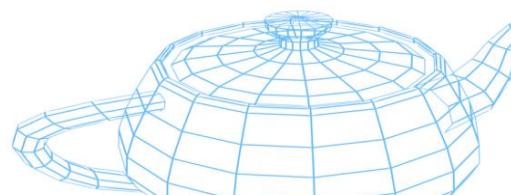


SUPSI

Computer Graphics

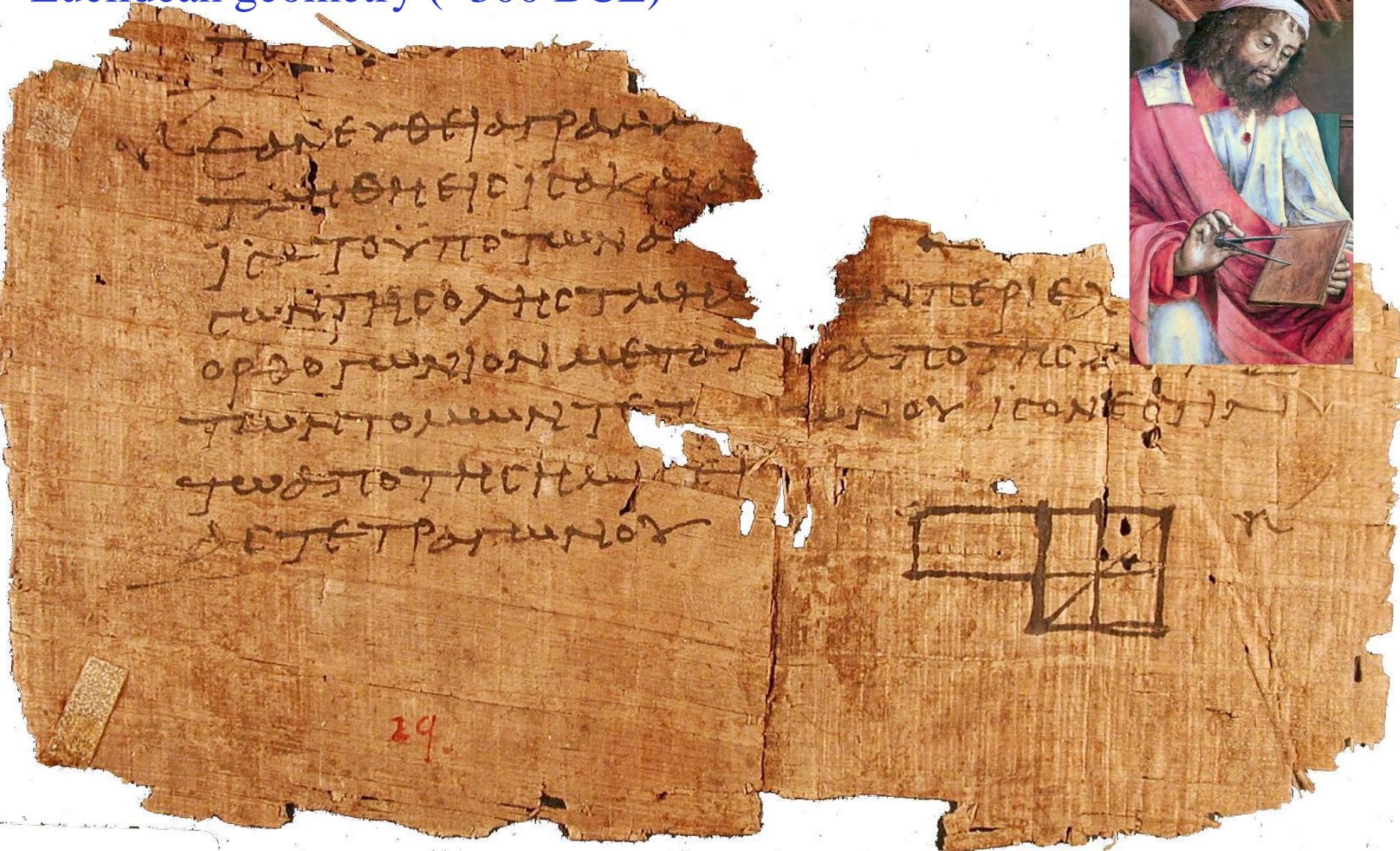
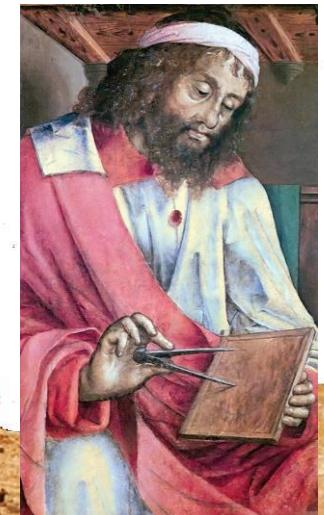
A brief history of Computer Graphics

Achille Peternier, lecturer

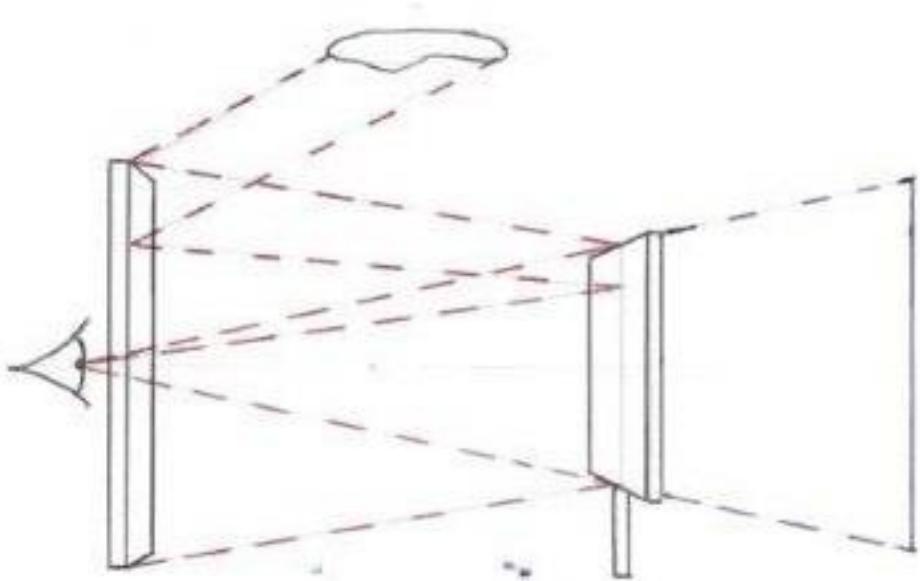


Euclidean geometry (~300 BCE)

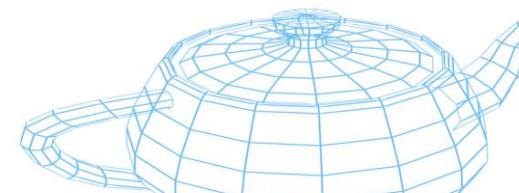
Euclid of Alexandria
~300 BCE



Perspective (~1413)



Filippo Brunelleschi
1377 - 1446



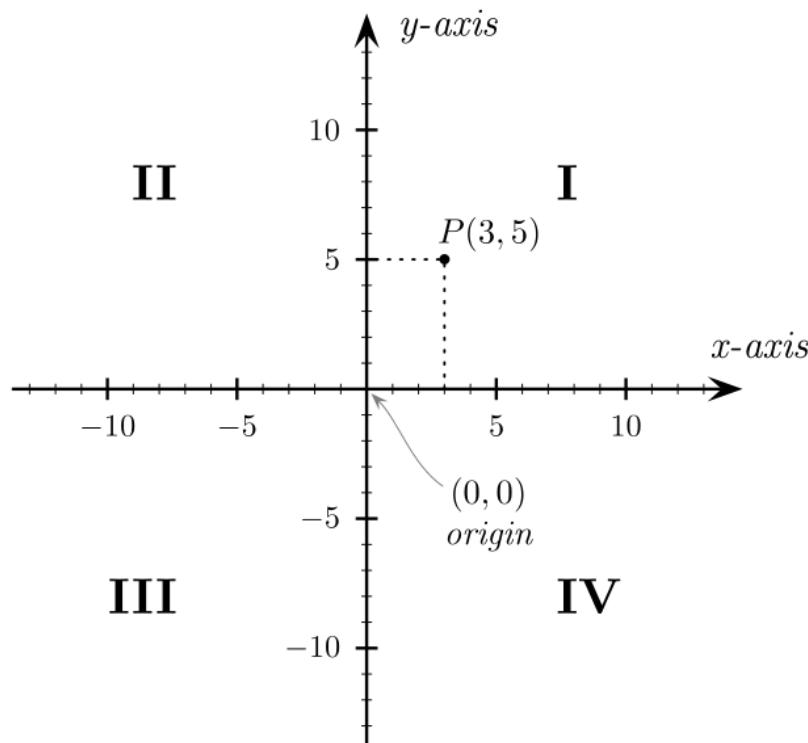


Città ideale, anon., ~1480-90

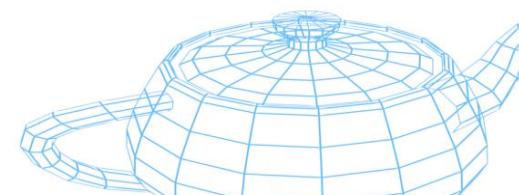


Andrea Pozzo, church of S. Ignazio, Rome (1691-1694)

Coordinate systems (1637)



