CSCI 4550/6550 Interactive Visualization

`https://www.cs.rpi.edu/~cutler/classes/visualization/S24/`

Lecture 16:
Illustration, Animation, & Interaction for Visualization

Erik Johansson, Cut & Fold
http://erikjohanssonphoto.com/worktoo/cut-fold/

Today
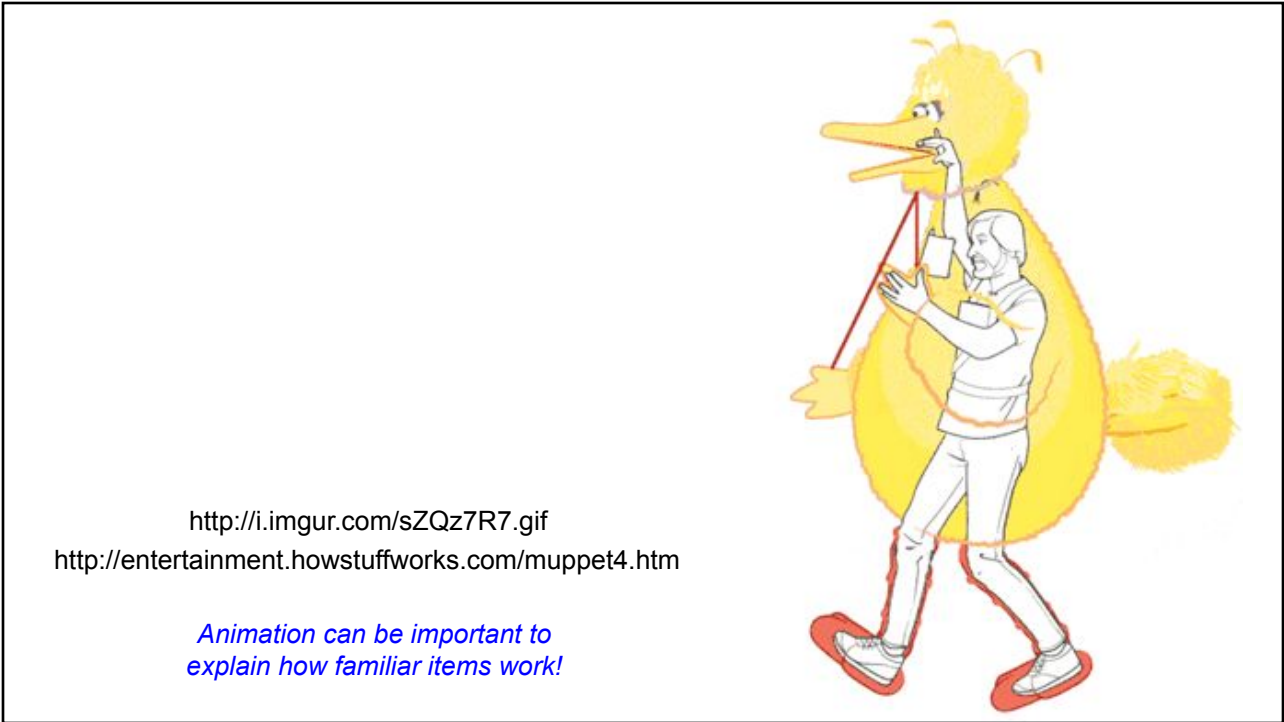
- Marching Cubes Worksheet
- Homework 7: Volume Visualization using Paraview
- Examples of Animation & Interaction for Visualization
- Readings for Today
  - "Designing Effective Step-by-step Assembly Instructions" Agrawala et al., SIGGRAPH 2003
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Homework 7: Volume Visualization Using Paraview

- *The last non-final project assignment*
- Download and experiment with Paraview
  - Based on VTK: The Visualization Toolkit from Kitware, an open-source software company *in Clifton Park, NY (with lots of RPI alums!)*
- Start with the Paraview Tutorial & sample datasets
- Experiment with settings, take screenshots
- Try your hand at creating your own input dataset
  - generated input is probably easiest
  - or construct a real-world dataset!
- Write a short review of the tool

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https://vimeo.com/96300915

Stop motion cutaway animation of a physical object!

http://i.imgur.com/sZQz7R7.gif
http://entertainment.howstuffworks.com/muppet4.htm

*Animation can be important to
explain how familiar items work!*

Visual Response to Interaction

- Hide/Unhide elements
  - Increase/Decrease level of detail
  - Change camera/magnification
  - Add text labels
- Highlight element(s)
  - Change color
  - Change transparency
- Motion
  - Showing time simulation
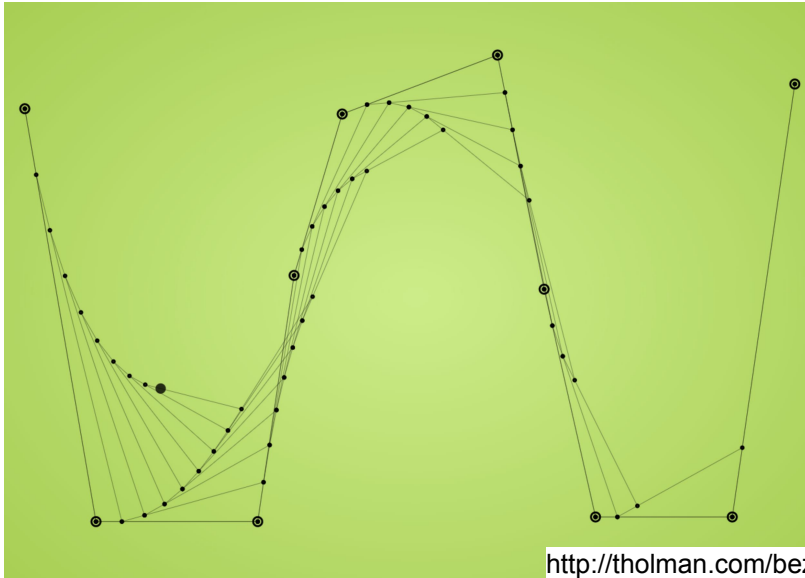 - User can rearrange for clarity/exploration
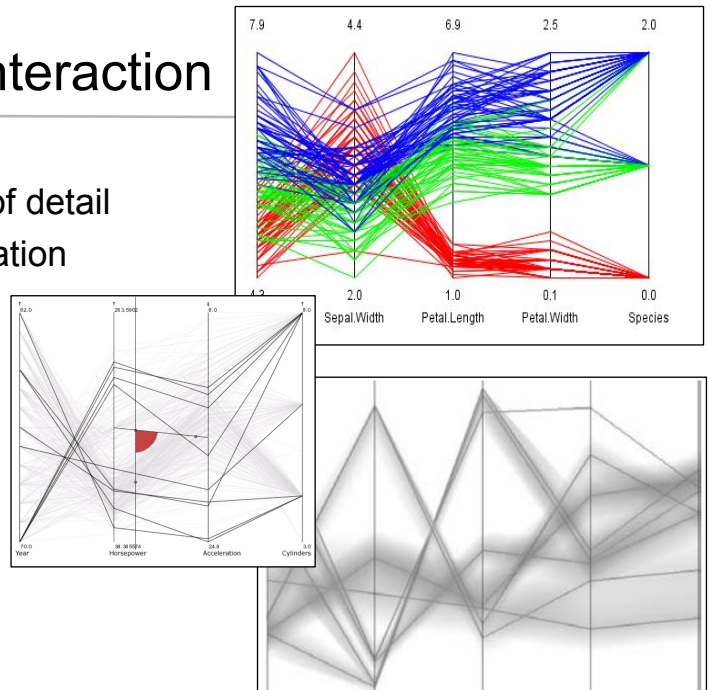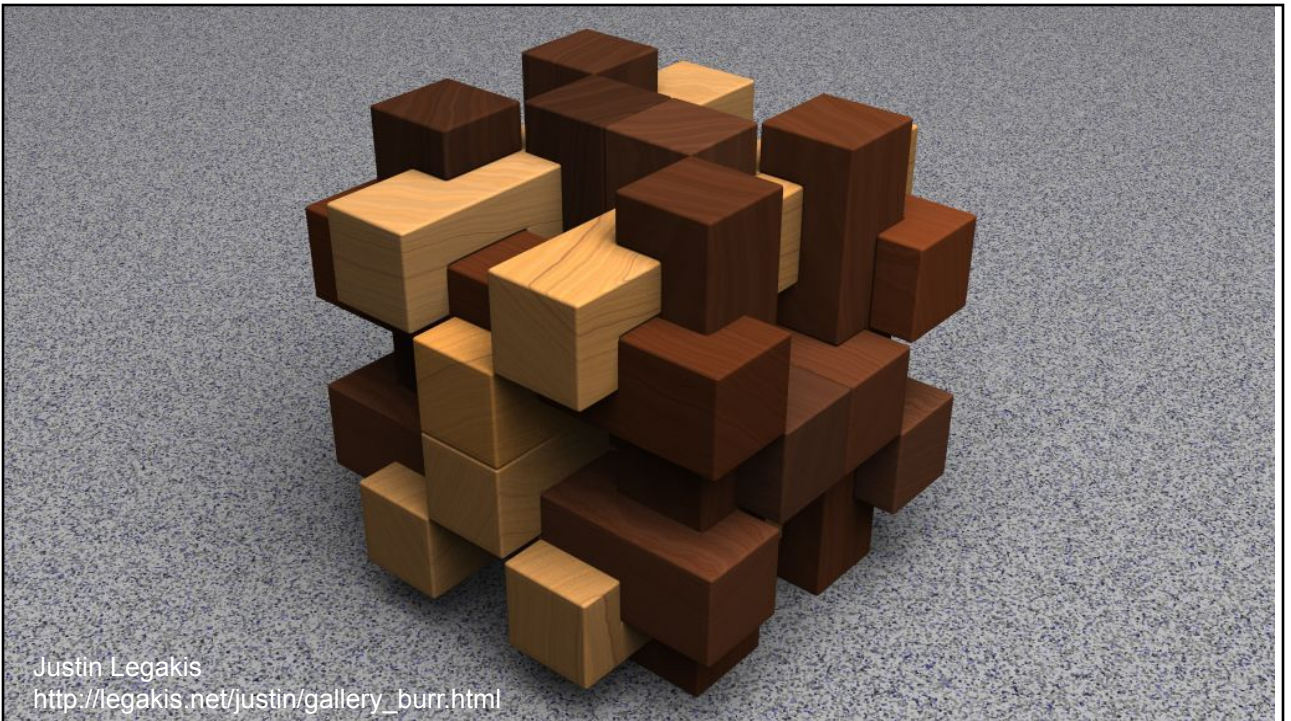

