

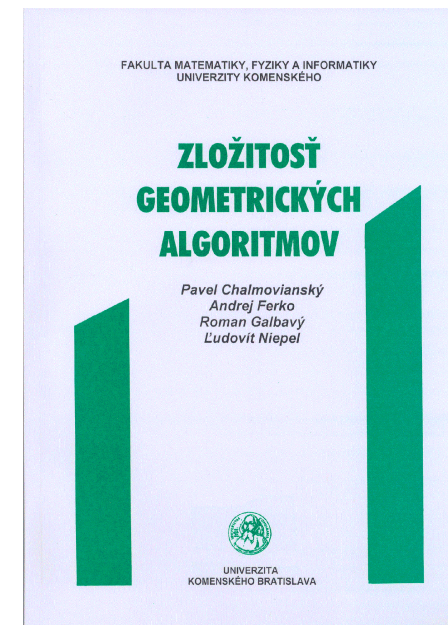
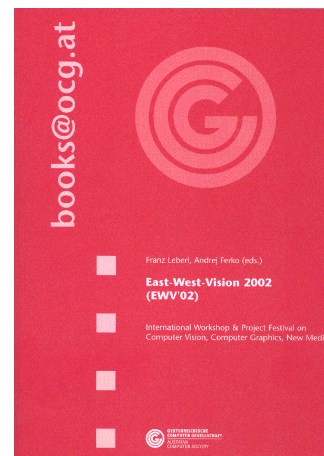
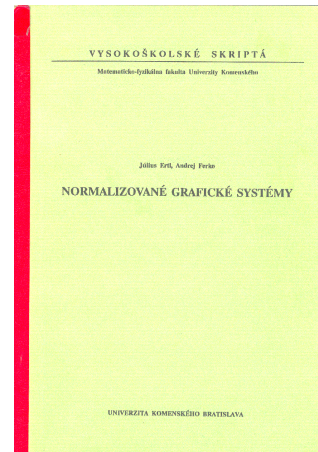
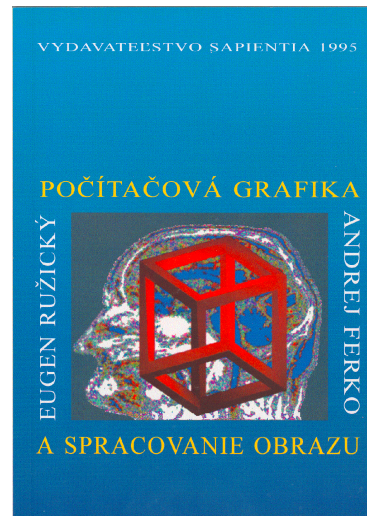
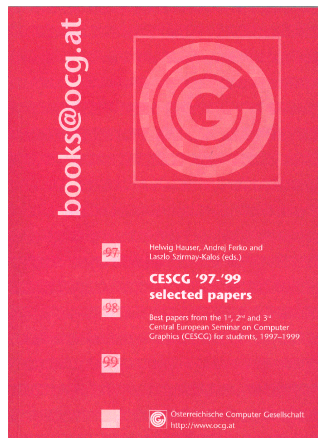
Computer Graphics

Motivation and Introduction



Andrej FERKO
Comenius University Bratislava
May 2006, online

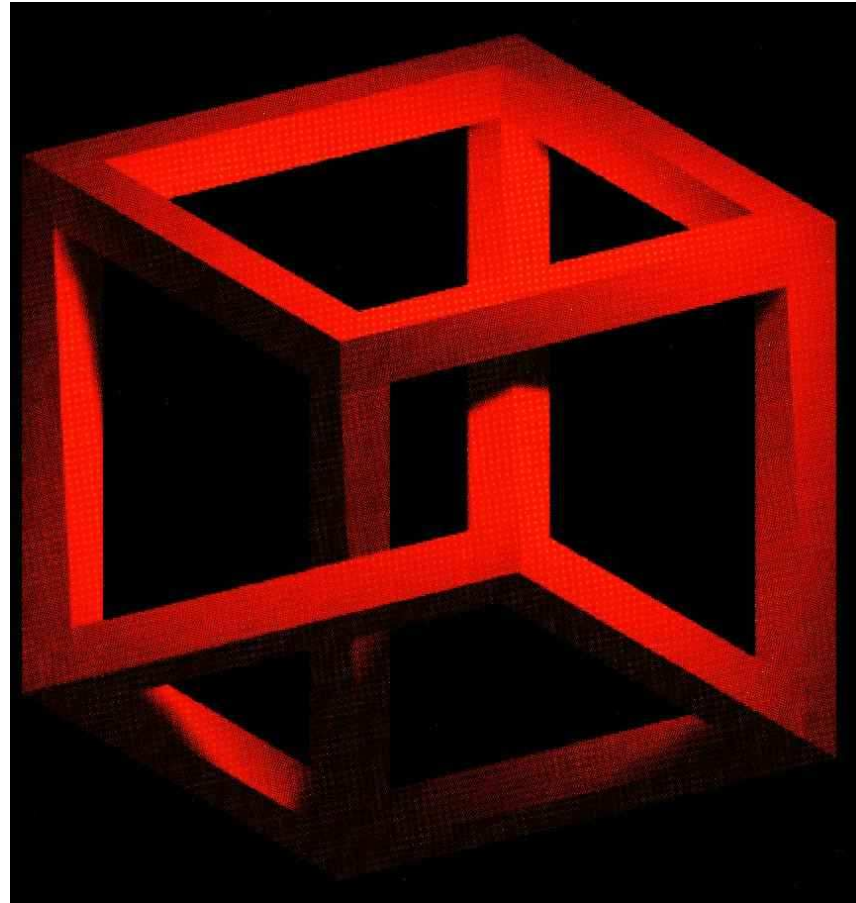
Background: Bratislava & Graz



Agenda

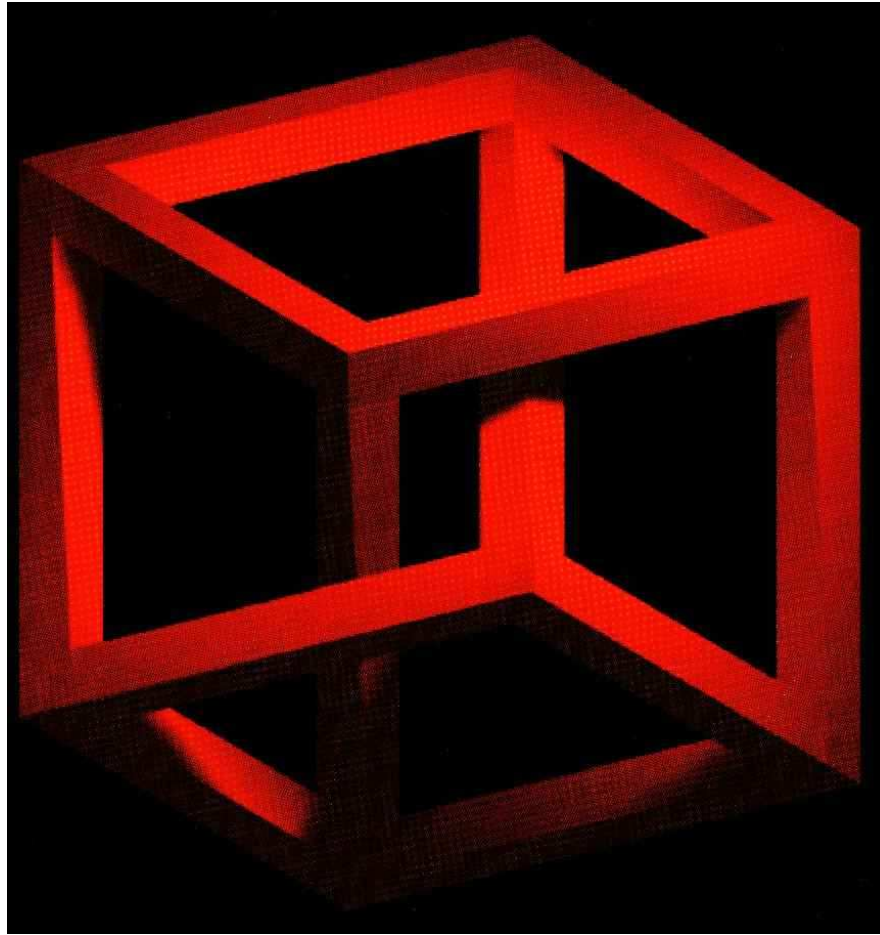
- **1. Introduction & Motivation**
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- **4. What Is Possible?**
- **5. Conclusions**
- **...**

Does this exist ?

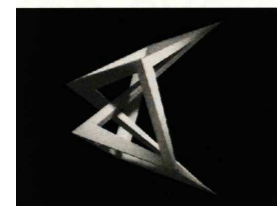
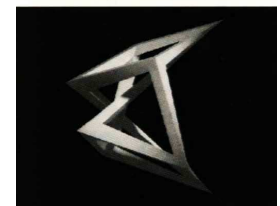
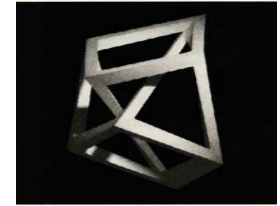
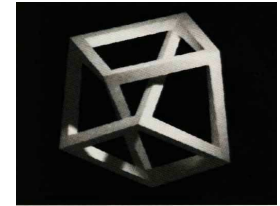


• $\exists?$

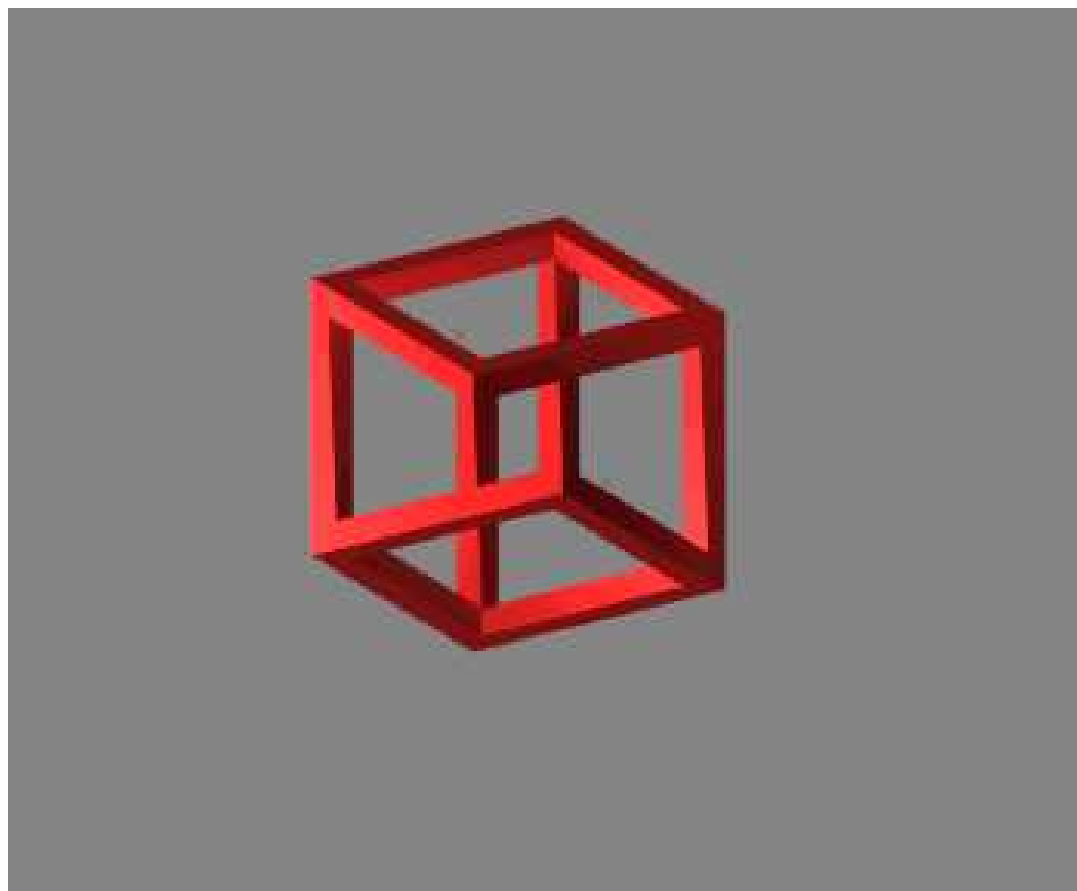
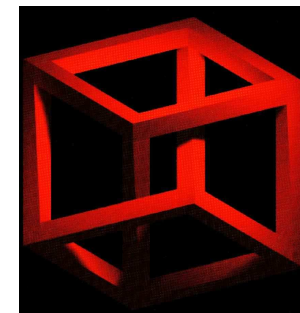
KUBOID by P. Eliáš



- E!



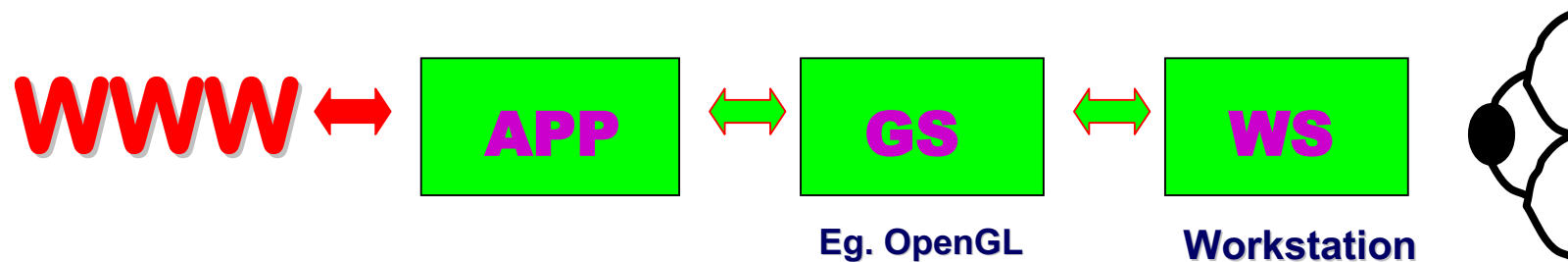
KUBOID by P. Eliáš



- <http://www.dunako.com/pavol/cuboid/>

Communication Interfaces

- Author - Application Programmer - GS Author - User

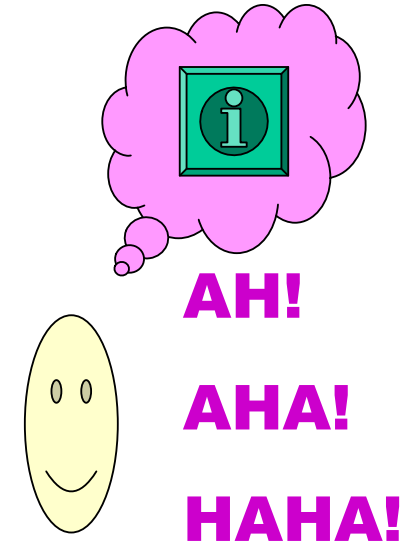


- What is interesting for users?

Ambiguity Interesting Unlimited

- Communication

A
S
H

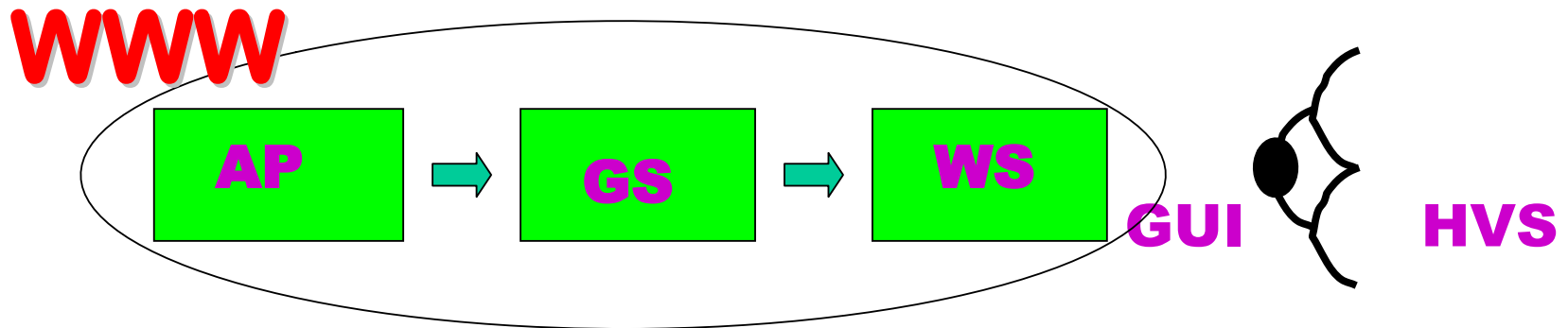


- Arthur KOESTLER, 1964

Web Graphics

- Human visual system fed through GUI perceives the content dominantly through web pages

-

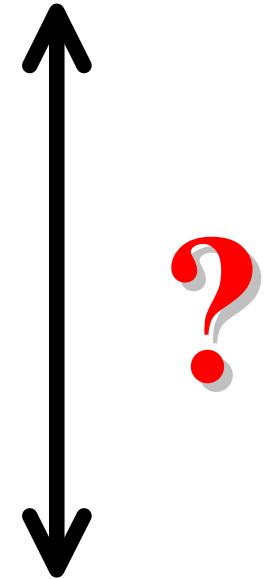


Parallel Use of Space in Graz...

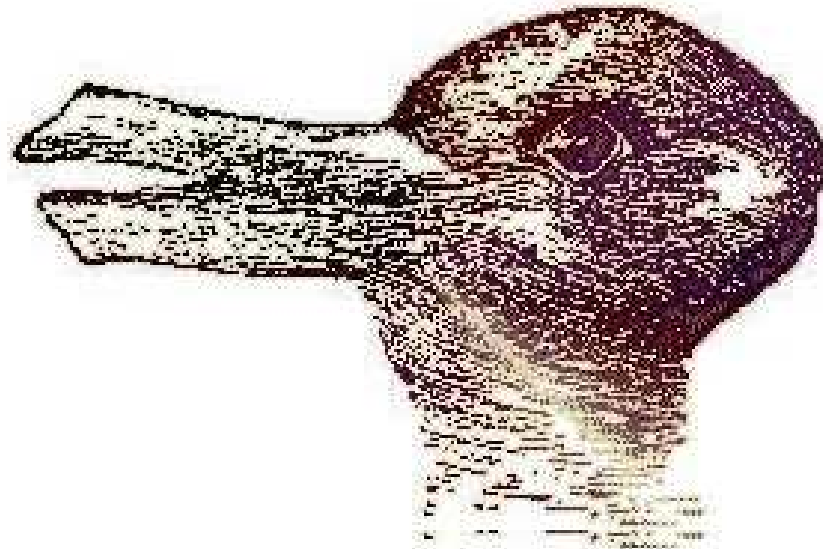


- Real world photo by A. F., Graz 2001

Where is the Ambiguity? (Very Individual)



Where is the Ambiguity?



A Rabbit.... Or A Duck?

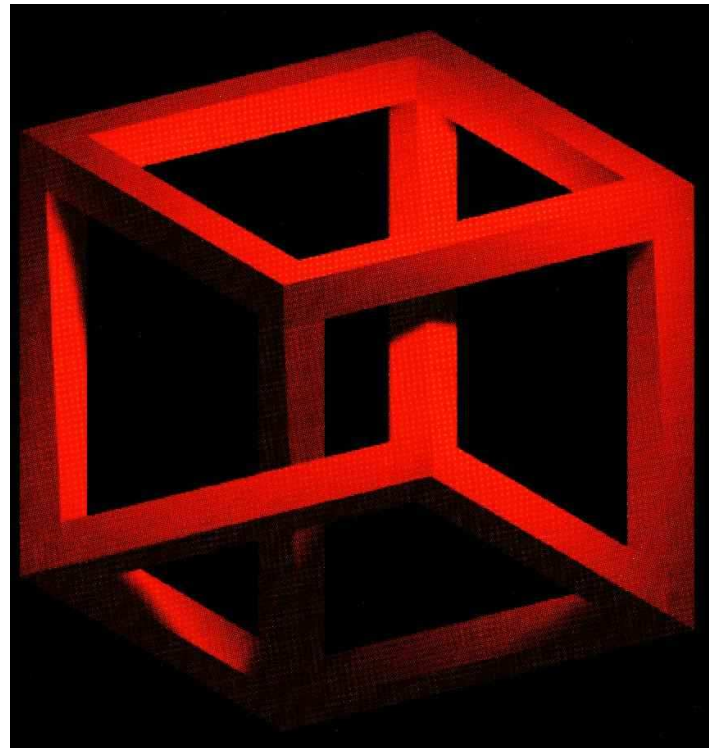
hint: the duck is looking left, the rabbit is looking right

Where is the Ambiguity?



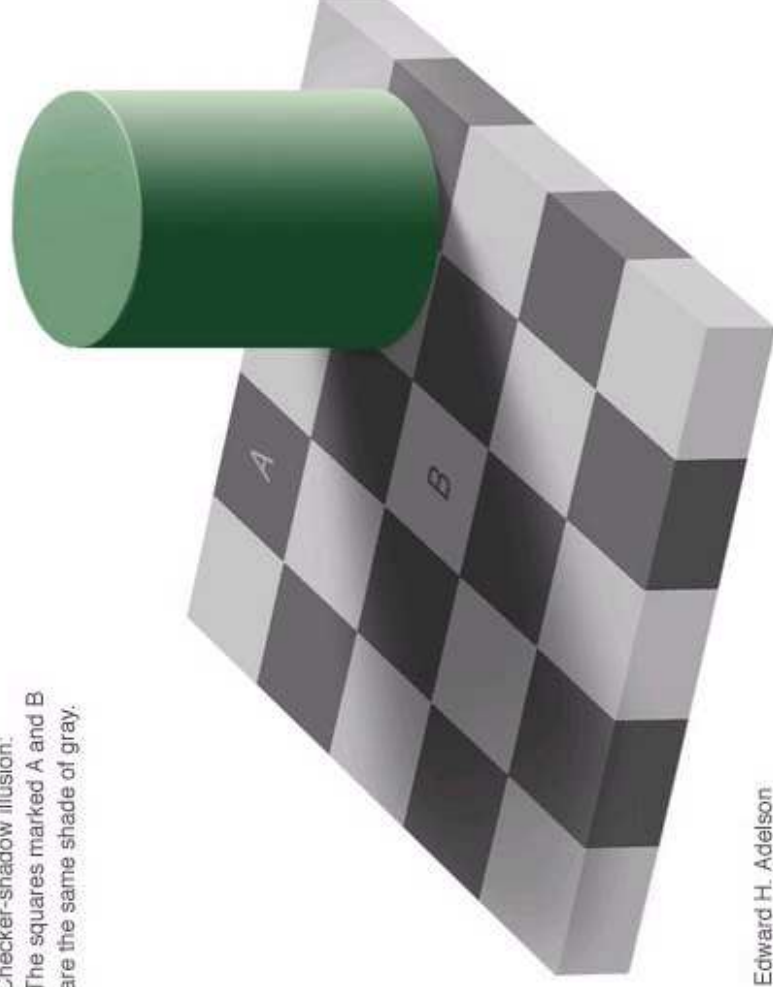
- Ambassadors by H. Hobein, jr.
-

Pavol Elias gives the construction of existing paradoxical 3D objects by cutting them into unambiguous parts



- Here are two unambiguous parts

Checker-shadow illusion:
The squares marked A and B
are the same shade of gray.



Edward H. Adelson

VRML Test-Szene - Microsoft Internet Explorer

Datei Bearbeiten Ansicht Favoriten Extras ?

