2021 Fall CPSC 240-3 Answers

Midterm Concepts Test #1

28 Sept 2021: 11:30am – 3:30pm

Take Home Test

Read me

Place your answers in the space following each question.

Place your name in the test either in this front page or on the last page or both.

Near 3:20pm begin to save your test document in either odt, or doc, or docx format.

Before 3:29pm 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. Use any tools that work for you such as:

- recordings of lectures
- class notes
- ebooks
- calculators
- internet

Proceed to the next page.

1. The following integer number is known to be in little endian format.
0XA755 81D4 63B3 8E90
In this environment the standard order is from left to right. Show the same number in big endian format. [3]

Answer: 0x 908E B363 D481 55A7

2. Explain to a philosophy major in non-technical terms what is LSB. [3]
[When this question is graded the professor will pretend to know only what a philosophy major knows.]

Hello Philosophy Major
I hear you got paid in paper currency in your high-paying job last week.
Oh yes, it was a big pile of US paper money. It was heavy to carry all of that cash.
You know Mr Major, suppose you sorted the cash with the 100 dollar notes on top of a stack and the low valued notes on the bottom of the stack.
Because the stack weighs a lot you discard the one-dollar notes from the bottom of the stack.
Sure I did that last week.
Well, you just through away the LSBs. We in computer science are usually try to find our LSBs.
Oh, I get it. Your LSB is my worthless money.

3. What is a key purpose for having cache in a computer? [3]

Answer: In one word “speed”. By keeping frequently used data inside the CPU itself the program does not have to make a “slow” fetch of data from memory. Cache is inside the microprocessor itself.

4. How many bytes are in the entire big register xmm8? [3]

Answer: 16 bytes

5. Suppose you are working with twos complement integers in dword size registers. What is the smallest integer possible. Give the answer in hex. [5]

Answer: 0x8000 0000

6. Let's say you created a fantastic game app called Extreme Hang Gliding 4.0. You decided to go open source with your new game. What license should you put on your game. [3]

Answer: GPL3.0

7. Suppose you discovered how to run your cpu at 8.0 GHz and still keep the temperature under 45° Celsius. You write all the step-by-step instructions of how to do it into a mini-ebook. You want to post your document for others who might be interested, but you don't want someone else to make a profit from your intellectual property. What license do you put on your mini ebook? [3]

Answer: Creative Commons

A Complete answer is Creative Commons with restriction NC

Note: The author of our class textbook used Creative Commons with restrictions BY NC SA.

8 What is -1765 in a quadword register. [5]
[Plugging this into a calculator wins no points. You must show me a large portion of your mathematical work. There should be sufficient math to convince me you know what you're doing.]

Answer: First we work on the absolute value, namely: 1765. We will use the algorithm of successive division by 2.

1765/2 = 882+r1
882/2 = 441R0
441/2 = 220R1
220/2 = 110R0
110/2 = 55R0
55/2 = 27R1
27/2 = 13R1
13/2 = 6R1
6/2 = 3R0
3/2 = 1R1
1/2 = 0R1
0/2 = 0R0
0/2 = 0R0
Repeats

Therefore, +1765 =
0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0000 0110 1110 0101

Compute the complement of each bit:

Complement =
1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1001 0001 1010

Next add 1: -1765 =
1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1111 1001 0001 1011

In hex the answer is -1765 = 0xFFFF FFFF FFFF F91B

9. We have seen the prefix extern "C" used in programming during this course. What is the rule that governs when to use that prefix and when not to use it? [4]

Answer:

1. The prefix must be used only in source files that will be compiled by a C++ compiler.

2 The prefix must be place on the left side of the prototype of the given function; not on the left side of the body of the function.

10. When the ALU is finished working on a specific instruction how does it know what to do next? [4]

Answer: The ALU fetches the value currently stored in rip. Using that value as a memory address the ALU retrieves the data stored there and uses that retrieved data as an instruction to be executed.

11. What benefit does having cache provide us? [4]

Answer: In one word "speed" of execution. Much less time is required to retrieve one datum from nearby cache that from distant memory (RAM).

12. Show a block of X86 instructions that will perform as follows. Divide r14 by r15 and place the quotient in r8 and the remainder in r9. Your answer must be valid for use with both large integers and with integers near 0. We assume r15 is not zero. [6]

Answer

```
mov rax, r14
cqo
idvi r15
mov r8,rax
mov r9,rdx
```

13. Name the defining characteristics of a Van Neumann computer. [4]

Answer: The definition states that any computing machine having all five properties listed below is in the class of Von Neumann computers.

There are input devices: mouse, keyboard, light pen, etc
There is volatile storage, aka memory.
There is persistent storage, aka HDD, SSD, NVMe
There is a CPU
There is a connecting data path called “bus”.

14. What is the last word of text in the textbook on page 77 not including “Page 77”? [4]

Answer: cqo

15. How do you place 64 bits of binary zeros in r8 without use of the “mov” instruction? [4]

Answer: xor r8,r8

16. What are five components of the programmer’s “tool chain”? [4]

Answer: Debugger, Compiler, Editor, Linker, Loader

17. Show a block of an x86 program that implements the following dialog.

Please enter the street address: 3624 Bashtanchury Parkway
Oh. You live on Bastanchury Parkway

We will assume that all street numbers have 4 digits. The text in yellow is inputted by the user. [6]

Answer begins:

```
segment .data
prompt db “Please enter the street address”, 0
response db “Oh.  You live on %s street”,0

segment .bss
street_name resb 256

segment .text


;===== Prompt for street name input
mov rax,0
mov rdi, prompt
call printf

;===== Input the street into char array: street_name
mov rax,0
mov rdi,street_name
mov rsi,256
mov rdx, [stdin]
call fgets

;========= Output street name without the number
mov rax,0
mov rdi, response
mov rsi, street_name
add rsi,5
call printf


;Done
```

18. This declaration is found in a C or C++ function. **double treasure = 15.777;**

Show that GDB command that will output the address where number of treasure is stored. Don't output extra stuff only the address. [4]

Answer: p/d &treasure

19. This declaration is found in a C or C++ function: char name [46];
We assume at least some of name has been filled with user input.

Show the GDB command that will output the string data of the array [4]

Answer: p/s name

20 Continuation of the preceding question. Show the GDB command that will show the ascii values in decimal for each character stored in the array name. Output only decimal integers and no extra data. [4]

Answer: p/d name

21 Show the GDB command that output the quadword at the back of the activation record in hex. [4]

Answer: x/1xg $rbp

22 Show the GDB command that will output the number of qwords in the current activation record. [4]

Answer: p/d ($rbp-$rsp)/8+1

23. This array was declared in the .data segment:

conclusion db "The final result will be sent now",10,0

Show the GDB command that will output the whole string in printable characters. [4]

Answer: x/s &conclusion
or
p/s (char*)&conclusion

24. Show the GDB command that will output the address of an array named “conclusion”. [4]
[The array name and the data of the array are stored separately. This question is about storage of the array’s name not the storage of the array’s data.]

Answer: p/x &conclusion

25. Show the GDB command that will output the low half of xmm5 in hex. [4]
[The output is an example of an IEEE number.]

Answer: p/x $xmm5.v2_int64[0]

Remember to put your name and your email address on this test someplace.

Two pieces of ID help to better identify you.

Only submit an answer file in one of these formats: doc, docx, odt.

No pdf’s, no jpegs. They are too cumbersome to write one. Yes, I can write onto a pdf, but I don’t want to take the extra time to do it.