

# Computer Graphics

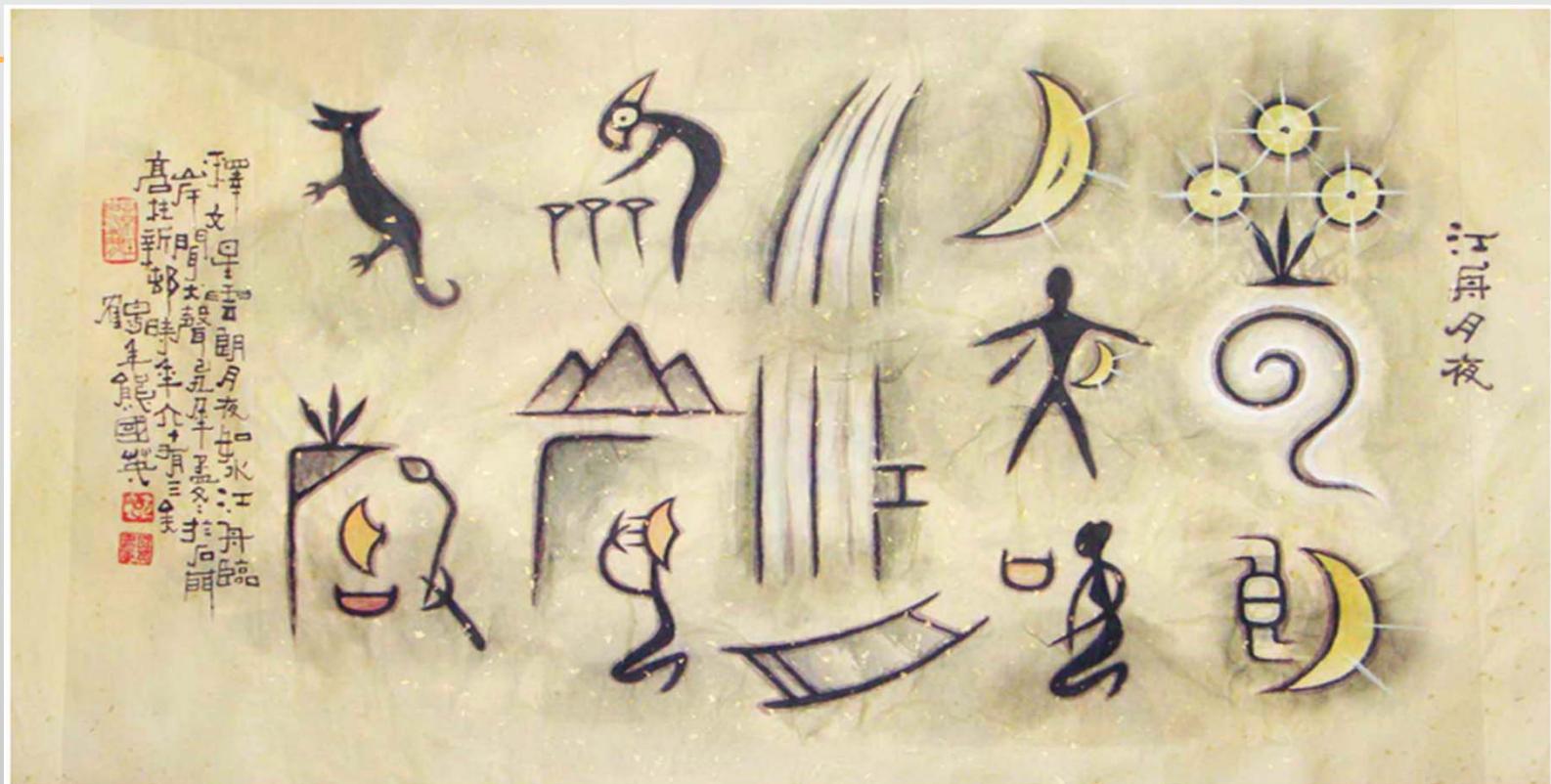


## Ch1 : Introduction

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# 1 History of Graphics



# Painting Art



# Sculpture



# Image



**Joseph Niépce, "View from the Window at Le Gras" (1826)**



# Sketchpad (1963)

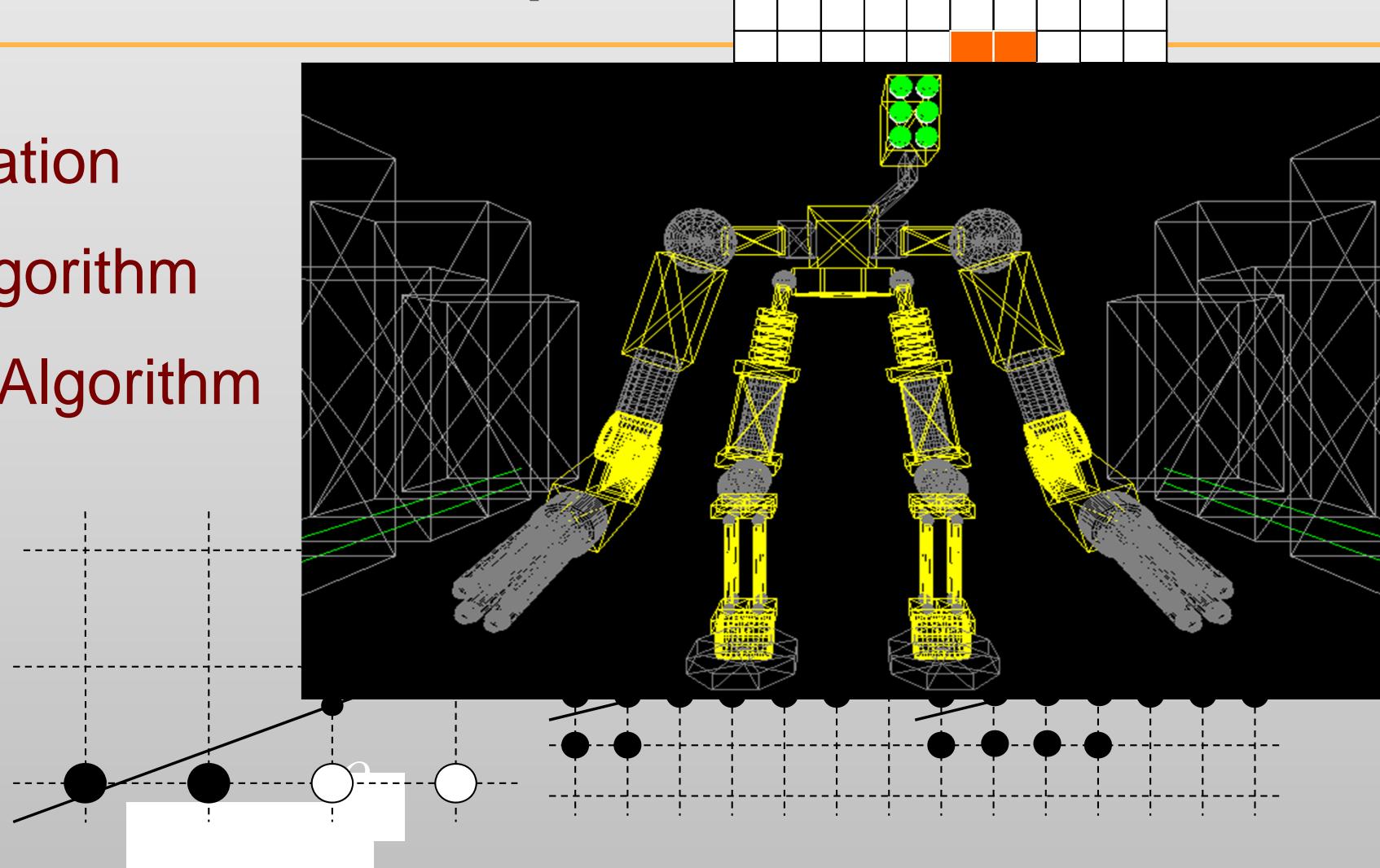


# Wire Frame Model(1960s)

Rasterization

Filling Algorithm

Clipping Algorithm



