

Lecture 4

1

**CORE ELEMENTS
COLLECTIONS
&
REPETITION**

What we have seen so Far

2

- What variables are
- Introduced the notion of Functions & Parameters
- Selection Structure (branching)
- How to do simple repetitions/iterations

Overview

3

- How to represent a collection of values?
 - Tuples
 - Lists
- Mutable, Immutable object
- For Loops
- While Loops

Data Types

4

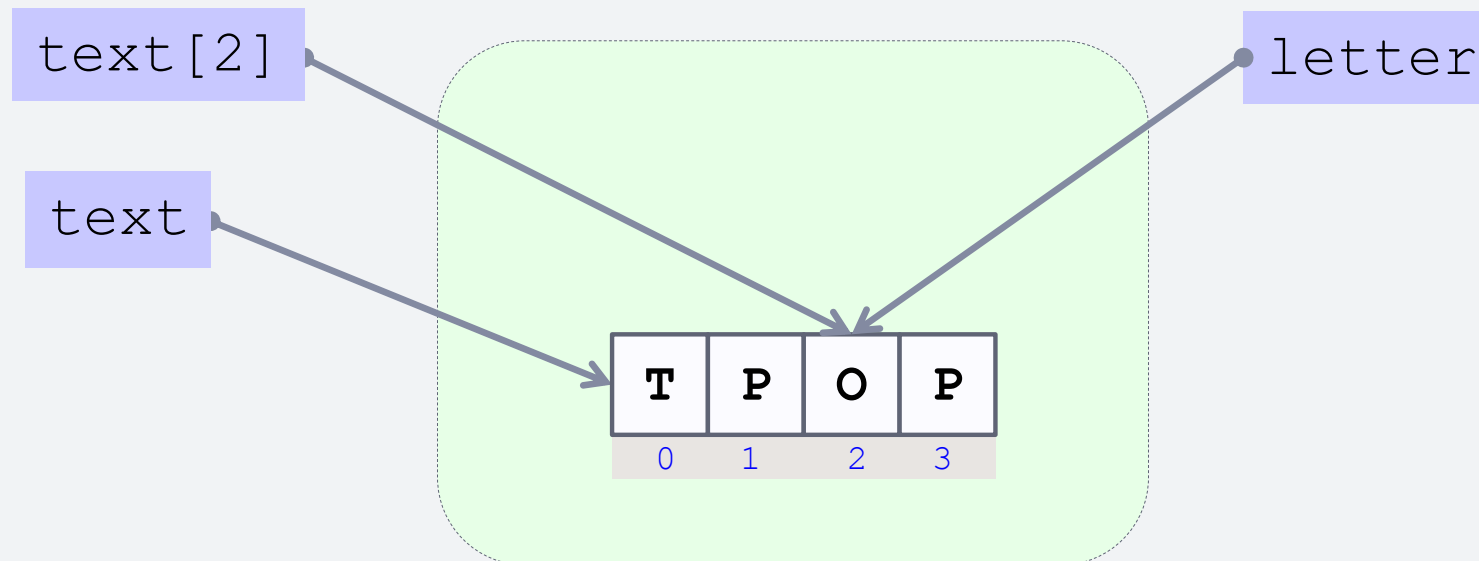
- We have seen numbers
 - int: whole number
 - float: decimal point
 - boolean (True, False)
- String
 - str: “a word”
- What about a collection of data?

String (str)

5

- A kind of collection of characters

```
>>> text = 'TPOP'  
>>> letter = text[2] # Accessing the third element  
>>> letter  
'O'
```



Tuples in Python

6

- Tuples are immutable objects, e.g. we CANNOT modify their contents.

Code

```
>>> my_tuple = (1, 10, 4, 5) # tuple creation ( , )
>>> my_tuple[2]           # Accessing the third element
4
>>> my_tuple
(1, 10, 4, 5)
>>> my_tuple[2] = 9 # Modifying the third element
```

```
Traceback (most recent call last):
```

```
  File "<pyshell#15>", line 1, in <module>
```

```
    my_tuple [2] = 9
```

```
TypeError: 'tuple' object does not support item
assignment
```

```
>>>
```

Tuples in Python

7

- Tuples are immutable objects, e.g. we CANNOT modify their contents.

Code

```
>>> my_t = (1, 10, 4, 5) # tuple creation ( , )
>>> my_t[1]
10
>>> my_t = my_t[:2] + (9,) + my_t[3:] # Modifying the
third element
>>> my_t
(1, 10, 9, 5)
```

- Note that numbers and strings are immutable too.

Lists in Python

8

- Lists are mutable objects, e.g. we can modify their contents.

Code

```
>>> my_list = [1, 10, 4, 5] # List creation [ ]
>>> my_list[2]             # Accessing the third element
4
>>> my_list
[1, 10, 4, 5]
>>> my_list[2] = 9 # Modifying the third element
>>> my_list         # The modified list
[1, 10, 9, 5]
>>>
```


Be Careful

9

- Example:

Code

```
>>> lst1 = lst2 = [2, 4, 6, 8]
>>> t1 = t2 = (1, 3, 7, 9)
>>> lst1
[2, 4, 6, 8]
>>> lst2
[2, 4, 6, 8]
>>> t1
(1, 3, 7, 9)
>>> t2
(1, 3, 7, 9)
>>>
```

Be Careful

10

- Example:

Code

```
>>> t2 = t2[:2] + (5, ) + t2[3:] # Modifying the third  
element t2  
>>> lst2[2] = 5 # Modifying the third element of lst2  
>>> t1  
(1, 3, 7, 9)  
>>> t2  
(1, 3, 5, 9)  
>>>
```

A change in t2 **does not** affect t1

Be Careful

11

- Example:

Code

```
>>> t2 = t2[:2] + (5, ) + t2[3:] # Modifying the third  
element t2  
>>> lst2[2] = 5 # Modifying the third element of lst2  
>>> t1  
(1, 3, 7, 9)  
>>> t2  
(1, 3, 5, 9)  
>>> lst1  
[2, 4, 5, 8]  
>>> lst2  
[2, 4, 5, 8]  
>>>
```

A change in t2 **does not** affect t1

A change in lst2 **does** affect lst1

Be Careful

12

- State Diagram:

Code

```
>>> lst1 = lst2 = [2,4,6,8]  
>>>
```

lst1

lst2

2	4	6	8
0	1	2	3

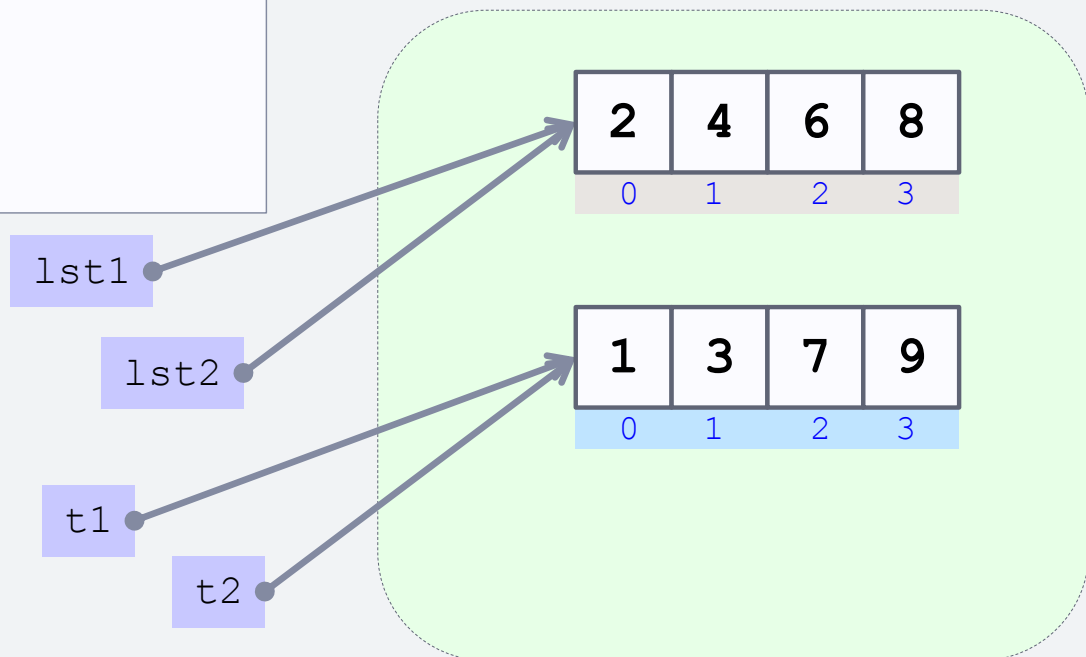
Be Careful

13

- State Diagram:

Code

```
>>> lst1 = lst2 = [2,4,6,8]  
>>> t1 = t2 = (1,3,7,9)  
>>>
```



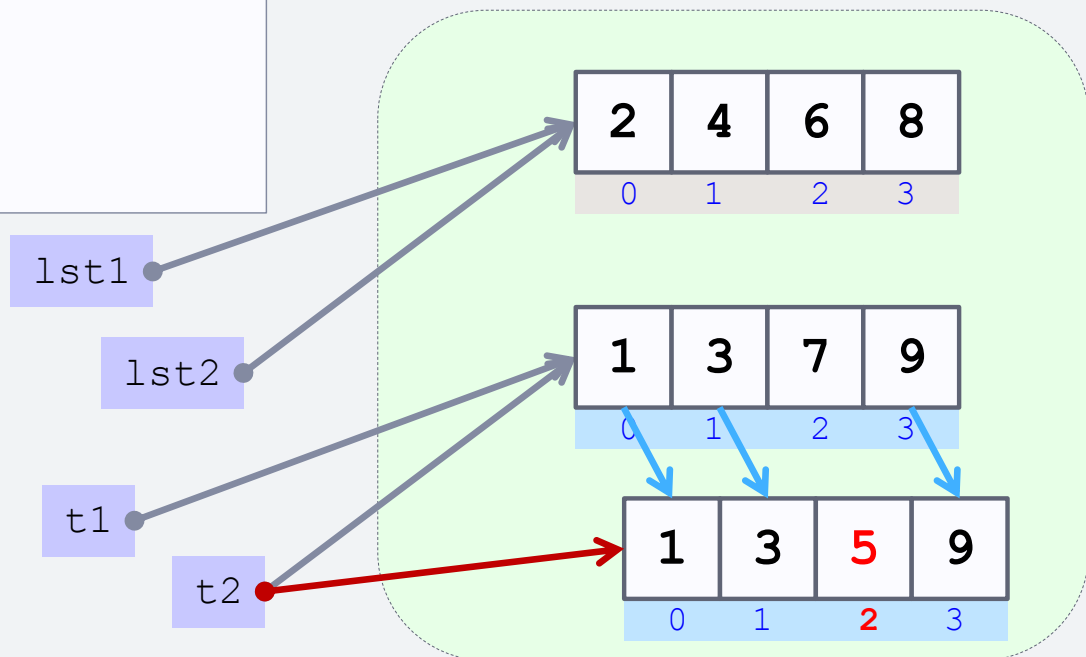
Be Careful

14

- State Diagram:

Code

```
>>> lst1 = lst2 = [2,4,6,8]
>>> t1 = t2 = (1,3,7,9)
>>> t2 = t2[:2] + (5, ) + t2[3:]
>>>
```



