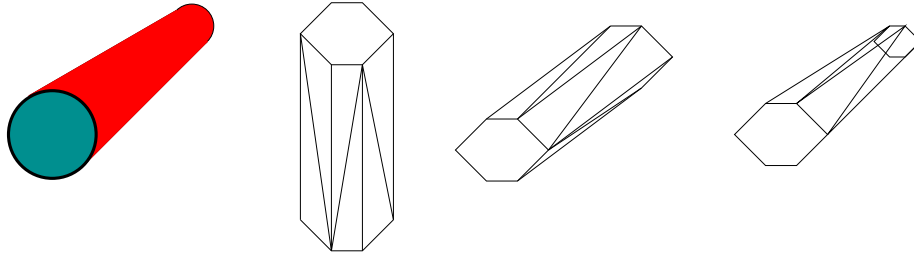
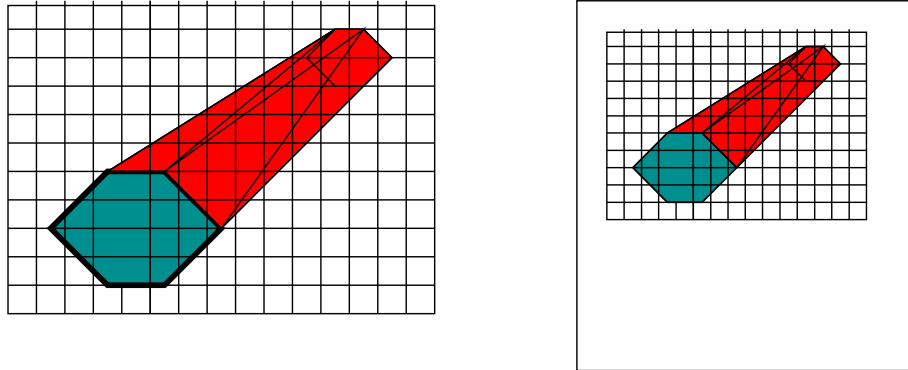


# 1. Introduction to Graphics

Designer's Mental image

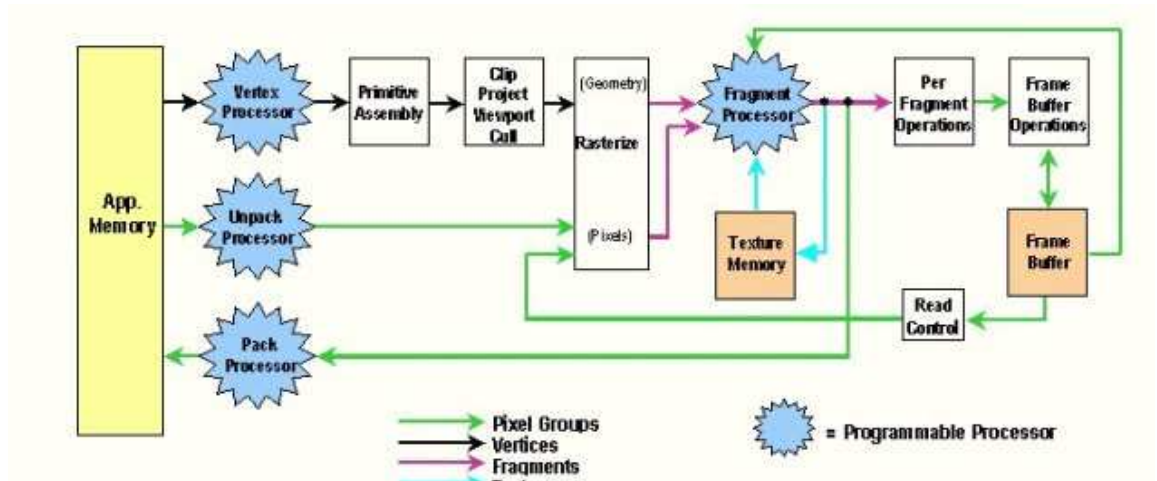


$\mathbb{R}^3$  nonlinear       $\mathbb{R}^3$  linear       $\mathbb{R}^3$  world space       $\mathbb{R}^3$  projective space  
Scene in 3D Coordinates (Vertex Processor) .



.       $\mathbb{N}^2$  rasterized       $\mathbb{N}^2$  window placement  
(Fragment Processor  $\rightarrow$ ) Rasterized Scene in 2D Coordinates

Modern graphics architecture

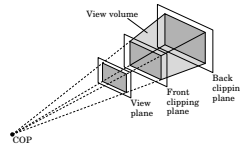


## Data flow structure of Animation Packages

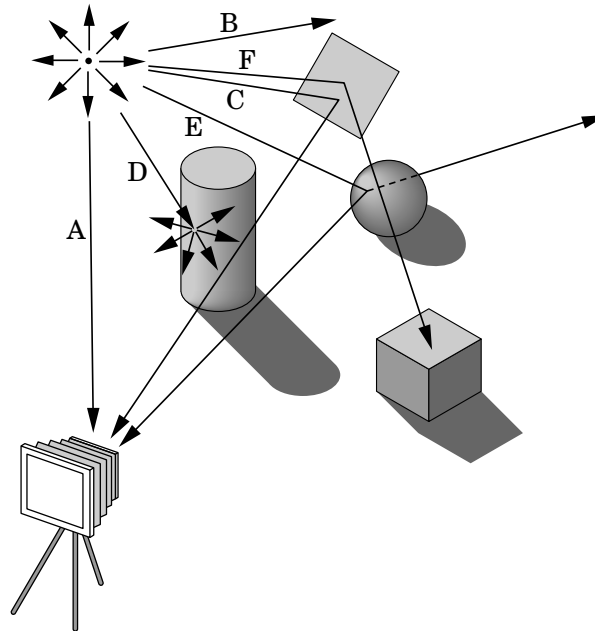
*Generators and Filters*(composition).

## Mathematical structure

- **Spaces:**  $\mathbb{R}^k$ ,  $\mathbb{Z}^k$ , Quaternions, ...  
 NOT 'homogenous, projective' but weighted masspoint = vertex



- **Objects:** graph + geometry;  
 control net (spline, subdivision), fractals, triangulation, or polygonal, point cloud, field (scalar, vector, tensor) *representations!* → spline curve → teapot
- **Maps:** linear, nonlinear  $\mathbb{R}^m \rightarrow \mathbb{R}^n$  (*splines, ODE, PDE, quaternions*)  
 texture:  $\mathbb{Z}_{128 \times 128} \rightarrow \mathbb{Z}_2^{8 \times 8 \times 8} \rightarrow \text{video}$
- **Rendering:** OpenGL lighting (specular, diffuse, ambient), particle or wave ray tracing, radiosity, material (BRDF) Reflection, Refraction, ...



- **compression** pixel packing, remote display (*Wavelets, LoD*) (maps graph + geometry).

## Graphics is related to

- ←→ image processing, vision (recognition)
- ←→ geometric modeling, computational geometry
- ←→ applied differential, algebraic geometry
- ←→ computer architecture
- ←→ content creation, art, simulation, applied physics

- Design
  - CAD (computer aided design) — constraint solving
  - interactive modeling
  - animation, movie
- Information display
  - image analysis
  - PET, MRI, CT (voxel visualization, Radon transform)
  - Tufte: visualizing data
- Simulation
  - Games (flight simulator)
  - Augmented reality
  - Virtual Reality