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/
/ Michael Beaver
/ CS 311 - Fall 2013
/ p. 264, #28:  $A \times B + C \times D \Rightarrow (A \times B) + (C \times D)$ 
/ The final answer is located in the Accumulator.
/ Assuming  $A = 5, B = 2, C = 8, D = 3$ 
/ Multiplication is performed by a subroutine.
/
ORG 100
/
/ Calculate  $A \times B$ 
/
100 111D | Start LOAD B /Load value of B
101 2115 | STORE TempN /Store B into TempN
102 111C | LOAD A /Load value of A
103 2116 | STORE TempM /Store A to temp for multiplication
104 1118 | LOAD Prod1 /Load value of Prod1
105 2117 | STORE TempQ /Store Prod1 to temp for multiplication
106 0120 | JNS Mult /Perform multiplication
107 1117 | LOAD TempQ /Load product of multiplication
108 2118 | STORE Prod1 /Store to Prod1
/
/ Calculate  $C \times D$ 
/
109 111F | LOAD D /Load value of D
10A 2115 | STORE TempN /Store D into TempN
10B 111E | LOAD C /Load value of C
10C 2116 | STORE TempM /Store C to temp for multiplication
10D 1119 | LOAD Prod2 /Load value of Prod2
10E 2117 | STORE TempQ /Store Prod2 to temp for multiplication
10F 0120 | JNS Mult /Perform multiplication
110 1117 | LOAD TempQ /Load product of multiplication
111 2119 | STORE Prod2 /Store to Prod2
/
/ Calculate  $A \times B + C \times D$ , or  $(A \times B) + (C \times D)$ 
/
112 1118 | LOAD Prod1 /Load product  $A \times B$ 
113 3119 | ADD Prod2 /Add product  $C \times D \Rightarrow$  AC holds  $A \times B + C \times D$ 
114 7000 | HALT
/
/ Memory declarations
/
115 0000 | TempN DEC 0 /Temp multiplier
116 0000 | TempM DEC 0 /Temp multiplier
117 0000 | TempQ DEC 0 /Temp quotient
118 0000 | Prod1 DEC 0 /Product  $A \times B$ 
119 0000 | Prod2 DEC 0 /Product  $C \times D$ 
11A 0000 | Ctr DEC 0 /Loop counter
11B 0001 | One DEC 1
11C 0005 | A DEC 5
11D 0002 | B DEC 2
11E 0008 | C DEC 8
11F 0003 | D DEC 3
/
/ Multiplication Subroutine:
/  $M \times N$  is defined as  $M + M, N$ -times
/
120 0000 | Mult HEX 0 /Store return address to caller
121 1115 | LOAD TempN /Load TempN as loop counter
122 411B | SUBT One /Decrement Counter
123 211A | STORE Ctr /Store this value into loop counter
124 1117 | Loop LOAD TempQ /Load value of TempQ into AC
125 3116 | ADD TempM /Add TempM to TempQ

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126 2117 |          STORE TempQ      /Store product
127 111A |          LOAD Ctr         /Load counter
128 411B |          SUBT One         /Decrement Counter
129 211A |          STORE Ctr        /Store loop counter
12A 8000 |          SKIPCOND 000     /If loop counter < 0, exit loop
12B 9124 |          JUMP Loop        /Jump to top of Loop
12C C120 |          JUMPI Mult       /Return to caller
      |          END

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Assembly successful.

SYMBOL TABLE

Symbol	Defined	References
A	11C	102
B	11D	100
C	11E	10B
Ctr	11A	123, 127, 129
D	11F	109
Loop	124	12B
Mult	120	106, 10F, 12C
One	11B	122, 128
Prod1	118	104, 108, 112
Prod2	119	10D, 111, 113
Start	100	
TempM	116	103, 10C, 125
TempN	115	101, 10A, 121
TempQ	117	105, 107, 10E, 110, 124, 126