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CEG2536 Architecture des ordinateurs I

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University of Ottawa
Faculty of Engineering
School of Electrical Engineering
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CEG2136 Computer Architecture I

NAME / ID#

Quiz 4 / Fall 2014

Even

Q1. The second column of the following table contains a list of instructions in machine code and related operands that are stored in the memory unit of the basic computer starting with memory location at address $(600)_{16}$. All numbers listed below are in hexadecimal.

a. Convert this program from Machine Language to Assembly Language, using the annexed instruction list and write the corresponding symbolic codes of these instructions in the 3rd column of the table ("Assembly Language").
b. The computer executes the instructions starting from address 600. Show the content of the *AC* (in hexadecimal) after each instruction is executed.
c. What is the content of the memory word at address 608 when the computer halts?
d. Describe in a sentence what is this program doing?

Memory Address	Machine Code	Assembly Language (**a = 6 pts**)	AC (**b = 4.5**)
600	2607	LDA 607 (1 pt)	(1 pt) $000A_{16}=10_{10}$
601	7200	CMA (1 pt)	(1 pt) $FFF5_{16}$
602	7020	INC (1 pt)	(0.5 pt) $FFF6_{16}=-10_{10}$
603	1606	ADD 606 (1 pt)	(1 pt) $000D_{16}=13_{10}$
604	3608	STA 608 (1 pt)	(0.5 pt) $000D_{16}=13_{10}$
605	7001	HLT (1 pt)	(0.5 pt) $000D_{16}=13_{10}$
606	0017	$0017_{16}=23$	
607	000A	$000A_{16}=10$	
608	0000	$000D_{16}=13_{10}$ (**c**) **(1.5 pt)**	

(d) Subtract number from memory location with address 707 from number at 706 and stores the difference at 708. **(2 pts – equivalent statements would be OK; give partial marks)**

Bonus: 1 pt. for comments or explanations

Q2. Write a program loop in assembly language, using a pointer and a counter, which writes $(2222)_{16}$ to 128 consecutive memory locations starting at address A00 . Your program should be stored in the memory of the basic computer starting with address F40.

NOTE: All numbers in the above text are in hexadecimal.

Solution:

⇨ The counter CTR should be initialised with $-128_{10} = FF80_{16}$

Assembly Language					10
	ORG F40	Addr	Code		.1.
	LDA ADS	F40	2F4A		1
	STA PTR	F41	3F4B	/Initialize pointer to the first memory location to be modified	
	LDA NBR	F42	2F4C		1
	STA CTR	F43	3F4D	/Initialize counter to -128	
	LDA PAT	F44	2F4E	/Prepare pattern 2222 in Accumulator to be written to the memory	1
LOP,	STA PTR I	F45	BF4B	/Load pattern 2222 to the memory location indicated by PTR	1
	ISZ PTR	F46	6F4B		1
	ISZ CTR	F47	6F4D	/ Loop mechanism	2
	BUN LOP	F48	4F45		
	HLT	F49	7001		1
ADS,	HEX A00	F4A	0A00	/ 1st memory location to be written with the PAT pattern	
PTR,	HEX 0	F4B	0000	/ will be used as pointer to the current memory location to be written	
NBR,	DEC -128	F4C	FF80	/or HEX FF80 = number of loops to be performed	
CTR,	HEX 0	F4D	0000	/ will be used as counter of loops until = 0	
PAT,	HEX 2222	F4E	2222	/ the pattern to be written in the memory	
	END				

1 pt for comments

1pt BONUS for **good** comments

Symbol	Hex code	Description
AND	0 or 8	AND M to AC
ADD	1 or 9	Add M to AC, carry to E
LDA	2 or A	Load AC from M
STA	3 or B	Store AC in M
BUN	4 or C	Branch unconditionally to m
BSA	5 or D	Save return address in m and branch to m + 1
ISZ	6 or E	Increment M and skip if zero
CLA	7800	Clear AC
CLE	7400	Clear E
CMA	7200	Complement AC
CME	7100	Complement E
CIR	7080	Circulate right E and AC
CIL	7040	Circulate left E and AC
INC	7020	Increment AC
SPA	7010	Skip if AC is positive
SNA	7008	Skip if AC is negative
SZA	7004	Skip if AC is zero
SZE	7002	Skip if E is zero
HLT	7001	Halt computer
INP	F800	Input information and clear flag
OUT	F400	Output information & clear flag
SKI	F200	Skip if input flag is on
SKO	F200	Skip if output flag is on
ION	F080	Turn interrupt on
IOF	F040	Turn interrupt off