Chapter 3
Repetition Control Structures

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Outline

Contents

Repetition Instructions 2
The WHILE Structure 2
The DO..WHILE Structure 4
The FOR Structure 7
Objectives

After completing this lesson, students will be able to:

- Develop algorithms that use the WHILE and DO..WHILE control structures
- Introduce a pseudocode structure for counted repetition loops (FOR loops)
- Develop algorithms using variation of the repetition construct

Repetition Instructions

Three different ways that a set of instructions can be repeated

1. At the beginning of the loop (Leading decision loop)
   - The WHILE structure
2. At the end of the loop (Trailing decision loop)
   - The DO..WHILE structure
3. A counted number of times (Counted loop)
   - The FOR structure

The WHILE Structure

Leading Decision Loop

- Condition is tested before any statements are executed
  - If the condition is true,
    - The statements will then be repeated until the condition becomes false

Format:
WHILE condition p is TRUE
   statement block
ENDWHILE
Figure 1: The WHILE flowchart.

Example I
Initialize $i$ to 1
WHILE ($i < 50$)
  $i = i \times 2$
ENDWHILE

Figure 2: The WHILE flowchart.
Example II
Initialize i to 1
WHILE (i < 50)
   i = i x 2
   DISPLAY i
ENDWHILE

Figure 3: The WHILE flowchart.

The DO..WHILE Structure

Trailing Decision Loop

- The condition is tested at the end of the loop
  - The statements within the loop will be executed once before the condition is tested
  - If the condition is true,
    * The statements will then be repeated until the condition becomes false

Format:
DO
   statement block
WHILE condition is TRUE
The **WHILE** structure can be written by the **DO..WHILE** structure

**Example I: The WHILE structure**

```plaintext
Print_countdown
  Set i to 3
  WHILE (i > 0)
    Display i
    Subtract 1 from i
  ENDWHILE
END
```

**Can Be Written by Using the DO..WHILE structure**

```plaintext
Print_countdown
  Set i to 3
  DO
    Display i
    Subtract 1 from i
  WHILE (i > 0)
END
```
Example II: The WHILE structure

Process student_records
  Set student_count to 0
  Read student record
  WHILE (student_id <> 5022300049)
    Display student record
    Increment student_count
    Read student record
  ENDWHILE
  Display student_count
END

Can Be Written by Using the DO..WHILE structure

Process student_records
  Set student_count to 0
  DO
    Read student record
    IF (student_id <> 5022300049) THEN
      Display student record
      Increment student_count
    ENDIF
    WHILE(student_id <> 5022300049)
  END
  Display student_count
END

DO..WHILE loops are used less frequently than WHILE loops

  • Because of the extra IF statement required within the loop.

Process student_records
  Set student_count to 0
  DO
    Read student record
    IF (student_id <> 5022300049) THEN
      Display student record
      Increment student_count
    ENDIF
    WHILE(student_id <> 5022300049)
  END
  Display student_count
END
The FOR Structure

Counted Loop

- The execution of the loop is controlled by a loop index
- A counted repetition construct will perform
  - Initializing the loop counter
  - Testing the loop counter
  - Incrementing the loop counter
- The loop will be terminated when the require number of repetitions has been executed

Format:
FOR (loop_cnt = initial_value; condition p; loop_cnt updating) 
statement block
ENDFOR

Figure 5: The FOR flowchart.
Example I: The FOR structure
Print_countdown
    FOR (i=3; i>0; i=i-1)
        Display i
    ENDFOR
END
Same logic as the WHILE structure
Print_countdown
    Set i to 3
    WHILE (i > 0)
        Display i
        Subtract 1 from i
    ENDFILE
END

Summary

• The repetition control structure
  1. WHILE structure
     – Leading decision loops
  2. DO..WHILE structure
     – Trailing decision loops
  3. FOR structure
     – Counted loops

• The general pattern of repetition loops
  – Some initial processing before the loop
  – Some processing for each record within the loop
  – Some final processing once the loop has been exited
References


Sources of Pictures:


