For our practicum, we developed three unique project ideas that have the potential to fulfill all requirements of the practicum. The stated highest level requirements of the practicum project are that it must have a sensor, a controller, and an actuator. We considered a bike-cadence regulating device, an exercise oriented personal lighting system, and a Command, Communication, and Control (C3) board for OreSat. After much deliberation, we decided we would pursue the development of the C3 board for our practicum.

The first project idea was a device that would be installed on a bicycle and would monitor the user's pedal strokes and provide feedback to the user to help him or her maintain cadence, thereby resulting in a maximally efficient bike ride. The device would have an inertial measurement unit (**sensor**) attached to one of the pedals, which would report the rate of motion to an ATmega32U4 microcontroller (**controller**) that would be attached to the bike frame. The microcontroller would calculate the average rate of pedaling over the last 100 pedal strokes and determine if the current rate of pedaling is greater than, less than, or equal to the average rate of pedaling. If the current rate was too fast or too slow, it would transmit a signal via a wired connection to illuminate a corresponding number of red or green pixels(respectively) on an RGB LED matrix (**actuator**) attached to the bicycle's handlebar. The number of lights illuminated would be proportional to the difference between the current pedal rate and the average rate, thereby indicating to the rider whether they should be slowing down or speeding up, and to what extent they should be doing either.

The second project idea was for an exercise oriented personal lighting system. This is a system with neo-pixels or similar individually addressable RGB leds (**actuator**) that would be mounted on a vest or backpack cover. The leds would be arranged in grid would allow them to be used as a rudimentary display. If used in cyclist mode for example, the system would display a pulsating caution sign. An accelerometer (**sensor**) mounted on the signing arm would feed into the controller which would decode the following hand signals: stop, right, left, and neutral. Depending on which hand signal was indicated, the vest would display the appropriate pulsating sign: a stop signal, a right arrow, a left arrow, or a caution sign. The system would also have a button to turn the whole system on or off (**sensor**). If used in night runner mode, the leds would display a caution symbol that would pulsate in a delayed cadence to the runner’s gait sensed by the accelerometer. The system's ATmega32U4 microcontroller board (**controller**) and battery would be housed in an exercise armband with female 3.5 mm stereo terminals for wires leading to the LED matrix and the accelerometer. Ideally the whole system would run on rechargeable LiPo batteries and would include a charger daughter board to enable battery recharging via a 5 volt mini USB plug.

The third project idea was for a C3 board for OreSat. This board would integrate several different sensors and actuators involved in the OreSat project together and act as the controlling subsystem for OreSat. In the case of the Practicum, this will be a slightly simplified system that integrates together the basic radio interface (**actuator/sensor**) for communicating data, an STM32 microcontroller with storage that manages the satellite (**controller**), and several sensors that collect system health data from the satellite via a CAN bus interface (**sensors**). In addition,

the satellite has several subsystems that can be powered on and commanded to perform various operations (**actuators**). The specific goals we would be focusing on for this practicum will be receiving a command via radio to activate a subsystem (like a **sensor**), **actuating** power control circuits to power on the specified subsystem, which will in turn provide its system health data back to the controller (such as temperature and power supply **sensor** data), and then ultimately relay this data (via **actuating** the radio interface) down to a receiving station.

In the end, we decided that the C3 board would be our best choice for this practicum. It fulfills all of the requirements of the practicum, it will be of great service to OreSat if we begin contributing to the group through this practicum, and it has the potential to develop into a capstone project that we can work on for the remainder of the school year. We're all very excited to begin working on our project and being part of the greater OreSat team.