Animations Explaining Mechanical Parts

http://imgur.com/gallery/FvCTr
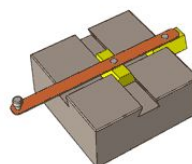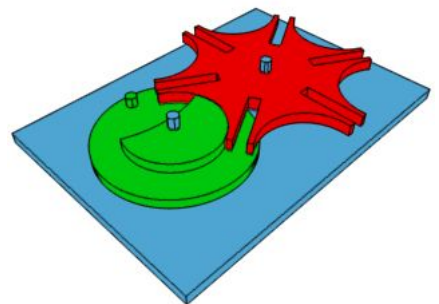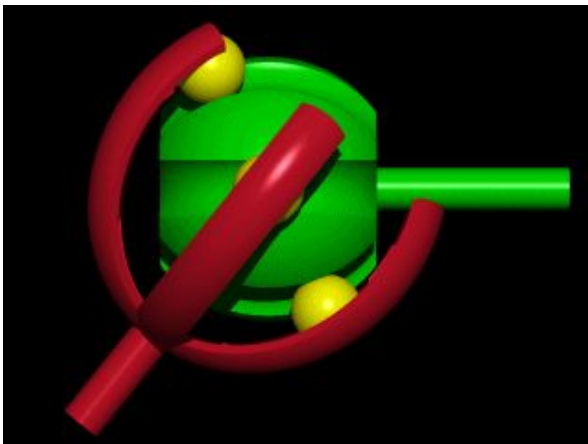
Animation to Explain an Algorithm

http://tholman.com/bezier-curve-simulation/

Justin Legakis
http://legakis.net/justin/gallery_burr.html

Quite Interesting for "Just" a Slider

How Birth Year Influences Political Views

By **AMANDA COX** JULY 7, 2014

How whites born in 1962 have leaned politically over their lives

Born in 1962

'90 '85 '80 '75 '70 '65 '60 '55 '50 '45 '40

At age 10   20   30   40   50   60   70
1972   1982   1992   2002   2012   2022   2032

