DATA SCIENCE 101:
PYTHON ITERATIONS (PART 1)

AGENDA

- Recap of previous lessons
- Python iterations

RECAP OF PREVIOUS LESSON

- Decision structure & Boolean logic:
  - Sequence structure
  - Boolean operators (conditional & relational)
  - IF, ELIF, ELSE
  - Nested decisions
  - Try-Except
  - “Not” operator

- Collections:
  - What are collections?
  - Lists
  - Tuples
  - Dictionaries

INTRODUCTION

- Purpose of iterations?
- What are variable tasks?
- Types of iteration constructs (While & For)

PROBLEM: REPETITIVE TASKS

- Example of repetitive tasks: Just imagine if you were asked by your boss to write a program that can print “Hello World” one hundred times
- This is a simple program, but yet you are going to have to write 100 lines of codes just to render this ☹

ANALYSIS OF PROBLEM

- By just using the current tools available at our disposal to deal with the previous problem, we face the following disadvantages:
  - We would have ended up with a long sequence of code just to solve the previous problems
  - Writing this kind of program can be time consuming
  - If duplicated part of code needs to be corrected, then the correction must be implemented many times

SOLUTION TO PROBLEM: ITERATION

- The solution to the above disadvantages would be:
  - Write the codes for the operation one time
  - Place the codes in a repetition structure for it to be repeated as many times as possible
- This repetition structure is actually call an iteration device or more commonly known as the “loop”
- There are different kinds of iteration device we can write in python: While & For loops

