

Printers and plotters

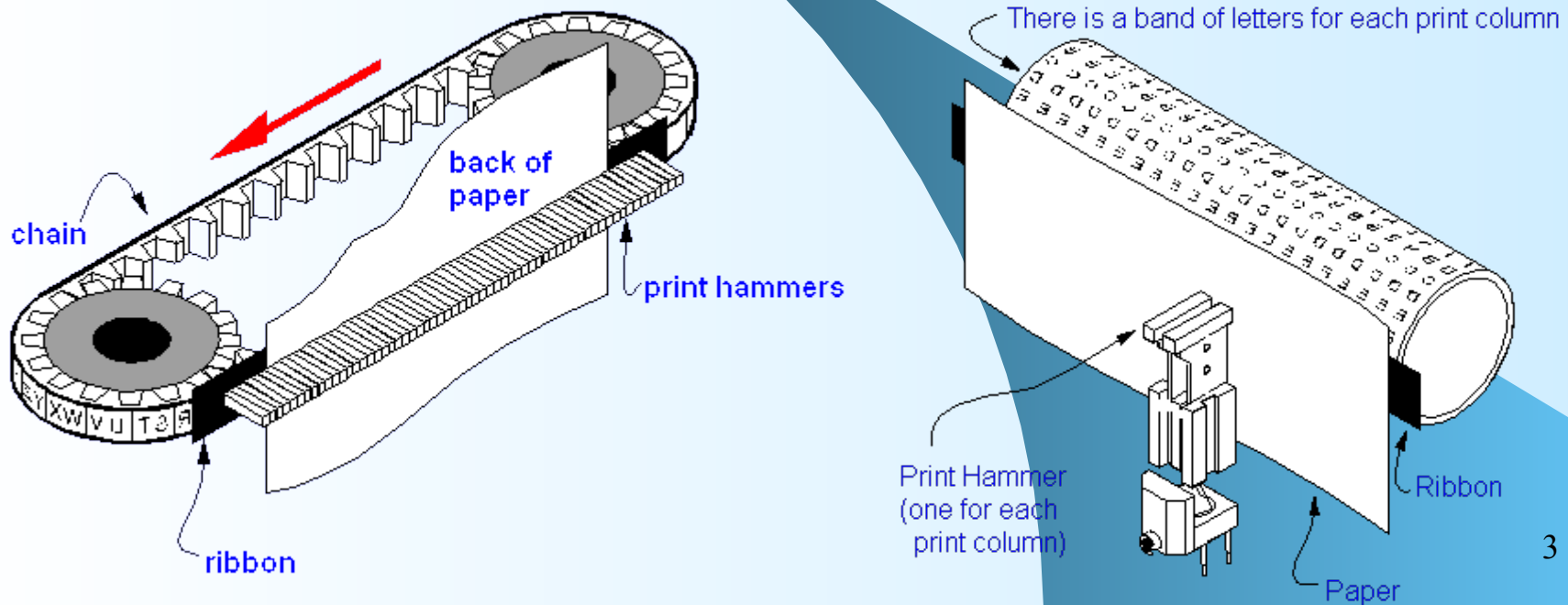
RNDr. Róbert Bohdal, PhD.

Types of printers

- Text (drum, chain, rotating disc, ...)
- Dot matrix (1, 9, 18, 24)
- Thermal
- Inkjet (bubblejet/thermal, piezoelectric)
- Electrostatic (laser, LED)
- Solid ink
- Thermal wax
- Dye sublimation
- Thermal autochrome
- Cyclic

