

## Outline for April 25, 2007

*Question:* What are the advantages of having people vote using computers? What are the disadvantages?

1. Greetings and felicitations!
  - a. I will do a review session in class on Friday, so bring your questions to it!
  - b. Sample midterm available on Thursday, on the web
  - c. Warning: no office hours on Wednesday!
2. Brief history of computer games
  - a. 1961: Spacewar! implemented on a PDP-1 at MIT; two ships fired torpedos at one another and moved around screen; DEC liked it so much they distributed it with the PDP-1
  - b. 1971: Star Trek created on Sigma 7 minicomputer at MIT in 1971
  - c. 1972: Hunt the Wumpus created on PDP-10; ported to a wide variety of systems
  - d. 1974: Maze War at NASA Ames Research Center was early multi-player 3D “first person shooter” game
  - e. 1975: Adventure written in FORTRAN for PDP-10 by Will Crowther; very widely ported to other systems
  - f. 1980s: Pong, Pac-Man, etc. on home computers
3. 3D graphics
  - a. 3 numbers to specify each point in space.
  - b. 2D triangles (or other polygons) composed to create 3D objects.
  - c. Geometry engine of the GPU (Graphics Processing Unit) calculates position of each corner with respect to a vantage point and camera angle, called *tessellation* or *triangulation*. Also calculates position of light sources, and clips lines outside viewpoint
4. Rendering engine of the GPU creates 2D rasterization of 3D scene
  - a. Creates a wire frame of lines of the polygons.
  - b. Z-Sorting (depth from viewer) of each polygon so closer objects are drawn last and properly cover more distant objects.
  - c. Z-buffering calculates depth values of each pixel of on the surface of each polygon, and stores them. Then displays pixel with smallest depth on each ray.
5. Filling things in
  - a. Texture maps are unchanging bitmaps that are tiled to cover surfaces.
  - b. MIP mapping (multum in parvum) “many in few” uses different bitmaps for the same surface depending on the surfaces projected size and resolution.
  - c. Perspective correction changes texture maps to wedges
  - d. Alpha blending, for translucent effects, takes a percentage of the fog and the original pixel. Faster to “stipple” which shows fog on every other pixel.
  - e. “Fogging” makes diffuses distant objects. “Depth cueing” makes distant objects darker. Both reduce details and make rendering less complicated for the rendering engine.
6. Shading
  - a. Bilinear filtering averages the four surrounding texture map pixels
  - b. Shading is based on light sources. Gouraud shading interpolates values between vertices of the same polygon
  - c. Ray tracing follows the path of a light ray as its reflected, refracted, and absorbed
  - d. Vertex shaders apply Gouraud shading principles to non-visual properties of animated objects, e.g. temperature and weight, and displacement
  - e. Particle shaders operate on individual pixels independent of polygons
7. Video cards
  - a. Two cards use “scissors rendering” to split though, with one to doing the upper part of the scene and one doing the lower part.
  - b. If the two cards finish a scene early, “frame buffers” hold the scenes until it is their turn.
  - c. Cards need their own power connectors, fans, and heat sinks.