GRAPHICS WORKSTATIONS
(Section 2-3 in Computer Graphics)

DISPLAY PROCESSORS
(Section 2-4 in Computer Graphics)

GRAPHICS SOFTWARE
(Section 2-5 in Computer Graphics)
GRAPHICS WORKSTATIONS

- CPU and Memory
- Display Processors
- Input Devices
  - keyboard
  - lightpen
  - joystick, mouse or tablet and stylus
  - function buttons
  - touch panel
  - voice system
  - three-dimensional input devices
- Output Devices
  - vector CRT
  - raster CRT
  - plasma panel
  - printer
  - plotter

- see figure 2-23 on page 45
  - an artist’s workstation
- see figure 2-24 on page 45
  - a graphics workstation
Display Processors

- receives digital information from the CPU and memory
- provides analog information to the display device

- display graphics primitives
  - line segments
  - characters

advanced display processors
- various line styles
- colored areas
- curved lines
- transformations

refresh display processors
- maintain the image (sometimes a task for the display controller)
random-scan systems
random-scan systems with a refresh display file
drawing primitives

- lines
  - defined by the coordinates of their endpoints
  - drawn with a vector generator
    - analog vector generator
    - digital vector generator

- curves
  - defined by a functional representation
  - drawn by
    - an analog curve generator
    - a digital curve generator
      - as a series of short lines
      - as a series of points

- characters
  - hardware or software
  - a series of short lines or
    a rectangular point grid (5-by-7 to 9-by-14)
DVST display processor

- refresh storage for "write-through"
- screen erasure
raster-scan systems

- refresh storage in the frame buffer (refresh buffer, raster, bit map)
- each position is a pixel (picture element, pel)
- each line is a scan line
- generating pixel information for the frame buffer is called scan conversion
- 1 to 24 bits/pixel
memory reduction

- 1024 x 1024 x 24 bits = 3 megabytes
- run-length encoding
  - scan line stored as a set of integer pairs
    - first element is an intensity value
    - second element is a pixel count
- cell encoding
  - encode the raster as a set of rectangular areas
GRAPHICS SOFTWARE

- Graphics Packages
  - generate picture components
  - set colors and intensities
  - select views
  - apply transformations

- Applications Graphics Packages
  - for nonprogrammer graphics users
  - art, business, medicine, CAD
coordinate representations

- usually Cartesian
- world coordinates for the user
- normalized device coordinates for the system
- physical device coordinates (screen coordinates) for the output device
graphics functions

- output primitives
  - geometric entities
  - character strings

- input operations
  - control and process data from interactive devices

- attributes
  - intensity
  - color
  - line style
  - text style
  - area-filling pattern

- segment processing
  - creation
  - deletion
  - transformation

- viewing
  - what portion of the world is seen
  - where is it presented

- general control
  - clear screen
  - initialize parameters
software standards

- portability of graphics software is the goal

- graphical kernel system (GKS), adopted by
  - International Standards Organization
  - American National Standards Institute

- Core Graphics Standard
  - developed by the Graphics Standards Planning Committee of SIGGRAPH (ACM)

- functions defined as abstract specifications
  - anticipates a language binding
  - example: polyline (n,x,y) (GKS)
    CALL GPL (N, X, Y) (FORTRAN)
  - bindings for
    FORTRAN
    Pascal
    Ada
    C
    PL/I
    COBOL
weaknesses of GKS

- no standard for graphics interfaces to output devices
  - Computer Graphics Interface (CGI)

- no specifications for real-time modeling
  - Programmer's Hierarchical Interactive Graphics Standard (PHIGS)

- no specifications for storing and transmitting pictures
  - Computer Graphics Metafile (CGM)
GRAPHICS WORKSTATIONS

- CPU and Memory
- Display Processor
- Input Devices
- Output Devices

DISPLAY PROCESSORS

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- provide analog information to the display device
- display graphics primitives

Advanced Display Processors
- various line styles
- colored areas
- curved lines
- transformations

Refresh Display Processors
- maintain the image (sometimes a task for the display controller)

GRAPHICS SOFTWARE

- Graphics Packages
- Applications Graphics Packages
- Coordinate Representations
- Graphics Functions
- Software Standards