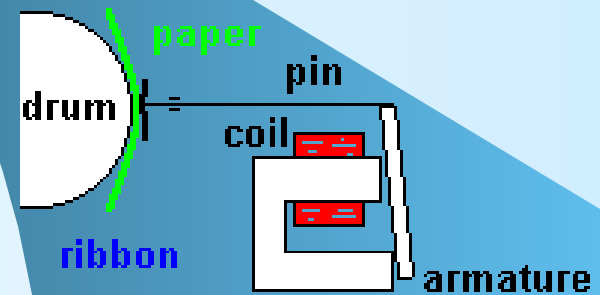
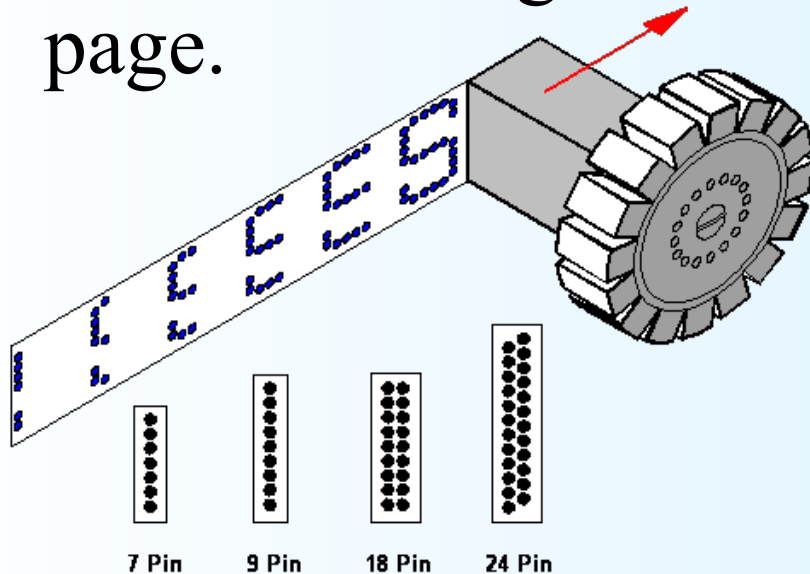
Text printers

- They use ink ribbon, print hammer and relief of characters placed on chain.
- Hammer strike against the back of the paper. The paper presses forward against a ribbon which then presses against the character relief.



Dot matrix printers

- Each dot is produced by a tiny metal pin, which is driven forward by the tiny electromagnet.
- Each pin strikes an ink-soaked cloth ribbon against the paper.
- Usually they are 9 in one row or 24 in two rows.
- Their advantage is the very low price per printed page.

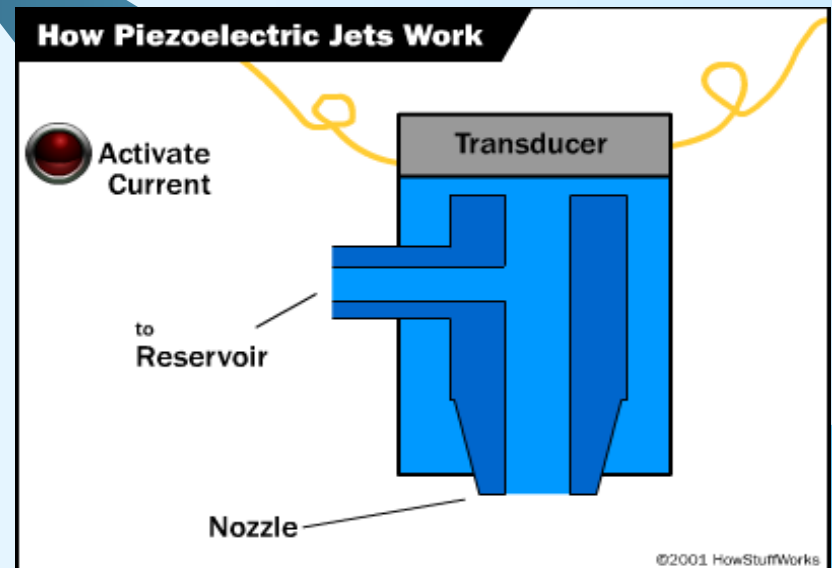
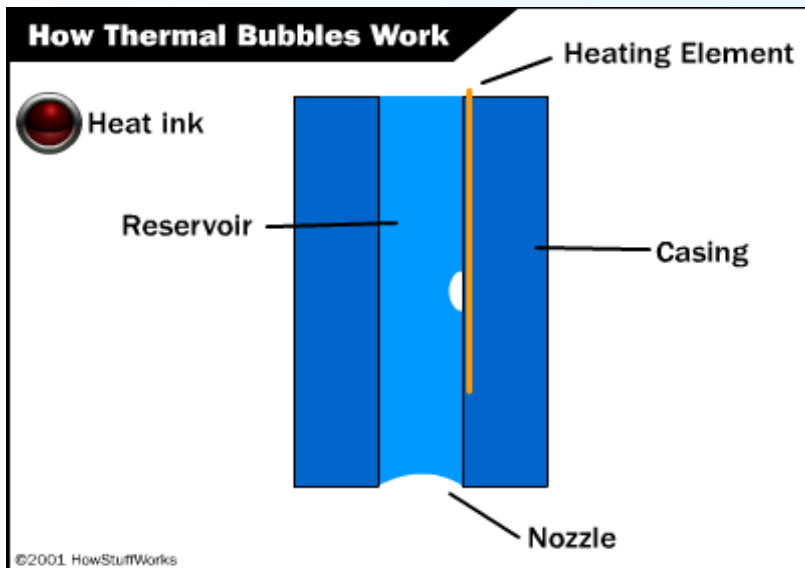


