

Problem 13. The table below shows part of a machine-language program for the MARIE computer. Three memory words are shown, beginning at address 100 (hex). If possible, convert each machine-language instruction to an equivalent assembly-language instruction. (If this is not possible, carefully explain why.)

Memory address (hex)	Memory contents (binary)
100	1010000000000000
101	0100000100000100
102	0010000100000101

Opcode	Instruction	RTN
0000	Jns X	$MBR \leftarrow PC$ $MAR \leftarrow X$ $M[MAR] \leftarrow MBR$ $MBR \leftarrow X$ $AC \leftarrow 1$ $AC \leftarrow AC + MBR$ $PC \leftarrow AC$
0001	Load X	$MAR \leftarrow X$ $MBR \leftarrow M[MAR]$ $AC \leftarrow MBR$
0010	Store X	$MAR \leftarrow X, MBR \leftarrow AC$ $M[MAR] \leftarrow MBR$
0011	Add X	$MAR \leftarrow X$ $MBR \leftarrow M[MAR]$ $AC \leftarrow AC + MBR$
0100	Subt X	$MAR \leftarrow X$ $MBR \leftarrow M[MAR]$ $AC \leftarrow AC - MBR$
0101	Input	$AC \leftarrow InREG$
0110	Output	$OutREG \leftarrow AC$
0111	Halt	
1000	Skipcond	If $IR[11-10] = 00$ then If $AC < 0$ then $PC \leftarrow PC + 1$ Else If $IR[11-10] = 01$ then If $AC = 0$ then $PC \leftarrow PC + 1$ Else If $IR[11-10] = 10$ then If $AC > 0$ then $PC \leftarrow PC + 1$
1001	Jump X	$PC \leftarrow IR[11-0]$
1010	Clear	$AC \leftarrow 0$
1011	AddI X	$MAR \leftarrow X$ $MBR \leftarrow M[MAR]$ $MAR \leftarrow MBR$ $MBR \leftarrow M[MAR]$ $AC \leftarrow AC + MBR$
1100	JumpI X	$MAR \leftarrow X$ $MBR \leftarrow M[MAR]$ $PC \leftarrow MBR$

TABLE 4.7 MARIE's Full Instruction Set