

Part zero: Introduction

3. Input/output

1. Introduction?

1.1 영상의 획득

Outline

- I. 카메라 영상의 획득
 - A. 카메라
 - B. 스마트폰
 - C. Color 영상 획득
 - D. 해상도
- II. Graphics 영상 획득
 - A. Modeling
 - B. Rendering
- III. AR 영상 획득
 - A. 획득
 - B. 렌더링
 - C. Processing - GPU
 - D. Output Hardware
 - E. Interaction
 - F. Applications

o. 영상의 획득



1. 카메라



2. 그래픽



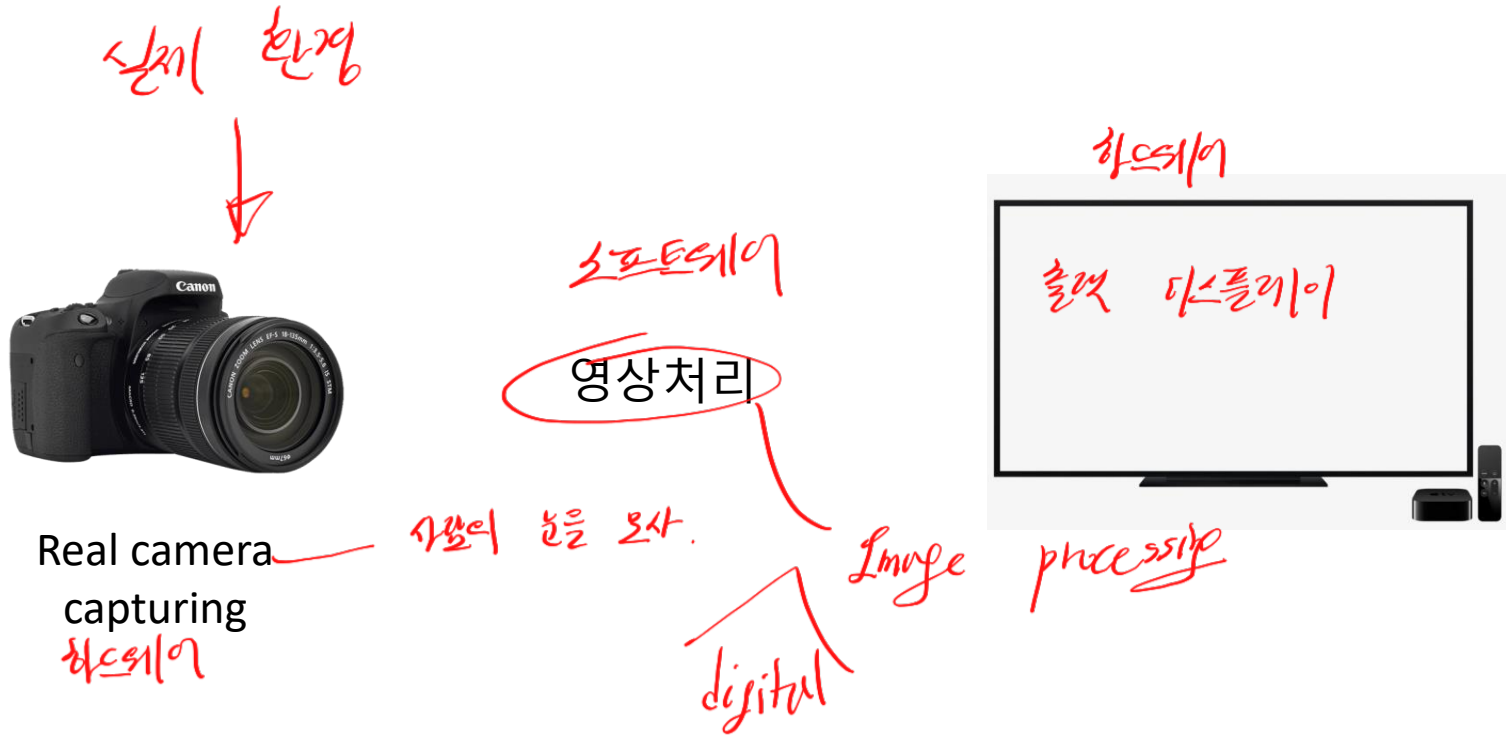
3. AR: 카메라 + 그래픽

Outline

- I. 카메라 영상의 획득
 - A. 카메라
 - B. 스마트폰
 - C. Color 영상 획득
 - D. 해상도

1. 영상의 획득: 카메라

- 디지털 영상 획득

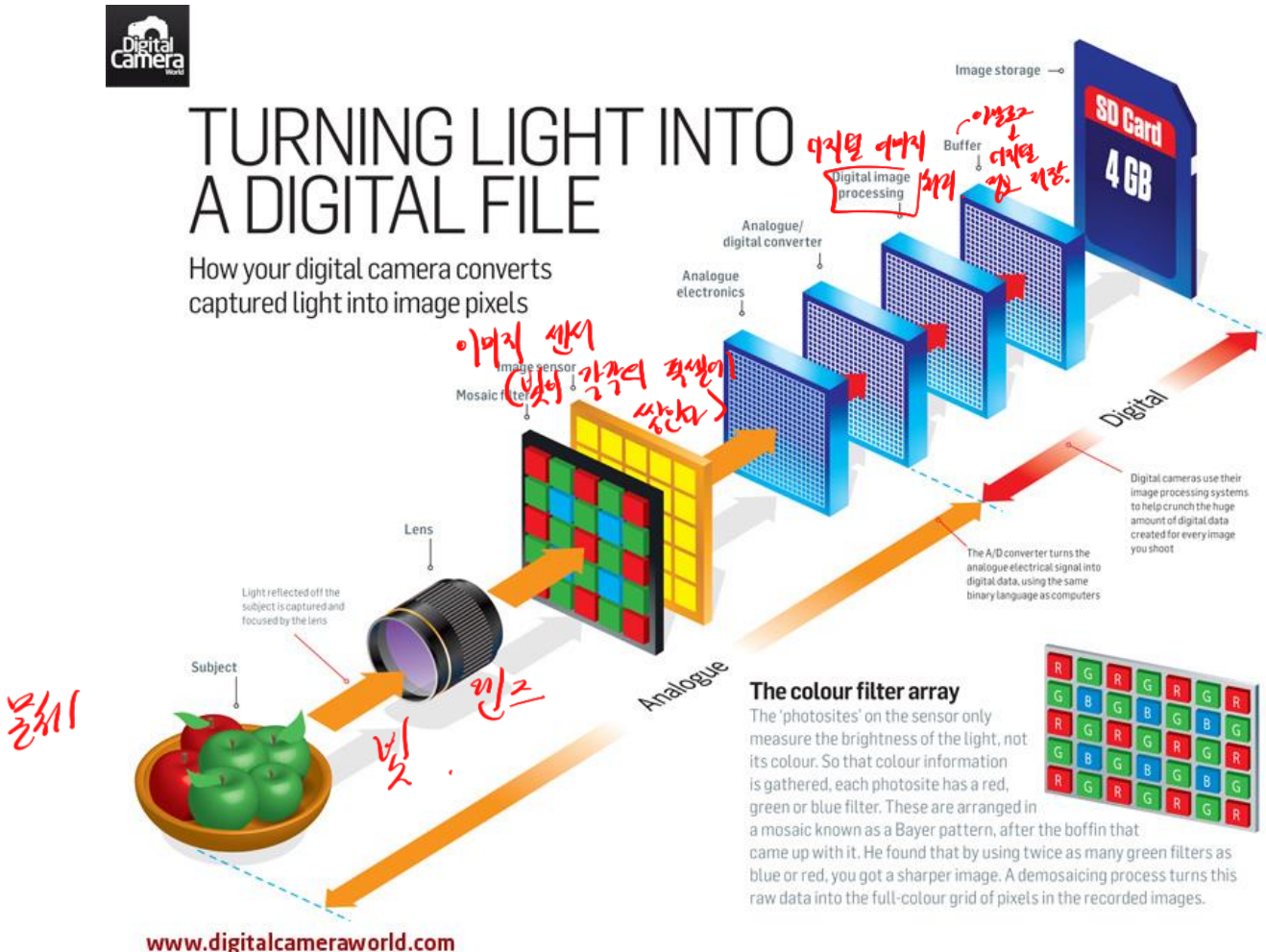


필름을 사용하는 카메라 → 영화.

디지털 카메라 → 이미지를 숫자로 표현.

