**PSEUDOCODE STANDARD**

Pseudocode is a kind of structured English for describing algorithms. It allows the designer to focus on the logic of the algorithm without being distracted by details of language syntax. At the same time, the pseudocode needs to be complete. It describes the entire logic of the algorithm so that implementation becomes a rote mechanical task of translating line by line into source code.

Each textbook and each individual designer may have their own personal style of pseudocode. Pseudocode is not a rigorous notation, since it is read by other people, not by the computer. There is no universal "standard" for the industry, but for instructional purposes it is helpful if we all follow a similar style. The format below is recommended for expressing your solutions in our class.

The "structured" part of pseudocode is a notation for representing six specific structured programming constructs:

* **SEQUENCE**
* **WHILE**
* **IF-THEN-ELSE**
* **REPEAT-UNTIL**
* **FOR**
* **CASE**

Each of these constructs can be embedded inside any other construct. These constructs represent the logic, or flow of control in an algorithm.

It has been proven that three basic constructs for flow of control are sufficient to implement any "proper" algorithm.

* **SEQUENCE** is a linear progression where one task is performed sequentially after another.
* **WHILE** is a loop (repetition) with a simple conditional test at its beginning.
* **IF-THEN-ELSE** is a decision (selection) in which a choice is made between two alternative courses of action.

Although these constructs are sufficient, it is often useful to include three more constructs:

**REPEAT-UNTIL** is a loop with a simple conditional test at the bottom.

**CASE** is a multiway branch (decision) based on the value of an expression. CASE is a generalization of IF-THEN-ELSE.

**FOR** is a "counting" loop.

**SEQUENCE**

Sequential control is indicated by writing one action after another, each action on a line by itself, and all actions aligned with the same indent. The actions are performed in the sequence (top to bottom) that they are written.

Example (non-computer)

Brush teeth   
Wash face   
Comb hair   
Smile in mirror

Example

READ height of rectangle   
READ width of rectangle   
COMPUTE area as height times width

Common Action Keywords

Several keywords are often used to indicate common input, output, and processing operations.

Input: READ, OBTAIN, GET   
Output: PRINT, DISPLAY, SHOW   
Compute: COMPUTE, CALCULATE, DETERMINE   
Initialize: SET, INIT   
Add one: INCREMENT, BUMP

**IF-THEN-ELSE**

Binary choice on a given Boolean condition is indicated by the use of four keywords: IF, THEN, ELSE, and ENDIF. The general form is:

IF condition THEN

sequence 1

ELSE

sequence 2

ENDIF

The ELSE keyword and "sequence 2" are optional. If the condition is true, sequence 1 is performed, otherwise sequence 2 is performed.

Example

IF HoursWorked > NormalMax THEN

Display overtime message

ELSE

Display regular time message

ENDIF

**WHILE**

The WHILE construct is used to specify a loop with a test at the top. The beginning and ending of the loop are indicated by two keywords WHILE and ENDWHILE. The general form is:

WHILE condition

sequence

ENDWHILE

The loop is entered only if the condition is true. The "sequence" is performed for each iteration. At the conclusion of each iteration, the condition is evaluated and the loop continues as long as the condition is true.

Example

WHILE Population < Limit

Compute Population as Population + Births - Deaths

ENDWHILE

Example

WHILE employee.type NOT EQUAL manager AND personCount < numEmployees

INCREMENT personCount  
CALL employeeList.getPerson with personCount RETURNING employee

ENDWHILE

**CASE**

A CASE construct indicates a multiway branch based on conditions that are mutually exclusive. Four keywords, CASE, OF, OTHERS, and ENDCASE, and conditions are used to indicate the various alternatives. The general form is:

CASE expression OF

condition 1 : sequence 1   
condition 2 : sequence 2   
...   
condition n : sequence n   
OTHERS:   
default sequence

ENDCASE

The OTHERS clause with its default sequence is optional. Conditions are normally numbers or characters

indicating the value of "expression", but they can be English statements or some other notation that specifies the condition under which the given sequence is to be performed. A certain sequence may be associated with more than one condition.

