Debugging (1)

• Software Bug
  – Error, flaw or fault in a computer program
  – Produces incorrect or unexpected results
  – Prevents correct operation of the program

• Debugging
  – Process of finding and resolving software bugs
Debugging (2)

• Techniques
  – Print debugging
    • Display the value of variables
    • Indicate the flow of execution
  – Software supported debugging
    • With the aid of a debugger
  – Post-mortem debugging
    • Analyze core dumps of a crashed process
  – Hardware debugging
Errors

• Types of Error
  – Syntax error
    • Prevents that the source code gets compiled
  – Semantic error (logic error)
    • Prevents a program from correct operation
    • Does not cause abnormal termination
  – Run-time error
    • Provokes an abnormal termination (crash)
    • Example: disk full or write protected
Debugger

• Features
  – Single step execution
  – Breakpoints
  – Displaying variables
  – Changing variables
  – Visual feedback
Hardware Debugging

• Probes available
  – Circuit analyzer *(multimeter)*
  – Oscilloscope
  – Logic analyzers

• Power-On Self-Test *(POST)*
  – Beep code if test fails

• Hardware debug interface
  – Query the state of the system
JTAG

- Joint Test Action Group
  - Hardware debug interface
  - Dedicated debug port
  - Implements a serial communications interface

**Diagram:**

1. **Device 1**
   - **TMS**
   - **TCK**
   - **TDI**
   - **TDO**

2. **Device 2**
   - **TMS**
   - **TCK**
   - **TDI**
   - **TDO**

3. **Device 3**
   - **TMS**
   - **TCK**
   - **TDI**
   - **TDO**

**Key Signals:**
- **TDI:** Test Data In
- **TDO:** Test Data Out
- **TCK:** Test Clock
- **TMS:** Test Mode Select