Lecture 3: Focus+Context

Information Visualization
CPSC 533C, Fall 2007

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Papers Covered

A Review and Taxonomy of Distortion-Oriented Presentation Techniques. Y.K. Leung and M.D. Apperley, ACM Transactions on Computer-Human Interaction, Vol. 1, No. 2, June 1994, pp. 126-160. [http://www.ai.mit.edu/people/jimmylin/papers/Leung94.pdf]

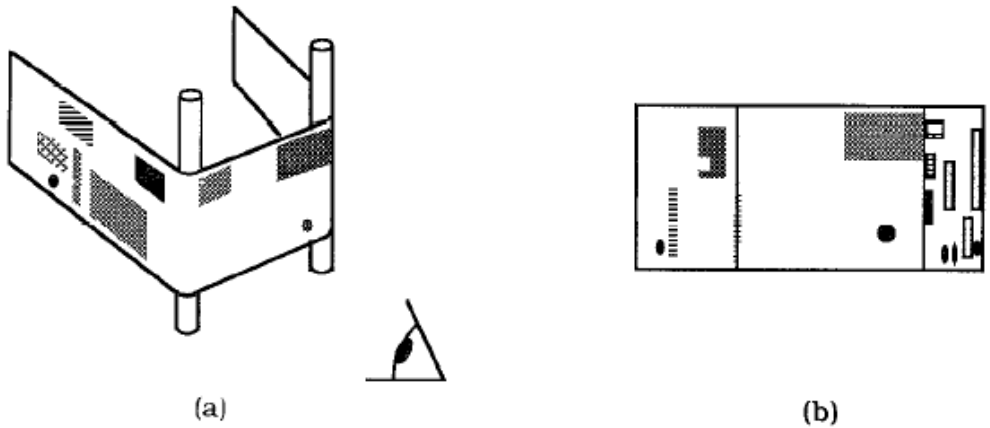
A Fisheye Follow-up: Further Reflection on Focus + Context. George W. Furnas. SIGCHI 2006.

The Hyperbolic Browser: A Focus + Context Technique for Visualizing Large Hierarchies. John Lamping and Ramana Rao, Proc SIGCHI '95. [http://citeseer.nj.nec.com/lamping95focuscontext.html]

SpaceTree: Supporting Exploration in Large Node Link Tree, Design Evolution and Empirical Evaluation. Catherine Plaisant, Jesse Grosjean, and Ben B. Bederson. Proc. InfoVis 2002. ftp://ftp.cs.umd.edu/pub/hcil/Reports-Abstracts-Bibliography/2002-05html/2002-05.pdf
TreeJuxtaposer: Scalable Tree Comparison using Focus+Context with Guaranteed Visibility. Munzner, Guimbretiere, Tasiran, Zhang, and Zhou. SIGGRAPH 2003. [http://www.cs.ubc.ca/~tmm/papers/tj/]

Focus+Context Intuition

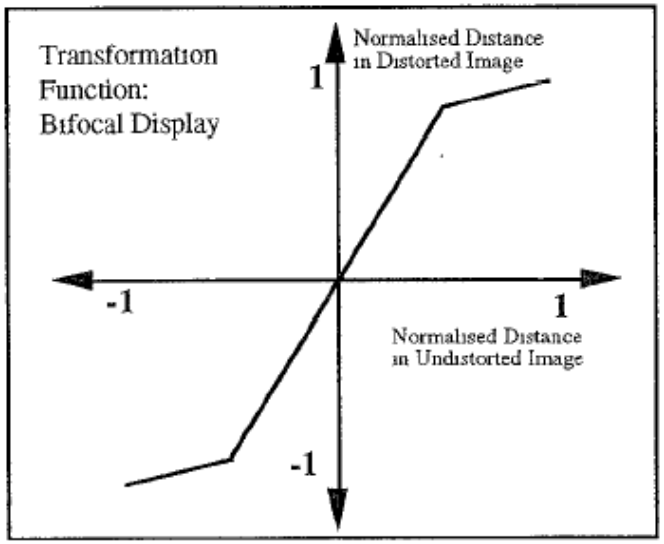
- move part of surface closer to eye



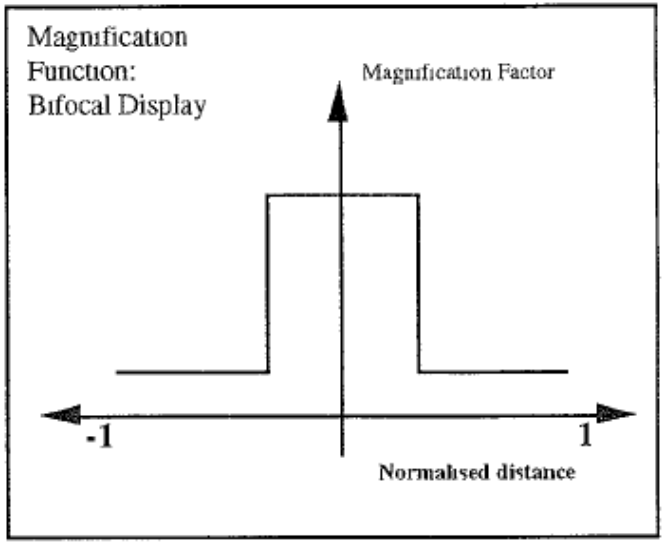
- stretchable rubber sheet
- borders tacked down
- merge overview and detail into combined view

