BRANCHING, ITERATION

6.0001 LECTURE 2

TODAY

- string object type
- branching and conditionals
- indentation
- iteration and loops

STRINGS

- letters, special characters, spaces, digits
- enclose in **quotation marks or single quotes**

```
hi = "hello there"
```

“123"

- **concatenate** strings (addition)

```
name = "ana"

greet = hi + name

greeting = hi + " " + name
```

- **Repetition operation**

```
silly = name * 3 = name + name + name
```

Errors

- Error 1: NameError: name 'a' is not defined

```
>>> a
```

Because a is not a literal of any type, the interpreter treats it as a name. But that name is not bound to any object, attempting to use it causes a runtime

- Error 2: TypeError: can't multiply sequence by non-int of type 'str'

```
>>> 'a'*'a'
```

Other operations can be used in str type

1. Length of a String:

- Use len() to find the length of a string
  - Ex: len('abc') returns 3.

2. Indexing:

- To get individual characters from a string using indexing, which starts at 0
  - Ex: 'abc'[0] gives ‘a'
- Negative indices start from the end of the string.
  - Ex: 'abc'[-1] returns 'c’

3. Slicing:

- To get a part of the string.
- Syntax s[start:end] which returns the substring from start to end
  - Ex: 'abc'[1:3] returns 'bc’
- Omitting the start value defaults it to 0, and omitting the end value defaults it to the string’s length.
  - 'abc'[:] is the same as 'abc'[0:3]

INPUT/OUTPUT: `print`

- used to **output** stuff to console
- keyword is `print`

```
x = 1
print(x)
x_str = str(x)
print("my fav num is", x, ".", "x =", x)
print("my fav num is " + x_str + ". " + "x = " + x_str)
```

INPUT/OUTPUT: `input("")`

- prints whatever is in the quotes
- user types in something and hits enter
- binds that value to a variable

```
text = input("Type anything... ")
print(5*text)
```

- `input` **gives you a string** so must cast if working with numbers

```
num = int(input("Type a number... "))
print(5*num)
```

COMPARISON OPERATORS ON `int, float, string`

- `i` and `j` are variable names
- comparisons below evaluate to a Boolean

`i > j`
`i >= j`
`i < j`
`i <= j`

used to compared 2 strings ex: 'a' > 'ab'
or 2 numbers only ex: 3 > 2

`i == j` → **equality** test, `True` if `i` is the same as `j`

`i != j` → **inequality** test, `True` if `i` not the same as `j`

LOGIC OPERATORS ON bools

- `a` and `b` are variable names (with Boolean values)

`not a` → `True` if `a` is `False`
`False` if `a` is `True`

`a and b` → `True` if both are `True`

`a or b` → `True` if either or both are `True`

A	B	A and B	A or B
True	True	True	True
True	False	False	True
False	True	False	True
False	False	False	False

COMPARISON EXAMPLE

```
pset_time = 15
sleep_time = 8
print(sleep_time > pset_time)
derive = True
drink = False
both = drink and derive
print(both)
```

CONTROL FLOW – BRANCHING- conditional statement

```
if <condition>:
    <expression>
    <expression>
    ...
```

```
if <condition>:
    <expression>
    <expression>
    ...
else:
    <expression>
    <expression>
    ...
```

```
if <condition>:
    <expression>
    <expression>
    ...
elif <condition>:
    <expression>
    <expression>
    ...
else:
    <expression>
    <expression>
    ...
```

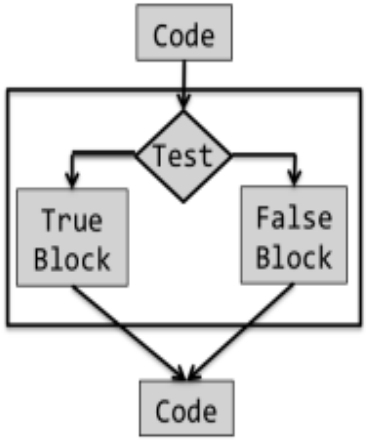


Figure 2.3 Flow chart for conditional statement

- `<condition>` has a value `True` or `False`
- evaluate expressions in that block if `<condition>` is `True`