Zurück

Suchen

Favoriten

Verlauf

Adresse http://www.icg.tu-graz.ac.at/~Education/Vorlesung/CAD_KU/demo/demo.html Wechsell zu Links

Favoriten

Hinzufügen... Verwal

Links

Media

MSN

Radio Station Guide


Webereignisse

Index of -grabner

Computer Graphics and ...

The novice computer user's paradise

This simple embedded VRML world illustrates one of the most threatening fears of novice computer users and a reasonable solution to overcome the arising problems. To investigate the world's behaviour, just move towards the computer screen and follow the instructions.



standard view

by grabner

find

* direct jump *

top of page

Internet

Start

lectures

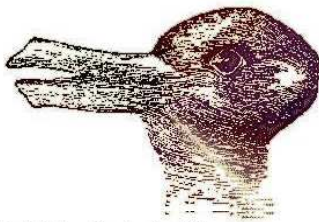
Web3D

VRML Test-Scen...

07:50

Categories of Ambiguous Web Graphics

- Categories of ambiguous messages created and communicated by web graphics:
- **static** (stills) and **dynamic** (animations, interactive 3D worlds)



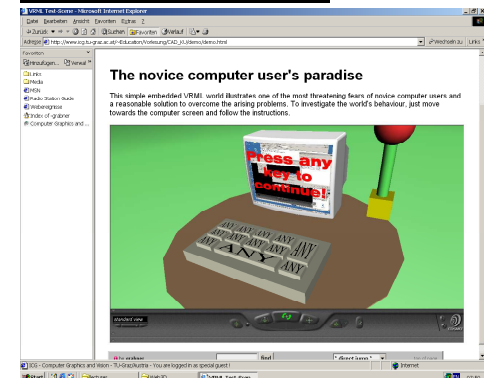
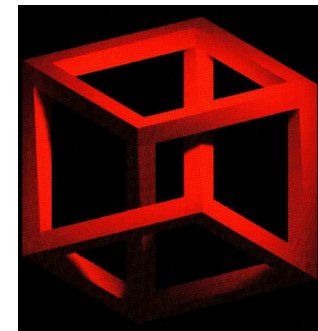
*A Rabbit.... Or A Duck?
hint: the duck is looking left, the rabbit is looking right*

One view



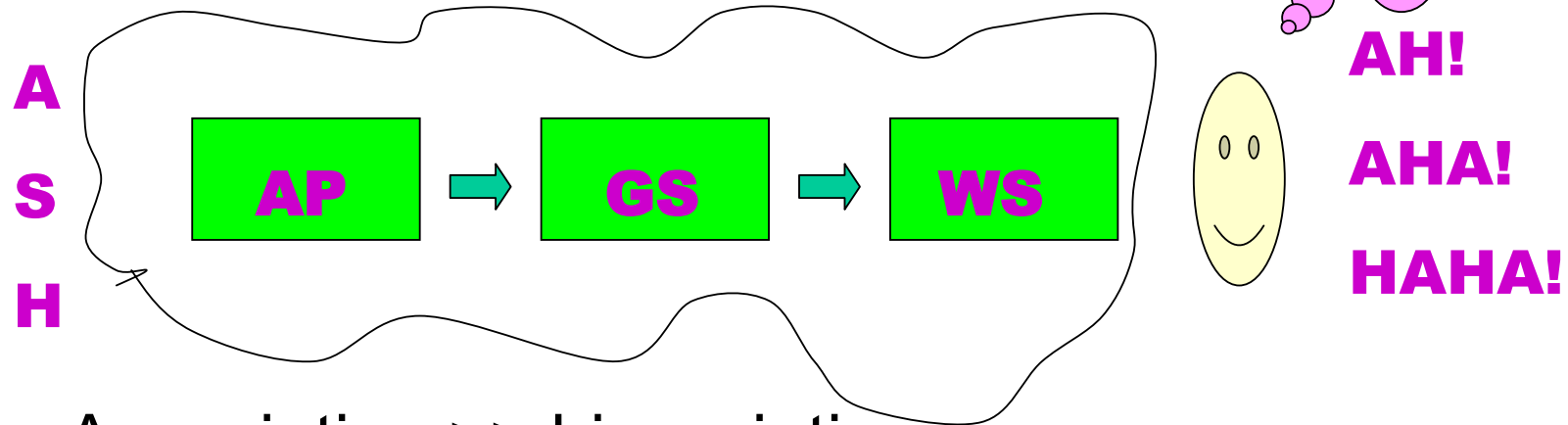
2+ views

N views (using mirrors)



On Model of a Human Being

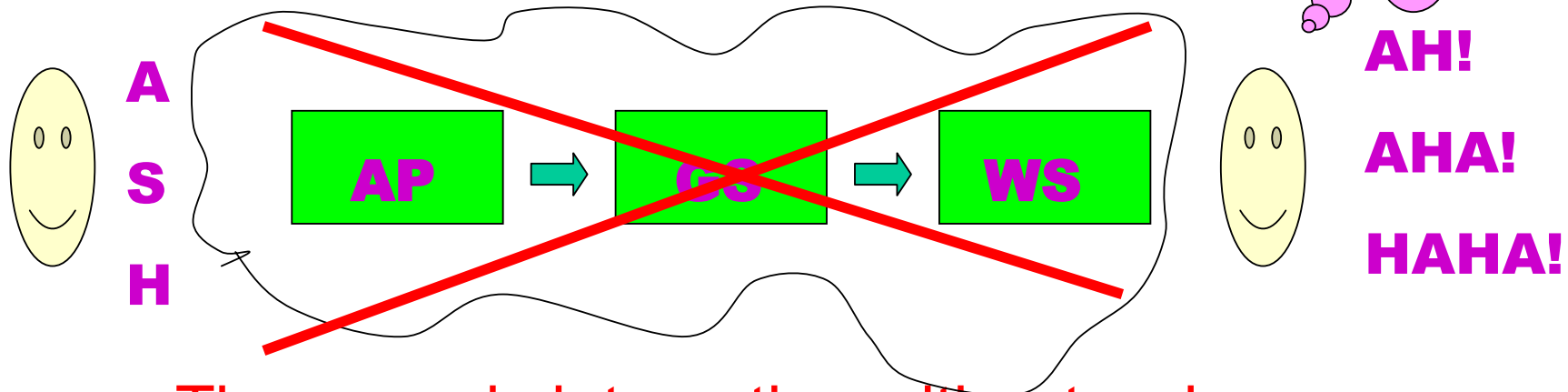
- The Act of Creation (creatology):



- Association >> bissociation
- Arthur KOESTLER: no labyrinth, no mouse, just bissociating two contexts

Human – Human Interface

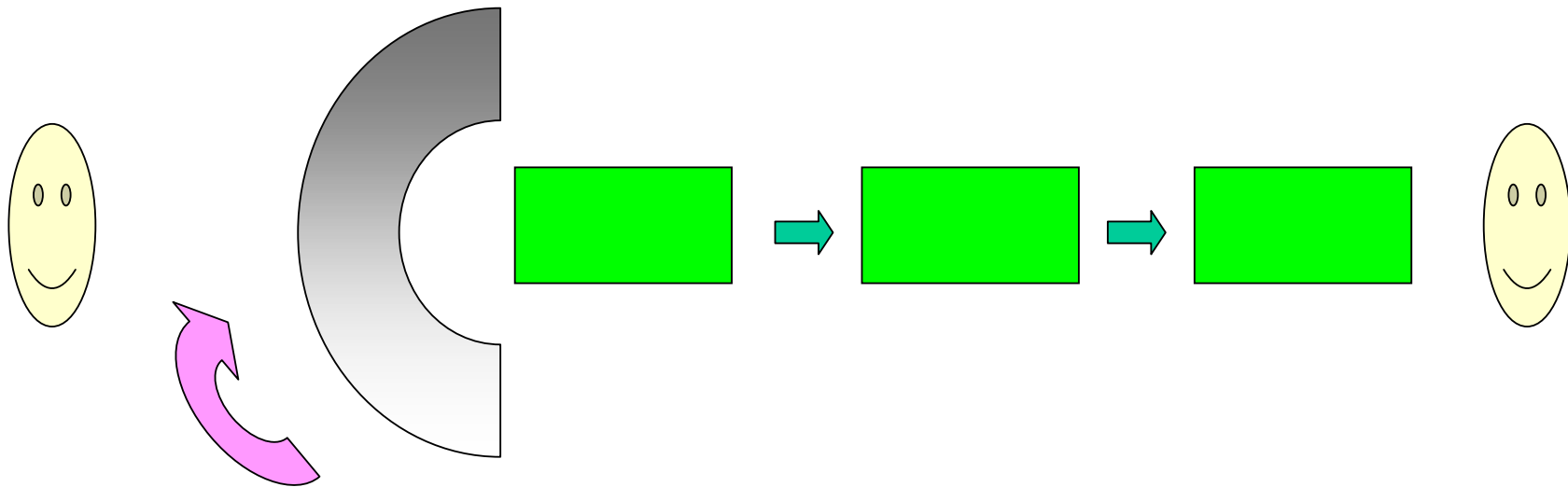
- The Act of Creation (creatology):



- The same is interesting without web
- Art, scientific discovery, comic inspiration (Humor)
- Note that Humor is undefined like Set or Shape

Serious Unambiguous Messages

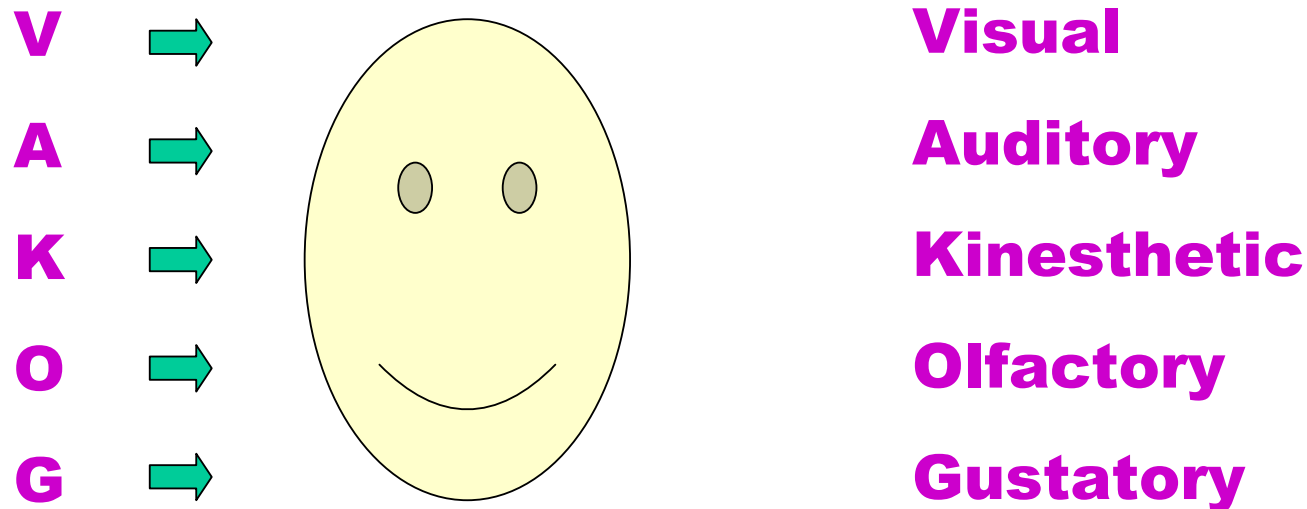
- White box... Black Box: known to unknown



- **Knowledge Increase** (electric circuits... CFD... Big Bang or humor theory)
- **Labyrinth and Mouse** (standard brainstorming creatology)

On Model of a Human Being

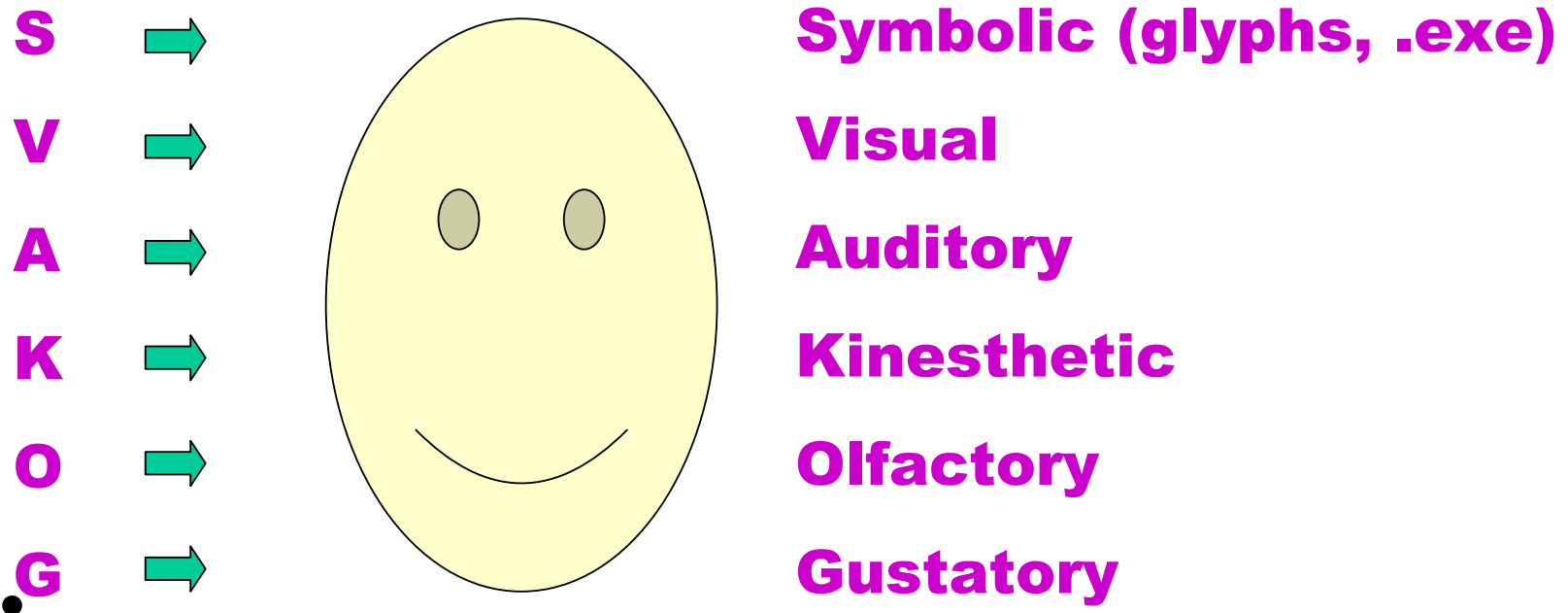
- Communication World Champions: NLP



- John GRINDER & Richard BANDLER, 1972+
- NLP = Neurolinguistic Programming

On Model of a Human Being

- Input Completion: Add Symbolic Channel



Agenda

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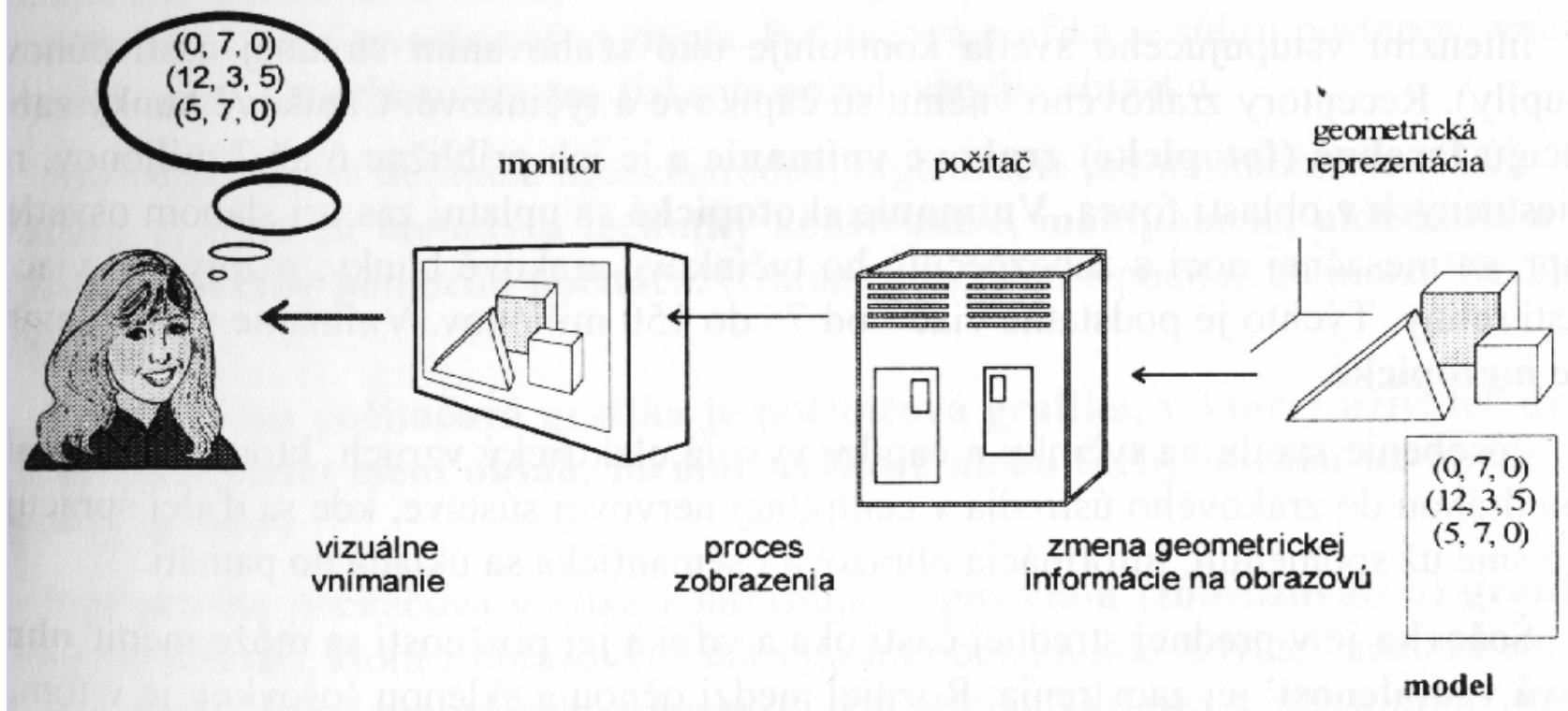
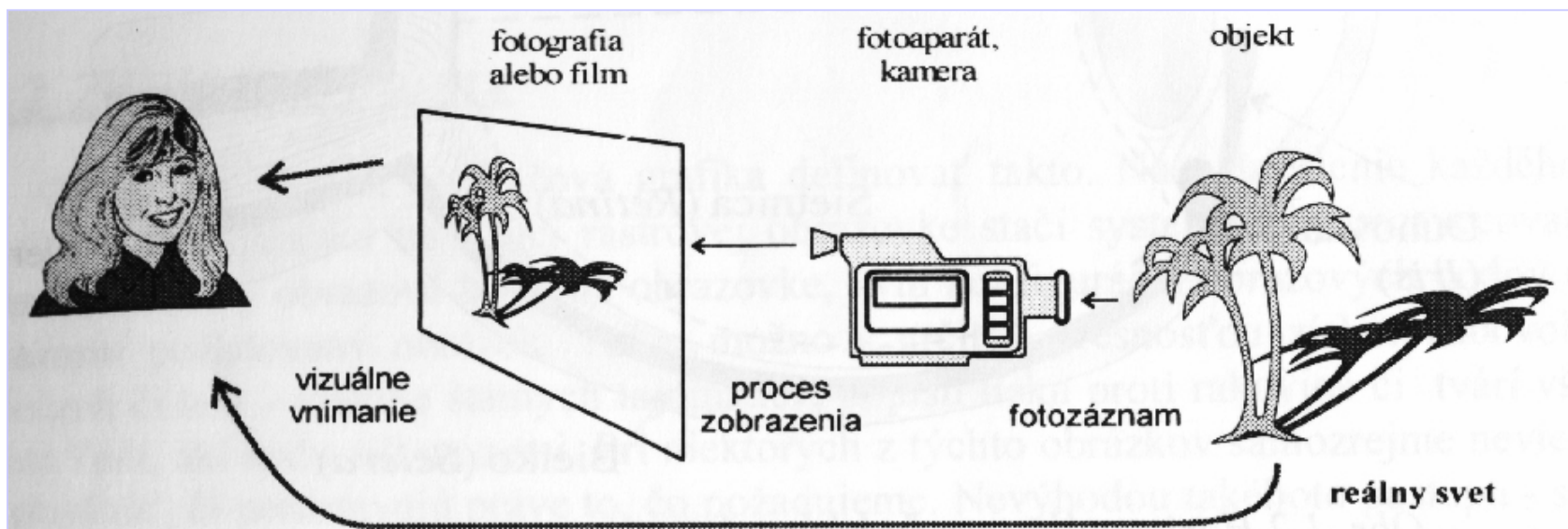
Compare Reality - Synthesis



Photograph



Rendering using the discrete method



CG Functional Unit

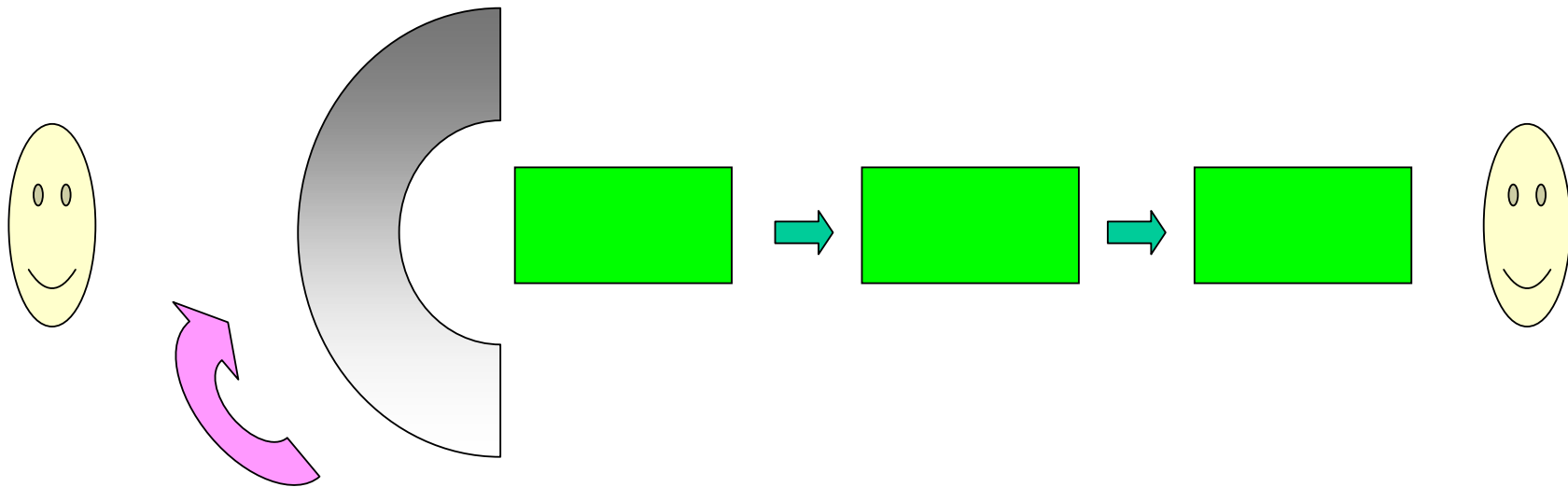
- **known model**
- **wireframe or surface representation:** geometric transformations, visibility calculations, interpolations and raster manipulations
- **photorealistic quality:** the lighting and rendering equations solved to simulate the illumination, shading, shadows, natural and synthetic textures and colors
- **viewing:** parallel or perspective projections) create the image space
- **animation:** kinematic & dynamic data compute/capture, hierarchy of motions, interpolations in the scene and in the resulting sequence of frames (fps)

Photography ~ computer graphics

- **ISO: Computer graphics:** methods & techniques for construction, manipulation, storage and displaying pictures using computer.
- [Dobkin97]: Computer graphics is a radiometrically weighted counterpart of computational geometry
- 8D (x, y, z, t) (r, g, b, transparency)
- Schnellkurs

Serious Unambiguous Messages

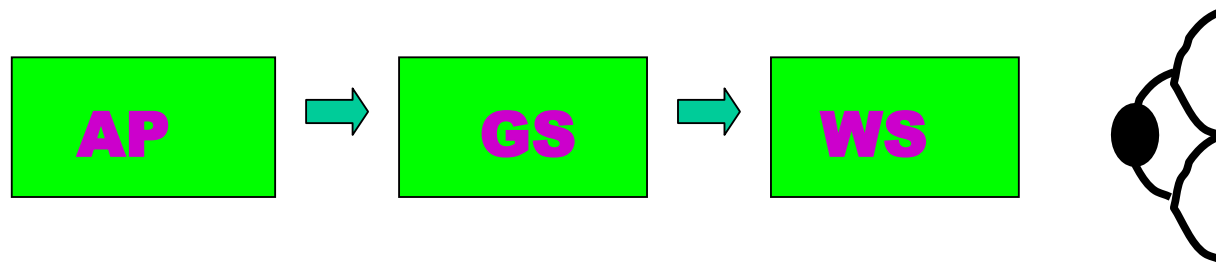
- White box... Black Box: known to unknown
- Problem, model, algorithm, software, results...



