

## Lab 2: Hardware and Software for Polled I/O

In this lab, you will build the low-level hardware and software support for input and output for the HERA processor. You will need to check out projects from the course shared repository.

Divide into groups of 2-3 people each, and work on *one* of the following projects. Coordinate with a group of people doing the other project, and produce a working hardware/software combination:

**HARDWARE.** Add a terminal to the HERA system you built in CS240. The data transfer and status/control signals should be added as memory-mapped addresses, so that LOAD can be used to receive status information or transferred data, and STORE can be used to send control signals and data. Coordinate with the software group to set standards for the addresses to be used and the bits to be used for various status/control information.

**SOFTWARE.** Develop a program to read characters from the terminal and change the capitalization of any alphabetic characters by exclusive-or'ing the character's bit pattern with 0x20, and replacing all non-alphabetic characters with '\*'. Coordinate with the hardware group to set standards for the addresses to be used and the bits to be used for various status/control information. Also create functions to input or output a "tiger string", i.e. a string represented by the address of a sequence of words, the first of which is a count of the number of characters, and the rest of which are the characters themselves, one per word of memory. The output function should be named `print` and print an entire string; for input you should provide `getchar` to read a single character (and produce a tiger string) and `getline` to read an entire line (up to a newline character).

You should use CVS to communicate between the groups and make periodic backup copies of your work.