if x < y and x < z → compound Boolean expression

INDENTATION

- matters in Python
- how you denote blocks of code

```
x = float(input("Enter a number for x: "))
y = float(input("Enter a number for y: "))
if x == y:
    print("x and y are equal"
    if y != 0
        print("therefore, x / y is", x/y
elif x < y:
    print("x  s smaller"
else:
    print("y  s smaller"
print("thanks!")
```

nested

= vs ==

```
x = float(input("Enter a number for x: "))
y = float(input("Enter a number for y: "))
if x == y:
    print("x and y are equal")
    if y != 0:
        print("therefore, x / y is", x/y)
elif x < y:
    print("x is smaller")
else:
    print("y is smaller")
print("thanks!")
```

What if x = y here?

get a SyntaxError

CONTROL FLOW: Iteration

`while` LOOPS

```
while <condition>:
    <expression>
    <expression>
    ...
```

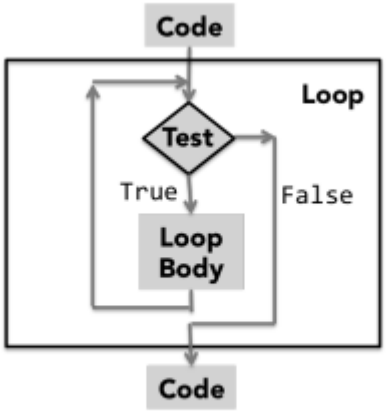


Figure 2.4 Flow chart for iteration

- `<condition>` evaluates to a Boolean
- if `<condition>` is `True`, do all the steps inside the while code block
- check `<condition>` again
- repeat until `<condition>` is `False`

CONTROL FLOW: `for` LOOPS

```
for <variable> in range(<some_num>):
    <expression>
    <expression>
    ...
```