# Photorealistic Rendering(1970s-1980s)

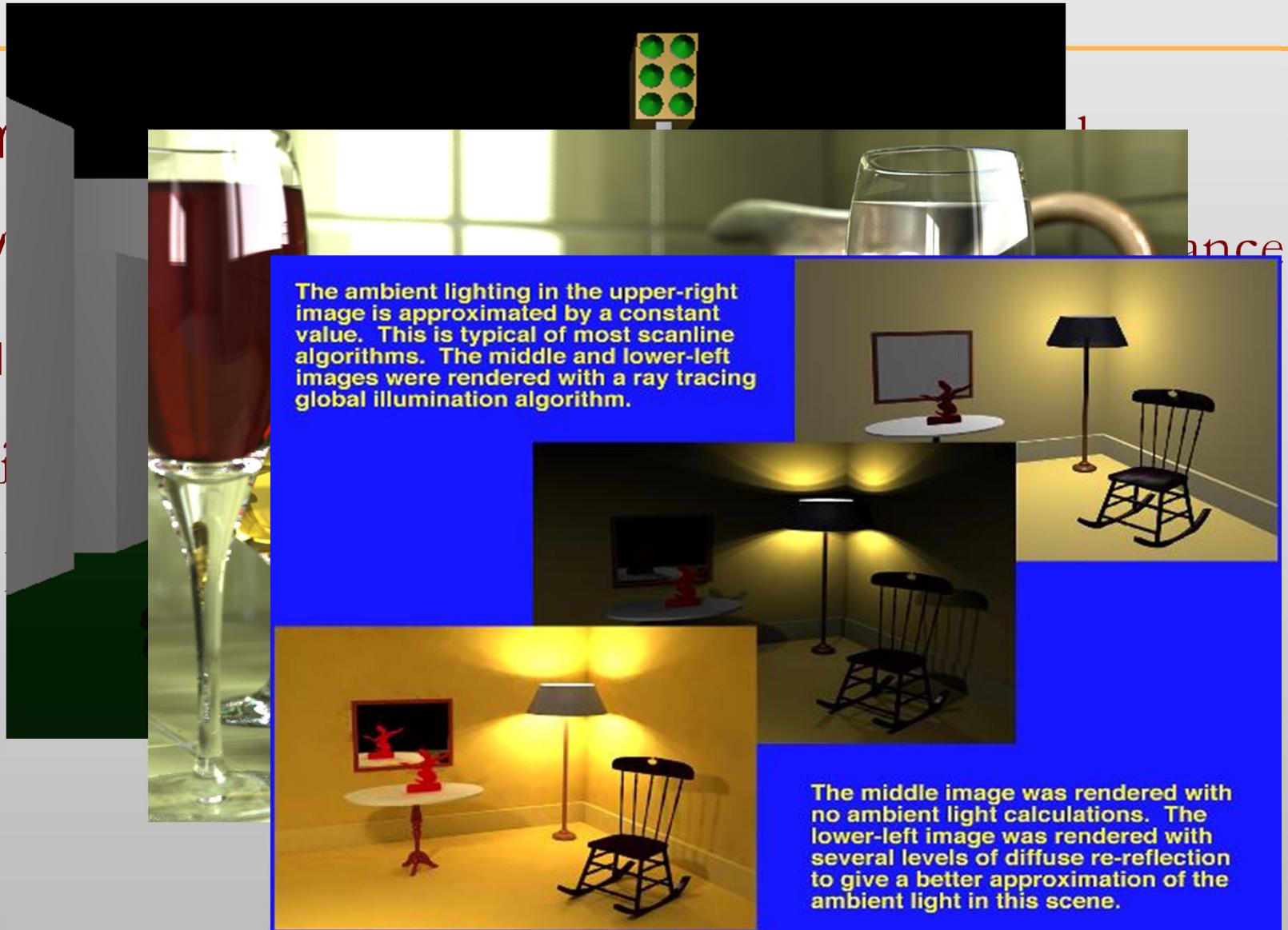
Local illumination

Physically based rendering

Global illumination

Ray Tracing

BRDF (Microfacet)



# 1990s

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- **Geometry modeling** : Mesh presentation, subdivision mesh, multi-solutions
- **Rendering**: Volume rendering, Image-based rendering
- **Scientific visualization**

...