- Knowledge++ (electric circuits... CFD... Big Bang/humor theory)
- Labyrinth and Mouse (standard brainstorming creatology)

On Model of a Human Being

- Problem – Application Program - Solution

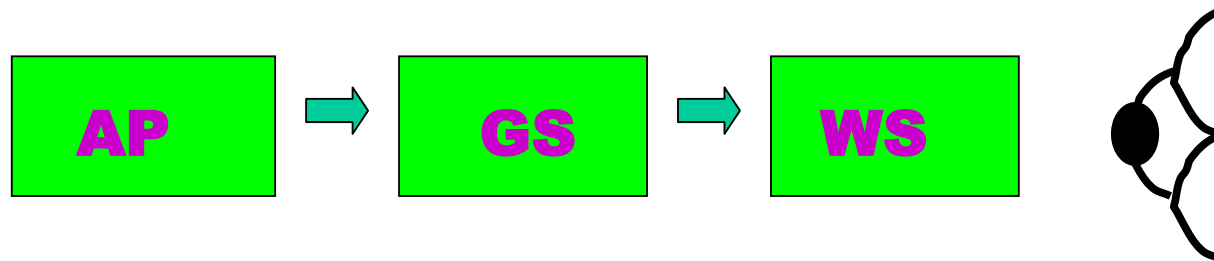


GUI

HVS

On Model of a Human Being

- Application Programmer - GS Author - User



- Triple Schizophrenia in
- Computer Graphics Reference Model (ISO)

Science

- Discovery

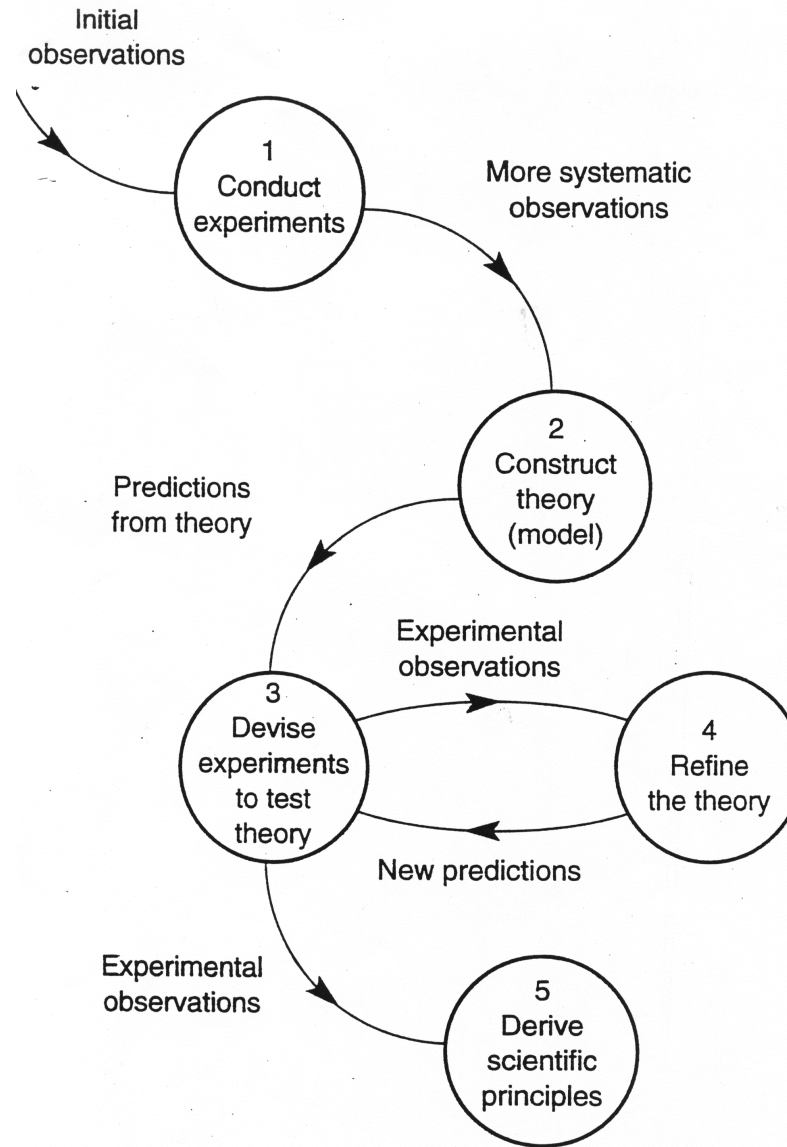


Figure 1.1 The nature of scientific analysis.

Design

- Invention

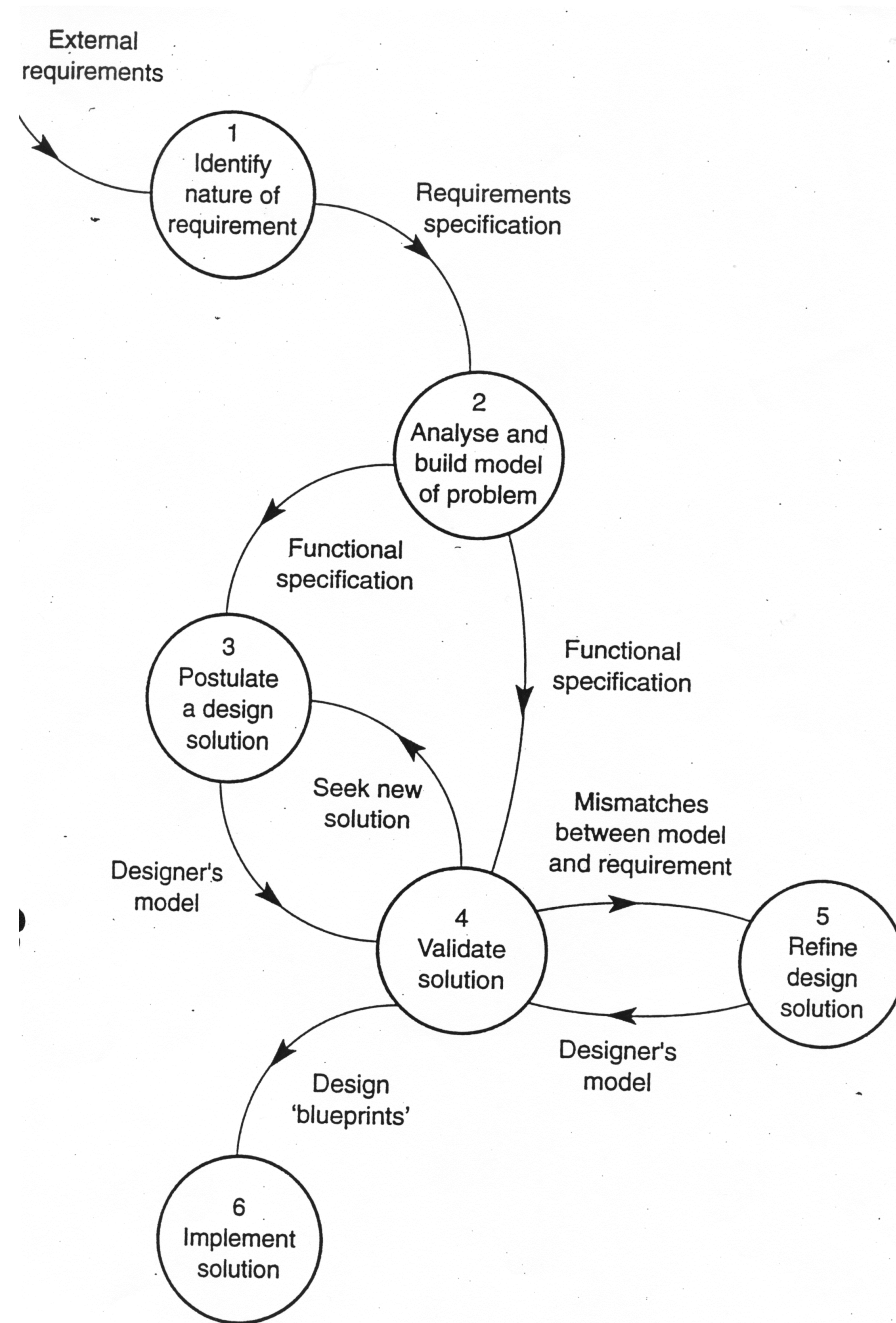


Figure 1.2 A model of the design process.

SIGGRAPH Slide Show



1991 SIGGRAPH Educators' Slide Set

Editor
Steve Cunningham
California State University Stanislaus



S I G G R A P H • 9 1

ShutterBug Credits

Produced by Tom Williams and H. B. Siegel, with the assistance of
M. W. Mantle

All images rendered with PhotoRealistic RenderMan 3.2

Copyright Pixar, 1990

Produced for Computer Graphics, Principles and Practice, Second
Edition, by Foley, van Dam, Fierer, and Hughes

Copyright Addison-Wesley, 1990



S I G G R A P H • 9 1

The Shutterbug Rendering Progression

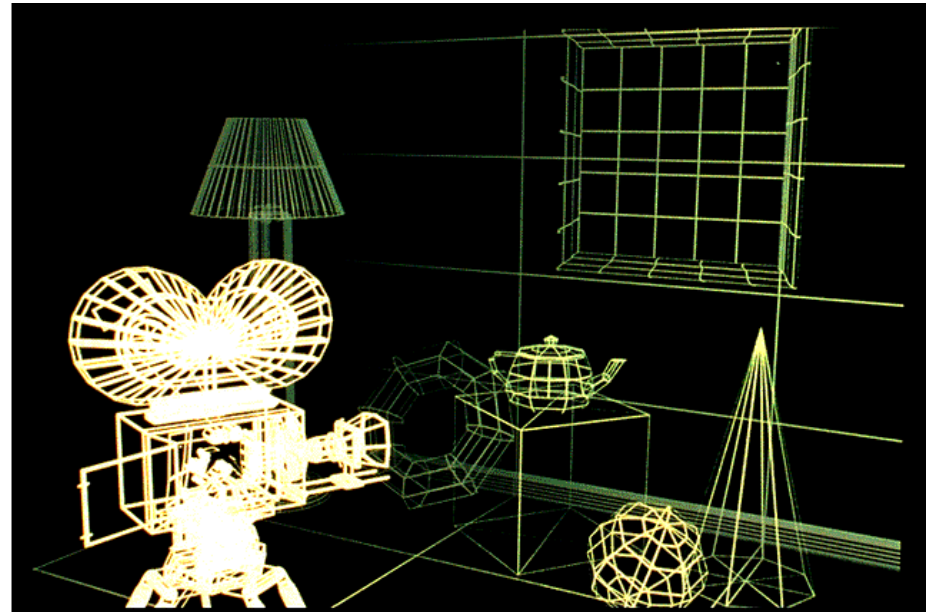
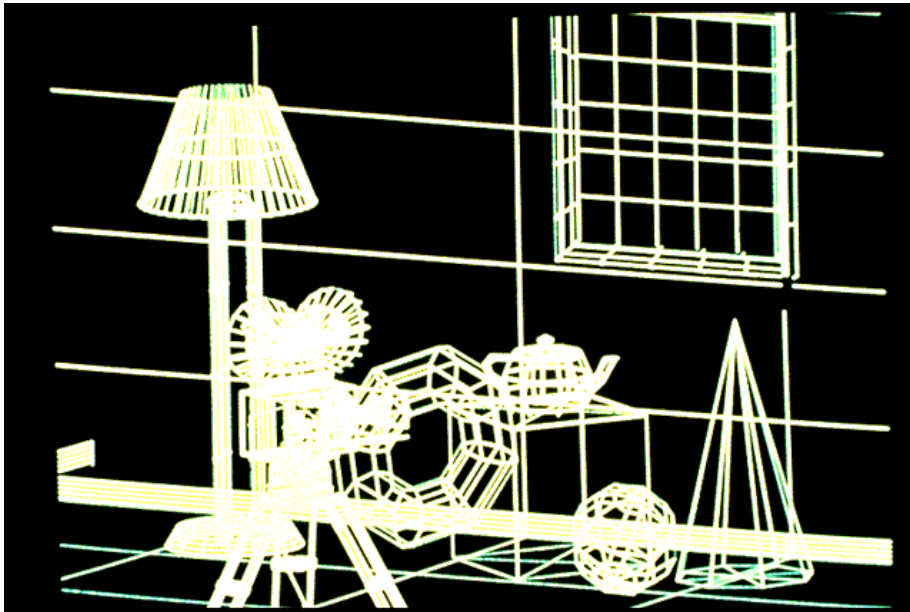
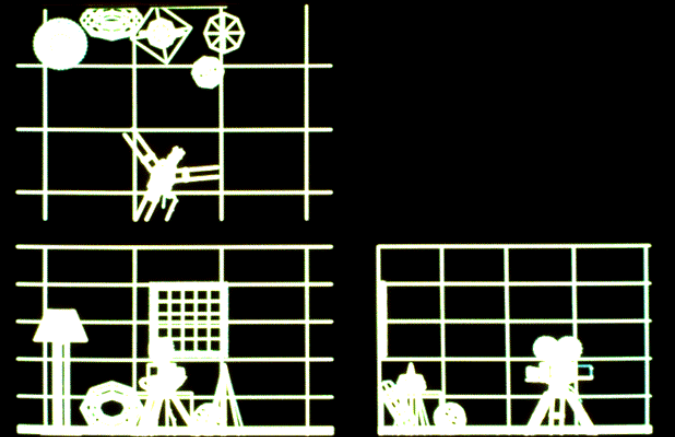
This sequence illustrates the progressive refinement of rendering algorithms.

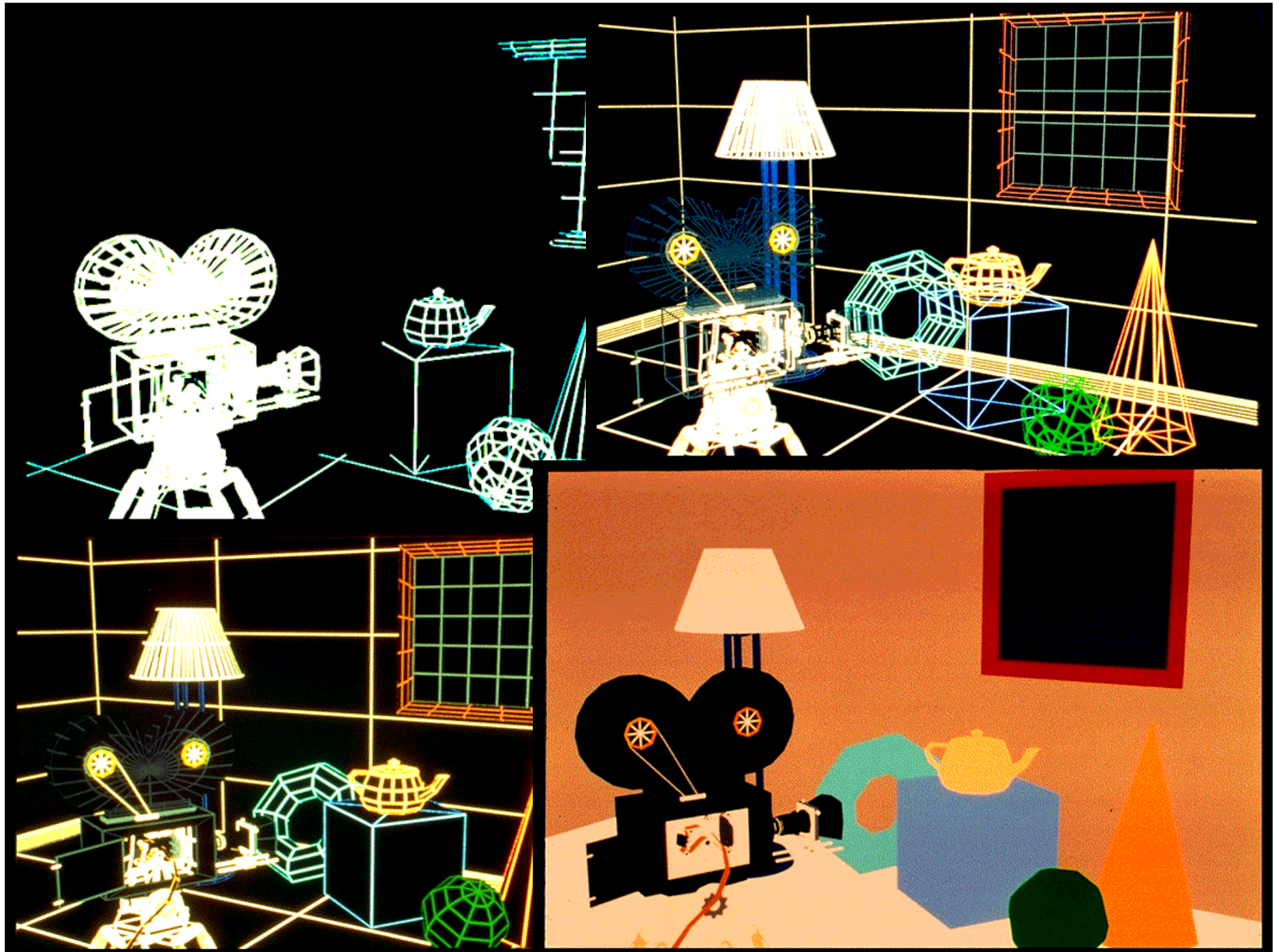
The images range from wire frames to photo-realistic renditions including reflections and shadows.

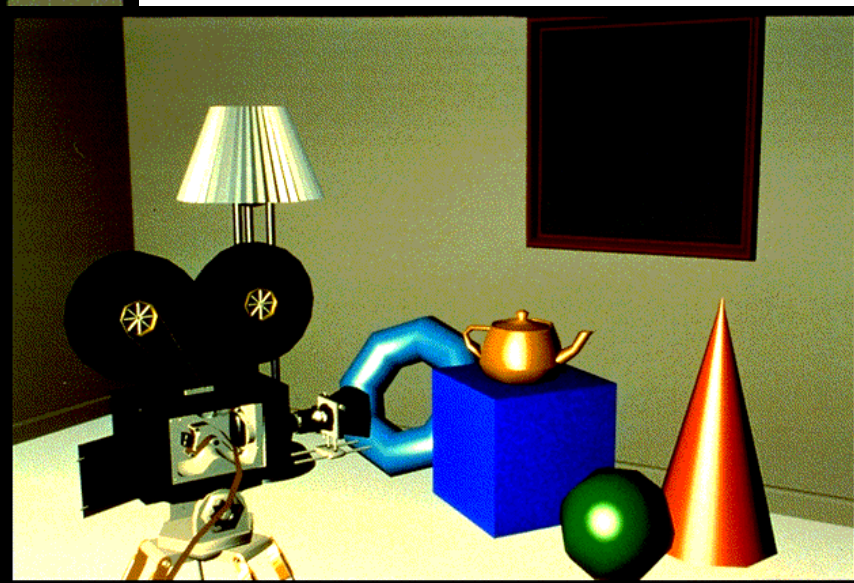
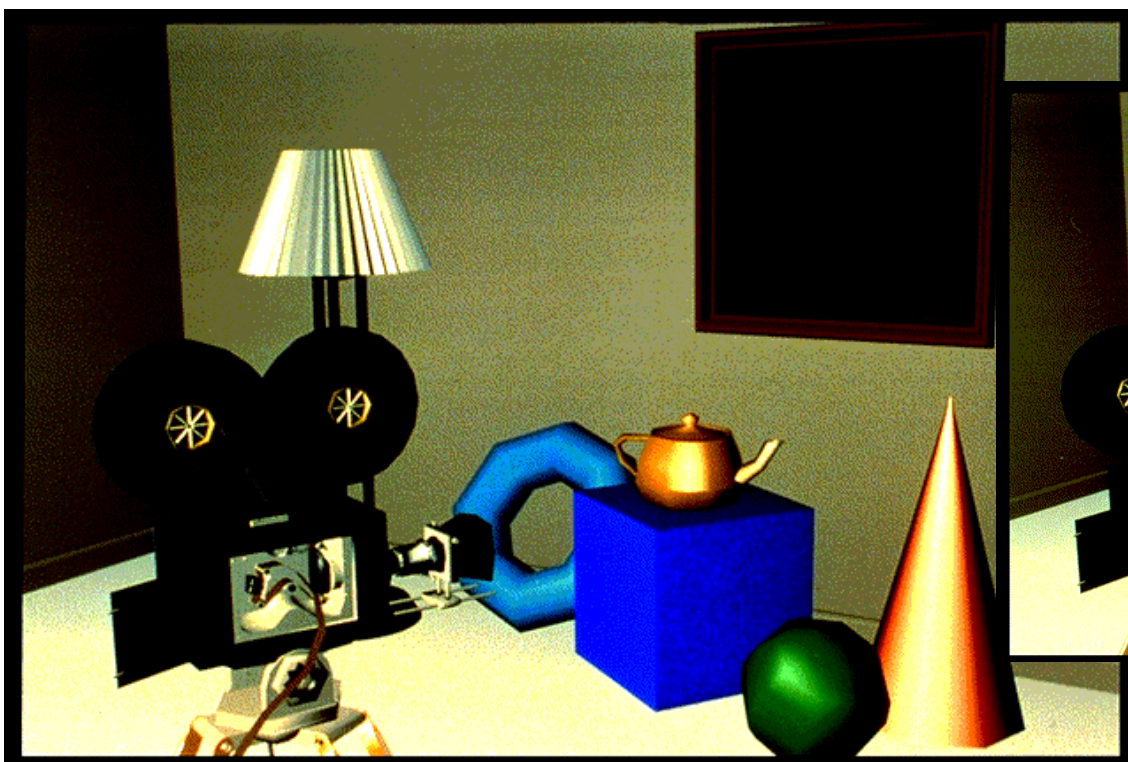
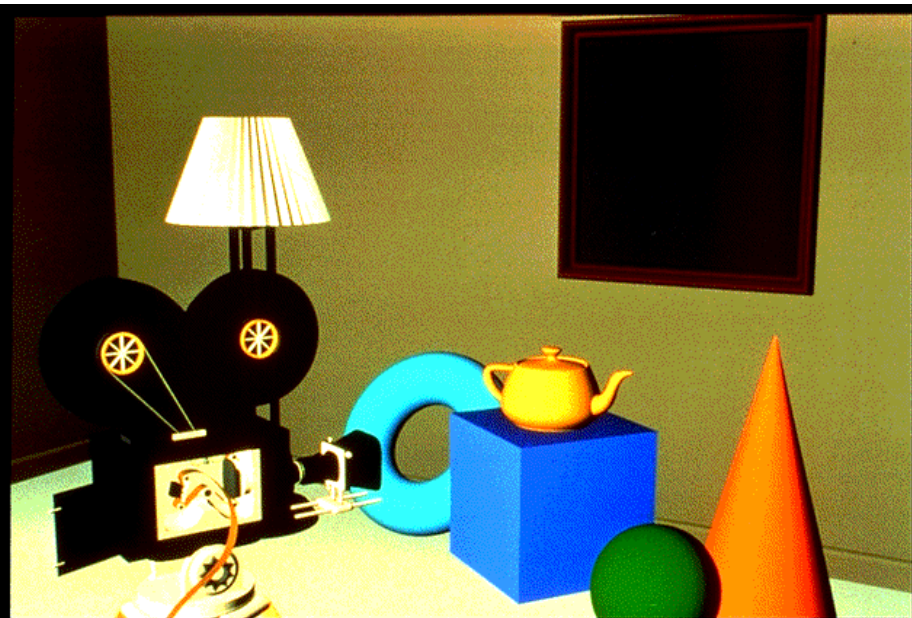
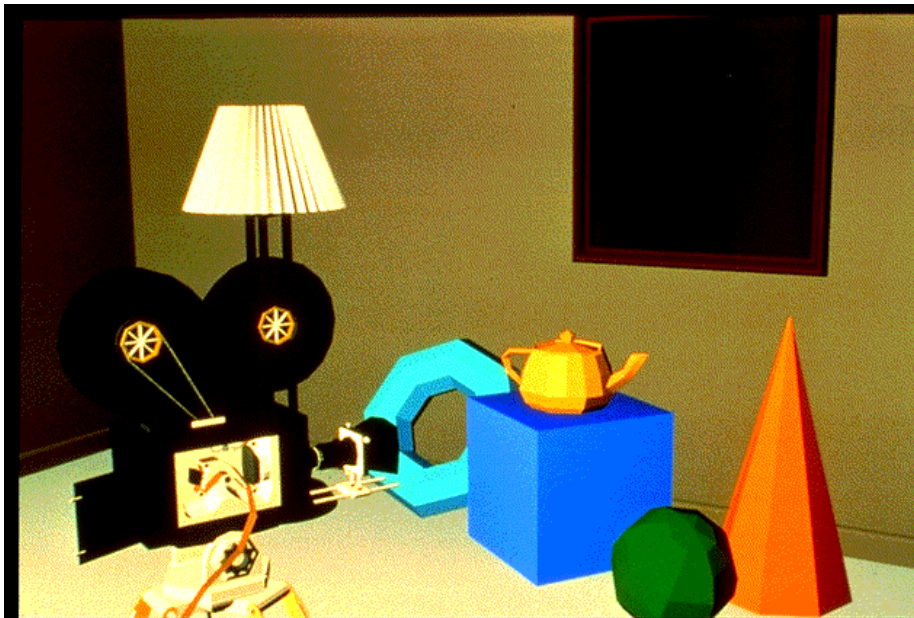
The rendering algorithm affects the quality and information conveyed by the image, independent of the underlying three-dimensional model.

