Digital Systems: Input/Output (I/O)

Session for
"Digital Systems: Computers and Communications"
A Fairfield University E-Course
Powered by LearnLinc

Module: Digital Systems (in two parts)

- Texts:
  - "Computers," Capron, Benjamin Cummings, 1996, ISBN 0-8053-0662-5
  - "Telecommunications," Blyth, McGraw-Hill, 1990, ISBN 0-02-680841-2
  - "Understanding Telephone Electronics," Bigelow, Newnes, 1997, ISBN 0-7506-9944
- References:
  - Electronics Tutorial (Thanks to Alex Pounds)
  - Electronics Tutorial (Thanks to Mark Sokos)
- Part 9 – Computers
  - 5 on-line sessions plus one lab
- Part 10 – Digital Communications
  - 5 on-line sessions plus one lab
- Mastery Test part 5 follows this Module

Digital Systems: Topics

- Computer Architecture
  - Memory: ROM, RAM, Cache, Error Checking
  - CPU and Program Control
  - Secondary Storage: Floppy, Hard Drive, CD / DVD
  - I/O (Human: Video, Keyboard, & Pointer)
- Digital I/O: Serial, Parallel, IDE, USB. FireWire, SCSI

Part 9

- Serial I/O: RS232
- Modems
  - Telephone: Modulation and Data compression
  - Cable and DSL
- Telephony Digital Transmission
- Packet Transmission
- Fiber Optics: SONET

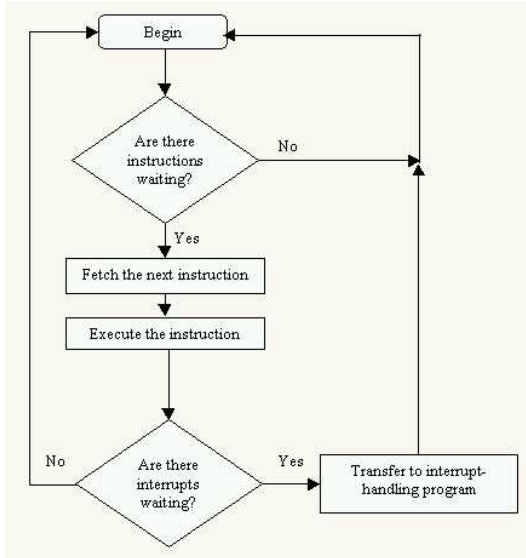
Part 10

Section 9 Schedule

Session 9a (5/26 – Holiday)	05/21	Introduction: Computer Overview	Capron: Ch 1; Notes
Session 9b	06/02	The CPU (Central Processing Unit)	Capron: Ch 2;
Session 9c	**06/04**	**I/O**	**Capron: Ch 3;**
Session 9d	06/09	Data Storage	Capron: Ch 4;
Session 9e (Lab - 06/14, Sat.)	06/11	Digital I/O: Serial, Parallel, IDE, SCSI, USB, and Firewire	Bigelow: pp. 285-288, 301-305; Notes
Session 9f Quiz 9 due 06/22)	06/16	Review for Quiz 9	
Session 9g (6/18 – no class)	06/23	Quiz Results	

CPU Review

- Machine Cycle
  - Fetch: Get the next instruction ("Program Counter")
  - Decode: Determine the "Op Code"
  - Execute: Perform the operation
  - Store: Save the result and increment the "Program Counter"



- Programming
  - Machine Language: 1's and 0's
  - Assembly Language: Human readable but machine dependent
  - Compiled High-Level Language: Compiled, assembled and linked into an executable machine language program (slower, e.g. "C")
  - Interpreted High-Level Language: Executed by the interpreter line by line (slowest, e.g. Java, Basic)

ALU Review (Arithmetic Logic Unit)

