Q: What is computer graphics about?

A: Providing tools to help human designers produce images that communicate visual information for some purpose.

Whether to use photorealism depends on the purpose of the image:

- Documentation
- Illustration
- Story-telling
- Expression

Qualities of hand-drawn images

- Many details left out
- Some details emphasized
- Stylization / abstraction
  - used to evoke complex things
- Recognizable individual style
Outline

- Technical illustration
- Pen & Ink
- Painterly rendering for animation
- Cartoonish rendering

Technical illustration

- Saito and Takahashi, Siggraph 90
- Purpose: render 3D models in styles that are more “comprehensible”
- Method:
  - Render various intermediate images
  - Do image-processing operations on them
  - Combine the results
Problem

- Parameters need careful tuning for good results

Pen and Ink

- Winkenbach and Salesin, Siggraph 94
- Purpose: render 3D models as pen & ink drawings
- Method:
  - annotate model with procedural “textures”
  - Render tonal “reference image”
  - Use it to guide pen and ink textures
Pen and Ink

- Salisbury, Anderson, Lischinski and Salesin, Siggraph 96
- Purpose: define a scale-independent representation for pen & ink images
Salisbury et al., cont’d

• Method:
  – Store lo-res greyscale image annotated with discontinuities
  – Filter greyscale image to desired size, run stroke generation algorithm on it

Problems

• Only produces still images
  – Would not provide temporal coherence
• What’s the application?
Painterly rendering

• Meier, Siggraph 96
• Problem: produce animations in a “painterly” style with temporal coherence of strokes
• Method:
  – Populate surfaces with stroke “particles”
  – Render with the help of reference images

Problem

• Particles have fixed distribution
  – Need prescribed camera path
Cartoonish rendering

- Kowalski, Markosian, Northrup, Holden, Bourdev, Hughes, Siggraph 99
- Problem: render scenes like those truffula trees I showed you earlier
- Method:
  - Populate scene with detail elements "graftals"
  - Render with the help of reference images

Graftal textures

Detail elements (graftals) generated as needed

Graftals

- Oriented in local frame
- Can choose level of detail

(a) (b) (c) (d)

Needed for placement of graftals:

- Primarily at silhouettes (e.g.)
- Controlled screen-space density
- Placement on surfaces
- Persistence of graftals
Problems

- Temporal incoherence
- Hard to author new scenes
  - You have to write C code

Static graftals

- Markosian, Kowalski, Meier, Northrup, Holden, Hughes, NPAR 00
- Problem: improve temporal coherence
- Method:
  - Graftals are fixed on surfaces
  - Draw with view-dependent LOD

Demo: night scene
Problems

- Still hard to author scenes
  - You have to edit text files
- LOD handling too restrictive

Pen & Ink: trees

- Deussen and Strothotte, Siggraph 00
- Problem: temporally coherent pen and ink rendering of trees
- Method:
  - Draw leaf entities w/ controlled size/abstraction
  - Do image processing on depth buffer

Tree I  Tree II  Tree III

Video
The future

- More rendering algorithms
- Better tools (UI)
  - NPR images need this especially
- Prediction: big advances in our ability to model stylized characters (people) are coming
- Reason: the content creators will demand it