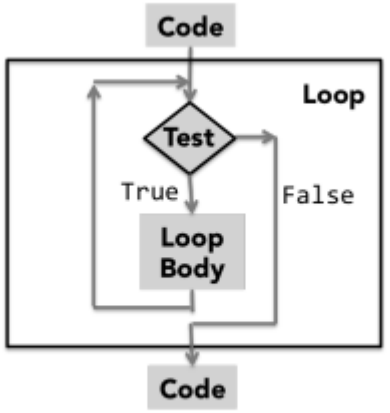


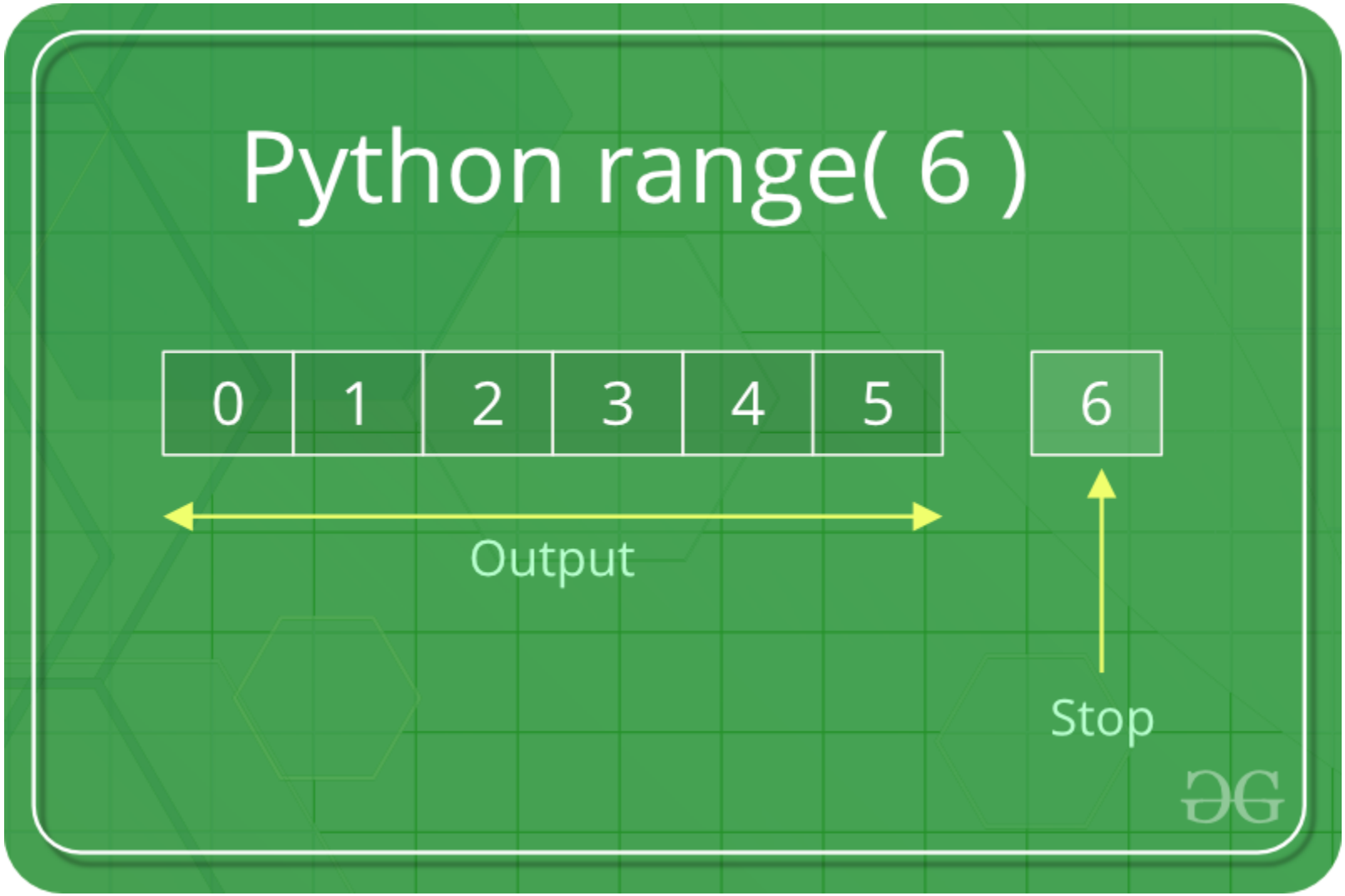
Figure 2.4 Flow chart for iteration

- each time through the loop, `<variable>` takes a value
- first time, `<variable>` starts at the smallest value
- next time, `<variable>` gets the prev value + 1
- etc.