Bifocal Display

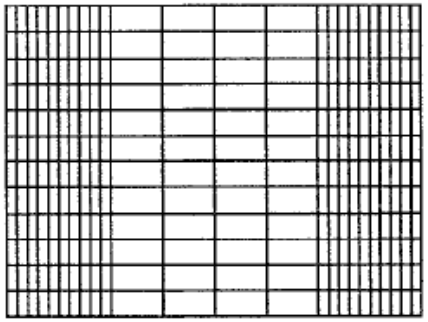
transformation



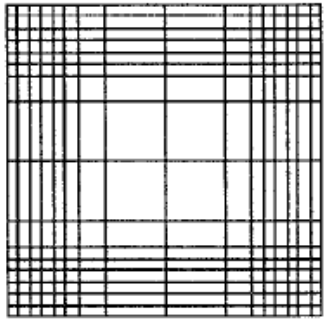
magnification



1D

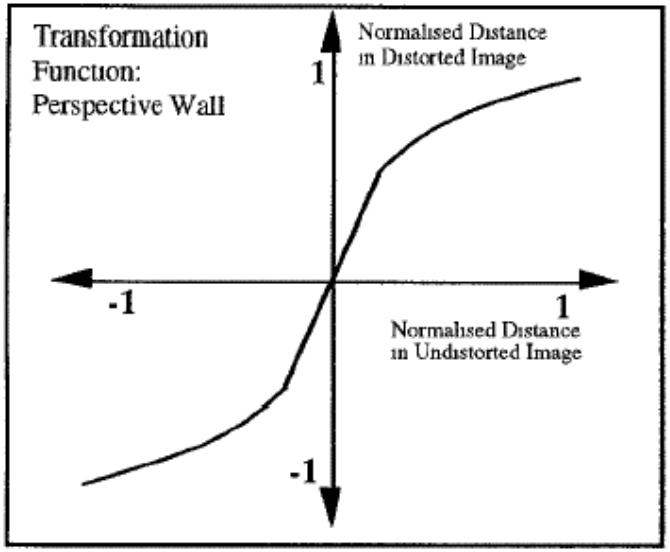


2D

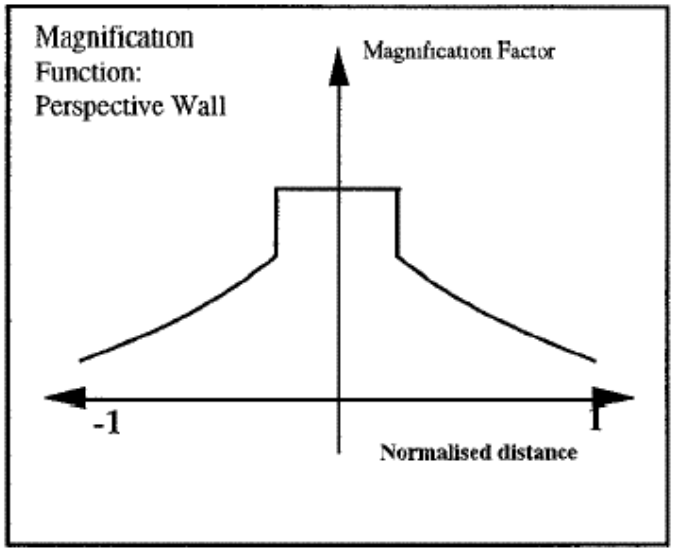


Perspective Wall

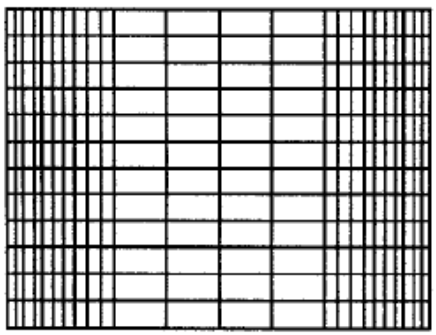
transformation



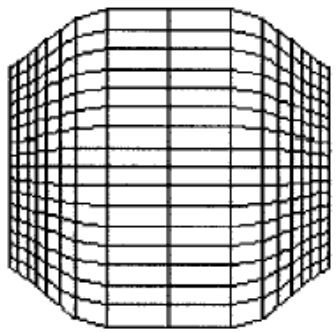
magnification



1D

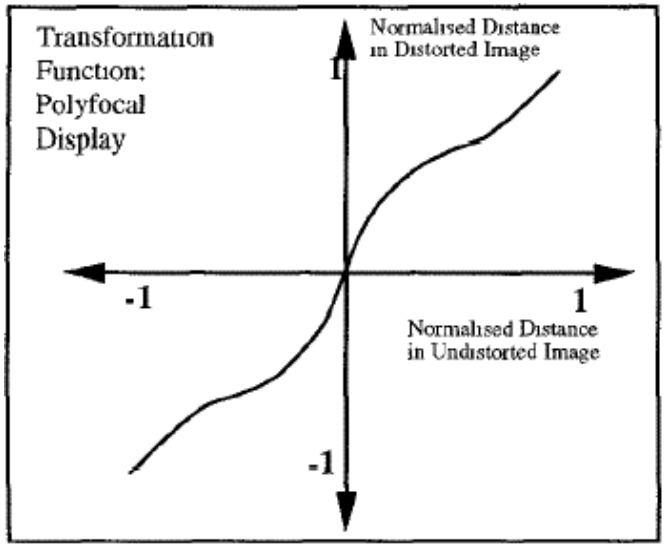


2D

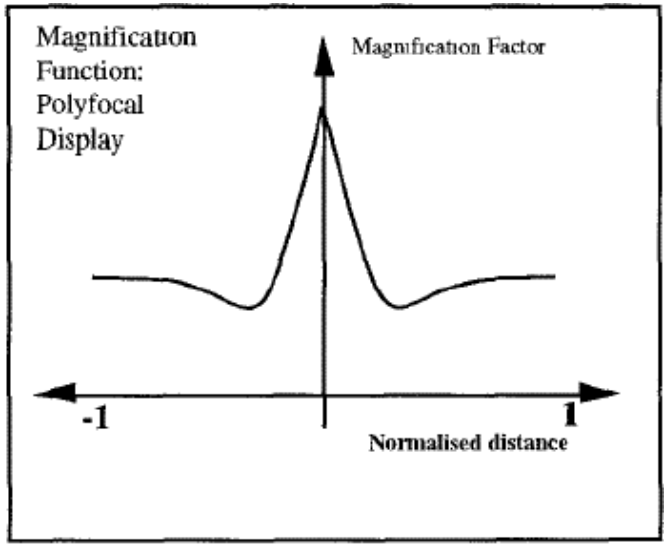


Polyfocal: Continuous Magnification

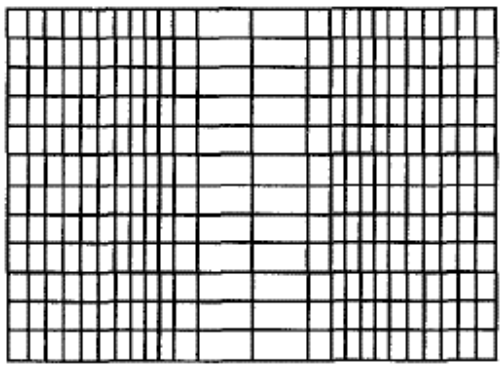
transformation



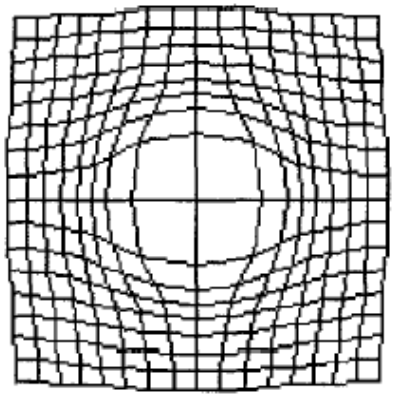
magnification



1D

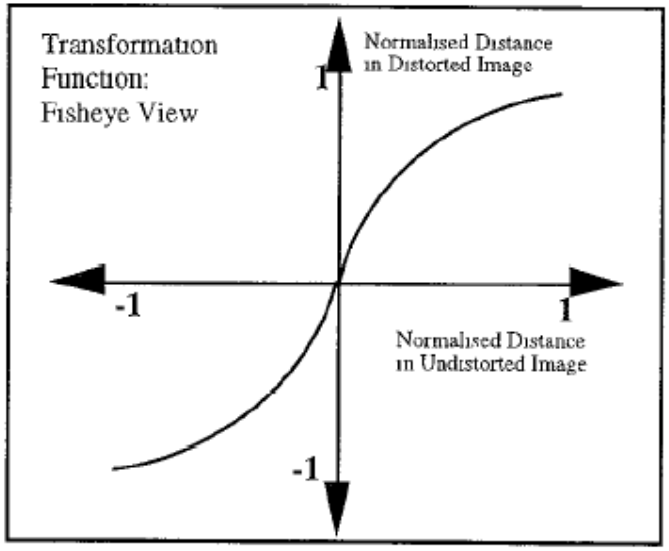


2D

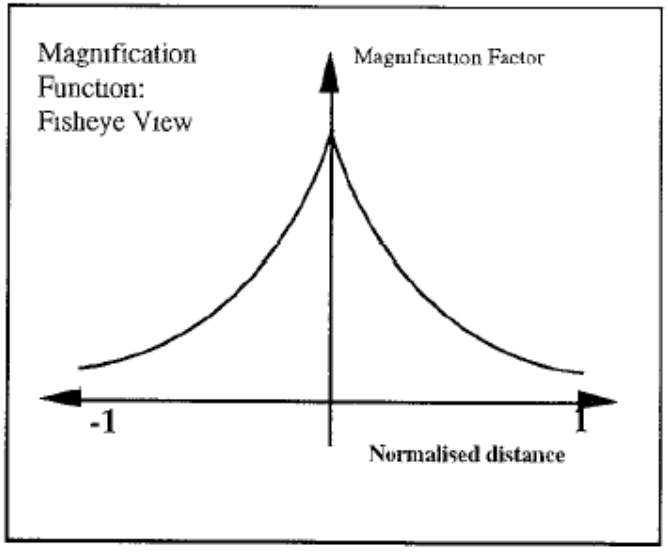


Fisheye Views: Continuous Mag

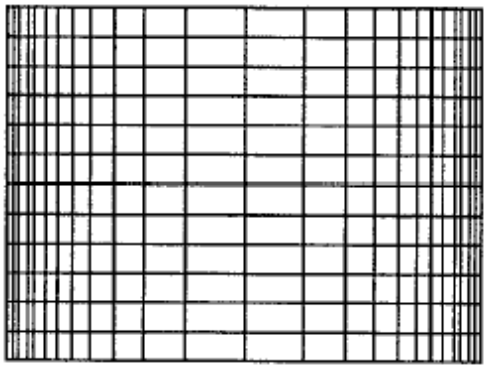
transformation