René Descartes
1596 - 1650



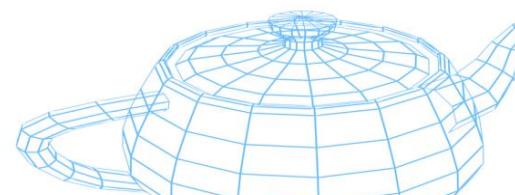
Homogeneous coordinates (1827)

August Ferdinand Möbius
1790 - 1868

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{pmatrix}$$

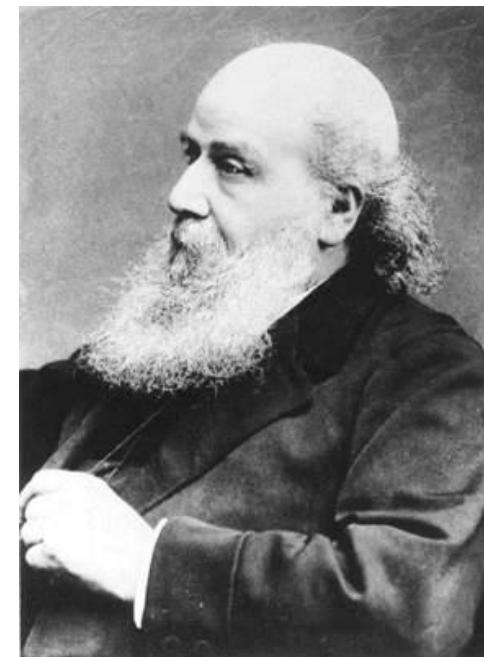


A. F. Möbius

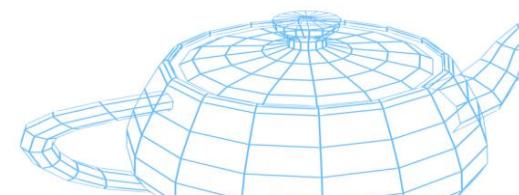


Matrix notation (1850)

James Joseph Sylvester
1814 - 1897

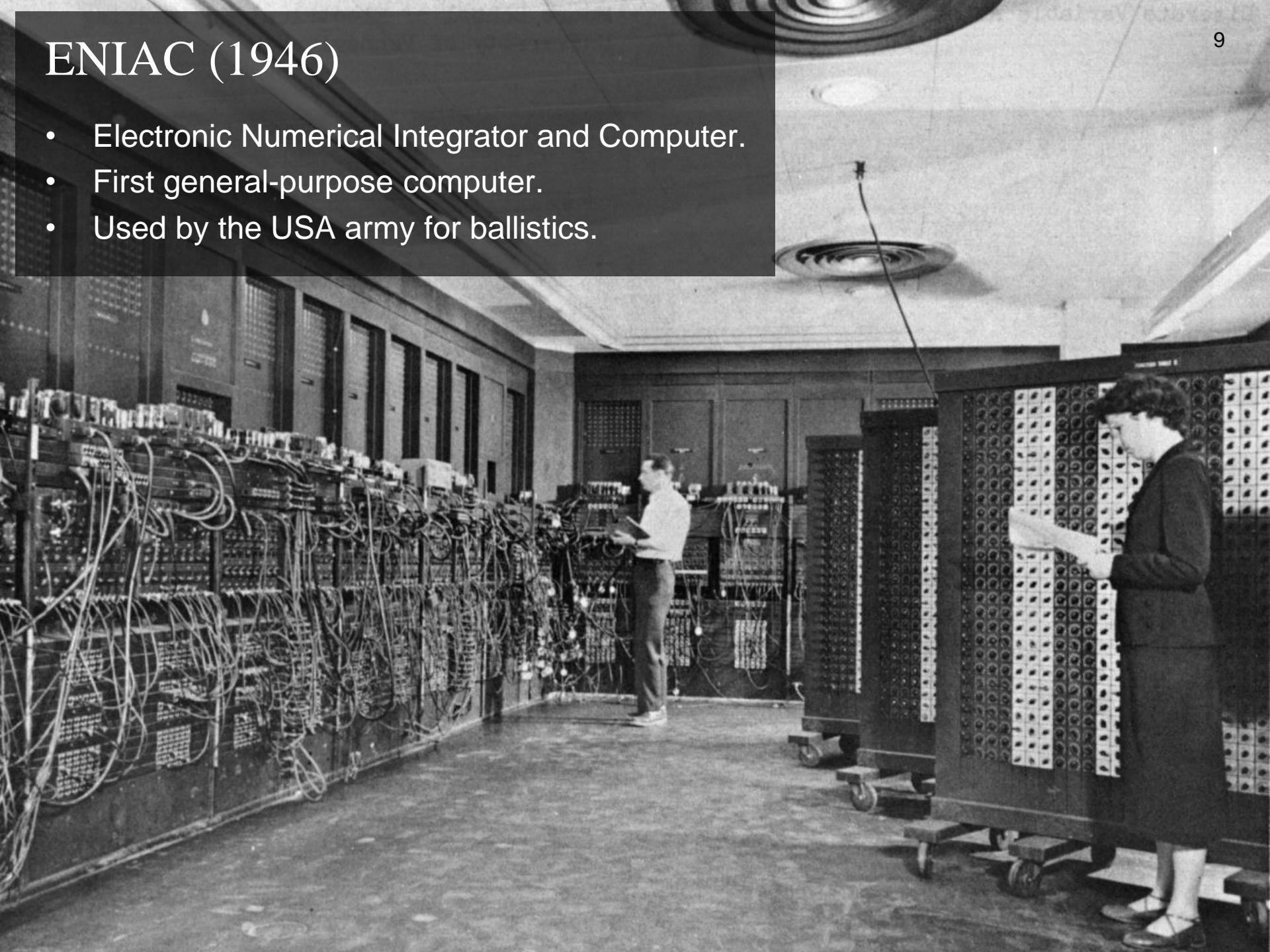


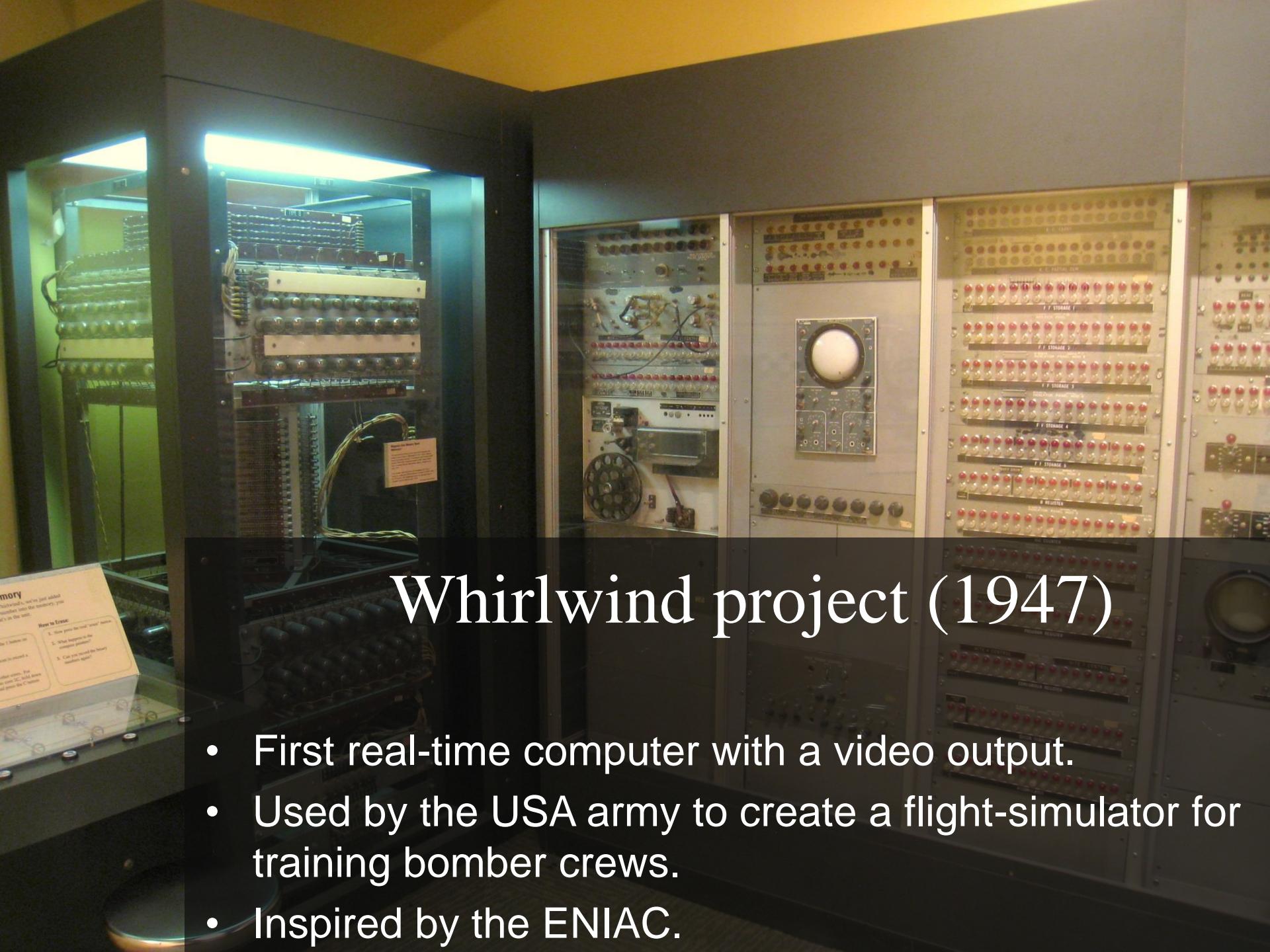
$$\mathbf{A} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix}$$



ENIAC (1946)

- Electronic Numerical Integrator and Computer.
- First general-purpose computer.
- Used by the USA army for ballistics.