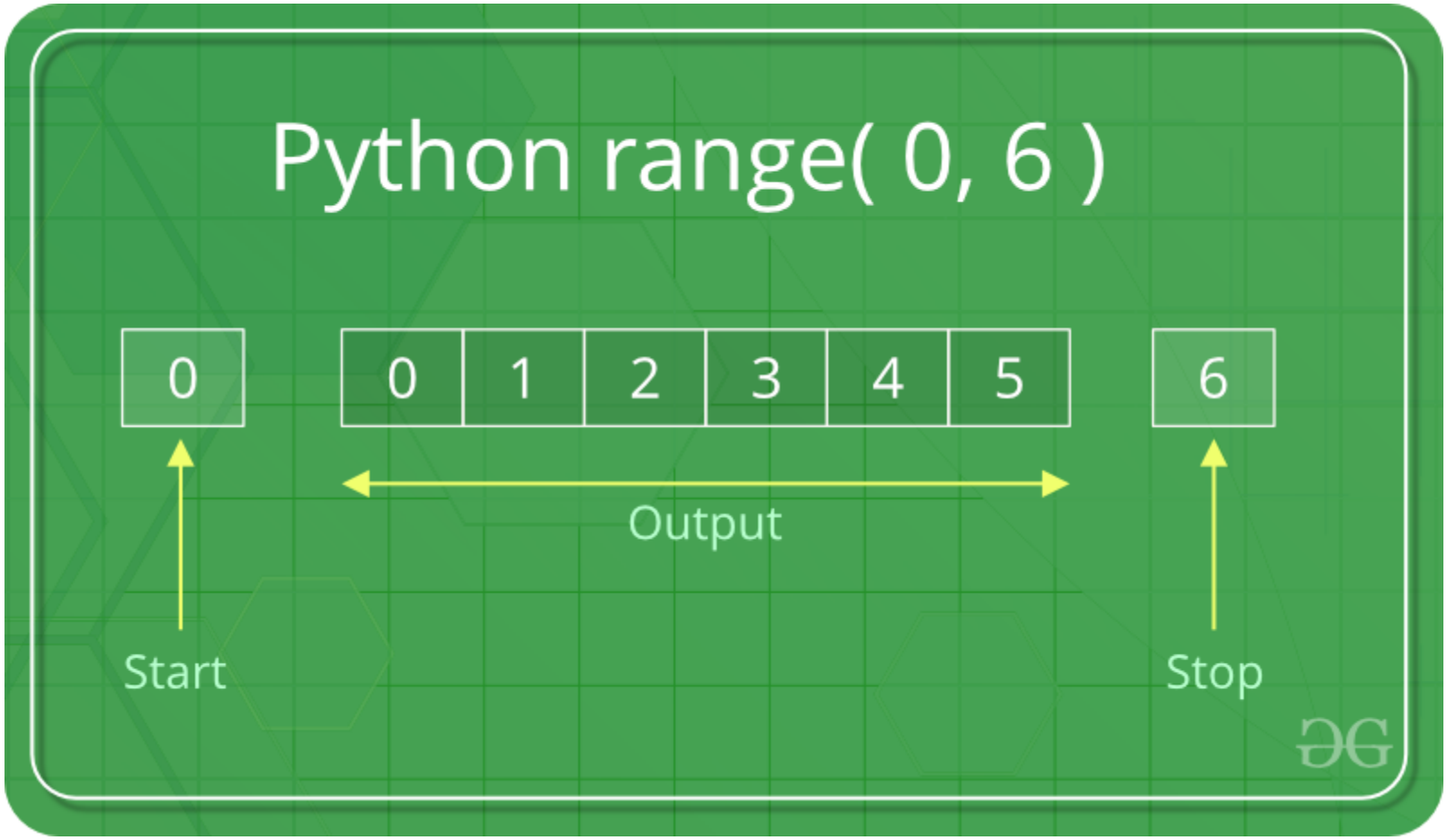
`range(start,stop,step)`

- *start: [optional] start value of the sequence. Default value = 0*
- *stop: next value after the end value of the sequence. loop until value is stop - 1*
- *step: [optional] integer value, denoting the difference between any two numbers in the sequence*