Thermal printers

- They work on a similar principle as dot matrix printers.
- Ink ribbon is not using, but instead of common paper a special heat-sensitive paper paper is used.
- The pins are permanently heated and the hot dots on the heat-sensitive paper are heated at the point of contact.
- The heated point changes color from white to black.

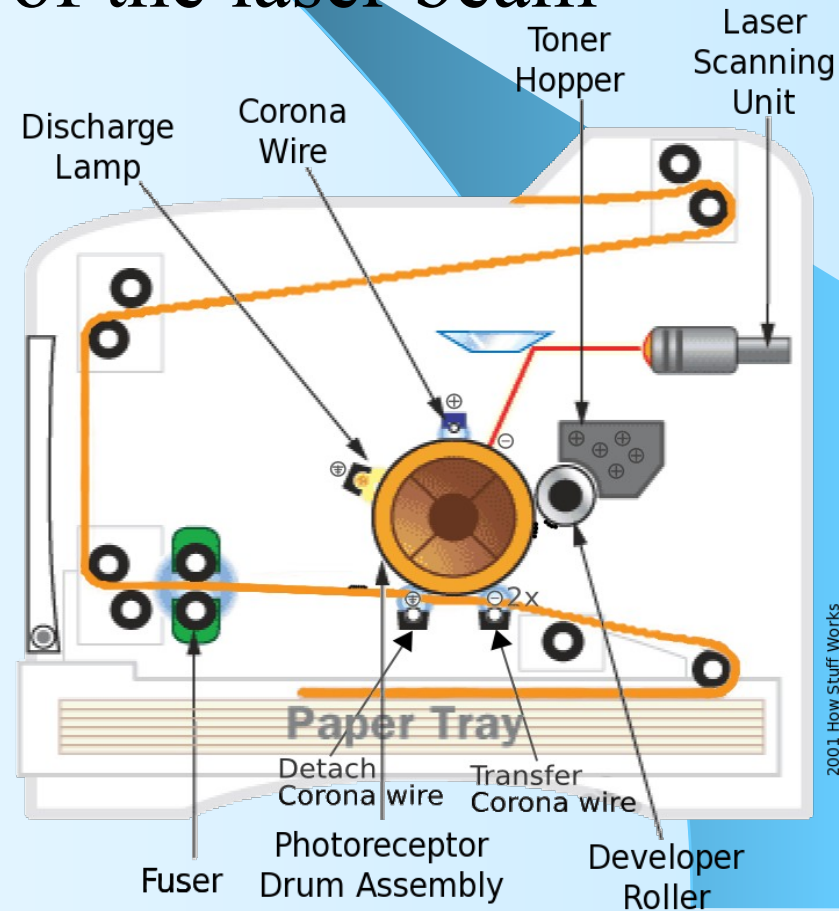
Inkjet printers

- Piezoelectric – the crystal vibrates and increases the ink pressure in the chamber, which then escapes through the nozzle out.
- Bubblejet – the ink is heated until bubbles are formed. Because of the increasing pressure, the ink jets through the nozzle.