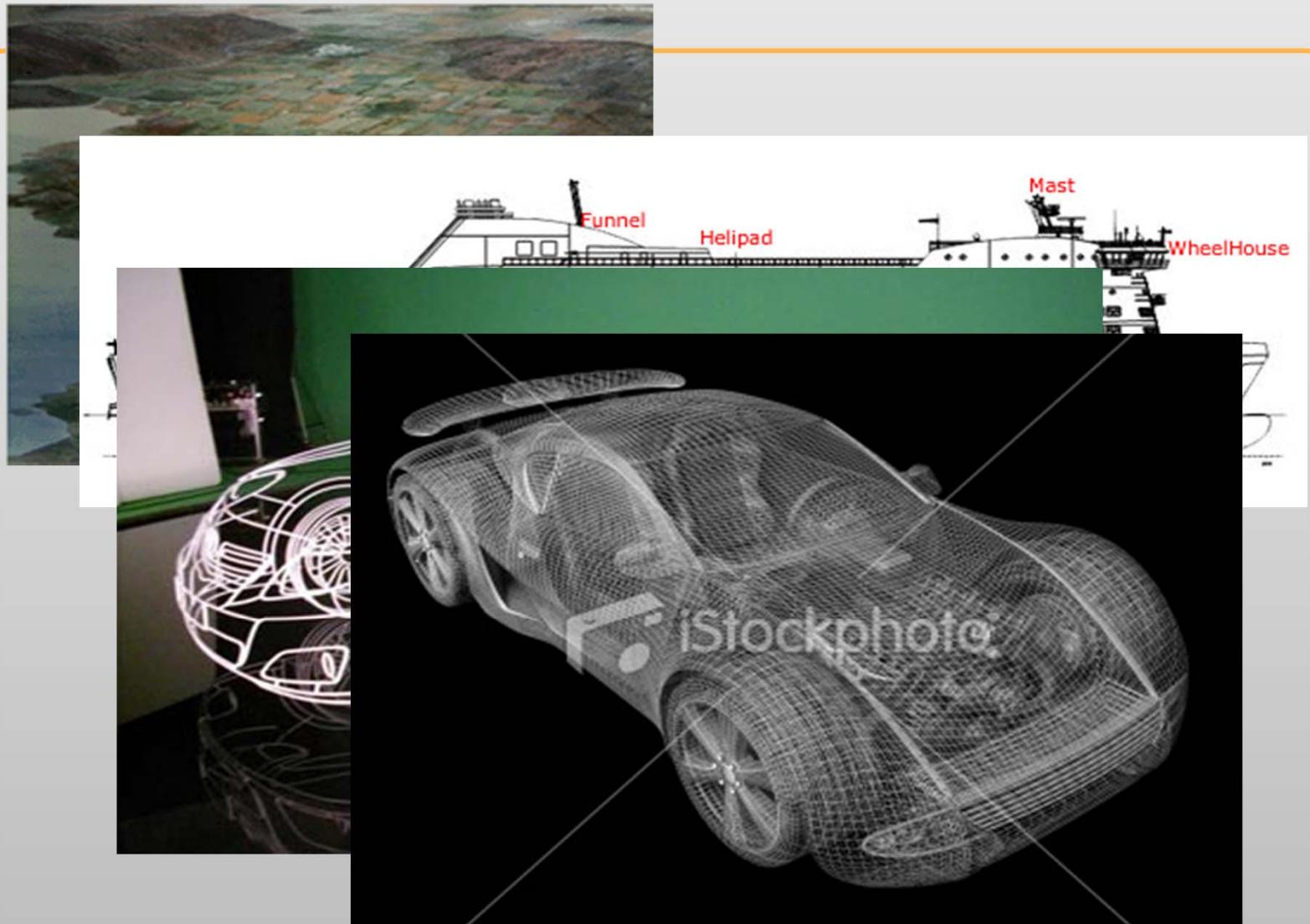
1997-Geri's game

## 2 Industry Application

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- Movie
- Game
- Design
- Research
- Art

# CAD/CAM



2007.10.11



# Movie special effects

- The earliest effects were produced within the camera (in-camera effects)
- Computer graphics are more modern techniques that are widely used for creating incredible special or visual effects
  - Terminator 2
  - Start the time of computer-based special effect in 1990s





Stuart Little 2



Bolt



10,000 BC



Transformers



## The Water Horse

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## Kung Fu Panda



## The World of Avatar



## Star Wars Episode 3



Harry Potter



ICE AGE

# PC Game

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- PC games reached widespread popularity following the video game crash of 1983, particularly in Europe
- Fantasy
- Online



网络游戏《传奇3》



Shooting Game



Warcraf

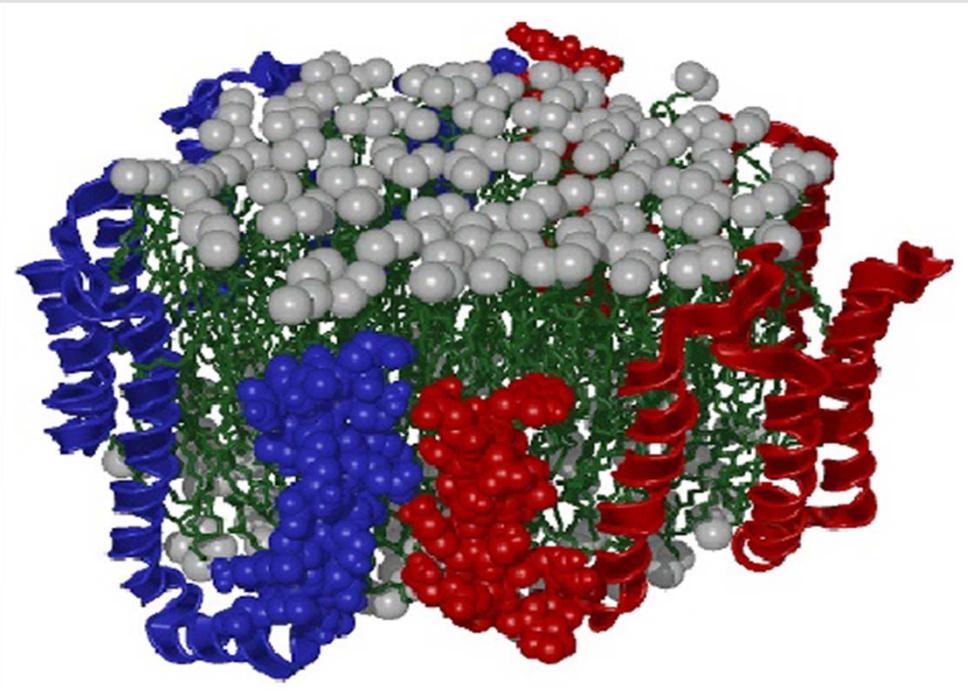


Warcraf

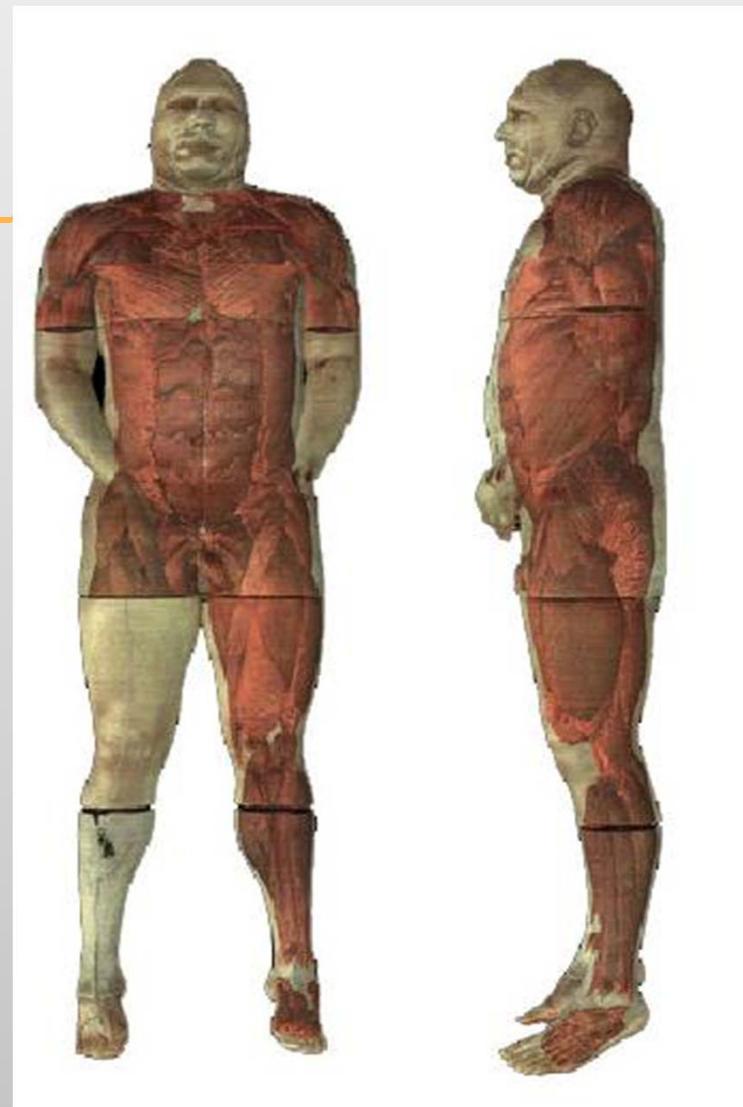
# Scientific visualization

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The purpose of scientific visualization is to graphically illustrate scientific data to enable scientists to understand, illustrate, and glean insight from their data.