55%
Republican*

Age 50 in 2012
55% Republican

45%

JOHNSON | NIXON | FORD | CARTER | REAGAN | BUSH | CLINTON | G.W. BUSH | OBAMA
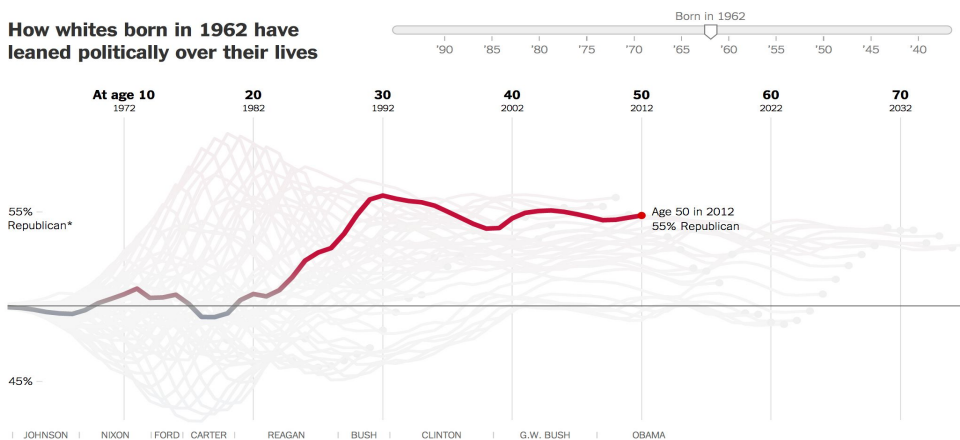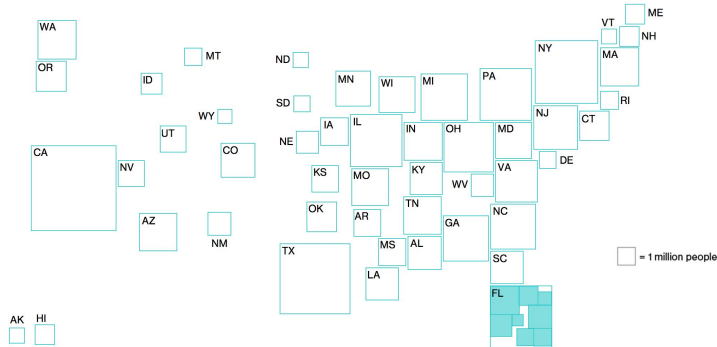
Motion for Attention/Continuity

A Really Small Slice of Americans Get to Decide Who Will Rule the Senate

| 1 | 2 | 3 | 4 | 5 | 6 | **7** | Next |

Put another way: The number of people who'll decide this election will likely be **smaller than the population of Florida**.

= 1 million people

http://www.bloomberg.com/politics/graphics/2014-who-votes-in-midterms/

https://i.imgur.com/Gzsq5HS.jpg

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- "Designing Effective Step-by-step Assembly Instructions" Agrawala, Phan, Heiser, Haymaker, Klingner, Hanrahan, & Tversky, SIGGRAPH 2003

- *Inspired by robotics planning research*
- *Need to solve planning & presentation simultaneously for best result*
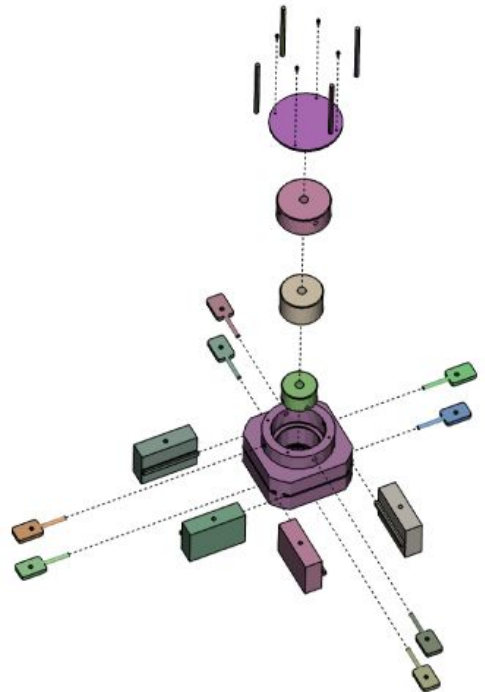
Design Principles for Illustrations