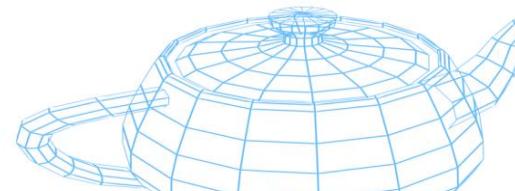
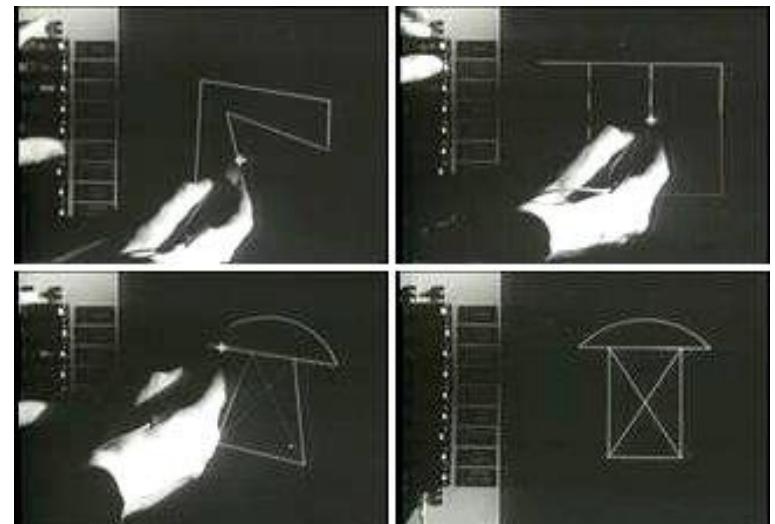
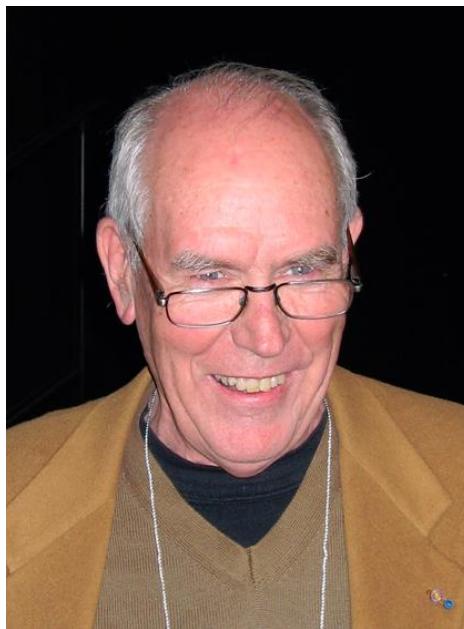
Whirlwind project (1947)

- First real-time computer with a video output.
- Used by the USA army to create a flight-simulator for training bomber crews.
- Inspired by the ENIAC.

Sketchpad (1962)

- Ivan Sutherland, MIT.
- Generally considered as the origins of Computer Graphics.

Ivan Edward Sutherland
1938





INK

“Spacewar!” (1962)

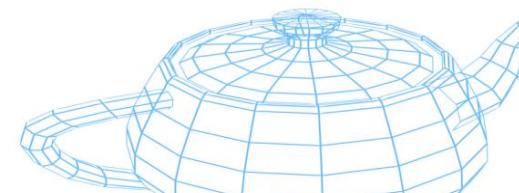
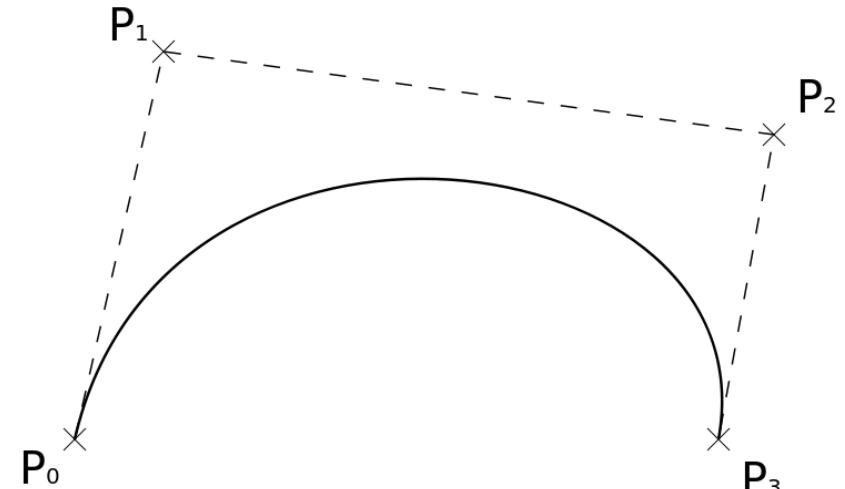
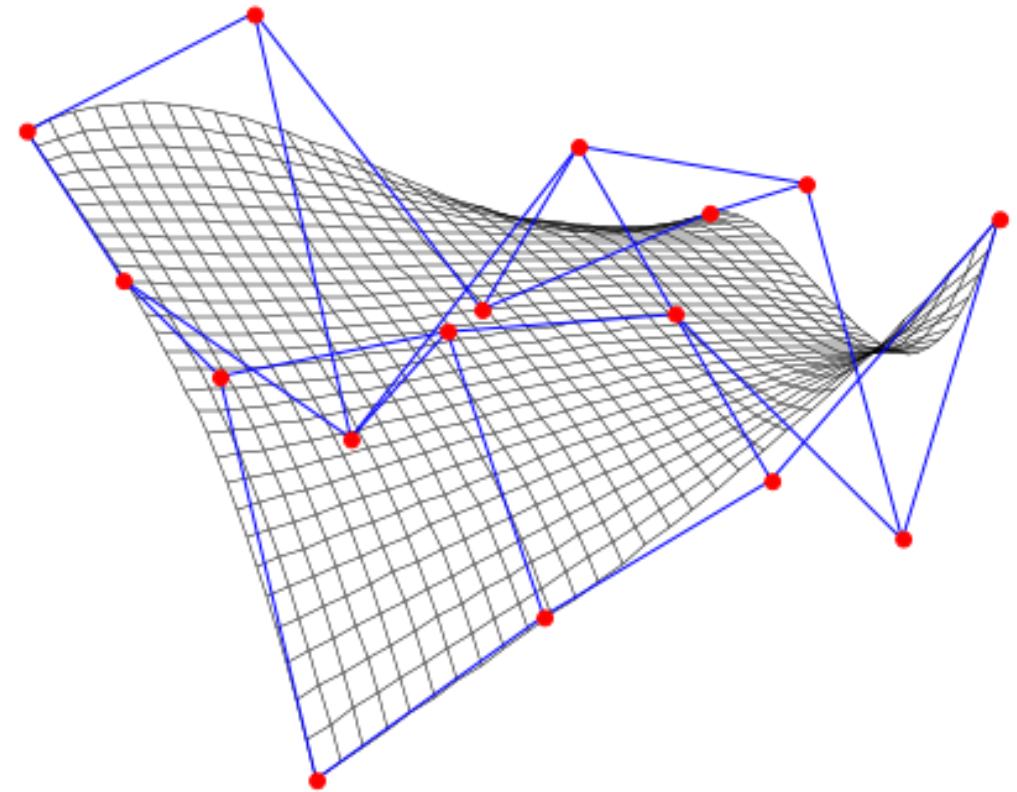
- Steve Russell, MIT.
- First videogame (player VS player).



Bézier curves and surfaces (1962)

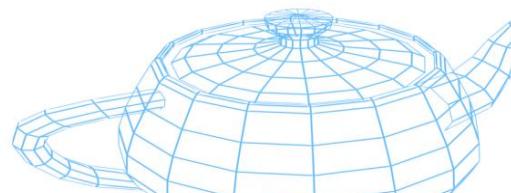
- Pierre Bézier, Renault engineer.
- Parametric, smooth curves used to design automobiles.

Pierre Bézier
1910 - 1999



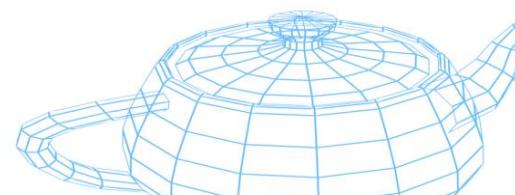
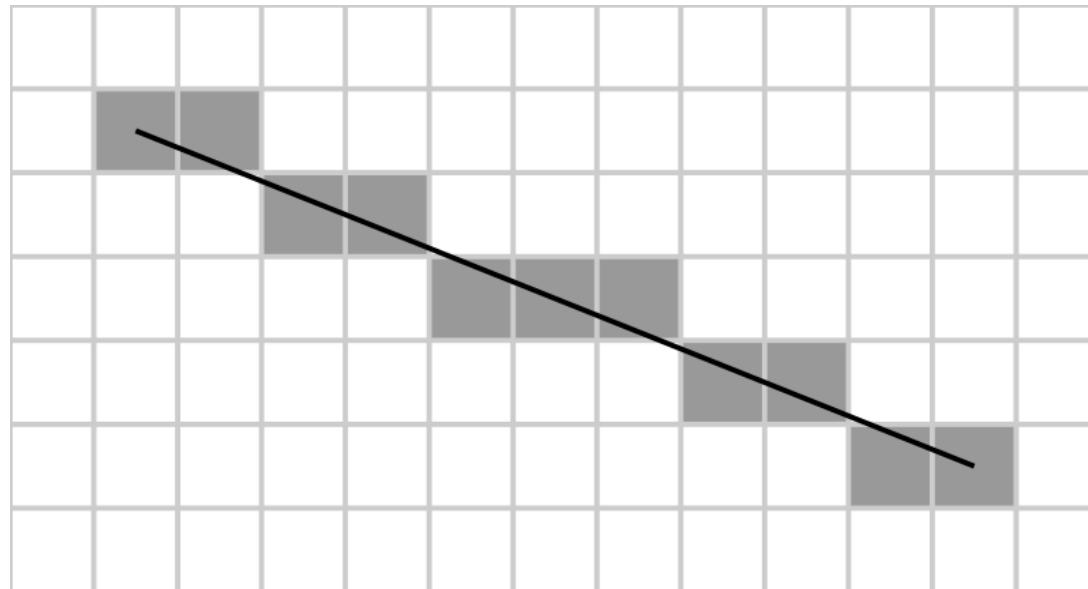
The mouse (1963)

- Douglas Engelbart, Standford Research.



