CS1101: Lecture 18

Computer Systems Organization: Input/Output II

Dr. Barry O'Sullivan
b.osullivan@cs.ucc.ie

Course Homepage
http://www.cs.ucc.ie/~osullb/cs1101

Lecture Outline

- Mice
- Printers
  - Dot-Matrix Printers
  - Inkjet Printers
  - Laser Printer
- Communication
  - Modems
  - ISDN
- Character Codes
  - ASCII
  - Code Page
  - UNICODE
  - Issues with UNICODE
- **Reading**: Tanenbaum, Chapter 2, Section 4

Mice

- When a mouse is a device for pointing at, and selecting items on a desktop.
- The mouse has one, two, or three buttons on top, to allow users to select items.
- Three kinds of mice have been produced:
  - mechanical mice
  - optical mice
  - optomechanical mice.
- Low-level software in the computer accepts this information as it comes in and converts the relative movements sent by the mouse to a position on the screen.
- When the user clicks a mouse button, the computer can then figure out which item has been selected from its knowledge of where the arrow is on the screen.

Dot-Matrix Printers

- The cheapest kind of printer is the **matrix printer**
- In this printer a print head containing between 7 and 24 electromagnetically activatable needles is scanned across each print line.
- Low-end printers have seven needles, for printing, say, 80 characters in a 5 x 7 matrix across the line.
- In effect, the print line then consists of 7 horizontal lines, each consisting of 5 x 80 = 400 dots.
- Each dot can be printed or not printed, depending on the characters to be printed.

Dot-Matrix Printer

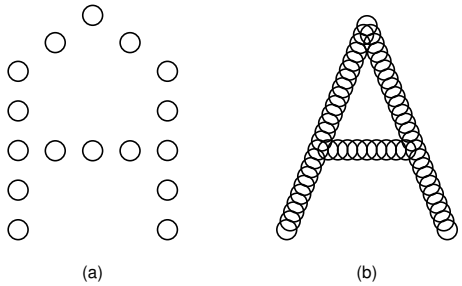

Figure 2-36. (a) The letter ”A” on a 5 x 7 matrix. (b) The letter ”A” printed with 24 overlapping needles.

The print quality can be increased by two techniques:

- Using more needles, and
- Having the circles overlap.

Inkjet Printers

- A movable print head, which holds an ink cartridge, is swept horizontally across the paper while ink is sprayed from its tiny nozzles.
- Inside each nozzle, an ink droplet is electrically heated to the boiling point until it explodes and passes out the front of the nozzle onto the paper.
- The nozzle is then cooled and the resulting vacuum sucks in another ink droplet.
- Printer speed is limited by the **boil/cool cycle**.
- Inkjet printers typically have resolutions of 300 **dpi (dots per inch)** to 1440 dpi.
- They are cheap, quiet, and have good quality, although they are also slow, use expensive ink cartridges, and produce ink-soaked output.

Laser Printer

- This device combines a high quality image, excellent flexibility, good speed, and moderate cost into a single peripheral.
- Laser printers use almost the same technology as photocopy machines.
- The heart of the printer is a rotating precision drum (or in some high-end systems, a belt).
- A laser is used to project charged areas into the drum.
- These area can then attract **toner** which is transferred, and set, on the paper

Laser Printer

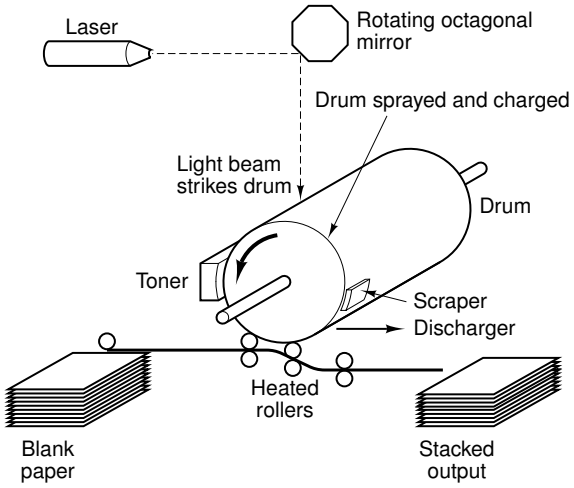

Figure 2-37. Operation of a laser printer.

Modems

- Many people have personal computers at home that they use for communicating with their computer at work, with an Internet Service Provider, or with a home banking system.
- Communication medium: the telephone line and **modem**.
- Two-level signals suffer considerable distortion when transmitted over a voice-grade telephone line, thereby leading to transmission errors.
- A pure sine wave signal at a frequency of 1000 to 2000 Hz, called a **carrier**, can be transmitted with relatively little distortion, however, and this fact is exploited as the basis of most telecommunication systems.
- By varying the amplitude, frequency, or phase, a sequence of 1s and Os can be transmitted – this process is called **modulation**.

