What Does This Program Do?

Frequently, one must use or modify sections of another programmer’s code. Since the original author is often unavailable to explain his/her code, and documentation is, unfortunately, not always available or sufficient, it is essential to be able to read and understand an arbitrary program.

This category presents a program and asks the student to determine that the program does. The programs are written using a pseudocode that should be readily understandable by all programmers familiar with a high-level programming language, such as Python, Java, or C.

Contents

Description of the ACSL Pseudo-code

We will use the following constructs in writing this code for this topic in ACSL:

Construct	Code Segment
Operators	! (not) , ^ or ↑(exponent), *, / (real division), % (modulus), +, -, >, <, >=, <=, !=, ==, && (and), || (or) in that order of precedence
Functions	abs(x) - absolute value, sqrt(x) - square root, int(x) - greatest integer <= x
Variables	Start with a letter, only letters and digits
Sequential statements	INPUT variable variable = expression (assignment) OUTPUT variable

Decision statements	IF boolean expression THEN
	Statement(s)
	ELSE (optional)
	Statement(s)
	END IF

Indefinite Loop statements	WHILE Boolean expression
	Statement(s)
	END WHILE

Definite Loop statements	FOR variable = start TO end STEP increment Statement(s) NEXT
Arrays:	1 dimensional arrays use a single subscript such as A(5). 2 dimensional arrays use (row, col) order such as A(2,3). Arrays can start at location 0 for 1 dimensional arrays and location (0,0) for 2 dimensional arrays. Most ACSL past problems start with either A(1) or A(1,1). The size of the array will usually be specified in the problem statement.
Strings:	Strings can contain 0 or more characters and the indexed position starts with 0 at the first character. An empty string has a length of 0. Errors occur if accessing a character that is in a negative position or equal to the length of the string or larger. The len(A) function will find the length of the string which is the total number of characters. Strings are identified with surrounding double quotes. Use [ ] for identifying the characters in a substring of a given string as follows: S = “ACSL WDTPD” (S has a length of 10 and D is at location 9) S[:3] = “ACS” (take the first 3 characters starting on the left) S[4:] = “DTPD” (take the last 4 characters starting on the right) S[2:6] = “SL WD” (take the characters starting at location 2 and ending at location 6)

	S[0] = “A” (position 0 only). String concatenation is accomplished using the + symbol

The questions in this topic will cover any of the above constructs in the Intermediate and Senior Division. In the Junior Division, loops will not be included in contest 1; loops will be used in contest 2; strings will be used in contest 3; and arrays will be included in contest 4.

Sample Problems

Problem 1

After this program is executed, what is the value of B that is printed if the input values are 50 and 10?

```
input H, R
B = 0
if H>48 then
    B = B + (H - 48) * 2 * R
    H = 48
end if
if H>40 then
   B = B + (H - 40) * (3/2) * R
   H = 40
end if
B = B + H * R
output B
```

Solution:

This program computes an employee’s weekly salary, given the hourly rate (R) and the number of hours worked in the week (H). The employee is paid an hourly rate for the number of hours worked, up to 40, time and a half for the overtime hours, up to 48 hours, and double for all hours over 48. The table monitors variables B and H:

B	H
0	50
40	48
160	40
560	40

Therefore, the final value of B is 2*2*10 + 8*3/2*10 + 40*10 = 40 + 120 + 400 = 560.

Problem 2

After the following program is executed, what is the final value of NUM?

```
A = “BANANAS”
NUM = 0: T = “”
for J = len(A) - 1 to 0 step –1
```

```
     T = T + A[j]
next
for J = 0 to len(A) - 1
    if A[J] == T[J] then NUM = NUM + 1
next
```

Solution:

The program first stores the reverse of variable A into variable T and then counts the number of letters that are in the same position in both strings. Variable NUM is incremented each time a character at position x of A is the same as the character in position x of string T. There are 5 such positions: 1, 2, 3, 4, and 5.

Problem 3

After the following program is executed, what is the final value of C[4]?

```
A(0) = 12: A(1) = 41: A(2) = 52
A(3) = 57: A(4) = 77: A(5) = -100
B(0) = 17: B(1) = 34: B(20 = 81
J = 0: K = 0: N = 0
while A(J) > 0
  while B(K) <= A(J)
    C(N) = B(K)
    N = N + 1
    k = k + 1
  end while
  C(N) = A(J): N = N + 1: J = J + 1
end while
C(N) = B(K)
```

Solution:

The following table traces the variables through the execution of the program.

J	K	N	A(J)	B(K)	C(N)
0	0	0	12	17	12
1	0	1	41	17	17
1	1	2	41	34	34
1	2	3	41	81	41
2	2	4	52	81	52
3	2	5	57	81	57
4	2	6	77	81	77
5	2	7	-100	81	81

Thus, the value of C(4) is 52. Note that this program merges two arrays in increasing order into one array until a negative number is input.

Video Resources