Last name (Surname, family name) _____
First name (Given name) _____
Student ID _____

Read this first!

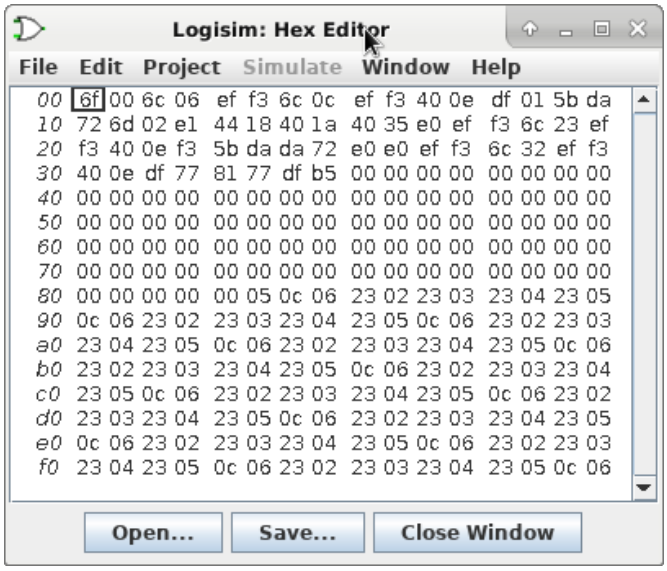
- Final exam of CISP310 (2018/12/19)
- Time: 1015 to 1215
- Location: CMC 407
- Open material printed or hand written prior to the exam, with the exception of the final exam itself of the same semester, regardless of class section.
- Individual assessment:
  - The score should reflect the competency of the student with the name and ID as indicated above without any prior knowledge of the exam questions.
  - Answer should be independently and originally derived in the allotted time frame, observing all applicable rules and restrictions.
  - No sharing of open book/notes material during the exam.
  - Do not discuss the questions with students who may not have taken the exam.
- Use additional sheets of paper if necessary
  - Write your name on each extra sheet of paper.
  - Clearly indicate the question number.
- Write legibly, I cannot give points to answers that I cannot interpret without post exam explanation.
- Make your answers as complete as possible. If there is something that I look for to assign partial credit, I cannot and will not infer that from what you write. In any proof or trace, write your answers as completely as possible.
- All questions have equal weight.
- Some questions may cross pages, be sure to read and answer the entire question!
- The exam accounts for 40% of your final grade.

Question 1 of 4

addr	code	b1	b2
00	ldi d,0	6F	00
02	ldi a,6	6C	06
04	dec d	EF	
05	st (d),a	F3	
06	ldi a,. 6 +	6C	0C
08	dec d	EF	
09	st (d),a	F3	
0A	jmpi fib	40	0E
0C	inc d	DF	
0D	halt	01	
	fib:		
0E	cpr c,d	5B	
0F	inc c	DA	
10	ld a,(c)	72	
11	ldi b,2	6D	02
13	cmp a,b	E1	
14	jci thenBranch	44	18
	// elseBranch		
16	jmpi elseBranch	40	1A
	thenBranch:		
18	jmpi endIf	40	35
	elseBranch:		
1A	dec a	E0	
1B	dec d	EF	
1C	st (d),a	F3	
1D	ldi a,. 6 +	6C	23
1F	dec d	EF	
20	st (d),a	F3	
21	jmpi fib	40	0E
23	st (d),a	F3	
24	cpr c,d	5B	
25	inc c	DA	
26	inc c	DA	
27	ld a,(c)	72	
28	dec a	E0	
29	dec a	E0	
2A	dec d	EF	
2B	st (d),a	F3	
2C	ldi a,. 6 +	6C	32
2E	dec d	EF	
2F	st (d),a	F3	
30	jmpi fib	40	0E
32	inc d	DF	
33	ld b,(d)	77	
	// inc d		
34	add a,b	81	
	endIf:		
35	ld b,(d)	77	
36	inc d	DF	
37	jmp b	B5	

In the table above, column `addr` is the address of an instruction, column `code` is the mnemonic of the instruction, `b1` is the first byte of the instruction, and `b2` is the second byte of the instruction. This is the implementation of the recursive Fibonacci code in the last homework assignment.

This code is incorrect, resulting in the following memory content when the program was interrupted.



Part A: What is the purpose of the byte at locaion 0xfe?

Part B: What is the purpose of the bytes at locations 0xfc, 0fa, 0xf8, and 0xf6?

Part C: The problem is the repeating pattern starting at location 0xf5. There are two locations that the program can branch to to cause this, what are those two possible locations?

Part D: Why do you think the program branched incorrectly? A hint is that the only bug of this program is missing the `inc d` insruction that is commented out (after location 0x33). Explain why this missing instruction causes the observed symptom.

Question 2 of 4

Implement the following C subroutine in TTPASM. Your code must include minimum comment to associate code in TTPASM to line number of C code. If you plan to use labels, you must define the labels. Do not assume any defined labels.

```
1  int8_t srsh(int8_t x, uint8_t y)
2  {
3    int8_t m;
4    if (x<0)
5    {
6      m = 128;
7    }
8    else
9    {
10     m = 0;
11   }
12   while (y)
13   {
14     x = m | (x >> 1);
15     --y;
16   }
17   return x;
18 }
```

Question 3 of 4

Implement the following C subroutine in TTPASM. Your code must include minimum comment to associate code in TTPASM to line number of C code. You may assume findmax2 is already implemented, but the prototype is included for clarification. If you plan to use labels, you must define the labels (except for findmax2). Do not assume any other defined labels.

```
1 int8_t findmax2(int8_t x, int8_t y);
2 int8_t findmax4(int8_t w, int8_t x, int8_t y, int8_t z)
3 {
4   return findmax2(findmax2(w,x),findmax2(y,z));
5 }
```

Note that your implementation must preserve the correct order of parameters and not just merely have the same effect as the C code.

Question 4 of 4

Implement the following C subroutine in TTPASM. Your code must include minimum comment to associate code in TTPASM to line number of C code. If you plan to use labels, you must define the labels. Do not assume any defined labels.

```
1  int8_t sum(int8_t x)
2  {
3    int8_t *p;
4    int8_t s;
5    p = &x;
6    s = 0;
7    while (*p)
8    {
9      s = s + *p;
10     ++p;
11   }
12   return s;
13 }
```

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