



Computação Visual

FUNDAMENTOS – GRAPHICS PIPELINE

2023

Computação Visual - modalidades



Tempo Real (on-line)

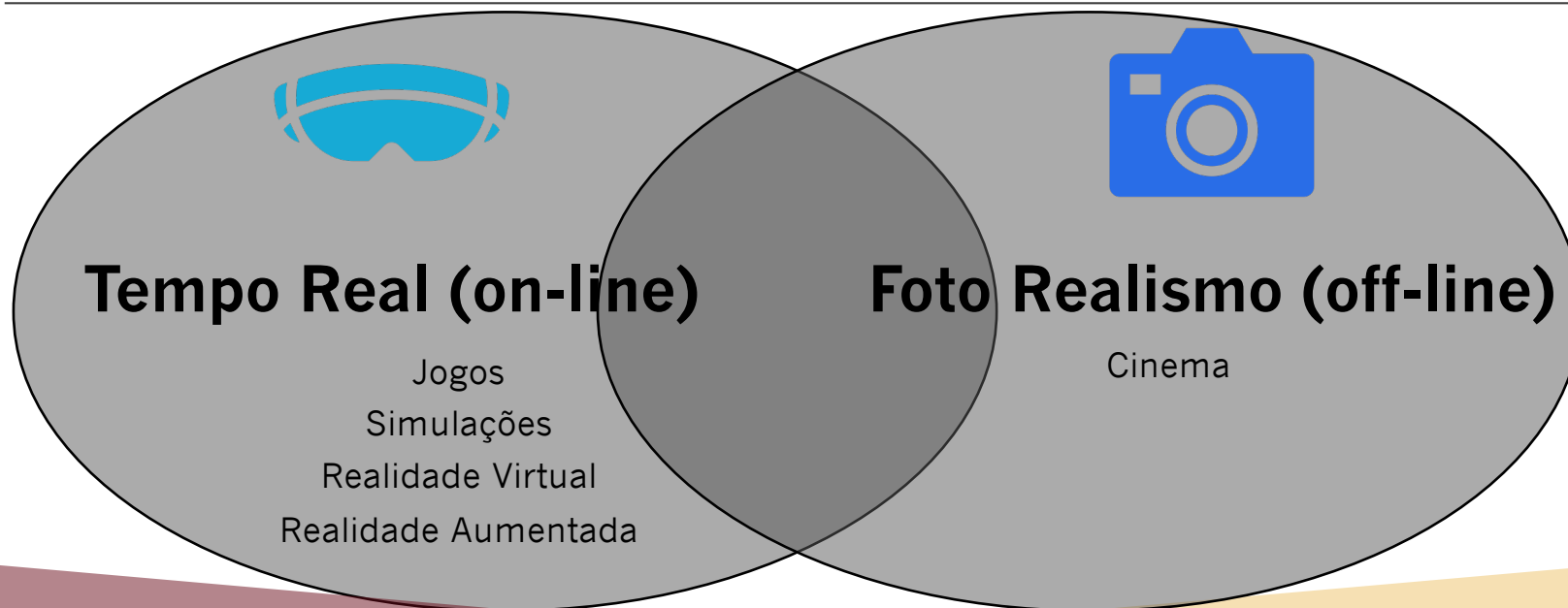
Jogos
Simulações
Realidade Virtual / Aumentada



Foto Realismo (off-line)