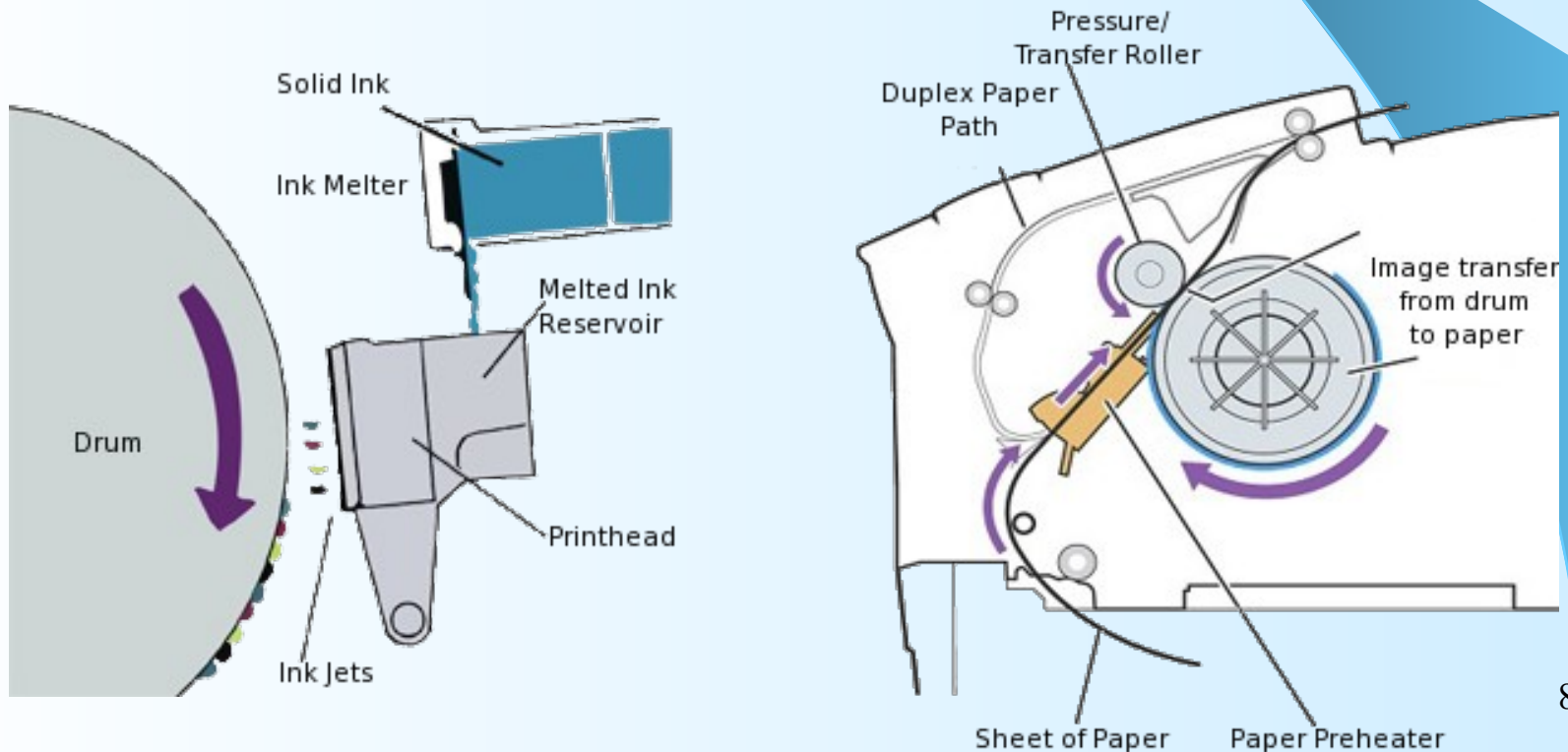
Laser printers

- Electrostatic principle – the entire photoconductor drum is charged with a positive charge. The laser beam reverses the charge on the surface of the drum at the point of impact of the laser beam
- The positively charged toner is attracted by the photoconductor drum and further transferred to the paper because paper has a 2x larger charge.
- The paper passes through the hot fuser and permanently bond the toner to the paper.