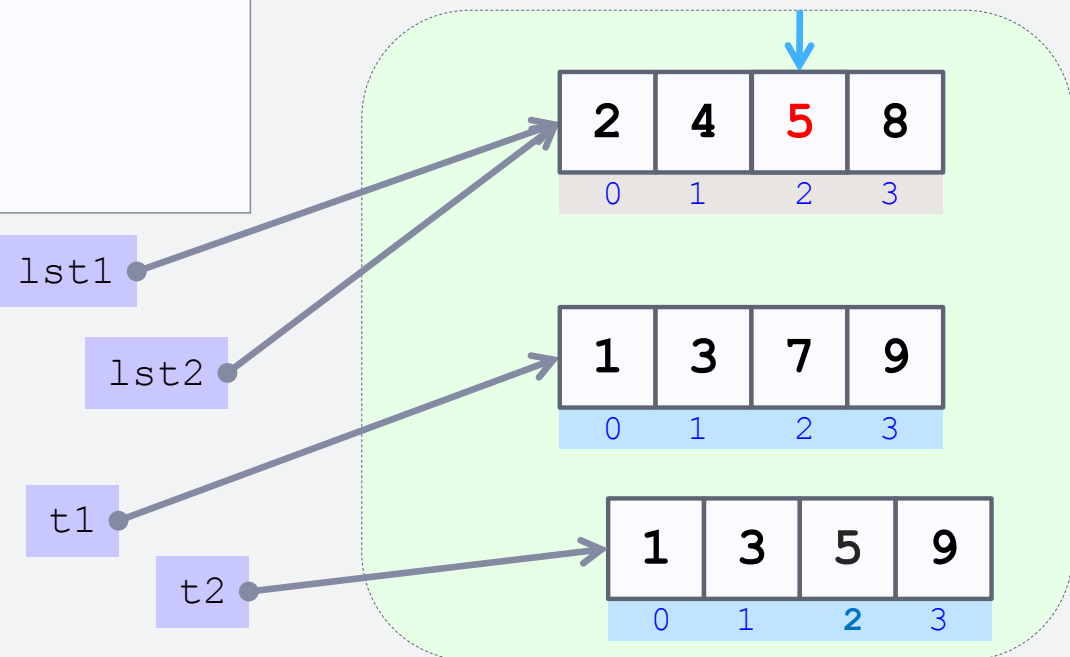
Be Careful

15

- State Diagram:

Code

```
>>> lst1 = lst2 = [2, 4, 6, 8]
>>> t1 = t2 = (1, 3, 7, 9)
>>> t2 = t2[:2] + (5, ) + t2[3:]
>>> lst2[2] = 5
>>>
```



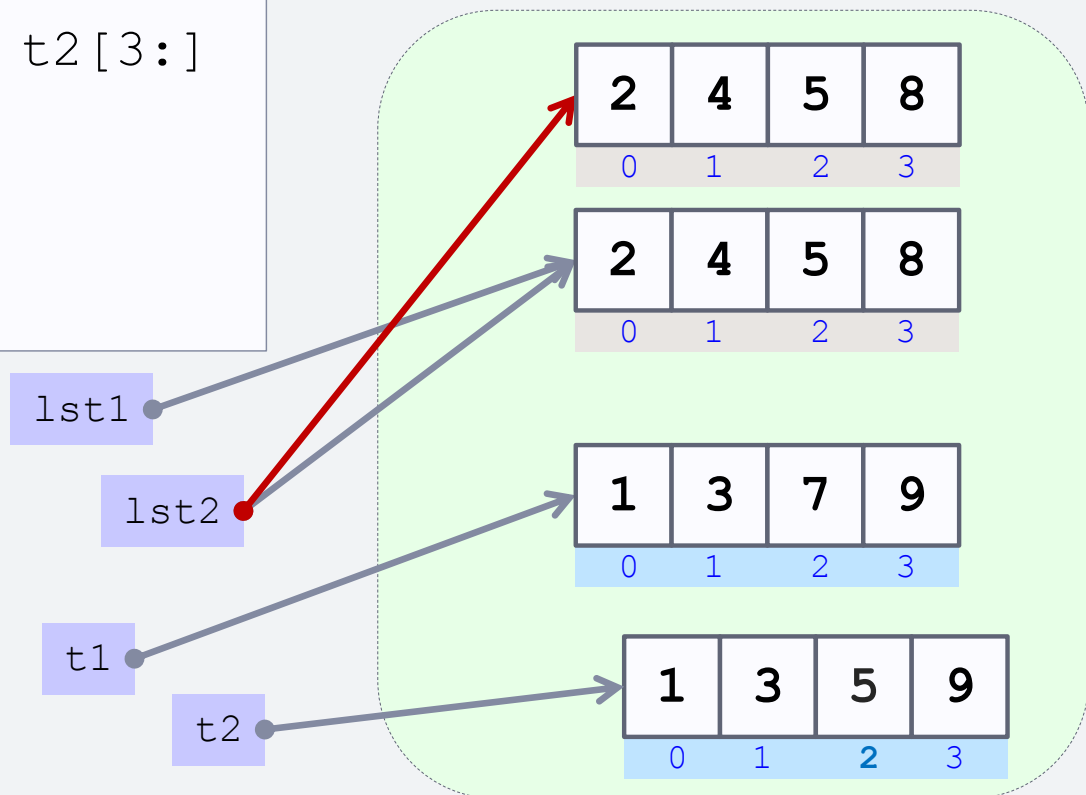
Be Careful

16

- State Diagram:

Code

```
>>> lst1 = lst2 = [2,4,6,8]
>>> t1 = t2 = (1,3,7,9)
>>> t2 = t2[:2] + (5, ) + t2[3:]
>>> lst2[2] = 5
>>>
>>> lst2 = [2, 4, 5, 8]
>>>
```



Be Careful

17

- State Diagram:

Code

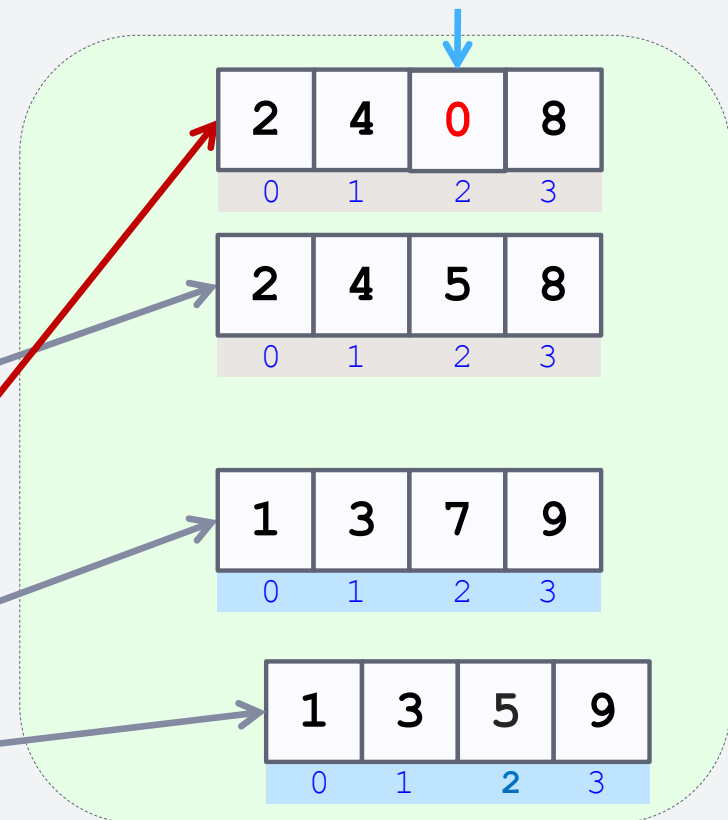
```
>>> lst1 = lst2 = [2, 4, 6, 8]
>>> t1 = t2 = (1, 3, 7, 9)
>>> t2 = t2[:2] + (5, ) + t2[3:]
>>> lst2[2] = 5
>>>
>>> lst2 = [2, 4, 5, 8]
>>> lst2[2] = 0
```

lst1

lst2

t1

t2



Swapping Values

18

- State Diagram:

Code

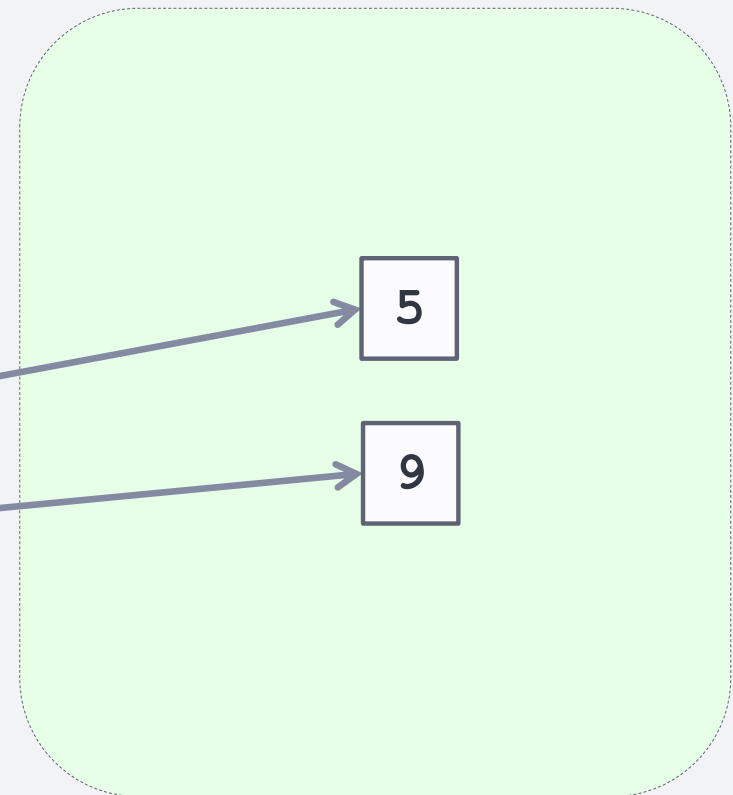
```
>>> num_one = 5  
>>> num_two = 9  
>>>
```

num_one

num_two

5

9



Swapping Values

19

- State Diagram: First Attempt

Code

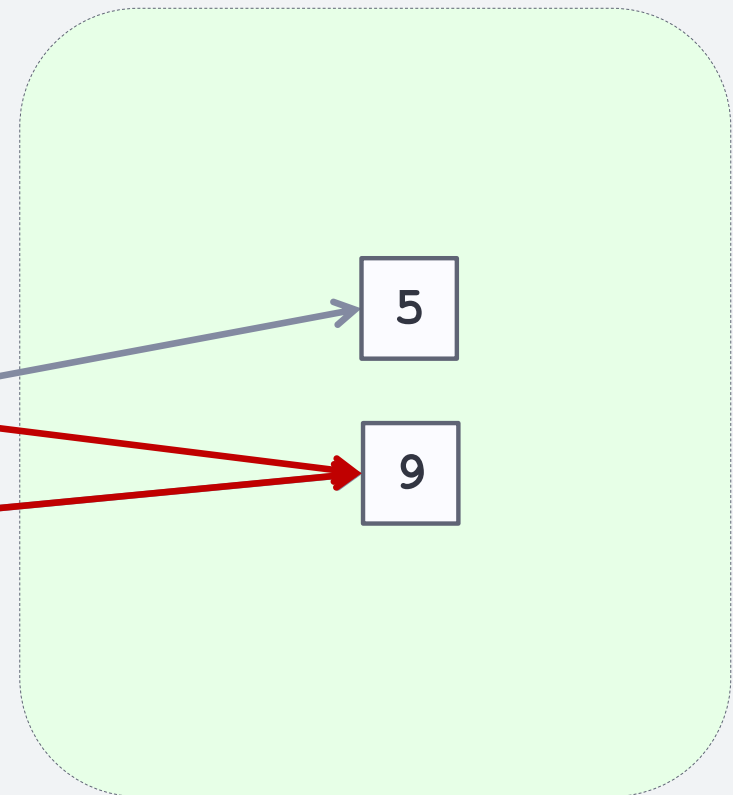
```
>>> num_one = 5  
>>> num_two = 9  
>>> num_one = num_two  
>>> num_two = num_one  
>>>
```