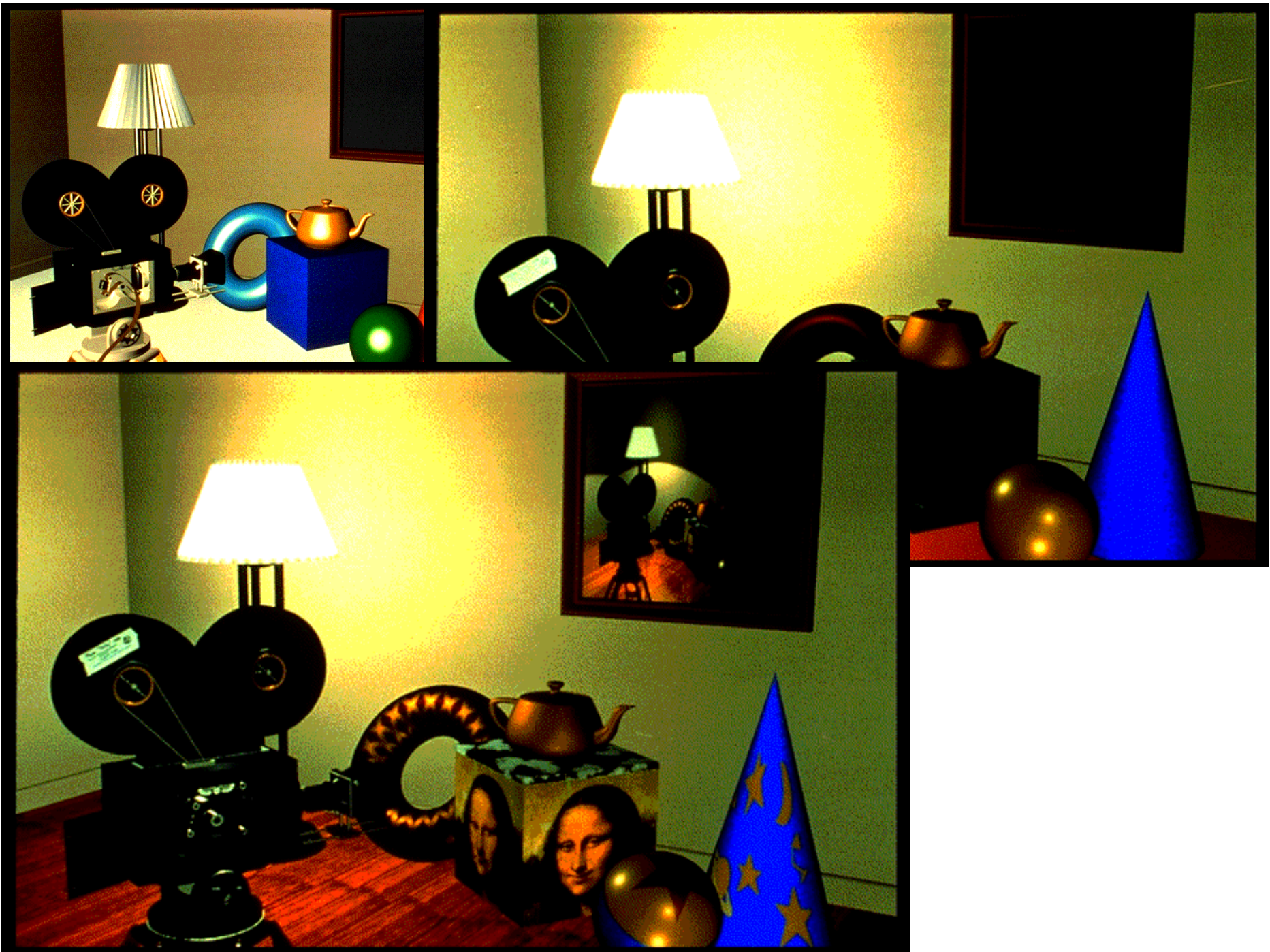


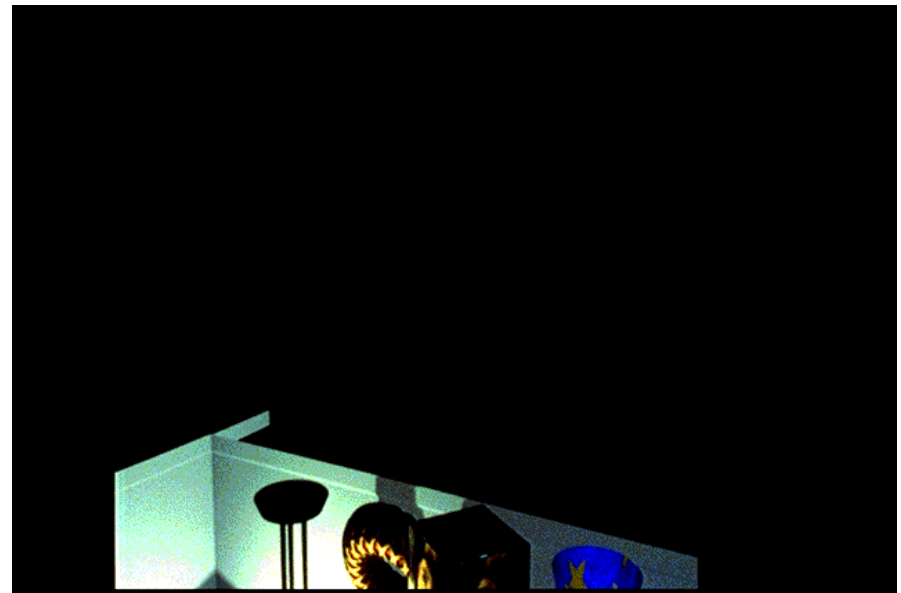
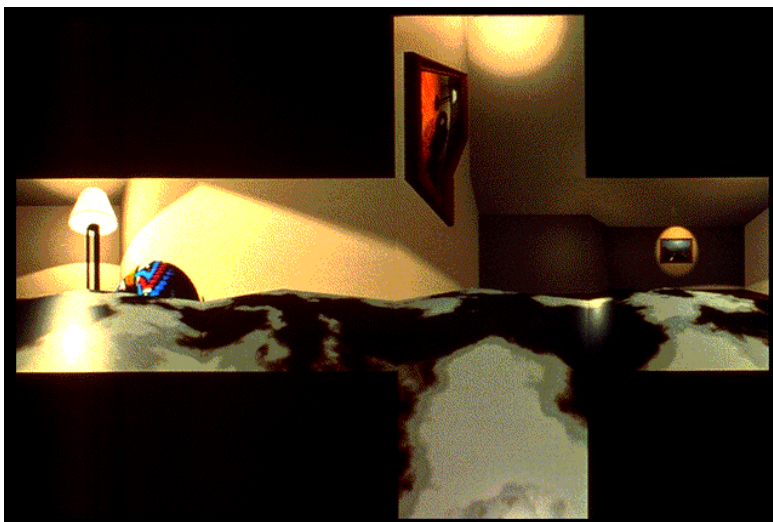
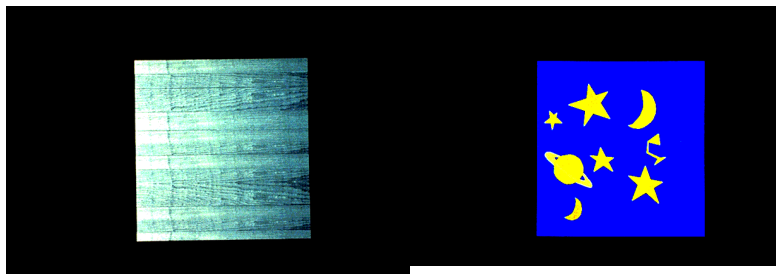
S I G G R A P H • 9 1





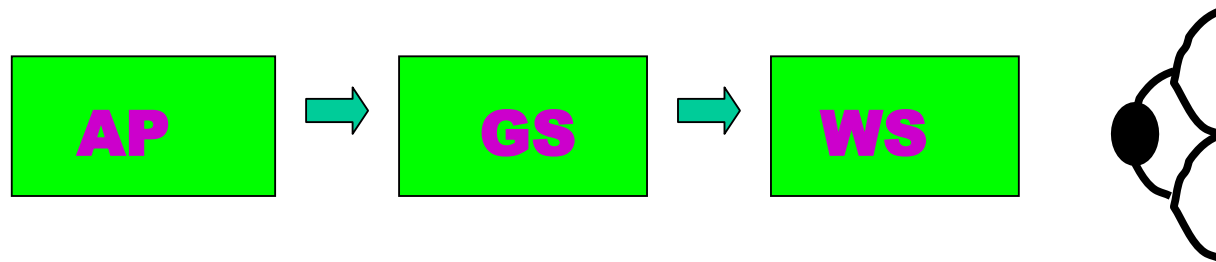






Graphics vs. Visualization

- Controlled Error: Model, Algorithm... Solution



- Computer Graphics >> Visualization

$\varepsilon \rightarrow 0$

>> $\varepsilon \rightarrow \text{infinity}$

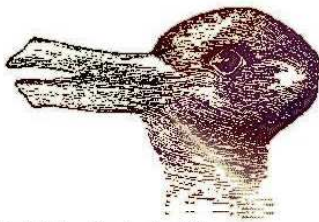


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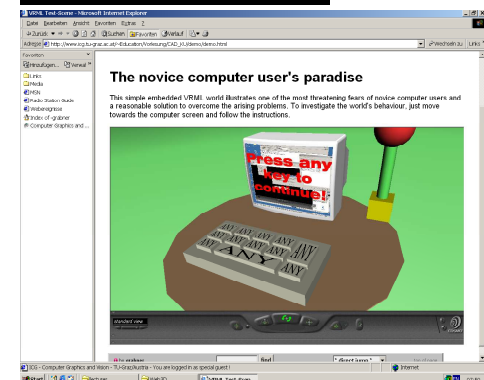
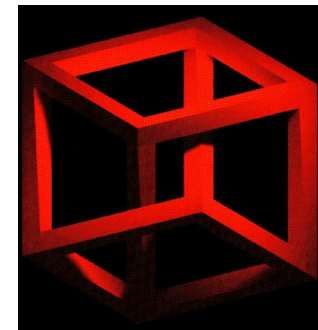
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hint: the duck is looking left, the rabbit is looking right*

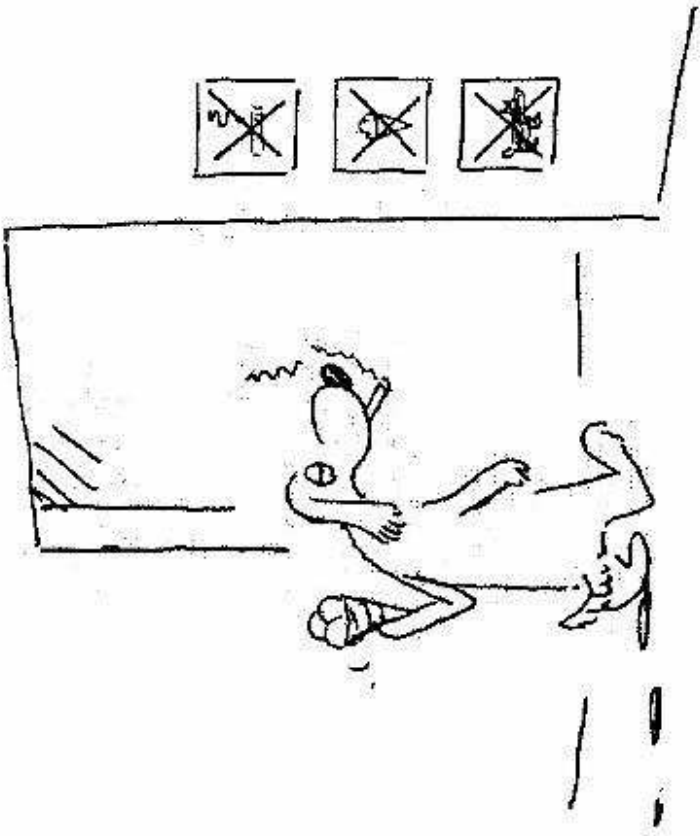
One view



2+ views

N views (using mirrors)