Cinema

Computação Visual - modalidades

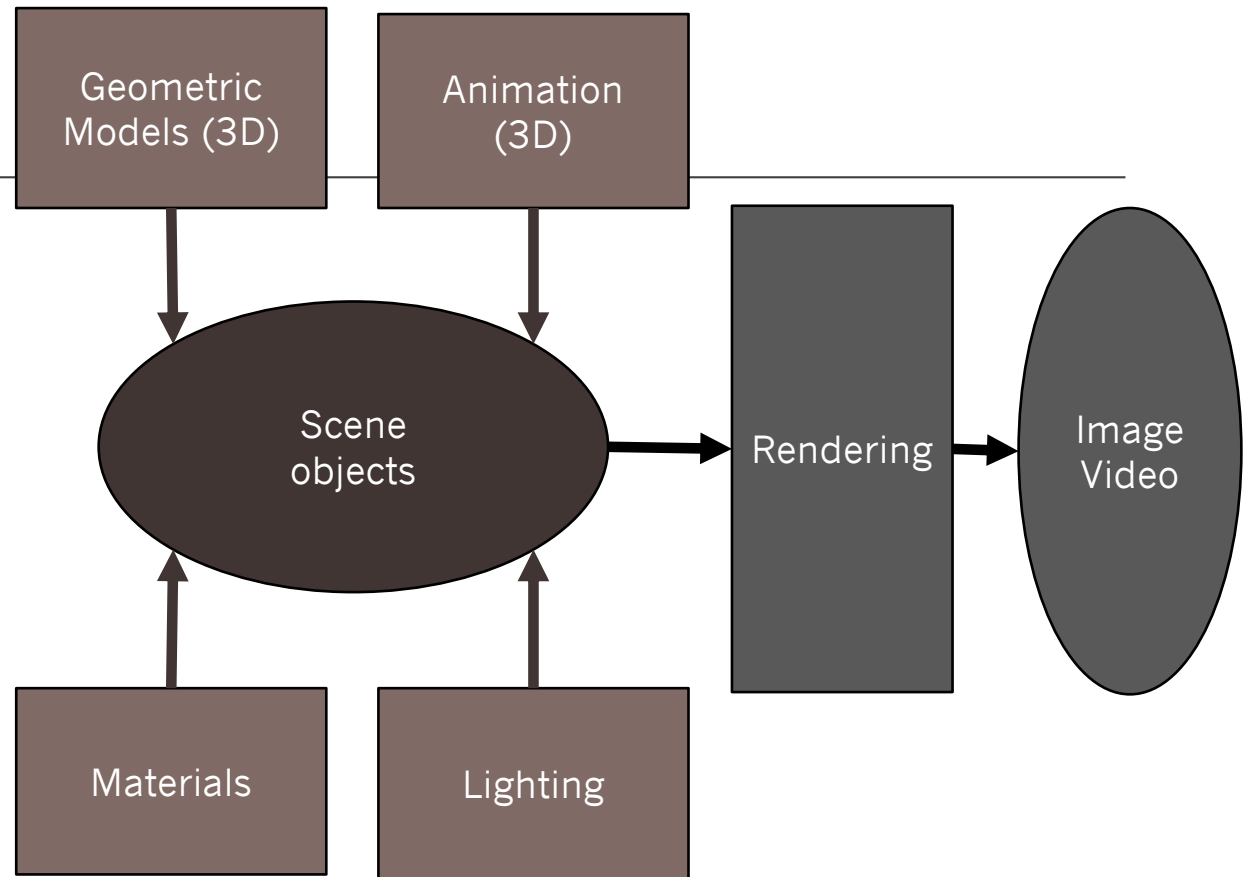


Desempenho

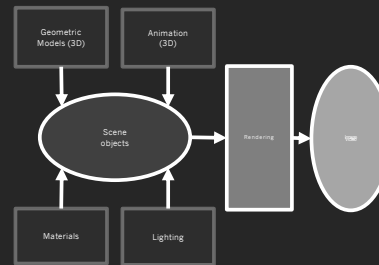
Qualidade



Graphics Process



Graphics Pipeline



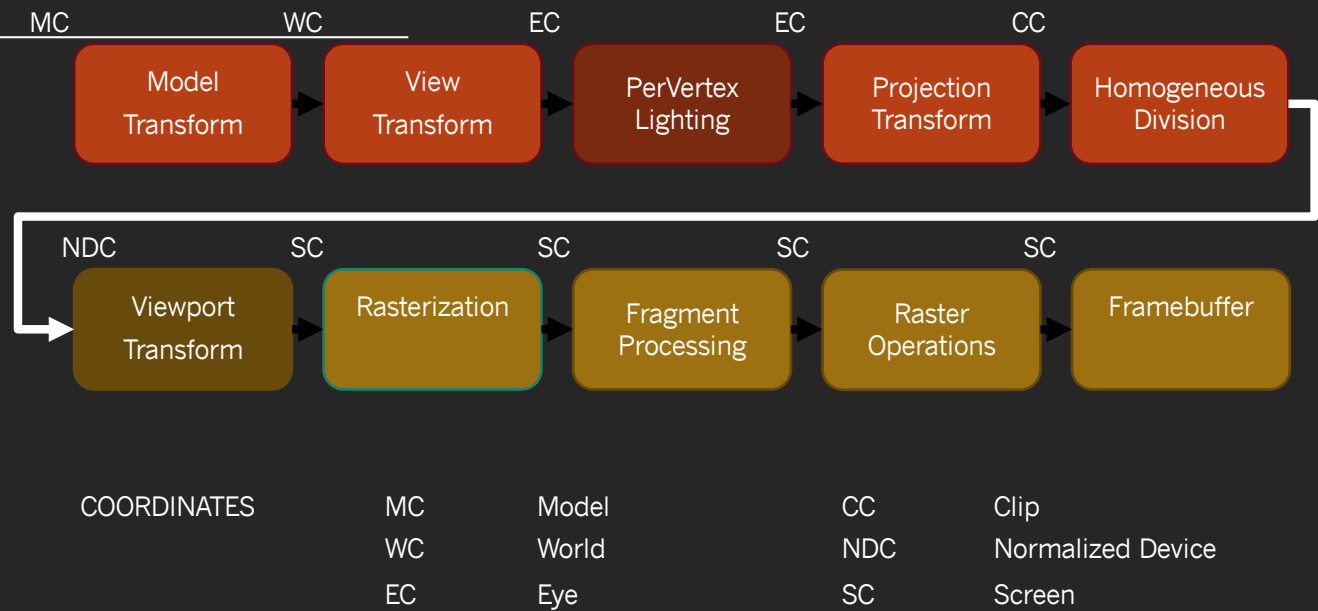
Fotografando / Filmando
a Cena Virtual

Técnica Clássica

- *Projetiva*
 - Geométrica
 - adequada a GPU
 - rápida

veremos outras ao longo do curso

- *Ray / Particle Tracing*
- *Radiosity*

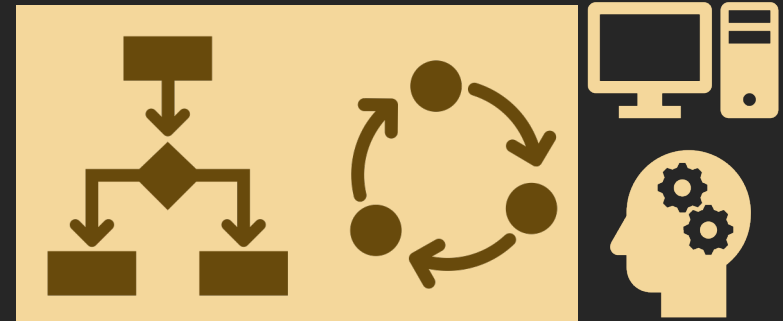


CG

Graphics Process (creating the scene)

- Modelagem
- Animação / Simulação
- Materiais
- Iluminação
- *Rendering*

Próximas aulas



Graphics Pipeline (rendering)