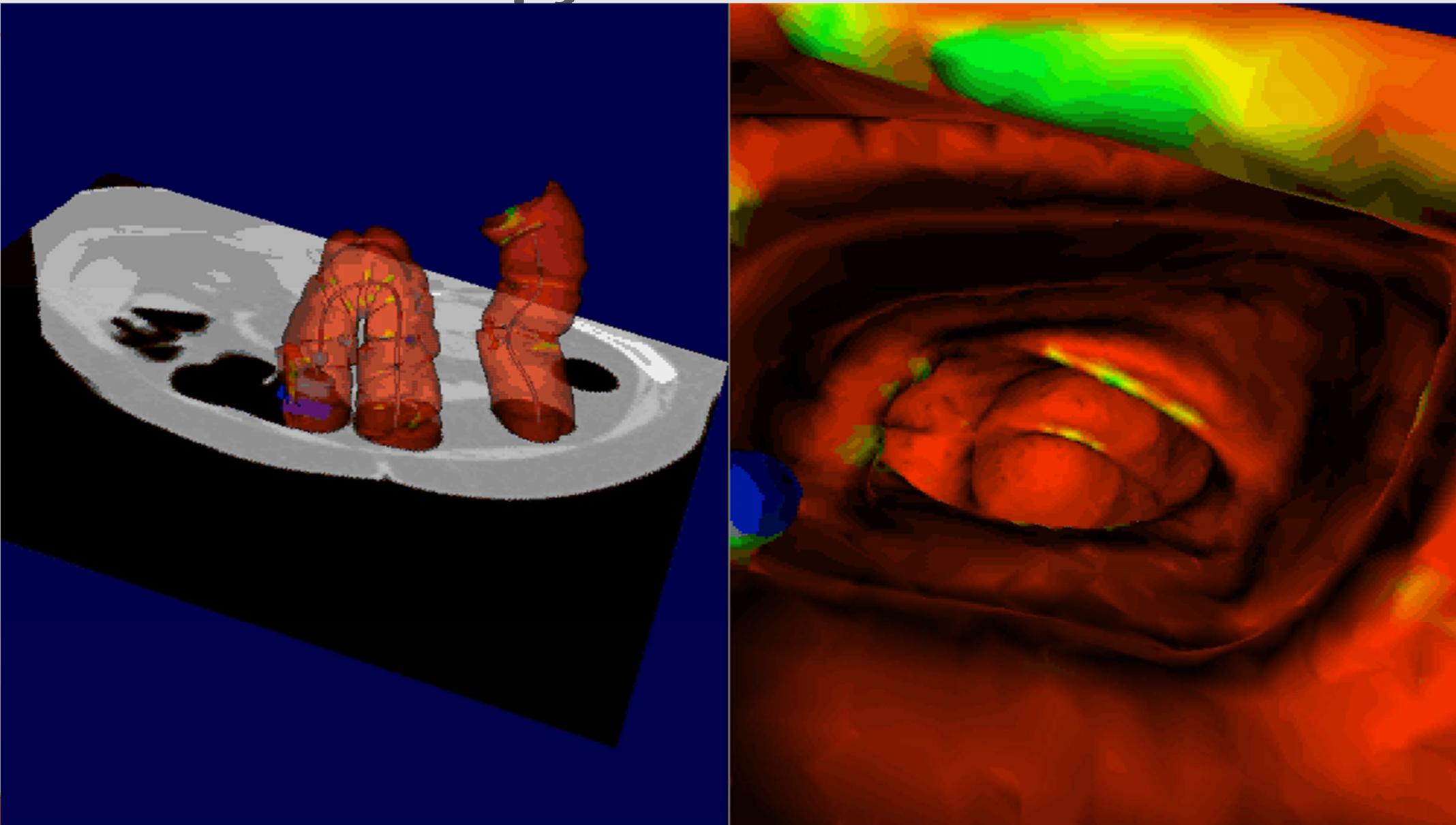


DNA structure



Body muscle

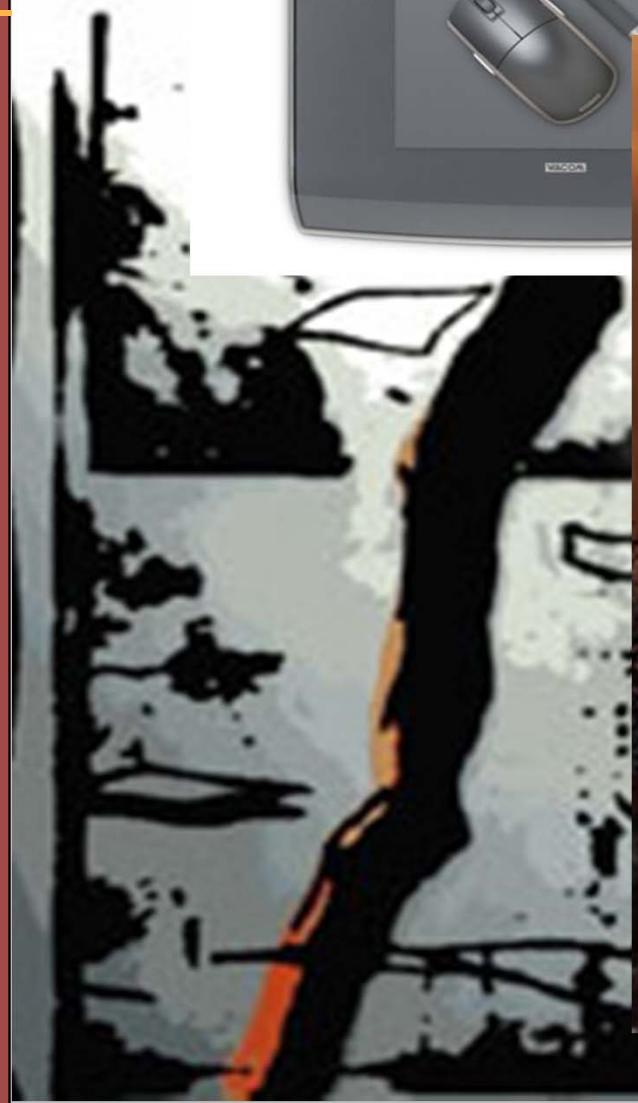
# Virtual Endocopy



# Computer art

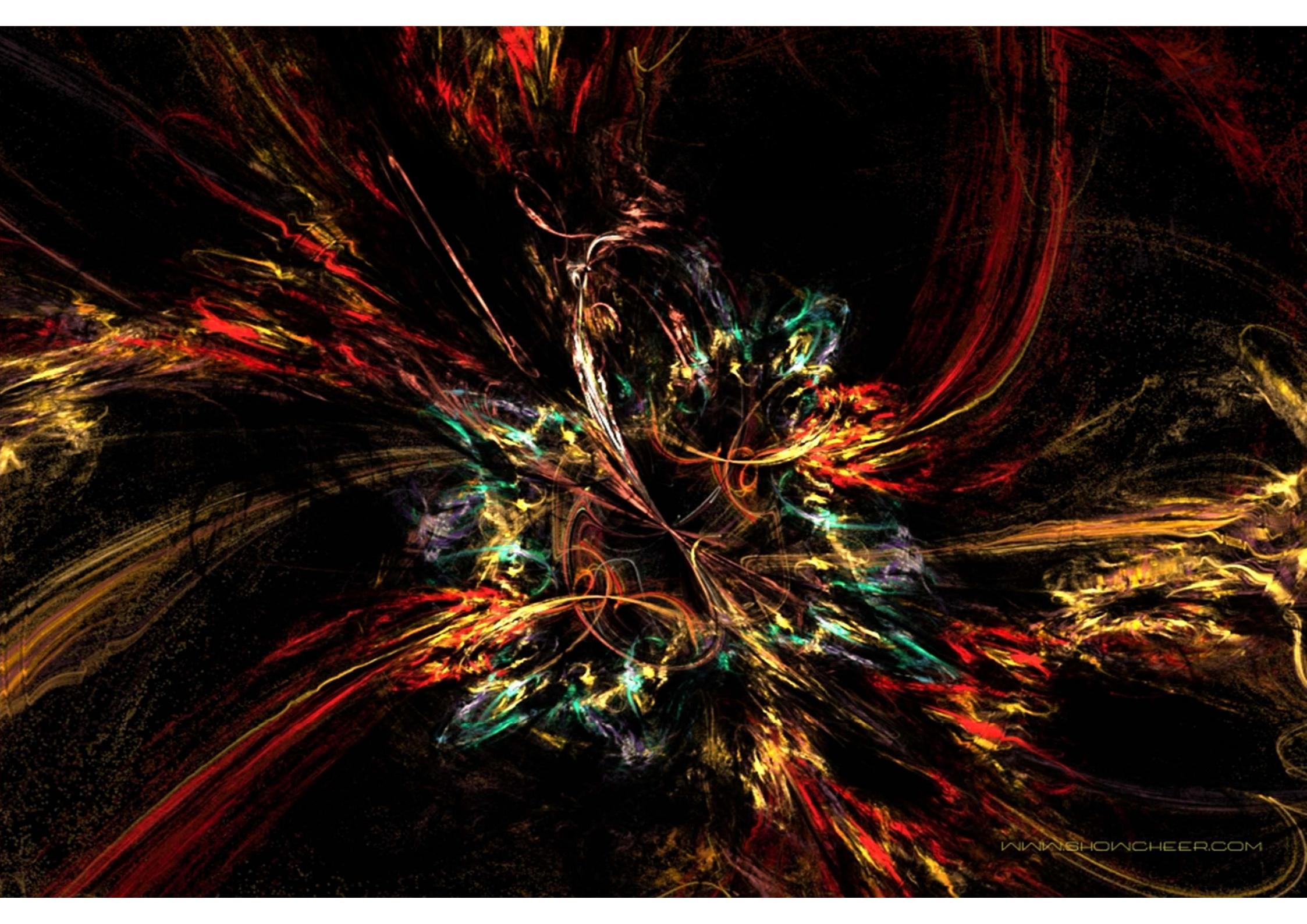
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- Computers play a role in production or display of the artwork. Such art can be an image, sound, animation, video, CD-ROM, DVD-ROM, videogame, web site, algorithm, performance or gallery installation





Chinese painting

