CS65: Introduction to Computer Science

Sequence
The for Loop

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Topics

- Sequence
    - Strings
    - List

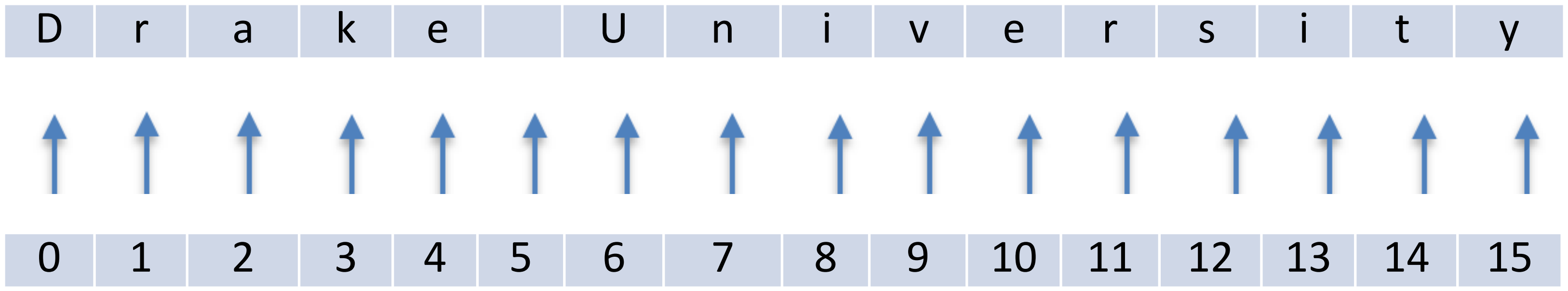
- Two different ways to solve a repetitive task in Python
    - The **for** loop
    - The **while** loop - we already covered

Sequence: Strings

- Sequence is an ordered group of elements (numbers, characters, etc)

- String is a sequence of characters
    - “Drake University”
    - “cs65:introduction_to_computer_science!”

- Each position in a sequence is marked with an **<u>index</u>** or **<u>position</u>**
    - Starts (from left) at position *0* and ends at position (*length-1*)
    - Start indexing from the <u>*left* to *right*</u>

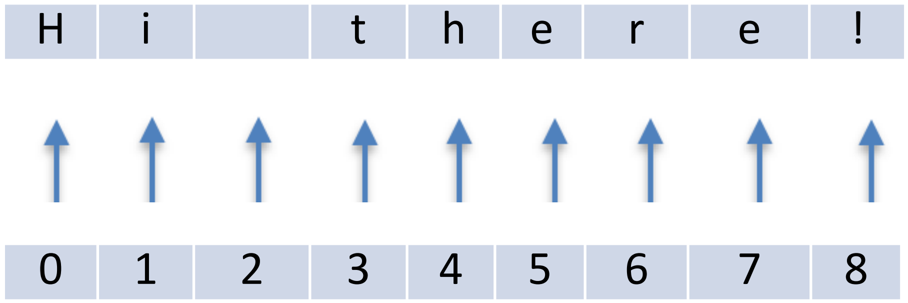


D	r	a	k	e		U	n	i	v	e	r	s	i	t	y
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Strings

- String is a sequence of characters
    - “”
    - “Hi there!”

- Each position is marked with an ***<u>index</u>***
    - <u>What are the lengths of the strings above?</u>
    - Starts (from left) at position *0* and ends at position (*length-1*)



Strings

- String is a sequence of characters
    - "Drake University"
    - "cs65:introduction_to_computer_science!"

- Each position in a sequence is marked with an **index** or **position**
    - Starts (from left) at position *0* and ends at position (*length-1*)
    - Start indexing from the *left* to *right*
    - Python reports with an **IndexError** if the index goes out of bound

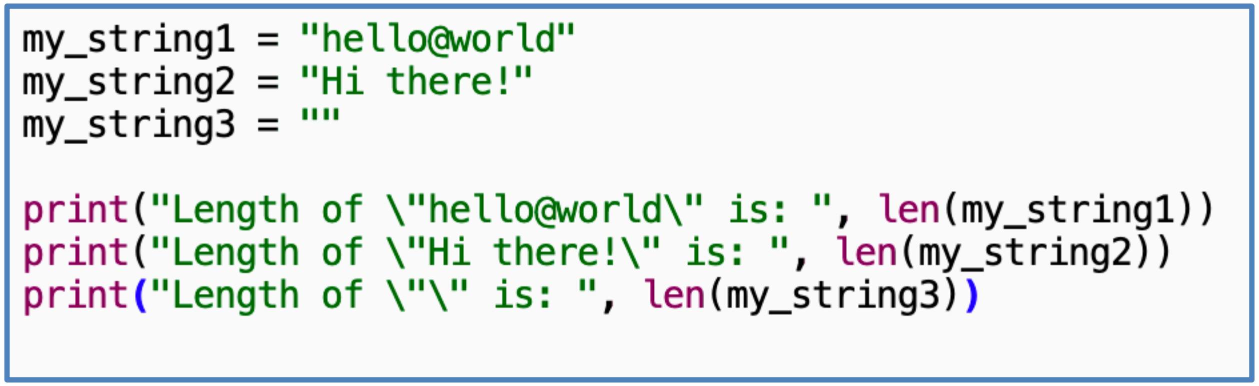
Length of a Sequence

- String is a sequence of characters
    - “”
    - “Hi there!”

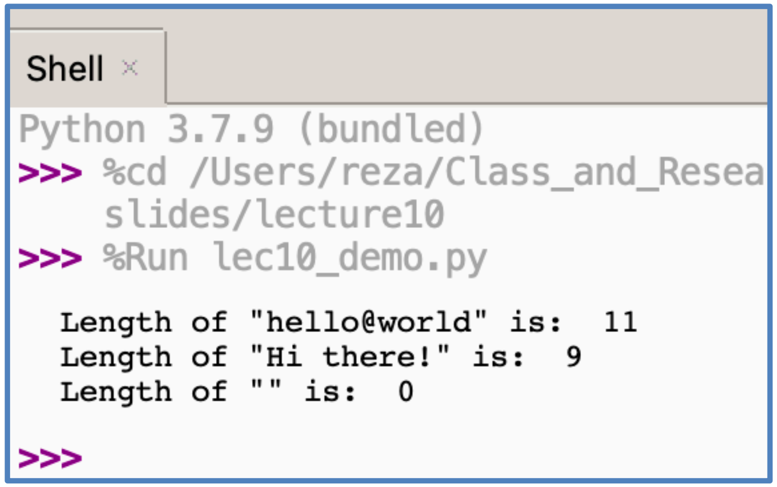
- How can you find the length of a string?
    - Use built-in ***len()*** function

Demo: Length of a Sequence

- How can you find the length of a string?
  - Use built-in ***len()*** function



```
my_string1 = "hello@world"
my_string2 = "Hi there!"
my_string3 = ""

print("Length of \"hello@world\" is: ", len(my_string1))
print("Length of \"Hi there!\" is: ", len(my_string2))
print("Length of \"\" is: ", len(my_string3))
```



```
Python 3.7.9 (bundled)
>>> %cd /Users/reza/Class_and_Resea
    slides/lecture10
>>> %Run lec10_demo.py

  Length of "hello@world" is:  11
  Length of "Hi there!" is:  9
  Length of "" is:  0

>>>
```

Accessing Sequence Items with **Positive** Index Left ———> Right

- String is a sequence of characters
    - my_string1 = “Drake University”

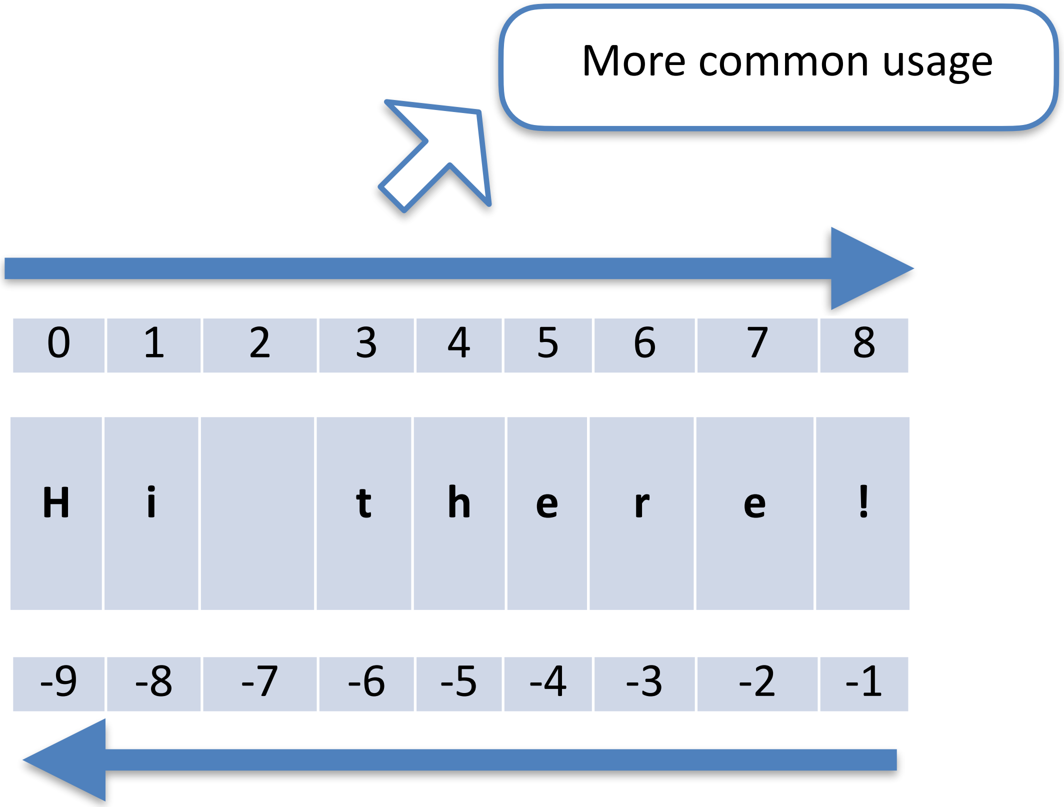
- Access a specific item by appending ***brackets []*** containing an index
    - ***my_string1[0]*** to access *D*
    - ***my_string1[1]*** to access *r*
    - ***my_string1[2]*** to access *a*
    - …
    - ***my_string1[15]*** to access *y*

