

# Lecture outline

The slide features a decorative header with two groups of three circles. The first group, located to the left of the title, consists of a solid light purple circle, an empty light purple circle with a thin outline, and another solid light purple circle. The second group, located to the right of the title, also consists of a solid light purple circle, an empty light purple circle with a thin outline, and another solid light purple circle.

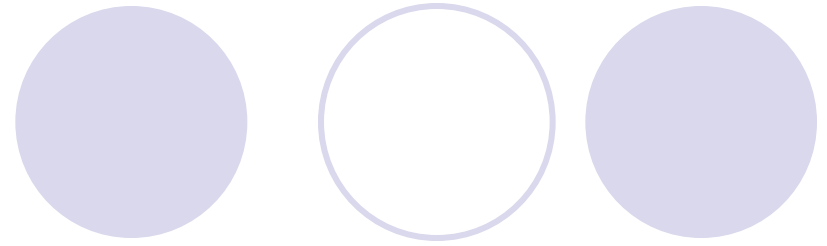
- Subroutines
- Adding I/O to the Simple Computer
- SHIFT instruction
- Logic analyzer and disassembly
- **Debugging**

# Lab 8 common problem



- In lab 8 prelab and early lab, you:
  - Add the shifter hardware and SHIFT instruction
  - Add IN and OUT instructions, including
    - adding the DECODE and EXECUTE states
    - adding the tri-state driver hardware
    - controlling IO\_CYCLE and IO\_WRITE
  - Add new signals to SCOMP's PORT statement
  - Write an assembly program from scratch
- **All with nearly no intermediate testing!**

## Lab 8 step 7



- When you test your assembly program (lab step 7) it will almost certainly not work
- How do you find the problem?
- **Isolate individual components!**

# Debugging process basics



- Start with the basics:
  - Do you have the correct Quartus project open?
  - Are you editing the correct asm file?
  - Is SCOMP's memory configured to use the correct mif file?
  - Is the PLL configured correctly (3/5 ratio)?

# Debugging process example

- Start by making it easier to see what's going on by getting OUT working
- **Isolate OUT:**
  - Remove any INs, SHIFTs, and as much logic as possible from the assembly

**Test:**

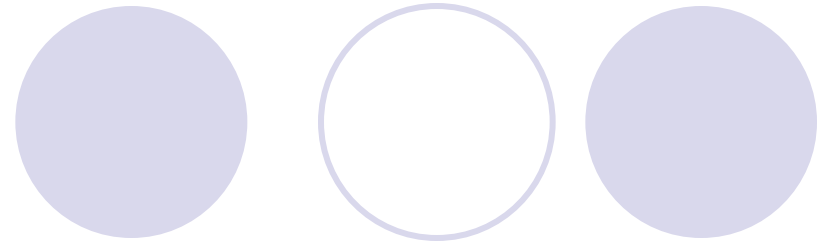
**LOAD    Number**

**OUT     LEDS**

**JUMP    Test**

**Number: DW  &B1010101**

# OUT not working



- If the above doesn't work, then there is most likely a problem with OUT
  - (but not absolutely; it could be other things)
- What does OUT need to work?
  - Correct DECODE => EX\_OUT => EX\_OUT2
  - IO\_CYCLE, IO\_WRITE, and IO\_WRITE\_INT
  - LPM\_BUSTRI device (tri-state driver)

# OUT working

- Once OUT is working, you can use it to test IN:

**Test:**

<b>IN</b>	<b>SWITCHES</b>
<b>OUT</b>	<b>LEDS</b>
<b>JUMP</b>	<b>Test</b>

- Then test SHIFT
- Then move on to your full assembly code for step 6/7.