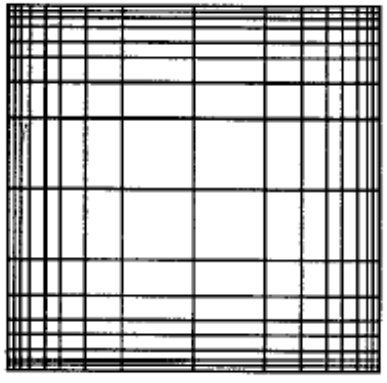
magnification



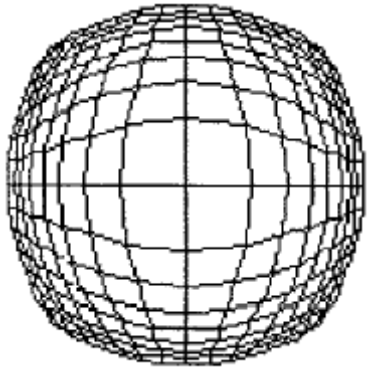
1D



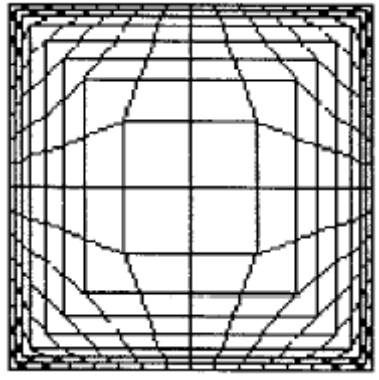
2D rect



polar

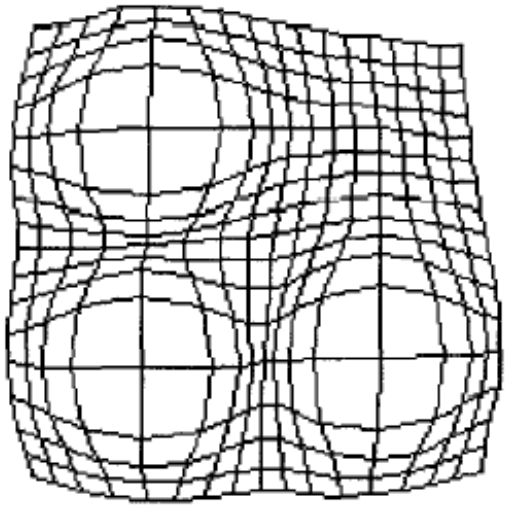


norm polar

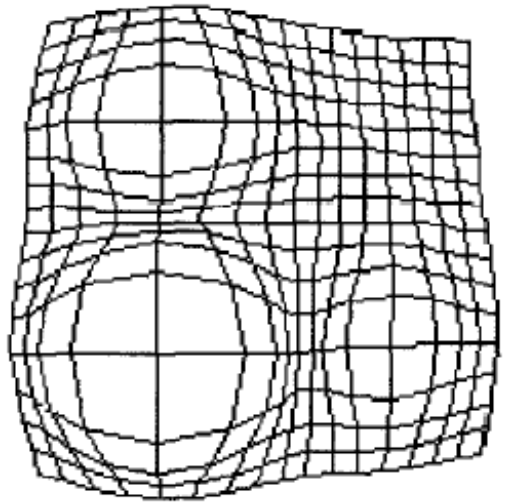


Multiple Foci

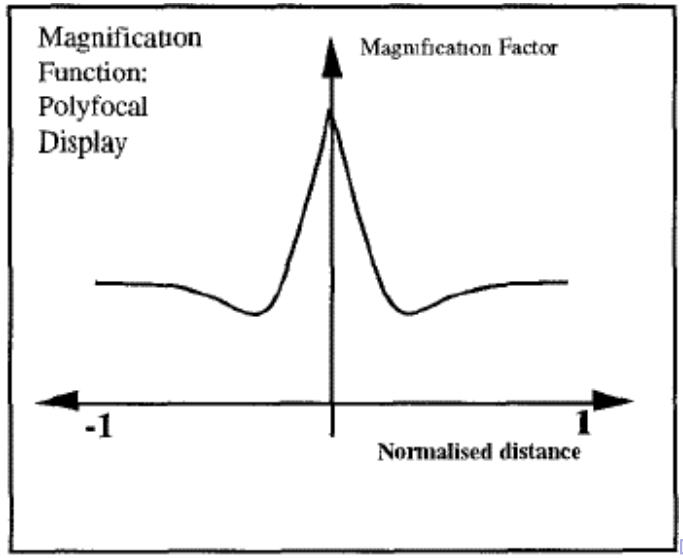
same params



diff params



polyfocal magnification function dips allow this

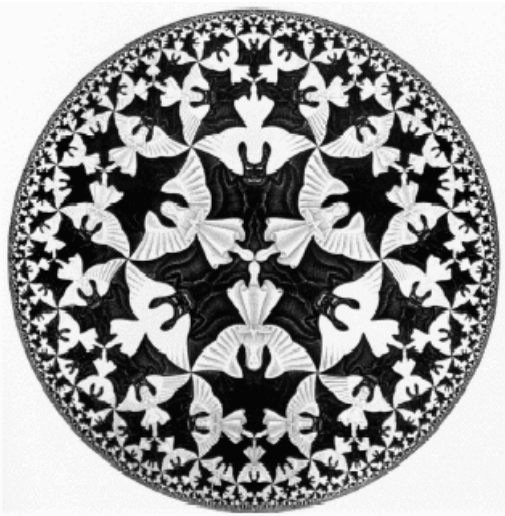


Fisheye Followup

- degree of interest (DOI): a priori importance (API), distance (D)
  - distortion vs. selection
  - agnostic to geometry
- what is shown vs. how it is shown
- how shown
  - geometric distortion: TrueSize as implicit API
  - ZUIs: temporal/memory harder than side by side
  - multiple views: topological discontinuity at edges
  - multires displays: big and heavy...

2D Hyperbolic Trees

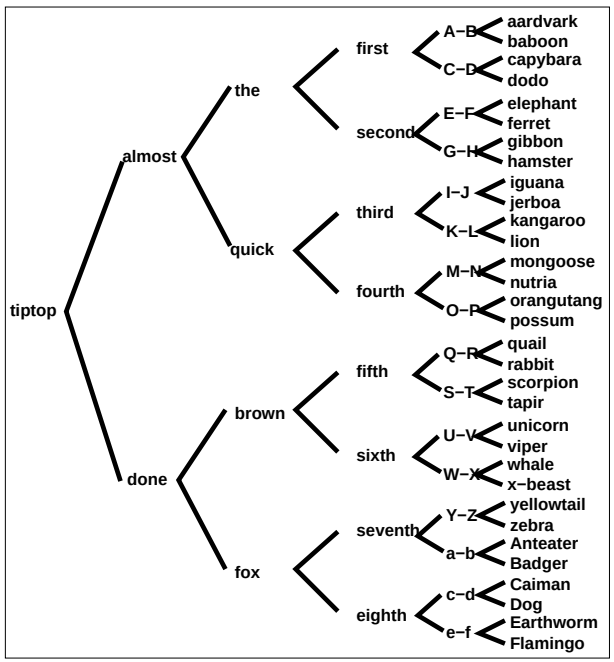
- static structure, allowing distance defn
- LOD/API at points within structure
- interaction focused at point/region
- fisheye effect from hyperbolic geometry



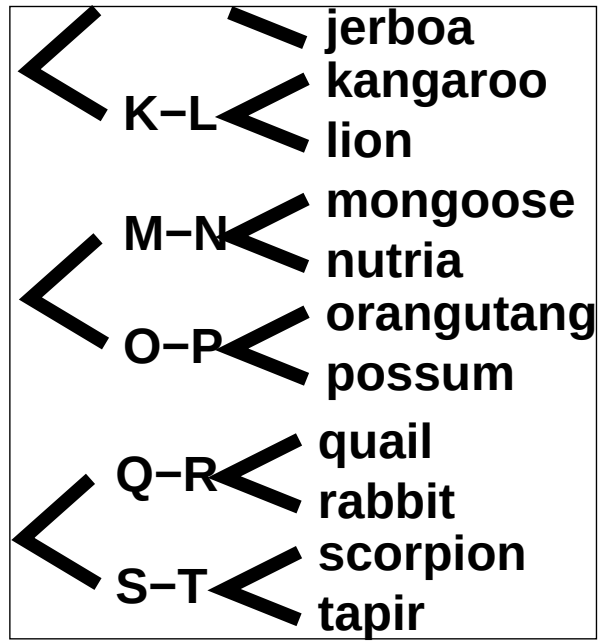
Avoiding Disorientation

- problem
  - maintain user orientation when showing detail
  - hard for big datasets
- exponential in depth
  - node count, space needed

