 iterations of ”seconds”.



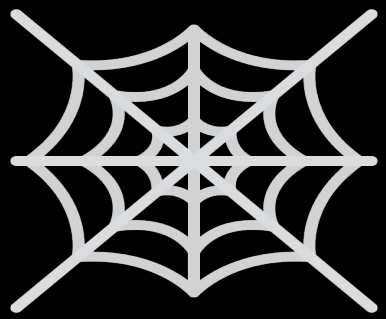
Nested Loops (2 of 3)

Figure 4-8 Flowchart for a clock simulator



Nested Loops (3 of 3)

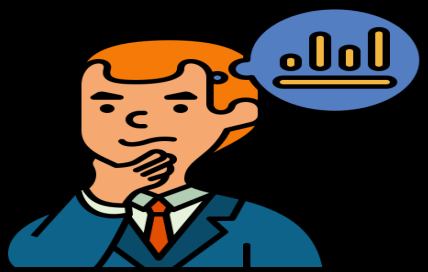
- Key points about nested loops:
  - Inner loop goes through all of its iterations for each iteration of outer loop.
  - Inner loops complete their iterations faster than outer loops.
  - Total number of iterations in nested loop: **number of iterations of inner loop $\times$ number of iterations of outer loop**.



Lesson Summary

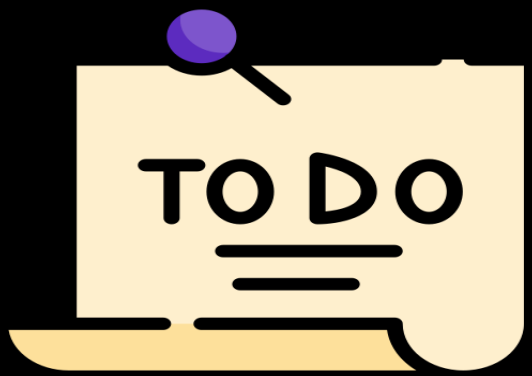
This chapter covered:

- Repetition structures, including:
  - Condition-controlled loops.
  - Count-controlled loops.
  - Nested loops.
- Infinite loops and how they can be avoided.
- range function as used in for loops
- Calculating a running total and augmented assignment operators.
- Use of sentinels to terminate loops.
- Using loops to draw turtle graphic designs.



Things to do

- Get Started with Assignment-2.
- Read Textbook Chapter-4.
- Complete all the class activity for Week-5 and Week-6.



Questions?

Please ask your Questions to clarify!