2021 Fall CPSC 240-3 Answers
Midterm #2 Concepts Test
November 9, 2021 11:30am-1:30pm

Read me

Place your answers in the space following each question.

Place your name in the test in this front page and on the last page.

Near 1:25pm begin to save your test document in either odt, or doc, or docx format.

Before 1:29pm send your document as an attachment to me: holliday@fullerton.edu

If you encounter a question where you feel that you must guess an answer then place the word “Blank” in the space for the answer and you will receive 20% of the credit for that question.

If the answer space is empty then the points for that question are zero.

You may use any word processing tool at your disposal provided it can save files in one of the three accepted formats.

If your computer has no word processor program then try Google Docs, which saves files in every format ever created on this planet.

The total point value of this test is 100 points, which is one-sixth of your course grade.

Every effort has been made to create unambiguous questions. If a question is truly ambiguous send me ordinary email or a chat message to ask for clarification. I will be at computer during the test period probably answering the backlog of email.

This is an open note test.

Proceed to the next page.

1. 0xA7B9 60F4 381C 5D9E is an integer in a twos-complement 64-bit number system. What is its negative?

Show sufficient intermediate steps to convince the grader that you know how to do it.

Answer: First copy the original number to the work space below. Then write the complement of each digit below that digit.

0xA7B9 60F4 381C 5D9E	<==Original number
0x5846 9F0B C7E3 A261	<==Complement
+1	
0x5846 9F0B C7E3 A262	<== Final answer

2.Convert this IEEE number to base 10 in simplest form. 0X410F A000 0000 0000

Show sufficient intermediate steps to convince the grader that you know how to do it.

Answer: Consider the stored exponent 410. Note that the number is positive.

Subtract the bias number: 410 – 3FF = B, which is 11 in decimal

11 is the true exponent.

The significand (in hex) is FA00000000000. From that sequence of hex digits we can write the significand in binary as shown below.

Number = 1 . 1111 1010 0...0 x 2^{11}

We will drop the trailing zeros on the right because they contribute nothing to the solution.

Number = 1 . 1111 101 x 2^{11}

Shift the point 7 places to the right.
Number = 11111101. x 2^{4}

= 253 x 16

= 4048.0 <== Calculator used here.

3.Convert $118\frac{7}{12}$ to a 64-bit IEEE float number.

Solution: The whole number part 118 is 1110110 in binary.

Now we use repeated multiplication by 2 to find a repeating pattern for the seven-twelfths part.

(7/12) x 2 = 1 + (2/12) = 1 + (1/6)
(1/6) x 2 = 0 + (1/3)
(1/3) x 2 = 0 + (2/3)
(2/3) x 2 = 1 + (1/3)
(1/3) x 2 = 0 + (2/3)
a pattern is starting to develop. We can write the number in binary as follows:

1110110 . 10010101010101010101010101 ….. x 2^0

= 1.11011010010101010101010101010101 ….. x 2^6

= 1.1101 1010 0101 0101 0101 0101 0101 0101 01 ….. x 2^6

Now we compute the stored exponent = EFF + 006 = 405

Now we are ready to write the number in IEEEE:

Number = 0x405D A555 5555 5555. End of solution.

4.What useful contribution did Charles Babbage give to the modern world of computing?

Answer: He invented tens complement integers. From there it is an easy step to twos complement integers.

5.What was the great accomplishment of Chris Sawyer?

Answer: Single-handedly he wrote the world's largest (publicly known) program in 100% x86 assembly. That program was Roller Coaster Tycoon #2.

Roller Coaster Tycoon #3 was produced by using multiple programming languages.

There may be larger programs in all assembly but they are not publicly known.

6. Suppose you wrote a function that computed the standard deviation of any set of float numbers in extremely short execution time. You plan to post the source code of that function in github.com to share with the world. What license should you put on it?

Answer: LGPL Wrong answer: GPL

7. Suppose you created a function in C++ or C where the prototype called for 6 long ints to be passed to the function at calling time. Another person wants to call your function from his or her assembly module. That other programmer wants to pass the second quadword from the top of stack as the sixth parameter. How should the programmer set-up the block for calling the function? Parameters 1 through 5 can come from any source you choose. Parameter #6 needs special attention.