1.1 디지털 영상 획득

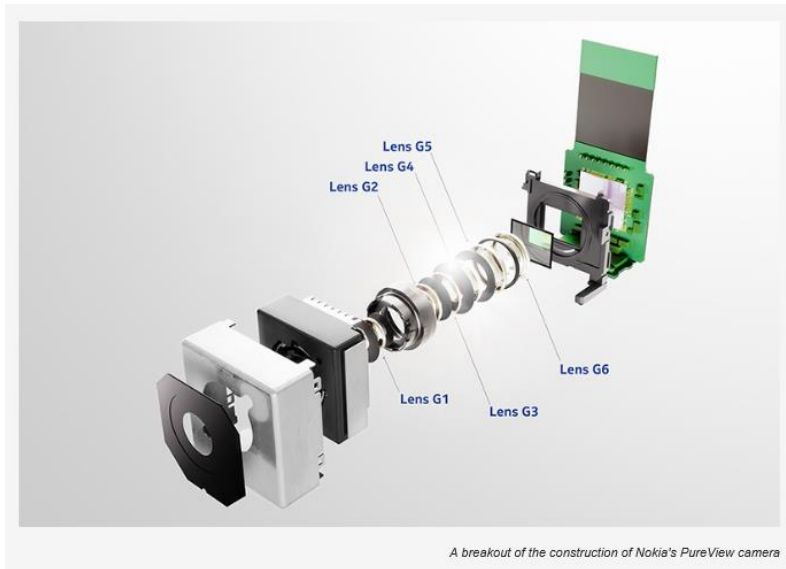
- 카메라



<https://www.youtube.com/watch?v=XPec2EaBSSM>

1.2 스마트폰

- Smart Phone



MOBILE : SOFTWARE

Google Camera Go Brings Some Google Camera Features to Low-Cost Phones

By Anil Ganti

Mar 19, 2020

f SHARE

TWEET

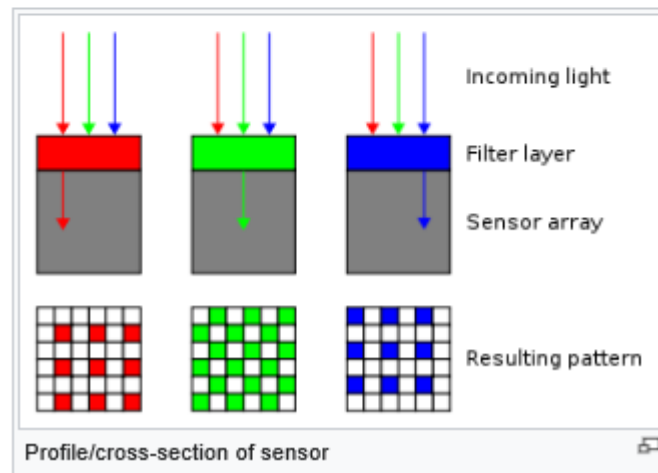
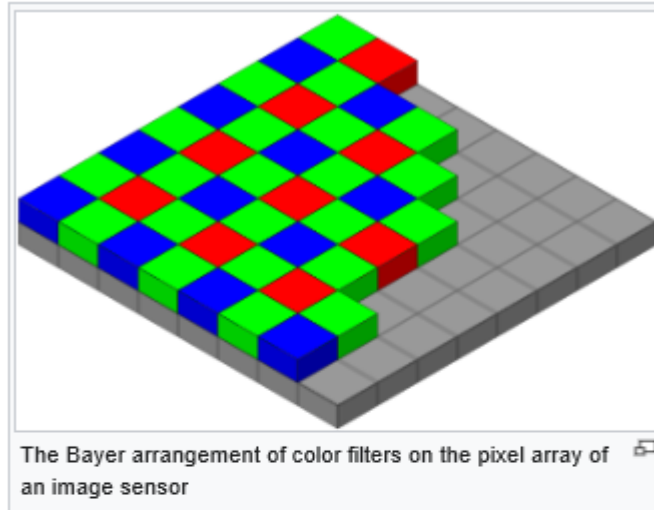
SUBMIT



1.3 Color 영상 획득

- Bayer filter

r, g, b 3원색.