Example

CASE Title OF  
 Mr : Print "Mister"  
 Mrs : Print "Missus"  
 Miss : Print "Miss"  
 Ms : Print "Mizz"  
 Dr : Print "Doctor"  
 ENDCASE

Example

CASE grade OF  
 A : points = 4  
 B : points = 3  
 C : points = 2  
 D : points = 1  
 F : points = 0  
 ENDCASE

**REPEAT-UNTIL**

This loop is similar to the WHILE loop except that the test is performed at the bottom of the loop instead of at the top. Two keywords, REPEAT and UNTIL are used. The general form is:

REPEAT

sequence

UNTIL condition

The "sequence" in this type of loop is always performed at least once, because the test is peformed after the sequence is executed. At the conclusion of each iteration, the condition is evaluated, and the loop repeats if the condition is false. The loop terminates when the condition becomes true.

**FOR**

This loop is a specialized construct for iterating a specific number of times, often called a "counting" loop. Two keywords, FOR and ENDFOR are used. The general form is:

FOR iteration bounds

sequence

ENDFOR

In cases where the loop constraints can be obviously inferred it is best to describe the loop using problem domain vocabulary.

Example

FOR each month of the year (good)   
FOR month = 1 to 12 (ok)

FOR each employee in the list (good)   
FOR empno = 1 to listsize (ok)

**NESTED CONSTRUCTS**

The constructs can be embedded within each other, and this is made clear by use of indenting. Nested constructs should be clearly indented from their surrounding constructs.

Example

SET total to zero   
REPEAT

READ Temperature   
IF Temperature > Freezing THEN   
INCREMENT total   
END IF

UNTIL Temperature < zero   
Print total

In the above example, the IF construct is nested within the REPEAT construct, and therefore is indented.

**INVOKING SUBPROCEDURES**

Use the CALL keyword. For example:

CALL AvgAge with StudentAges   
CALL Swap with CurrentItem and TargetItem   
CALL Account.debit with CheckAmount   
CALL getBalance RETURNING aBalance   
CALL SquareRoot with orbitHeight RETURNING nominalOrbit

**EXCEPTION HANDLING**  
  
BEGIN   
statements   
EXCEPTION   
WHEN exception type   
statements to handle exception  
WHEN another exception type   
statements to handle exception  
END

**Sample Pseudocode**

**"Adequate"**  
  
FOR X = 1 to 10   
FOR Y = 1 to 10   
IF gameBoard[X][Y] = 0   
Do nothing   
ELSE   
CALL theCall(X, Y) (recursive method)   
increment counter   
END IF  
END FOR  
END FOR

**"Better"**

Set moveCount to 1  
FOR each row on the board   
FOR each column on the board   
IF gameBoard position (row, column) is occupied THEN   
CALL findAdjacentTiles with row, column  
INCREMENT moveCount   
END IF   
END FOR  
END FOR  
  
(Note: the logic is restructured to omit the "do nothing" clause)

**"Not So Good"**

FOR all the number at the back of the array   
SET Temp equal the addition of each number   
IF > 9 THEN   
get the remainder of the number divided by 10 to that index   
and carry the "1"   
Decrement one   
Do it again for numbers before the decimal

**"Good Enough (not perfect)"**

SET Carry to 0   
FOR each DigitPosition in Number from least significant to most significant

COMPUTE Total as sum of FirstNum[DigitPosition] and SecondNum[DigitPosition] and Carry

IF Total > 10 THEN   
SET Carry to 1   
SUBTRACT 10 from Total   
ELSE   
SET Carry to 0   
END IF

STORE Total in Result[DigitPosition]

END LOOP

IF Carry = 1 THEN   
RAISE Overflow exception   
END IF

**"Pretty Good"**

This example shows how pseudocode is written as comments in the source file. Note that the double slashes are indented.

public boolean moveRobot (Robot aRobot)   
{   
//IF robot has no obstacle in front THEN   
// Call Move robot   
// Add the move command to the command history   
// RETURN true   
//ELSE   
// RETURN false without moving the robot   
//END IF   
}

Example Java Implementation

* source code statements are interleaved with pseudocode.
* comments that correspond exactly to source code are removed during coding.

public boolean moveRobot (Robot aRobot)   
{   
//IF robot has no obstacle in front THEN   
if (aRobot.isFrontClear())   
{   
// Call Move robot   
aRobot.move();   
// Add the move command to the command history   
cmdHistory.add(RobotAction.MOVE);   
return true;   
}   
else // don't move the robot   
{   
return false;   
}//END IF   
}