Accessing Sequence Items with **Negative** Index Left <— — — Right

- String is a sequence of characters and negative indexing begins at the end with a **-1** (not zero anymore)
    - my_string1 = “Drake University”

- Access a specific item by appending ***brackets []*** containing an index
    - ***my_string1[-1]*** to access *y*
    - ***my_string1[-2]*** to access *t*
    - ***my_string1[-3]*** to access *i*
    - …
    - ***my_string1[-16]*** to access *D*

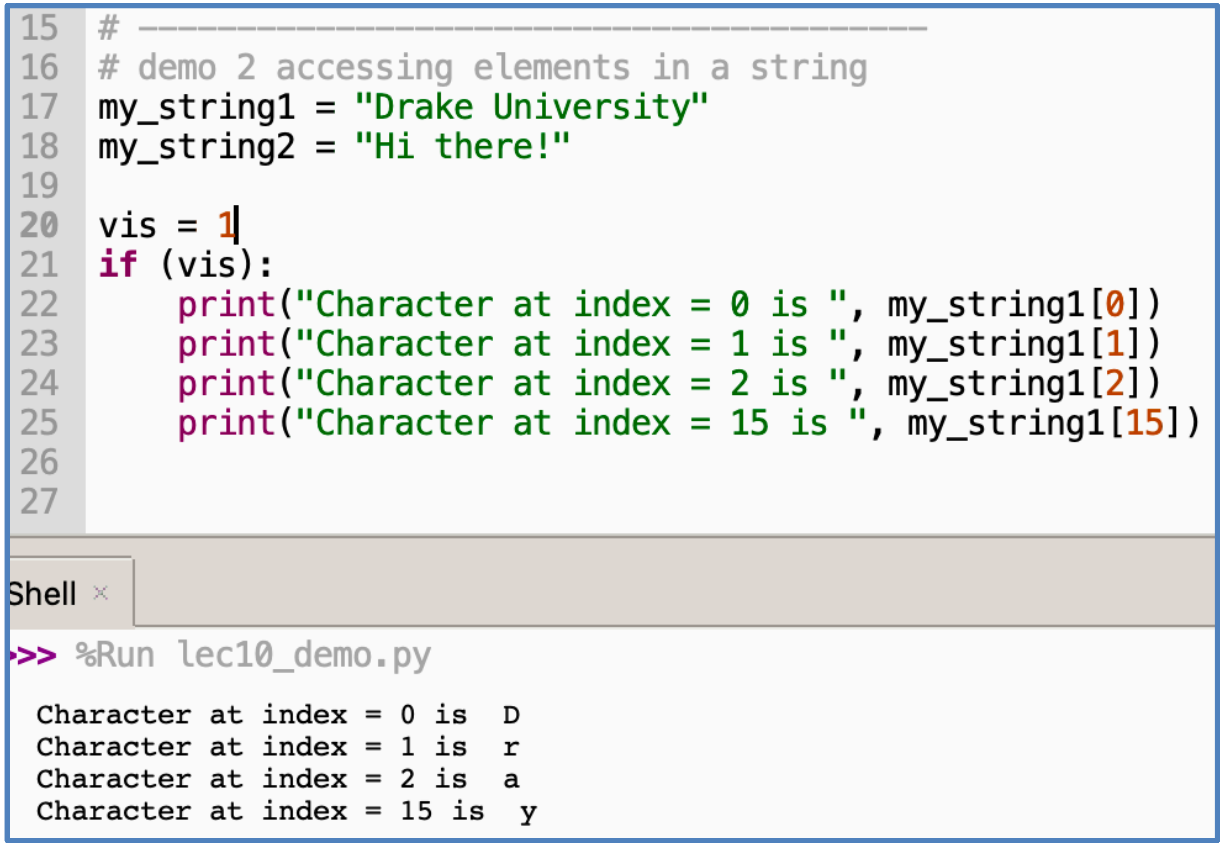
Summary of Indexing



0	1	2	3	4	5	6	7	8
H	**i**		**t**	**h**	**e**	**r**	**e**	**!**
-9	-8	-7	-6	-5	-4	-3	-2	-1