num_one

num_two

5

9



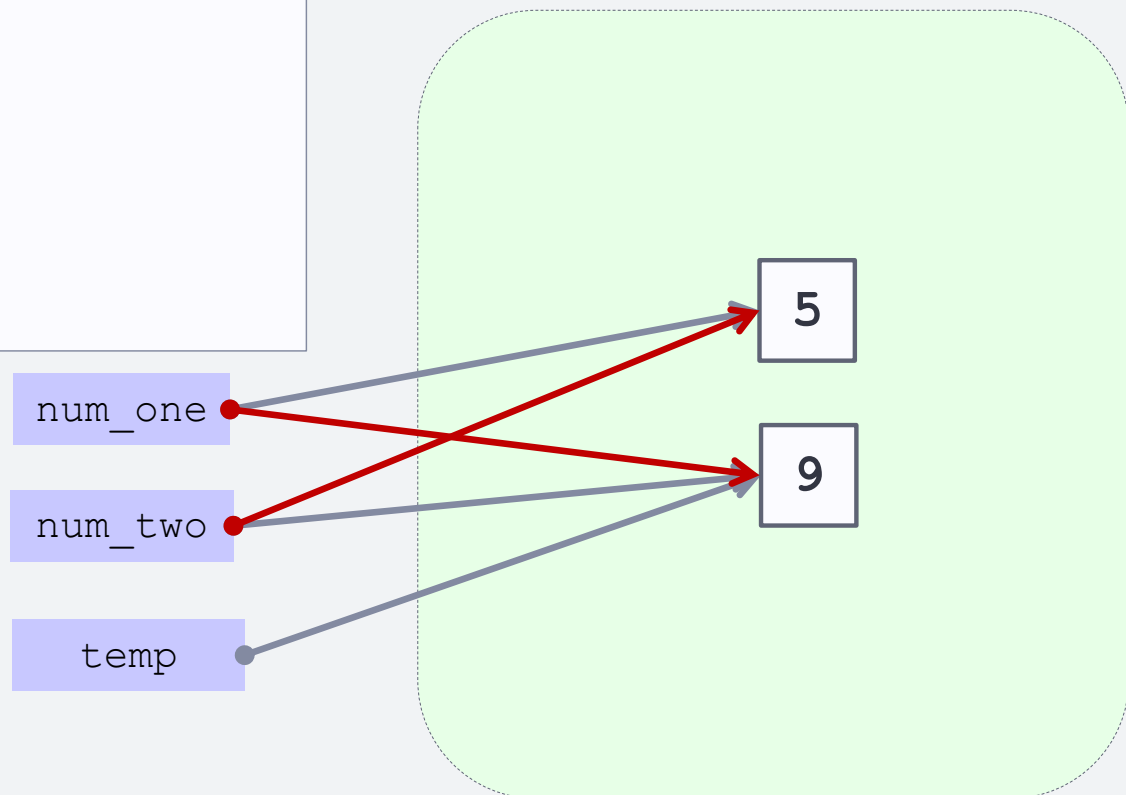
Swapping Values

20

- State Diagram: Second Attempt

Code

```
>>> num_one = 5  
>>> num_two = 9  
>>> temp = num_two  
>>> num_two = num_one  
>>> num_one = temp  
>>>
```



Personal work

21

Investigate what is meant by SLICING strings, lists and tuples.

Iteration

22

**DEFINITE
&
INDEFINITE
LOOPS**

Iteration

23

- We need a structure to execute a sequence of statements multiple times in succession
- How can we proceed if we are not sure how many times it needs to be repeated?

Definite Loop: For statement

24

- The simplest kind of loop
- It will execute a definite amount of times

- The for loop statement

```
for <var> in <iterable>:  
    <body>
```

- Iterable can return its element one at a time
- The body of the loop can be any sequence of Python statements
- The variable after the keyword `for` is called the **loop index**.

Example

25

Code

```
print "Before the for loop"

for val in [1,2,3]:
    square_val = val * val
    print "--> inside loop: square of", str(val), "is",
        str(square_val)

print "After the for loop"
```


Python shell

```
Before the for loop
--> inside loop: square of 1 is 1
--> inside loop: square of 2 is 4
--> inside loop: square of 3 is 9
After the for loop
```

Example

26

Code

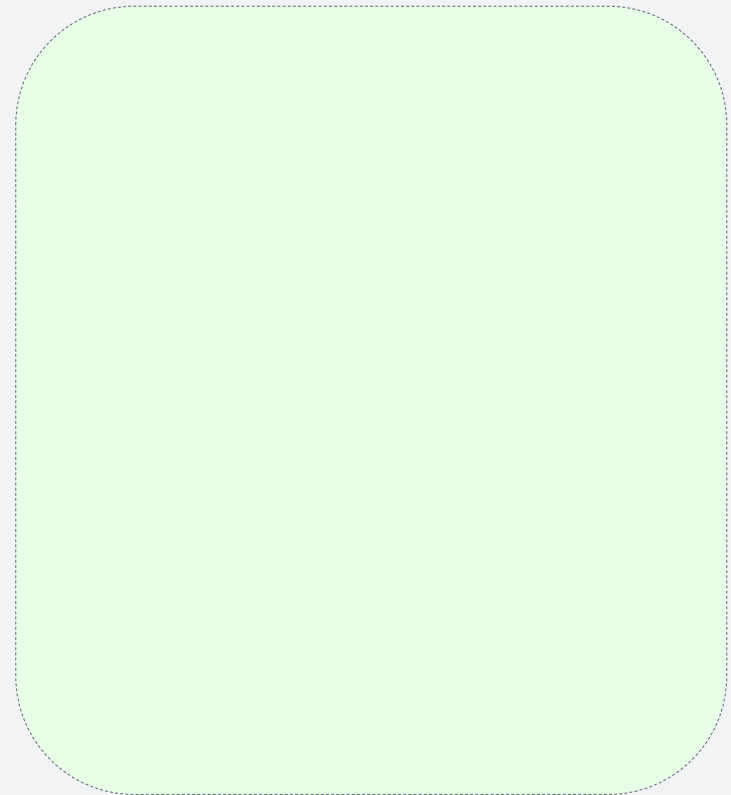


```
print "Before the for loop"

for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

print "After the for loop"
```

Python shell



Example

27

Code

```
print "Before the for loop"

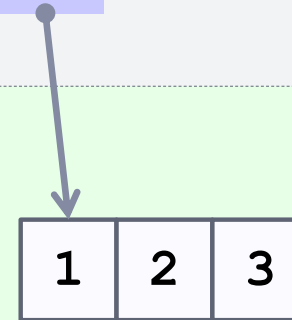
→ for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

print "After the for loop"
```

Python shell

Before the for loop

val



Example

28

Code

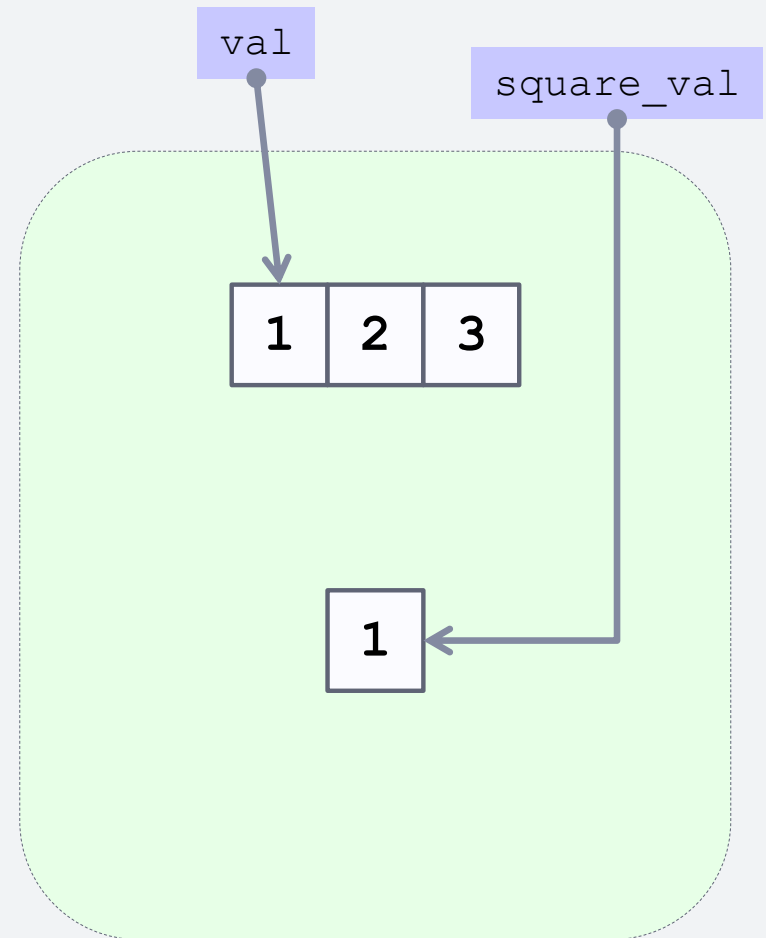
```
print "Before the for loop"

for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

print "After the for loop"
```

Python shell

Before the for loop



Example

29

Code

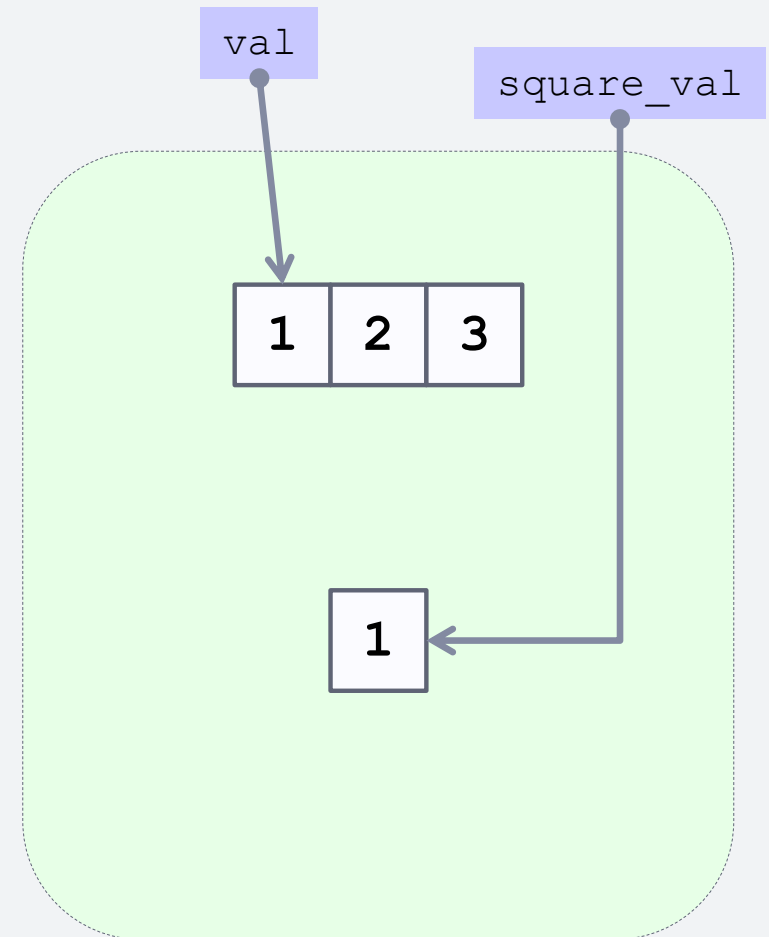
```
print "Before the for loop"

for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

print "After the for loop"
```