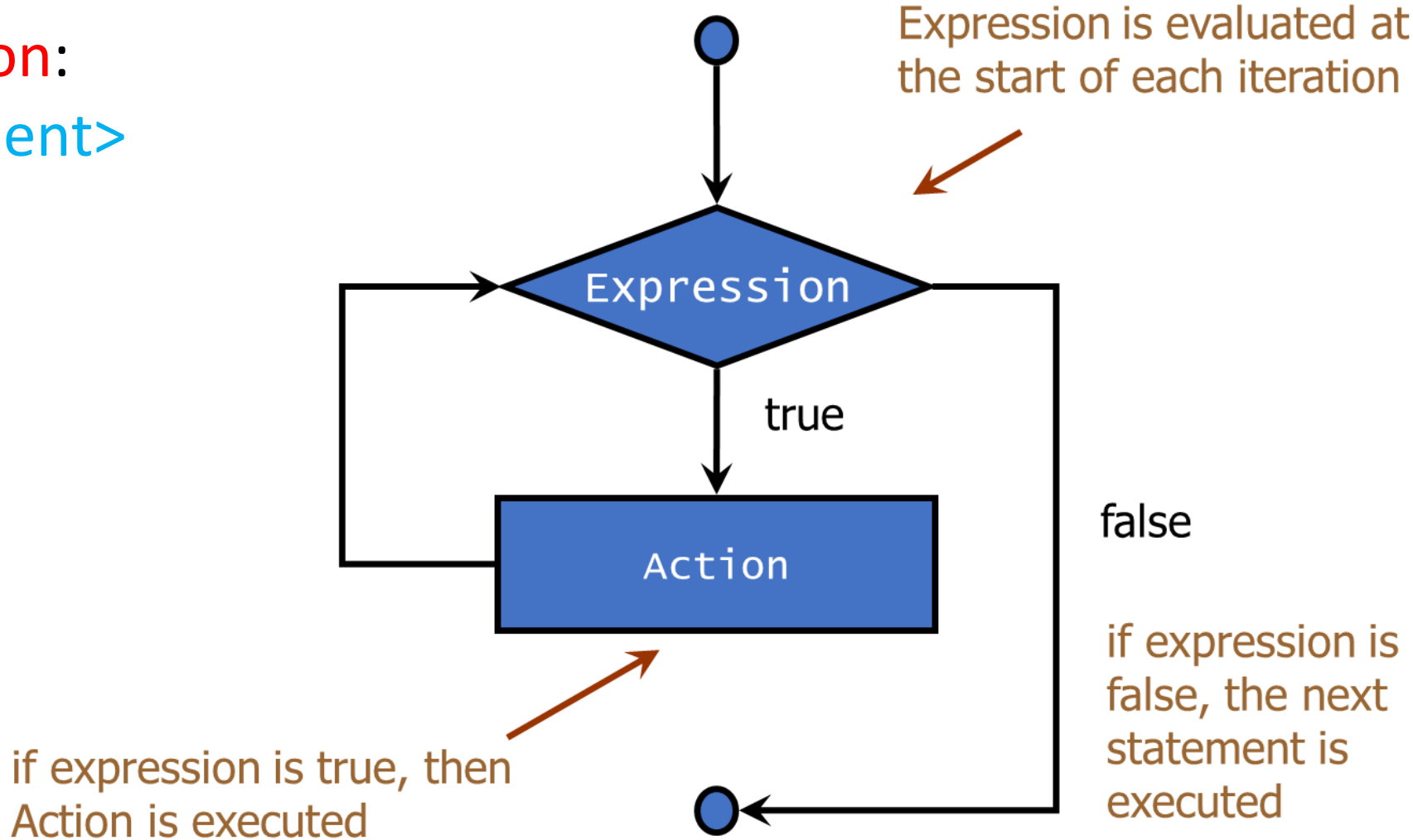
WHILE LOOP

- Execution
- What are variable tasks?
- Types of iteration constructs (While & For)