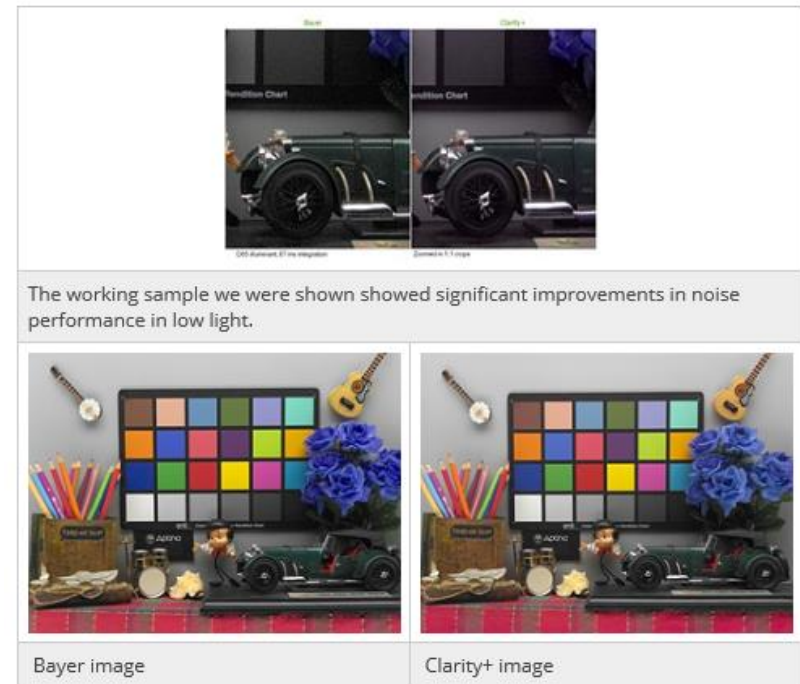


1.3 Color 영상 획득

- Bayer filter

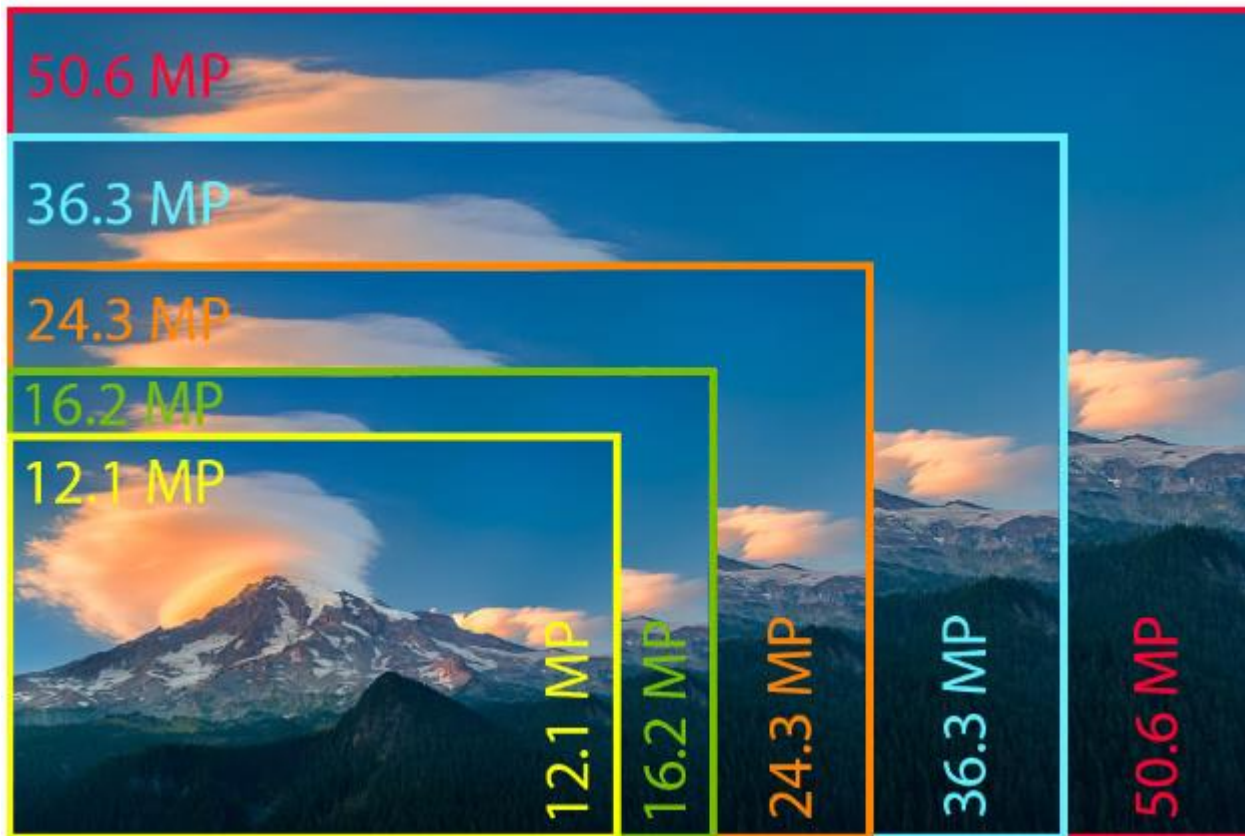


Pattern:	Bayer RGB	25% C	50% C: RG/BC Pattern A	50% C: RG/BC Pattern B	50% C: RC/CB Clarity+
Unit cell	2 x 2	2 x 2	4 x 4	4x4	2 x 2
SNR Improvement	0 dB (ref.)	1dB	3-4 dB	3-4 dB	3-4 dB
Sharpness	reference	lower	slightly lower	slightly lower	equivalent
Spatial Color Artifacts	reference	slightly worse	serious	serious	equivalent



1.4 해상도 ^{안쪽 NW / 이미지 / 아웃쪽 NW}

- Camera Resolution



<https://photographylife.com/camera-resolution-explained>

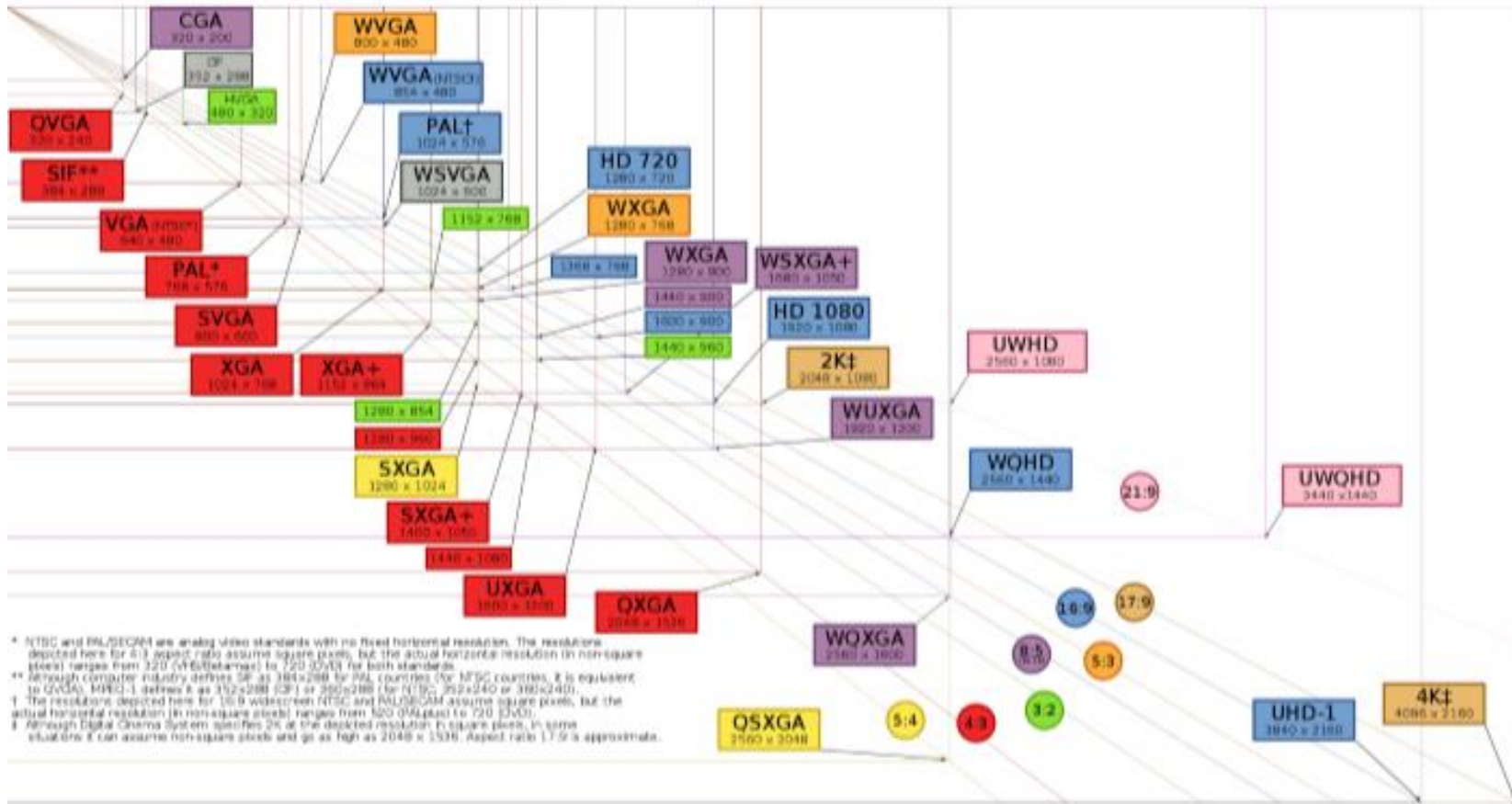
1.4 해상도

- Camera Resolution

HD (1280 X 720)

FHD (1920 X 1080)