- Etapas da síntese de imagem

Esta aula



Graphics Pipeline

Fotografando



Filmando



Interagindo

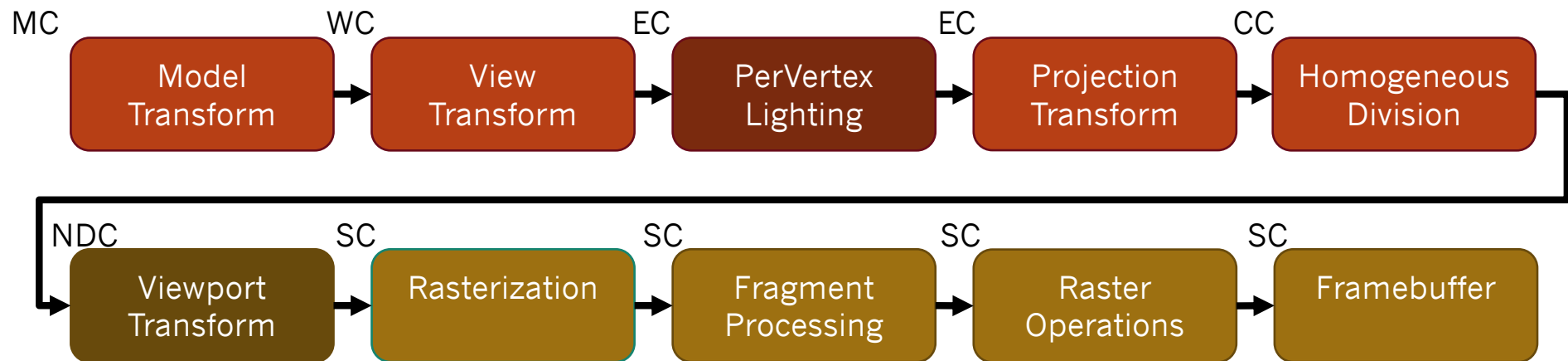


cena / mundo virtual



Graphics Pipeline (object => picture)

- fotografando um objeto virtual



COORDINATES

MC
WC
EC

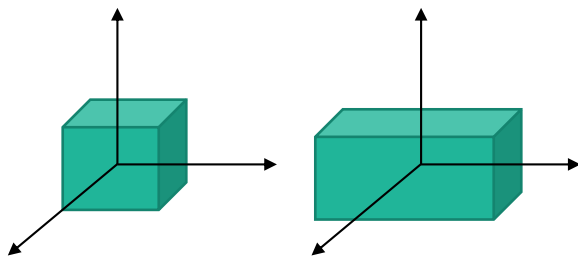
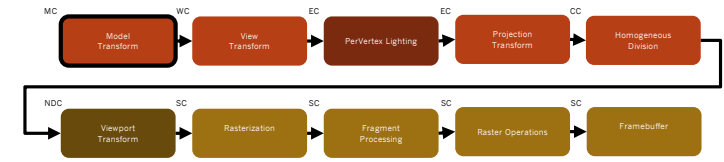
Model
World
Eye

CC
NDC
SC

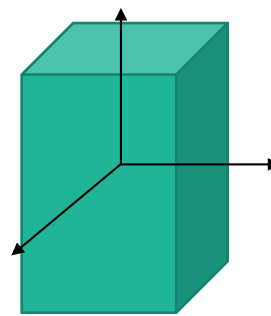
Clip
Normalized Device
Screen

Graphics Pipeline

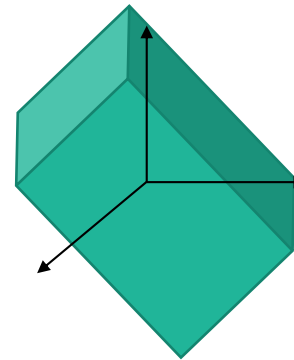
Model Transform (MC)



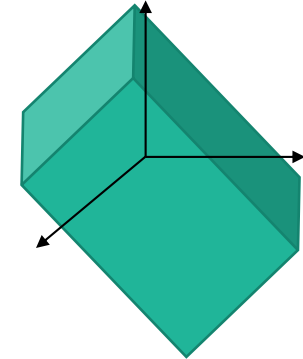
scale (x)



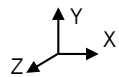
scale (y)



rotate (z)