- hierarchy/grouping of parts
- hierarchy of operations
- step by step instructions vs. single diagram
- only 1 significant piece at a time
- structural vs. action diagrams
- present as much information as possible
  - don't repeat, don't be tedious
- orientation, natural & preferred views
  - maximize # of important features visible
  - minimize accidental alignments
- visibility
  - occlusion ok when symmetry is clear
  - earlier parts visible for context
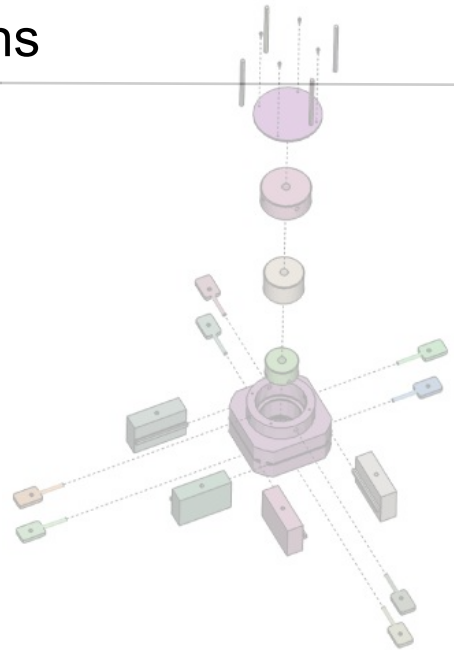
Input/Output/Automated/User-Driven

- Input:
  - geometry, orientation, grouping, ordering constraints
- Automatic:
  - location translational blocking, visibility
  - at each step, "planner" chooses to attach a part or reorient diagram
  - optimization for visibility
  - direction (maximally separate, interference free) & separation distance
  - diagrammatic elements, guidelines (based on bounding box or contact)
- Semi-automated user-driven/interactive editing
  - add grouping
  - add constraints
- Not automatic (yet):
  - structure
 - zoom in/use insets to show small details, e.g., subassemblies
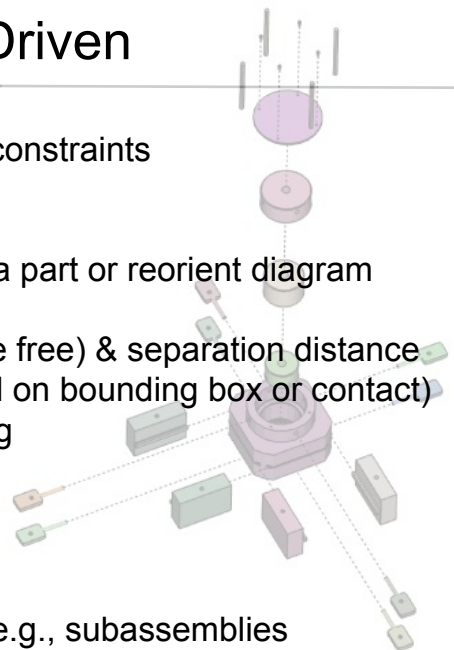
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Reading for Today