4K 3840 X 2160



Outline

2. Graphics 영상 획득

- A. Modeling

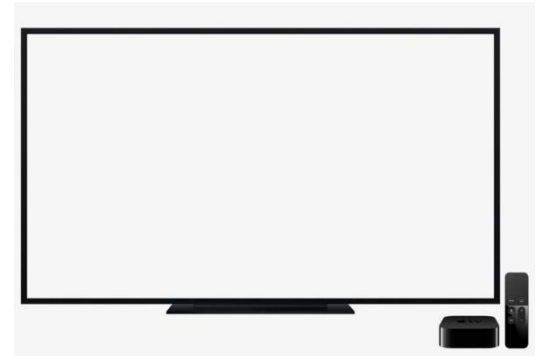
- B. Rendering

2 영상의 획득: Graphic

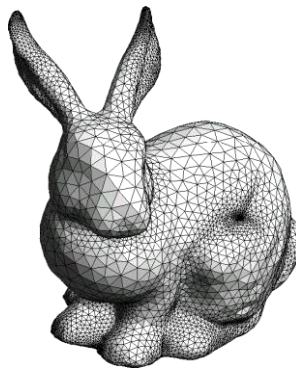


Real camera
capturing

영상처리



Virtual camera



Modeling



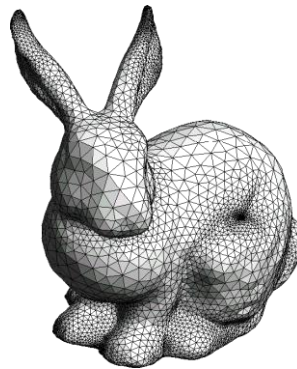
Rendering

2.1 획득

- 획득 - Model



Virtual camera

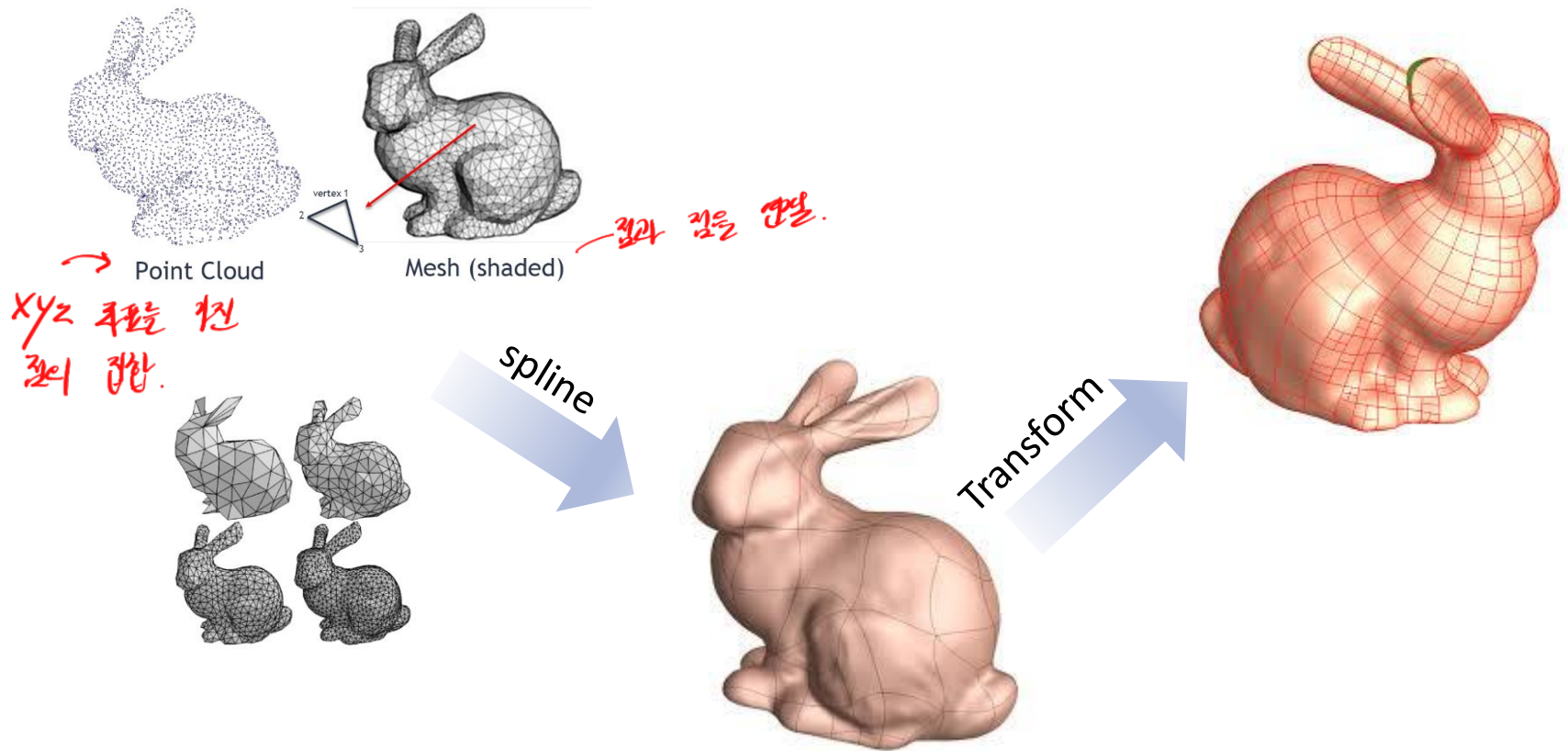


Model

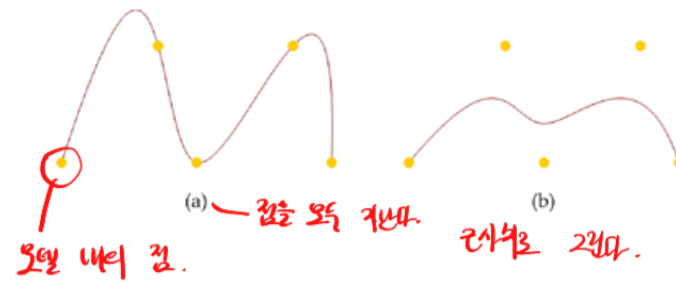
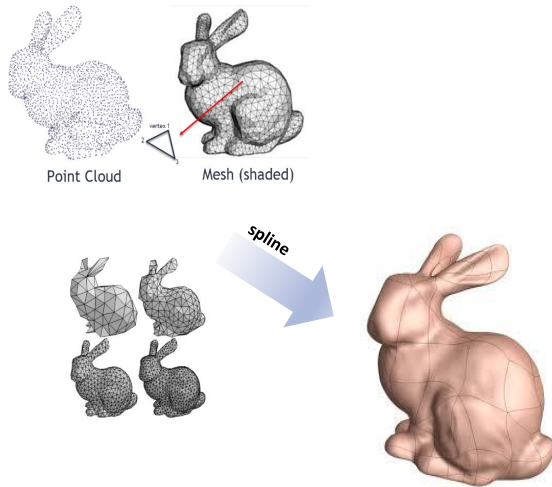
Vertex
Mesh
Curve
Spline
Coordinate
Transformation
Animation

2.1 Modeling

메모리를 적게 차지하고
프로세싱 시간이 짧아야 한다.

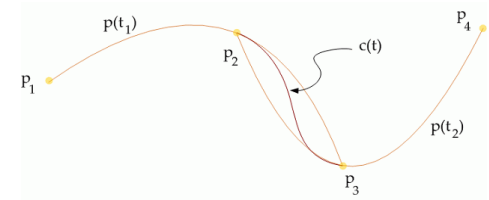
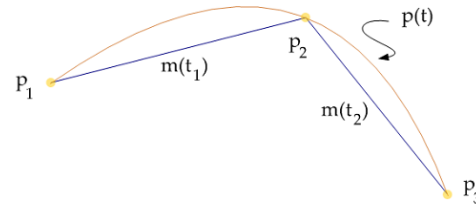
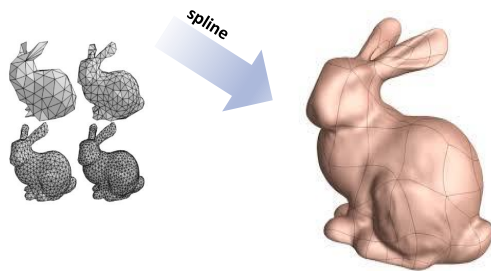
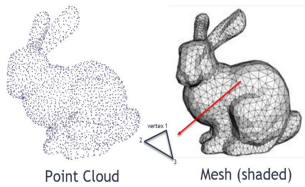


2.1.1 Splines

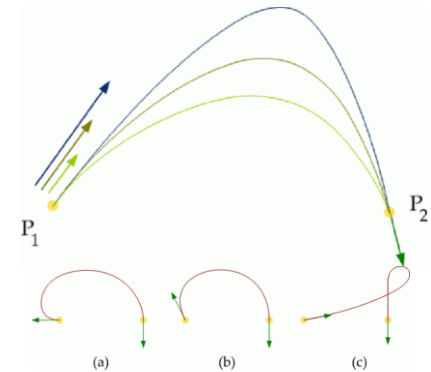
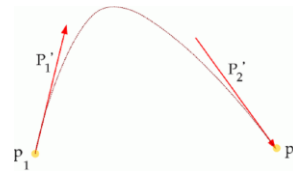


2.1.1 Splines 곡선

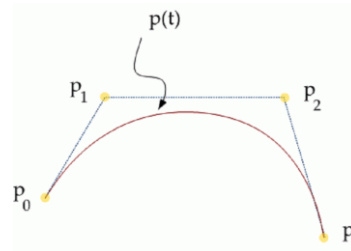
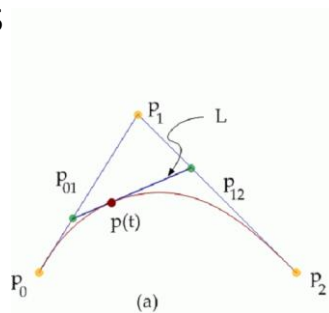
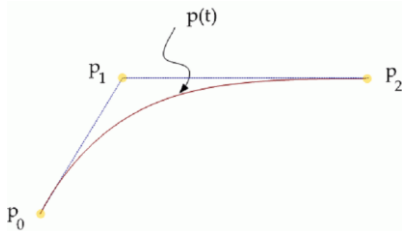
Cardinal Splines



