CS220: Lab#9A

1.[10 marks] Implement an instruction memory that has width 32 bits and has 8 rows. Initialize the contents of the memory using the following MIPS instruction sequence. Use MIPS instruction encoding as discussed in the class and given in the text book. The relevant opcodes are given on the side. The opcode for jal is 0x3. Use an initial block to do this initialization.

```
addi $4, $0, 0x3456      // opcode: 0x8
addi $5, $0, 0xffff
add  $6, $5, $4          // opcode: 0x0, function: 0x20
addi $3, $0, 0x7
sllv $6, $6, $3          // opcode: 0x0, function: 0x4
srl  $3, $3, 0x1         // opcode: 0x0, function: 0x2
lw   $5, 0x9abc($4)      // opcode: 0x23
j    0x123456            // opcode: 0x2
```

Each row of memory gets one instruction. Initialize a program counter register to zero. Design a hardware that on each posedge of clock reads the instruction from the memory row pointed to by the program counter, decodes the instruction into three classes: R-format, I-format, and J-format, keeps three counters to count the number of instructions of each class, and increments the program counter by one. You should maintain four more counters to count the number of instructions that write to $3, $4, $5, and $6. The program terminates after decoding eight instructions. After termination, it displays the number of R-format, I-format, and J-format instructions encountered as follows: use LED2, LED1, LED0 to display the count of R-format instructions, use LED5, LED4, LED3 to display the count of I-format instructions, and use LED7 and LED6 to display the count of the J-format instructions. Next, use the LEDs to show the count of instructions that write to $3, $4, $5, and $6. LED1 and LED0 should be used to show the count of instructions that write to $3; LED3 and LED2 for $4; LED5 and LED4 for $5; LED7 and LED6 for $6. The LEDs should be changed from first display showing format classification to the second showing instruction count with different destinations only when a slide switch is set to one from zero. Make sure that initially the slide switches are all in zero position.