- "Interactive Cutaway Illustrations of Complex 3D Models", Li, Ritter, Agrawala, Curless, & Salesin, SIGGRAPH 2007
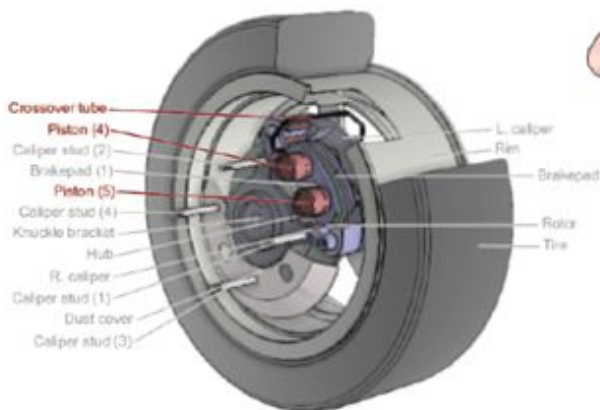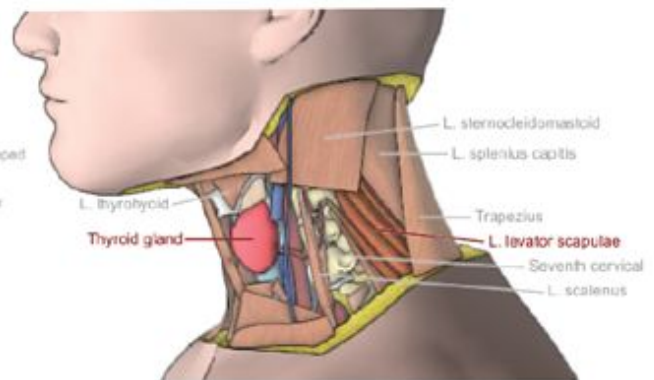
(a) Disk brake   (b) Neck

"Interactive Cutaway Illustrations of Complex 3D Models"

- Authoring interface to prepare model for interactive cutaway visualization
- Improve on naive cutting plane/cross section or simple transparency
- Provide more context for complex interactions between components
- Respect for structure/shape/position of internal components
- Consideration of impact of occlusion / occlusion graph
- Standards/Conventions for volume cuts
- Inset cuts to emphasize layering
- Use of shading/shadows to emphasize important parts
- Automatic Label Layout
- Example application to both CAD and anatomical models

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Frank Lloyd Wright's *Fallingwater*


Frank Lloyd Wright's *Fallingwater*
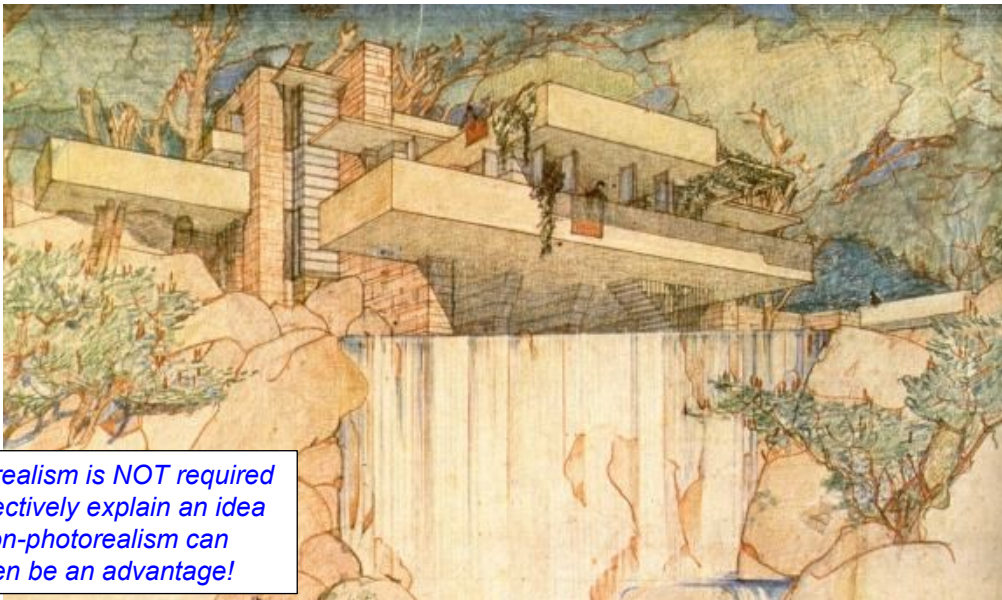
Photorealism is NOT required to effectively explain an idea Non-photorealism can even be an advantage!
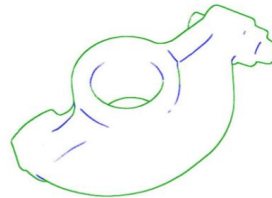
Types of Edges in Line Drawings

contours in original view **c**   contours in nearby view **c′**   suggestive contours and contours in **c**