Python shell

```
Before the for loop
--> inside loop: square of 1 is 1
```



Example

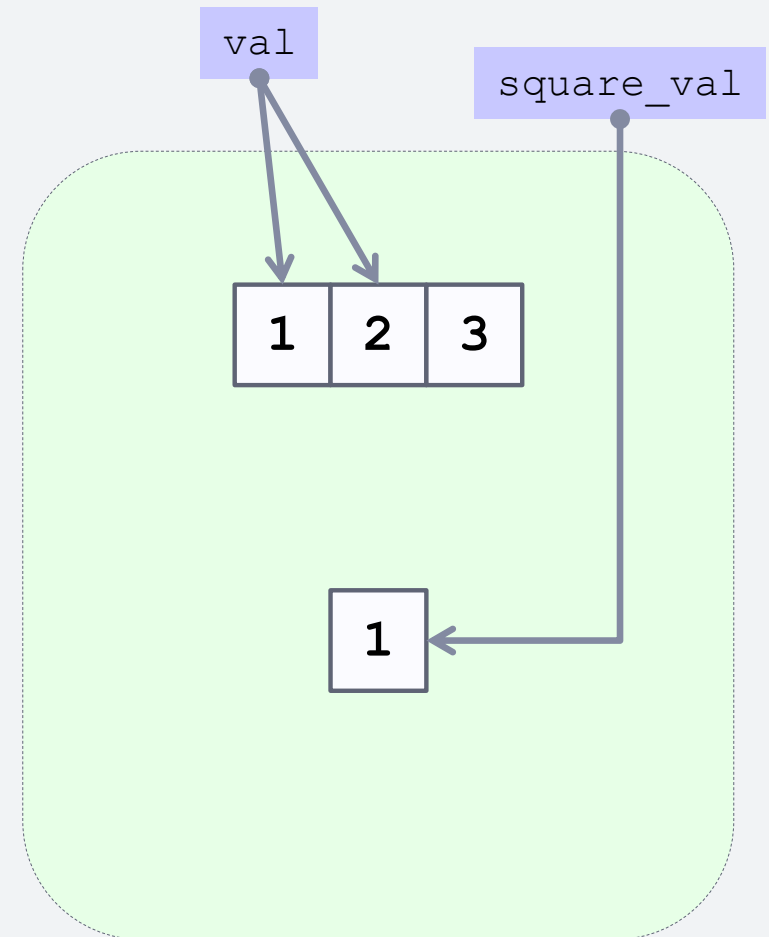
30

Code

```
print "Before the for loop"
→ for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."
print "After the for loop"
```

Python shell

```
Before the for loop
--> inside loop: square of 1 is 1
```



Example

31

Code

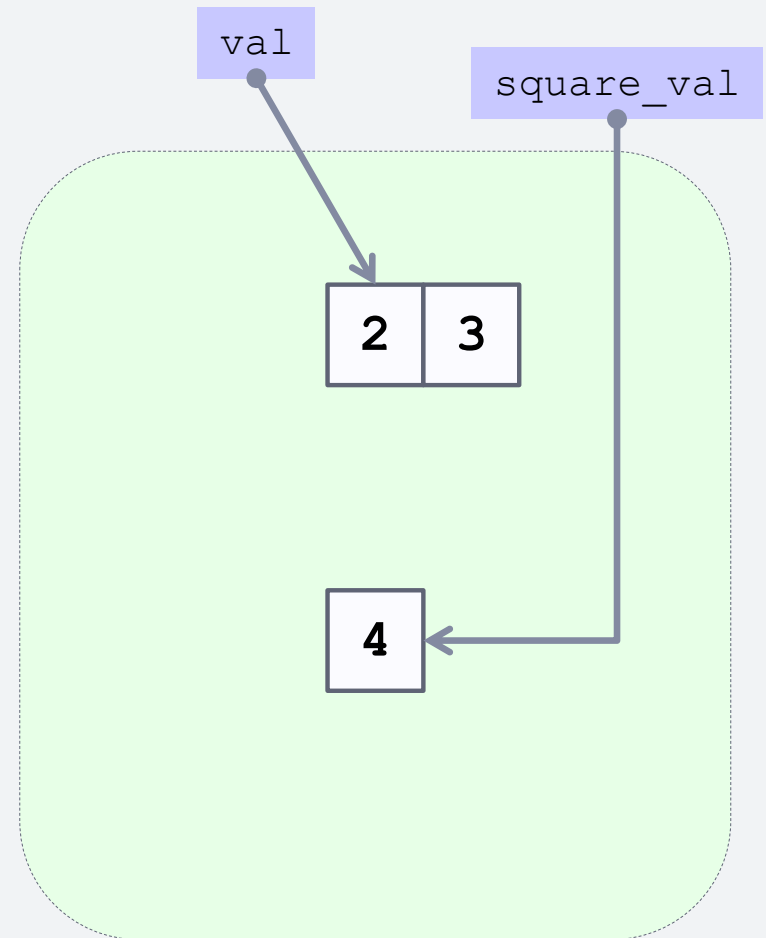
```
print "Before the for loop"

for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

print "After the for loop"
```

Python shell

```
Before the for loop
--> inside loop: square of 1 is 1
```



Example

32

Code

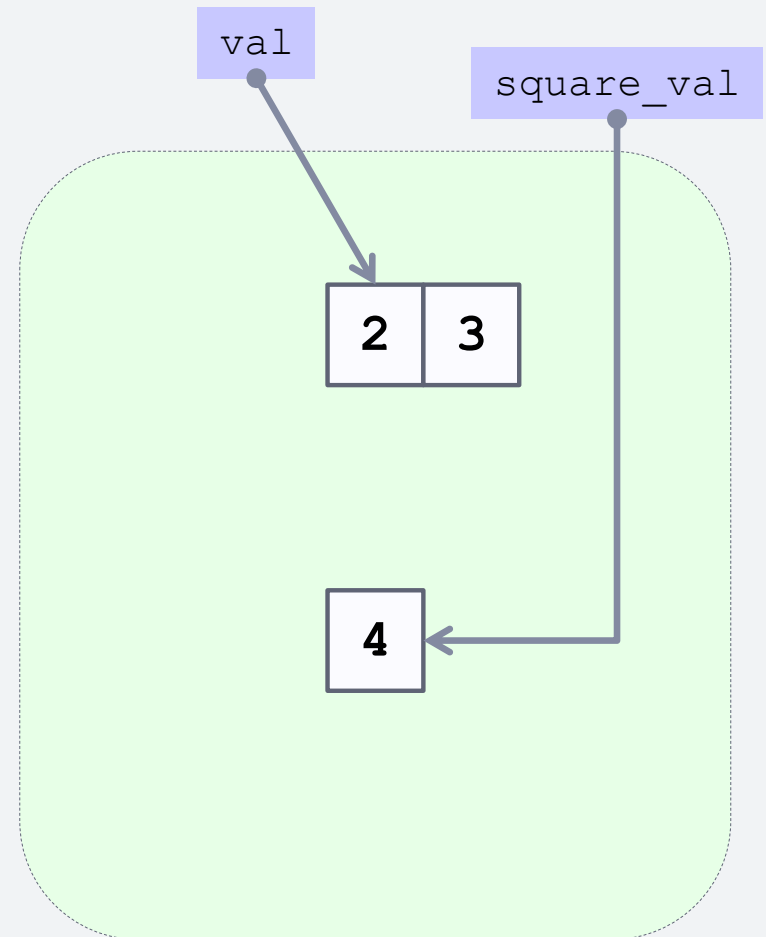
```
print "Before the for loop"

for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

print "After the for loop"
```

Python shell

```
Before the for loop
--> inside loop: square of 1 is 1
--> inside loop: square of 2 is 4
```



Example

33

Code

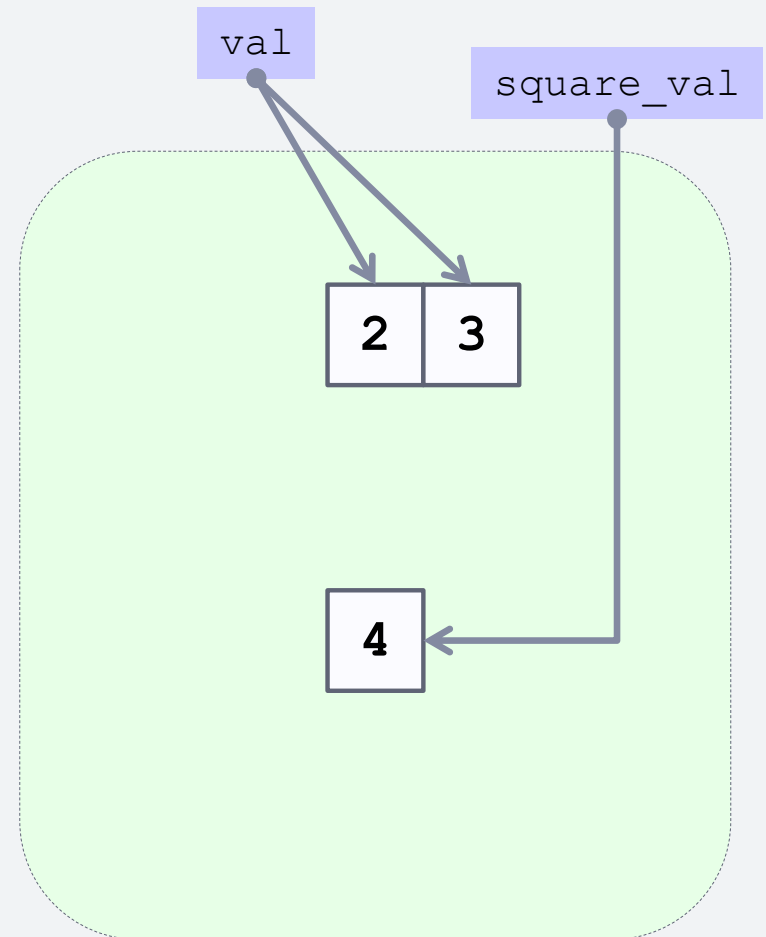
```
print "Before the for loop"

→ for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

print "After the for loop"
```

Python shell

```
Before the for loop
--> inside loop: square of 1 is 1
--> inside loop: square of 2 is 4
```