global overview

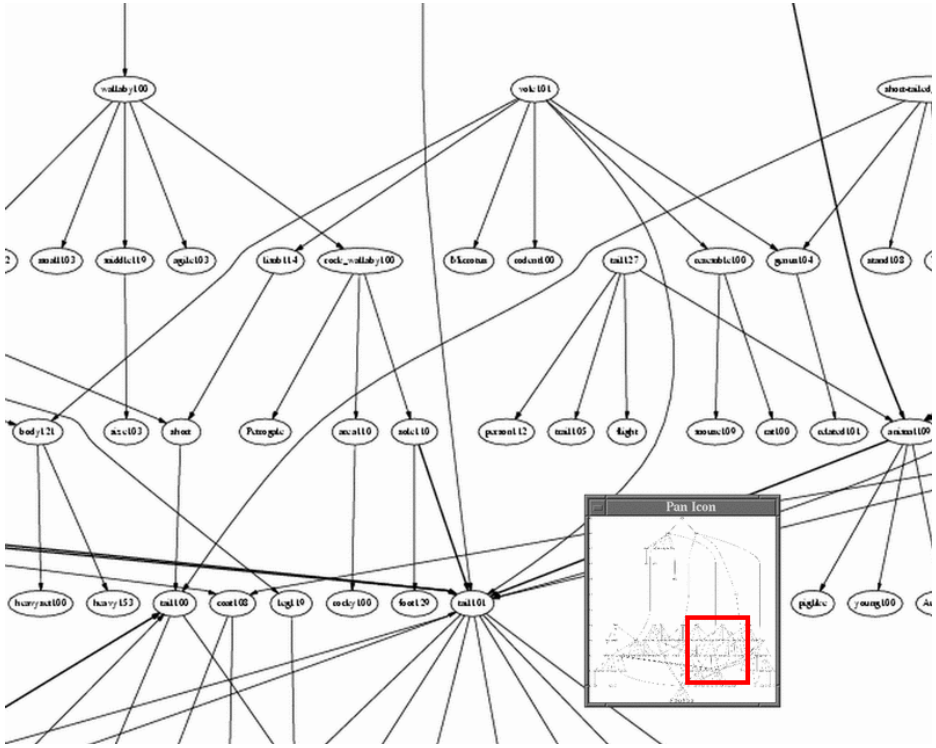


local detail



Overview and detail

- two windows: add linked overview
  - cognitive load to correlate



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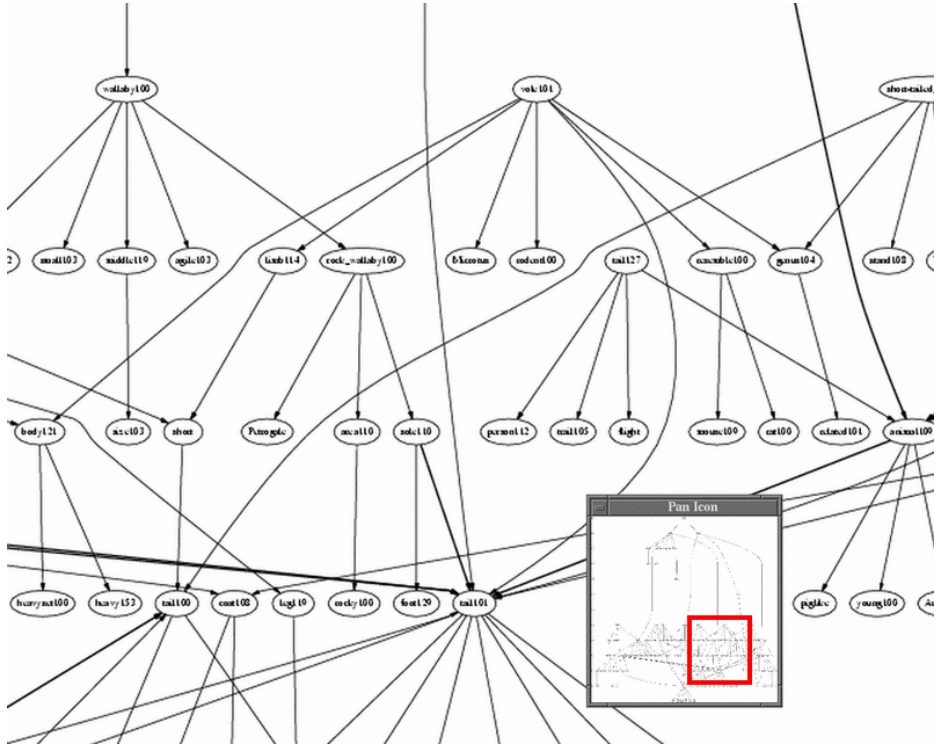
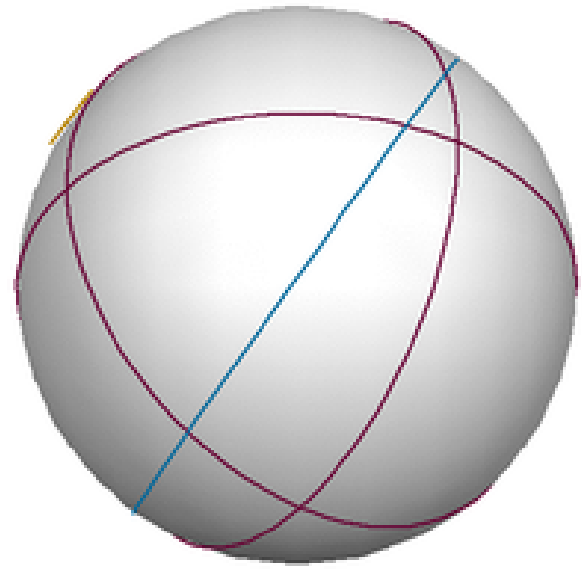


- solution
  - merge overview, detail
  - focus+context

Noneuclidean Geometry

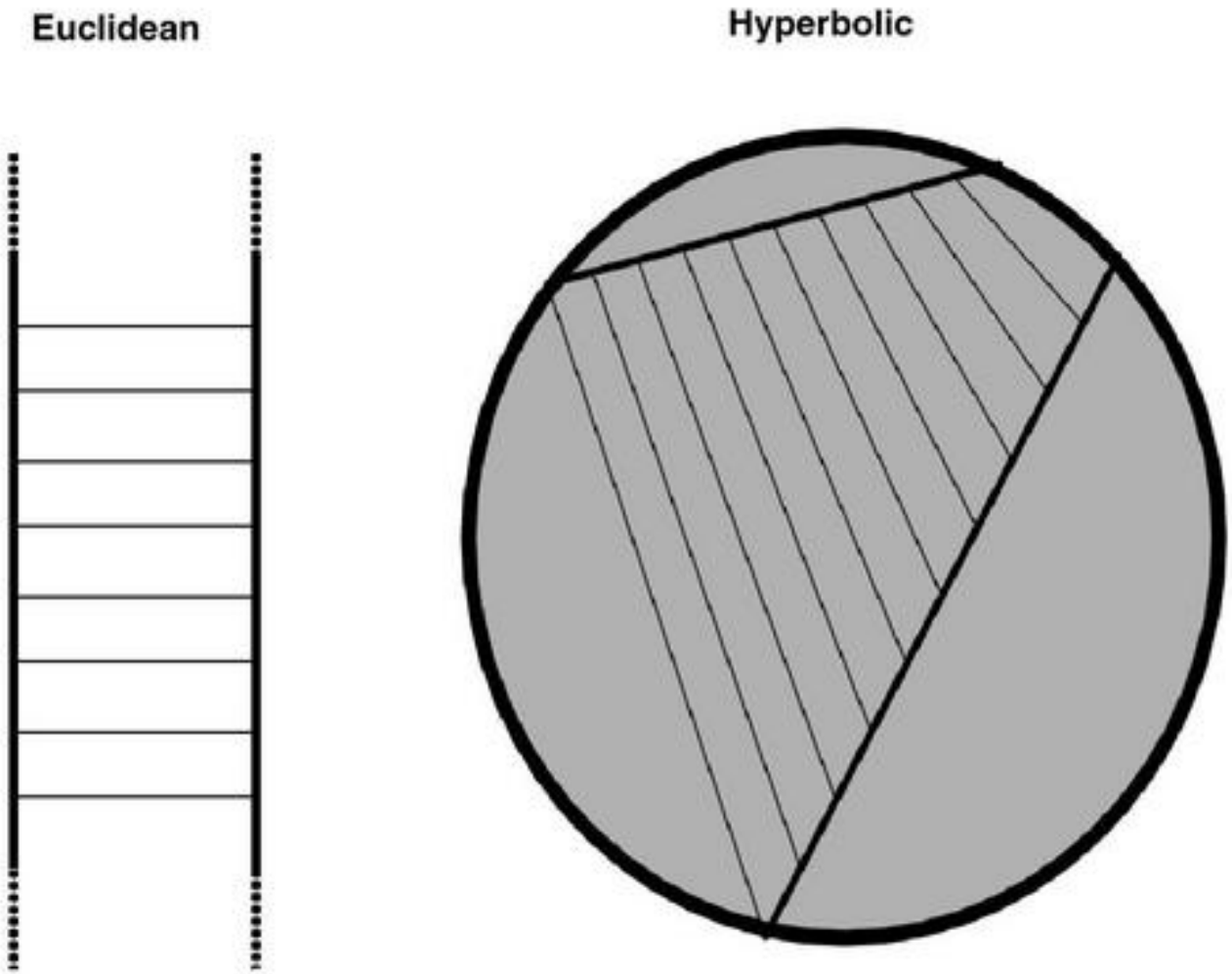
- Euclid's 5th Postulate
  - exactly 1 parallel line
- spherical
  - geodesic = great circle
  - no parallels
- hyperbolic
  - infinite parallels



(torus.math.uiuc.edu/jms/java/dragsphere)