Hermite Splines

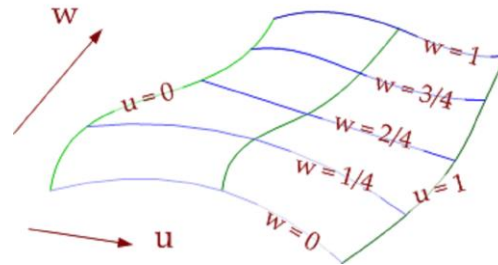
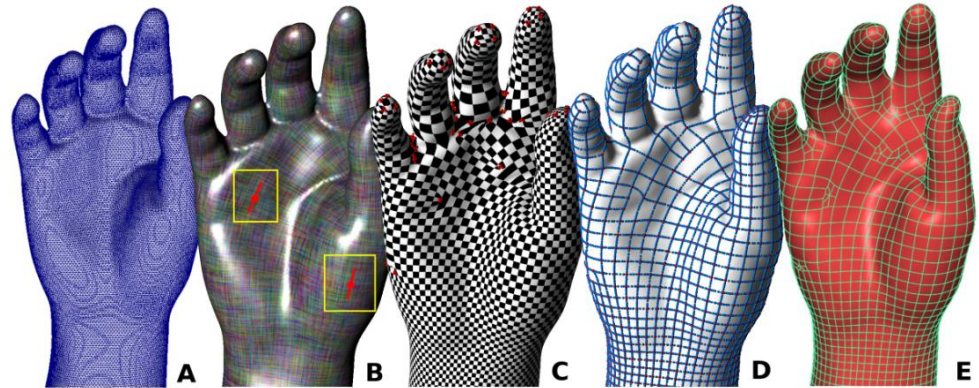
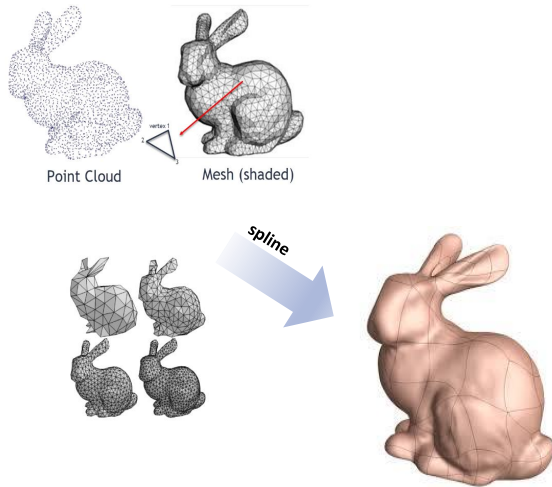


Bezier Splines



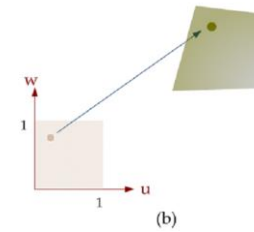
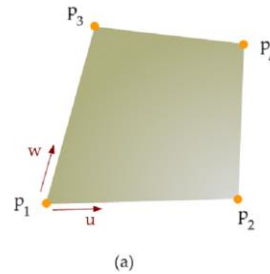
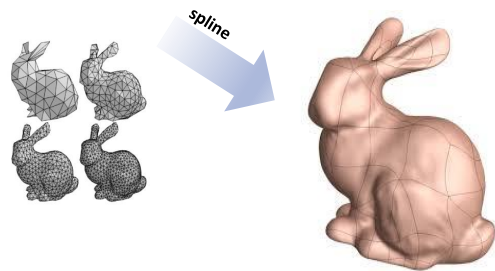
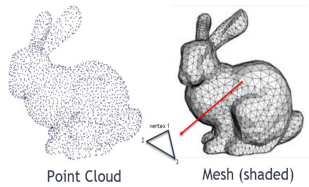
2.1.2 Surfaces

Spline 곡면 (곡면 확장) -

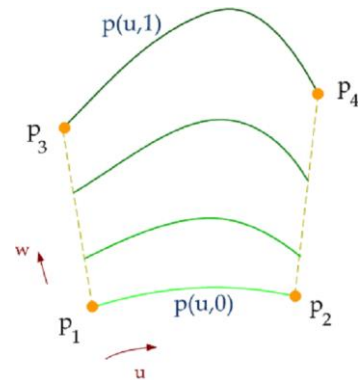


2.1.2 Surfaces

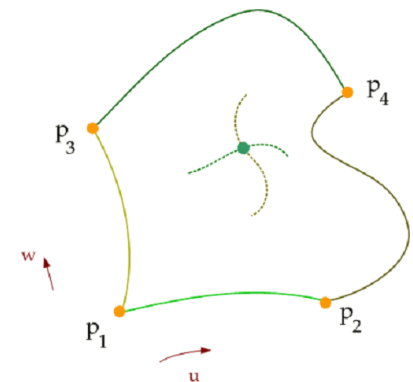
공간상 4점



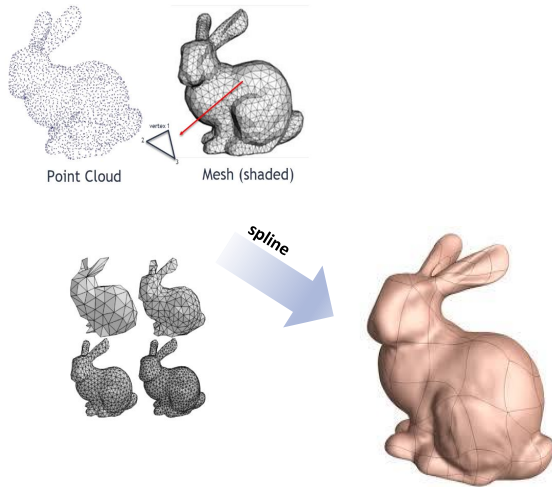
2개의 공간 곡선



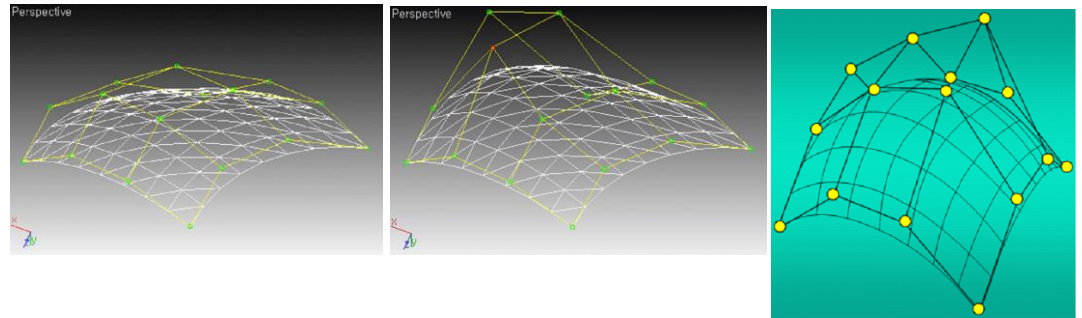
4개의 경계 곡선



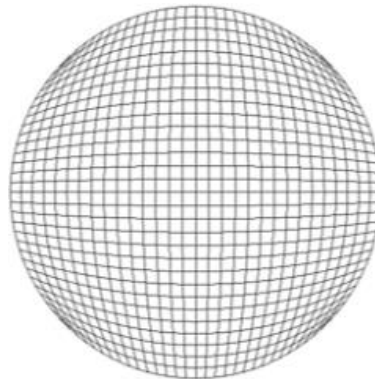
2.1.2 Surfaces



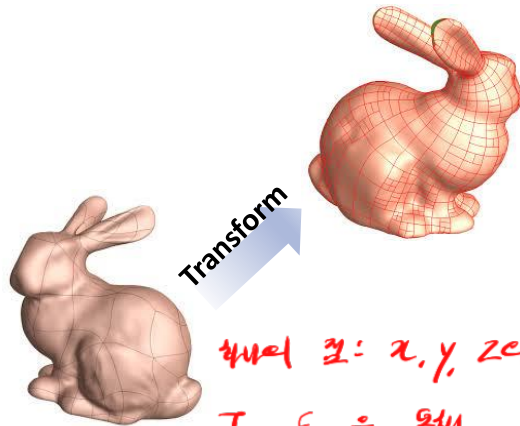
Bezier Surfaces



Quadric Surfaces

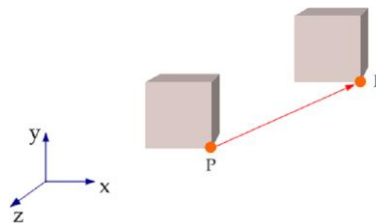


2.1.3 Transform



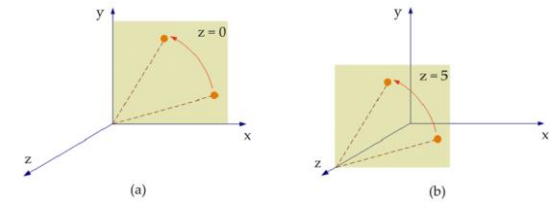
해의 좌: x, y, z 의 좌표.
Transform을 통해
새로운 좌표로 변환.