A dynamic abstract motion background featuring a dense network of glowing, multi-colored particles (red, yellow, green, blue) against a black background. The particles are scattered across the frame, creating a sense of motion and energy. The overall effect is reminiscent of a star field or a microscopic view of a complex system.

WWW.SHOWCHEER.COM

# 3. Hot Topics in Graphics

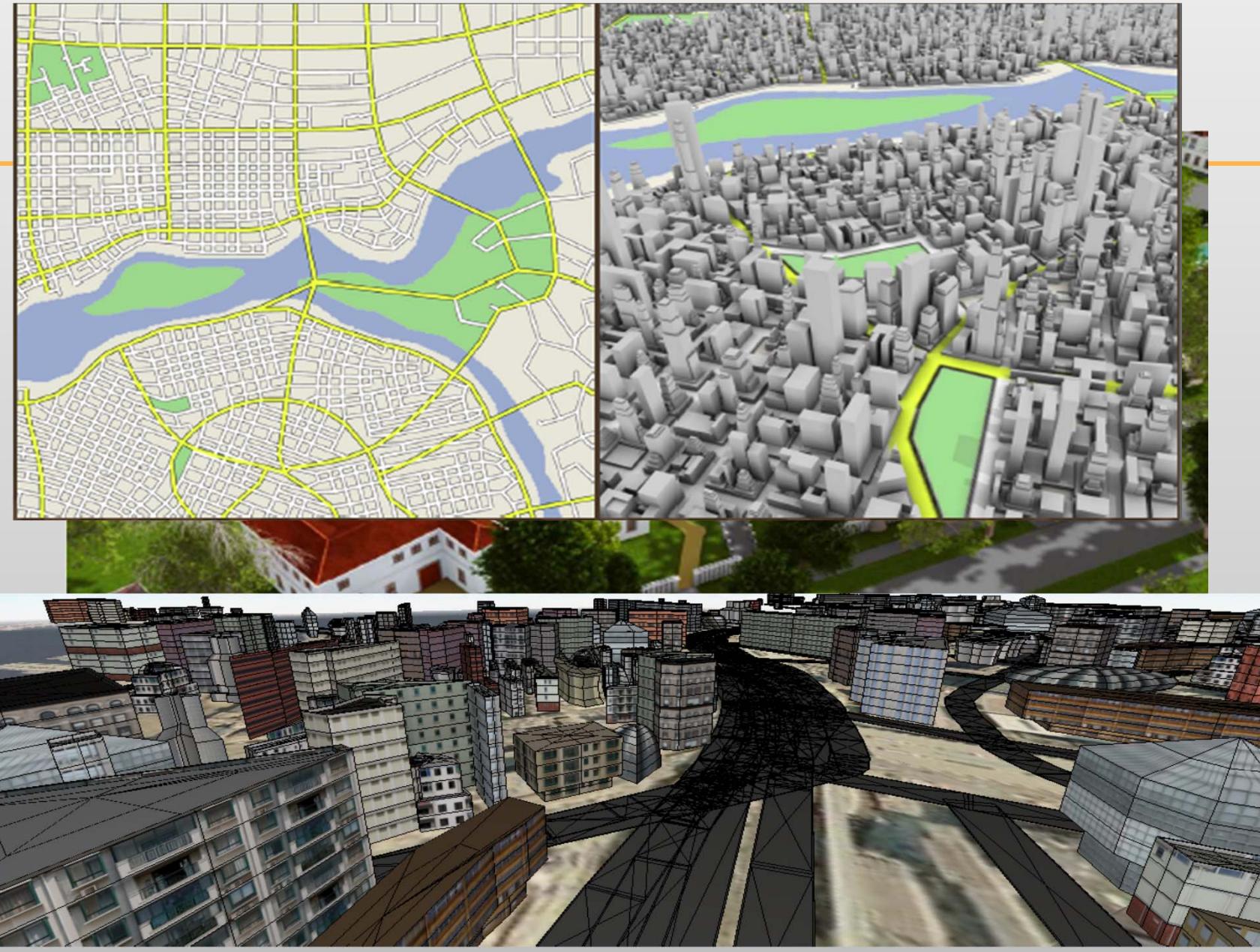
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- Geometric modeling
- Rendering
- Image processing
- Computer animation
- GPU acceleration
- Virtual reality

