**Input/Output Devices**

**Typewriter**
- QWERTY, Christopher Sholes
- 52% Q W E R T Y U I O P
- 32% A S D F G H J K L ; '
- 16% Z X C V B N . /

**Writing Ball**
- Rasmus Malling-Hansen
- different placements of the letters on the keys
- electromagnetic escapement for the ball
- the first electric typewriter

**Teletype**
- 1910: first commercial installation of a printing telegraph
- trademark used for a teletypewriter / teleprinter
- 1915: 30 or 50 WPM
- 1957: 300 WPM

**Drum Printer**
- 1954: UNIVAC, UNIPRINTER, Earl Masterson
- typewriter with an attached tape drive
- first commercially available high speed printer
- 600 LPM, 130 CPL

**Line Printer**
- IBM 1403, 600 LPM
- 600-1200 LPM (10-20 PPM)
- a lot of noise
- were always enclosed in sound-absorbing cases of varying sophistication
- not expensive
**1959**

**Plotter**
- Graphics printer that draws images with ink pens
- 1959: Calcomp 560, first computer graphics output devices sold
- 1970: Hewlett Packard and Tektronix desk-sized flatbed plotters

**1961**

**IBM Selectric Printer**
- Pivoting typeball
- Different fonts
- 14.8 CPS
- High quality printed output

**1970**

**Dot Matrix Printer**
- Impact matrix printer
- The oldest of the three technologies used in most of today's printers
- 1970: 165 CPS, $2,995
- 1977: speed of 240 CPS
- 1983: ImageWriter, $675

**Dot Matrix Printer**
- Each character as a group of small dots
- Tiny metal rod, also called a "wire" or "pin"
- One or two columns of dot hammers
- Speeds range from 200 to 400 CPS

**Dot Matrix Printer**
- Few of the more common problems:
  - Light or poor print quality
  - Paper jams
  - Missing print
  - Paper out
  - Dark smudges
  - Flecks of ink

**1970**

**Inkjet Printer**
- Non-impact method
- Canister of ink instead of ribbon
- Three ink colors (cyan, magenta and yellow)
- Black ink for pure black printing
- Propelling tiny droplets of liquid ink onto paper
- Higher quality text than dot matrix printers
Technologies to control the flow of ink:
- Thermal Ink Jet
- Piezoelectric Ink Jet
- Continuous Ink Jet

1867: William Thomson
1951: first commercial model, Siemens
one of the oldest ink jet technologies in use and is fairly mature
control a continuous inkjet droplet stream direction onto the printed media or into a gutter

1964
Thermal Wax Printer
dye-sublimation and solid ink
small resistive heating pins melt wax-based ink onto ordinary paper or burn dots onto special coated paper
typically 300dpi
specialist applications

1938
Electrophotography
Chester Carlson
Xerography
10-22-38 ASTORIA
$150,000,000

1948
Xerography
“dry writing”
a dry photographic or photocopying process
used in copy machines, laser and LED printers
officially announced in 1948
1949
Xerography
- General Electric, Eastman Kodak, IBM
- Haloid Company - 1949
- Xerox Corporation

1972
Laser Printer
- 1972: Butler Lampson and Ronald Rider – control system
- EARS: Ethernet, Alto, Research character generator, Scanned laser output terminal
- first laser printer
- base of the Xerox 9700

1978
Xerox 9700
- Xerox 9700 laser printing system
- industry's first commercial laser printer
- 120 pages per minute
- fastest commercial laser printer
- huge

Laser Printer
- high quality text and graphics on plain paper
- fastest models can print over 200 monochrome pages per minute (12,000 pages per hour)

Color Laser Printer
- CMYK colored toner (cyan, yellow, and magenta)
- complexity of the printing process
- each of the four inks is applied to the drum before the page is printed
**Printer Technologies**

- drum
- dot matrix
- inkjet
- impact
- piezo electric
- thermal wax
- laser
- thermal bubble
- dye sublimation
- daisy-wheel
- bubblejet

**1936**

**Keyboard**

- 1936: August DVORAK
  - 22% ', ., P Y F G C R L ?
  - 70% A O E U I D H T N S -
  - 8% : Q J X B M W V Z
- One-handed versions

**Non-Traditional Keyboards**

**1952**

**Light Pen / Gun**

- photosensitive device
- 1952: handmade prototype of a "light gun", Whirlwind Project at MIT
- 1957: Lincoln TX-0 computer at the MIT Lincoln Laboratory

**1964**

**Graphics Tablet**

- sketching new images or tracing old ones
- 1964: RAND Tablet, (Grafacon - Graphic Converter)
- 1984: Koala Pad, first home computer graphics tablet

**1963**

**Early Mouse**

- 1963: Douglas Engelbart, Stanford Research Institute
- one button on top and two wheels on the underside
- device with its long cable tail looked something like a mouse
1972: Bill English, ball mouse, part of the hardware package of the Xerox Alto computer
- rubber or metal ball rotates in any direction
- mechanical sensors detect the direction

1980:
- optical sensors detect motion of the ball
- 1980: Steve Kirsch, Mouse Systems Corporation, infrared light-emitting diodes and a four-quadrant infrared sensor
- 1981: Richard F. Lyon, 16-pixel visible-light image sensor with integrated motion detection, sold by Xerox

1980: optical mouse sensor, developed by Agilent Technologies
- a tiny camera takes thousands of pictures every second
- most optical mice use a small, red light-emitting diode

1998: Sun Microsystems
- 2004: Logitech with Agilent Technologies introduced MX 1000
- infrared laser instead of an LED
- wireless mouse

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