Translation



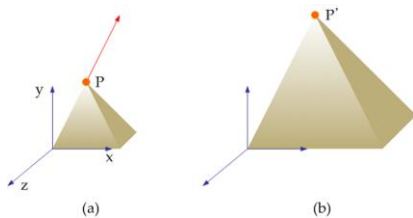
$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & T_x \\ 0 & 1 & 0 & T_y \\ 0 & 0 & 1 & T_z \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Rotation



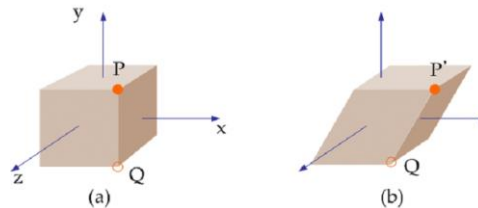
$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos \theta & -\sin \theta & 0 & 0 \\ \sin \theta & \cos \theta & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Scaling



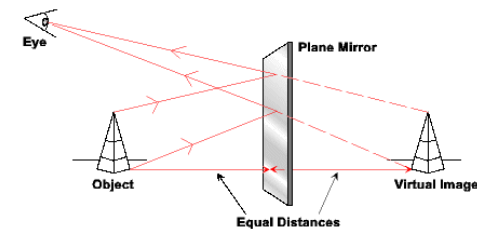
$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} S_x & 0 & 0 & 0 \\ 0 & S_y & 0 & 0 \\ 0 & 0 & S_z & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Shearing



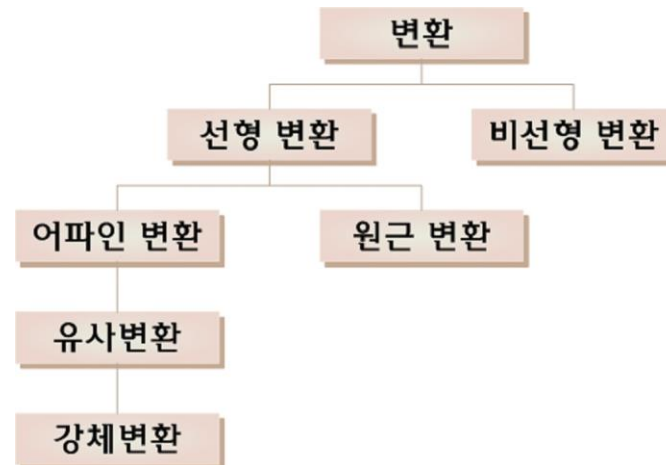
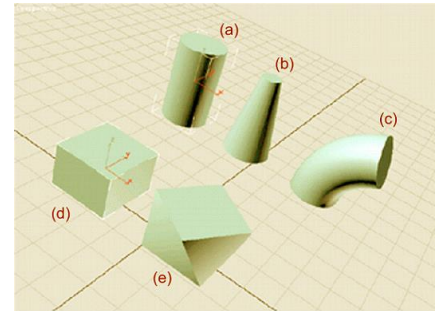
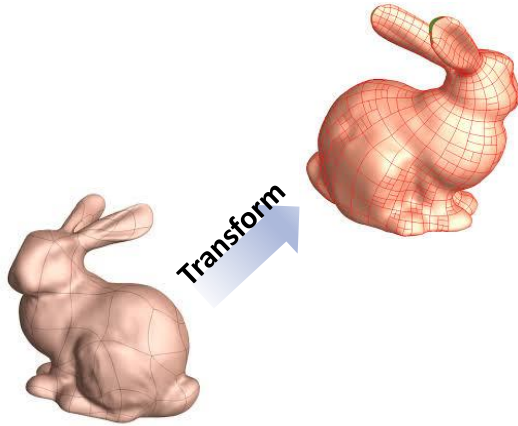
$$\begin{bmatrix} x' \\ y' \\ z' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & Sh_y & 0 & 0 \\ Sh_x & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

Reflection



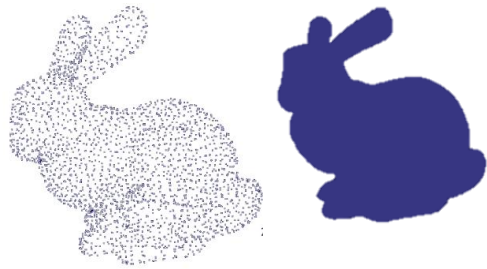
$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

2.1.3 Transform



2.2 Rendering

→ 이것도 하드웨어에 특화된 영역은 아니다.



Shading

Rendering

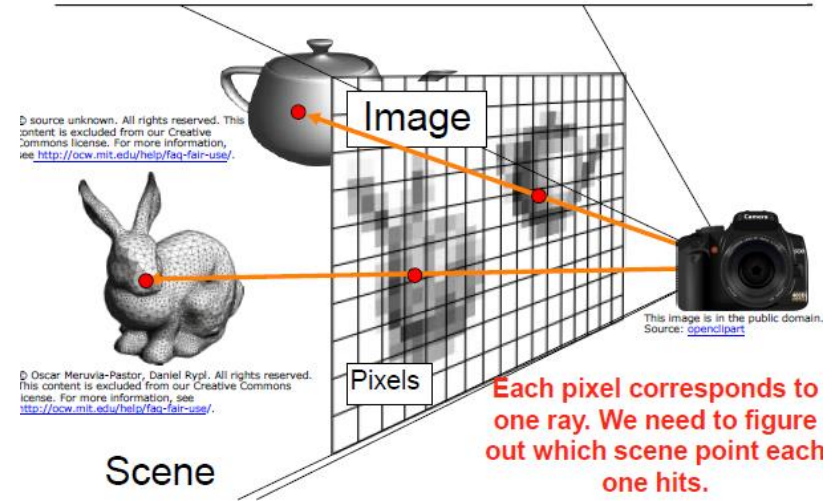


Texturing

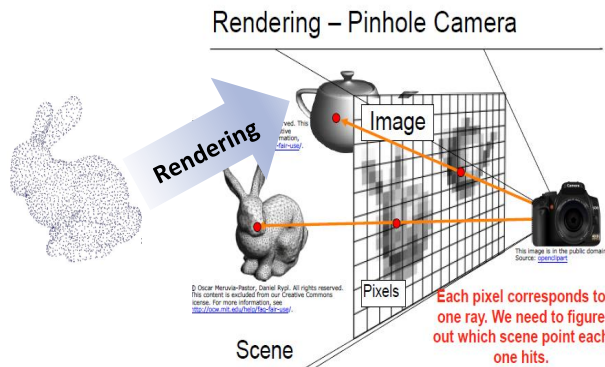
질감



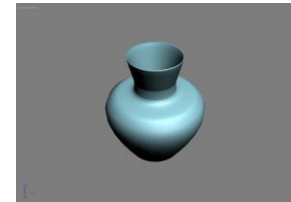
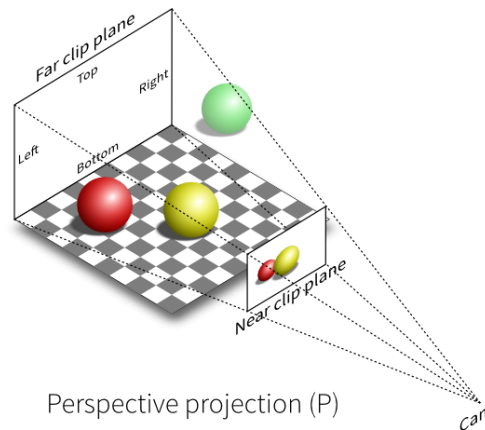
Rendering – Pinhole Camera



2.2.1 Projection, 투상변환



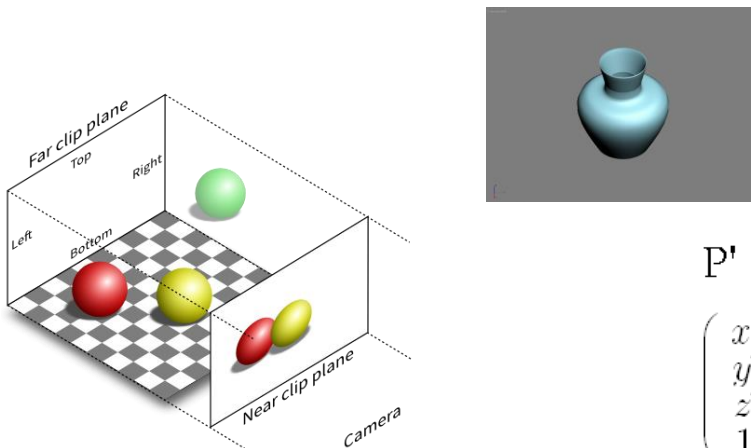
Perspective Projection



$$P' = \begin{pmatrix} x' \\ y' \\ -d \\ 1 \end{pmatrix} = \begin{pmatrix} x \\ y \\ -z/d \\ 1 \end{pmatrix}$$

$$= \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & -1/d & 0 \\ 0 & 0 & 1/d & 0 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix}$$