- Silhouettes/Contours: where normal is perpendicular to the view direction

- Suggestive Contour: inflection points of the surface normal

- Ridges & Valleys: extremum of curvature

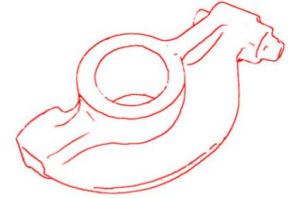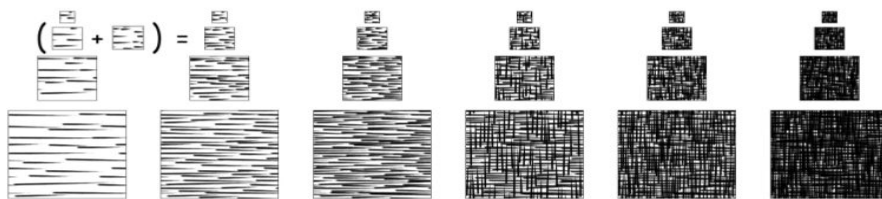- Apparent Ridges: based on *view dependent* curvature
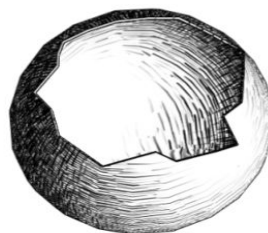
Suggestive Contours for Conveying Shape
DeCarlo et al., SIGGRAPH 2003
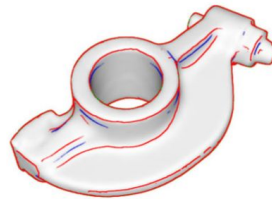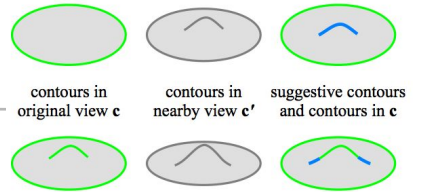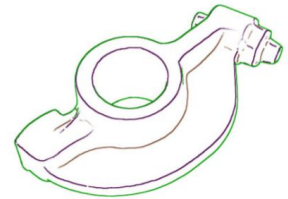
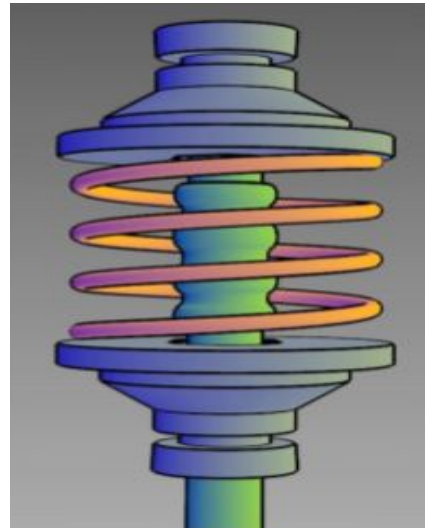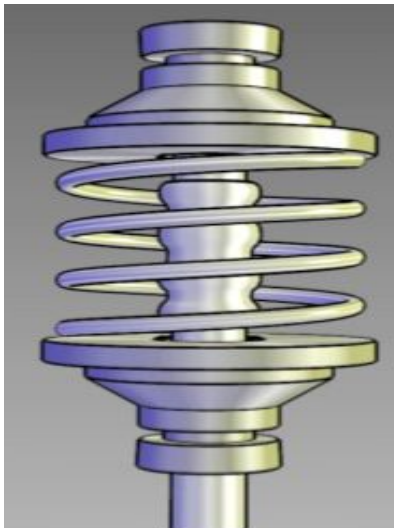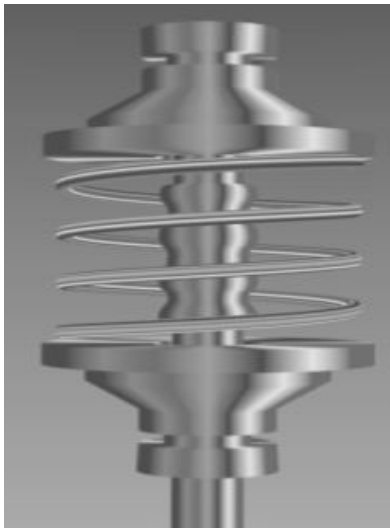Shaded View   Ridges & Valleys   Suggestive Contours   Apparent Ridges