Example

34

Code

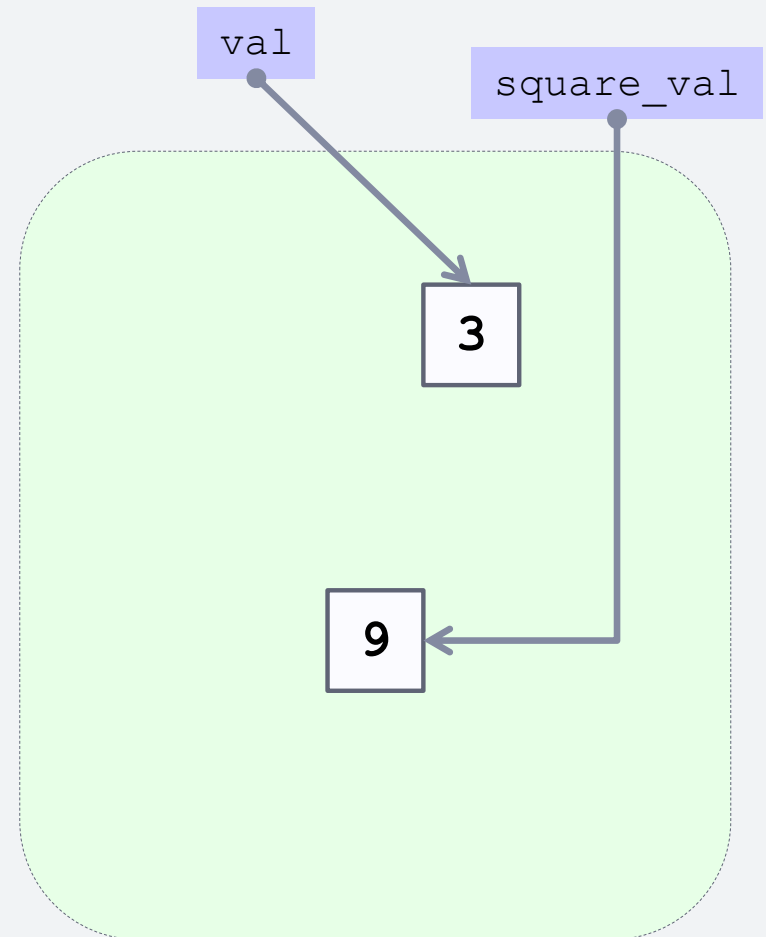
```
print "Before the for loop"

for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

print "After the for loop"
```

Python shell

```
Before the for loop
--> inside loop: square of 1 is 1
--> inside loop: square of 2 is 4
```



Example

35

Code

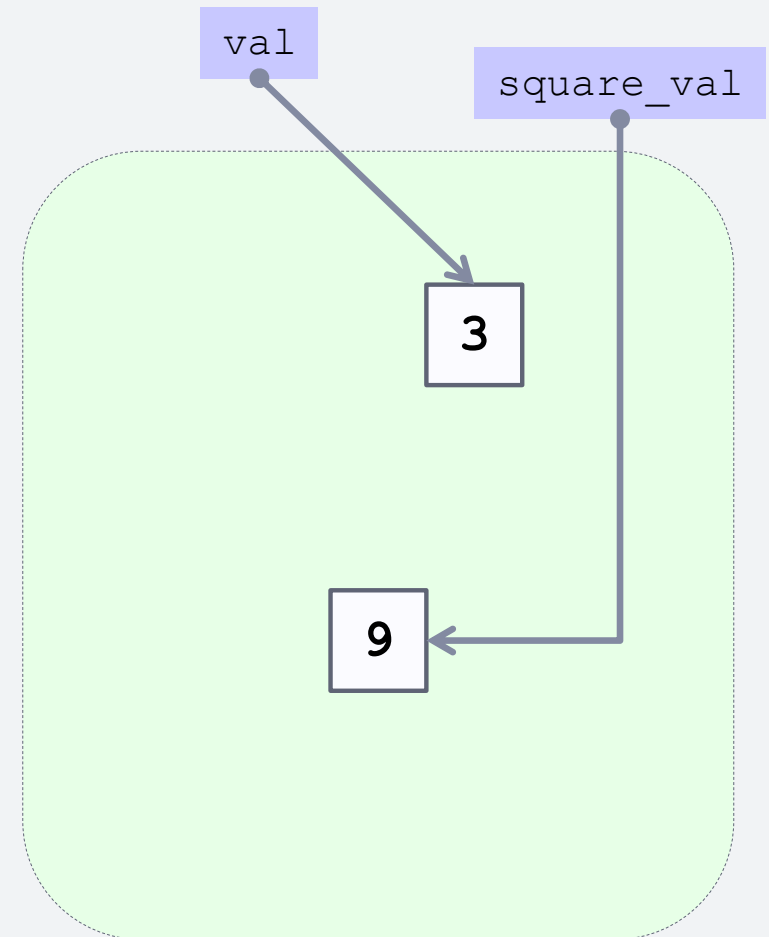
```
print "Before the for loop"

for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

print "After the for loop"
```

Python shell

```
Before the for loop
--> inside loop: square of 1 is 1
--> inside loop: square of 2 is 4
--> inside loop: square of 3 is 9
```



Example

36

Code

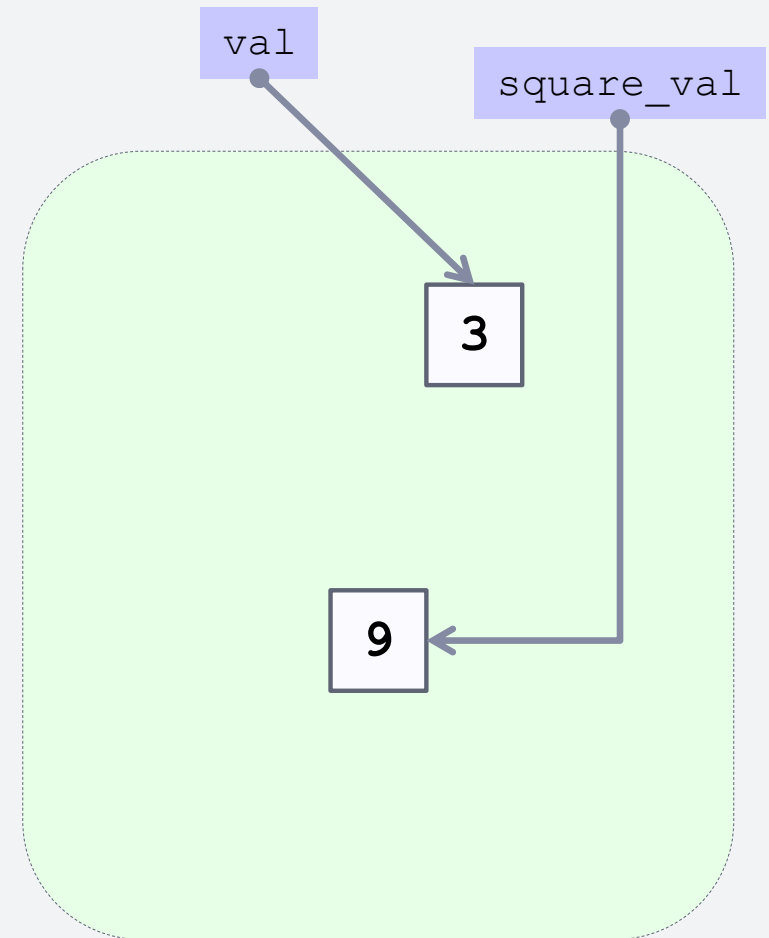
```
print "Before the for loop"

for val in [1,2,3]:
    square_val = val * val
    print "--> inside . . ."

→ print "After the for loop"
```

Python shell

```
Before the for loop
--> inside loop: square of 1 is 1
--> inside loop: square of 2 is 4
--> inside loop: square of 3 is 9
After the for loop
```



Indefinite Loop: While Statement

37

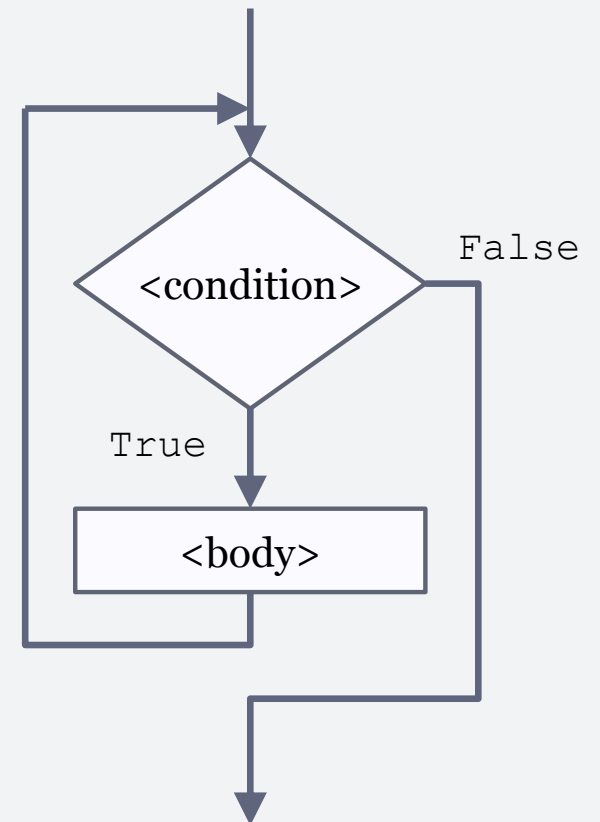
- An indefinite loop keeps iterating until certain condition are met (conditional loop)
- There is no guarantee ahead of time regarding how many times the loop will go around
 - zero time
 - x-times
 - indefinitely