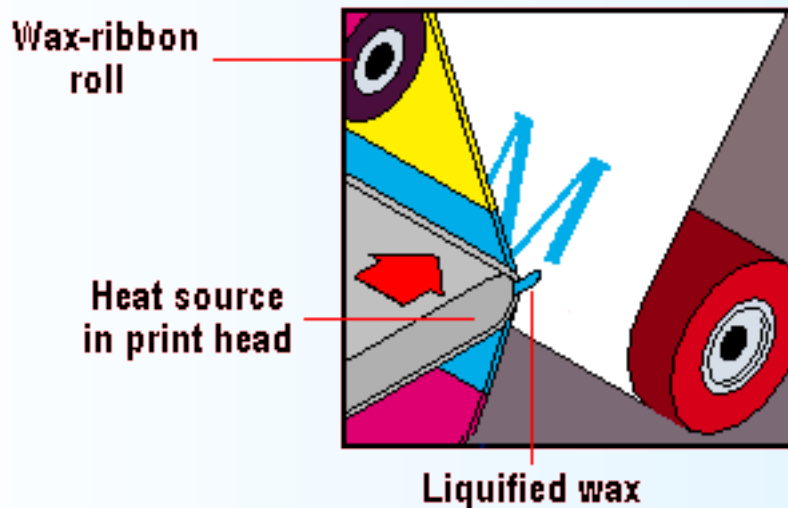
Solid ink printers

- Solid ink is melted into the reservoirs before printing and then is squirted onto the print drum. Next the ink is stamped using a press roller to the heated paper.



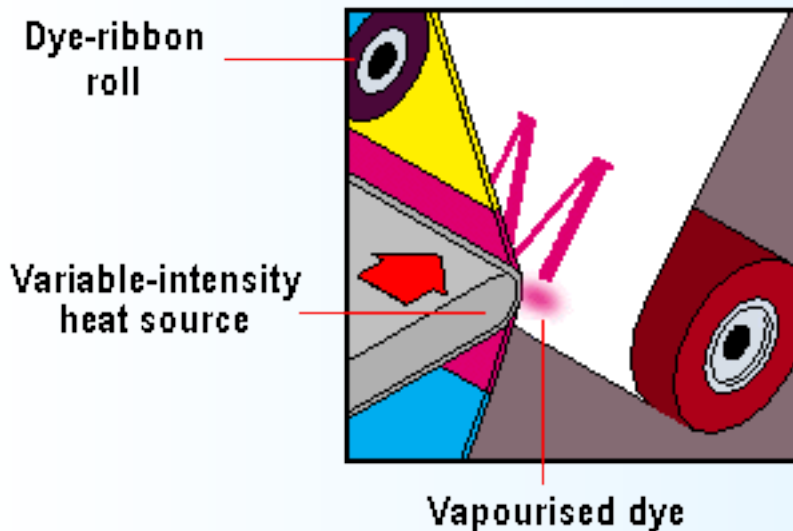
Thermal wax printers

- The ribbon containing the CMYK wax strips passes before the print head.
- Hot needles melt wax and transfers it onto the paper.