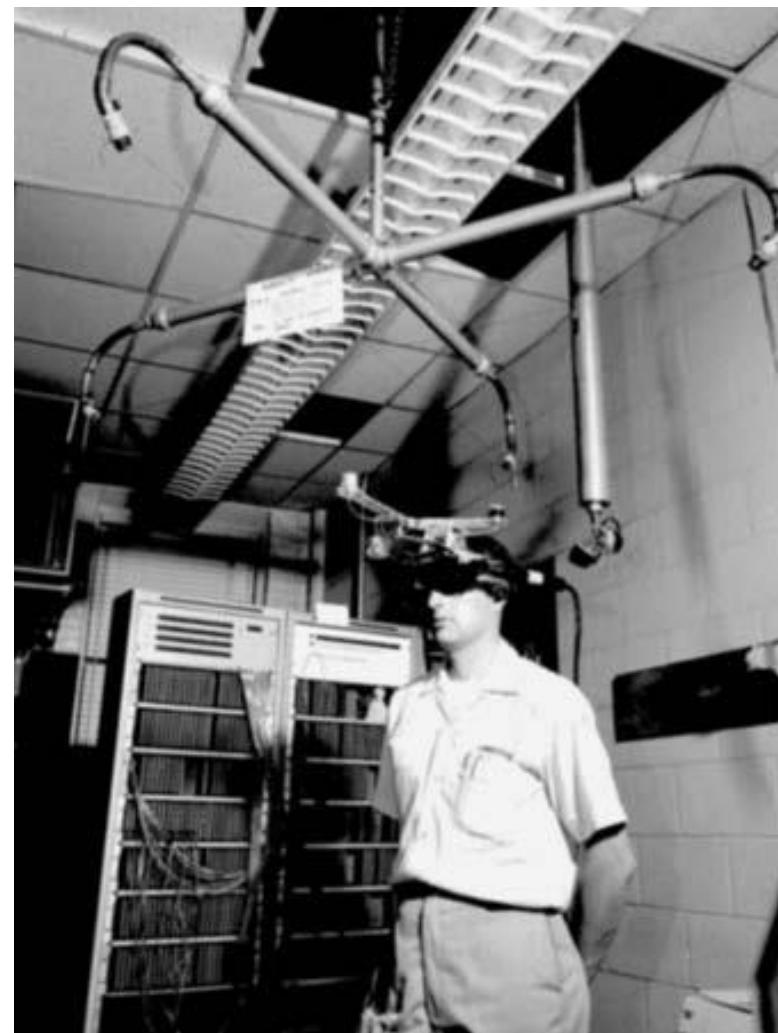
Line drawing algorithm (1965)

- Jack Bresenham, IBM.
- It requires only integer operations (addition, subtraction and bit shifting).



First stereographic HMD (1966)

- Head Mounted Display (HMD).
- Ivan Sutherland, MIT.
- “Sword of Damocles”.
- Wireframe.



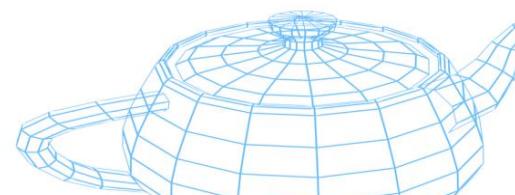
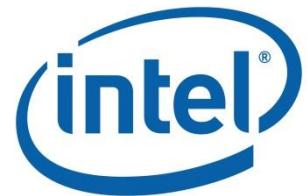
Evans & Sutherland (1968)

- Company specialized in hardware for Computer Graphics.



EVANS & SUTHERLAND

- Intel is founded.





Ray-casting (1968)

- Arthur Appel, IBM.
- Precursor to ray-tracing.

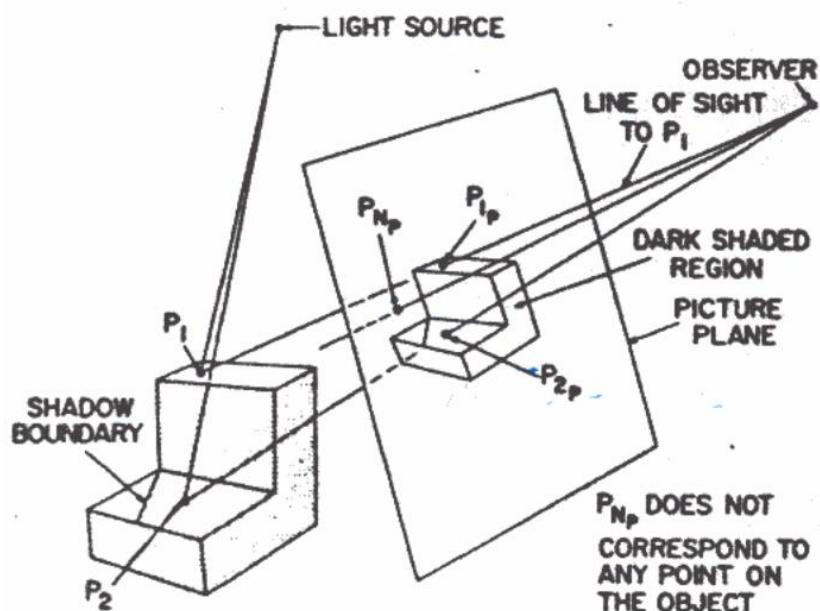


Figure 6 – Point by point shading

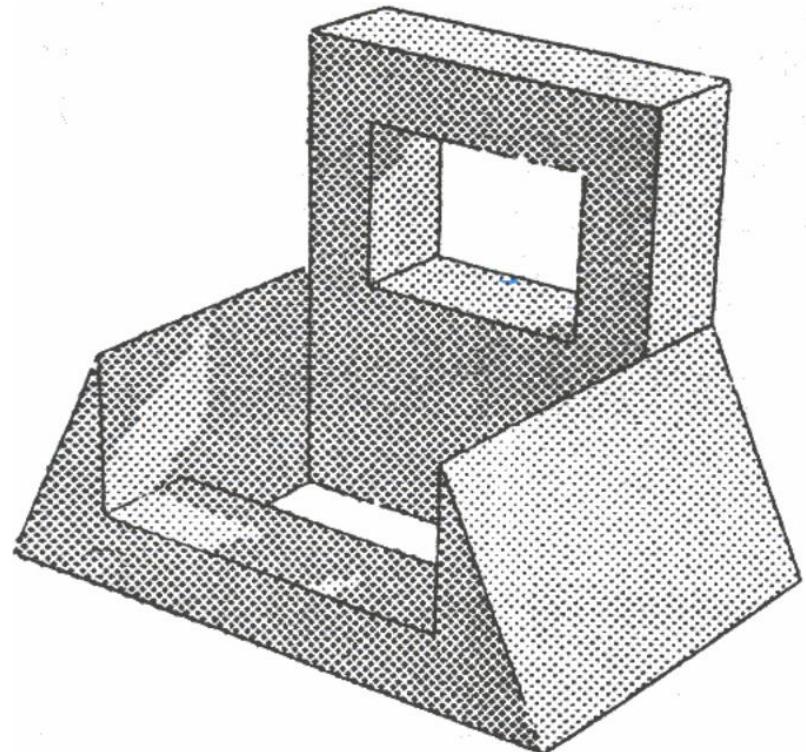
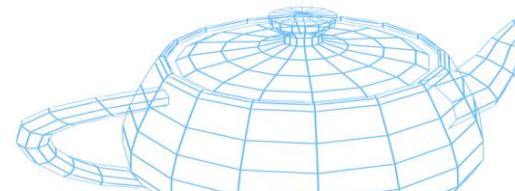
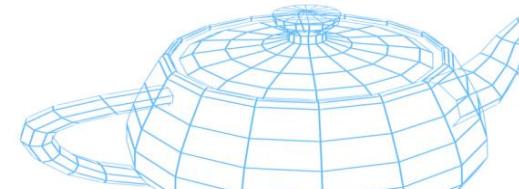


Figure 14 – Another view of the machine part shown in the previous figure. The light source has been moved relative to the object. Notice the light passing through the opening in the object



