**Self-Assessment 3-9**

9. Write code that performs the computation:

 X = (A + B \* C) + ((D + E) \* F)

using CPUs that have the following instruction formats:

1. three-operand instructions
2. two-operand instructions
3. one-operand instructions
4. stack instructions

Do not modify the values of A, B, C, D, E, or F. If necessary, use a temporary location, T, to store the intermediate results.

**Answer**

1. MUL X, B, C  
   ADD X, A, X  
   ADD T, D, E  
   MUL T, F, T  
   ADD X, T, X
2. MOVE T, B  
   MUL T, C  
   ADD T, A  
   MOVE X, D  
   ADD X, E  
   MUL X, F  
   ADD X, T
3. LOAD B  
   MUL C  
   ADD A  
   STORE T  
   LOAD D  
   ADD E  
   MUL F  
   ADD T  
   STORE X
4. Comments on the stack instructions are in parentheses.

|  |  |
| --- | --- |
| PUSH | (pushes A onto the stack) |
| PUSH | (pushes B onto the stack) |
| PUSH | (pushes C onto the stack) |
| MUL | (pops B and C, multiplies them, and pushes the result back onto the stack) |
| ADD | pops B \* C and A off the stack, adds them, and pushes the result back onto the stack) |
| PUSH | (pushes D onto the stack) |
| PUSH | (pushes E onto the stack) |
| ADD | (pops D and E, adds them, and pushes the result back onto the stack) |
| PUSH | (pushes F onto the stack) |
| MUL | (pops D + E and F off the stack, multiplies them, and pushes the result back onto the stack) |
| ADD | (pops (D + E) \* F and A + B \* C off the stack, adds them, and pushes the result onto the stack) |
| POP | (pops the final result, X, off the stack) |