A History of Computer Graphics

note: dates are approximate

15-463

Paul Heckbert

Big Bang - 1960

-300, Euclid: geometry codified

1400, Brunelleschi et al: perspective illustration rediscovered

1600, Rene Descartes: analytic geometry, xyz

1660, Leibniz, Newton: calculus

Gauss, Fourier, Hermite…

1850, Sylvester: matrix notation

1930’s, Schoenberg: B-splines for applied mathematics

1940’s: first computer

1950’s: SAGE air defense system (CRT’s & light pens)

1960’s: State of the Art

processor: IBM Computer with a few K memory

display: none

peripherals: punch cards, line printer, and roll-paper plotter

OS: none to speak of

language: FORTRAN or assembler

graphics: Snoopy calendars, function graphs

1960's

Hardware:

- 1966, Doug Englebart: mouse
- mid 60's, Evans & Sutherland and General Electric: real time raster (specialized flight simulators)
- late 60's: head-mounted displays

Software:

- 1963, Ivan Sutherland: **Sketchpad**, interactive design (w. light pen)
- 1965, Jack Bresenham: digital line drawing algorithm
- 1967, Larry Roberts: homogeneous coords, 4x4 matrices, hidden line alg.
- late 60's, Steve Coons: parametric surfaces, early CAGD
- late 60's, Pierre Bezier: Bezier curves & surfaces (car design)

also FFT algorithm, ARPANET

1970: State of the Art

processor: IBM 360 Computer with 64K memory

display: Tektronix 4014 storage tube (or vector display with light pen if you were very lucky)

peripherals: punch cards, line printer, and roll-paper plotter

OS: none to speak of

language: FORTRAN

graphics: wireframe perspective, for defense contractor

1970's

Hardware:

- **Evans & Sutherland Picture System**: dynamic vector display (persp., clip)
- 1974?, Xerox PARC: Alto (first personal computer)
- 1977: Apple II (commercial personal computer)
- 1979: Dec VAX (mainframe that dominated the 80's)
- arcade video games: PONG, Pac Man; early home game consoles

Software:

- keyframe animation for 3-D graphics
- 1974, Xerox PARC: paint program
- 1974, Ed Catmull: parametric patch rendering, z-buffer algorithm, texture mapping
- 1979, Turner Whitted: ray tracing

BASIC, PL/I, UNIX, C, Pascal, ADA, ...

1980: State of the Art

processor: DEC VAX with 2 MB memory, 256MB disk

display: 24x80 terminal; dynamic vector display, or 24-bit raster frame buffer

peripherals: dot matrix printer, early film recorder

OS & libraries: UNIX or VMS, custom graphics

language: C or FORTRAN

graphics: hidden line drawings or shaded raster for flying logos & TV advertising

1980's

Hardware:

1981: IBM PC

early 80's: Sun Workstation

1984: Apple Macintosh

1985: Apple Laserwriter (earlier invented by Xerox PARC)

mid 80's: **microprocessors take off**

mid 80's, PC's take off (Intel x86, but still toys)

mid 80's, workstations take off (Motorola 680x0)

late 80's: Silicon Graphics Workstation (real time raster lines, then polygons)

data glove

VLSI for special purpose graphics processors, parallel processing, fear of Japanese domination

1980's

Software:

- 1980, Jim Blinn: blobby models
- 1980: BSP trees (mostly a curiosity at the time)
- 1980, Loren Carpenter: fractals for computer graphics
- 1985: PostScript
- 1986, Cook: stochastic sampling for computer graphics
- Photoshop

- arcade video games
- desktop publishing, character animation, radiosity, lotsa ray tracing, scientific visualization
- UNIX, X Windows, C, C++, but MS-DOS rising...

1990: State of the Art

processor: SGI Workstation with 16MB memory

display: 24-bit raster with real-time Gouraud shading & z-buffer (no tex. map.);

- the terminal is the frame buffer

peripherals: laser printer, single-frame video recorder

OS & libraries: UNIX, X Windows, SGI GL

language: C

graphics: shaded raster for special effects in movies

meanwhile, PC's are getting decent, but still no 3D graphics hardware, so people use software scan conversion, Painter's algorithm, and tricks to get real time

1990's

Hardware:

Intel 486: PC's get passable floating point

mid 90's: laptops

1994: Silicon Graphics Reality Engine (real time texture mapping)

Nintendo 64 game console: Reality Engine-like graphics for the masses

late 90's: PC graphics cards (3dfx, Nvidia, …)

Pentium: PC's almost as fast as workstations

mid 90's: scanners (Cyberware)

late 90's: motion capture

PC market takes off, supercomputers waning, Microsoft Research growing, Apple collapses, SGI collapses, new startups, …

1990's

Software:

Internet

1990: MPEG compressed video standard

early 90's: dynamics (collisions, gravity, friction)

1992: OpenGL

1993: **World Wide Web**, Mosaic web browser

1994: subdivision surfaces rediscovered

late 90's: image based modeling & rendering

3-D video games take off: DOOM (BSP), Quake, Mario, Nintendo 64

Terminator 2, Jurassic Park, **Toy Story**, Titanic, Star Wars I

virtual reality, VRML

PDA's, Palm Pilot, flat panel displays

Linux, open source software

2000: State of the Art

processor: Intel PC with 256MB memory, 10GB disk

display: graphics board/chip with real time texture mapping

peripherals: flatbed scanner, color laser printer, digital video camera, DVD, MPEG encoder/decoder

OS & environment: Windows/Linux, Netscape, OpenGL/Direct3D

language: C++, Java

graphics: real-time humanoid characters, web commerce

real time 3-D graphics on home PC’s

2000’s (predictions)

Hardware:

- 2000: Sony Playstation 2
- HDTV
- gestural input devices
- ubiquitous computing

Software:

- transparent conversion of model formats
- 3-D modeling & video editing tools for the masses
- computer vision for facial expression capture
- voice recognition
- realistic face, hair, water
- C++ loses favor