# Geometric modeling

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- Methods and algorithms for the mathematical description of shapes
  - Video: 3D modeling



# Snow



# Clothing simulation

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- Deformation
- Draping
- Collision
- Wrinkle
- Video 1
- Video 2

# Feather



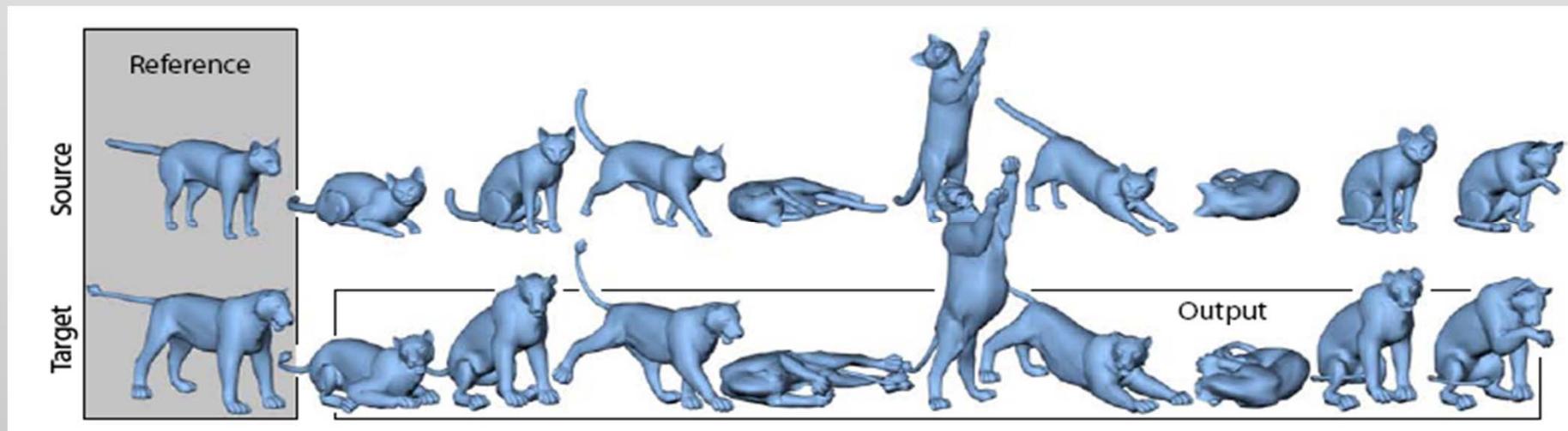
Argay 2007



Chen et al. 2002

# Mesh Editing and Deformation

Change the original models' shape, animation



Video: Mesh Editing

Video: Shape regress

# Photorealistic rendering

Global illumination

BRDF

Video: light illumination

# Animation

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Motion capture

Motion editing: motion transferring, retargeting, etc.

Crowd animation

Video: motion control

# GPU Rendering

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- GPU: reducing data exchange with
- CUDA:(Compute Unified Device Architecture): a parallel computing platform and programming model invented by NVIDIA. It enables dramatic increases in computing performance by harnessing the power of the graphics processing unit (GPU)

# Image Processing

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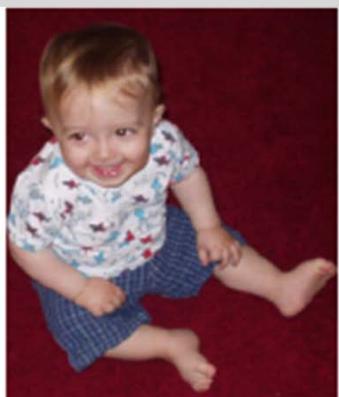
- Color conversion, transfer, analogy)
- Debluring)
- Image/video resizing)
- Video Stablization ...

Video: shape transfer

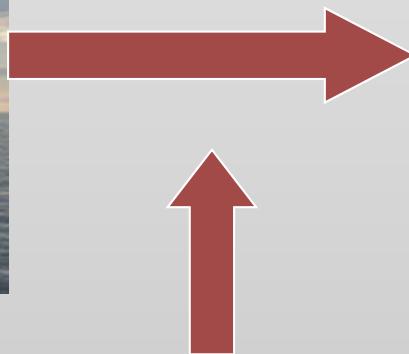
# Color to grey



# Colorization



# Color transfer



# Image Analogies



# Image morphing



Video

# Image resizing

Different size of equipment (e.g. computers, TV, Mobile Phones, PDAs (personal digital assistant))



