

CS520—Spring 2014—Midterm Exam

- This exam has ten questions for a total of 100 points.
- Closed book and closed notes.
- No calculators.
- Please keep all electronic devices turned off and out of reach.
- Answer the questions on separate paper.
- For partial credit show your work.
- When turning in your exam, please fold your papers in half length-wise and write your name on the outside.
- I will return your exam to your Kingsbury mailbox unless you tell me not to.

Question 1 (10 points)

Convert the UTF-32 character (shown in hexadecimal) `0x0BEEF` to UTF-8. Show your answer as a sequence of bytes. Show your answer in hexadecimal and show all the hex digits, even if they are zero.

Question 2 (10 points)

Consider the following two UTF-16 characters (shown in hexadecimal): `0xBEEF 0x1111`. Do these together represent one or two Unicode characters? What Unicode character(s) do they represent? Show your answer(s) as UTF-32 in hexadecimal and show all the hex digits, even if they are zero.

Question 3 (10 points)

Convert the following 32-bit 2's complement integer value (shown in hex) to IEEE single-precision floating point.

`A0A0A0A0`

Show your answer in hexadecimal and show all the hex digits, even if they are zero.

Question 4 (10 points)

Encode the `load` instruction in the following vm520 assembly language fragment:

answer:

```
word 1    # this directive allocates one word in memory
alloc 100 # this directive allocates 100 words in memory
```

skip:

```
load r4, answer
```

Show your answer in hexadecimal and show all the hex digits, even if they are zero.

The opcode for the `load` instruction is `0x01`. The format for the `load` instruction has the opcode in the low eight bits, the register in the next four bits, and the PC-relative address in the upper twenty bits.

Question 5 (10 points)

Why must an assembler make more than one pass over its input file?

Question 6 (10 points)

Show how the following C string (i.e. null terminated) `"beef"` would be represented using ASCII in the memory of a Big Endian machine with a byte-oriented memory. Show your answer in hexadecimal. Clearly label the order in which the bytes would lay in memory. The ASCII code for `'b'` is `0x62`. The ASCII code for `'e'` is `0x65`. The ASCII code for `'f'` is `0x66`.

Question 7 (10 points)

Write a C function that will take a single argument of type `long`, will interpret that argument as a pointer to a `float`, and will return the `float` pointed to by the argument.

Question 8 (10 points)

What is the result of adding the following two 32-bit hexadecimal values together as IEEE single-precision floating-point values?

42080002 40000008

That is, interpret the two 32-bit values as IEEE single-precision floating point, add them together as a machine implementing the IEEE standard would, and produce the result. Show your answer in hexadecimal.

Question 9 (10 points)

Is the following sequence of hexadecimal bytes a valid UTF-8 encoding of an Unicode character? Why or why not?

F0 89 84 91

Question 10 (10 points)

Explain carefully how a linker forms the Outsymbol Section of the output file. What symbols are included in the Outsymbol Section of the output file? How are the address fields of the Outsymbol section computed?