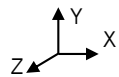
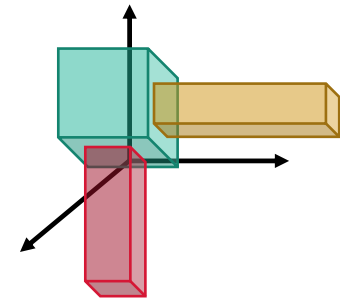
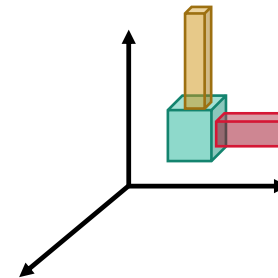
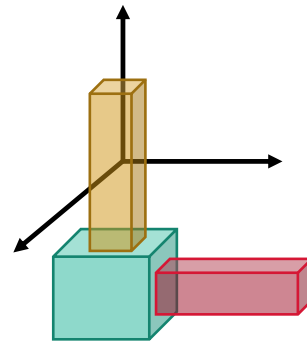
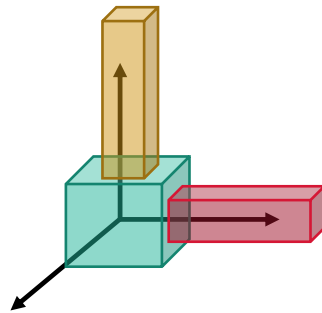
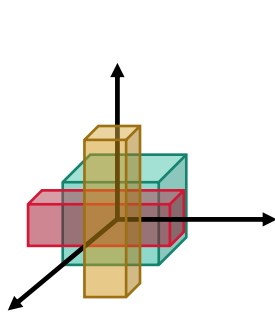
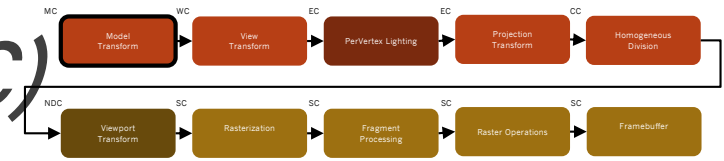


translate (y,z)



Graphics Pipeline

Model Transform ($MC \Rightarrow WC$)



replace

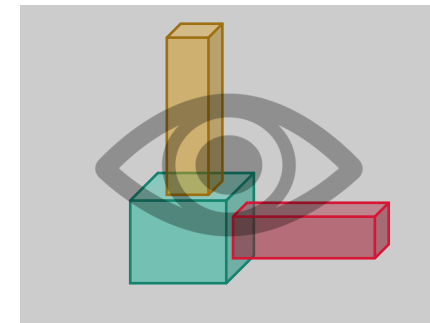
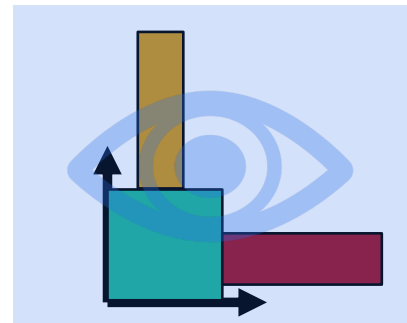
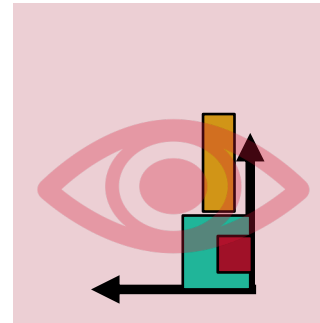
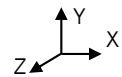
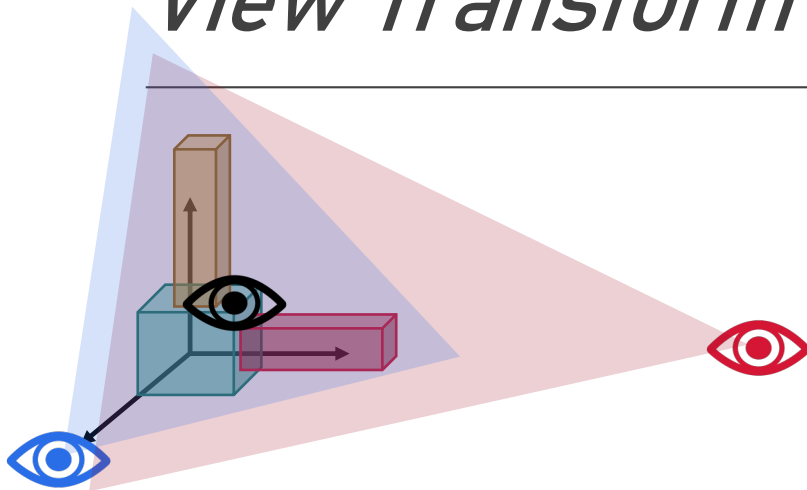
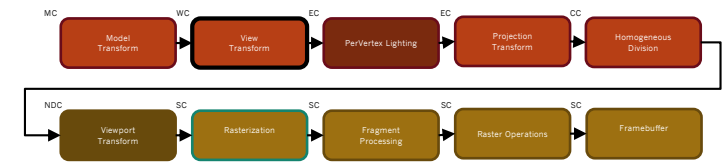
move

