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# CHAPTER 7

# **COMPOSITION AND DECOMPOSITION**

- 1. Suppose u, v = 10, 5 before the assignment. What are the values of u and v after the sequence of assignments?
  - $\begin{array}{ll}
    1 & u := v \\
    2 & v := u
    \end{array}$ 
    - (a) u, v = 5, 5 (b) u, v = 5, 10 (c) u, v = 10, 5 (d) u, v = 10, 10
- 2. Which of the following properties is true after the assignment (at line 3?

(b) i+j < 0

1 - i + j = 02 i, j := i+1, j-1 3 -- ? (a) i+j >0

(c) i+j=0 (d) i=j

3. If C1 is false and C2 is true, the compound statement



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#### Part II

#### 1. Distinguish between a condition and a statement.

CONDITION	STATEMENT	
Condition is the Checking process of either True	Processing the condition	
/ False.		
A condition is contained in a diamond shaped	A statement is contained in a rectangular box	
box with two outgoing arrows, labeled true and	with a single outgoing arrow, which points to the	
false.	box to be executed next.	
<b>EX:</b> a>b	<b>EX:</b> Print a (a-is a Biggest value)	

2. Draw a flowchart for conditional statement.



- 3. Both conditional statement and iterative statement have a condition and a statement. How do they differ?
  - Conditional statement is executed only if the condition is true. Otherwise nothing is done.
  - > Iterative statement repeatedly evaluates a condition and executes a statement as long as the condition is true.

#### 4. What is the difference between an algorithm and a program?

ALGORITHM	PROGRAM	
An algorithm is a self-contained step-by-step set of operations to be performed to solve specific problems.	A Computer program is a sequence of instructions that complete the rules of a specific programming language, written to perform a specified task with a computer.	
Method / Procedure of a program	Computer Coding / Program	

#### 5. Why is function an abstraction?

- > The parts of an algorithm are known as functions. A function is like a sub algorithm.
- > It takes an input, and produces an output, satisfying a desired input output relation.

#### 6. How do we refine a statement?

In refinement, starting at a high level, each statement is repeatedly expanded into more detailed statements in the subsequent levels.

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#### Part III

1. For the given two flowcharts write the pseudo code.



Enter A, B
 Initialize Q = 0, r = A
 if r≥B, then do Q = Q+1; r = r - B else r, q
 Exit

2. If C is false in line 2, trace the control flow in this algorithm.

- 1. SI
- 2. - C is false
- 3. if C
- 4. S2
- 5. else
- 6. S3
- 7. S4

Answer: **S**<sub>1</sub>; **S**<sub>3</sub>; **S**<sub>4</sub>

#### 3. What is case analysis?

Alternative statement analyses the problem into two cases. Case analysis statement generalizes it to multiple cases.

**S1** 

False

\$3

**S4** 

- Case analysis splits the problem into an exhaustive set of disjoint cases.
- 4. Draw a flowchart for -3case analysis using alternative statements.



- 5. Define a function to double a number in two different ways: (1) n + n, (2) 2 x n
- (1) **n** + **n** 
  - -- Input: **n** is a real number or an integer, **n>0**
  - -- Output: y is a real number or an integer such that y = n + n
- (2) 2 x n

-- Input: n is a real number or an integer, n>0

-- Output: y is a real number or an integer such that y = 2 x n

- Example:
- n=3 (assume)
- 1. n+n=3+3=6
- 2. 2xn=2x3=6

(Double a Value in above 2 Methods)

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#### Part IV

1. Exchange the contents: Given two glasses marked A and B. Glass A is full of apple drink and glass B is full of grape drink. Write the specification for exchanging the contents of glasses A and B, and write a sequence of assignments to satisfy the specification.

Solution:

Exchange (A, B)

-- inputs : A, B are real number or an integers,  $A \neq 0$ ,  $B \neq 0$ 

-- outputs : t is an integer such that t :=A; A:=B; B:=t.

2. Circulate the contents: Write the specification and construct an algorithm to circulate the contents of the variables A, B and C as shown below: The arrows indicate that B gets the value of A, C gets the value of B and A gets the value of C.



Solution:

Circulate (A, B, C)

--Inputs : A, B, C are real numbers or an integers,  $A \neq 0$ ,  $B \neq 0$ ,  $C \neq 0$ 

--**Outputs :** t<sub>1</sub>:=B; t<sub>2</sub>:=C such that B:=A; C:=t<sub>1</sub>; A:=t<sub>2</sub>;

3. Decanting problem. You are given three bottles of capacities 5,8, and 3 litres. The 8L bottle is filled with oil, while the other two are empty. Divide the oil in 8L bottle into two equal quantities. Represent the state of the process by appropriate variables. What are the initial and final states of the process? Model the decanting of oil from one bottle to another by assignment. Write a sequence of assignments to achieve the final state.

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Solution:
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1.	A := 8, B := 0, C := 0	
2.	E, F, T := A, B, C	$\sim$
3.	F := E - 3	
4.	T := F - 3	
5.	E := E + T	EF
6.	T := F	1. 8, 0,
	F := F - 2	2. 3, 5,
7.	F := E - 1	3. 3, 2, 4. $^{3+3}_{6 2}$
8.	F := F - 1	EFT
	T := T + 1	6, 2,
9.	E := E + T	1, 5,
	<b>T</b> . <b>T</b> 2	1, 4,
	1 := 1 - 3	4, 4,

4. Trace the step-by-step execution of the algorithm for factorial (4).

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factorial(n)

-- inputs : n is an integer ,  $n \ge 0$ -- outputs : f = n!f, i := 1 ,1 while  $i \le n$ f, i :=  $f \times i$ , i+1 <u>Solution:</u> Factorial (4) i = 1, f = 1;  $= f = 1 \ge 1$   $= f = 1 \ge 2$  $= f = 2 \ge 3$ 

= f = 6

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### **EXTRA QUESTIONS:**

#### 1. Define: Algorithm.

An algorithm expressed in a programming language is called a program. **Ex:** C, C++ and Python

#### 2. What is Pseudo code?

- > Pseudo code is a mix of programming language.
- > It uses the same building blocks as programs.
- > Condition based statement execution process.
- > Pseudo code is the most widely used notation to represent algorithms.

#### **3.** Define : Flowcharts

Flowchart is a diagrammatic notation for representing algorithms. They show the control flow of algorithms using diagrams in a visual manner. In flowcharts, rectangular boxes represent simple statements, diamond-shaped boxes represent conditions, and arrows describe how the control flows during the execution of the algorithm.

#### 4. What are three important control flow statements?

- Sequential
- Alternative
- Iterative

#### 5. What is Alternative statement?

A condition is a phrase that describes a test of the state. If C is a condition and both S1 and S2 are statements, then

if C S1 else S2

is a statement, called an alternative statement.

#### 6. Define: Iterative statement

An iterative process executes the same action repeatedly, subject to a condition C. If C is a condition and S is a statement, then

while C

S

is a statement, called an iterative statement.

#### 7. Explain: Composition and Decomposition

#### Composition

- > A statement is a phrase that commands the computer to do an action.
- ➤ We have already seen assignment statement.
- > It is a simple statement, used to change the values of variables.

#### Decomposition

- Problem decomposition is one of the elementary problem-solving techniques.
- ➤ It involves breaking down a problem into smaller and more manageable problems, and combining the solutions of the smaller problems to solve the original problem.

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