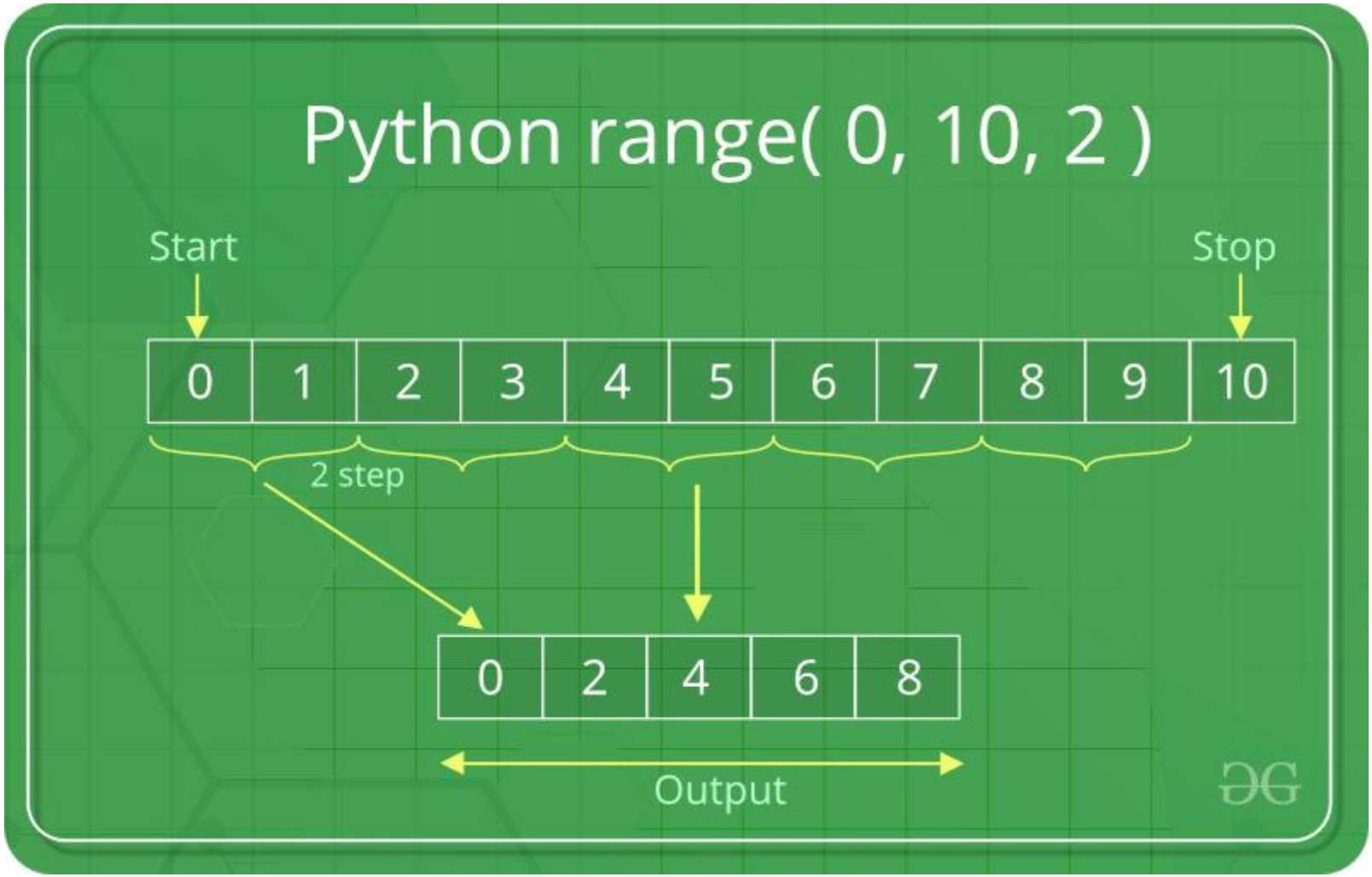
Python range (stop)



Python range (start, stop)



Python range (start, stop, step)



Important points to remember about range() function

•The range() function only works with integers, i.e. whole numbers.

•All arguments must be integers. Users can not pass a string or float number or any other type in a **start**, **stop,** and **step** argument of a range().

•All three arguments can be positive or negative.

•The **step** value must not be zero. If a step is zero, python raises a ValueError exception.

•Users can access items in a range() by index, just as users do with a list. (Explain in next page)

1. Accessing elements in range by index:

```
r = range(5, 15)  # This creates a range object with numbers from 5 to 14
print(r[0])  # Output: 5
print(r[4])  # Output: 9
print(r[-1]) # Output: 14
```

2. Iterating over elements in a range object:

```
r = range(3, 8)  # This creates a range object with numbers from 3 to 7
for i in range(len(r)):
    print(r[i])

#Output: 3 4 5 6 7
```

3. Slicing a range object:

```
r = range(20, 30)  # This creates a range object with numbers from 20 to 29
sliced_range = r[2:5]
print(list(sliced_range))  # Output: [22, 23, 24]
```

`break` STATEMENT

- immediately exits whatever loop it is in
- skips remaining expressions in code block
- exits only innermost loop!

```
while <condition_1>:
    while <condition_2>:
        <expression_a>
        break
        <expression_b>
    <expression_c>
```

`break` STATEMENT

```
mysum = 0
for i in range(5, 11, 2):
    mysum
     f mysum == 5
        break
        mysum += 1
print(mysum)
```

- what happens in this program?

`for` VS `while` LOOPS

`for` loops

- **know** number of iterations
- can **end early** via `break`
- uses a **counter**
- **can rewrite** a `for` loop using a `while` loop

`while` loops

- **unbounded** number of iterations
- can **end early** via `break`
- can use a **counter but must initialize** before loop and increment it inside loop
- **may not be able to rewrite** a `while` loop using a `for` loop

`while` and `for` LOOPS examples

- iterate through numbers in a sequence

```
# more complicated with while loop
n = 0
while n < 5:
    print(n)
    n = n+1


# shortcut with for loop
for n in range(5):
    print(n)
```