Indefinite Loop: While Statement

38

- The while loop statement

```
while <condition>:  
    <body>
```

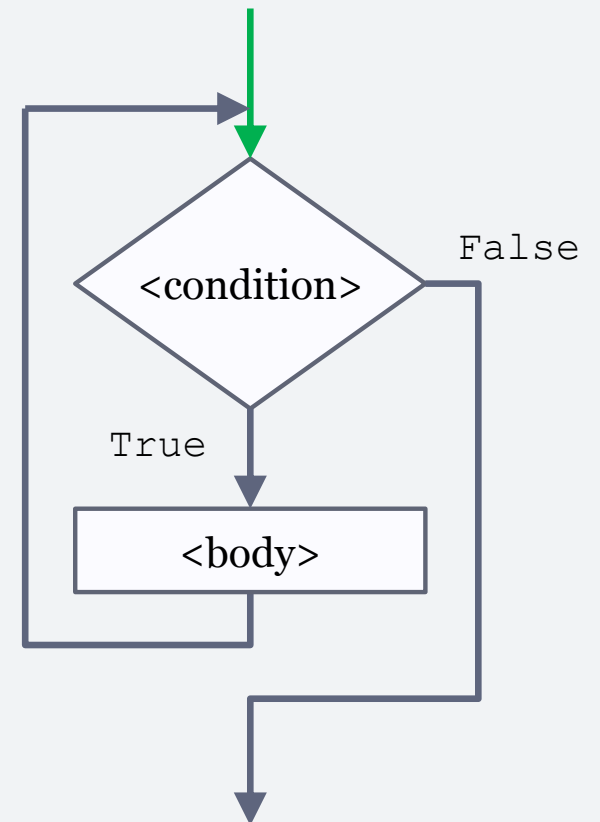


Indefinite Loop: While Statement

39

- The while loop statement

```
while <condition>:  
    <body>
```

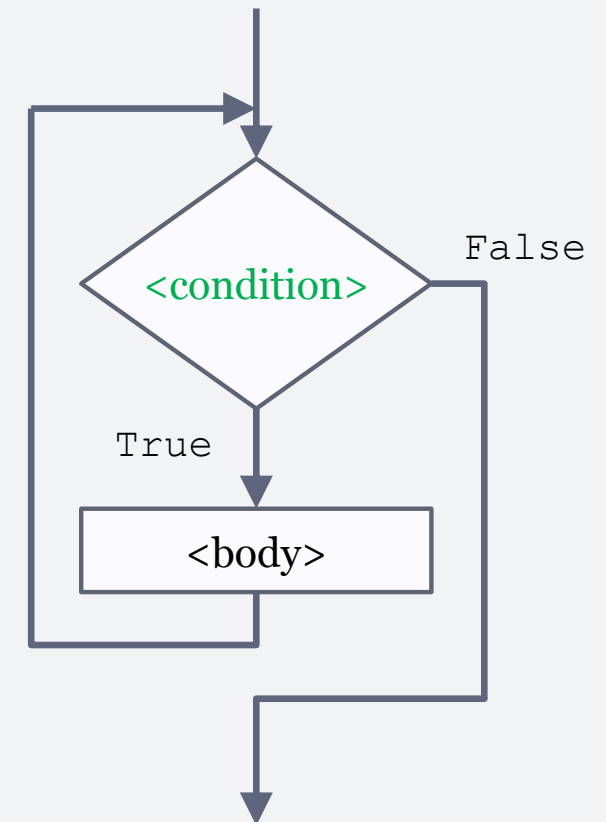


Indefinite Loop: While Statement

40

- The while loop statement

```
while <condition>:  
    <body>
```

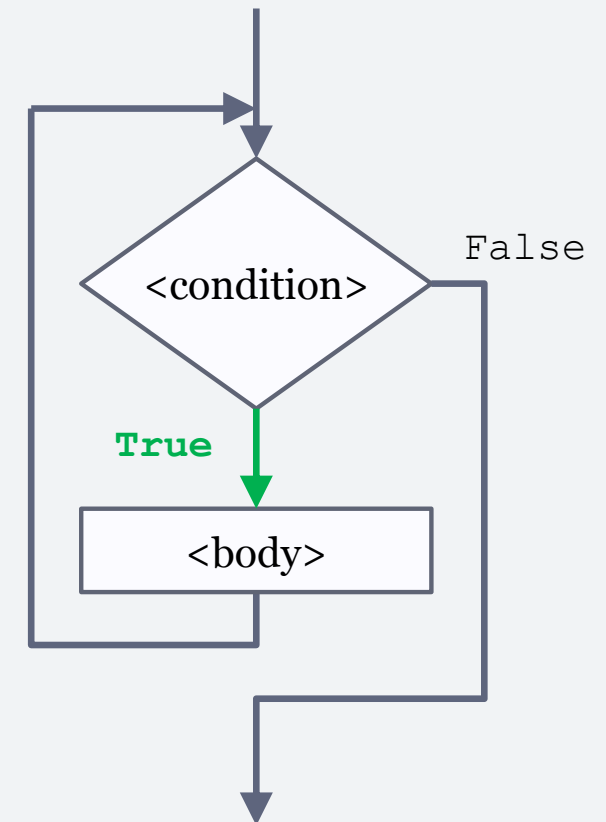


Indefinite Loop: While Statement

41

- The while loop statement

```
while <condition>:  
    <body>
```

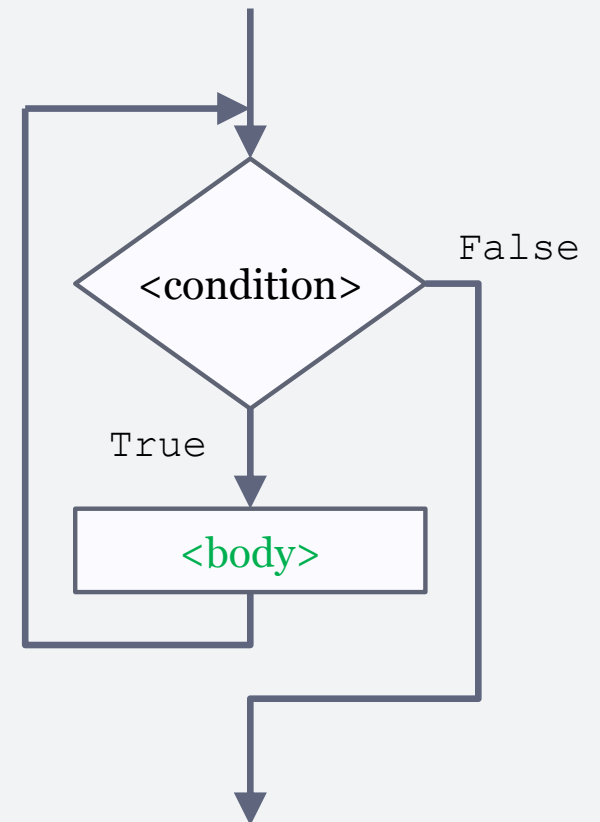


Indefinite Loop: While Statement

42

- The while loop statement

```
while <condition>:  
    <body>
```

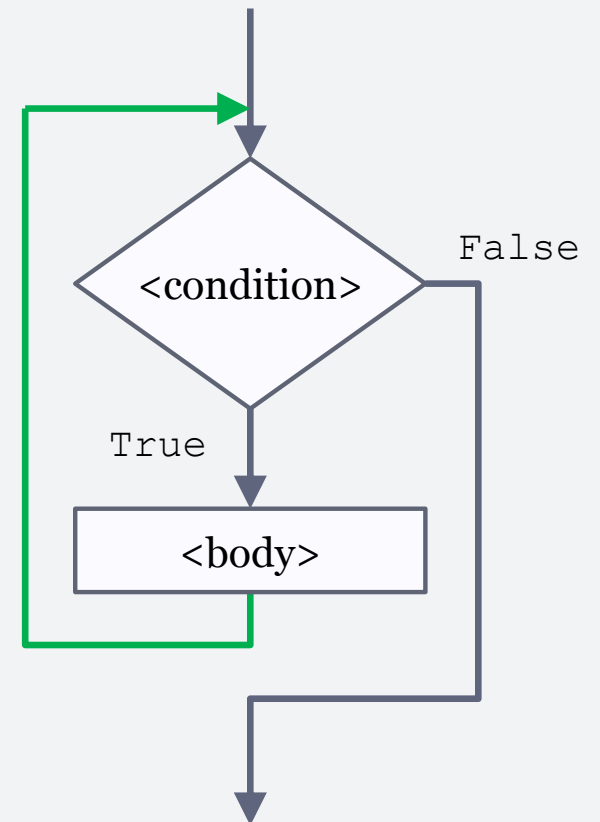


Indefinite Loop: While Statement

43

- The while loop statement

```
while <condition>:  
    <body>
```

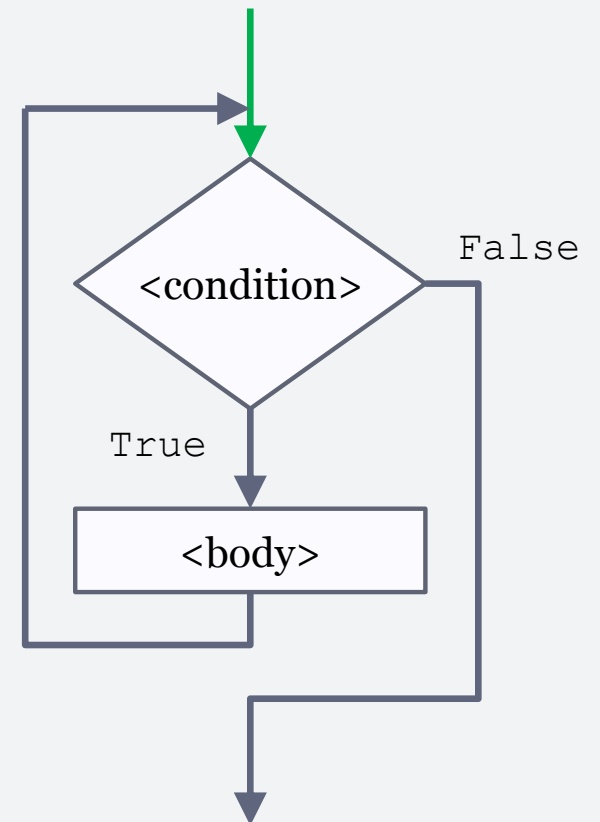


Indefinite Loop: While Statement

44

- The while loop statement

```
while <condition>:  
    <body>
```

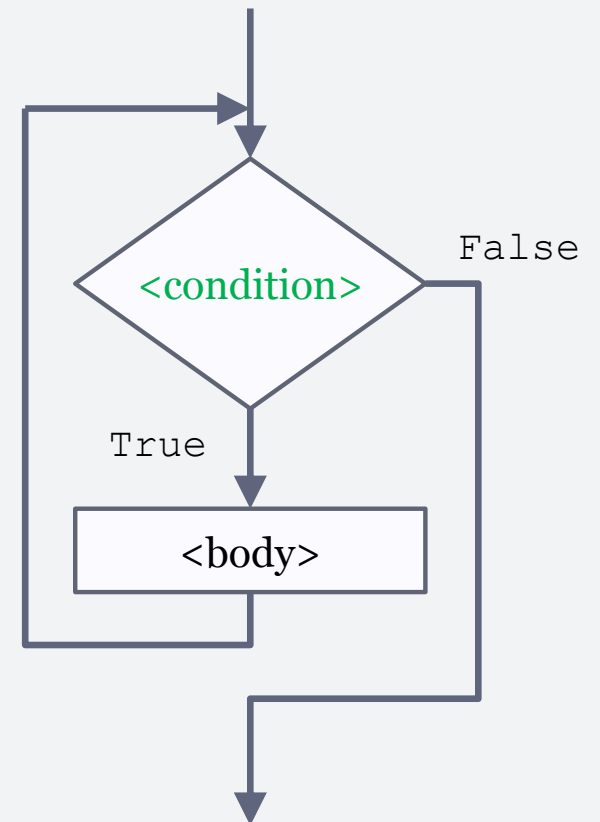


Indefinite Loop: While Statement

45

- The while loop statement

```
while <condition>:  
    <body>
```

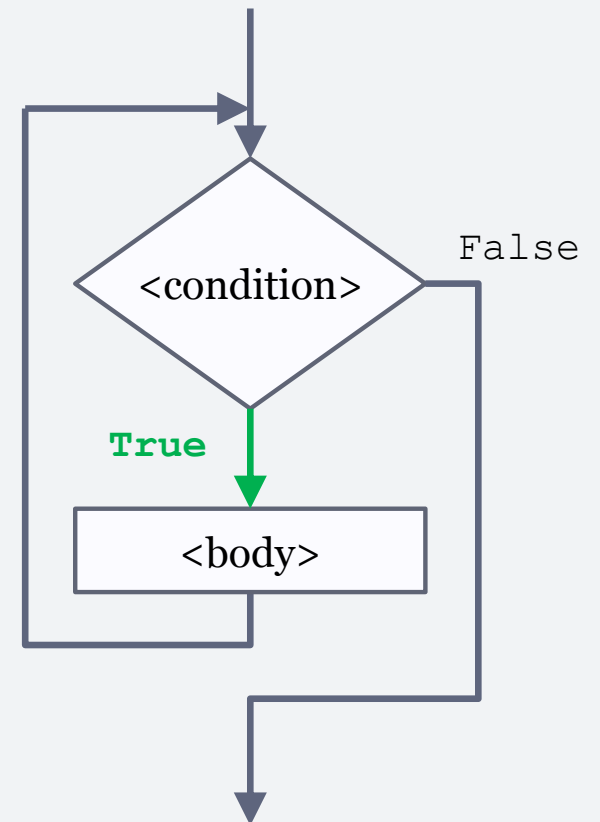


Indefinite Loop: While Statement