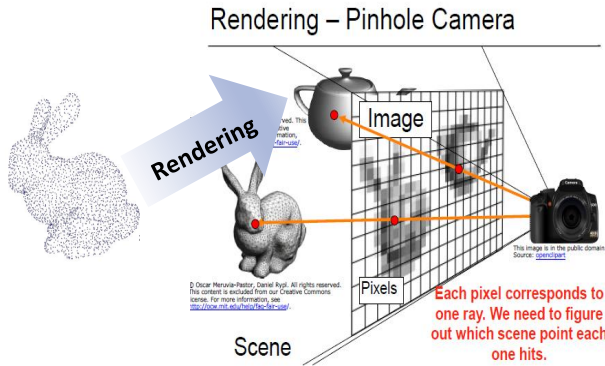
Orthographic Projection



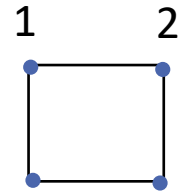
$$P' = M_{\text{parallel}} \cdot P$$

$$\begin{pmatrix} x' \\ y' \\ z' \\ 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & -d \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} x \\ y \\ z \\ 1 \end{pmatrix} = \begin{pmatrix} x \\ y \\ -d \\ 1 \end{pmatrix}$$

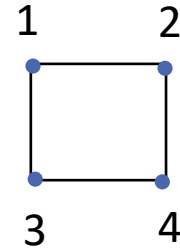
2.2.2 가시성 변환



표면과 이면

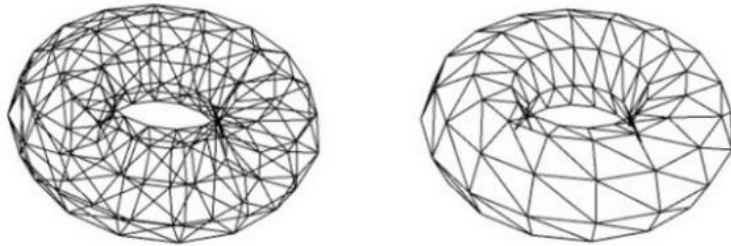


Polygon: 1, 2, 4, 3

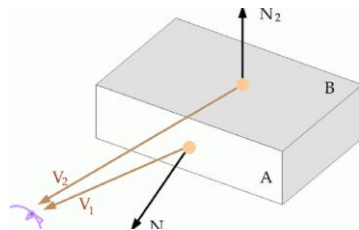
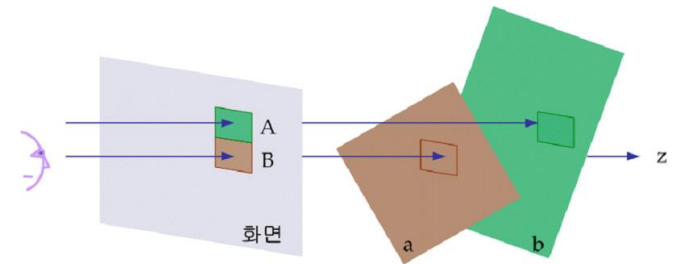


Polygon: 1, 3, 4, 2

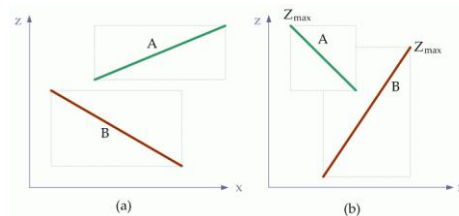
후면 제거



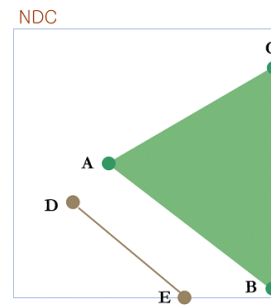
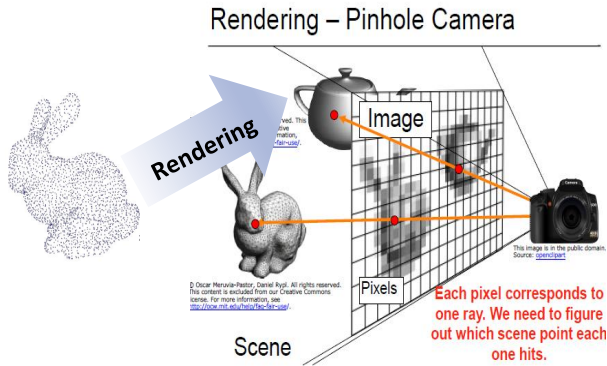
은면 제거



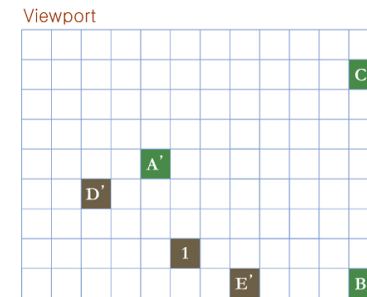
$$\text{Backface} = (N \cdot V < 0) = (|N| |V| \cos \theta < 0)$$



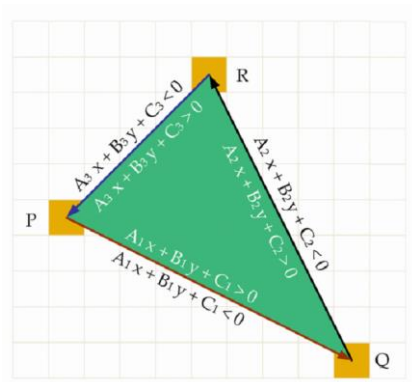
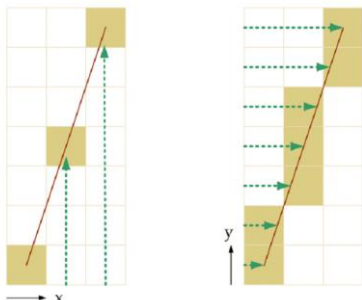
2.2.3 래스터 변환



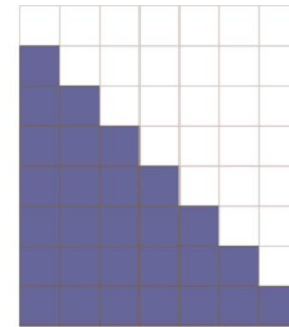
(a)



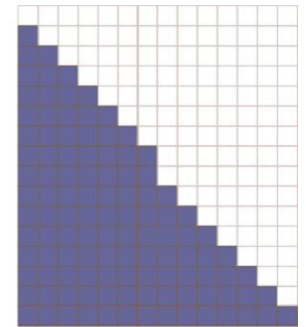
(b)



(a)



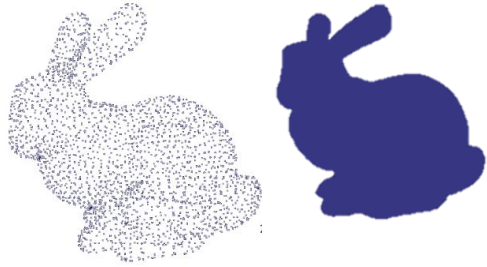
(b)



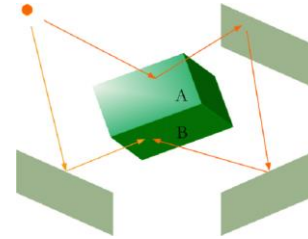
(c)

앨리어싱. (해상도 높으면 줄어든다.)