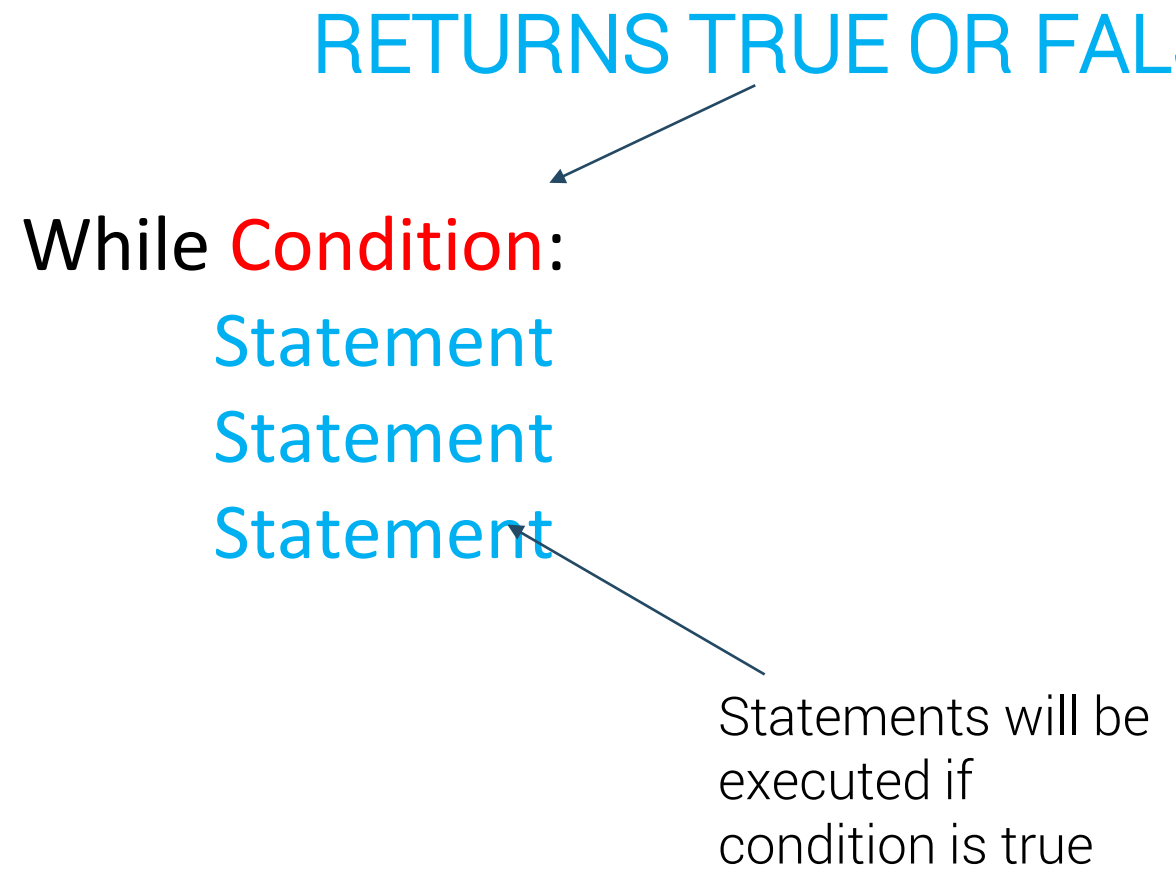
WHILE LOOP CONSTRUCT

While Condition:

<Statement>



WHILE LOOP CONSTRUCT



WHILE LOOP: SIMPLE EXAMPLE*

```
While Condition:
    Statement
    Statement
    Statement
```

Try these two simple examples to convince yourself that all the while loop really needs is a True/False to work!

And as long as the condition is True, the action will always be performed, as along as the condition is False, nothing will ever happen

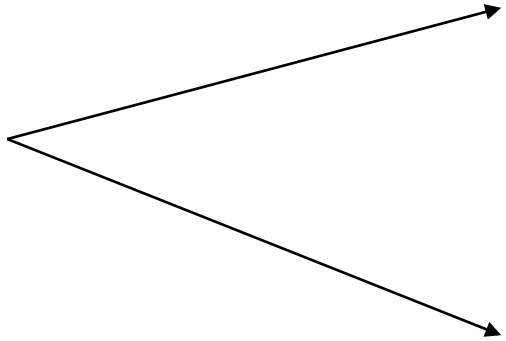
```
While True:
    print(1)
```

```
While False:
    print(1)
```

WHILE LOOP: TRUE / FALSE CONDITION TO WORK*

- Any conditions that return a true/false to the while construct would work

```
While Condition:
    Statement
    Statement
    Statement
```



```
i = 10
While i > 10:
    print(1)
```

```
i = 10
While i < 10:
    print(1)
```

You would realise that this loop is never ending though. How do we address this?

WHILE LOOP: CONDITIONS THAT ARE DEFINITE*

- Basically to end a loop, we create a condition that is only true for a limited amount of time

```
While Condition:
    Statement
    Statement
    Statement
```



```
i = 10
While i < 10:
    print(1)
    i += 1
```

As i increments every round, it means that the condition of i<10 does not hold true forever. This means that there will be an end to things!

EXECUTION TRACE: WHILE LOOP*

```
video_titles = [‘despacito’, ‘see_you_again’, ‘im_yours’]
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print(‘that’s all folks!’)
```

num_of_videos 0

current_video_index 0

output

EXECUTION TRACE: WHILE LOOP*

```
video_titles = [‘despacito’, ‘see_you_again’, ‘im_yours’]
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print(‘that’s all folks!’)
```

num_of_videos 3

current_video_index 0

output

EXECUTION TRACE: WHILE LOOP*

```
video_titles = [‘despacito’, ‘see_you_again’, ‘im_yours’]
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print(‘that’s all folks!’)
```

num_of_videos 3

current_video_index 0

output

EXECUTION TRACE: WHILE LOOP*

```
video_titles = [‘despacito’, ‘see_you_again’, ‘im_yours’]
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print(‘that’s all folks!’)
```

True

num_of_videos	3
current_video_index	0

output

EXECUTION TRACE: WHILE LOOP*

```
video_titles = ['despacito', 'see_you_again', 'im_yours']
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print('that's all folks!')
```

num_of_videos: 3

current_video_index: 0

output

despacito

EXECUTION TRACE: WHILE LOOP*

```
video_titles = [‘despacito’, ‘see_you_again’, ‘im_yours’]
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print(‘that’s all folks!’)
```

num_of_videos 3

current_video_index 1

output

despacito

EXECUTION TRACE: WHILE LOOP*

```
video_titles = ['despacito', 'see_you_again', 'im_yours']
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print('that's all folks!')
```

