Non-photorealistic rendering (NPR)

Overview
 Simulation of artistic media
  Watercolor
  Pen and ink
  Pencil
  Paint
 Toon-like rendering
  Silhouettes
  Artificial perspectives
 Artistic styles
Two detailed examinations
 Simulating pen and ink drawing
  Problem
   Make graphics look like pen and ink drawing
  Typical domains
   Illustration
   CAD/CAM
  Observations
   The basic unit of pen drawing is the "stroke"
   Strokes are used to convey
    "Tone": the lightness of the surface
    "Texture": the fine detail of the surface
    "Outlines" are highlighted high contrast edges
   Unlike traditional graphics rendering
    Tone and texture are coupled
    2D information is needed, not just 3D
     In particular, outline requires this
  Basic approach
   Input: a 3D polygonal model
   Apply: standard rendering techniques, with
    Object space hidden surface removal, e.g. BSP
    Object space shadow algorithm, e.g. BSP
   Major differences from standard rendering
    Maintain a 2D spatial subdivision of visible surfaces in view: BSP
    Instead of poly fill, fill with strokes
     These strokes must be clipped to poly edges
    Outlining is applied to highlight poly edges
  Critique
   +: works well and used widely
   -: Remaining challenge: animation
 Silhouette finding
  Problem
   Given a 3D model, find the silhouette edges quickly
  Basic approach
   It's a multipass algorithm:
    render once to find silhouette edges, do normal render
    render again to adjust silhouette edges
   Make a table
    Each entry corresponds to one vertex
    Each entry lists vertices connected to by edges
    Each element in an entry's list also has two F and B bits
   For each face
    If it is front facing
     XOR a 1 into the F bit

else
XOR a 1 into the B bit

In the result
Front edges have FB = 00
Back edges have FB = 00
Silhouette edges have FB = 11

Refinements
Artists can add additional bits to force silhouettes