

# CS2422 Final Exam (Fall 2004)

1 Given the following SIC/XE assembly program,

COPY	START	1000
FIRST	STL	RETADR
	LDB	#LENGTH
CLOOP	JSUB	RDREC
	LDA	LENGTH
	COMP	#0
	JEQ	ENDFILE
	JSUB	WRREC
	J	CLOOP
ENDFILE	LDA	EOF
	STA	BUFFER
	LDA	#3
	STA	LENGTH
	JSUB	WRREC
	J	@RETADR
EOF	BYTE	C'EOF'
RETADR	RESW	1
LENGTH	RESW	1
BUFFER	RESB	1600
RDREC	CLEAR	X
	CLEAR	A
	CLEAR	S
	LDT	#1600
RLOOP	TD	INPUT
	JEQ	RLOOP
	RD	INPUT
	COMPR	A,S
	JEQ	EXIT
	STCH	BUFFER,X
	TIXR	T
	JLT	RLOOP
EXIT	STX	LENGTH
	RSUB	
INPUT	BYTE	X'F1'
WRREC	CLEAR	X
	LDT	LENGTH
WLOOP	TD	OUTPUT
	JEQ	WLOOP
	LDCH	BUFFER,X
	WD	OUTPUT
	TIXR	T
	JLT	WLOOP
	RSUB	
OUTPUT	BYTE	X'05'
	END	FIRST

- (a) Write the location for each statement. (10%)
  - (b) Write the corresponding machine code for each statement (You need to use program counter relative addressing whenever it is possible). (20%)
  - (c) Write the symbol table for each symbol used in the program. (5%)
  - (d) Write the corresponding object program for the program. (10%)
  
- 2 Let  $(PC) = 3000_{16}$ ,  $(B) = 1000_{16}$ ,  $(L) = 2000_{16}$ , and  $(X) = 40_{16}$ . Write the corresponding assembly codes for the following machine codes. Since we do not have the variable symbols, you should use the target addresses instead. (30%)
 

(a) 77104060	(b) 3F2FCC	(c) 332010	(d) 3E4003	(e) 692040
(f) 53C003	(g) A010	(h) <u>0C2FDE</u>	(i) B850	(j) <u>682022</u>
  
3. Suppose that you have been given the task of writing an "unloader", that is, a piece of software that can take the image of a program that has been loaded and write out an object program that could later be loaded and executed. The computer system uses a relocating loader, so the object program you produce must be capable of being loaded at a location in memory that is different from where your unloader took it. What problems did you see that would prevent you from accomplishing this task? (15%)
  
4. What are the difference between linking loader and linkage editor (10%)

$6010$   
 $3060 + 15 = 3075$   
 $3075 - 24 = 3051$   
 $3051 - 2FCC = 2F51$   
 $2F51 + 15 = 2F66$   
FCC  
2FDE  
 $033_4$   
 $034_4$   
 $1000$  16 10  
 START 4096

Mnemonic	Format	Opcode
ADD m	3/4	18
ADDF m	3/4	58
ADDR r1,r2	2	90
AND m	3/4	40
CLEAR r1	2	B4
COMP m	3/4	28
COMPF m	3/4	88
COMPR r1,r2	2	A0
DIV m	3/4	24
DIVF m	3/4	64
DIVR r1,r2	2	9C
FIX	1	C4
FLOAT	1	C0
HIO	1	F4
J m	3/4	3C
JEQ m	3/4	30
JGT m	3/4	34
JLT m	3/4	38
JSUB m	3/4	48
LDA m	3/4	00
LDB m	3/4	68
LDCH m	3/4	50
LDF m	3/4	70
LDL m	3/4	08
LDS m	3/4	6C
LDT m	3/4	74
LDX m	3/4	04
LPS m	3/4	D0
MUL m	3/4	20

MULF m	3/4	60
MULR r1, r2	2	98
NORM	1	C8
OR m	3/4	44
RD m	3/4	D8
RMO r1, r2	2	AC
RSUB	3/4	4C
SHIFTL r1, n	2	A4
SIO	1	F0
SSK m	3/4	EC
STA m	3/4	0C
STB m	3/4	78
STCH m	3/4	54
STF m	3/4	80
STI m	3/4	D4
STL m	3/4	14
STS m	3/4	7C
STSW m	3/4	E8
STT m	3/4	84
STX m	3/4	10
SUB m	3/4	1C
SUBF m	3/4	5C
SUBR r1, r2	2	94
SVC n	2	B0
TD m	3/4	E0
TIO	1	F8
TIX m	3/4	2C
TIXR r1	2	B8
WD m	3/4	DC

## Registers

Mnemonic	Number
A	0
X	1
L	2
B	3
S	4
T	5
F	6
PC	8
SW	9

## Instruction Formats

Format 1:

8
op

Format 2:

8	4	4
op	r1	r2

Format 3:

6	1	1	1	1	1	1	12
op	n	i	x	b	p	e	disp

Format 4:

6	1	1	1	1	1	1	20
op	n	i	x	b	p	e	disp

0100  
1100

12 2

13  
1680  
1033  
65A  
9A5  
15  
16  
15  
10