Computer Systems and Networks

ECPE 170 – Jeff Shafer – University of the Pacific

Instruction Set Architecture

Schedule

- **Today**
  - **Chapter 5** – Closer look at instruction sets
  - **Quiz 3**
- **Next Mon, Wed, Fri**
  - *Continued…*
- **Friday March 2nd – Quiz 4**

Today's Goals

- What factors are involved in instruction set architecture design?
- Look at different instruction formats, operand types, and memory access methods
  - A lot more possibilities than what MARIE offered in Chapter 4
- See the relationship between machine organization and instruction formats

Recap – Common Terms

- **Instruction Set Architecture (ISA)** - "Contract" between processor vendor and programmers
  - Instructions?
  - Registers?
  - Addressing modes?
  - Memory architecture?
  - Interrupt and exception handling?
  - I/O?
- **Opcode** – What instruction is being performed
- **Operand** – What data does does that instruction need?
  - Memory address, register name, etc…

Instruction Formats

- What makes instruction sets different?
  - Types of operations
  - Number of bits per instruction
  - Stack, accumulator, or register-based
  - Number of explicit operands per instruction
  - Operand location
  - Type and size of operands

Instruction Formats

- How can we measure different instruction set architectures? (in order to determine how "good" they are)
  - Main memory space occupied by a program
  - Instruction complexity
  - Instruction length (in bits)
  - Total number of instructions in the instruction set
- When designing an instruction set, you had better make the right decisions, since you'll be stuck with the architecture for decades! *(just ask Intel…)*

Instruction Formats

- Many questions to answer when designing an instruction set:
  - Instruction length?
    - Short? Long? Variable?
    - Shorter takes up less space in memory (good), but also reduces the number of possible instructions and the number of operands (bad)
    - Fixed length is easy to decode (good) but wastes space in memory (bad)
    - **What did MARIE do?**

Instruction Formats

- Many questions to answer when designing an instruction set:
  - Number of operands?
  - Number of addressable registers?
  - Memory organization?
    - Whether byte- or word addressable
  - Addressing modes?
    - Choose any or all: **direct**, **indirect** or **indexed**
  - **What did MARIE do?**