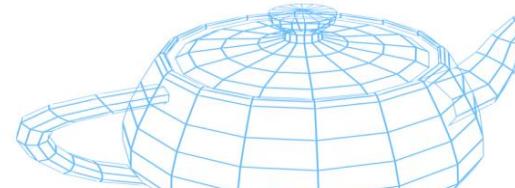
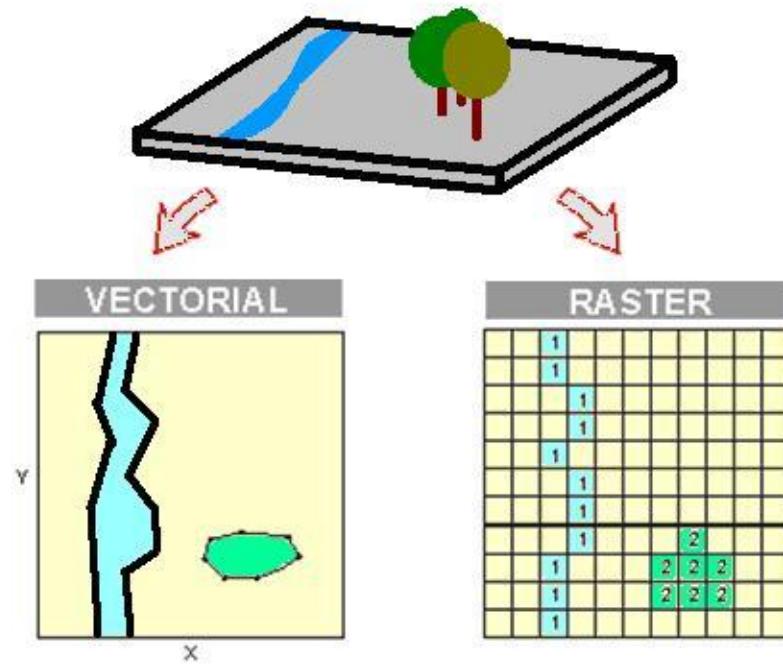
GUI concept (1969)

- Alan Kay, Xerox PARC (Palo Alto):
 - Moved to Apple in 1979.
- Graphical User Interface.



First framebuffer (1969)

- Michael Noll, Bell Labs.
- Transition from vector to raster graphics.

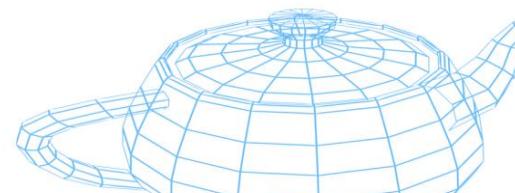
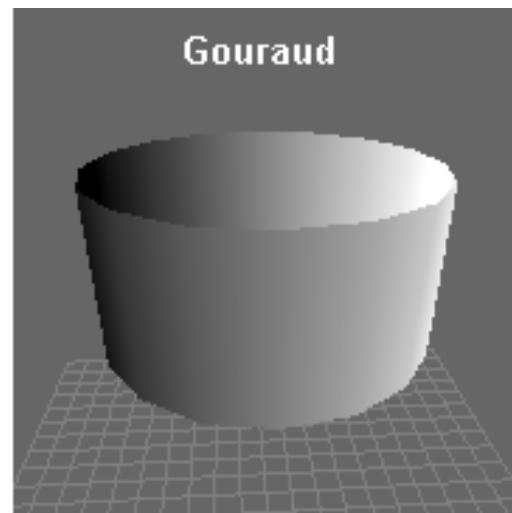
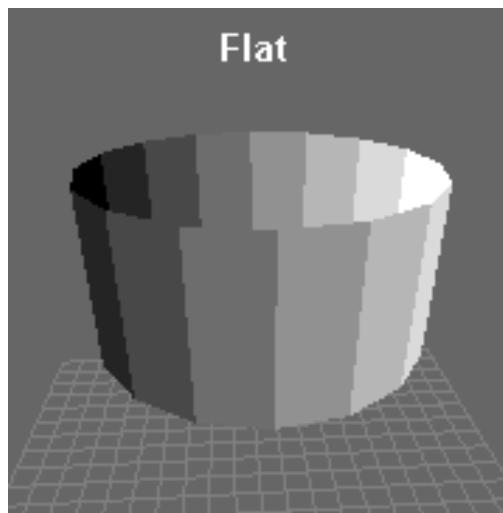


Gouraud Shading (1971)

- Henri Gouraud, Utah UNI.

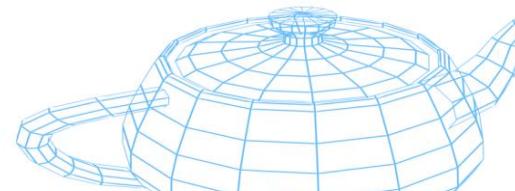
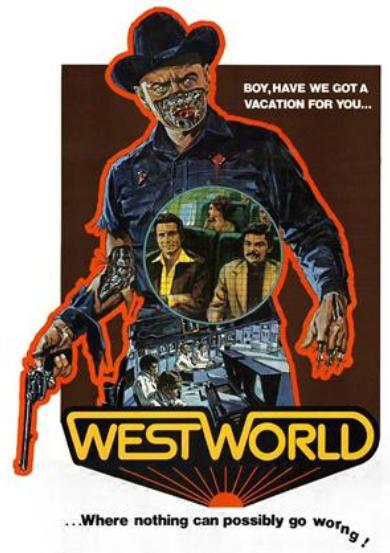


Henri Gouraud
1944



“Westworld” (1973)

- Michael Crichton, writer and director.
- First movie including CGI (Computer Generated Images).

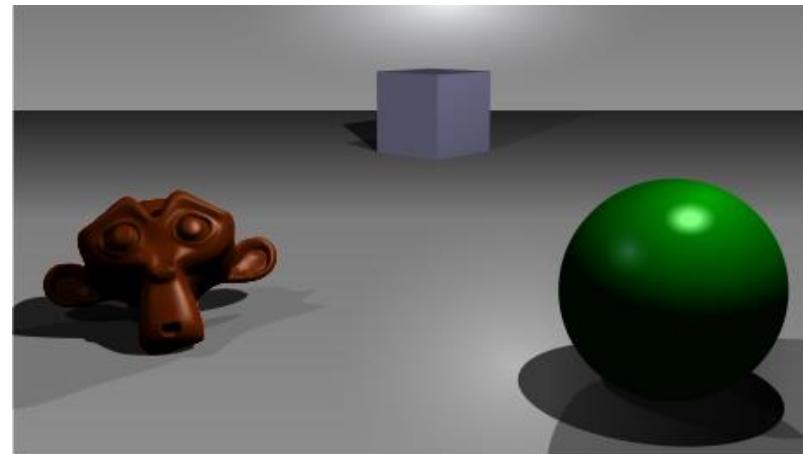


Z-Buffer (1974)

- Edwin Catmull, Utah UNI:
 - Founder of Pixar Studios.
- Used for hidden-face removal.



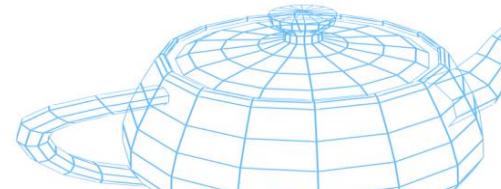
Edwin Catmull
1945



A simple three-dimensional scene



Z-buffer representation



Texture mapping (1974)

- Edwin Catmull, Utah UNI.

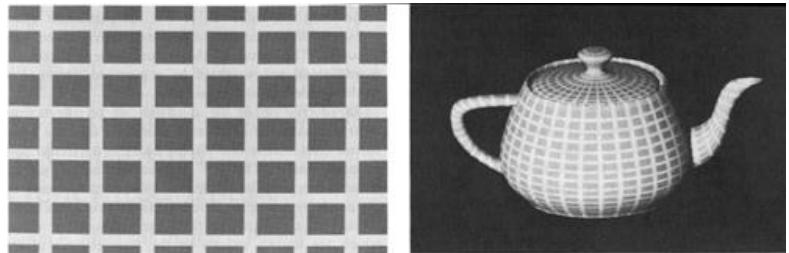


Fig. 3. Hand-sketched texture pattern: left-hand side shows texture pattern; right-hand side shows textured object.

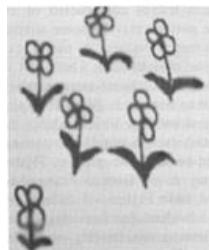
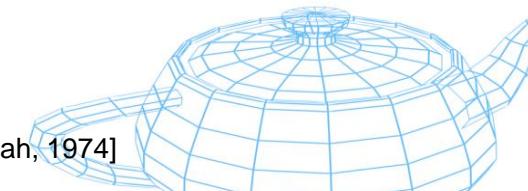


Fig. 4. Photographic texture pattern: left hand side shows texture pattern; right-hand side shows textured object.



Bui Tuong Phong
1942 - 1975

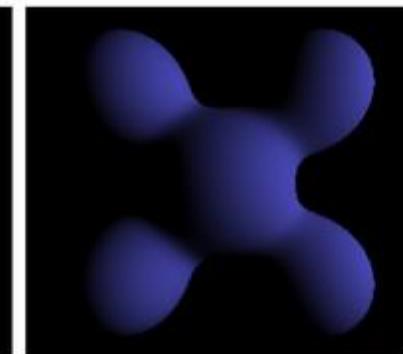


Phong model and shading (1975)

- Bui Tuong Phong, Utah UNI.
- New lighting model including specular light.
- Based on the interpolation of the surface normal (instead of the simpler color linear interpolation proposed by Gouraud).

