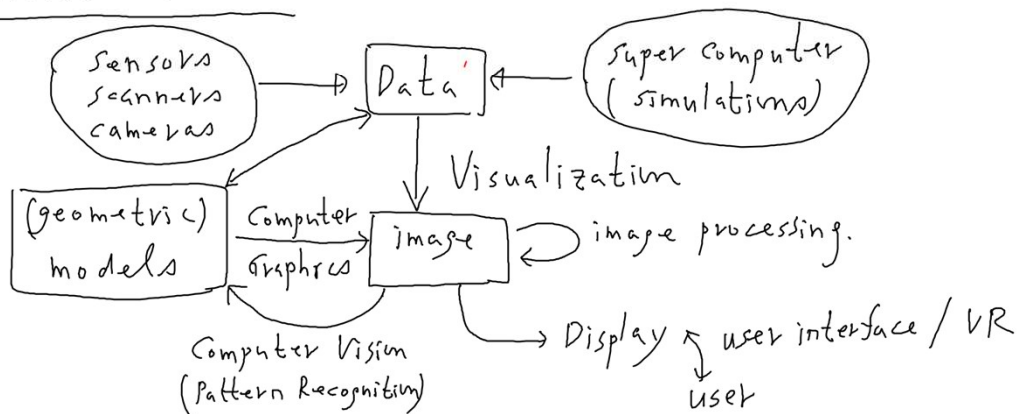# CS6533/CS4533 Lecture 1 Slides/Notes

Overview; Image Formation; Graphics Hardware, Software & Pipeline Architectures (Notes, Ch 1)

By Prof. Yi-Jen Chiang

CSE Dept., Tandon School of Engineering

New York University

1

Computer Graphics: All aspects of producing images or pictures using a computer.

Related Fields:

2

Applications of Computer Graphics:

1. Display of Information: Scientific Visualization.

    * Medicine : CT, MRI, X-ray, Ultrasound.
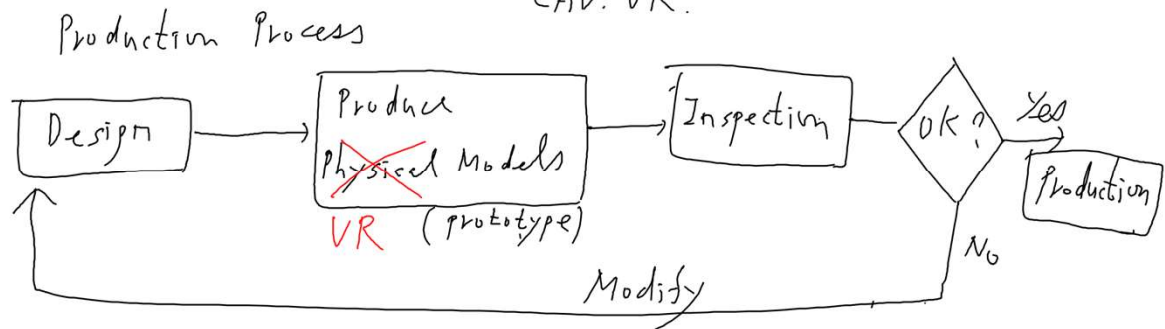   (diagnosis) eg. X-ray images: cross-section images

                                     Information Visualization.

    * Biology   * Earth Science
    * physics.   * Math. . . . —
    * chemistry

2. Design: Engineering, Architecture, etc
        (car engine, aircraft, --)
                           CAD. VR.
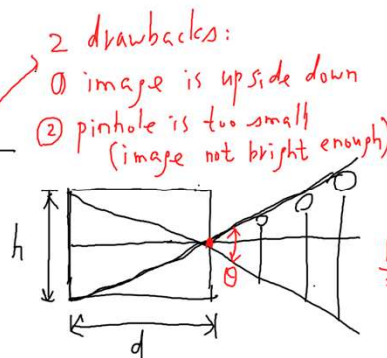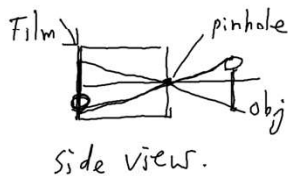   Production Process

    Eg. Boeing 777.

3. Simulation: eg. Graphical flight simulation for pilot training.
   knee surgery simulation for surgeon training.
   Animation. movies/television.

4. User Interface: window systems. web browsers, etc.

* **Image Formation:**

(1) **The Pinhole Camera**

Film → pinhole

obj

Side view.