原始图像



CR缩放



LG缩放



MT缩放



# The Problem (Shan Qi et al.'s ppt)



# Linear rail

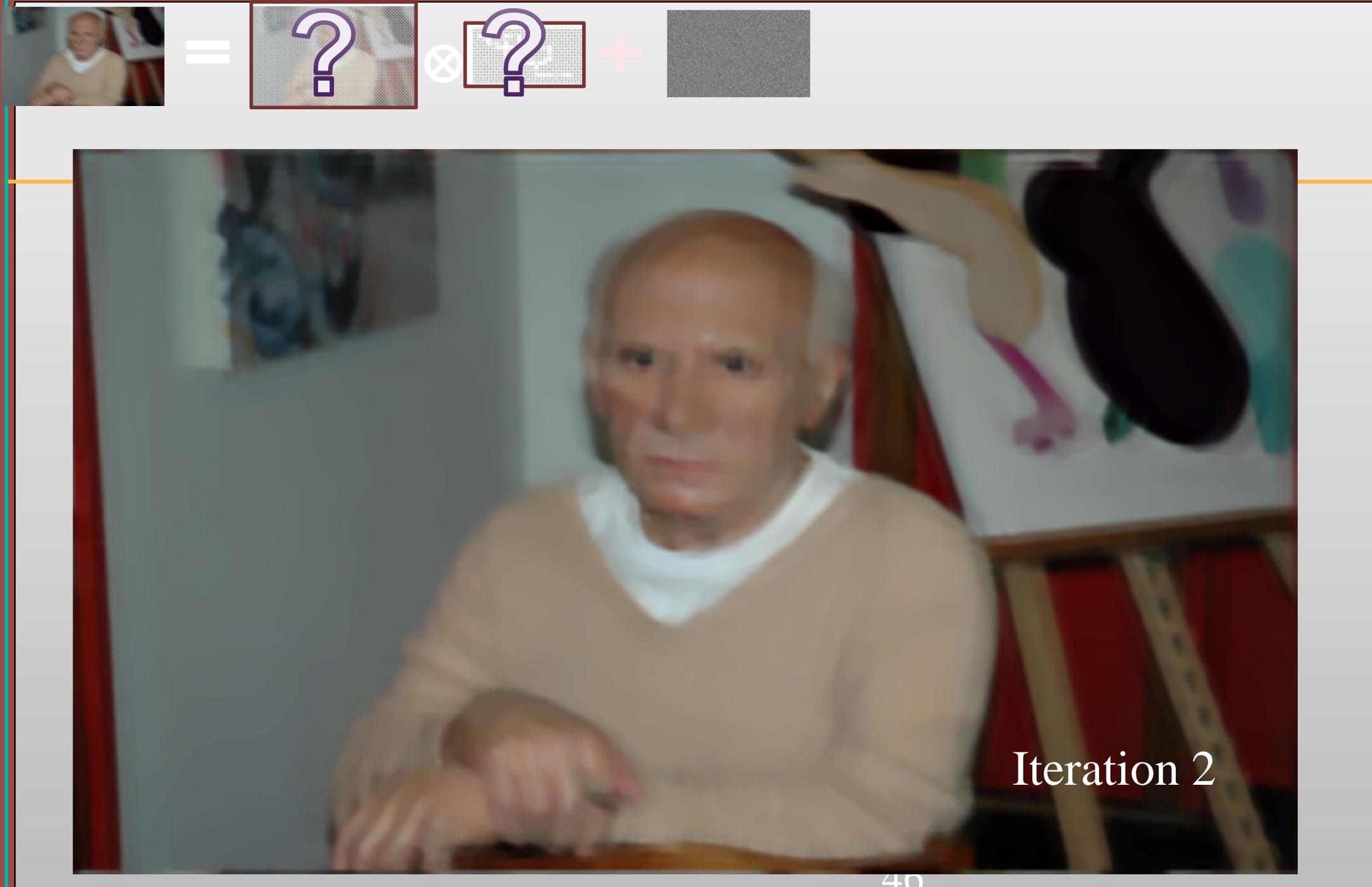


Levin et al. Siggraph 2007



$$= \boxed{?} \otimes \boxed{?} + \boxed{}$$







$$= \boxed{?} \otimes \boxed{?} + \boxed{}$$



Iteration 4



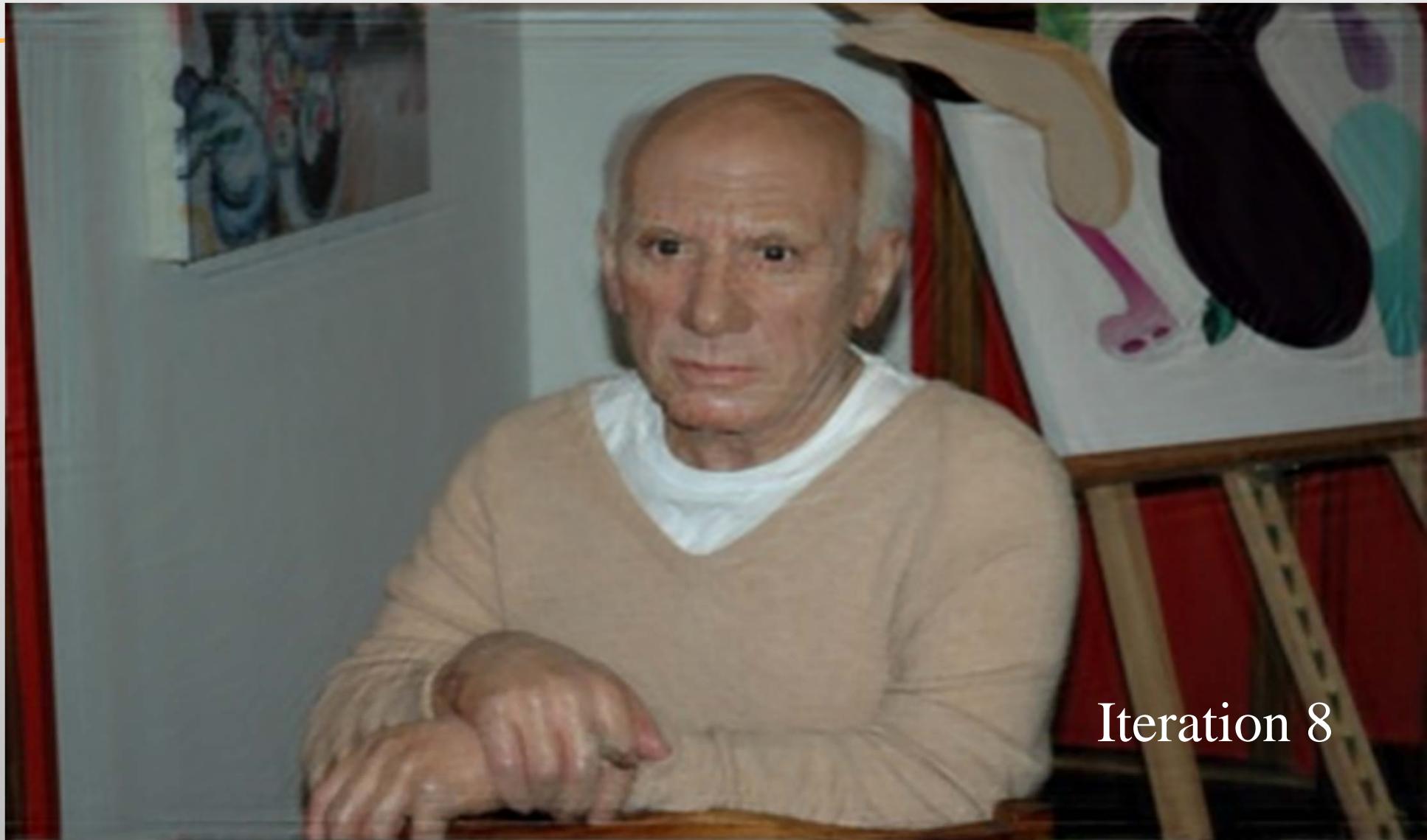
$$= \boxed{?} \otimes \boxed{?} + \boxed{}$$