Demo: Accessing Items with Index or Position

- How can you access an item in a sequence?
    - Use ***variable_name[index]***



```
# ----------------------------------------
# demo 2 accessing elements in a string
my_string1 = "Drake University"
my_string2 = "Hi there!"

vis = 1
if (vis):
    print("Character at index = 0 is ", my_string1[0])
    print("Character at index = 1 is ", my_string1[1])
    print("Character at index = 2 is ", my_string1[2])
    print("Character at index = 15 is ", my_string1[15])
```

```
>>> %Run lec10_demo.py

 Character at index = 0 is  D
 Character at index = 1 is  r
 Character at index = 2 is  a
 Character at index = 15 is  y
```

Sequence: List

- Sequence is an ordered group of elements (numbers, characters, etc)

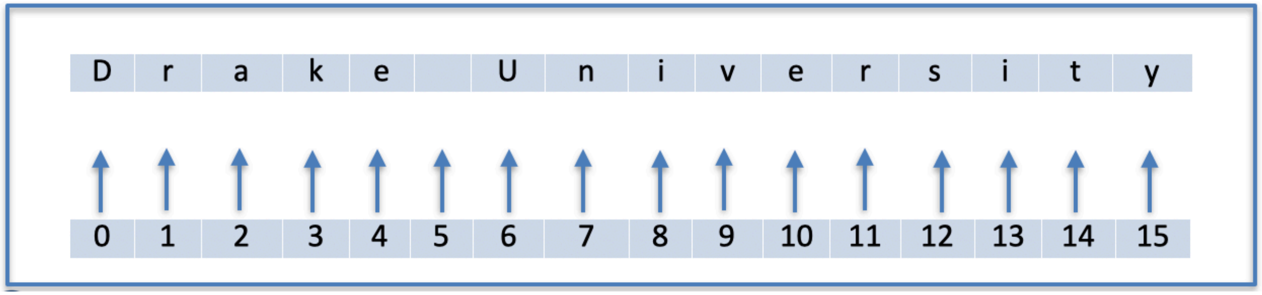
- **String** is a type of sequence whose members are characters
    - “Drake University”
    - “cs65:introduction_to_computer_science!”

- **List** is another type of sequence whose members can be numbers, strings, or even another list!
    - [“Drake University”, “hello”, “world”]
    - [1, 2, 3, 4, 5]
    - List will be discussed in greater detail in a separate lecture

Poll: String and index

- Please participate in poll below
  - https://tinyurl.com/zj4nvr2v

Previous example's reference in case that is helpful!



D	r	a	k	e		U	n	i	v	e	r	s	i	t	y
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Topics

- Sequence

- Two different ways to solve a repetitive task in Python
  - The **for** loop
  - The **while** loop

Solving Repetitive Task with for Loop

- Designed to solve a repetitive task — runs a block of code for a finite number of times

- Why do we need this alternative to while loop?
  - When we need to iterate for a finite number: **<u>count-controlled</u>**
  - When the location information is important for a task
  - When we need to access or update locations of sequence:
    - From beginning-to-end
    - From end-to-beginning

Solving Repetitive Task with **for** loop

- for loop
  - use it when there is a fixed & finite number of iterations
    - "Do a calculation *10 or N* times"
    - "Do a calculation from first to last item in a sequence"

Boolean expression

- while loop
  - use it for an indefinite number of iterations based on a condition:
    - "Do until user enters END"
    - "Do until the number becomes negative"
    - "Do until we reach the end of the file with a special marker"

Syntax of **<u>for</u>** loop

- **for** variable **in** [val_1, val_2, …, val_5] **:**
    statements

- This is also called **value for loop**
    - There is another form called **index for loop**

- Statements will be repeated sequentially from first to last item in a sequence (here it will be repeated 5 times since there are 5 numbers in the List)
    - <u>Iteration 1:</u> <u>variable</u> will be assigned **val_1**
    - <u>Iteration 2:</u> <u>variable</u> will be assigned **val_2**
    - …
    - <u>Iteration 15:</u> <u>variable</u> will be assigned **val_5**

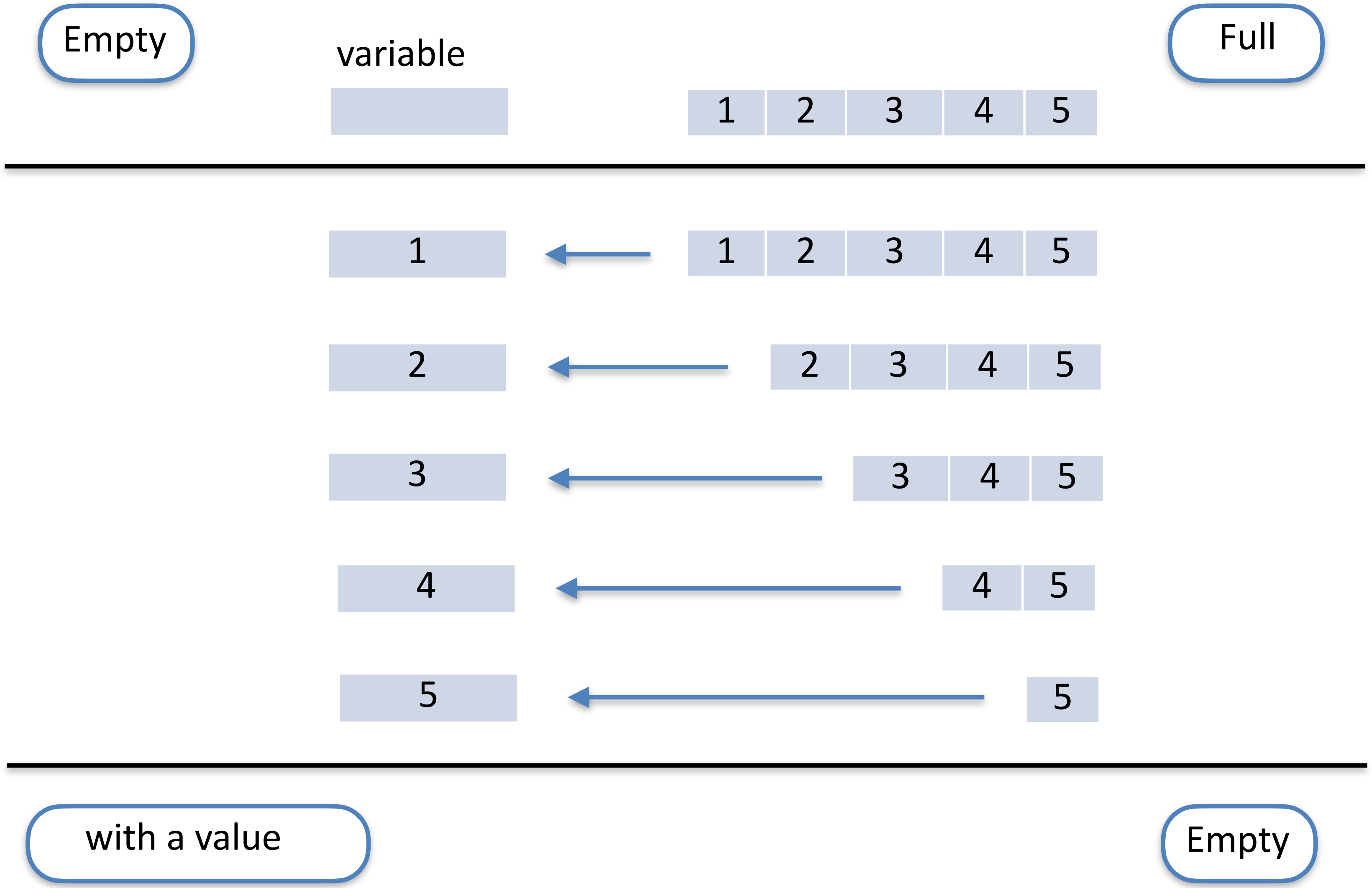
Syntax of **for** loop: concrete example

- **for** variable **in** [1, 2, …, 5] **:**
  statements

- Statements will be repeated sequentially from first to last item in a sequence (here it will be repeated 5 times since there are 5 numbers in the List)
  - Iteration 1: variable will be assigned **1**
  - Iteration 2: variable will be assigned **2**
  - …
  - Iteration 5: variable will be assigned **5**