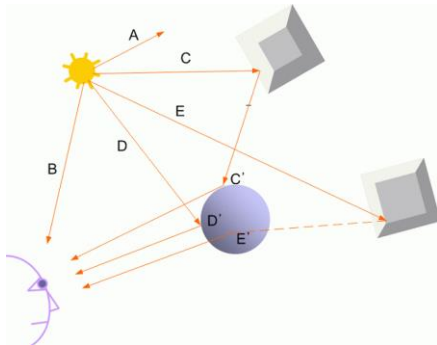
2.2.4 Lighting



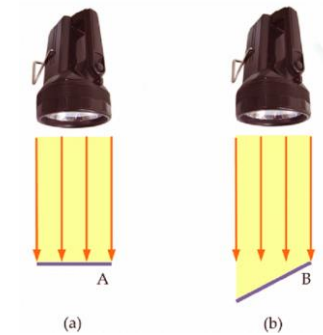
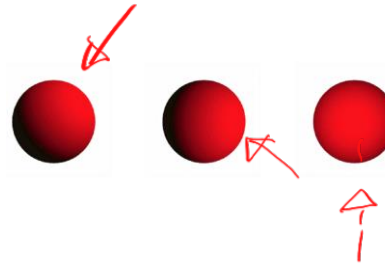
Ambient Reflection



Shading

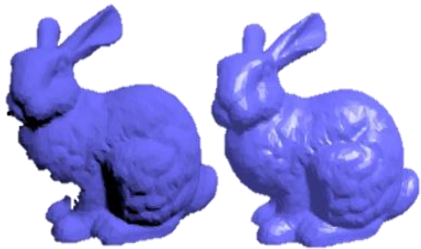
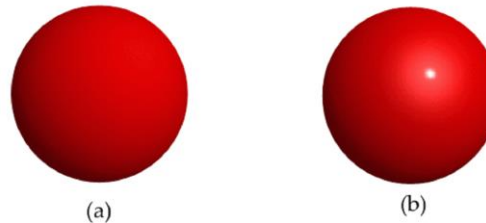


빛의 방향 알 수 있음.
Diffusive Reflection

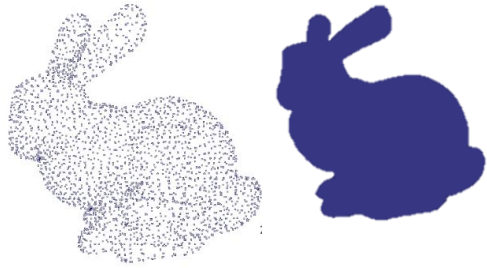


Specular Reflection

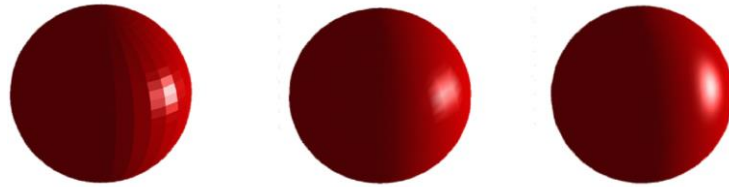
반사광.



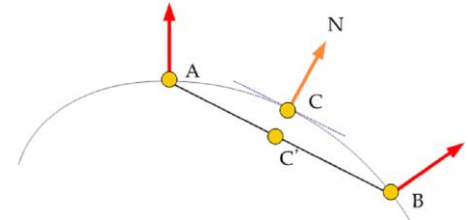
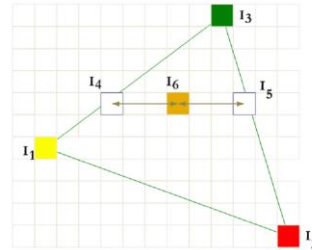
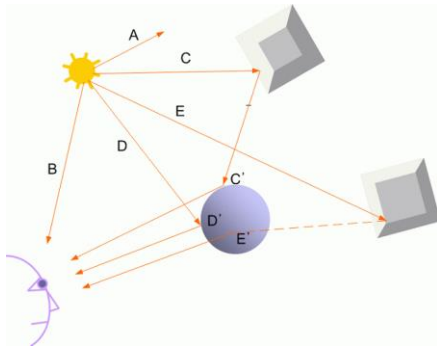
2.2.5 Shading (음영), Shade (그림자)



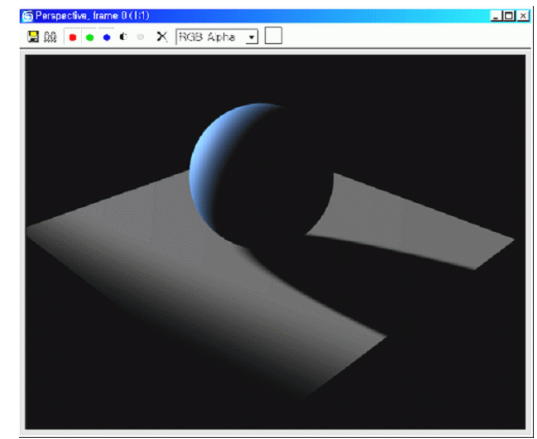
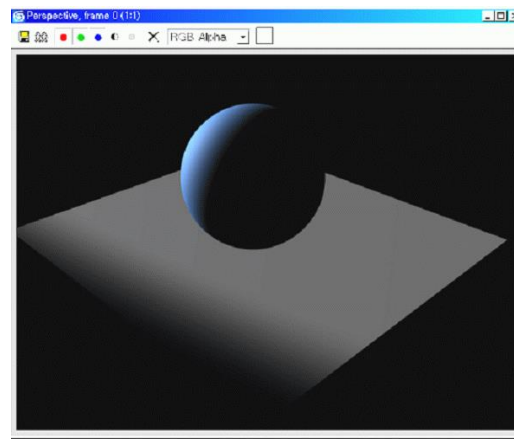
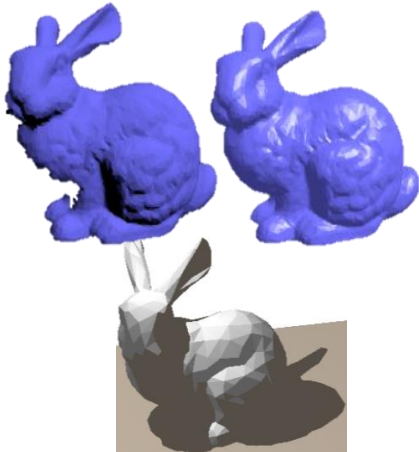
플랫, 구로, 폰 셰이딩



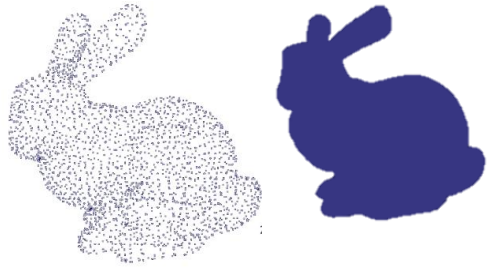
Shading
↓



그림자

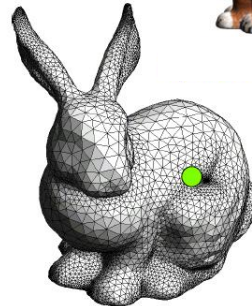


2.2.6 Texture Mapping

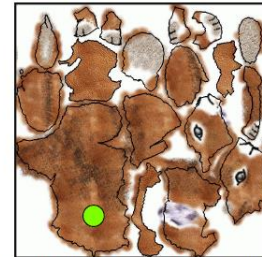


UV Texture

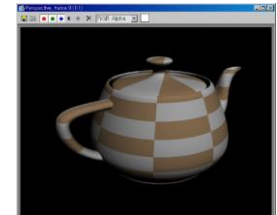
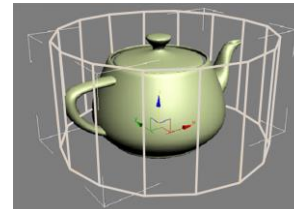
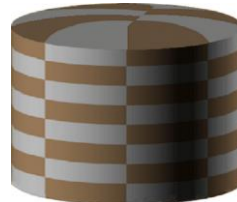
Texture mapped model



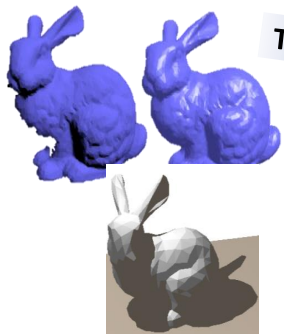
Texture map (2D image)



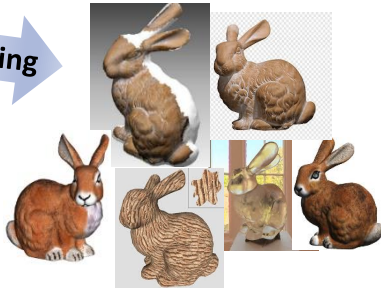
다각형 곡면



Shading



Texturing



3. 영상의 획득: AR



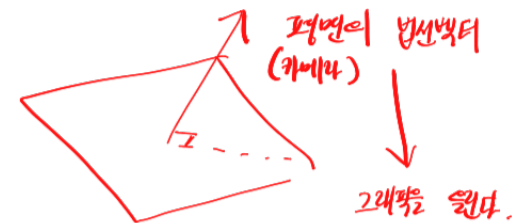
카메라



AR: 카메라 + 그래픽



그래픽



3. 영상의 획득: AR