Modem

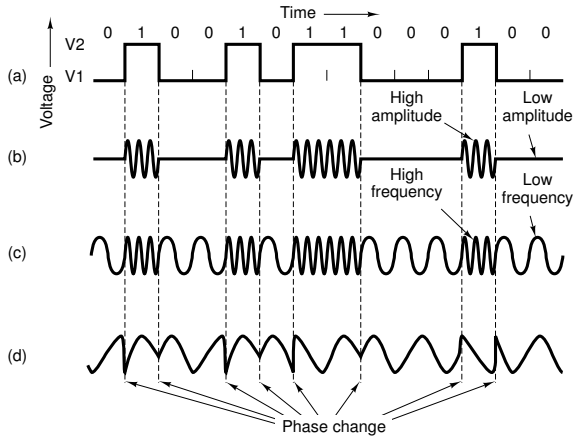

Figure 2-39. Transmission of the binary number 01001011000100 over a telephone line bit by bit. (a) Two-level signal. (b) Amplitude modulation. (c) Frequency modulation. (d) Phase modulation.

ISDN

- In the early 1980s, a standard for digital telephony called **ISDN (Integrated Services Digital Network)** was developed.
- When the World Wide Web happened and people were clamoring for **high-bandwidth** digital access to the Internet, ISDN suddenly discovered its killer application.
- An ISDN lines typically holds two independent digital channels at 64,000 bits/sec each, plus a signaling channel at 16,000 bits/sec.
- For businesses, a 30-channel ISDN line is typcially used.
- ISDN is faster than an analog channel, but also allows connections to be established in typically no more than 1 sec, no longer requires an analog modem, and is much more reliable (fewer errors) than an analog line, etc.

ISDN

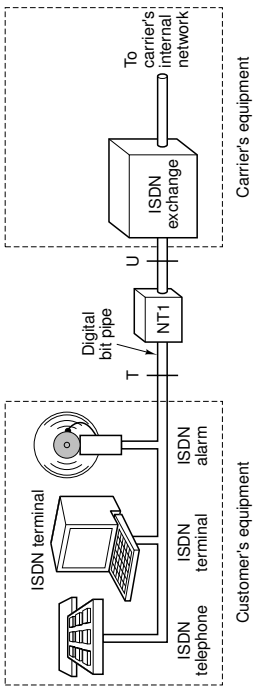

Figure 2-40. ISDN for home use.

Character Codes

- Each computer has a set of characters that it uses.
- As a bare minimum, this set includes the 26 upper case letters, the 26 lower case letters, the digits 0 through 9, and a set of special symbols such as space, full-stop, minus sign, comma, and carriage return.
- In order to transfer these characters into the computer, each one is assigned a number: for example, $a = 1, b = 2, ..., z = 26, + = 27, - = 28$.
- The mapping of characters onto integers is called a **character code**.
- It is essential that communicating computers use the same code or they will not be able to understand one another.

ASCII

- One widely used code is called **ASCII (American Standard Code for Information Interchange)**.
- Each ASCII character has 7 bits, allowing for 128 characters in all.
- Codes 0 to 1F (hexadecimal) are control characters and do not print.
- Many of the ASCII control characters are intended for data transmission, but are not used much any more.
- The ASCII printing characters include the upper and lower case letters, digits, punctuation marks and a few math symbols.

Code Page

- ASCII is fine for English but less fine for other languages.
- Some European languages have a few letters not found in ASCII, e.g. the German ßand the Danish ø.
- Some languages have entirely different alphabets (e.g., Russian and Arabic), and a few languages have no alphabet at all (e.g., Chinese).
- Thus, a different character set is needed.
- The **code page** is a set of 256 characters for a particular language or group of languages.
- The trouble with the code page approach is that the software has to keep track of which page it is on, it is impossible to mix languages over pages, and the scheme does not cover Japanese and Chinese at all.

UNICODE

- International Standard (IS 10646).
- UNICODE is supported by some programming languages (e.g., Java), some operating systems (e.g., Windows NT), and many applications.
- The basic idea is to assign every character and symbol a unique, permanent 16-bit value, called a **code point**.
- No multibyte characters and no escape sequences are used.
- With 16-bit symbols, UNICODE has 65,536 code points.
- Since the world's languages collectively use about 200,000 symbols, code points are a scarce resource that must be allocated with great care.

Issues with UNICODE

- To avoid wasting code points, each diacritical mark has its own code point.
- It is up to software to combine diacritical marks with their neighbors to form new characters.
- While UNICODE solves many problems associated with internationalization, it does not (attempt to) solve all the world's problems.
- For example, while the Latin alphabet is in order, the Han ideographs are not in dictionary order.
- A Japanese program needs external tables to figure out which of two symbols comes before the other in the dictionary.
- What about new words?
- What about braille?