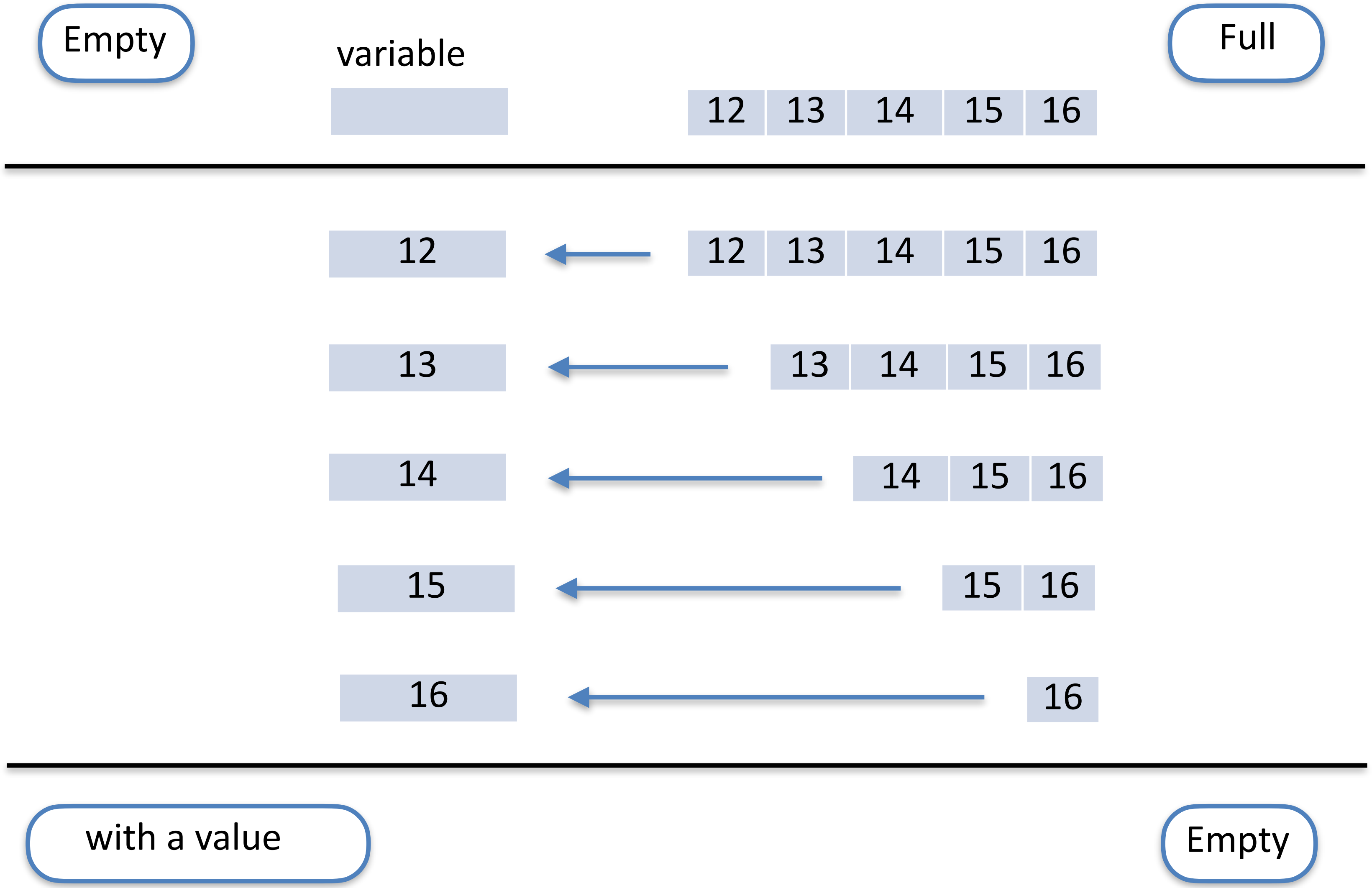
For loop: concrete visualization

```
for variable in [1, 2, …, 5] :
        statements
```



For loop: concrete visualization

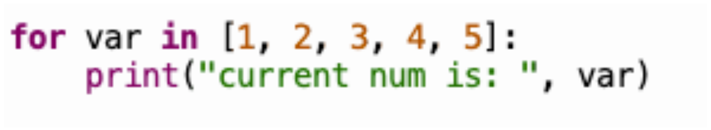
```
for var in [12, 13, 14, 15, 16]:
    print("current num is: ", var)
```



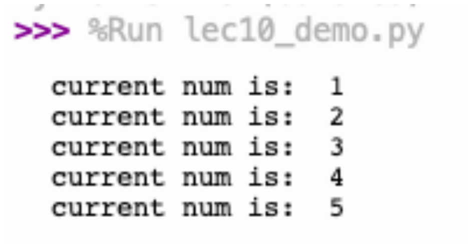
Demo: **for** loop

- **for** var **in** [1, 2, …, 5] **:**
  statements

- Python code: here statement is a simple print() function call



```
for var in [1, 2, 3, 4, 5]:
    print("current num is: ", var)
```