True

num_of_videos 3

current_video_index 1

output

despacito

EXECUTION TRACE: WHILE LOOP*

```
video_titles = [‘despacito’, ‘see_you_again’, ‘im_yours’]
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print(‘that’s all folks!’)
```

num_of_videos 3

current_video_index 1

output

see_you_again

EXECUTION TRACE: WHILE LOOP*

```
video_titles = [‘despacito’, ‘see_you_again’, ‘im_yours’]
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print(‘that’s all folks!’)
```

num_of_videos 3

current_video_index 2

output

see_you_again

EXECUTION TRACE: WHILE LOOP*

```
video_titles = ['despacito', 'see_you_again', 'im_yours']
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print('that's all folks!')
```

True

num_of_videos 3

current_video_index 2

output

see_you_again

EXECUTION TRACE: WHILE LOOP*

```
video_titles = ['despacito', 'see_you_again', 'im_yours']
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print('that's all folks!')
```

num_of_videos 3

current_video_index 2

output

im_yours

EXECUTION TRACE: WHILE LOOP*

```
video_titles = [‘despacito’, ‘see_you_again’, ‘im_yours’]
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print(‘that’s all folks!’)
```

num_of_videos 3

current_video_index 3

output

im_yours

EXECUTION TRACE: WHILE LOOP*

```
video_titles = ['despacito', 'see_you_again', 'im_yours']
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print('that's all folks!')
```

False

num_of_videos 3

current_video_index 3

output

im_yours

EXECUTION TRACE: WHILE LOOP*

```
video_titles = [‘despacito’, ‘see_you_again’, ‘im_yours’]
num_of_videos = len(video_titles)
current_video_index = 0

while current_video_index < num_of_videos:
        print(video_titles[current_video_index])
        current_video_index += 1

Print(‘that’s all folks!’)
```

num_of_videos 3

current_video_index 3

output

that’s all folks!

CONCEPT TEST*

- What do you think will happen if I remove the line “current_video_index+=1” from the previous code?
- What do you think will happen if I change the line “current_video_index < num_of_videos” to “current_video_index > num_of_videos”?

IN-CLASS PRACTICE: CHANNEL ENGAGEMENT*

- You are given the below list of YouTube channels' number of views and comments. Using a while loop, compute and print the engagement_scores
  - engagement_score = video_comments/video_views

```
channels = [{'title':'xiaxue', 'views':50000, 'comments':5100},
            {'title':'roy', 'views':123, 'comments':11},
            {'title':'brownietv', 'views':2380, 'comments':151}]
```

INDEFINITE LOOPS

- While loops are called "**indefinite loops**" because they keep going until a logical condition becomes **False**
- The loops we have seen so far are pretty easy to examine to see if they will terminate or if they will be " **infinite loops** "
- Sometimes it is a little harder to be sure if a loop will terminate

DEFINITE LOOPS

- Quite often we have a list of items or lines in a file - effectively a finite set of things
- We can write a loop to run the loop once for each of the items in a set using the Python “for” construct
- These loops are called "definite loops" because they execute an exact number of times
- We say that "definite loops iterate through the members of a set"

FOR LOOPS

- Applying for loops in fundamental questions (list as data type)
- Other ways to implement a loop (using range)
- Applying for loops in fundamental questions (dictionary as data type)

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print (‘Peekaboo!')
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

i 5

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print (‘Peekaboo!')
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print (‘Peekaboo!')
```

i	5

Output:

```
5
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print ('Peekaboo!')
```

i	4

Output:

```
5
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print (‘Peekaboo!')
```

i	4

Output:

```
5
4
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print ('Peekaboo!')
```

i | 3

Output:

```
5
4
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print ('Peekaboo!')
```

i	3

Output:

```
5
4
3
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

countdown = [5, 4, 3, 2, 1]

```
for i in countdown:
    print i
print ('Peekaboo!')
```

i 2

Output:

5

4

3

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print (‘Peekaboo!')
```

i 2

Output:

```
5
4
3
2
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print ('Peekaboo!')
```

i 1

Output:

```
5
4
3
2
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print (‘Peekaboo!')
```

i	1

Output:

```
5
4
3
2
1
```

EXECUTION TRACE: A SIMPLE DEFINITE FOR LOOP*

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print i
print ('Peekaboo!')
```

i	1

Output:

```
5
4
3
2
1
Peekaboo!
```

A DEFINITE LOOP WITH STRING*

- The for loop construct works regardless of the data type in the list

```
friends = ['Joseph', 'Glenn', 'Sally’]

for friend in friends :
   print('Happy New Year:’+  friend)

print ('Done!')
```

Output:

```
Happy New Year: Joseph
Happy New Year: Glenn
Happy New Year: Sally
Done!
```

WHAT YOU JUST OBSERVED

- The **iteration variable** “iterates” through the **sequence** (ordered set)
- The **Action** of code is executed once for each value in the **sequence**
- The **iteration variable** moves through all of the values in the **sequence**

```
countdown = [5, 4, 3, 2, 1]

for i in countdown:
    print (i)
print (‘Peekaboo!')
```

