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:stop] which returns the substring from start to stop-1
  - 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

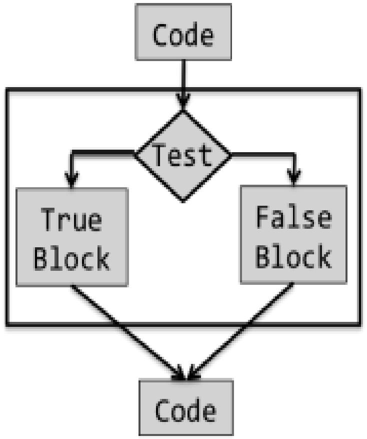
```
pset_time = 15
sleep_time = 8
print(sleep_time > pset_time)
derive = True
drink = False
both = drink and derive
print(both)
```

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>
    ...
```



igure 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>
    ...
```

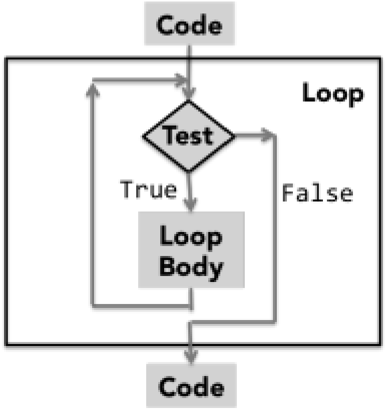


Figure 2.4 Flow chart for iteration

- <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>
    ...
```

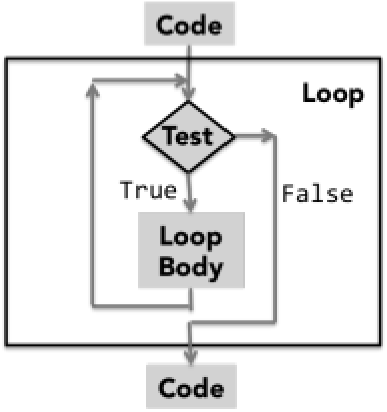


Figure 2.4 Flow chart for iteration

- 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.

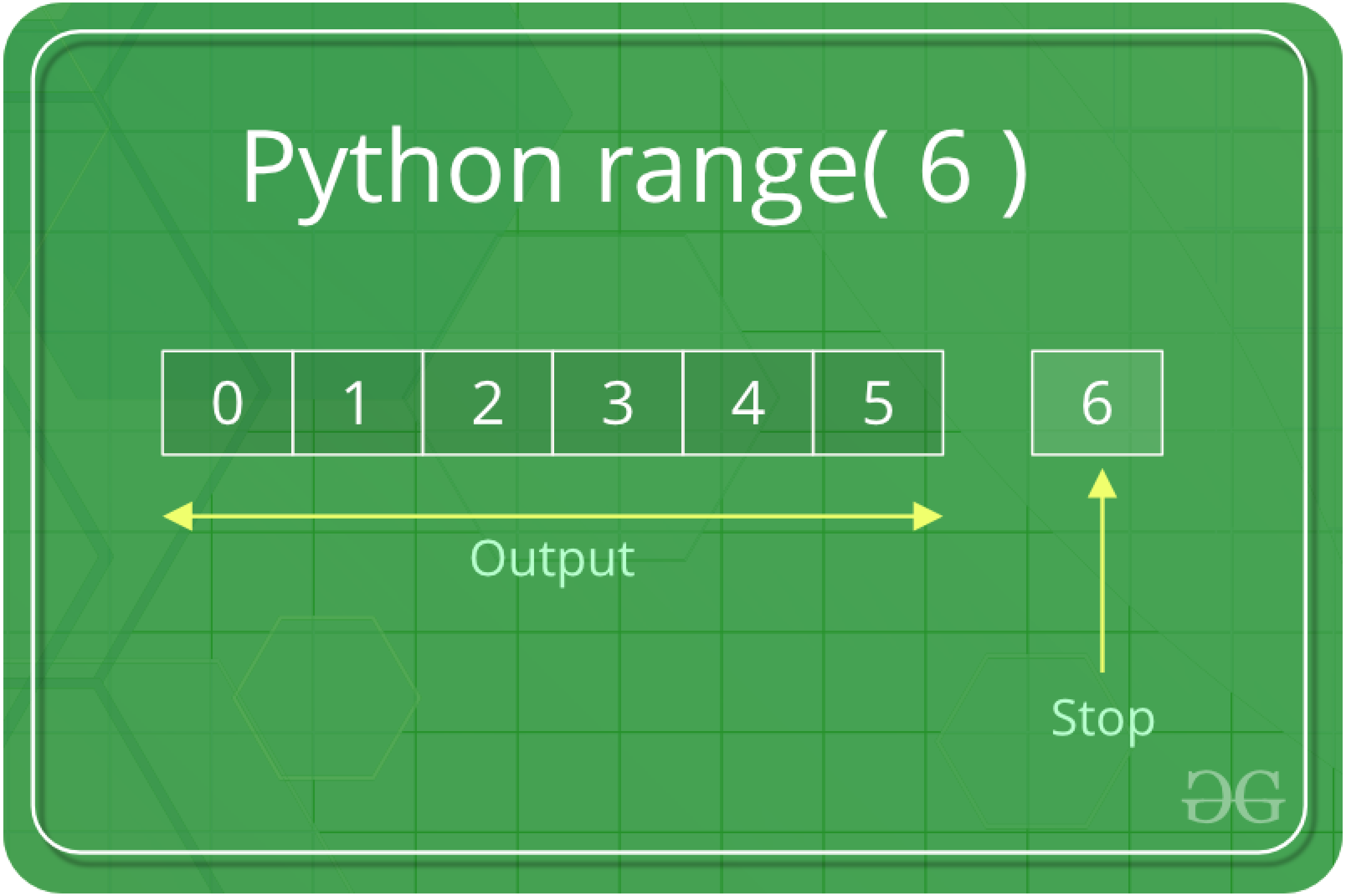
range(start,stop,step)

- *start: [optional] start value of the sequence. Default value = 0*