scale

rotate/scale/translate

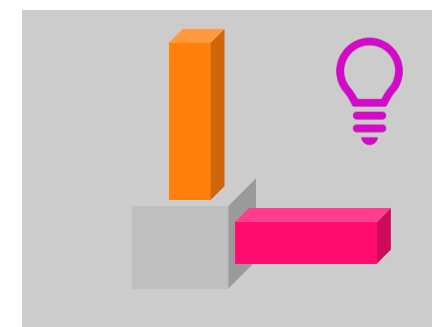
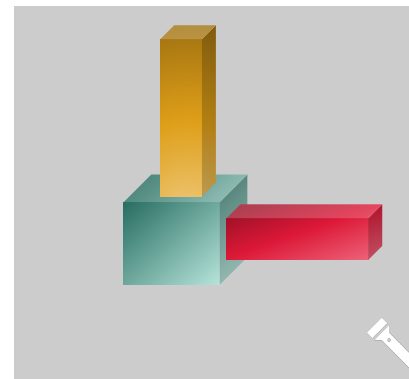
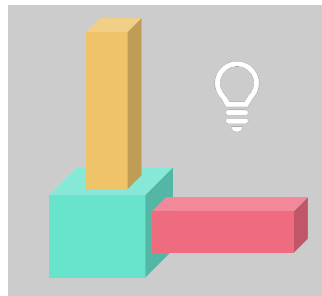
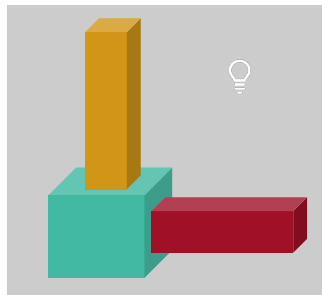
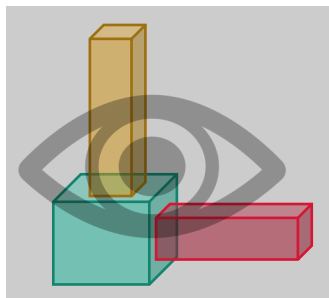
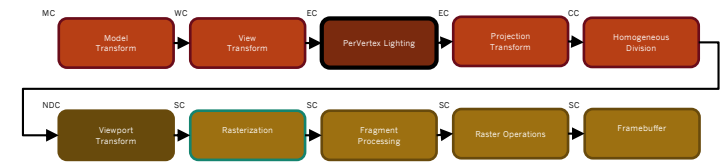
Graphics Pipeline

View Transform ($WC \Rightarrow EC$)

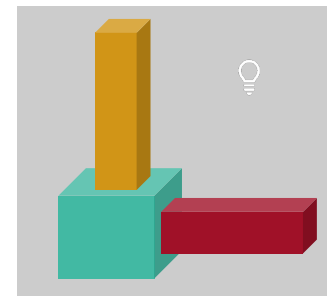
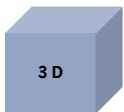
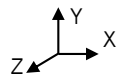
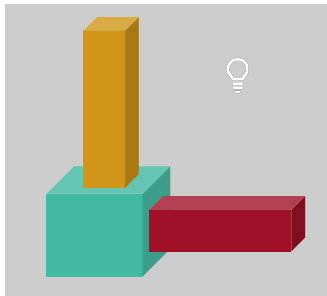
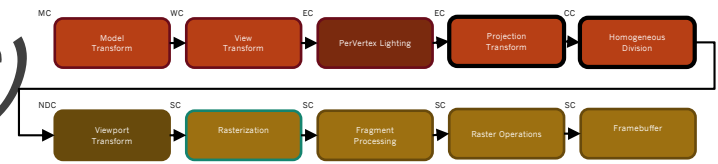