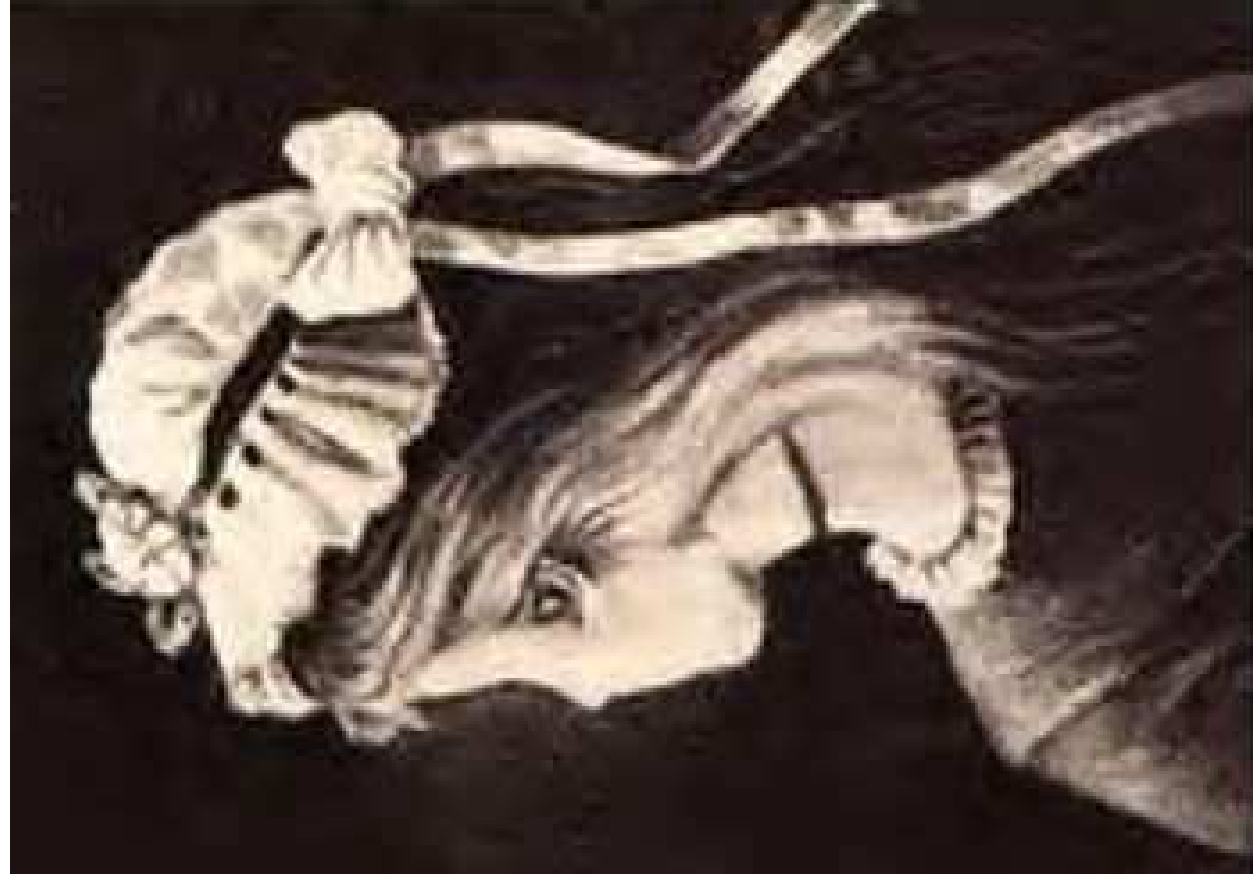




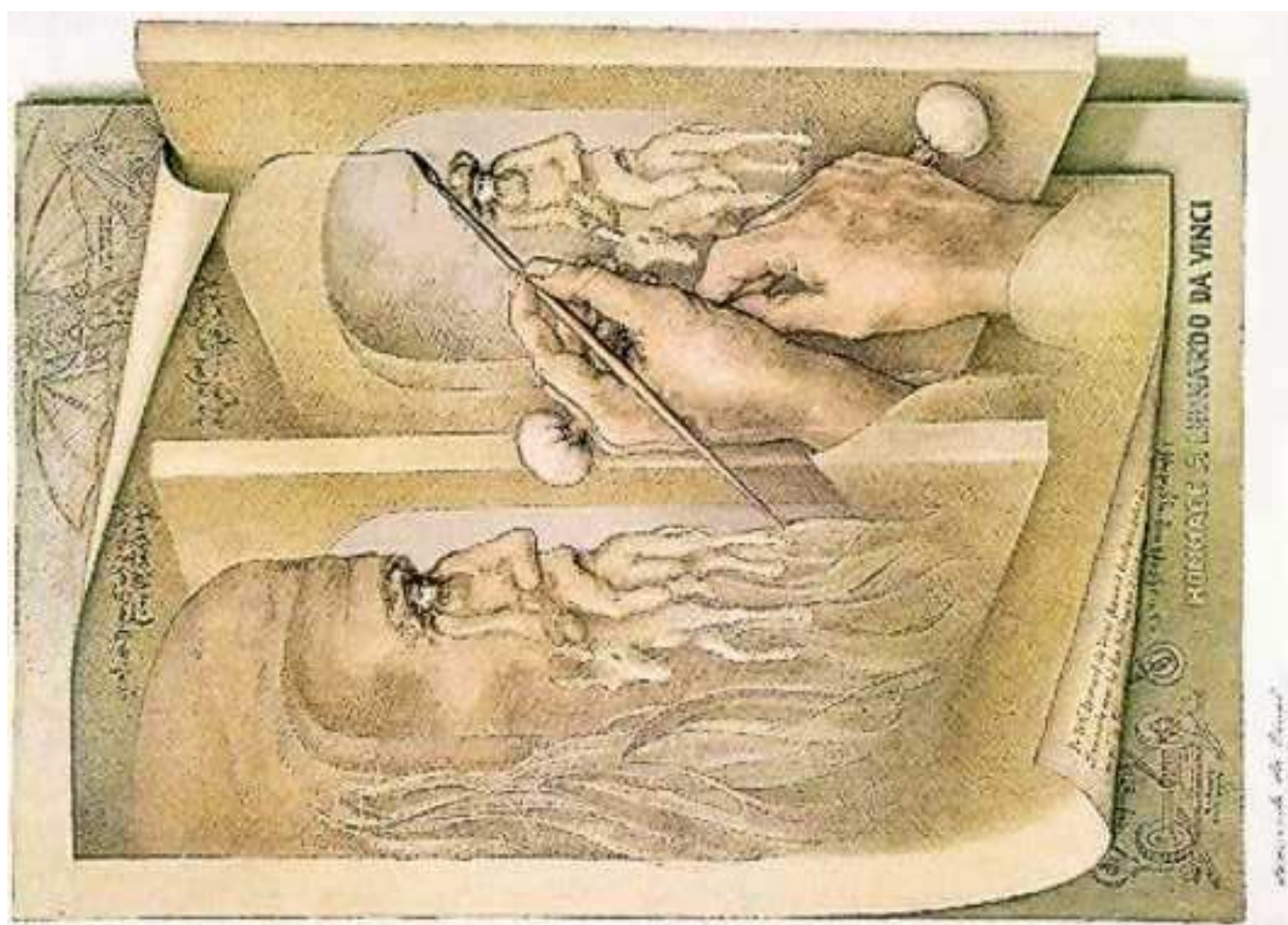








Old Woman...Or Young Girl

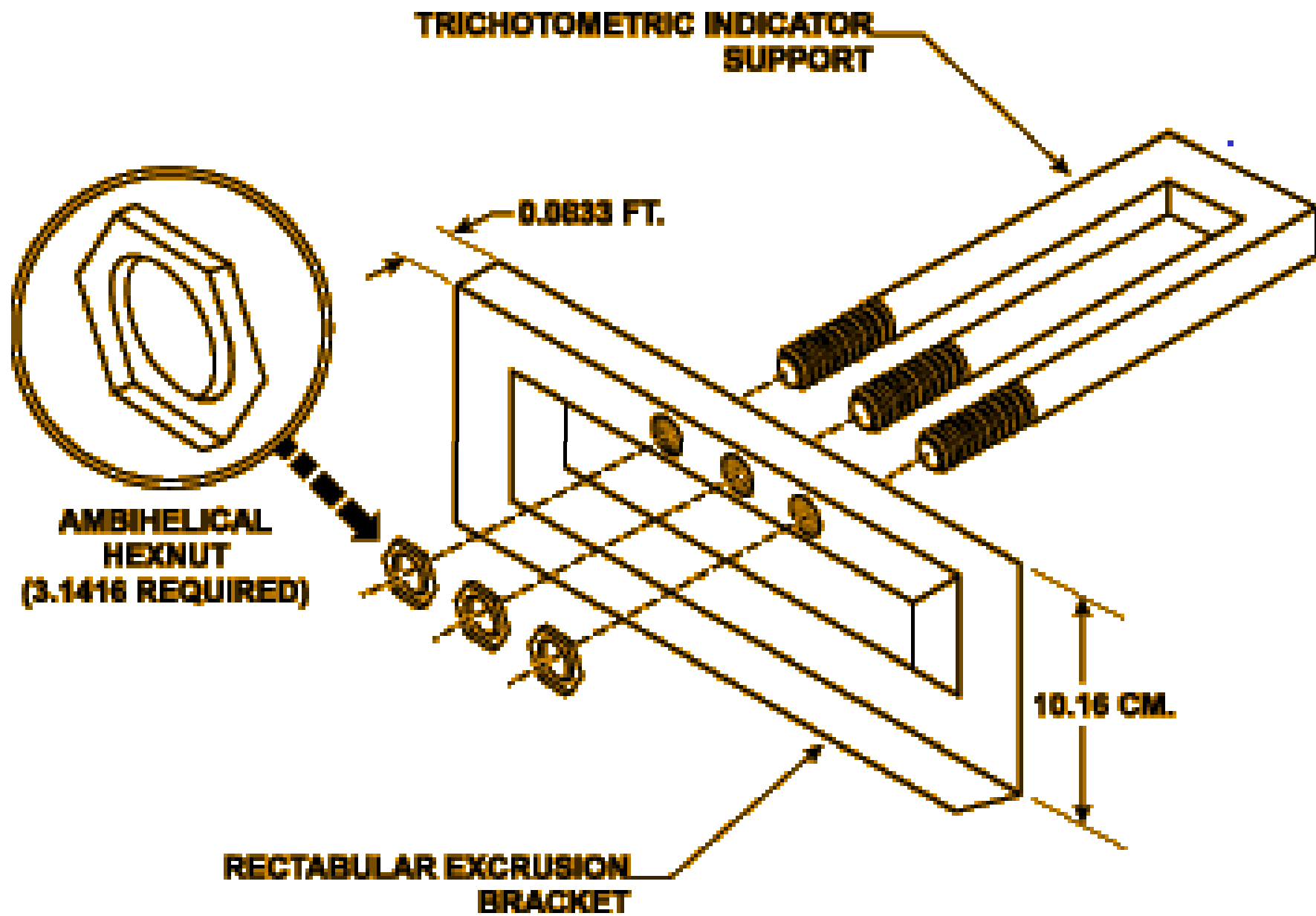


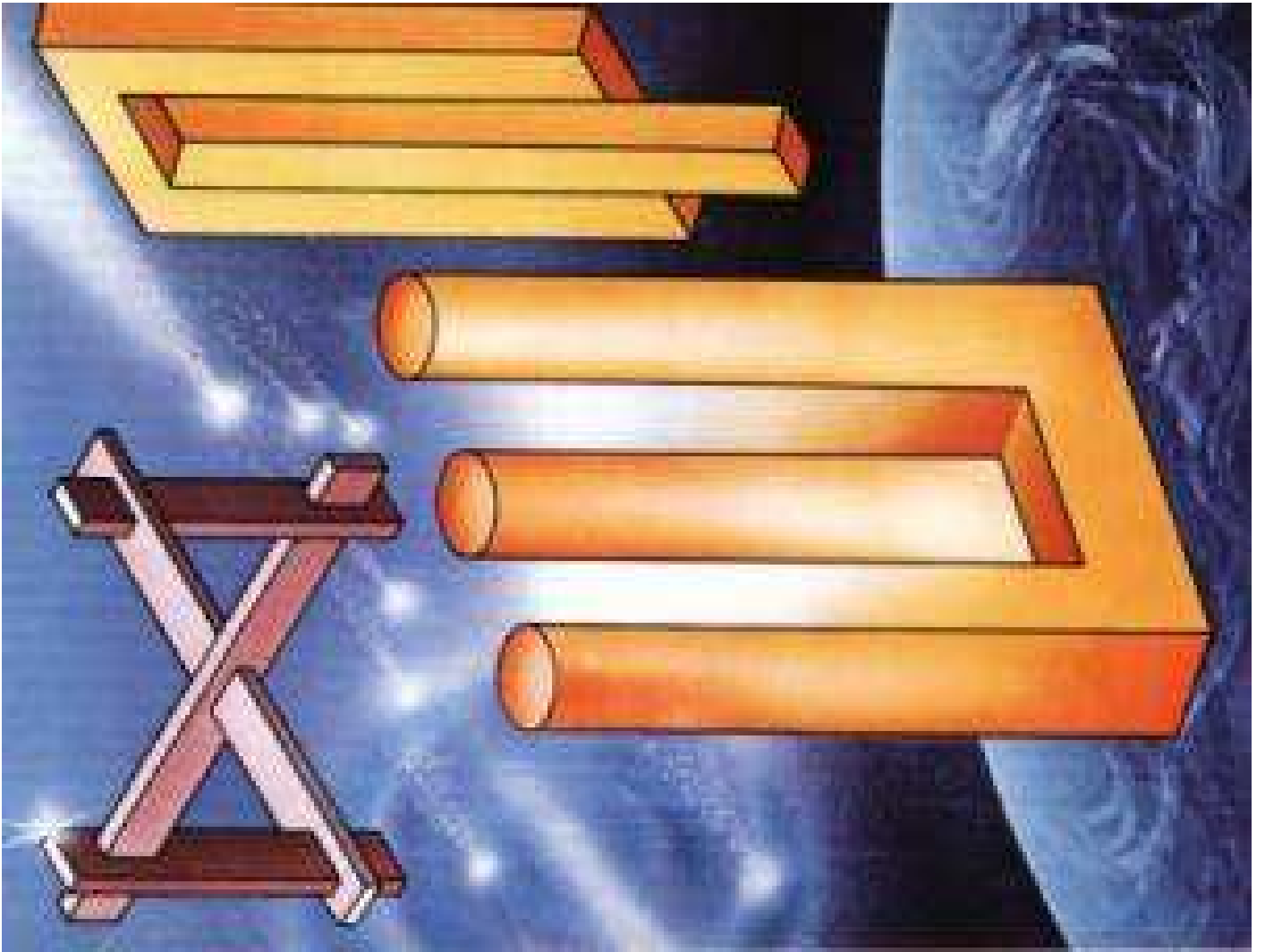


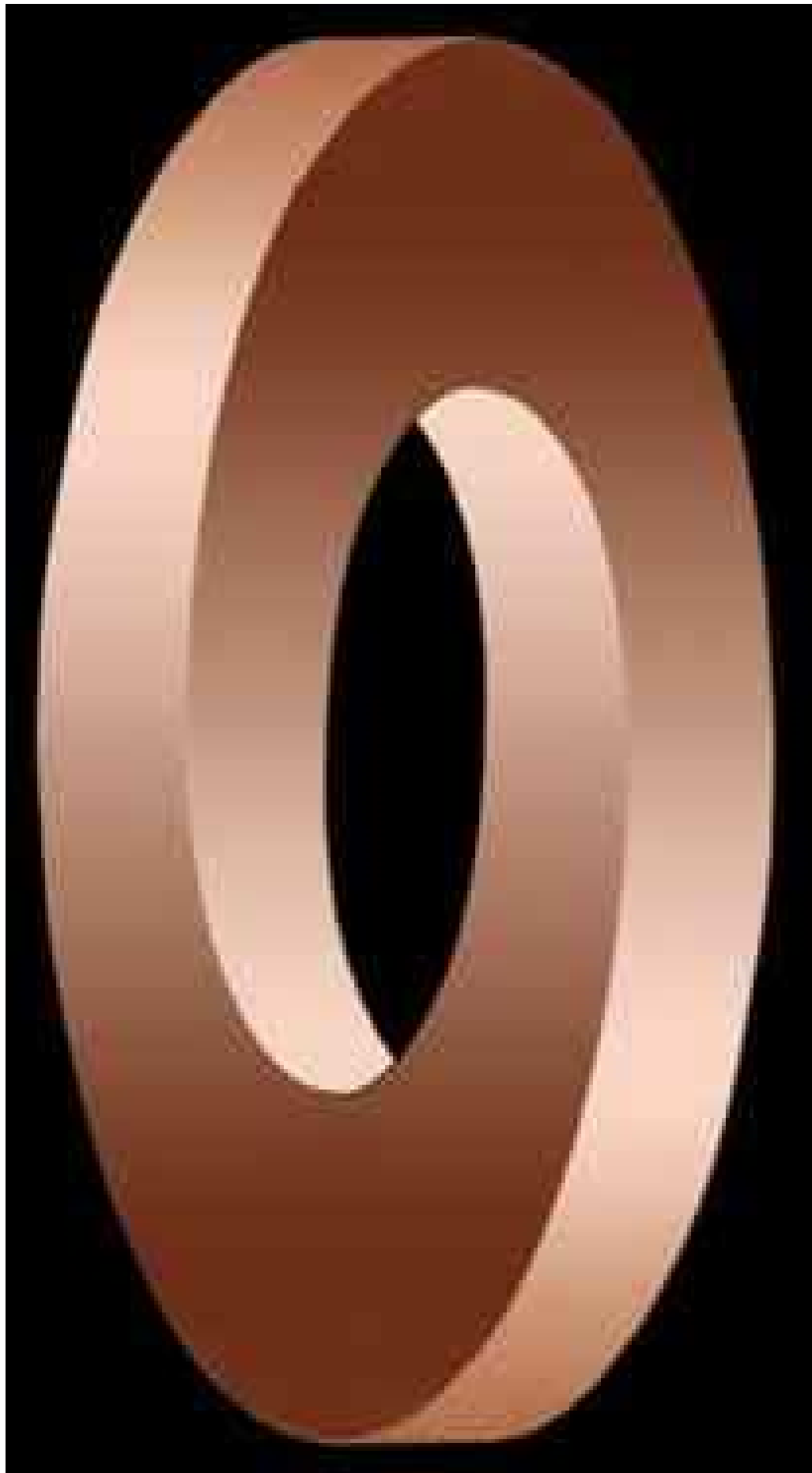
Zoek de baby



Zoek de 7 dolfijnen





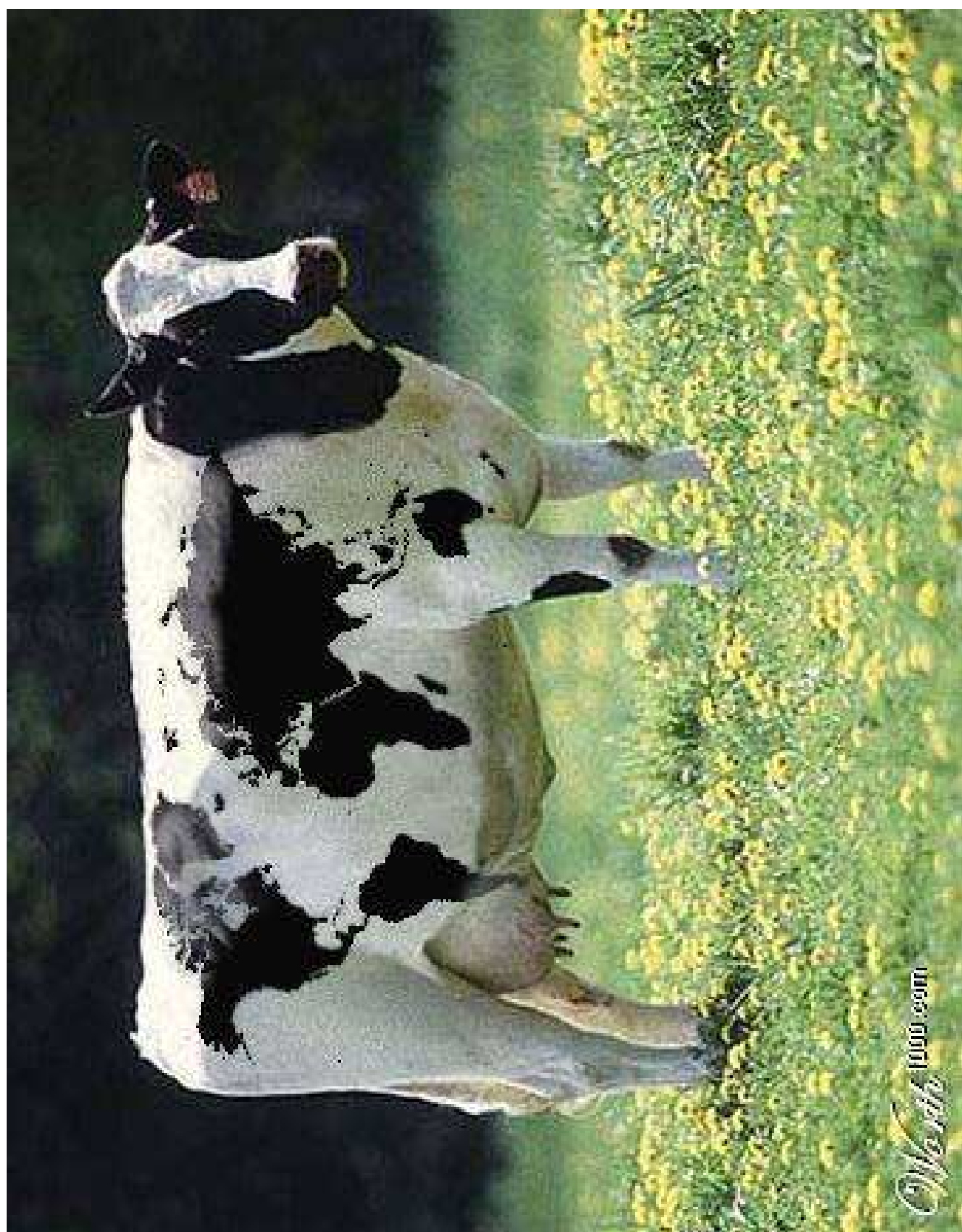








Worth 1000.com

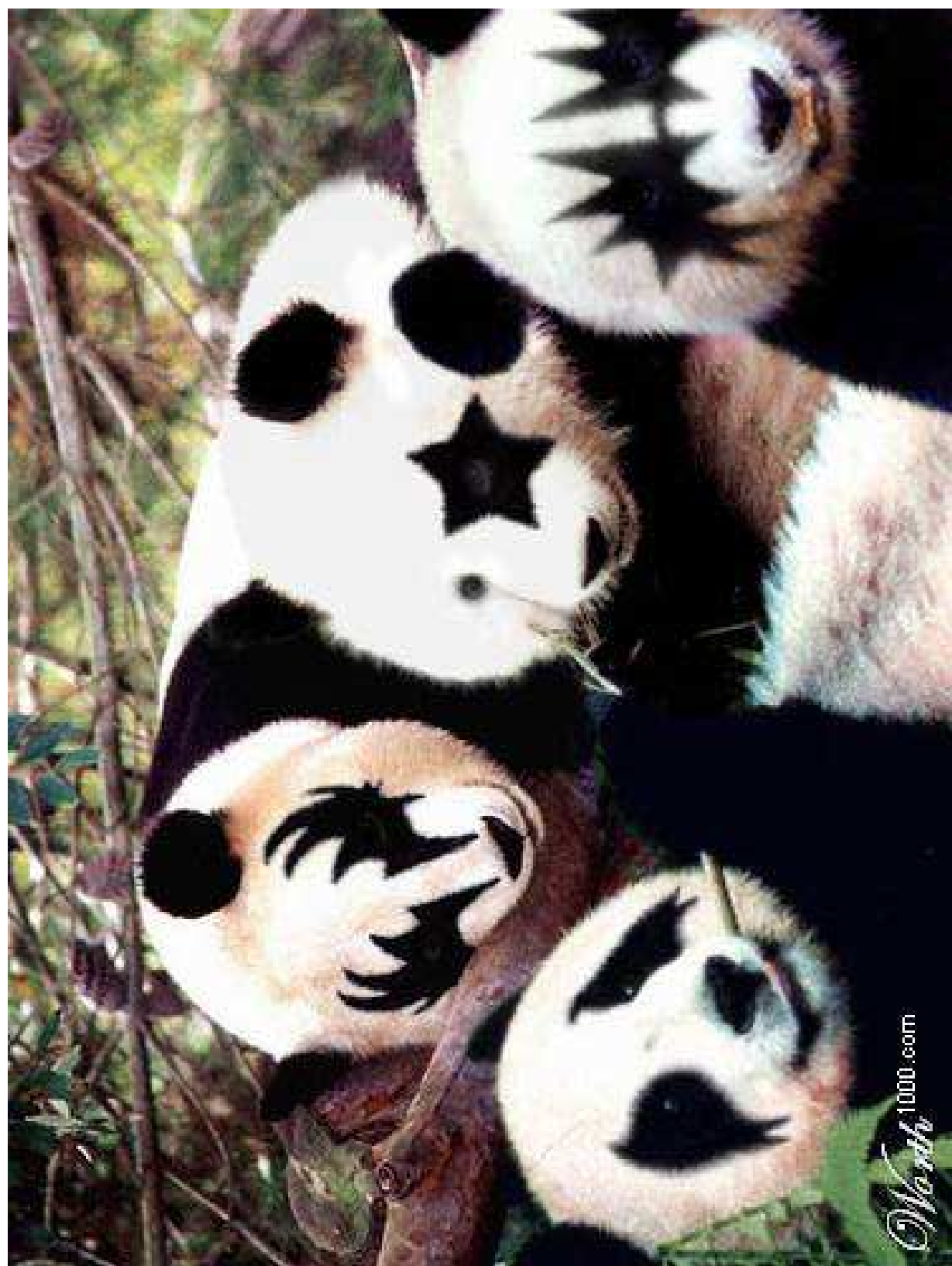


©Wendy 1100.com





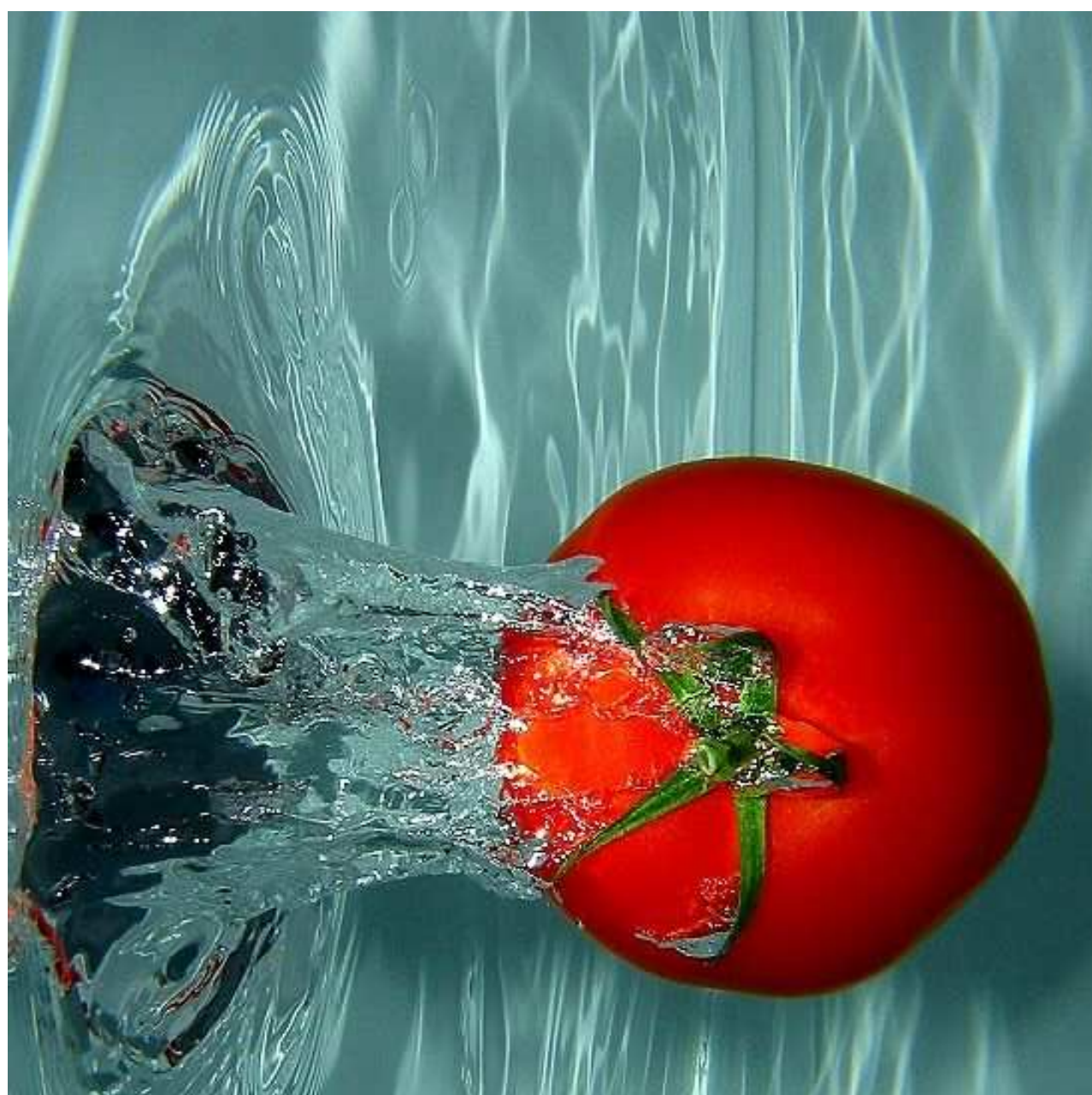
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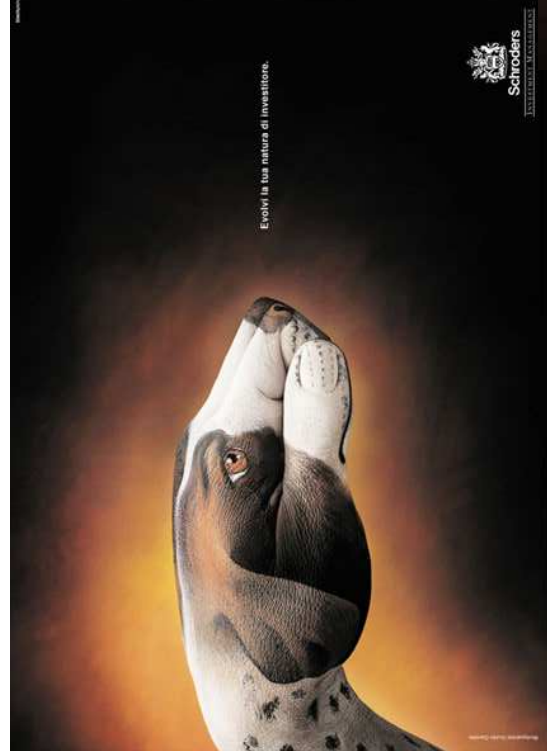
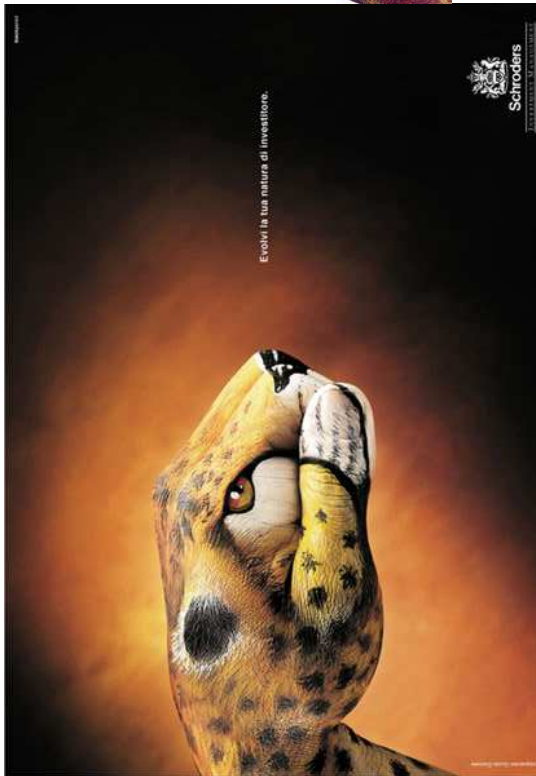
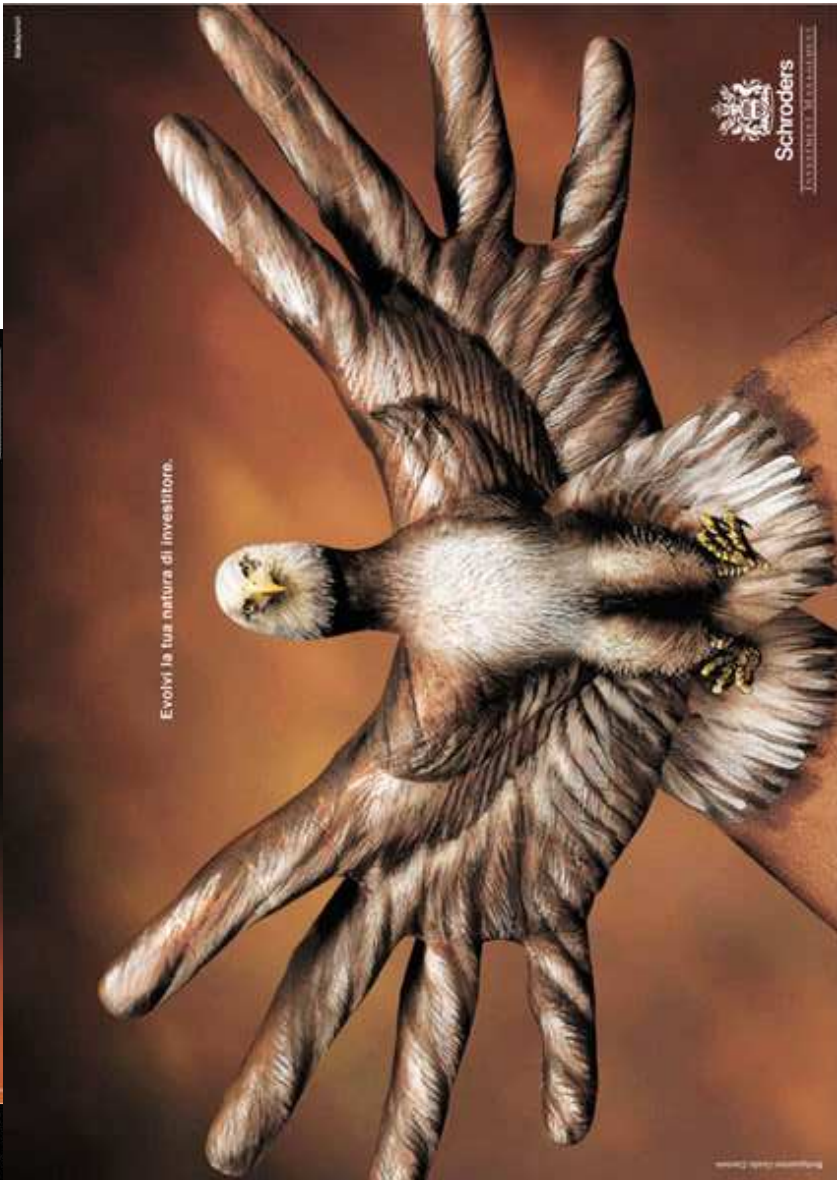