- Fixed Point
  - Decimal arithmetic: 18.75
  - Binary arithmetic: **0**0010010.1100 12-bit (1 sign bit)
    - Bits to the left of the "Binary Point"; Powers of 2
    - Bits to the right of the "Binary Point"; Powers of ½
    - -255 to 255 (7 significant bits for magnitudes above ± 4)
- Floating Point (scientific notation)
  - $0.1875*10^2$ decimal floating point
  - **0.**001100 * $2^{\mathbf{0}00010}$ 12-bit Binary (2 sign bits)
    $(1/8 + 1/16)*2^2$
  - 7 significant bits; $\pm 2^{-15}$ (1/32768) to $\pm 2^{+15}$ (32768)

Memory Review

- ROM-based routines (somewhat slower than RAM)
  - Power-on System Test (POST)
  - Bootstrap: Go to Disk (boot sector) to start the OS
  - Basic Input Output Sequences (BIOS)
    - Hardware specific operations
    - Used by the Operating system
      (in MSDOS used directly by application software)
- Operating System (OS): Windows, Linux, Mac (OSX) etc.
  - Provides environment for applications (API)
  - Resource Sharing: Multitasking, Virtual Memory
  - Programs stored on secondary storage

Memory Review (2)

- Registers: directly used by CPU
- Cache: Fast, local, temporary storage
  - L1: same speed as the CPU; small size (only 16 Kbytes in old PCs)
  - L2: somewhat slower; somewhat larger (Not often present)
- Core Memory: Originally magnetic cores (toroids)
  - Dynamic silicon RAM
    - Fast Page Mode (FPM) DRAM: old – early 1980s; PC XT; 8088
      - 70 ns; 36 pin SIMM : byte-wide data or 72 pin: wider data path
    - EDO DRAM: "486" (60 ns; 72 pin SIMM or DIMM)
    - SDRAM (DDR): Pentium (10ns to 5 ns-pc3200)
- Secondary Storage: Disk (cache memory in fast disks; 1-2 Mbytes)
  - Access time (Read/Write head speed)
  - Write speed (rotation rate; 5000, 7500, 10k rpm)

Input/Output Systems

- Human I/O
  - Input
    - Keyboard: Keystrokes translated to binary codes
    - Mouse: Trackball, Joystick, Touchpad
    - Video: Scanned image, Analog to Digital conversion
    - Audio: Analog to Digital conversion (Sound Card)
  - Output
    - Video: D/A, “Raster” screen, Video Memory
    - Audio: D/A, Amplifier, Speakers

Input/Output Systems (2)

- Machine I/O
  - Data Communications: (More Later)
    - LAN: Ethernet, Wireless
    - Serial: RS232
    - Modems: Telephone, DSL, Cable
  - Printers:
    - Impact (type / multi-pin): obsolete – no graphics
    - Laser: Still the best B&W, color for about $800
    - Ink Jet: Good fast color ~$150 (HP, Epson, Canon, Lexmark)
  - Removable Memory
    - Floppy: 5 inch (360 kbytes, 1.2 Mbytes), 3.5 inch (1.44 mbytes)
    - CD (660-700 Mbytes) / DVD (4.7 Mbytes)
    - Other: Zip, Magneto-Optical, Magnetic Tape (DAT, Cartridge, Reel)
    - Memory Modules: PC-Card, Compact Flash, Secure Digital, xD-Picture, Memory Stick (Sony), USB

Input/Output Systems (3)

- Machine I/O (continued)
  - Image Scanner (Good, Light duty, $150)
    - Resolution: 75 – 4800 "Pixels" per inch
      - Large files: 3x5 inches at 600 pixels/inch is 5.4 Mega Pixels
      - Data Compression: JPEG – less than 2 Mbytes for quality color
    - Speed: seconds (minutes?) / page
  - Optical Character Recognition (OCR)
    - Typed text from scanned image
    - Hand Written: Image (hard) or pen strokes
  - Bar Codes
  - Digital Still Camera: at least 2 Mega-Pixels (more gets expensive), short video clips
  - Digital VCR: Digital Video on magnetic Tape, low-resolution stills.

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