Graphics Pipeline

Per Vertex Lighting (EC)

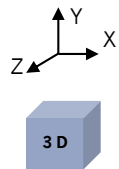
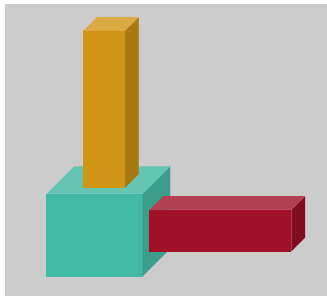
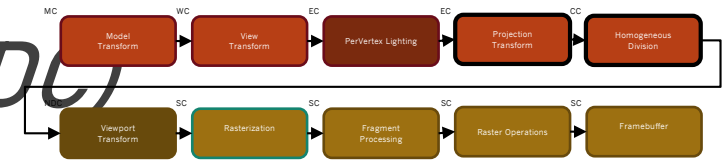


Graphics Pipeline Projection Transf. ($EC \Rightarrow CC$)



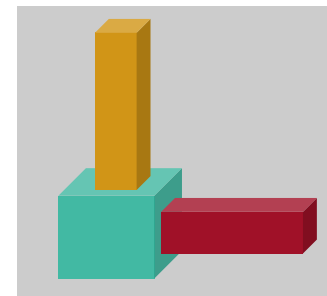
Graphics Pipeline

Homogeneous Div ($CC \Rightarrow NDC$)



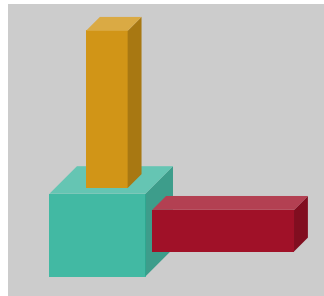
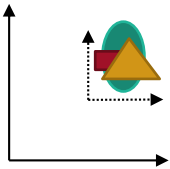
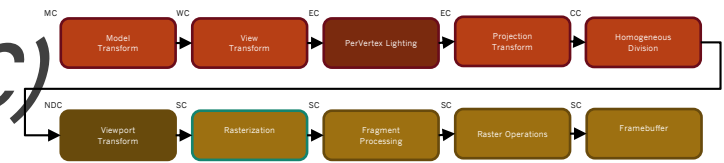
perspectiva
paralela

$$\begin{aligned} x &= X/Z & y &= Y/Z \\ x &= X & y &= Y \end{aligned}$$



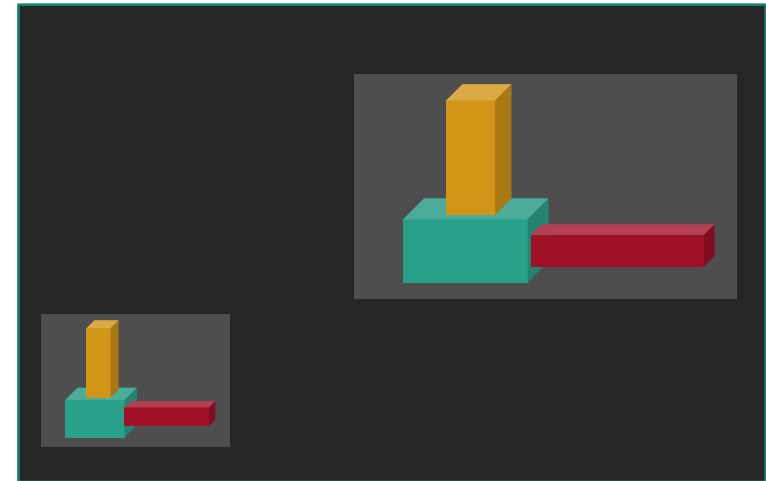
Graphics Pipeline

Viewport Transf. (NDC=>SC)