Towards the Troublems...



- Real world photo from P. Bourkes homepage





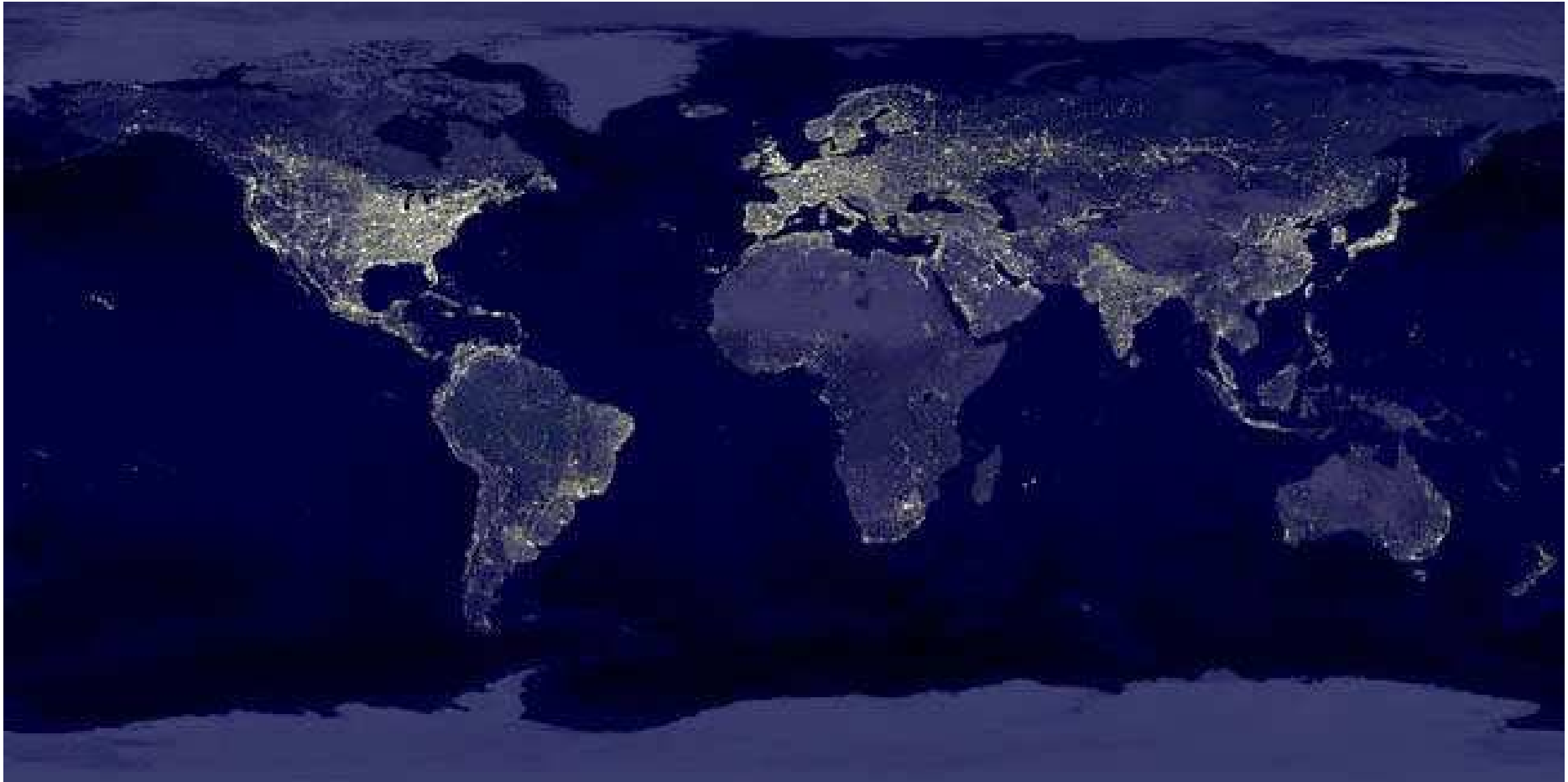




AH!



Earth in the Night **AHA!**



<http://antwrp.gsfc.nasa.gov/apod/ap001127.html>

HAHA!

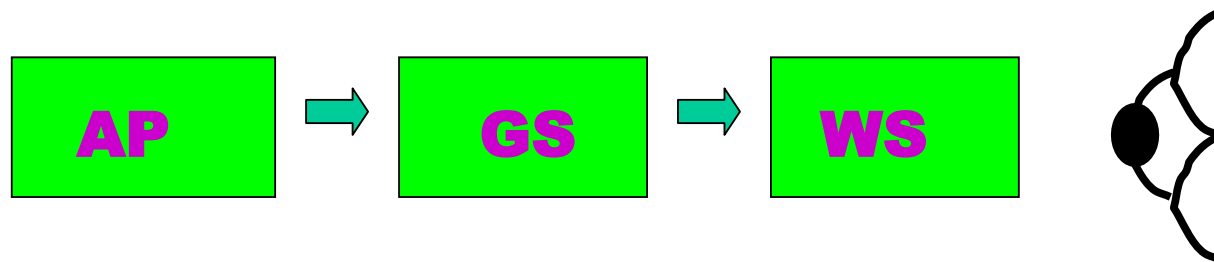


Agenda

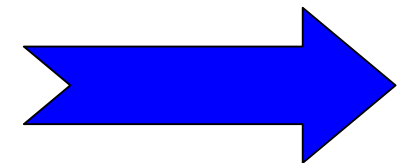
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On Model of a Human Being

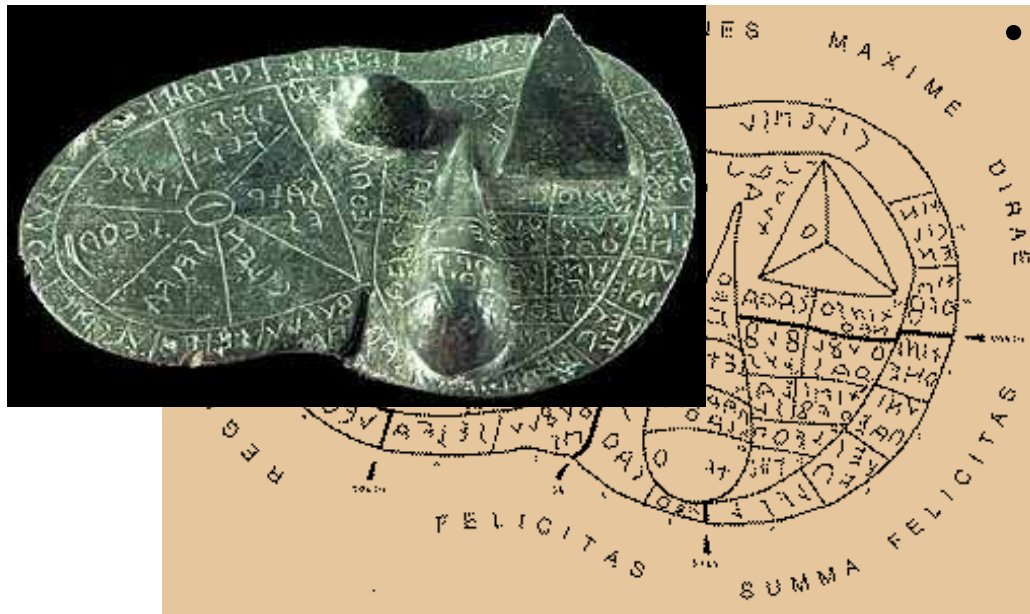
- Controlled Error: Model, Algorithm... Solution



- Computer Graphics >> Visualization
 $\varepsilon \rightarrow 0$ >> $\varepsilon \rightarrow \text{infinity}$



Etruscan Liver, Cholera in London



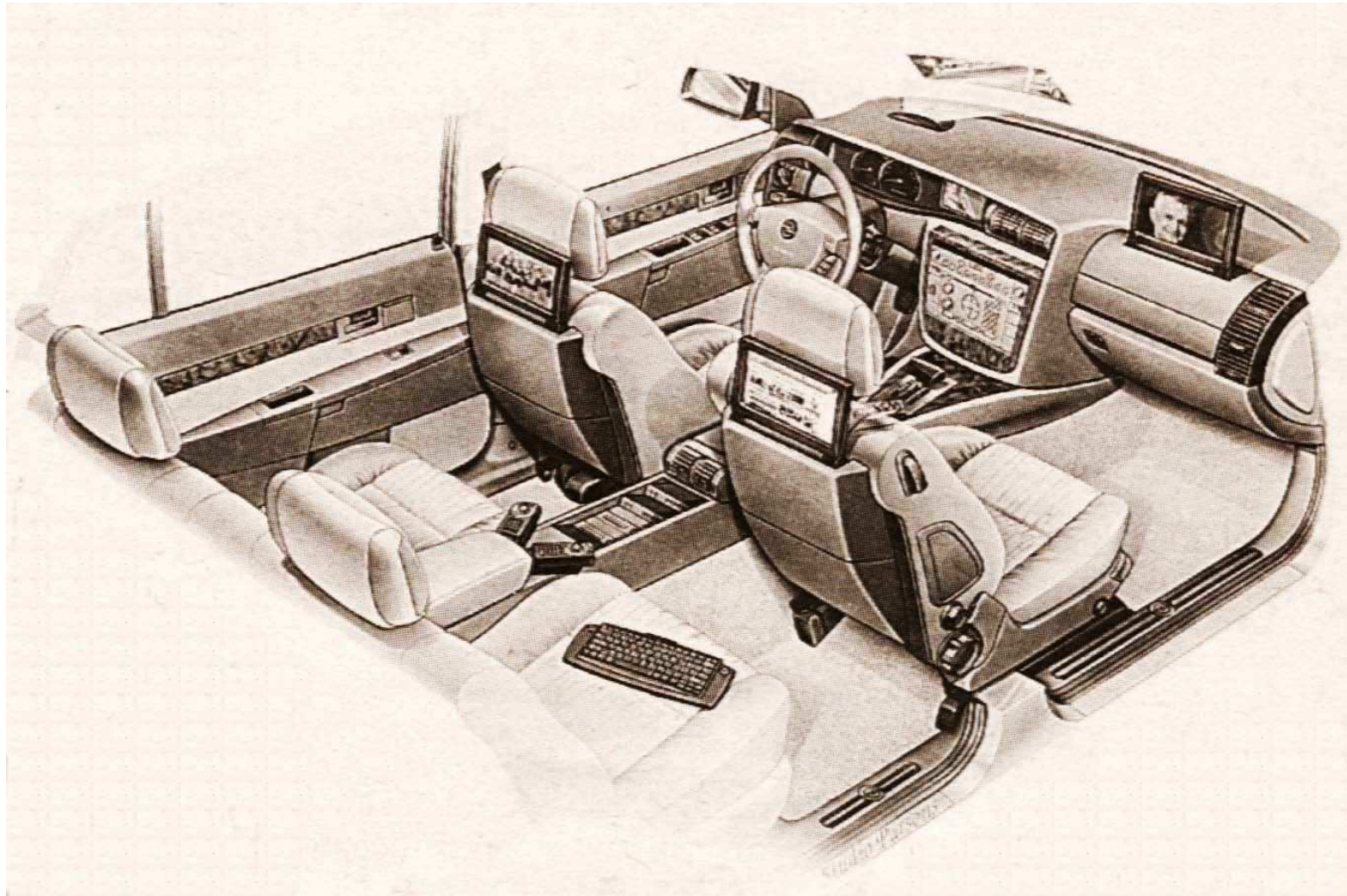
- **Sheep Liver & Names of Gods**

• <http://www.ou.edu/class/ahi4163/files/bronz12.html>



The idea of representing data visually has been around for much longer than computer based visualisation. The linking of the spread of cholera to water supply provides an early example of the use of visualisation in problem analysis. During the 1853-54 cholera outbreak in London, Dr. John Snow identified a large grouping in the Soho area. He went on to plot the homes of the 500 victims who died in the first 10 days of September 1854 on a map of the area. This simple representation of the data he had collected showed that the grouping of cholera sufferers in the area was centred round a particular water pump. Investigation of this water pump established that it had been contaminated by a leaking cesspool.

Opel OMEGA



Bratislava



Chatam Sófer M. by J. Krizik

- WCH?



Virtual Heart of Central Europe, Culture

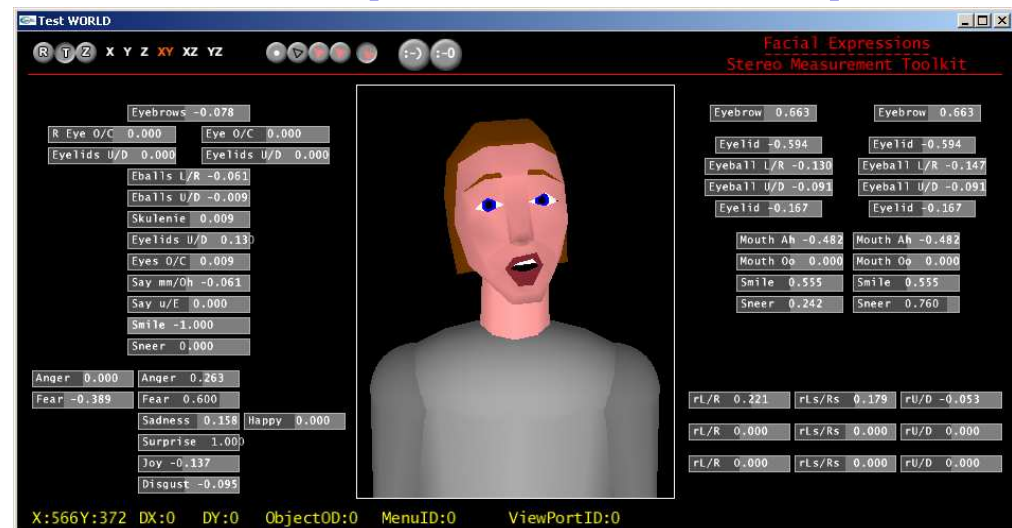
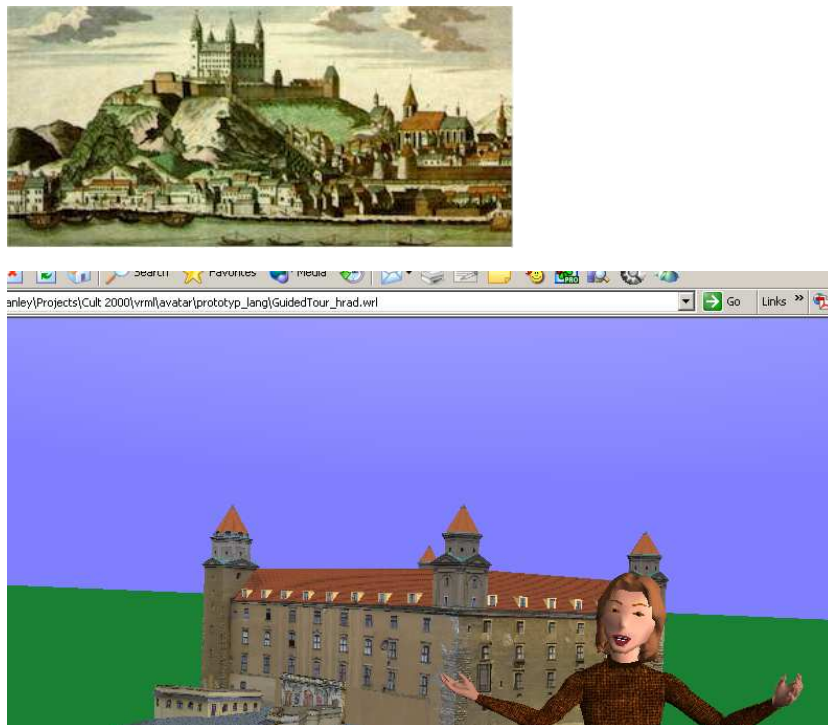


- Awarded by EuroPrix Quality Seal

www.VHCE.info

- 330 kEUR, 150 kEUR from EC, ready to submit – Pirelli Award
- follow-up 2005-2006 (SK, SI, PL, CZ), submitted, 256 kEUR

Navigation & Cooperation in VEs: Virtual Bratislava (2002-2004)



<http://www.sccg.sk/~projects/>

- 900 000 SKK, 506 000 SKK from Slovak government, APVT agency
- Follow-up 2005++
- Key researchers M. Zimanyi, S. Stanek & P. Kubini

Metaphor

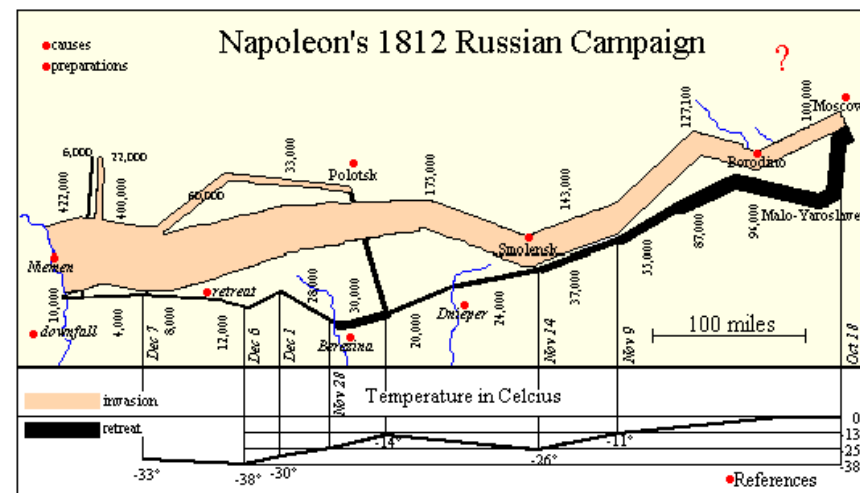
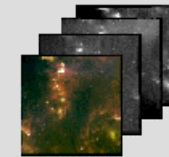
- **Confrontation of Meanings**
- **Pritaca, comparison...**
- **For example, desktop metaphor, GUI**
- **...Sweeping, D&C, Simulated Annealing...**
- **Recall Koestler & bisociation**
-

March of the Napoleon Army

Computer-generated Visualization

1. Introduction to Visualization

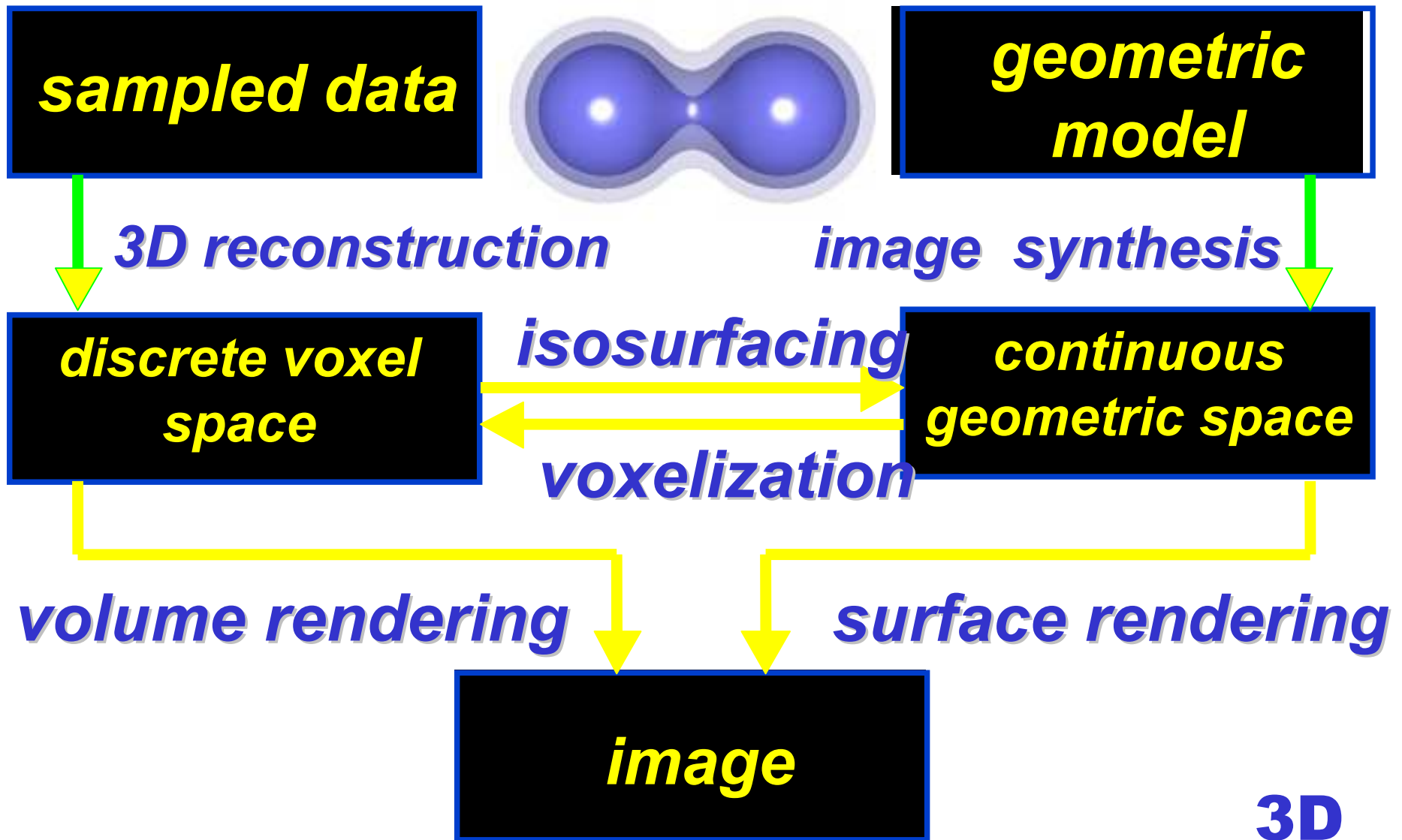
Examples of Visualization



This graphic is an adaptation of M. Charles Joseph Minard's „March of the Napoleon Army" by Sunny McClendon, as part of an Information Design Class at the University of Texas at Austin.