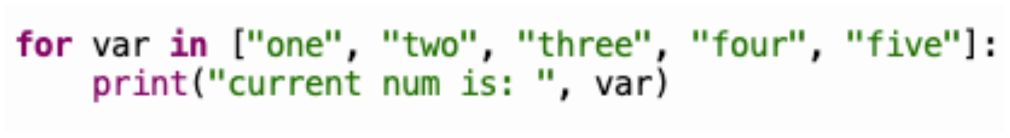
```
>>> %Run lec10_demo.py

  current num is:  1
  current num is:  2
  current num is:  3
  current num is:  4
  current num is:  5
```

Demo: **for** loop with sequence of strings

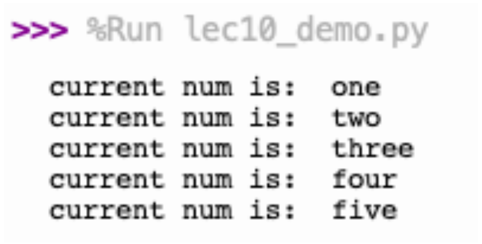
- **for** var **in** [“one”, “two”, “three”, “four”, “five”] **:**

  statements

- Python code: here statement is a simple print() function call



```
for var in ["one", "two", "three", "four", "five"]:
    print("current num is: ", var)
```



```
>>> %Run lec10_demo.py

  current num is:  one
  current num is:  two
  current num is:  three
  current num is:  four
  current num is:  five
```

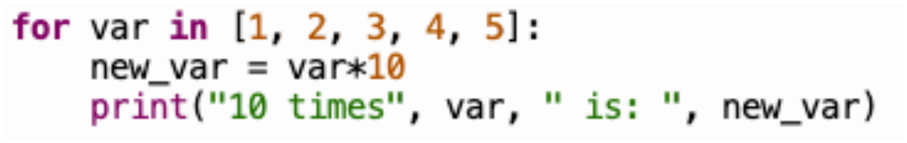
Demo: **for** loop doing more than mere print

- **for** var **in** [1 , 2, 3, 4, 5] **:**

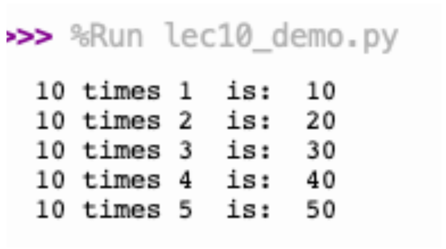
  new_var = var*10

  print(“10 times”, var, “ is ”, new_var)

- Python code



```
for var in [1, 2, 3, 4, 5]:
    new_var = var*10
    print("10 times", var, " is: ", new_var)
```



```
>>> %Run lec10_demo.py

 10 times 1  is:  10
 10 times 2  is:  20
 10 times 3  is:  30
 10 times 4  is:  40
 10 times 5  is:  50
```

Syntax of **for** loop vs Syntax of **while** loop

- **for** variable **in** [val_1, val_2, …, val_{15}] **:**
  statements

- Statements will be repeated sequentially from first to last item in a sequence

checking a condition

- **while condition expression :**

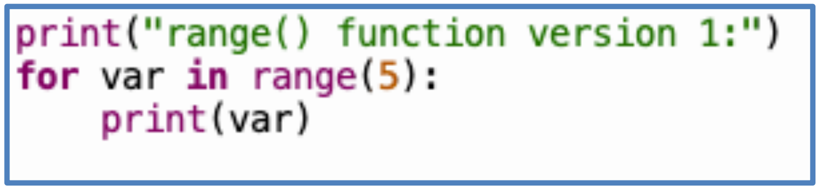
  statements

- **condition expression**: a boolean expression

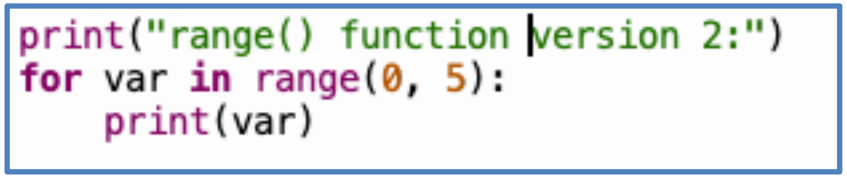
- **statements** will repeatedly be executed until the **condition expression** becomes False

Function *range*()

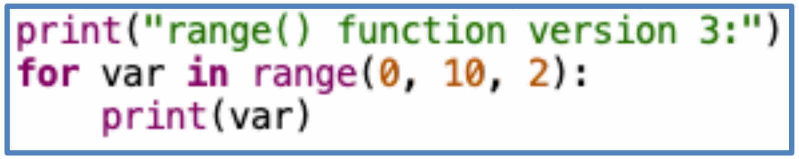
- The *range*() function simplifies the process of for loop writing
- Creates a sequence of numbers on the fly
- These numbers can be used to index the sequence
- It can be called with several variations



```python
print("range() function version 1:")
for var in range(5):
    print(var)
```



