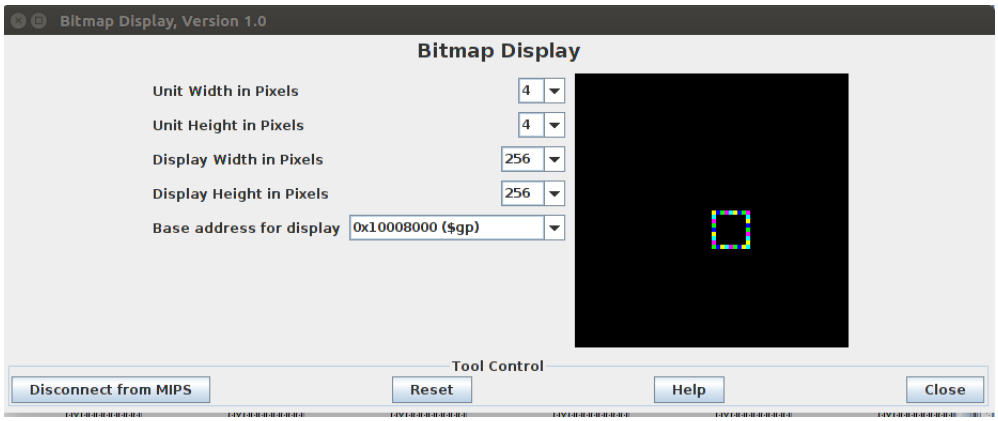
# CS 2340 Computer Architecture

## Homework 4: MMIO with MARS
## This homework is worth 200 points

**Objective:** To gain experience working with memory-mapped I/O.

## Instructions

1. Write and test a function to draw a box on the bitmap display. The box should be roughly in the center of the screen. Draw the box one pixel at a time. Use 4 loops, one for the top, one for the right side, one for the bottom, one for the left side. Each loop writes 7 pixels per side. To make debugging easier, make the box a solid color first, then go on to step 2. Make sure that your code uses these settings:




2. Modify the draw box function to have the marquee effect by drawing each pixel in a color from an array of colors. You can use colors similar to the following:

```
# colors
.eqv    RED     0x00FF0000
.eqv    GREEN   0x0000FF00
.eqv    BLUE    0x000000FF
.eqv    WHITE   0x00FFFFFF
.eqv    YELLOW  0x00FFFF00
.eqv    CYAN    0x0000FFFF
.eqv    MAGENTA 0x00FF00FF

.data
colors: .word   MAGENTA, CYAN, YELLOW, BLUE, GREEN, RED
```

3. Slow the marqee appearance down by adding a pause function between pixel writes, using syscall 32. Make the delay 5 ms.
4. Add keyboard functionality. You can see similar code in the bitmap sample program 2 in the GitHub. The w, a, s, and d keys should move the box up, left, right, or down one pixel. The space key should terminate the program.

Grading Rubric:
200 points

- 100 points – draw a box near the center of the screen; use a loop for each side
- 40 points – use rotating colors so that the box has a “marquee” appearance
- 10 points – use a pause function between pixel writes
- 30 points – keyboard functionality to move the box with wasd, or space to end
- 20 points – comments in the code, plus comments on how to run;
  and good use of white space

***Upload your .asm file to eLearning***