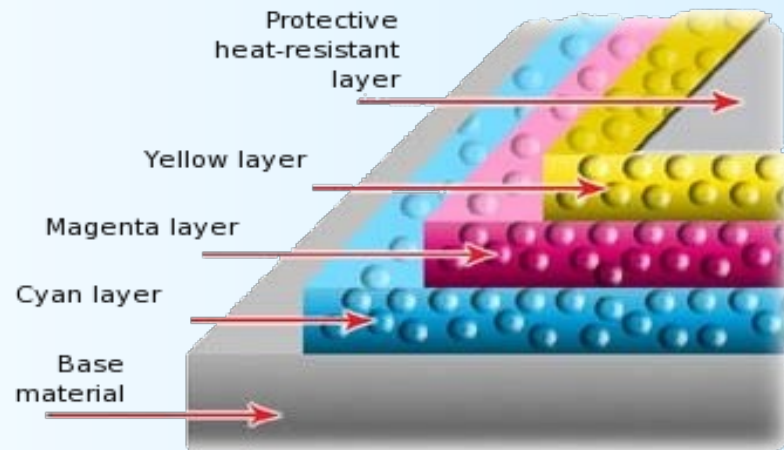
Dye-sublimation printers

- On the thin cellophane belt are stripes with CMYK colors. The color is sublimed by heat and the paper soaks up it.
- The amount of sublimed color is controlled by the heat change in the print head.



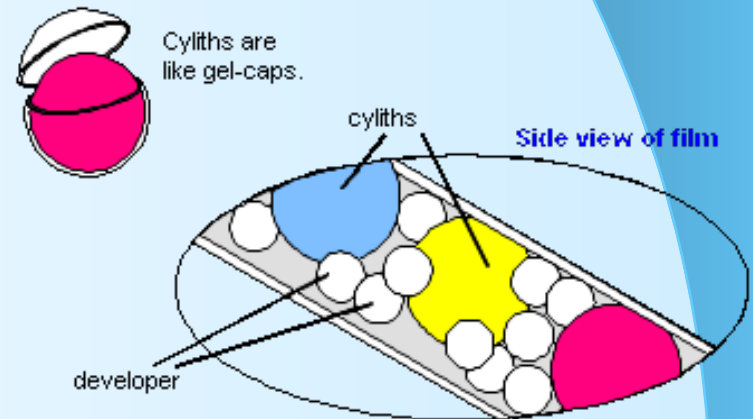
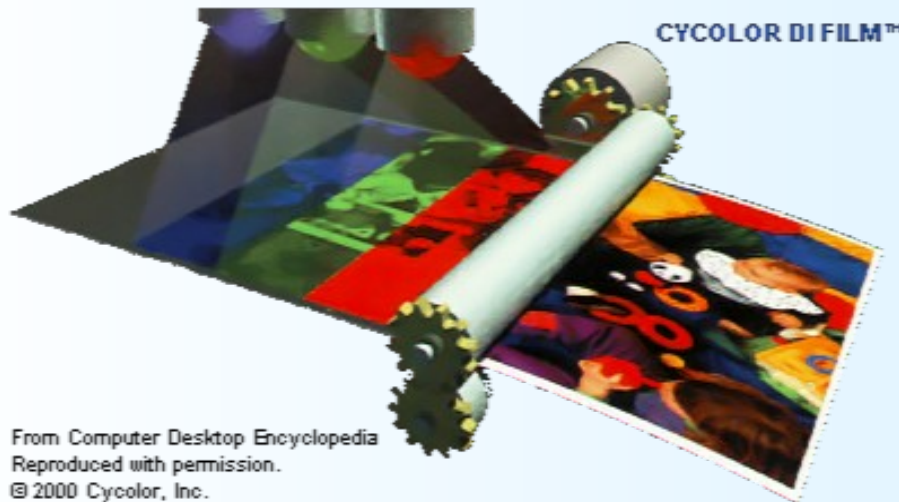
Thermal autochrome

- These printers use special paper containing 3 layers of CMY colors (dyes). Each layer is “activated” by another temperature.
- The print head with a heat source passes through the paper three times and each of the layers is heated to the exact temperature at the printed locations.
- After each pass, the layer is “fixed” by UV light.



Cycolor

- These printers use a special foil containing billions of light-sensitive microcapsules containing dye.
- The cyliths react to the individual color spectrum (RGB) and their content is hardened by light.
- The non hardened capsules are broken by rollers and the dye is transferred to the paper.

