- **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 left to right (not top to bottom) and write your name on the outside.**

Question 1 (10 points)

Convert the UTF-16 character (shown in hexadecimal) `1914` 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) Convert the UTF-32 character (shown in hexadecimal) `00071914` to UTF-16. Show your answer as a sequence of 16-bit values. Show your answer in hexadecimal and show all the hex digits, even if they are zero.

Question 3 (10 points)

Convert the following IEEE single-precision floating-point value (shown in hex) to IEEE double-precision floating point.

`A0A0A0A0`

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

Question 4 (10 points)

Decode this RISC-V instruction (shown in hex): `FE7686A3`.

Display the decoded instruction as specified by the Program 3 specification.

Question 5 (10 points)

An assembler produces as output an object code file. This file contains information about symbols in the assembly language code that was assembled. What symbols have information stored in the object code file? What information is stored about these symbols?

Question 6 (10 points)

Show how the following C string (i.e. null terminated) `"feed"` 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 'f' is `0x66`. The ASCII code for 'e' is `0x65`. The ASCII code for 'd' is `0x64`.

Question 7 (10 points)

Write a C function called `isLittleEndian` that will return 1 if the machine executing the function is Little Endian and 0 otherwise.

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?

C3880002   C1800009

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?

F1 89 84 C1

Question 10 (10 points)

Explain carefully how a linker forms the Insymbol Section of the output file. What symbols are included in the Insymbol Section of the output file? What error(s) can be detected when processing insymbols?