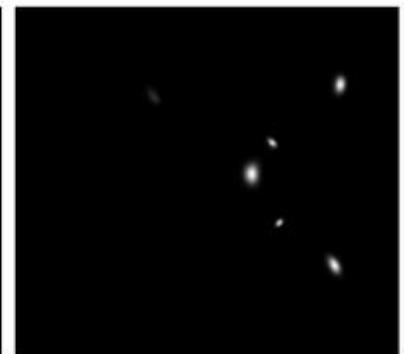


Ambient



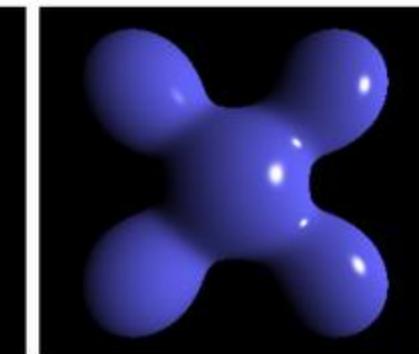
+

Diffuse

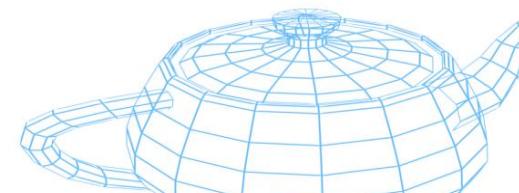


+

Specular



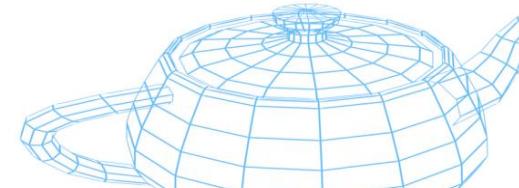
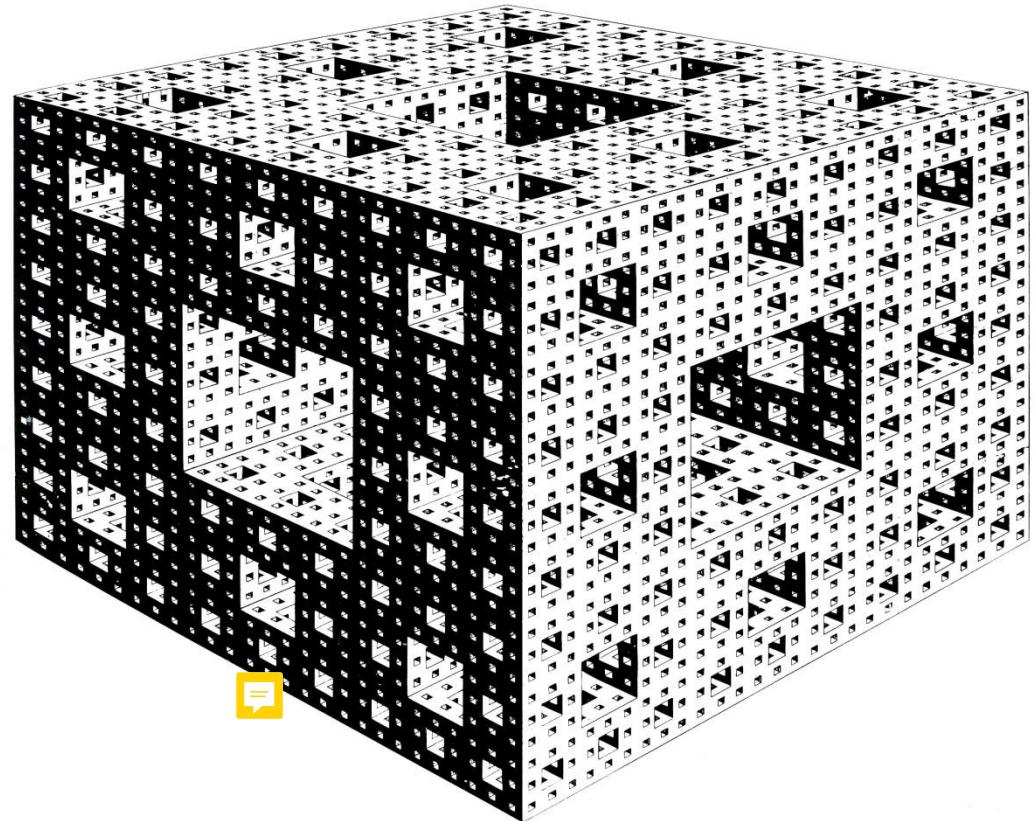
= Phong Reflection



Fractals (1975)

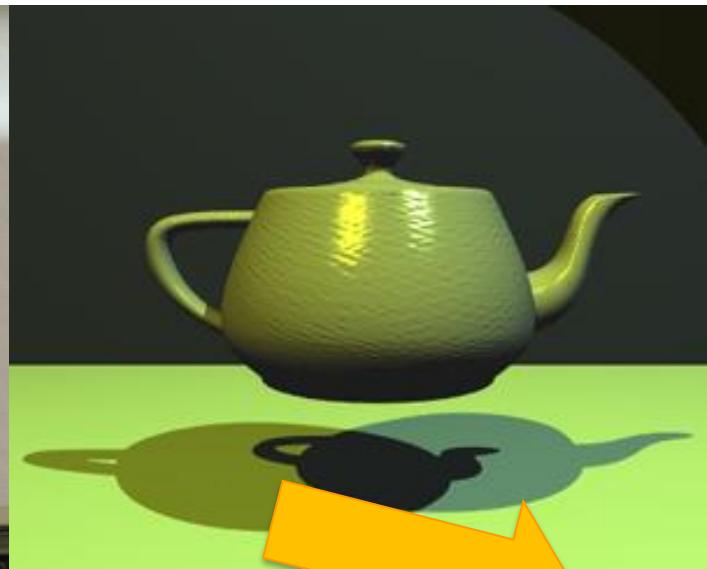
- Benoit Mandelbrot, IBM.

Benoit Mandelbrot
1924 - 2010



Teapot (1975)

- Martin Newell, Utah UNI.
- Created using Bézier patches.
- Used as benchmark model since then.





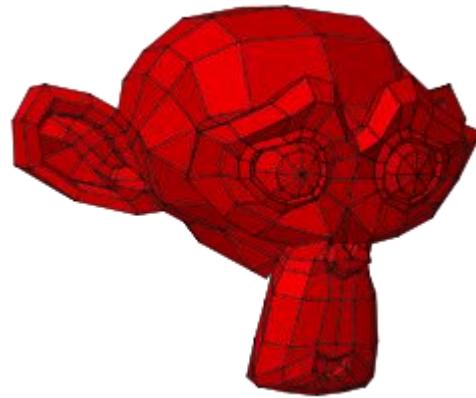
Stanford bunny



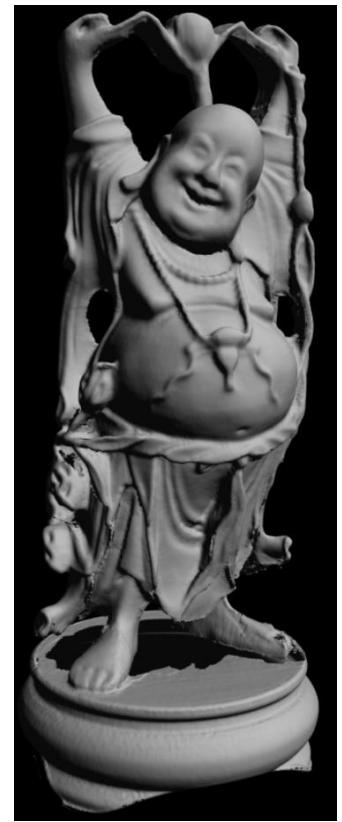
Sponza



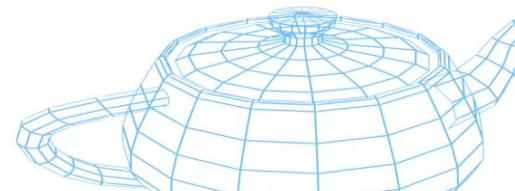
Stanford dragon



Suzanne

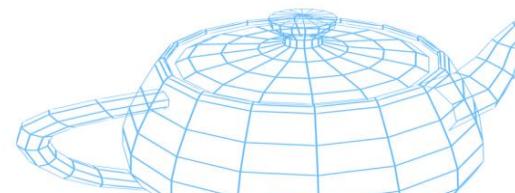


Happy Buddha



Ray tracing (1980)

- Turner Whitted, Bell Labs.
- Unified approach integrating reflection, refraction and shadows.