Iteration 6



$$= \boxed{?} \otimes \boxed{?} + \boxed{\phantom{?}}$$



Iteration 8



$$= \boxed{?} \otimes \boxed{?} + \boxed{}$$



Convergence

Time: about 350 seconds for an 800x600 image

# AI in computer graphics

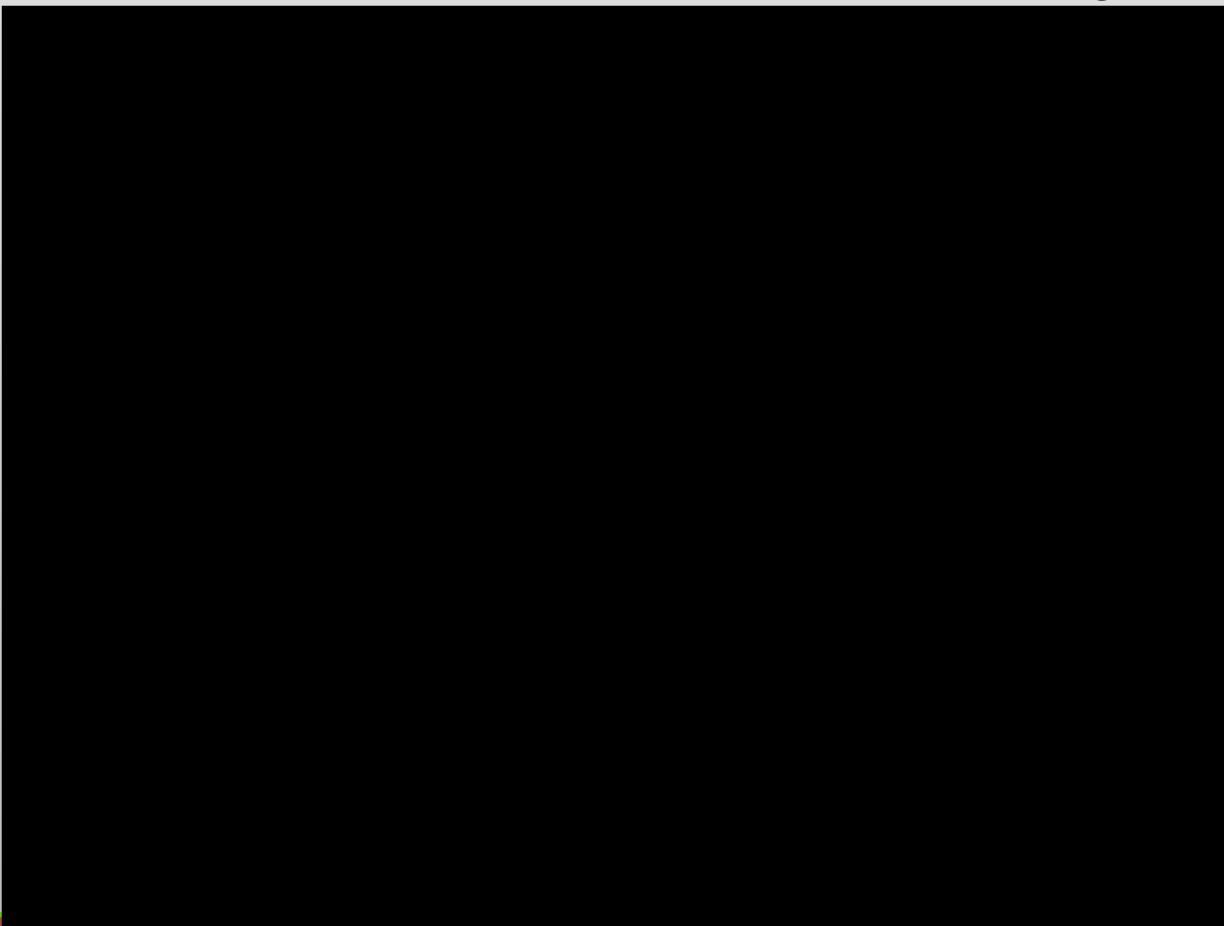
AI techniques allowing substantial improvements of traditional Computer Graphics methods

- **Video Games and Augmented Reality:** Creation of more intelligent interactive characters, who can adapt on user's input to determine its type of gameplay, its mood...
- **3D Simulation:** Modelization of complex structures given a defined set of elements
- **3D Rendering:** How precisely can we approximate and render the contents of a scene and render them while minimizing the global amount of calculus needed

# AI in computer graphics

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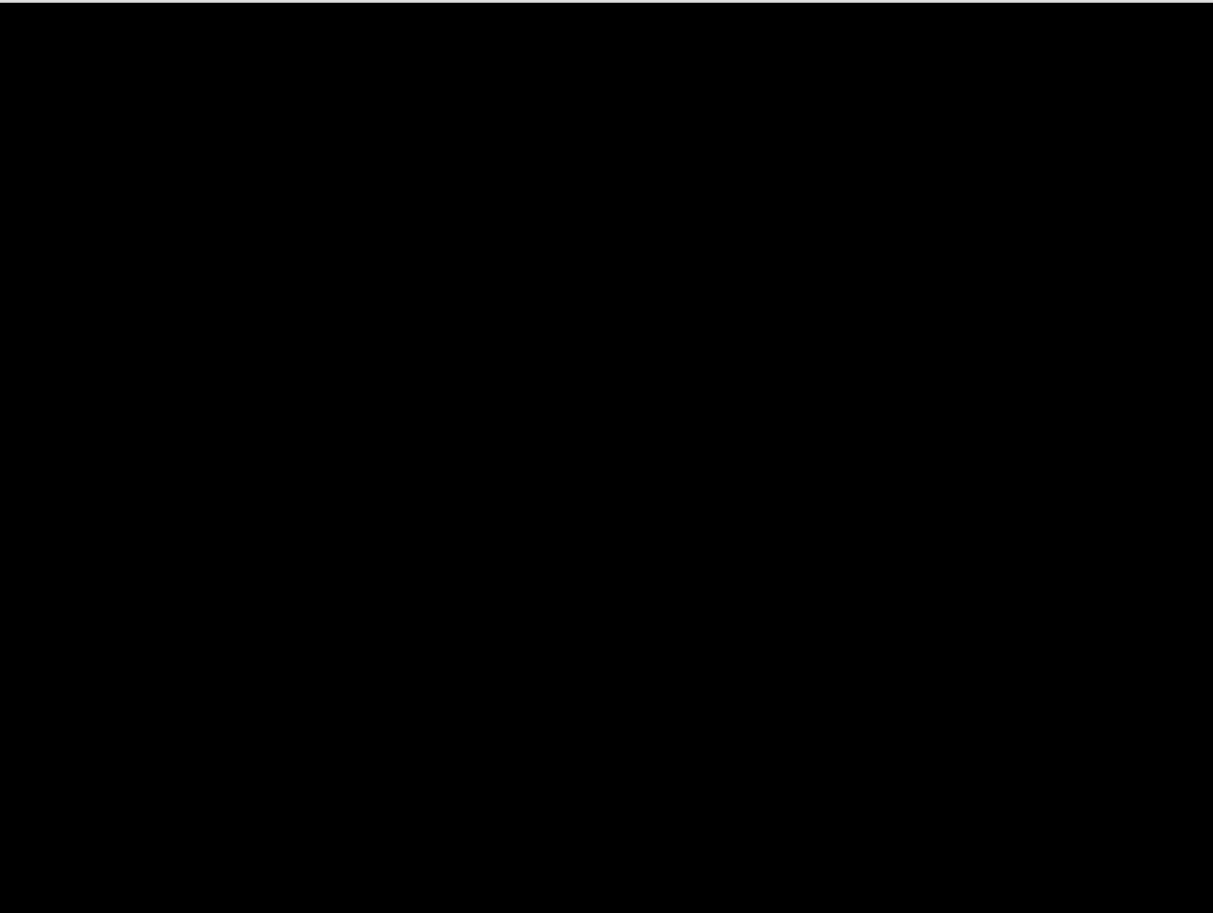
makes it far easier to animate realistic human faces, simulate how light interacts with surfaces in a scene and render realistic images



# AI in computer graphics

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high-quality facial texture inference technique based on deep convolutional neural networks, but also ensure a robust treatment of hair using a deep learning approach



# Team making

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- Group your team with 4 persons
  - Team leader email me your group members before 8<sup>th</sup> Oct.
- 
- Class discussion
  - Course project