Computer Graphics for Engineers

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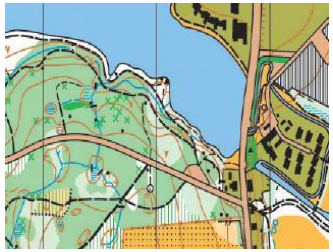
Computer Graphics

Computer Graphics – branch of Computer Science dealing with application of computers to generate pictures and visualize real data.

Sample applications:

- cartography,
- visualization of scientific data (in 2D and 3D),
- visualization of computer simulations,
- medical diagnostics,
- Computer Aided Design and drafting (CAD),
- DeskTop Publishing (DTP),
- special effects in movies,
- computer games.



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Computer Graphics

Origins in the middle of XX century, limited in popularity:

- research centers,
- large corporations,
- government entities

due to the high costs and limited access to the required equipment.

Situation changed after the advent of Personal Computing (PC) (eighties of XX century) due to rapidly falling equipment costs.

Nowadays affordable and thus very popular.

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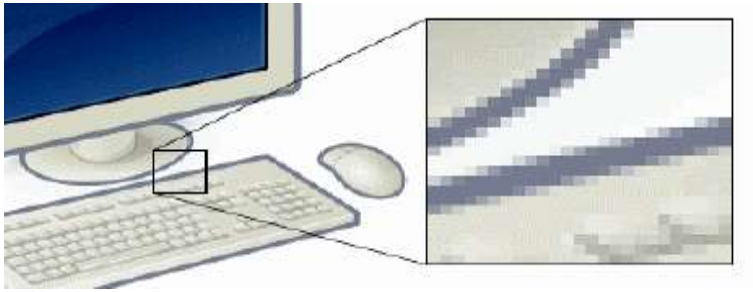
Computer Graphics

Computer representation of graphical objects:

- vector graphics – picture is composed of a set of lines and curves:
  - plotters,
  - some Cathode Ray Tube (CRT) monitors,
- raster graphics – picture is composed of evenly spaced points (picture elements – pixels):
  - scanners,
  - digital still and video cameras,
  - flat panel monitors,
  - printers,
  - ...



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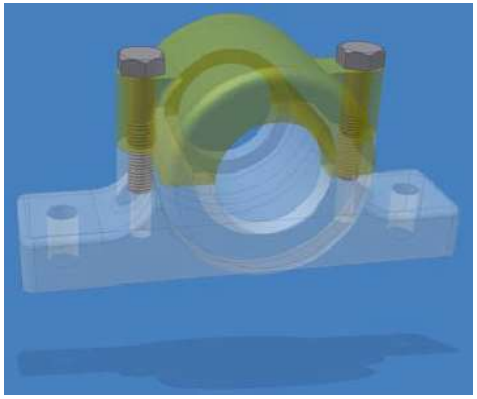
Computer Graphics

Data representation in computer programs:

- vector graphics – picture is composed of basic drawing primitives (lines, circles, parametric curves), which are saved as sets of numbers (endpoints, center and radius, control points),
- raster graphics – picture is represented as a two dimensional array of pixels (a bitmap).



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Vector vs. Raster Graphics

Vector graphics:

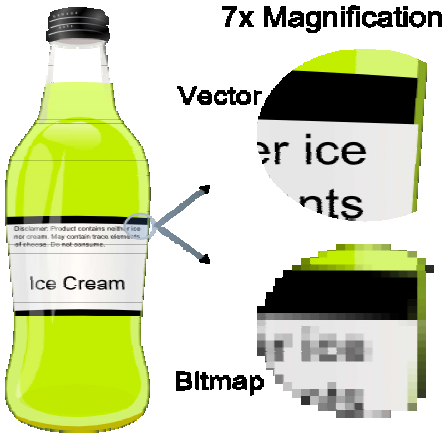
- component data preserved,
- editing possible without the loss of quality,

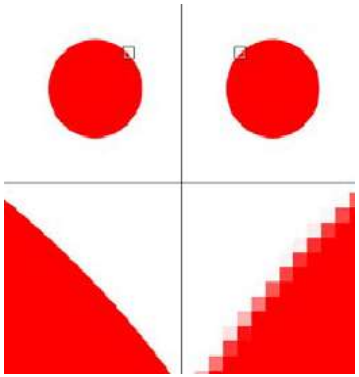
Raster graphics:

- component data (almost) irretrievably lost,
- limits on zooming in.

Transitions:

- raster to vector: Optical Character Recognition (OCR),
- vector to raster: drivers for peripherial devices.





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Computer Graphics

Other classification methods:

- dimensionality of space:
  - 2D graphics – flat objects only (all raster pictures fall into this category),
  - 3D graphics – objects suspended in 3D space, computer performs projection onto 2D screen plane;
- generation speed:
  - noninteractive graphics – the highest quality (ray tracing), may be very time consuming, offline generation of computer animations,
  - interactive graphics – short response time to user actions, simplified representation at the expense of quality,
  - realtime graphics – response time is the highest priority – simulators, computer games.

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