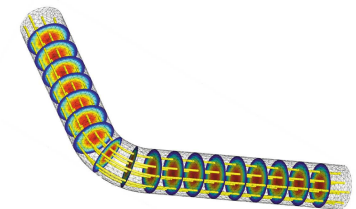
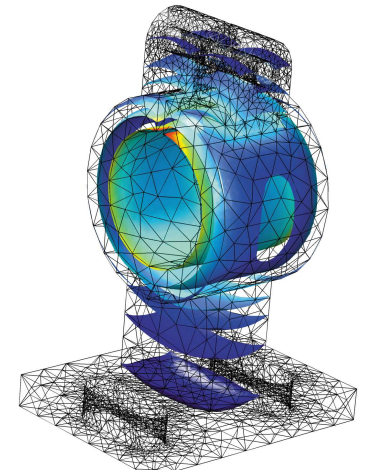
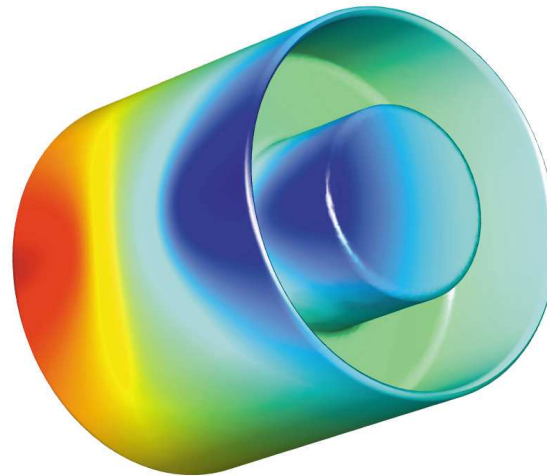
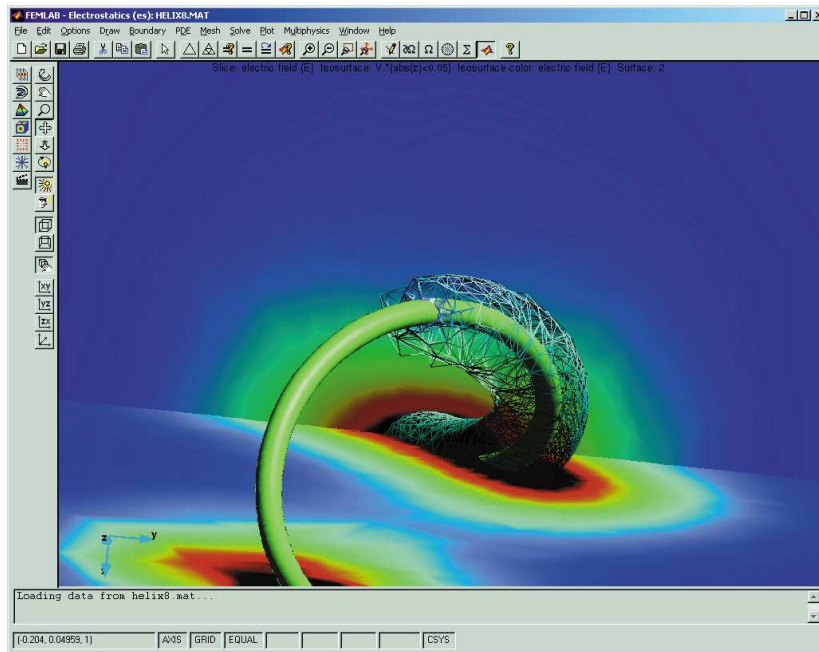
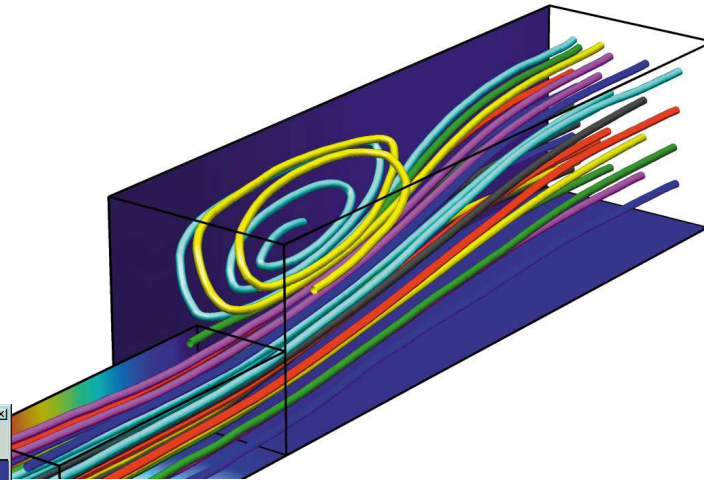
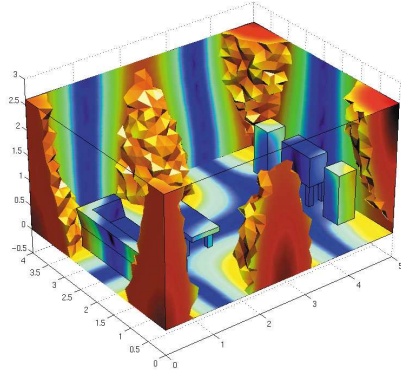
1D

Volume .. Surface



MatLab: www.femlab.com

moreD



Viz-Course Contents

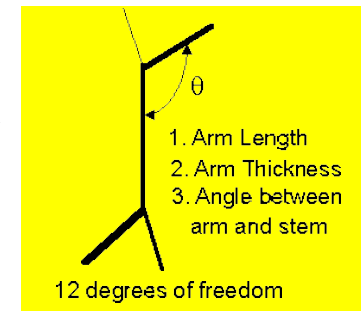
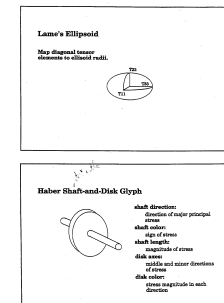
- **1. Introduction, motivation**
reference model, scenarios, graphics and visualization difference
- **2. Data**
data types, coordinate representations, data connectivity
- **3. Mathematical models and languages**
- **4. Representation**
scalar, vector, tensor, multivariate, using color, glyphs
- **5. Visualization software**
- **6. Information Visualization**
graph drawing, algorithm animation, ...
- **7. Recent Directions**
data sonification, visualizing relativity, NPR in scientific visualization...

Visualization of Data

- 1D, 2D, 3D: **Rendering**
- 4D: **Animation (Juran.)**
- nD - in general: **Open Problem**
- Glyphs, faces by statistician Herman Chernoff
 - <http://people.cs.uchicago.edu/~wiseman/chernoff/>
- other metaphors: terrain, garden, IFS...

Glyphs

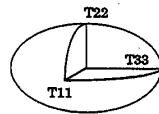
- **UNICODE glyphs: A, @, 7, α , β , γ , δ , Σ , θ , ω ... ?, *, §, ... symbolic information**
- **Visualization glyphs**



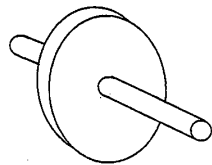
Visualization Glyphs

Lame's Ellipsoid

Map diagonal tensor elements to ellipsoid radii.



Haber Shaft-and-Disk Glyph



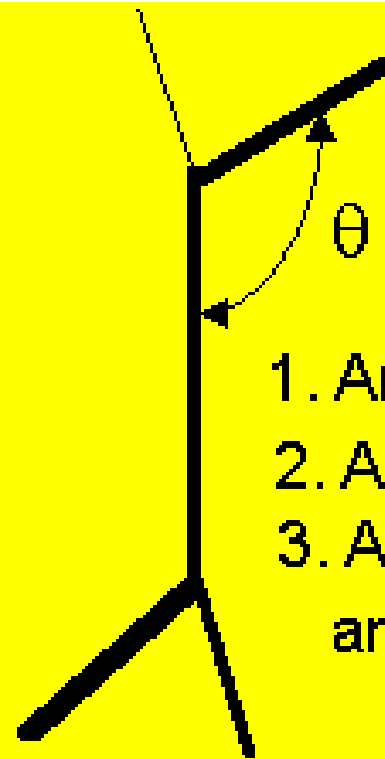
shaft direction:
direction of major principal stress

shaft color:
sign of stress

shaft length:
magnitude of stress

disk axes:
middle and minor directions of stress

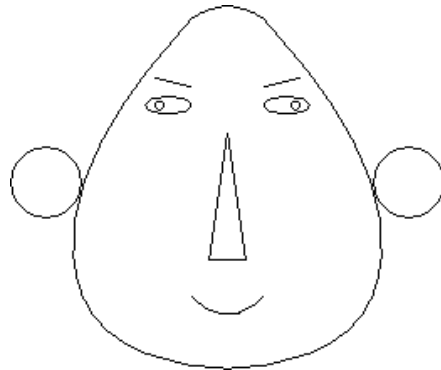
disk color:
stress magnitude in each direction



1. Arm Length
2. Arm Thickness
3. Angle between arm and stem

12 degrees of freedom

Chernoff Faces



20D

- http://www.epcc.ed.ac.uk/epcc-tec/documents/SciVis-course/SciVis.book_47.html

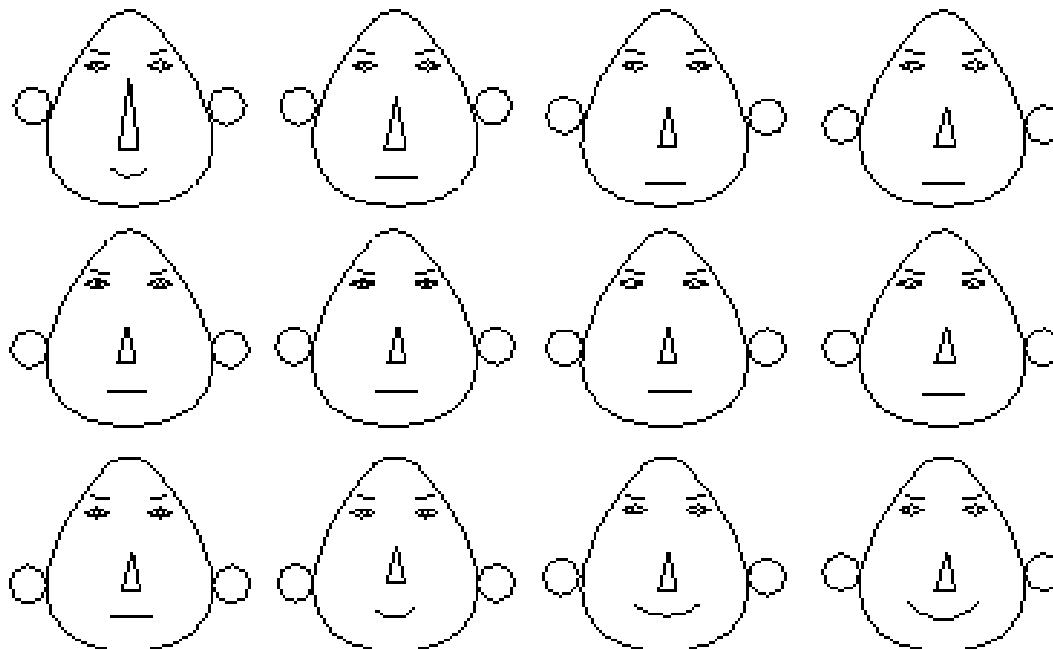


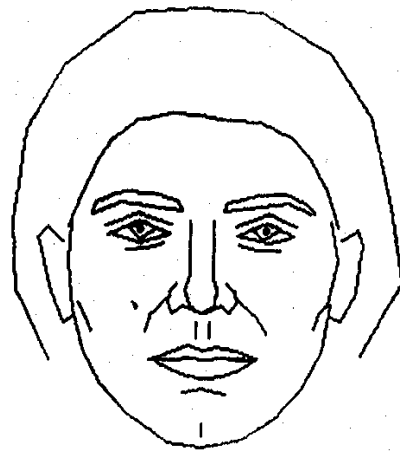
Table 1: Description of facial features of Chernoff face

Dimension	Facial Feature
1	Face width
2	Ear level
3	Half face height
4	Eccentricity of upper ellipse of face
5	Eccentricity of lower ellipse of face
6	Length of nose
7	Position of centre of mouth
8	Curvature of mouth
9	Length of mouth
10	Height of centre of eyes
11	Separation of eyes
12	Slant of eyes
13	Eccentricity of eyes
14	Half length of eye
15	Position of pupil
16	Height of eyebrow
17	Angle of brow
18	Length of brow
19	Radius of ear
20	Nose width

Facial Representation of nD Data?

Fig.3:

A
neutral
nose
face.



362D

- **Susan Brennan, 1985 and**

<http://www.sccg.sk/~ferko/VISFORUMABSTRACT.pdf>

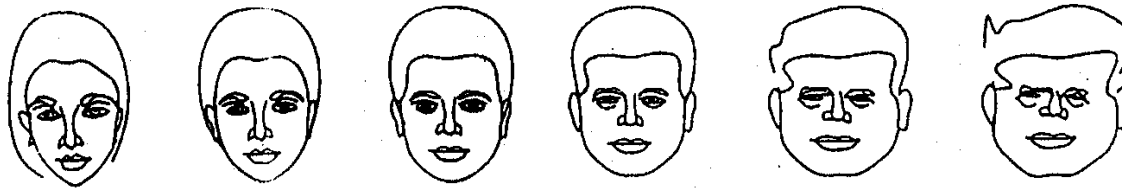


Fig.1: E. Taylor and Kennedy during changing their faces.

Fig. 4.1



Fig. 4.2



Fig. 4.3

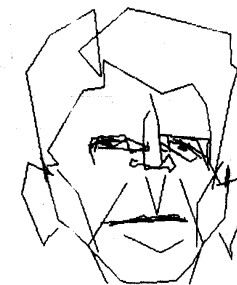


Fig. 4.4



Fig. 4.1 - 4.4: An example of four step generation of the caricature. Figure 4.1 represents a data snapped from the real image of the former president R. Reagan.

Reagan

-
- .

Fig. 4.1



Fig. 4.2



Fig. 4.3

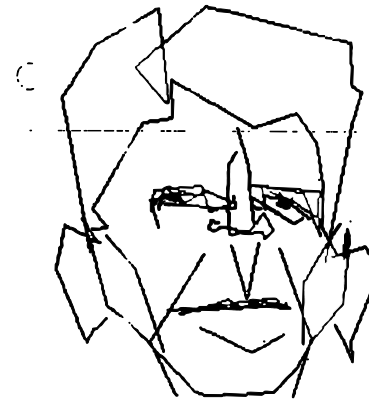


Fig. 4.4

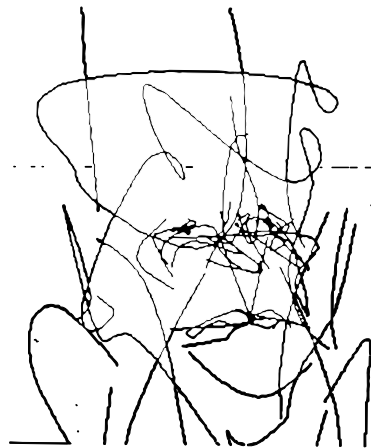
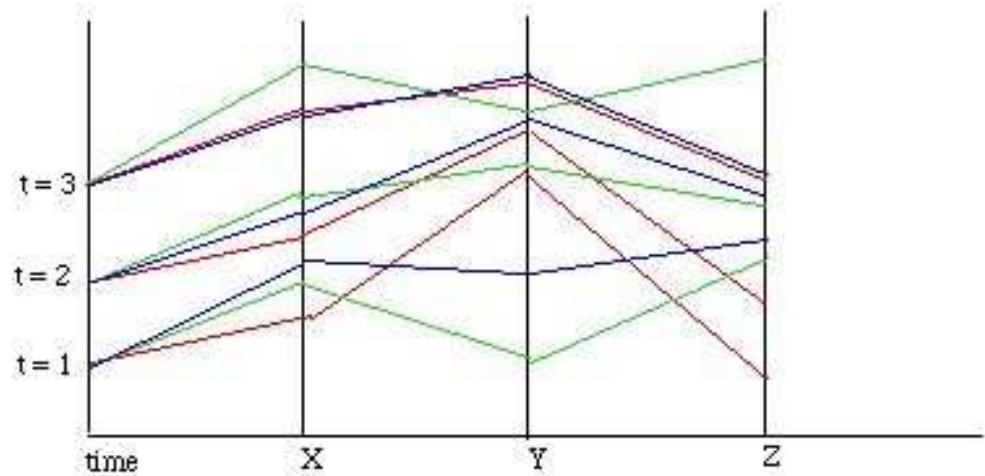


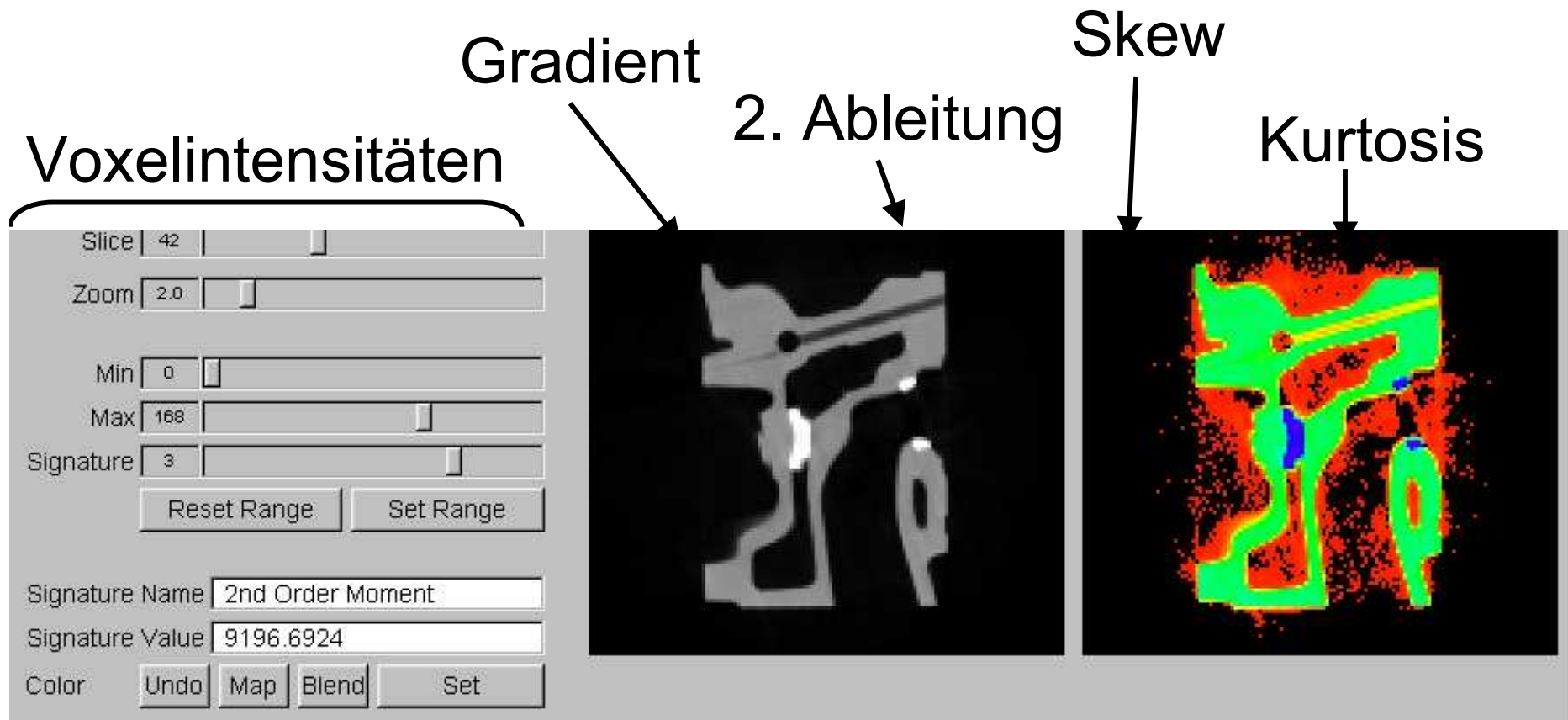
Fig. 4.1 - 4.4: An example of four step generation of the caricature. Figure 4.1 represents a data snapped from the real image of the former president R. Reagan.

