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NGEE ANN
SCHOOL OF INFOCOMM TECHNOLOGY

Repetition Structure
Nested loops

Programming I (PRG1)

Diploma in Information Technology
Diploma in Financial Informatics
Diploma in Cybersecurity & Digital Forensics
Common ICT Programme
Year 1 (2019/20), Semester 1

Objectives

At the end of this lecture, you will ….

- Be able to use a loop within a loop

Nested Loop

- If a loop contains another loop, it is known as a **nested loop.**
  - i.e. for every iteration of a loop, another loop is repeated.

- Nested loop can use ***any of the repetition structures***
  - different loop for the inner and outer loop is totally possible.

- Nested loops are often used to process matrix/tabular data and multi-dimensional/nested data structures. Another use for nested loops is in mathematical functions, where complex evaluations are done on data.

Example: 2D symbol pattern

- **Write a nested loop to display the following pattern**

```
******
******
******
```

Outer loop

```
for i in range(3):
    for j in range(6):
        print('*',end='')
    print()
```

Inner loop

Example: 2D number pattern

- **Write a nested loop to display the following pattern**

```
123
123
123
```

```
for i in range(3):
    for j in range(1, 4):
        print(j,end='')
    print()
```

Outer loop

Inner loop

Example: 2D number pattern trace table

i from range	Iteration (outer loop)	j from range	Iteration (inner loop)	Output
-	Before start	-	-	-
0	1	-	Before start	-
		1	1	1
		2	2	1 2
		3	3	1 2 3
		-	Stop inner loop	*Go to next line*
1	2	-	Before start	1 2 3
		1	1	1 2 3 1
		2	2	1 2 3 1 2
		3	3	1 2 3 1 2 3
		-	Stop inner loop	*Go to next line*

Example: 2D number pattern trace table

i from range	Iteration (outer loop)	j from range	Iteration (inner loop)	Output
2	3	-	Before start	**1 2 3** **1 2 3**
		1	1	**1 2 3** **1 2 3** **1**
		2	2	**1 2 3** **1 2 3** **1 2**
		3	3	**1 2 3** **1 2 3** **1 2 3**
		-	Stop inner loop	*Go to next line*
-	Stop outer loop	-	-	**1 2 3** **1 2 3** **1 2 3**

Activity 1: 2D number pattern II

- **Now trying using a nested loop to display the following pattern**

```
123
246
369
```

Activity 2: 2D number pattern III

- **Now trying using a nested loop to display the following pattern**

```
. . . . 1
. . . 2 2
. . 3 3 3
. 4 4 4 4
5 5 5 5 5
```

Activity 3: Temperature Sensor

- A flat unit has 3 rooms. Each room is installed with sensor that measures the temperature at random interval and adjust the air-conditioning correspondingly.

  Create 3 lists that stores the hourly temperatures of the rooms.
- Using a nested loop, calculate and display the average temperature reading for each room.

```
Average temperature in room [20, 21, 23, 25, 22] is 22.2
Average temperature in room [27, 23, 25, 20, 30, 24] is 24.8
Average temperature in room [22, 23, 24, 22] is 22.8
```

Activity 4: Calendar

- **Print a month view of a calendar. Given that the month has 30 days, and the first day starts on Sunday**

```
 S  M  T  W Th  F  S
 1  2  3  4  5  6  7
 8  9 10 11 12 13 14
15 16 17 18 19 20 21
22 23 24 25 26 27 28
29 30
```

Activity 5: Menu Selection

- On the right is a screen capture of a typical system interface

Write a Python program to print out the menu, and prompts the user to enter a selection. The program will print out the user's selection and show the menu again. If the user selects Go Back, the program should terminate.

```
Onix Recovery v2.5.1.0

[1] reboot system now
[2] apply sdcard:update.zip
[3] wipe data/factory reset
[4] +++++Go Back+++++

_____________________________
1
reboot system now

Onix Recovery v2.5.1.0

[1] reboot system now
[2] apply sdcard:update.zip
[3] wipe data/factory reset
[4] +++++Go Back+++++

_____________________________
2
apply sdcard:update.zip
```

Activity 6: Matrix Addition

- You are given two nested lists representing two 3-by-3 matrices.
- Write a test program that calculates and displays the result of the sum of the 2 matrices.
- The formula for matrix addition is as follows:

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{pmatrix} + \begin{pmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{pmatrix} = \begin{pmatrix} a_{11} + b_{11} & a_{12} + b_{12} & a_{13} + b_{13} \\ a_{21} + b_{21} & a_{22} + b_{22} & a_{23} + b_{23} \\ a_{31} + b_{31} & a_{32} + b_{32} & a_{33} + b_{33} \end{pmatrix}$$

- Output:

```
[[1.0, 4.0, 7.0],
[5.0, 9.5, 8.2],
[8.1, 12.3, 14.2]]
```

Activity 6: Matrix Addition

```
matrix1 = [[1.0, 2.0, 3.0], \
           [4.0, 5.0, 6.0], \
           [7.0, 8.0, 9.0]]

matrix2 = [[0.0, 2.0, 4.0], \
           [1.0, 4.5, 2.2], \
           [1.1, 4.3, 5.2]]

matrix3 = [] # the result
```

Summary

- A loop can be nested inside another loop, also known as a nested loop.
- Nested loop involves for each pass through the outer loop, you need to repeat some action on the data in the outer loop.
- Nested loops are often used to process matrix/tabular data and multi-dimensional/nested data structures.