Parallel vs. Equidistant

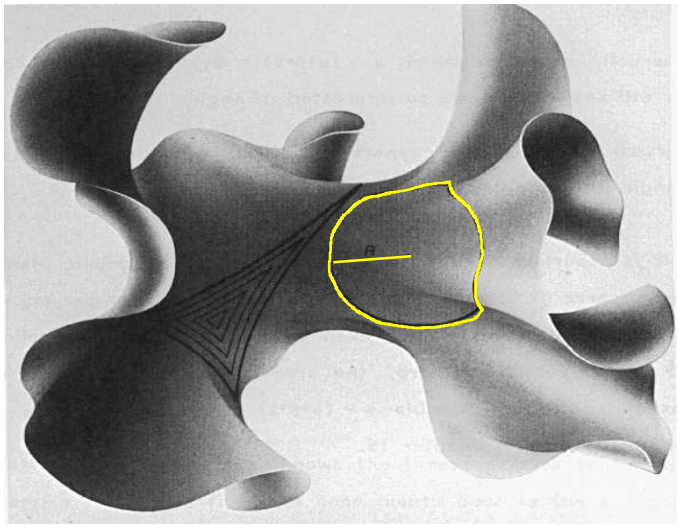
- euclidean: inseparable
- hyperbolic: different



Exponential Amount Of Room

room for exponential number of tree nodes

2D hyperbolic plane
embedded in 3D space



[Thurston and Weeks 84]

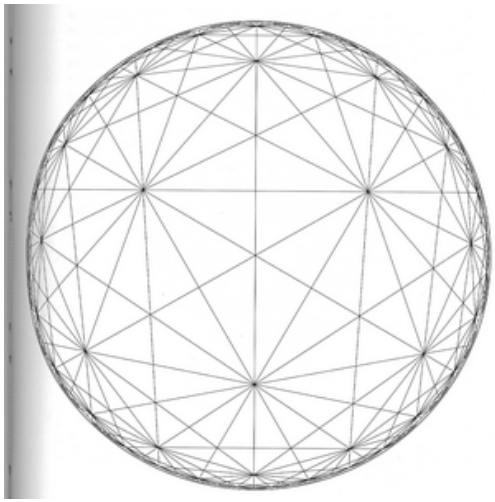
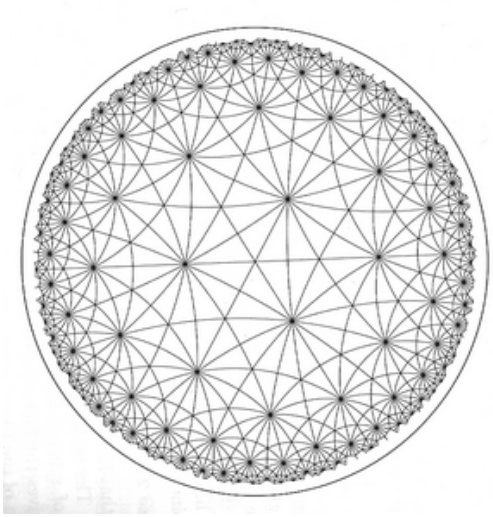
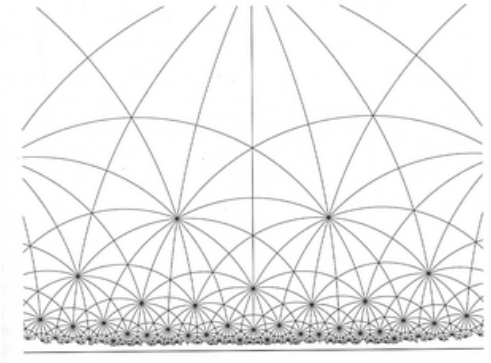
hemisphere area

hyperbolic: exponential
$2\pi \sinh^2 r$

euclidean: polynomial
$2\pi r^2$

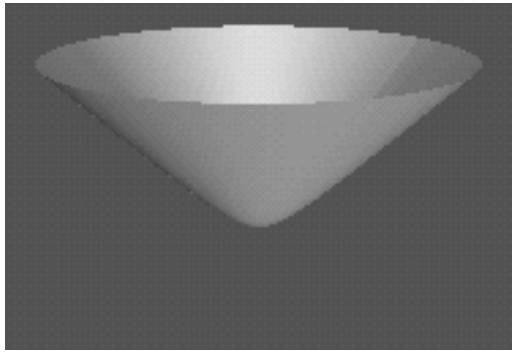
Models, 2D

Klein/projective Poincare/conformal Upper Half Space

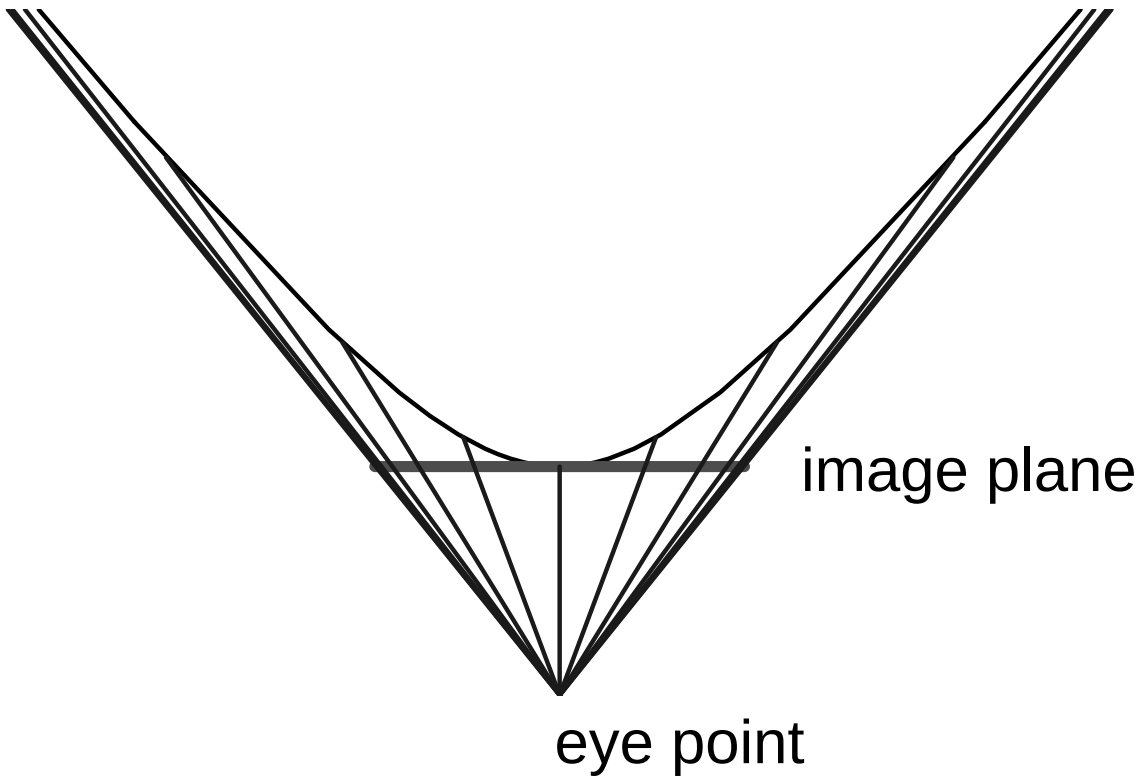
[Three Dimensional Geometry and Topology, William Thurston, Princeton University Press]