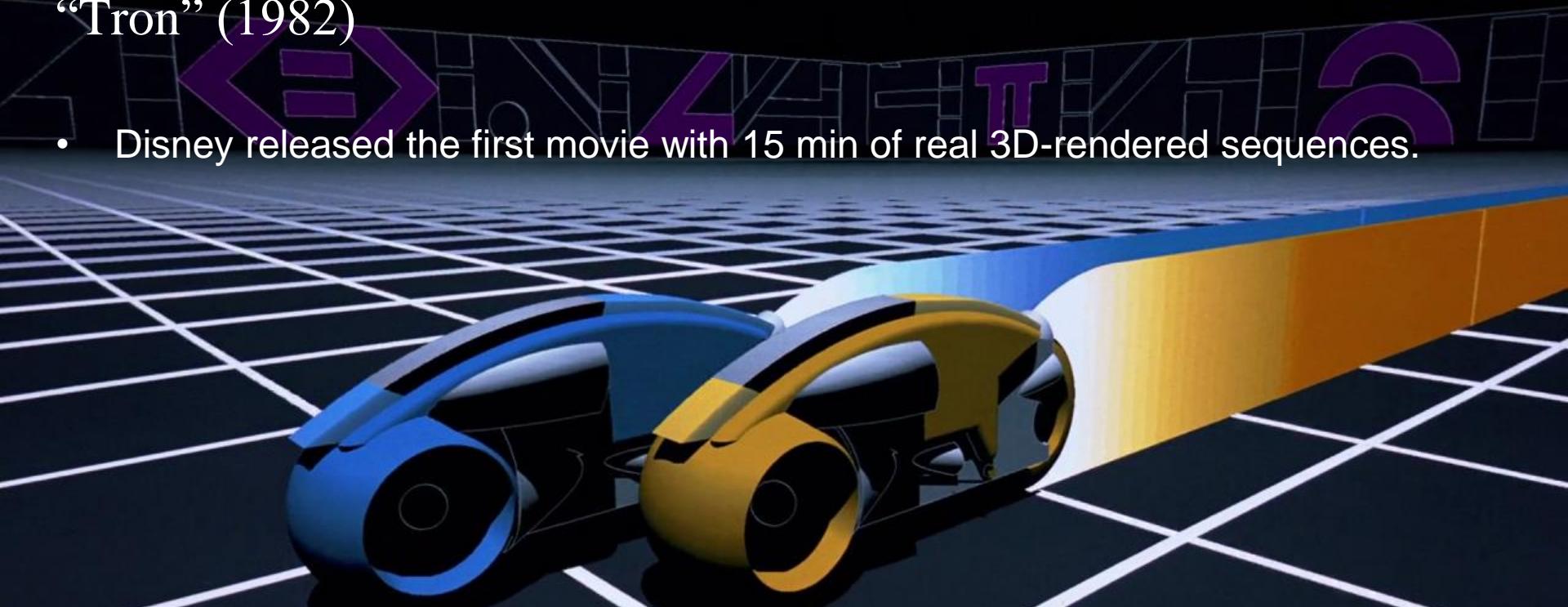
Silicon Graphics (1982)

- James Clark, Utah UNI.



“Tron” (1982)

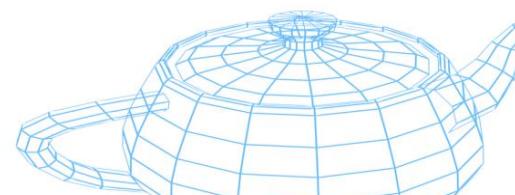
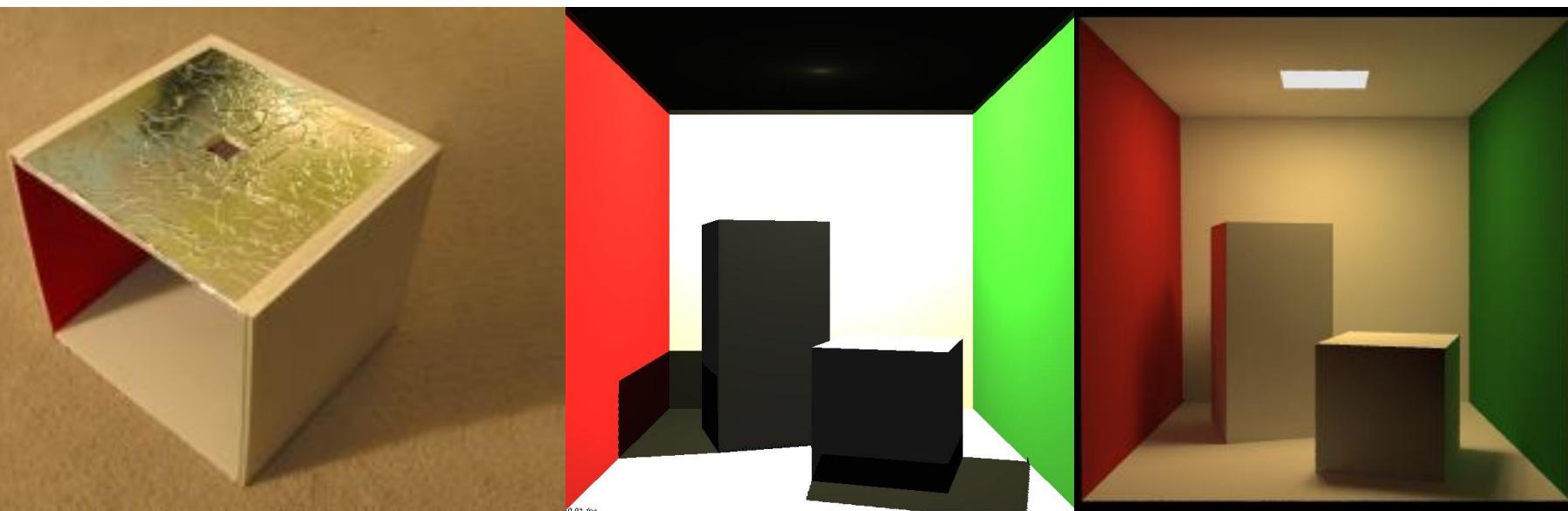
- Disney released the first movie with 15 min of real 3D-rendered sequences.

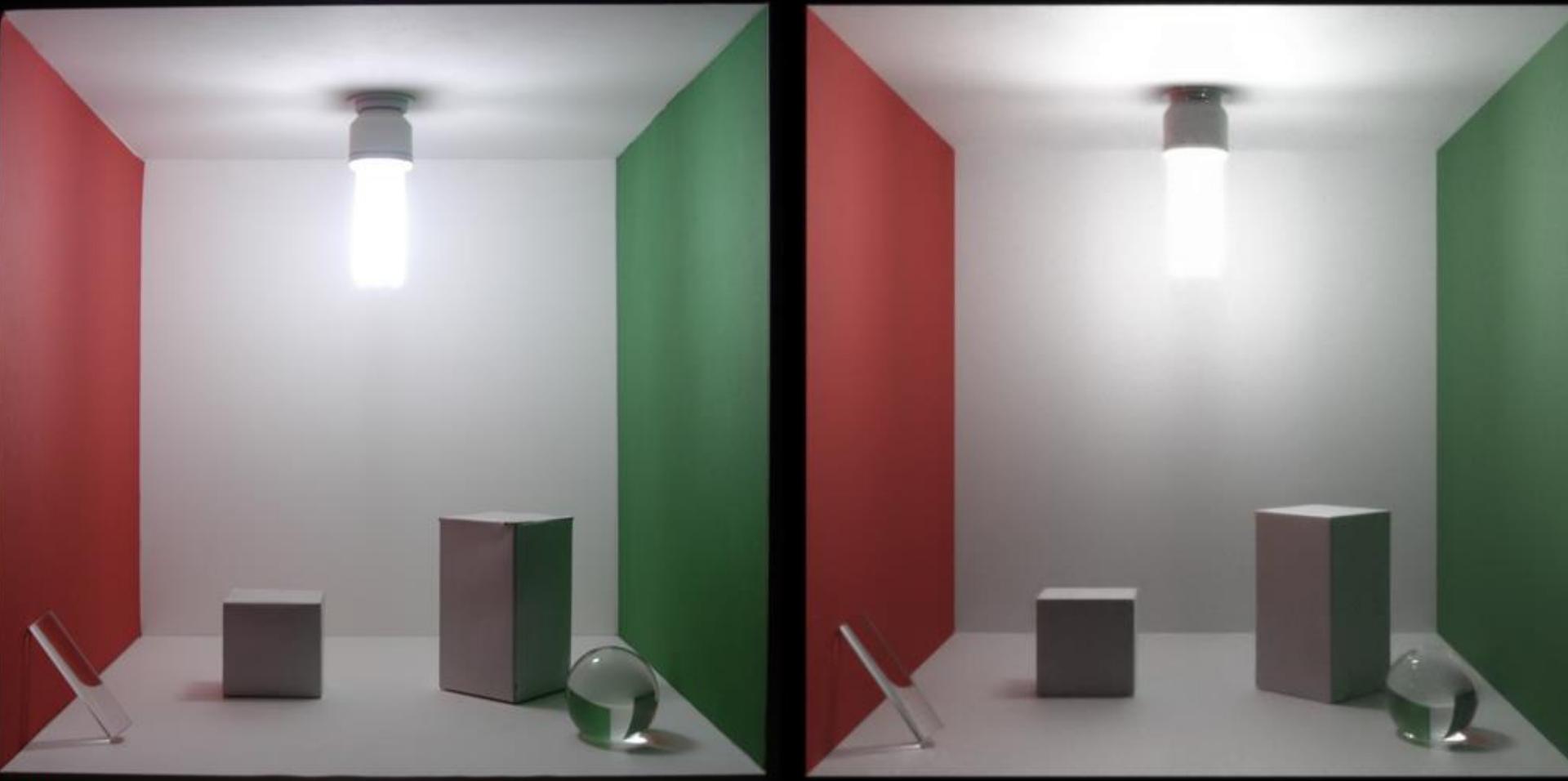


Cornell box (1984)

