



## The Basics

- **Theme: the four seasons**
- **Made for Assembly 2001, won 1<sup>st</sup> place**
- **Hardware accelerated**
- **Size: 64K**
  - To keep to this size, procedural everything.
  - Source code was 600k, spanning 160 files; mostly C++, some ASM.
  - Executable compressed with UPX packer.

## Terrain

- **Generated with 128x128 or 256x256 heightmaps.**
- **Rendered brute force.**
- **512x512 texture synthesized from grass, snow, and dirt procedural textures, plus a detail texture.**
  - Simple Monte Carlo ray-tracing done as a preprocess to give soft shadows on texture.

## Terrain Example



## Sun and Clouds

- **Sun's a billboard**
  - No lens flares, since they're cliché by now.
  - Center pixel of sun used to test its visibility.
- **Clouds are put on a skybox or hemisphere**
  - Made using render-to-texture of two sky txrs.
  - Alpha-compositing used to do smooth transitions.
- **Volumetric clouds done with hulls, like fur rendering (J. Lengyel, "Real-Time Fur").**

## Cloud Examples



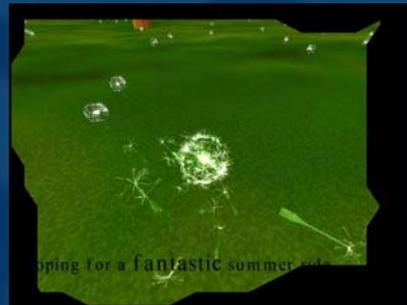
## Living Things

- Birds and butterflies have simple flocking and gravity to control them.
- Dandelions: stem and seeds model, and also impostors.
- Grass: string of cylinders model, and alpha-tested hulls.
- Trees: L-Systems, and impostors.

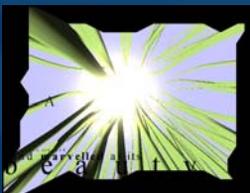
## Butterfly Example



## Dandelion Example



## Grass Examples



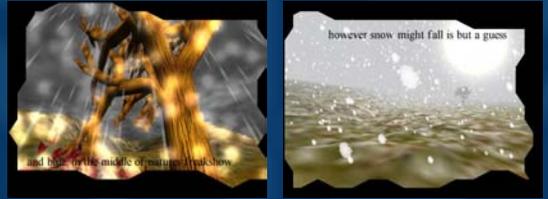
## Tree Examples



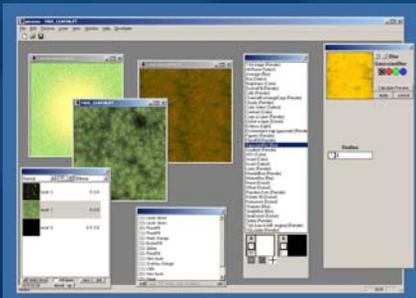
## Weather

- Rain and snow done with particle systems.
- Rain: thousands of billboards, spawned only if visible.
- Rain splats: hit the camera and blur the scene by using a low-res (64x64) rendering of the scene as a texture on the splat.
- Snow: billboards, slightly oscillating, and affect the ground texture when they hit.

## Weather Examples



## Development Tools



## More Info

<http://scene.org/dog/downloads.html>

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