Minkowksi



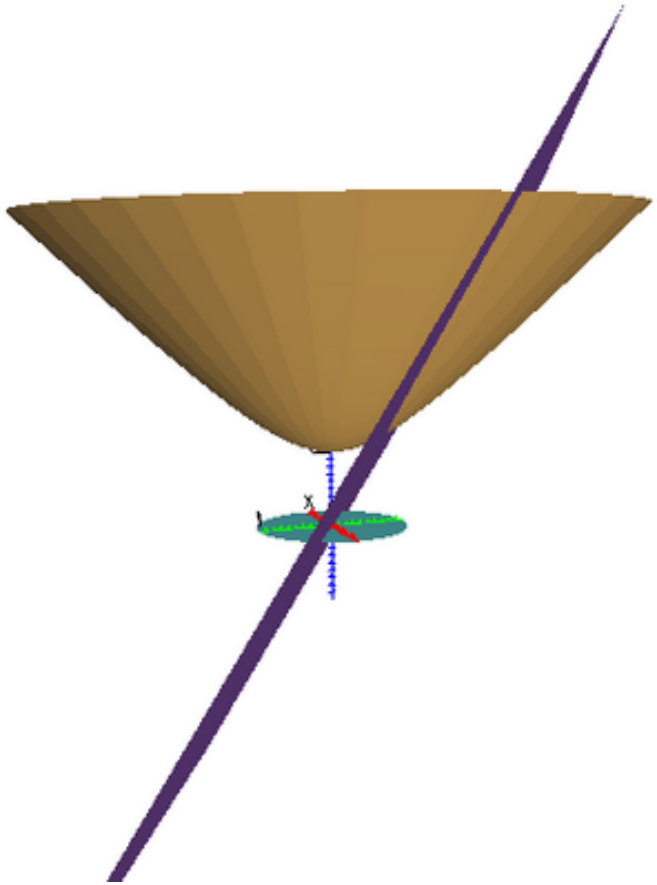
1D Klein

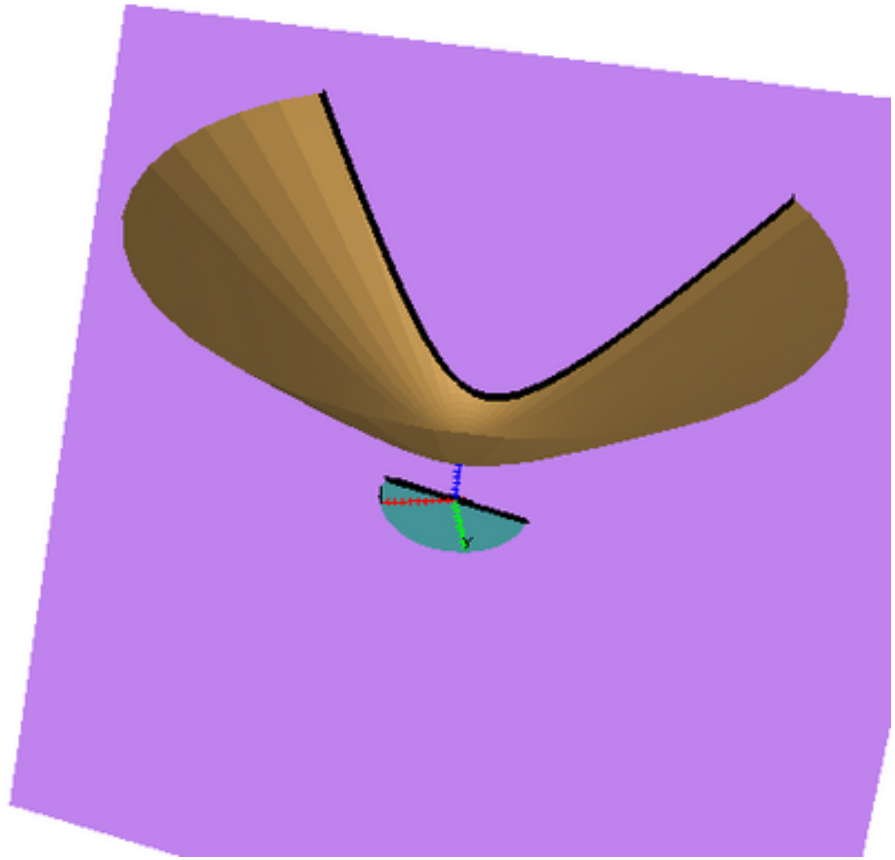
hyperbola projects to line



2D Klein

hyperbola projects to disk





(graphics.stanford.edu/papers/munzner_thesis/html/node8.html#hyp2Dfig)