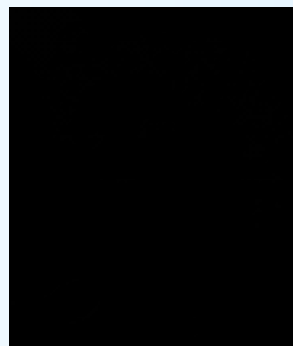


Printers and shades of colors

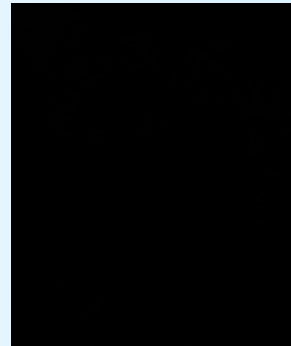
- When printing different color shades, the printer (except dye sublimation) must use dithering or halftoning techniques.
- By using dithering or halftoning, local print resolution (DPI) is reduced.



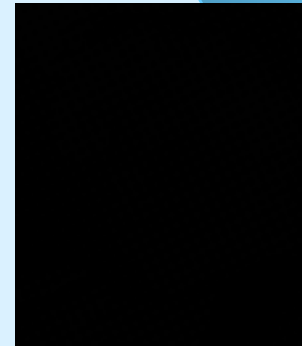
Original
picture



Dithering
Bayer



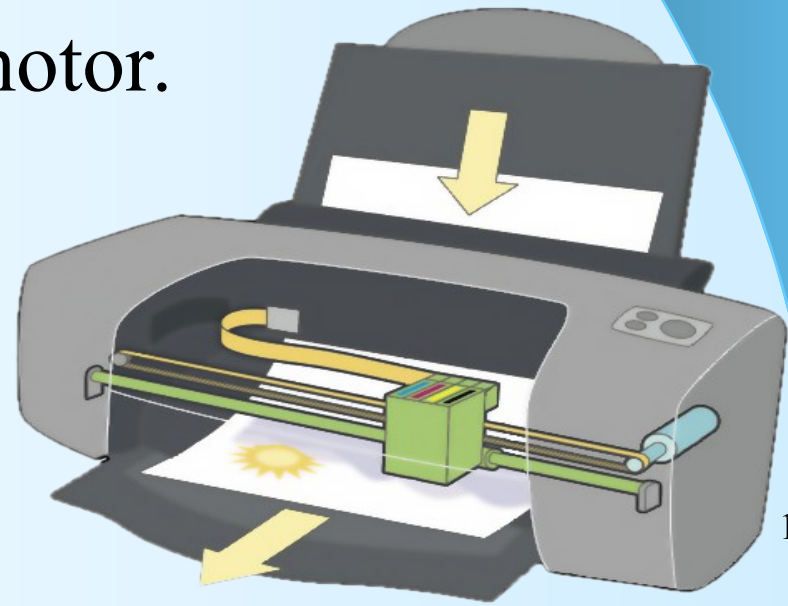
Dithering
Floyd-Steinberg



Halftoning

Movement of the printhead and paper

- The printer usually prints row by row.
- The row/line is drawn by the horizontal motion of the print head on the arm.
- Moving to a new line is provided by the drum on which the paper is attached.
- The movement of the print head and drum ensures a very precise stepper motor.



Plotters

- Drum
- Flatbed
- Pen
- Inkjet
- Electrostatic

These devices are able to draw exactly in fractions of a tenth of a millimeter.

Drum plotters

- The paper moves on the drum in the vertical direction.
- The print head moves horizontally.
- The print head includes a special pen or classic ink cartridge.



Flat plotters

- The paper is attached on a horizontal surface by electrostatic charge, vacuum, or magnet.
- The print head includes one or more pens (or a graver or light pen) and moves in both x and y directions.



Electrostatic plotters

- They work on a similar principle as laser printers, but the static charge is usually applied to paper using conductive “bristles”.



Communication languages of printers

- Page Description Language (PDL)
 - Printer Command Language (PCL)
example: ESC * c 5 V
 - PostScript
example: 200 250 lineto
 - Graphic device interface (GDI)
 - Portable Document Format (PDF)
- Hewlett-Packard Graphics Language (HPGL)
example: PD 100,0,100,100,0,100,0,0;