- *stop: next value after the end value of the sequence. loop until value is*

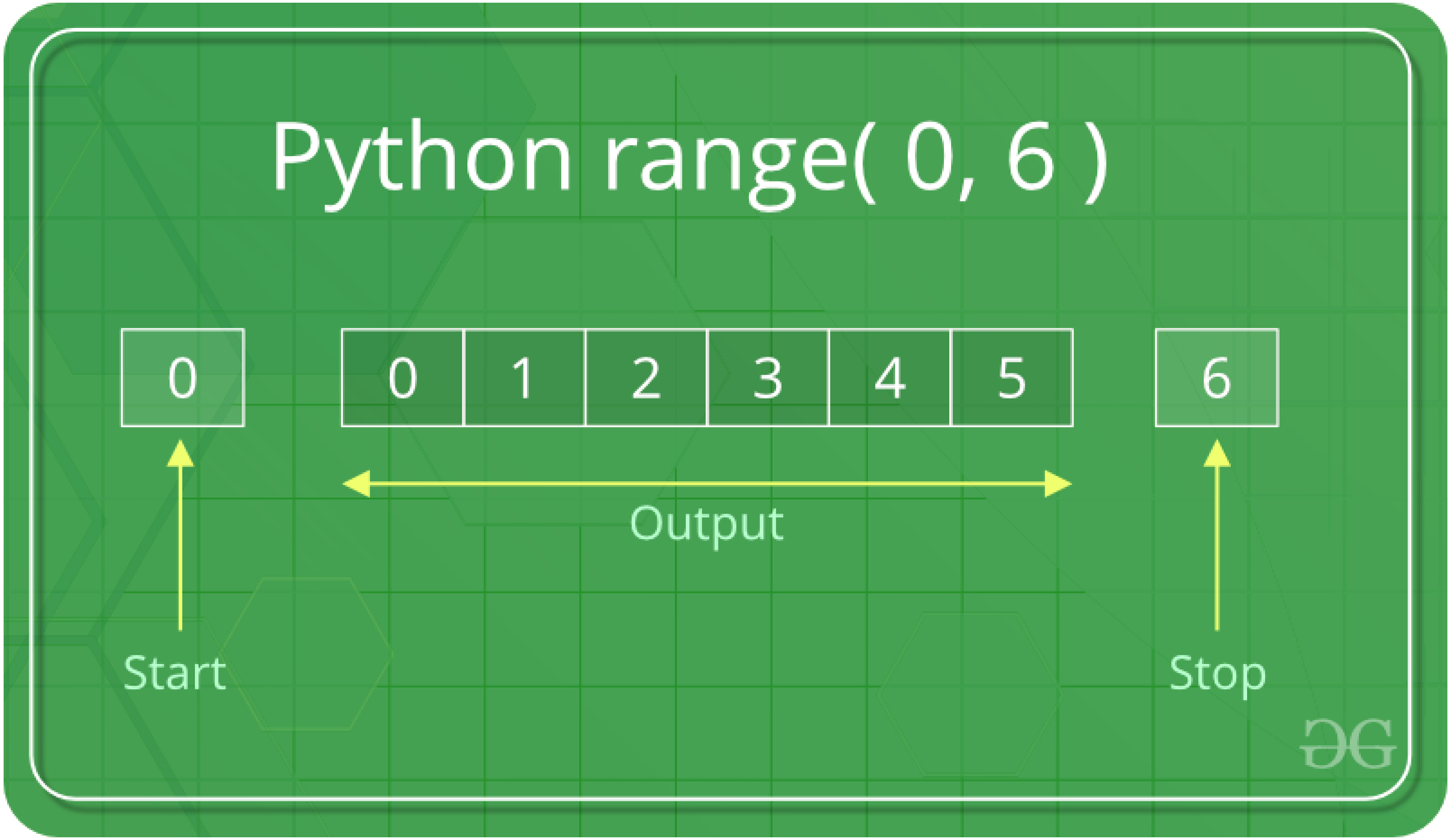
stop - 1

- *step: [optional] integer value, denoting the difference between any two numbers in the sequence*

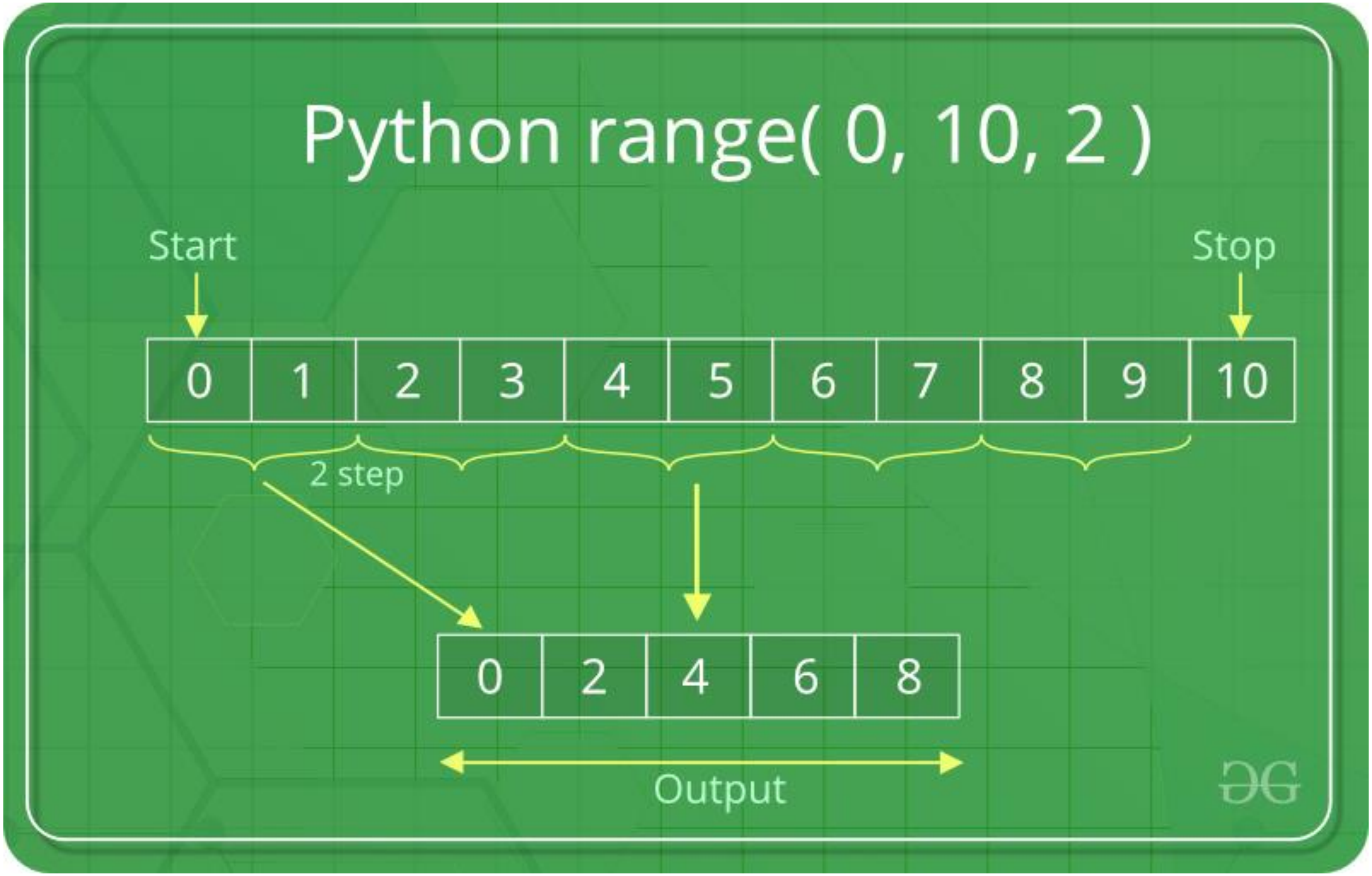
Python range (stop)



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
- Must initialize **counter** before using while 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)
```