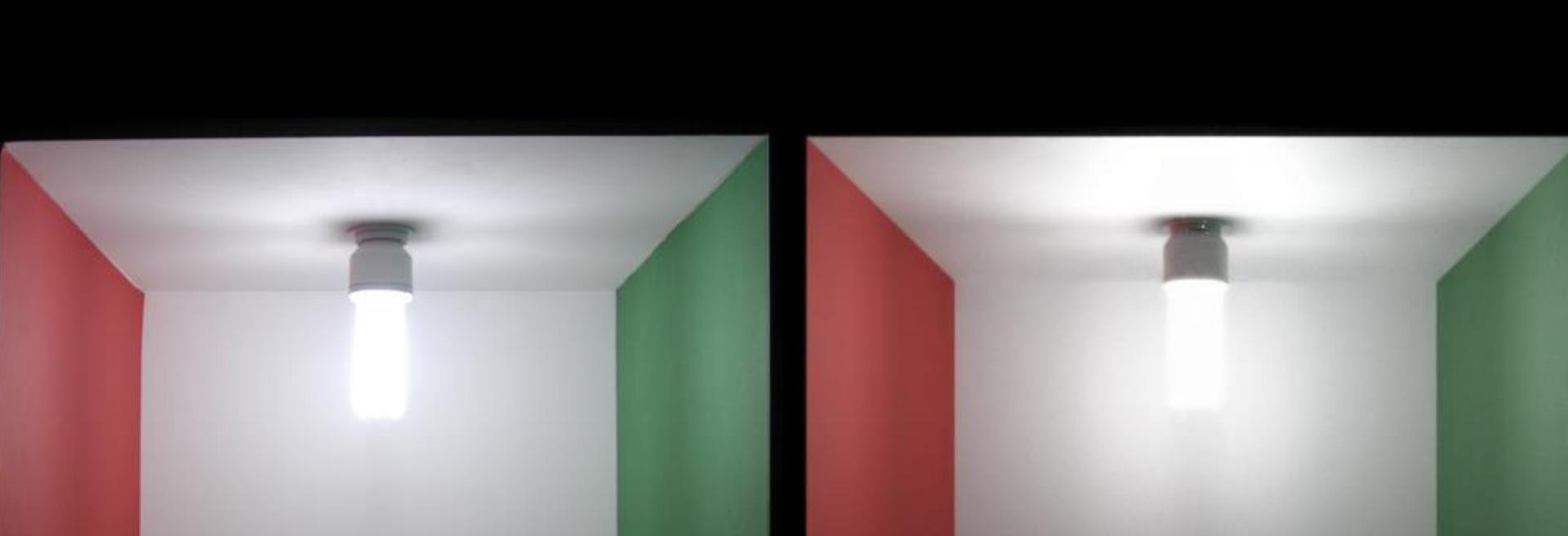


- Goral et al., Cornell University.





Which one is fake?



SPOILER ALERT



Which one is fake?

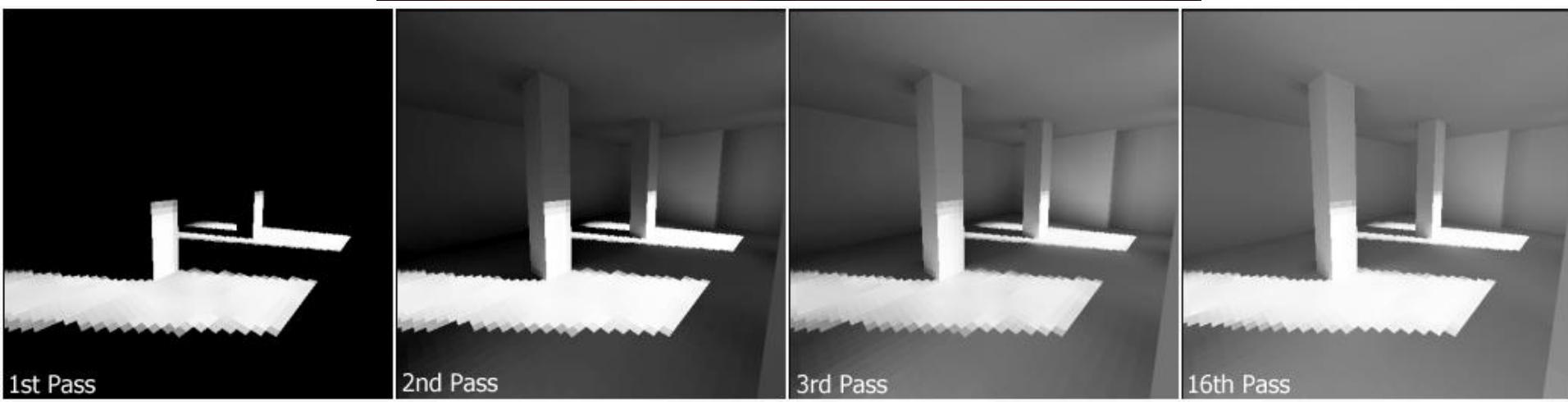
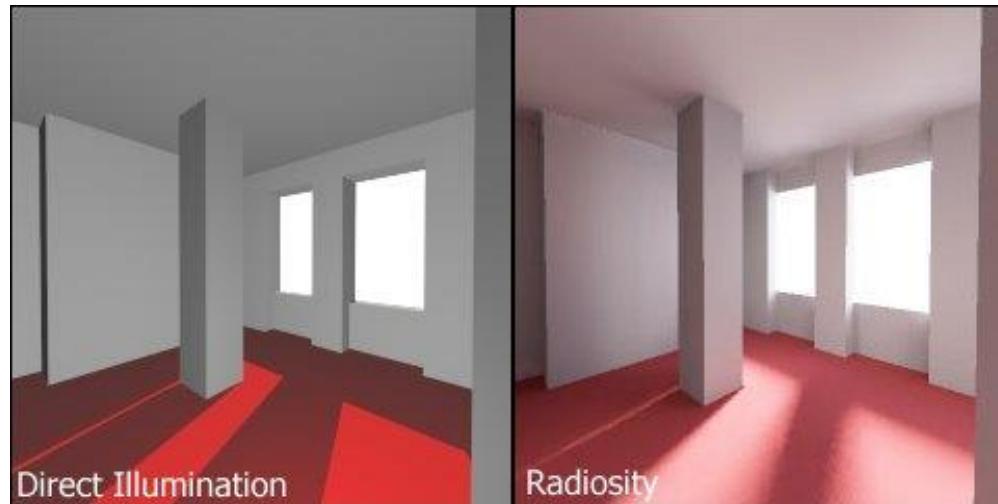


SPOILER ALERT

Radiosity (1984)

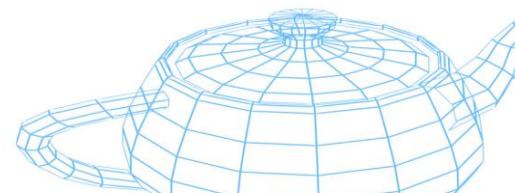
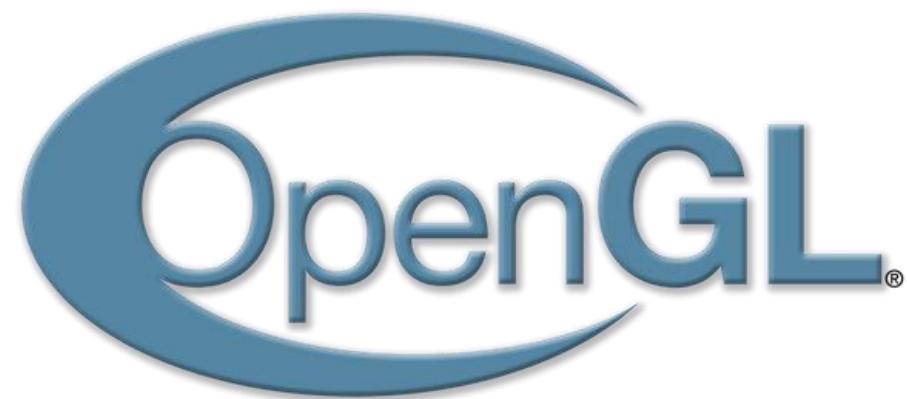


- Goral et al., Cornell University.



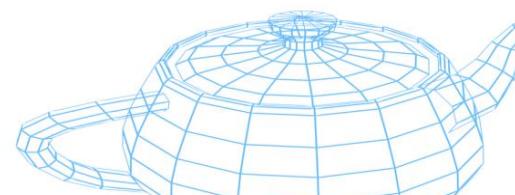
OpenGL (1992)

- Silicon Graphics releases OpenGL (Open Graphics Library).
- Cross-platform API for CG.
- <http://www.opengl.org>



Nvidia (1993)

- Nvidia is founded.



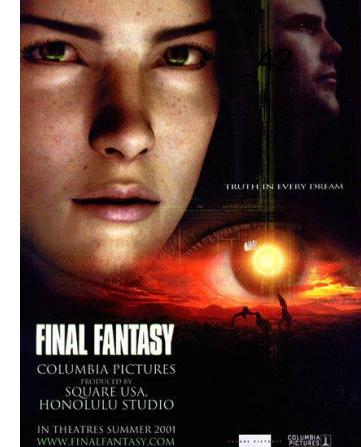
“Quake” (1996)

- Developed by John Carmack, ID Software.



“Final Fantasy” (2001)

- First full-length movie with photorealistic characters.





CryENGINE 3 (today)

GTA V (today)



Unreal Engine 4 (today)





B. Benoit (today)



R. Minervino (today)



Talcik & Demovicova (today)

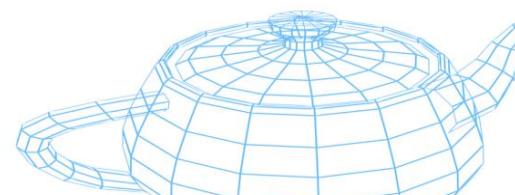
.DLL/.so

- How to create a Dynamic Link Library (.dll) under Windows:

http://www.codeguru.com/cpp/cpp/cpp_mfc/tutorials/article.php/c9855/DLL-Tutorial-For-Beginners.htm

- How to create Shared Object (.so) files (and other libraries) under Linux:

<http://www.yolinux.com/TUTORIALS/LibraryArchives-StaticAndDynamic.html>



Tutorial

Simple dynamic library