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Real-Time Hatching
Praun, Hoppe, Webb & Finkelstein
SIGGRAPH 2001

Painterly rendering with curved brush strokes of multiple sizes
Hertzmann SIGGRAPH 1998

A non-photorealistic lighting model for automatic technical illustration
Gooch, Gooch, Shirley, & Cohen SIGGRAPH 1998

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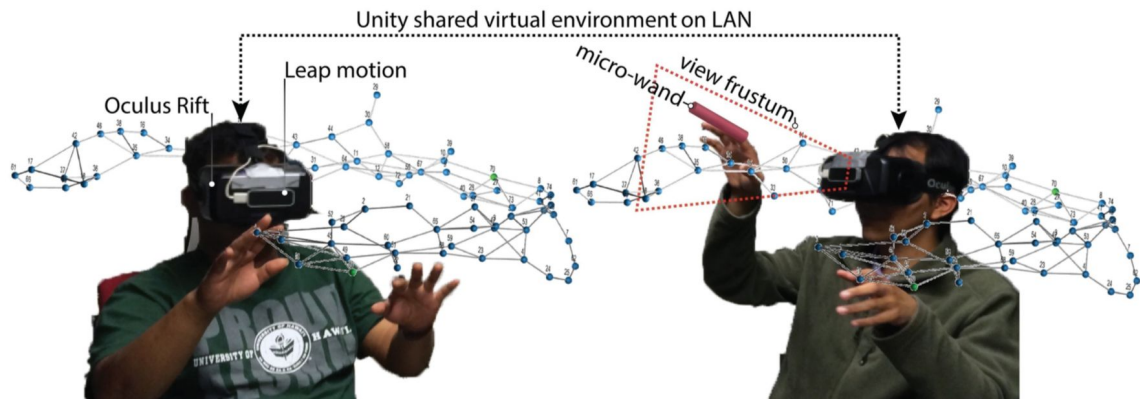- Readings for Friday

Reading for Friday *pick one*

- "Interactive Visualization on Large and Small Displays: The Interrelation of Display Size, Information Space, and Scale", Jakobsen and Hornbaek, IEEE Visualization 2013
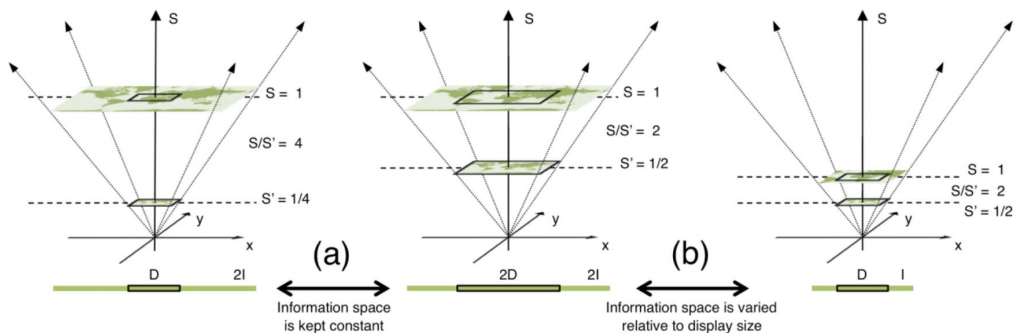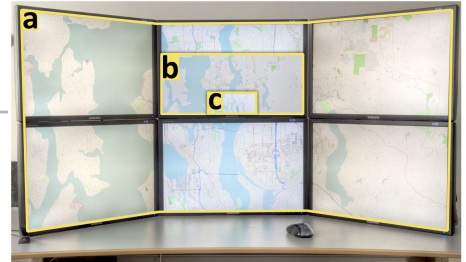
Reading for Friday *pick one*

- "Immersive Collaborative Analysis of Network Connectivity: CAVE-style or Head-Mounted Display?", Cordeil, Dwyer, Klein, Laha, Marriott, Thomas, IEEE InfoVis 20

Reading for Friday *pick one*

- "Walking > Walking-in-Place > Flying, in Virtual Environments", Usoh, Arthur, Whitton, Bastos, Steed, Slater, & Brooks, SIGGRAPH 1999