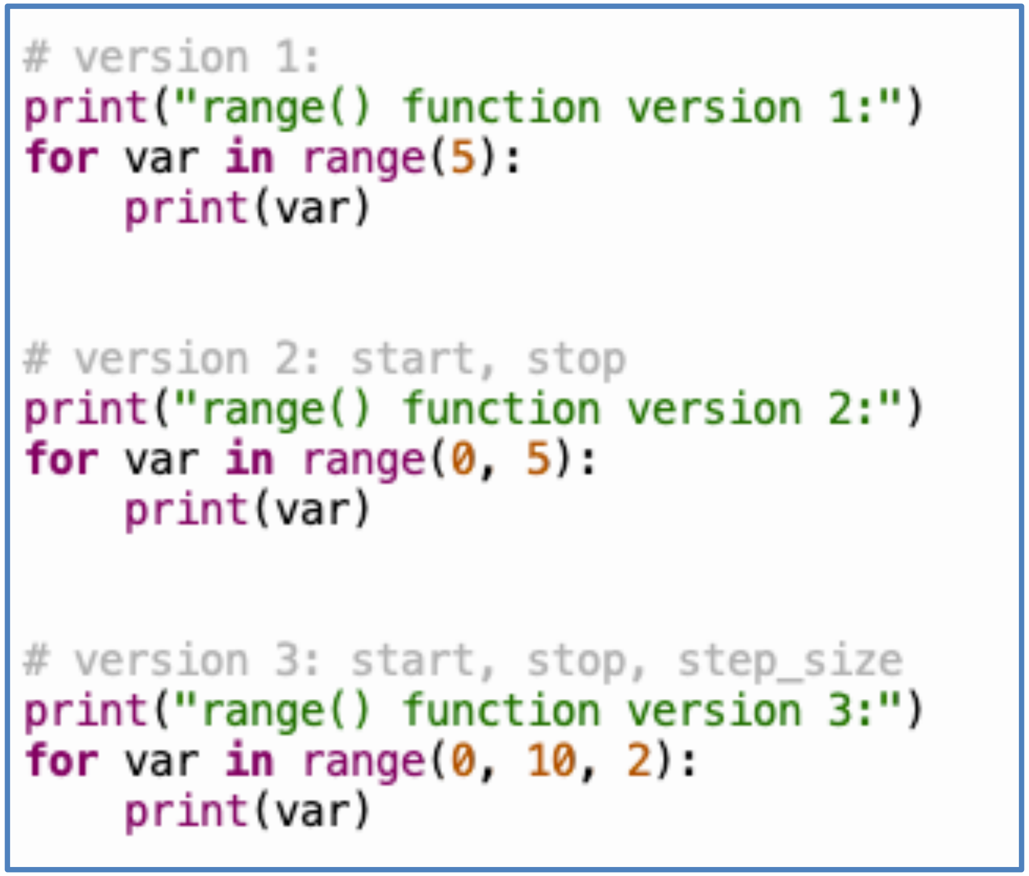
```python
print("range() function version 2:")
for var in range(0, 5):
    print(var)
```



```python
print("range() function version 3:")
for var in range(0, 10, 2):
    print(var)
```

Demo: Function ***range***()

- The ***range***() function simplifies the process of for loop writing
- It can be called with several variations



```
# version 1:
print("range() function version 1:")
for var in range(5):
    print(var)


# version 2: start, stop
print("range() function version 2:")
for var in range(0, 5):
    print(var)


# version 3: start, stop, step_size
print("range() function version 3:")
for var in range(0, 10, 2):
    print(var)
```

Value **for** loop vs **Index** **for** loop

- So far we have seen the syntax of **value** **for loop**

```
for var in [10, 20, 30, 40, 50] :
        print(var)
```

- There is another form called **index** **for loop**

```
my_list = [10, 20, 30, 40, 50]
length = len(my_list)
for i in range(length) :
        print( my_list[i] )
```

common practice is to name the index variables with **i, j,** or **k**

Value **for** loop vs Index **for** loop

- **value for loop**
  - directly assigns a value to the variable from the sequence
  - don't keep track of the indices
  - we have access to only value
    - **good**

- **index for loop**
  - generates all the indices of all elements in the list
  - each element can be accessed indirectly by that index
  - we have access to both i) index and ii) value
    - **better!**

Exercise 1:

- Write a code that will do the following:
    - prompt the user for an integer (between 1 to 100)
    - then **computes** the sum of all number from 0 to the given number

- **You have done it using while loop last time, now try it with for loop**

Exercise 2

- Write a code that will do the following:
  - prompt the user for an integer number (between 1 to 100)
  - then **prints** all the even numbers between 0 and the given number

- **You have done it using while loop last time, now try it with for loop**