Sequence

Action

Iteration Variable

IN-CLASS PRACTICE: CHANNEL ENGAGEMENT*

- You are given the below list of YouTube channels' number of views and comments. Using a for loop, compute and print the engagement_scores
  - engagement_score = video_comments/video_views

```
channels = [{'title':'xiaxue', 'views':50000, 'comments':5100},
            {'title':'roy', 'views':123, 'comments':11},
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```

TYPES OF FUNDAMENTAL PROBLEMS WE CAN SOLVE

- The earlier questions involved just mindlessly accessing data and printing it, but the clever combination of iteration + condition, can allow us to introduce some intelligence to our repetition

- The following are the fundamental types of questions we can solve using a for loop (works for while loop as well, but its more compatible with for loop) and conditions , and we will explore them through a series of in-class practice:

    - Solving counting questions
    - Finding and returning specific elements that fulfils certain conditions
    - Aggregation or tally of statistics

PROBLEM SOLVING FRAMEWORK FOR DUMMIES (CITU)

- Given the sequence: [3, -4, 12, 9, -72, 0, 15], count the number of elements that are larger than 10 in the sequence

PROBLEM SOLVING FRAMEWORK FOR DUMMIES (CITU)

- Given the sequence: [3, -4, 12, 9, -72, 0, 15], count the number of elements that are larger than 10 in the sequence

1. **C**reate an empty container to contain the results → results = 0

2. **I**terate thru the list using a for/while loop → for data in sequence:

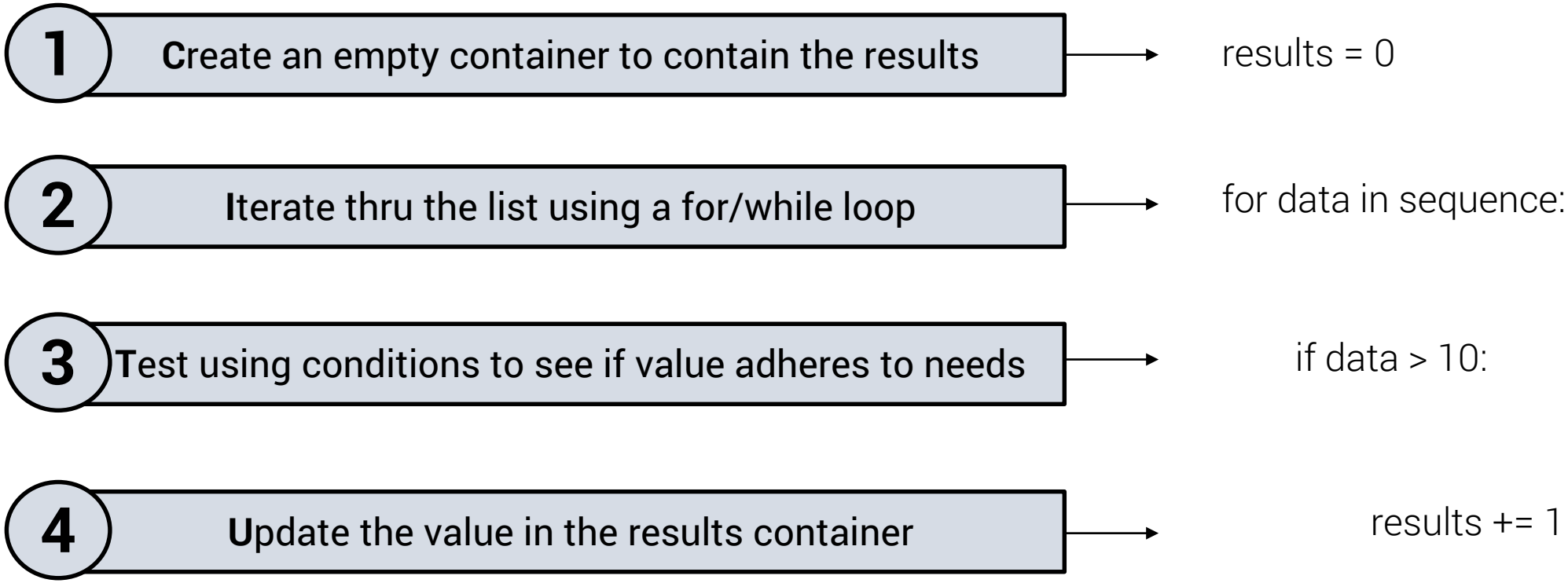
PROBLEM SOLVING FRAMEWORK FOR DUMMIES (CITU)

- Given the sequence: [3, -4, 12, 9, -72, 0, 15], count the number of elements that are larger than 10 in the sequence

1. **C**reate an empty container to contain the results → results = 0
2. **I**terate thru the list using a for/while loop → for data in sequence:
3. **T**est using conditions to see if value adheres to needs → if data > 10:

PROBLEM SOLVING FRAMEWORK FOR DUMMIES (CITU)

- Given the sequence: [3, -4, 12, 9, -72, 0, 15], count the number of elements that are larger than 10 in the sequence



PROBLEM SOLVING FRAMEWORK FOR DUMMIES (CITU)

- Given the sequence: [3, -4, 12, 9, -72, 0, 15], count the number of elements that are larger than 10 in the sequence

1. **C**reate an empty container to contain the results
2. **I**terate thru the list using a for/while loop
3. **T**est using conditions to see if value adheres to needs
4. **U**pdate the value in the results container

The **CITU / CIU** framework applies to most problem sets!!

This depends on whether there is a need to test conditions

SOLVING COUNTING QUESTIONS

- The question format and principle for solving counting questions are as follows:
  - Given the sequence: [3, -4, 12, 9, -72, 0, 15], count the number of positive numbers in the sequence
  - Thought process for solving this problem:

1. Create a counter/tally variable and set count to zero
2. Iterate through the list itself
3. Using a condition, check if the number is positive, if it is positive, I will increment the count by 1
4. Once the iteration end, I will print the counter to illustrate the total number of positive numbers in the sequence

IN-CLASS PRACTICE: UNDERSTANDING FOR LOOPS*

- Given the sequence: [3, -4, 12, 9, -72, 0, 15],
  - Count the number of positive numbers in the sequence

IN-CLASS PRACTICE: UNDERSTANDING FOR LOOPS*

- Given the sequence: [3, -4, 12, 9, -72, 0, 15],
  - Count the number of negative numbers in the sequence

SOLVING SEARCHING QUESTIONS

- The question format and principle for solving counting questions are as follows:
  - Given the sequence: [3, -4, 12, 9, -72, 0, 15], return the largest positive number
  - Thought process for solving this problem:

1. **C**reate a highest_number variable and assign the first value of the list to it
2. **I**terate through the list itself
3. **T**est if the number is larger than the number contained within the highest_number variable
4. **U**pdate the highest_number variable with the current number if it is larger than the number stored in highest_number

IN-CLASS PRACTICE: UNDERSTANDING FOR LOOPS*

- Given the sequence: [3, -4, 12, 9, -72, 0, 15],
  - Find the biggest number in the sequence

IN-CLASS PRACTICE: UNDERSTANDING FOR LOOPS*

- Given the sequence: [3, -4, 12, 9, -72, 0, 15],
  - Find the smallest number in the sequence

AGGREGATION & STATISTICAL TALLY QUESTIONS

- The question format and principle for solving counting questions are as follows:
  - Given the sequence: [3, -4, 12, 9, -72, 0, 15], return the aggregate of the sequence
  - Thought process for solving this problem:

1. **C**reate a total variable and set it to zero
2. **I**terate through the list itself
3. **U**pdate the total_variable by adding current number to total variable (total_variable += num)

IN-CLASS PRACTICE: UNDERSTANDING FOR LOOPS*

- Given the sequence: [3, -4, 12, 9, -72, 0, 15],
  - Find the sum of all the numbers in the sequence

IN-CLASS PRACTICE: UNDERSTANDING FOR LOOPS*

- Given the sequence: [3, -4, 12, 9, -72, 0, 15],
  - Find the mean (average) of the sequence
  - *Hint: Combine the aggregation concept + the counting concept*

OTHER WAYS TO IMPLEMENT A FOR LOOP

- Using the range() function in for loop