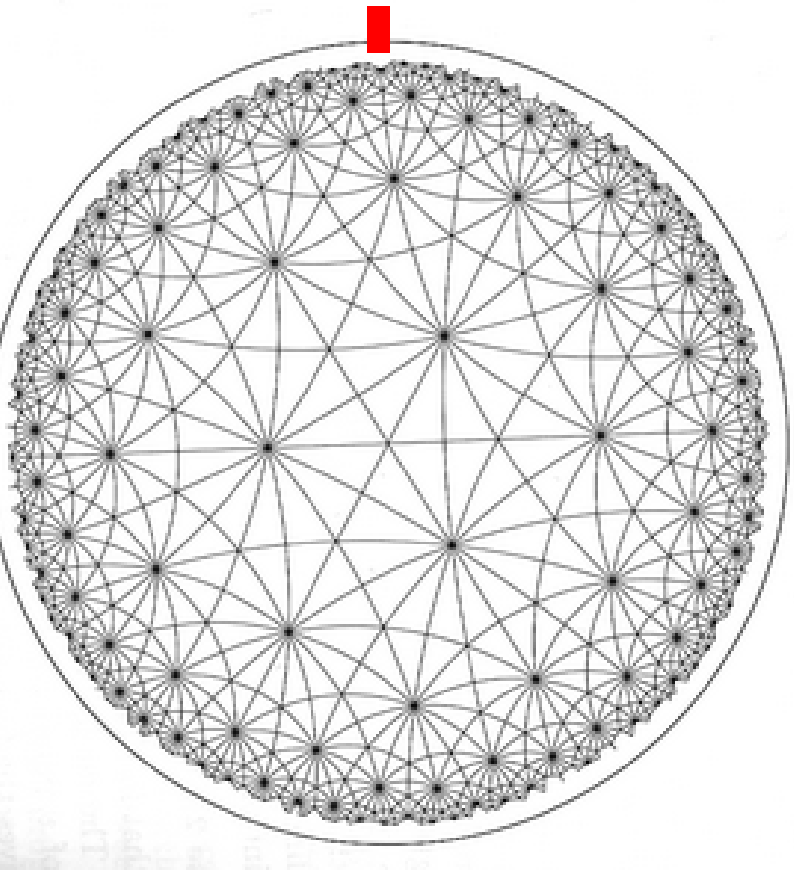
Klein vs Poincare

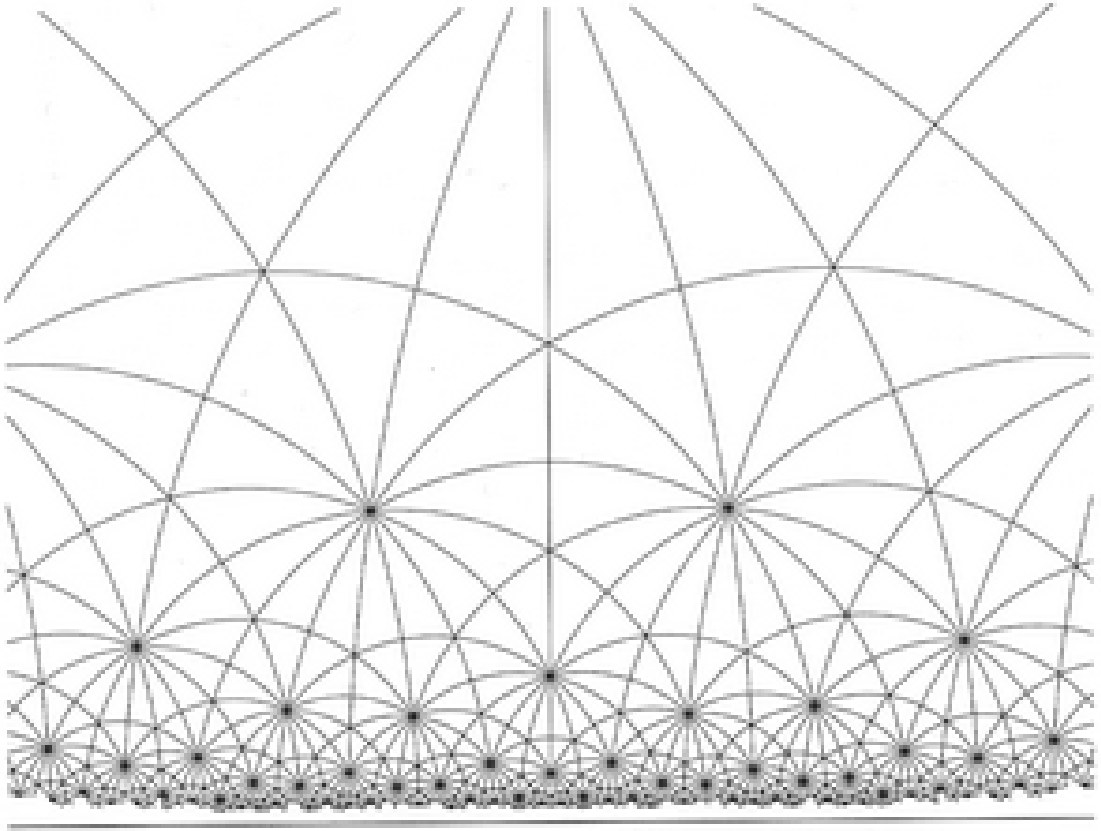
- Klein
  - straight lines stay straight
  - angles are distorted
- Poincare
  - angles are correct
  - straight lines curved

- graphics
  - Klein: 4x4 real matrix
  - Poincare: 2x2 complex matrix

Upper Half Space

- cut and unroll Poincare
  - one point on circle goes to infinity

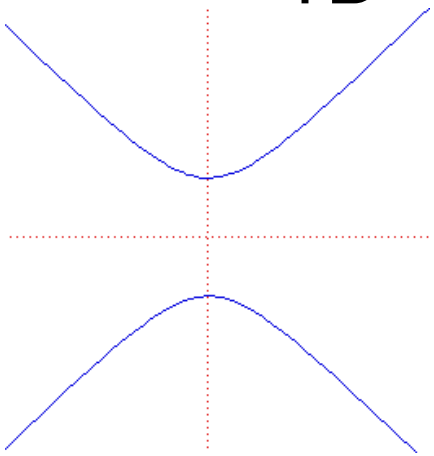




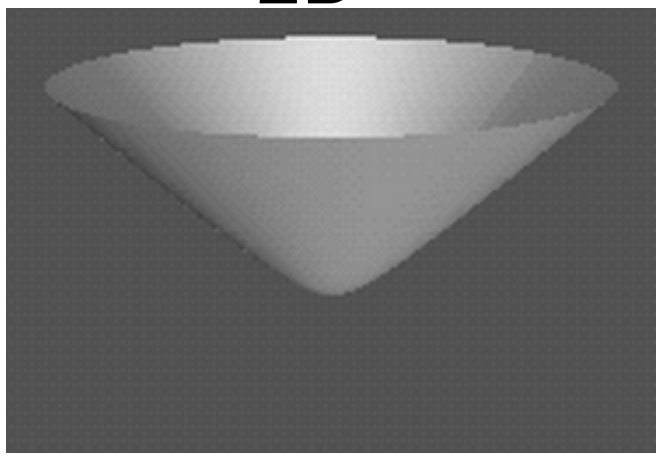
[demo: www.geom.umn.edu/~crobles/hyperbolic/hypr/modl/uhp/uhpjava.html]

Minkowski

1D



2D



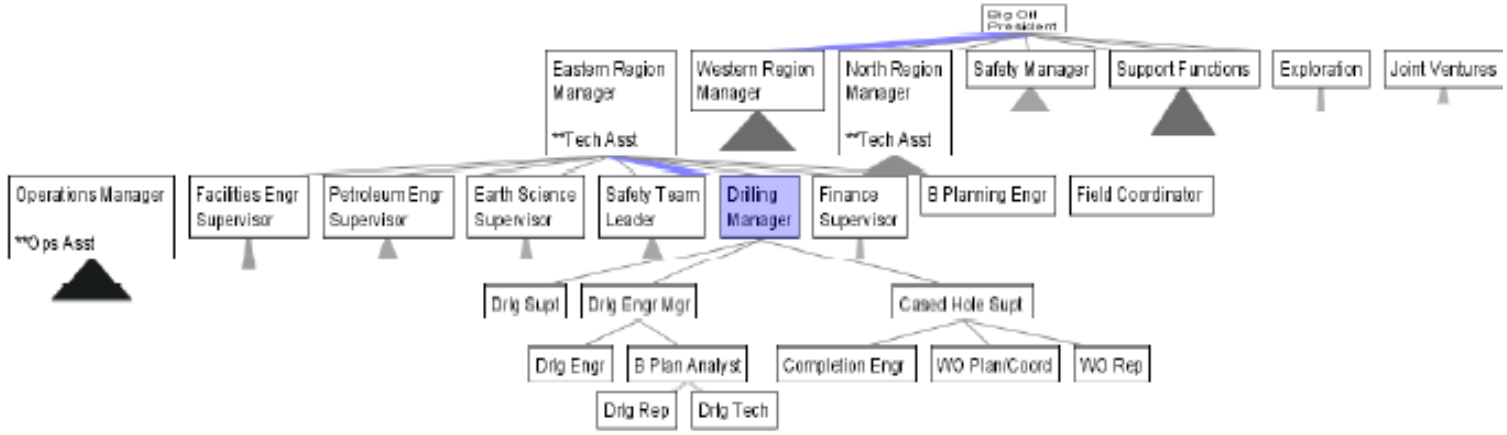
[www-gap.dcs.st-and.ac.uk/˜history/Curves/Hyperbola.html]

[www.geom.umn.edu/˜crobles/hyperbolic/hypr/modl/mnkw/]

the hyperboloid itself embedded one dimension higher

SpaceTree

- focus+context tree: filtering, not geometric distortion
  - animated transitions



- semantic zooming

- demo