2 drawbacks:
① image is upside down
② pinhole is too small
   (image not bright enough)

θ: angle of view field

h

d

$\frac{h}{2}$

$\theta/2$

d
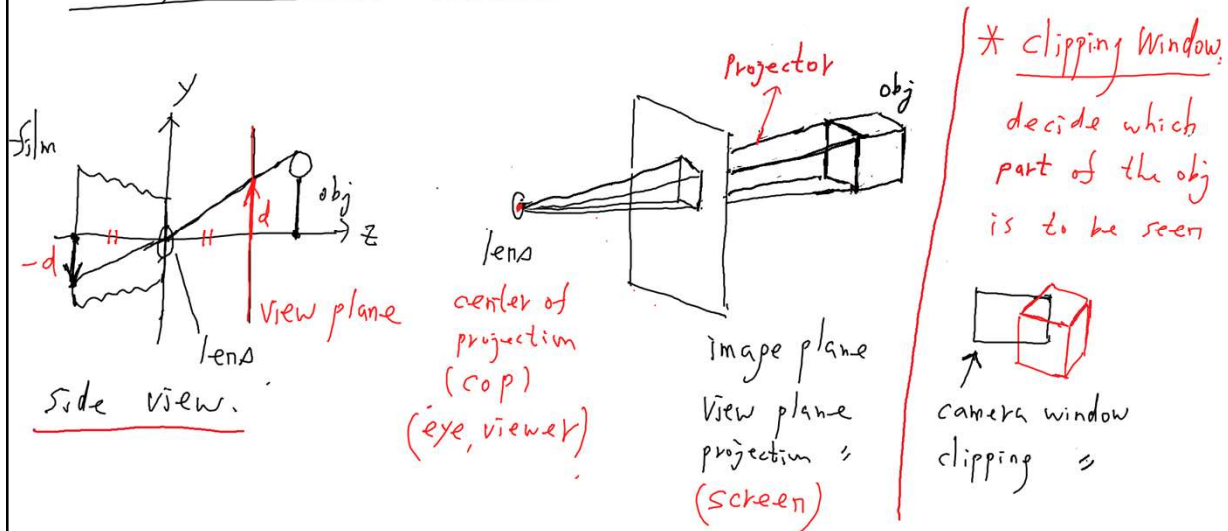
$\tan\frac{\theta}{2} = \frac{h/2}{d}$

$\Rightarrow \theta = 2\tan^{-1}\frac{h}{2d}$
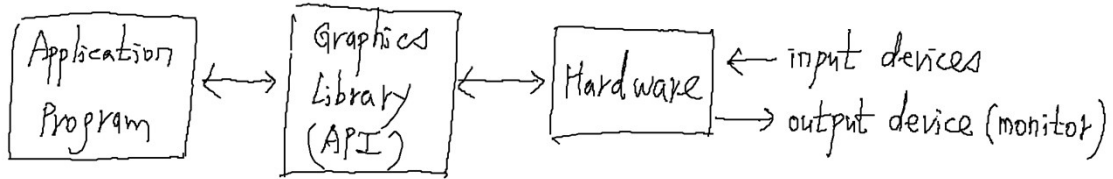
(2) The Synthetic Camera Model (the model used)

y

film

-d   # # |d   obj   z

View plane

lens

Side view.

Projector   obj

lens
center of
projection
(COP)
(eye, viewer)

image plane
View plane
projection =
(screen)

* Clipping Window:
decide which
part of the obj
is to be seen

camera window
clipping =

7

Graphics Hardware Architecture

disk ⟷ Memory → Graphics.

Input Devices →   CPU   scan conversion   Frame   →   Display   →   Display
(keyboard,   Rasterization.   Buffer   controller
mouse,   (DC)
etc.)   GPU

Double-Buffering

Each pixel has
1 byte per color
(Red, Green, Blue
primary colors)
⇒ 3 bytes per
pixel = 24
bits.

Rasterization.

1248 × 1024 pixels

DC → grid
locations
(pixels)
1248 × 1024
pixels
~60~75 Hz

show the content
from frame buffer
to Display & Refresh

(Monitor)

8

4

Application Programmer's (software) Graphics Model:

Application Program ↔ Graphics Library (API) ↔ Hardware ← input devices
→ output device (monitor)

API: application programmer's interface (eg. OpenGL)

* Need functions in API to specify
{ objects: vertices (modeling)
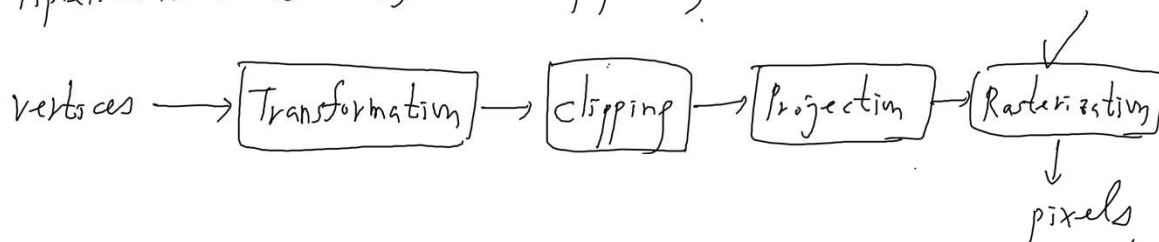the viewer (viewing)
light sources
material properties } (lighting & shading)

Tasks (4 major steps in imaging process)
Transformation
Clipping
Projection
Rasterization
(Scan-conversion)

9

---

* Pipleline Architecture (geometric pipeline)

vertices → Transformation → clipping → Projection → Rasterization → pixels

10