```
for i in range(0,5):
        print(i)
print("Peekaboo")
```

Output:

```
0
1
2
3
4
Peekaboo!
```

OTHER WAYS TO IMPLEMENT A FOR LOOP

```
for i in range(0,5):
        print(i)
print("Peekaboo")
```

Same as the following

```
the_list = [0,1,2,3,4]
for i in the_list :
        print(i)
print("Peekaboo")
```

- You can think of range(0,5) as a method that returns you a list: [0,1,2,3,4]
- Observe also that range does not include the last number

IN-CLASS PRACTICE: FILTERING LOOPS USING RANGE*

- Use the “for range” method to count and print the number of positive odd numbers in the following list: [3, -4, 12, 9, -72, 0, 15]

Hint:

1. *len() methods return the size of the list*
2. *Recall that using the index (i.e “list[0]”) function will return you a specific element for the list*

APPLYING THE FUNDAMENTALS TO DICTIONARY

- We learnt how to solve various fundamental types of questions we can solve using a for loop + conditions with list as the datatype. The same exact principle applies to dictionary, just that you have to do some extra

List	Dictionary

seq = [10,20,30,40]
large_num = seq[0]
 	
for i in seq:
  if i > large_num:
  large_num = I
 	
print(large_num)
	seq = {'num_1':10,'num_2':20,'num_3':30}
	large_num = seq['num_1']
	
	for key,value in seq.items():
	  if value > large_num:
	  large_num = value
	
	print(large_num)

APPLYING THE FUNDAMENTALS TO DICTIONARY

- Let's understand it a bit more in detail

```
seq = {'num_1':10,'num_2':20,'num_3':30}
large_num = seq['num_1']

for key,value in seq.items():
    print(key)
    print(value)

print(large_num)
```

By using .items() on a dictionary, it returns two items to you each iteration, instead of the usual 1 items for a list

Key & value are just arbitrary variables I created to contain the two items returned

When I print the 2 of them, we will realise that it is actually just a key, and its associated value

FOOD FOR THOUGHT*

- So how do we for example find the sample of seq?

seq = {‘num_1’:10,’num_2’:20,’num_3’:30}

SUMMARY

- While loops (indefinite)
- Infinite loops
- for loops (definite)
  - Finding the largest/smallest
  - Counting
  - Summing
  - Average
  - Filtering results
- Range for loop
- Dictionary