46

- The while loop statement

```
while <condition>:  
    <body>
```

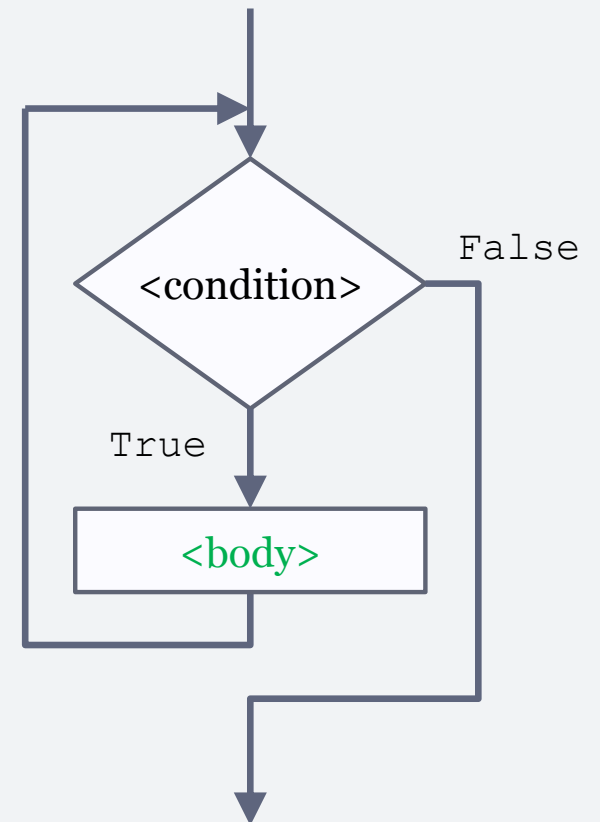


Indefinite Loop: While Statement

47

- The while loop statement

```
while <condition>:  
    <body>
```

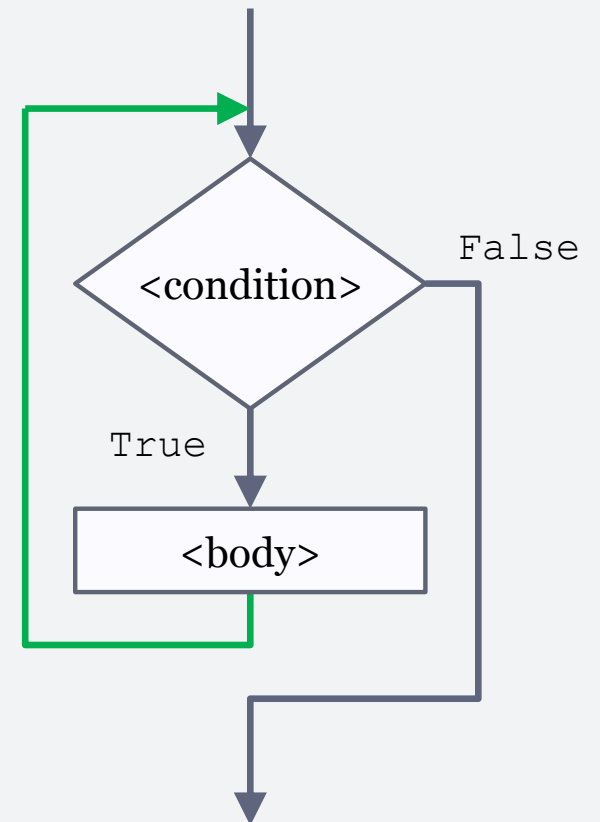


Indefinite Loop: While Statement

48

- The while loop statement

```
while <condition>:  
    <body>
```

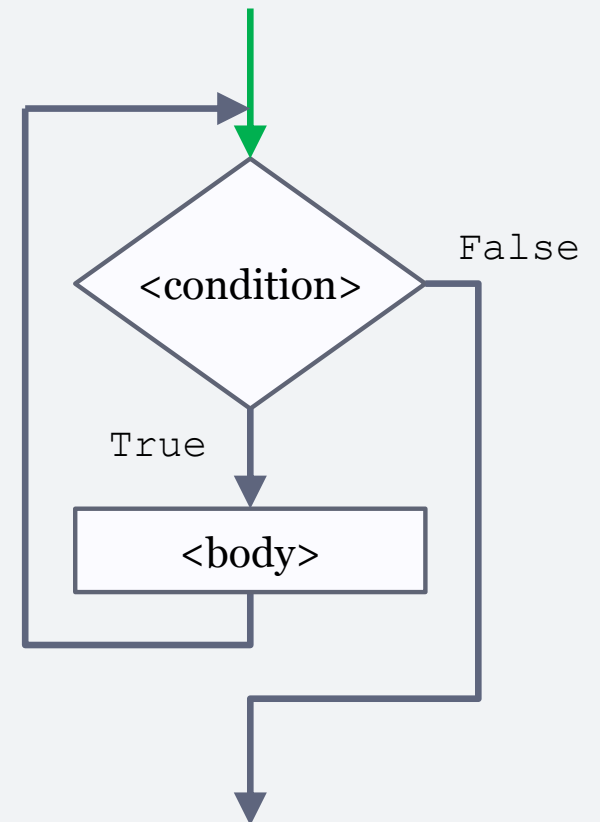


Indefinite Loop: While Statement

49

- The while loop statement

```
while <condition>:  
    <body>
```

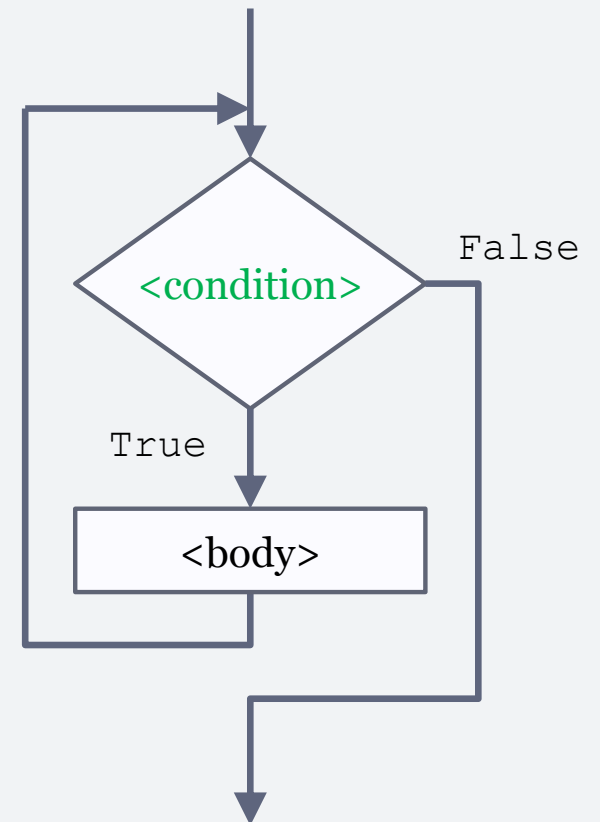


Indefinite Loop: While Statement

50

- The while loop statement

```
while <condition>:  
    <body>
```

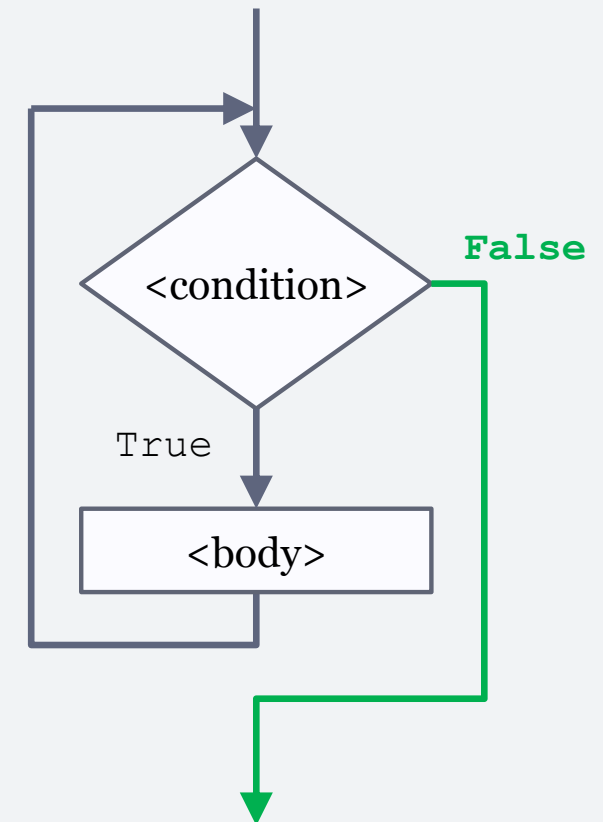


Indefinite Loop: While Statement

51

- The while loop statement

```
while <condition>:  
    <body>
```

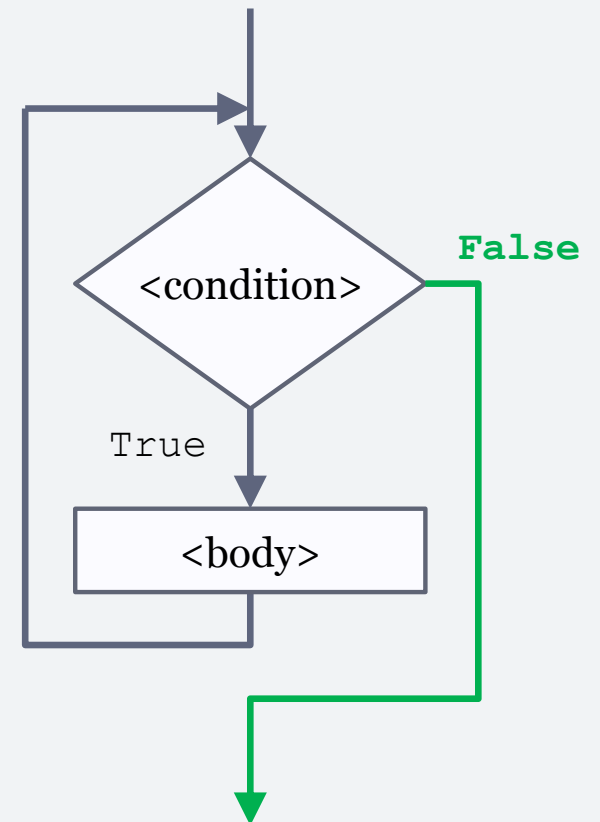


Indefinite Loop: While Statement

52

- The while loop statement

```
while <condition>:  
    <body>
```

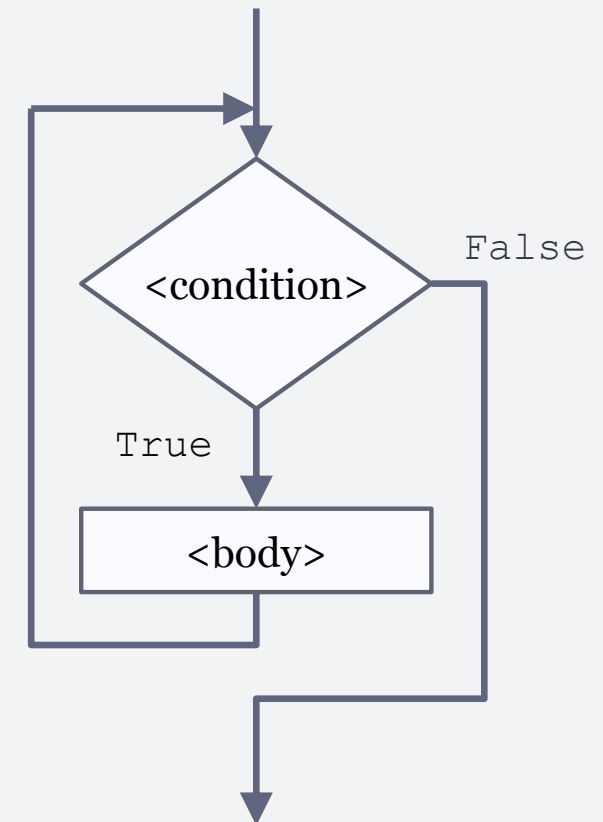


Indefinite Loop: While Statement

53

- The while loop statement

```
while <condition>:
    <body>
```
- The <body> usually contains statements that modify the evaluation of <condition> at some point

