THE UNIVERSITY OF WESTERN AUSTRALIA

Lecture 5
Definite loops

Objectives of this Lecture

- To understand simple definite loops

- Follow the software development process to develop a program that calculates the future value of investment

Definite Loops

- A definite loop executes a pre-specified number of times, iterations, which is known when program is loaded

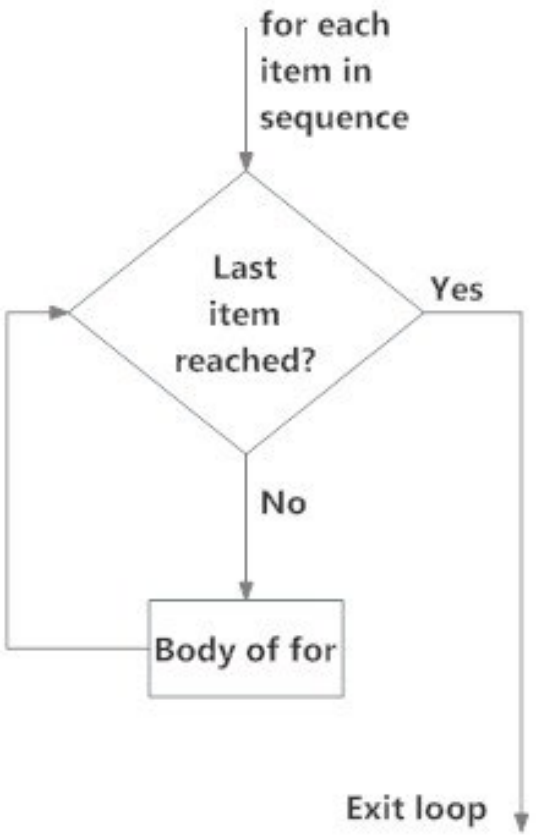
  for <var> in <sequence>:

  <body>

- The beginning and end of the body are indicated by indentation.
- Note that iterations are over sequences (more of this in a later lecture)
  - *For the time being, a sequence is a countable sequence of Python things (objects)*

Definite Loops

`for` loops alter the flow of program execution, so they are referred to as control structures.



Definite Loops

- `for <var> in <sequence>:`
  `<body>`

- The variable after the `for` is called the loop index. It takes on each successive value in sequence

Definite Loops

```
>>> for item in [1,2,3,4,6]:
        print(item)
1
2
3
4
6
```

Loop variable `item` first has the value 1, then 2, then 3, then 4 and finally 6 (there is no 5 in the sequence)

Definite Loops

- In `chaos.py` (from Labsheet 00), what did `range(10)` do?

```
>>> list(range(10))
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]
```

- `range` is a built-in Python function that generates a sequence of numbers, starting with 0.
- `list` is a built-in Python function that turns the sequence into an explicit list
- The body of the loop executes 10 times

Definite Loops

```
>>> for num in range(10)
        print(num)
0
1
2
3
4
5
6
7
8
9
```

Definite Loops

```
>>> for odd in [1, 3, 5, 7]:
        print(odd*odd)
1
9
25
49
```

Loop variable `odd` first has the value 1, then 3, then 5 and finally 7

Example Program: Interest Earned

Analysis

- *Money deposited in a bank account earns interest.*
- *How much will the account be worth 10 years from now?*
- *Inputs: principal amount, interest rate*
- *Outputs: value of the investment in 10 years*

Example Program: Future Value

Specification

- **Inputs**

  principal: The amount of money being invested, in dollars

  apr: The *annual percentage rate* expressed as a floating-point decimal number 0.0 < `apr` < 1.0

- **Output**

  The value of the investment 10 years in the future

- **Relationship**

  Value after one year is given by *principal* * (1 + *apr*).

  This needs to be done 10 times.

Example Program: Future Value

Design

- *Print an introduction*
- *Input the amount of the principal (`principal`)*
- *Input the annual percentage rate (`apr`)*
- *Repeat 10 times:*
  *principal = principal * (1 + apr)*
- *Output the value of principal*

Computational thinking: *Decomposition*

- *dividing the problem in small tasks*

Example Program: Future Value

Implementation

- *Each line translates to one line of Python (in this case)*
- *Print an introduction*

```
print("This program calculates the future")
print("value of a 10-year investment.")
```

- *Input the amount of the principal*

```
principal = float(input("Enter the initial principal: "))
```

Example Program: Future Value

- *Input the annual percentage rate*

```
apr = float(input("Enter the annual interest rate: "))
```

- *Repeat 10 times:*

```
for i in range(10):
```

- *Calculate principal = principal * (1 + apr)*

```
    principal *= (1 + apr)
```

- *Output the value of the principal at the end of 10 years*

```
print("The value in 10 years is:", principal)
```

Example Program: futval.py

```
#    A program to compute the value of an investment
#    carried 10 years into the future
#    Author: Unit Coordinator

def main():
   print("This program calculates the future")
   print("value of a 10-year investment.")

   principal = float(input("Enter the initial principal: "))
   apr = float(input("Enter the annual interest rate: "))

   for i in range(10):
       principal *= (1 + apr)

    print ("The value in 10 years is:", principal)

main()
```

Example Program: Testing futval.py

```
>>> main()
This program calculates the future
value of a 10-year investment.
Enter the initial principal: 100
Enter the annual interest rate: 0.03
The value in 10 years is: 134.391637934
>>> main()
This program calculates the future
value of a 10-year investment.
Enter the initial principal: 100
Enter the annual interest rate: 0.10
The value in 10 years is: 259.37424601
```

Example Program: Interest Earned (generalized)

Analysis

- *Money deposited in a bank account earns interest.*
- *How much will the account be worth after input years from now?*
- *Inputs: principal amount, interest rate, years*
- *Outputs: value of the investment after input years*

Example Program: futval_gen.py

```
#    A program to compute the value of an investment
#    after specific number of years
#    Author: Unit Coordinator

def main():
   print("This program calculates the future")
   print("value for the investment after number of years.")

   principal = float(input("Enter the initial principal: "))
   apr = float(input("Enter the annual interest rate: "))
   yrs = int(input("Enter number of years: "))

   for i in range(yrs):
       principal *= (1 + apr)

    print ("The value in", yrs, "years is:", principal)

main()
```

Example Program: Testing futval_gen.py

```
>>> main()
This program calculates the future
value for the investment after number of years.
Enter the initial principal: 100
Enter the annual interest rate: 0.03
Enter number of years: 10
The value in 10 years is: 134.391637934
>>> main()
This program calculates the future
value for the investment after number of years.
Enter the initial principal: 150
Enter the annual interest rate: 0.12
Enter number of years: 25
The value in 10 years is: 2550.009660996408
```

Lecture Summary

- Definite loop:
  - *"for" loop alters the sequence of the program*
  - *Runs equal to number of items in the sequence*
  - *The loop index takes a value of sequence for each iteration*
- Future value calculation for the investment