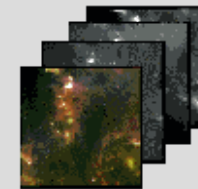
Parallel Coordinates

- INSELBERG, A. DIMSDALE, B. 1990. "Parallel Coordinates: A Tool for Visualizing Multi-Dimensional Geometry," Proc. of the First IEEE Conference on Visualization. 361 (1990).
- <http://www.caip.rutgers.edu/~peskin/epriRpt/ParallelCoords.html>

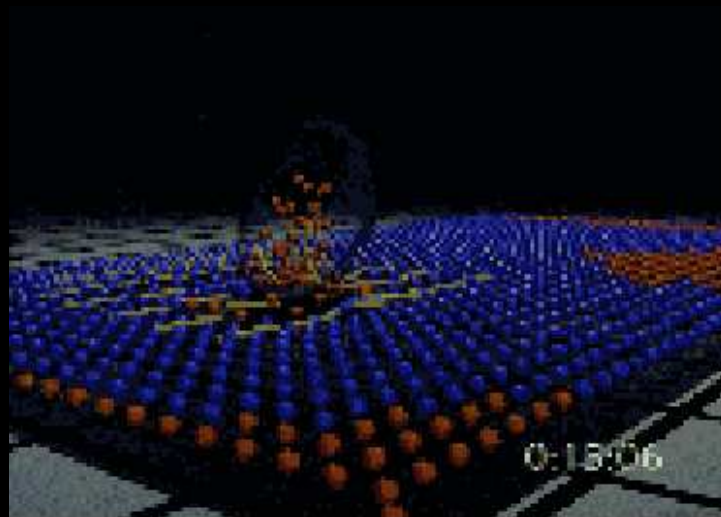


Volumendarstellung (19), Dr. Bartz



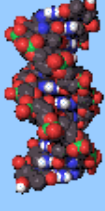


Examples of Visualization



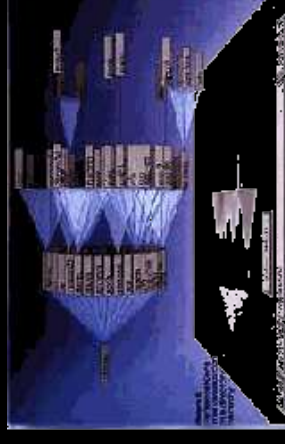
„Study of a Numerically Modeled Severe Storm“, Video by Williamson, Robert et al.
(Department of Atmospheric Studies and NCSA).

2.4 Examples



Complex data sets and their visual counterparts, e.g.

- scientific visualization
- proteins
- software
- web pages

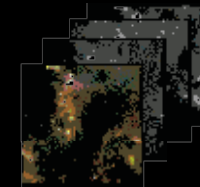


Perspective Wall and Cone Tree: from CACM April 1993, Information Visualizer by Robertson, Stuart and Mackinlay.

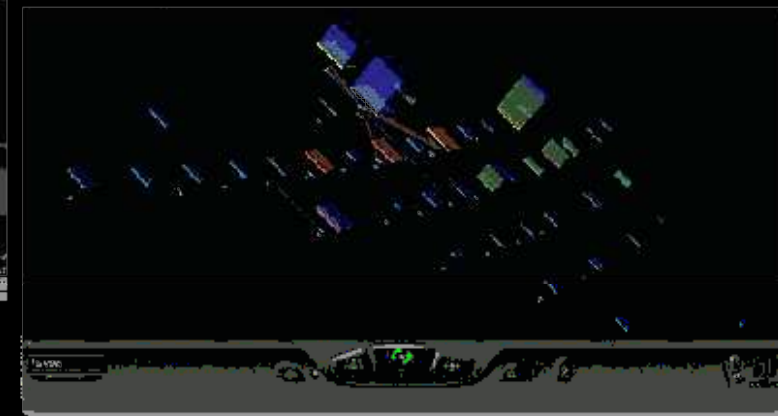
3 April, 2000

Page 19

- *Used even in movies: CSIs, Assa, Hackers 2, Amelie de Montmartre...*



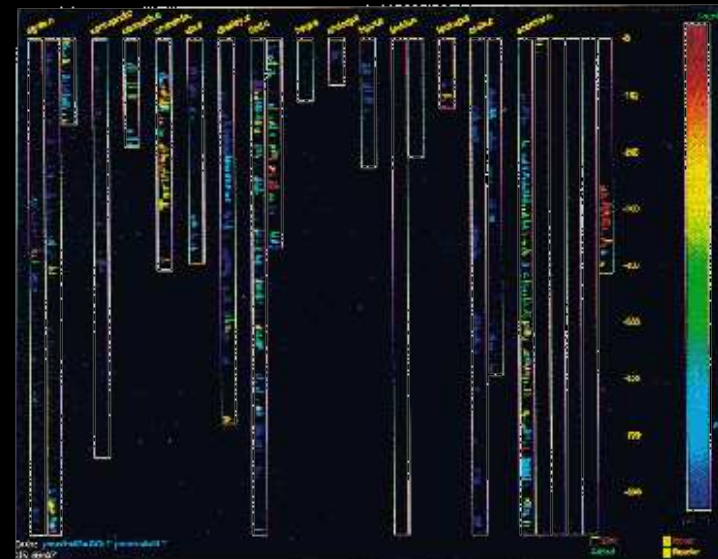
Examples of Visualization



Bauch, Kaiser, Steinkamp. Visualization of Internet Access at the University of Paderborn. Project Work.

25 Mai, 2000

Page 16

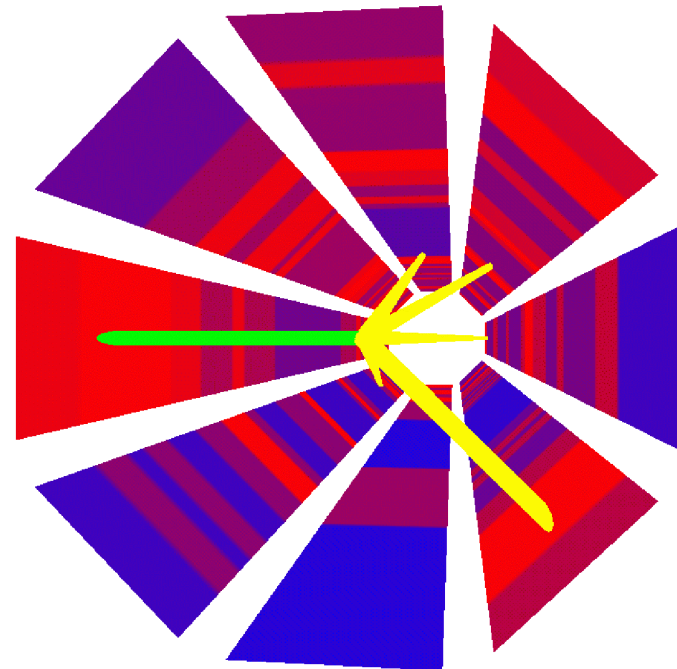
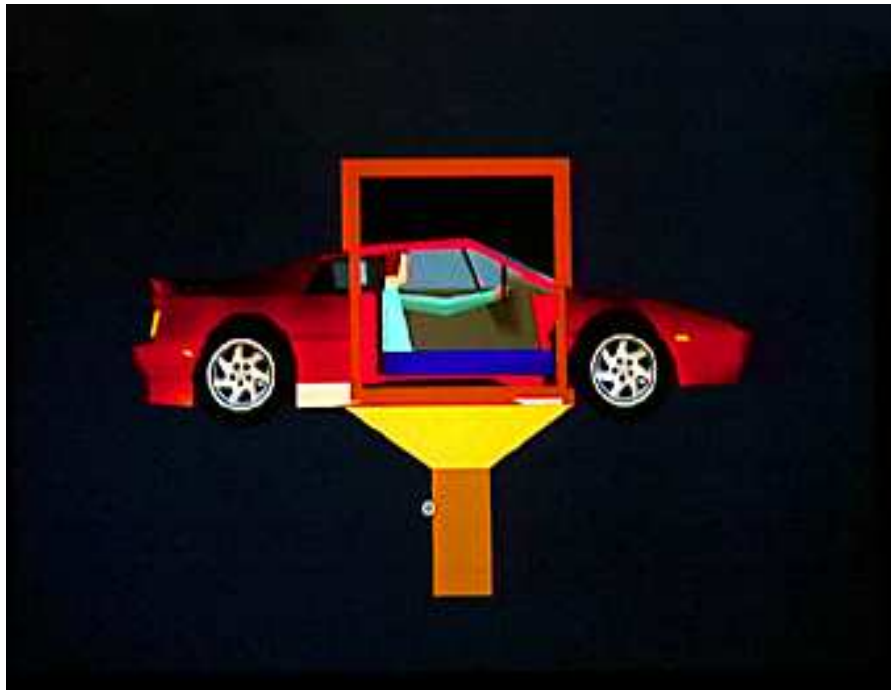


From: S.G. Eick and J.L. Steffen,
Proc. Vis'92, IEEE Comp. Soc. Press

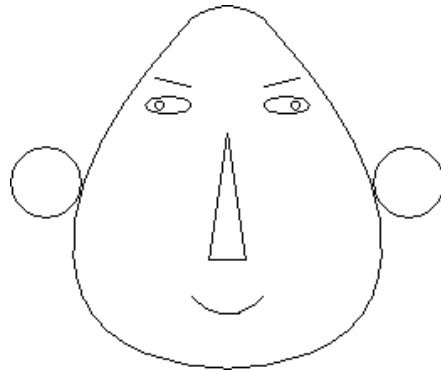
Page 15

Visualization Magic...

- **Magic Mirror by Jerome Grosjean et al.**
- **Magic Tunnel by Bernhard Reitinger et al.**



Chernoff Faces



20D

- http://www.epcc.ed.ac.uk/epcc-tec/documents/SciVis-course/SciVis.book_47.html

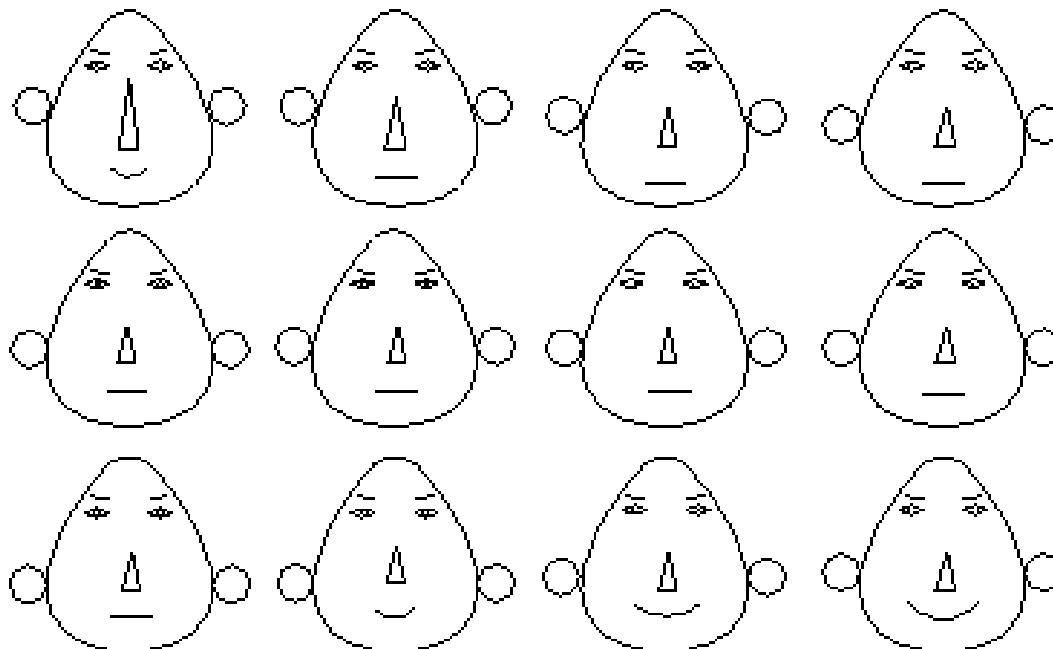


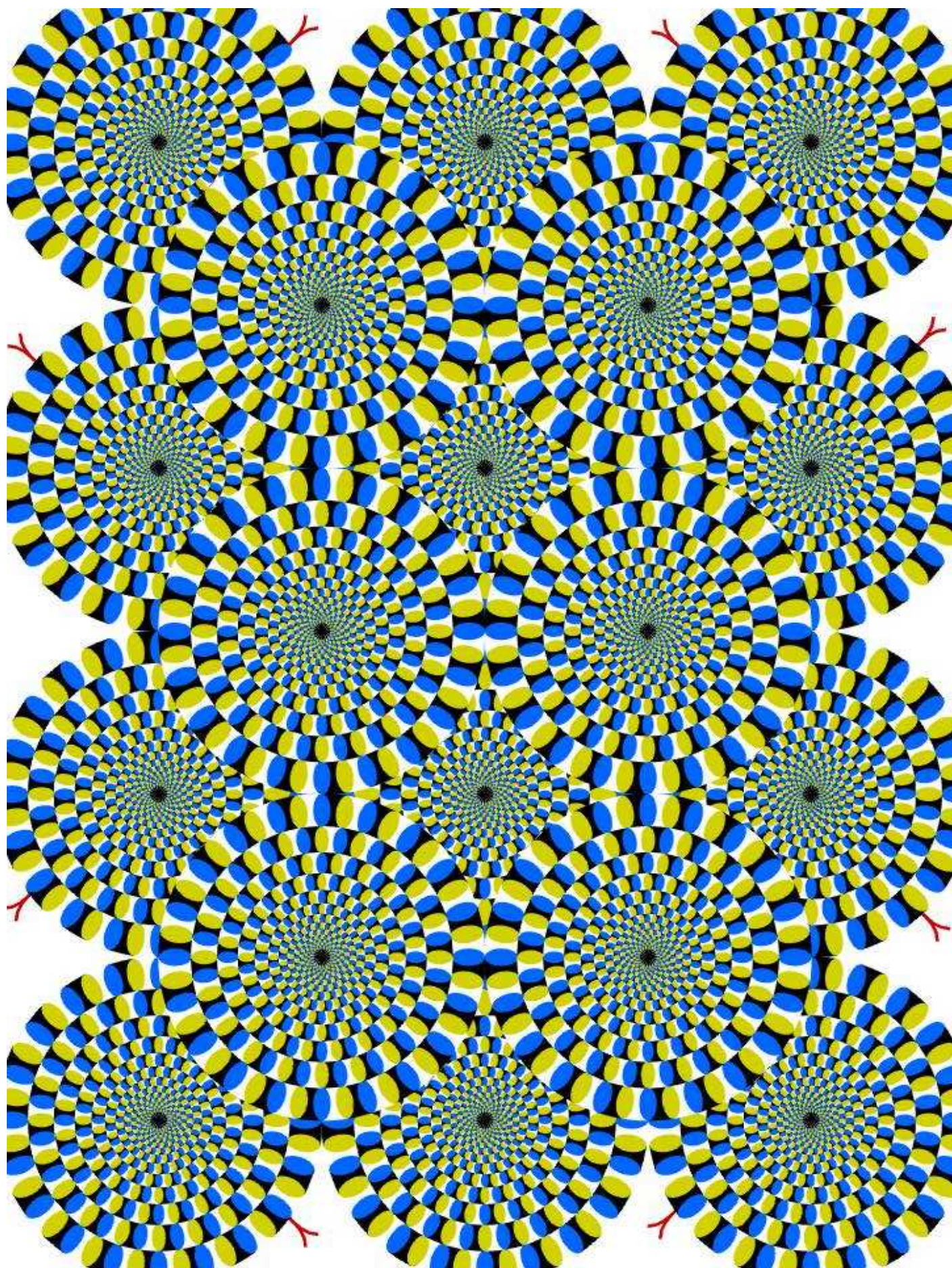
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12	Slant of eyes
13	Eccentricity of eyes
14	Half length of eye
15	Position of pupil
16	Height of eyebrow
17	Angle of brow
18	Length of brow
19	Radius of ear
20	Nose width

NPR Visualization



- <http://mrl.nyu.edu/projects/image-analogies/artistic.html> (SIGGRAPH 2001)





• Final Fantasy

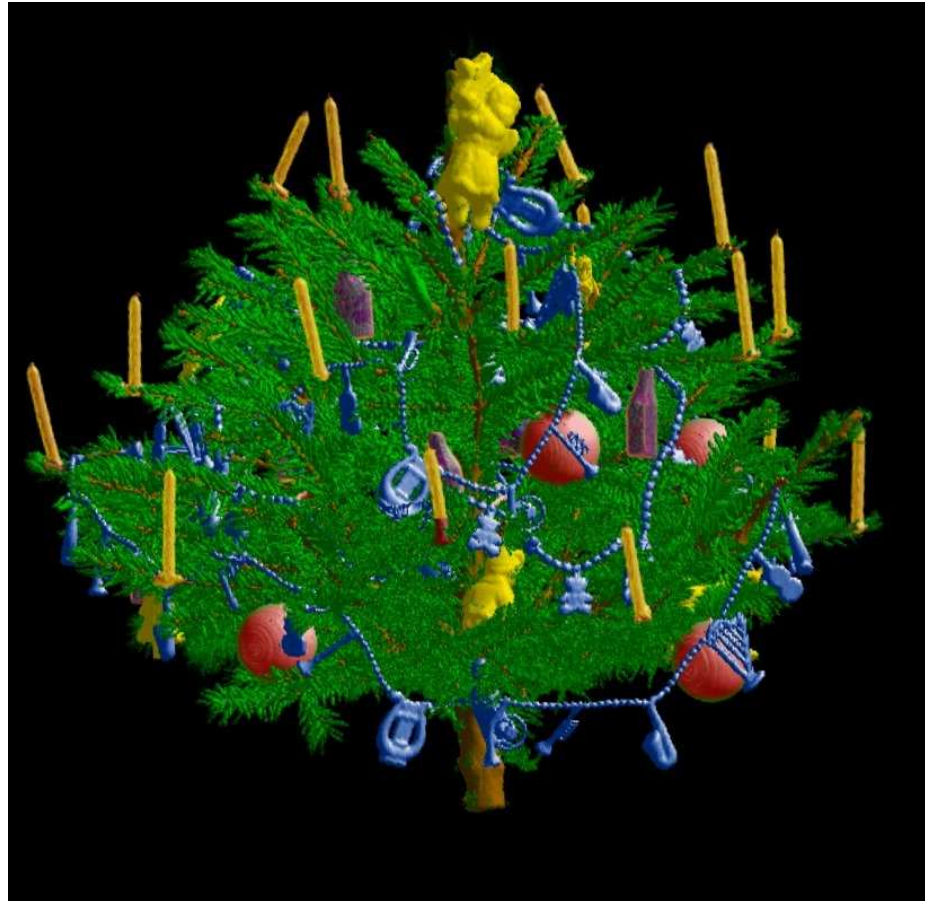


IMAGINATION/VR

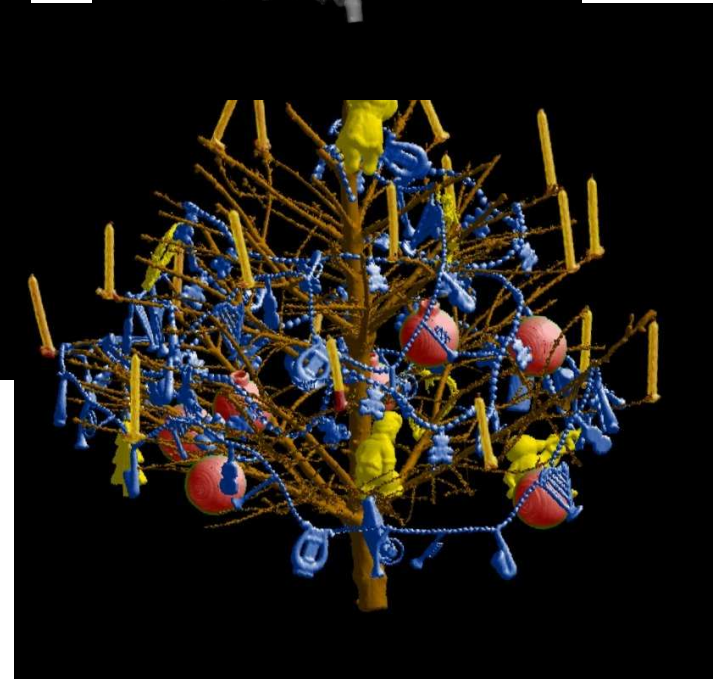
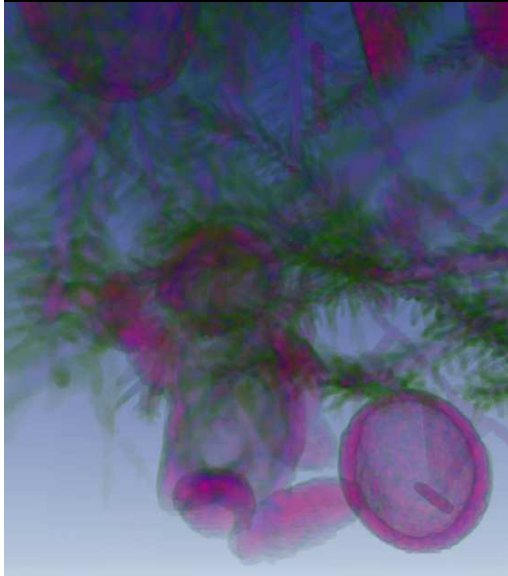
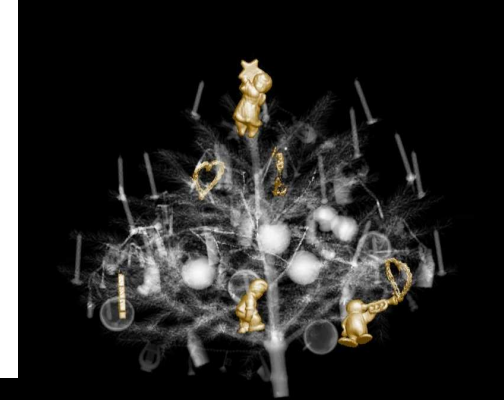
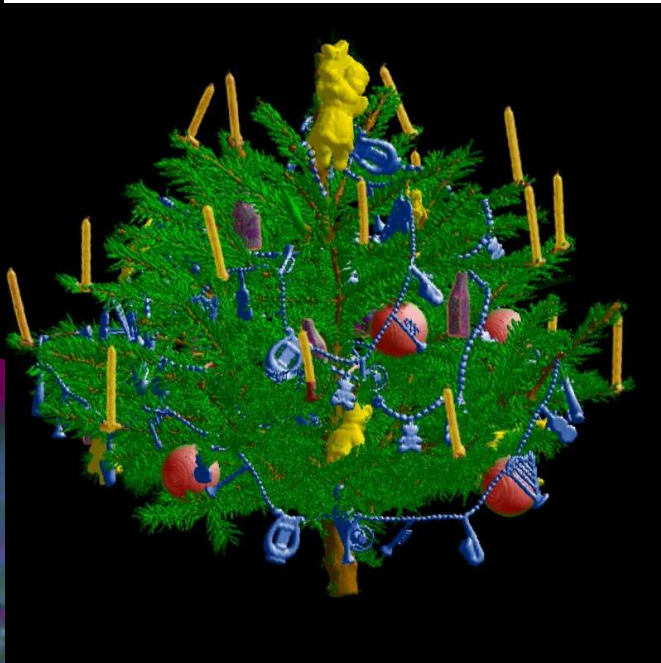


Xmas Tree in Heaven

- Christmas Tree Awarded Case Study, TU Vienna



Xmas Tree in Heaven



Conclusions...

- **www.sccg.sk/~ferko**
- **pg.netgraphics.sk**
- **www.siggraph.org**
- **Computer graphics reference model**
- **Visual information processing
motivation and methodology**
- **Thank You for Your attention**

Computer Graphics

Motivation and Introduction



Andrej FERKO
Comenius University Bratislava
May 2006, online