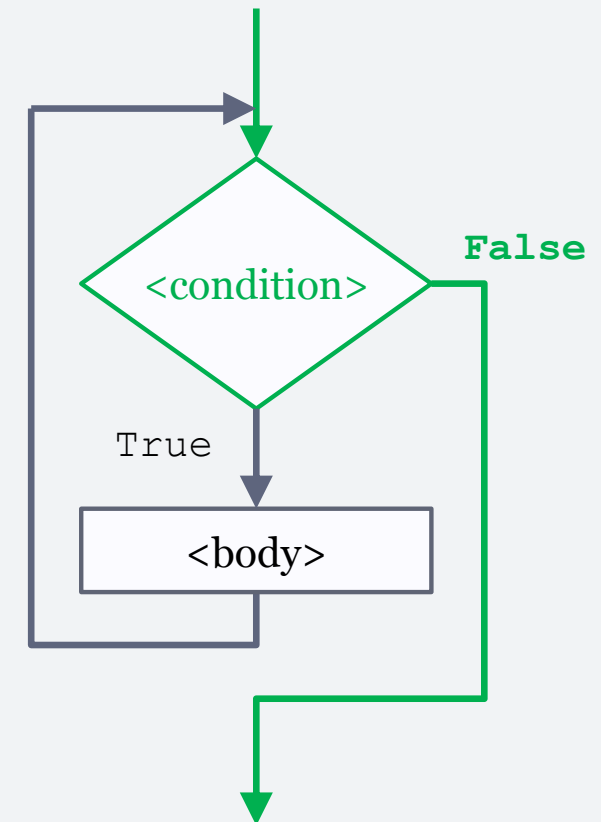


Indefinite Loop: While Statement

54

- The while loop statement

```
while <condition>:
    <body>
```
- The <body> usually contains statements that modify the evaluation of <condition> at some point
- The <body> may never be executed!



General Form

55

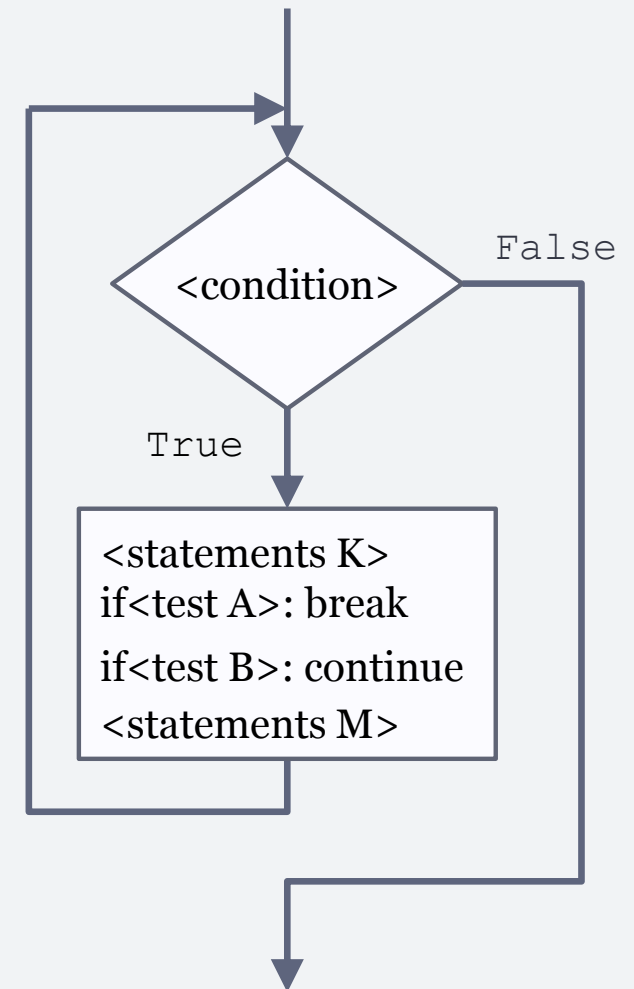
- The while loop general form

- Two new Keywords:

1. **break**

2. **continue**

```
while <condition>:  
    <statements K>  
    if<test A>: break  
    if<test B>: continue  
    <statements M>
```



General Form

56

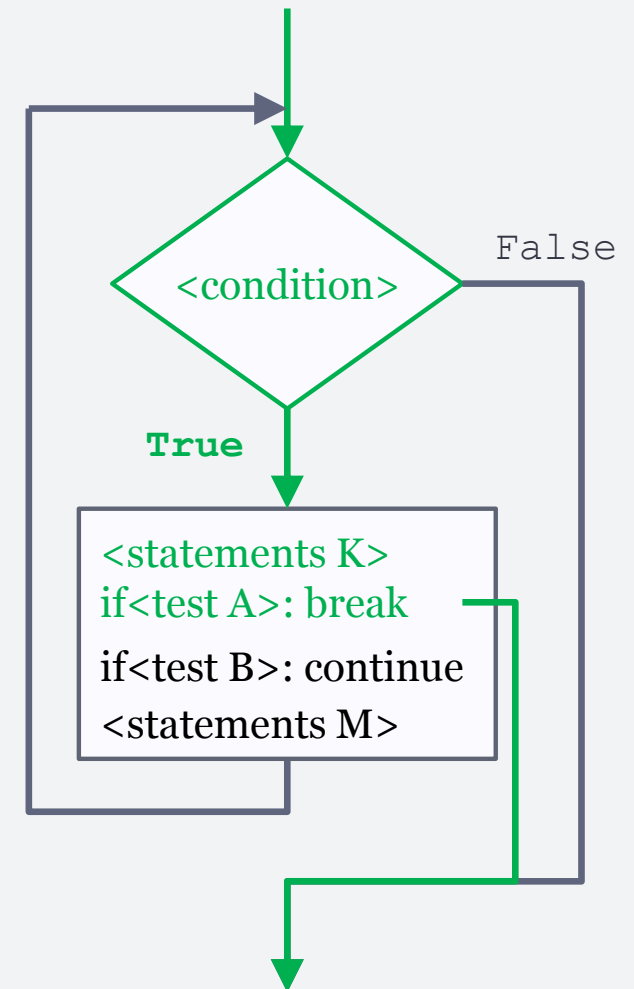
- The while loop general form

- Two new Keywords:

1. **break**
2. **continue**

```
while <condition>:  
    <statements K>  
    if<test A>: break  
    if<test B>: continue  
    <statements M>
```

- Test A is True



General Form

57

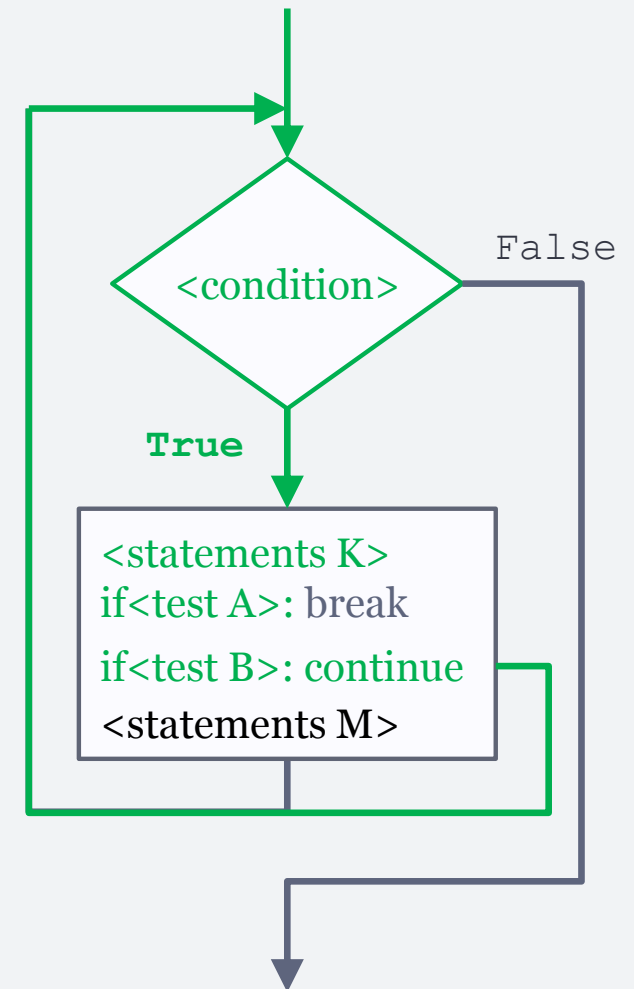
- The while loop general form

- Two new Keywords:

1. **break**
2. **continue**

```
while <condition>:  
    <statements K>  
    if<test A>: break  
    if<test B>: continue  
    <statements M>
```

- Test A is False & Test B is True



General Form

58

- The for loop general form

```
for <val> in <iterable>:  
    <statements K>  
    if<test A>: break  
    if<test B>: continue  
    <statements M>
```

Summary

59

- We have seen mutable and immutable data type
 - consequences when modifying data
- Definite iteration
 - for loops
- Indefinite iteration (a.k.a conditional loop)
 - while loops
- General form using `break` and `continue`

Next week

60

- Scope of variables and parameters
- Parameter passed by value or by reference
 - Understanding mutable and immutable object is essential

Exercises

61

- Consider a problem where we want to record and store the marks of many students, each students having more than one mark (several modules with same credits).
 - what form the data structure would look like
 - how would you write a program to enter the marks of one student
 - how would you proceed to enter the marks of more than one students
 - how would you calculate the average mark of each student
 - what if modules don't have the same credits (e.g. 10, 20, 30)

Exercises

62

- Calculate the average of values in a list
- Calculate the average of values entered by a user, we don't know how many values the user want to enter. The user should enter an empty value to signal the end of data input, then a result must be returned.