Answer:

```
mov rax,0
mov rdi,  <another source>
mov rsi,  <another source>
mov rdx,  <another source>
mov rcs,  <another source>
mov r8,   <another source>
mov r9,  [rsp+8]
call newfunction
```

8. Suppose a C++ or C function will execute the “return” statement at the end of a function. There are no data to be sent back to the caller. What happens when the return is executed.

Answer:

```
mov  rsp, rbp
pop  rbp
pop  rip
```

9. This semester we discussed “dynamic” data and “static” data on a number of occasions.

What is the key property used to distinguish between the two types of data?

Answer:

If the size (bytes) of the data is known to the compiler when it is compiling the colde then the data are static.

If the size is not known, then the data are dynamic.

10. A large hospital has a code system to classify new patients arriving in the emergency room as follows.

Code 10 means move patient to surgery
Code 20 means discharge patient to go home
Code 30 means send patient to intensive care

Translate the following to be a block of real assembly.
The patient's temperature is in xmm12.

```
if(temperature > 101.6) then
        assign 10 to rbx
else if(temperature < 95.6) then
        assign 30 to rbx
else
        assign 20 to rbx
output ("Get well soon")
```

//Notice that the output statement is not part of the if-then-else block.

//FYI: 101.6 = 0x4059666666666666
and 95.6 = 0x4057E66666666666

Solution: Oh wow. It looks like I might how to do real work here.

```
segment .data
recover db "Get well soon",10,0

segment .text
……
;Copy 101.6 into xmm14
mov rax,0x4059666666666666
push rax
movsd xmm14,[rsp]
pop rax

;Copy 95.6 into xmm13
mov rax,0x4057E66666666666
push rax
movsd xmm13,[rsp]
pop rax

;Now we have the following setup:
;xmm14 = 101.6
;xmm13 = 95.6
;xmm12 = patient temperature in Fahrenheit

;Begin block of nested if-then-else structure
ucomisd xmm12,xmm14
```

```
ja  surgery
ucomisd xmm12,xnn13
jb  intensive
discharge:
        mov rbx,20
        jmp getwell
surgery:
        mov rbx,10
        jmp getwell
intensive:
        mov rbx,30
        jmp getwell
```
;End of nested if-then-else struct: In other contexts it's called a "case statement".

```
getwell:
mov rax,0
mov rdi,recover
call printf

continue:
```

//No programmer ever uses a "ret" in this fragment of code.

//Even the presence of one "ret" invalidates all the code.

11. What is the GDB command that will output the low quadword in xmm9 in hex.

Solution: p/x $xmm9.v2_int64[0]

12. This is a declaration in a C++ function: int bottles[12];

What is the GDB command that will output all the values in the array?

Solution: x/12dw bottles

13. What is the GDB command that will show the address of the first value in the array?

Solution: p/x &bottles

14. Suppose the following was declare in the .data segment of an X86 function.

    message db “Hello World”,0

What is the GDB command that will output the stored data exactly as “Hello World” without any ascii numbers – only printable chars.

Solution:

    Displays the starting address followed by the printable chars
    x/s &message

Less desirable solution

    This is an inferior solution because the human must manually count the chars.
    x/s (char[11])message

That's it. Only 14 questions, but the total points for the entire test remains at 100.

Now you have time remaining before 1:30pm. Check your answers. You have the entire internet at your dispose. Use it to verify your answers or improve an answer. If the internet says your answer is all wrong, then consider changing it to blank.

If a question has multiple answers and one of the answers is "blank" then "blank" takes precedence over other answers.

When 1:30pm arrives then send your test document to me as a single file attachment.

Only odt, doc and docx are accepted. Pdf, jpeg, mp3, mkv, etc are not accepted. Don't even think about sending a pdf file.

Mailto: **holliday@fullerton.edu**

I can determine which is better style: Midterm with 25 question as in midterm #1 or a midterm with 14 questions as this test had. Does anyone have an opinion.