y
NDC
x

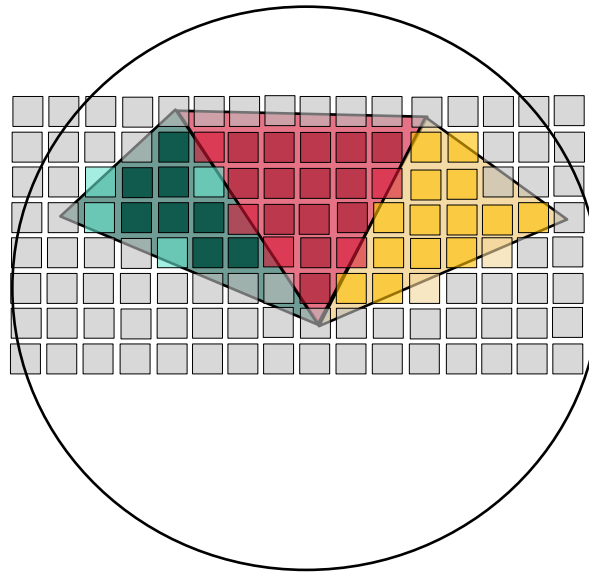
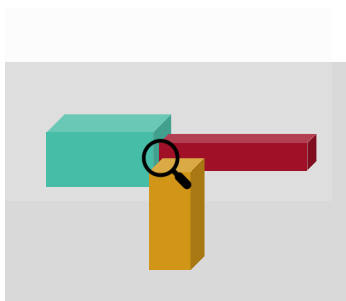
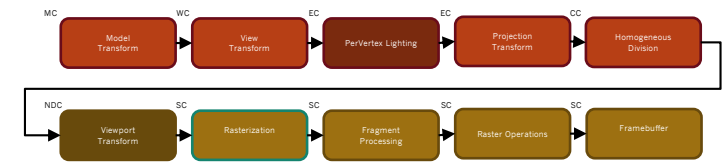
2D



y
SC
x

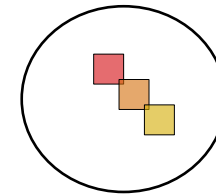
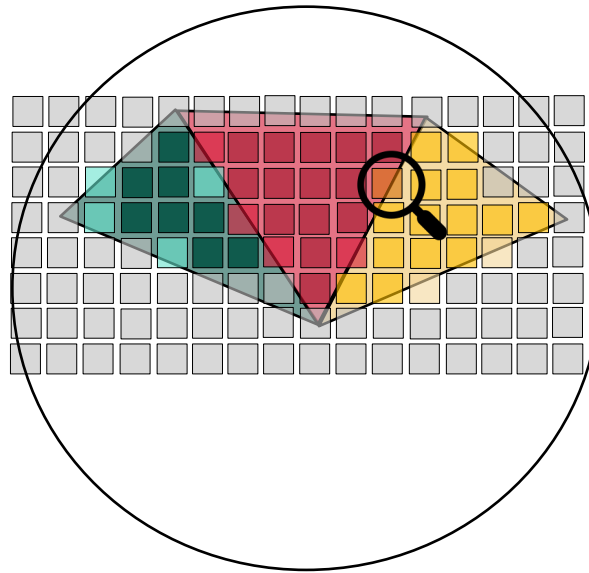
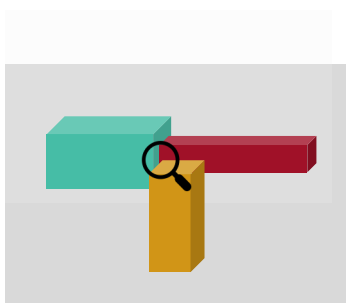
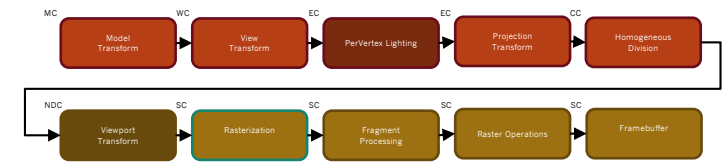
2D

Graphics Pipeline Rasterization



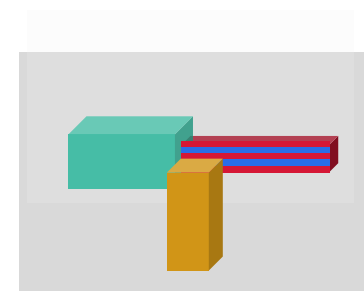
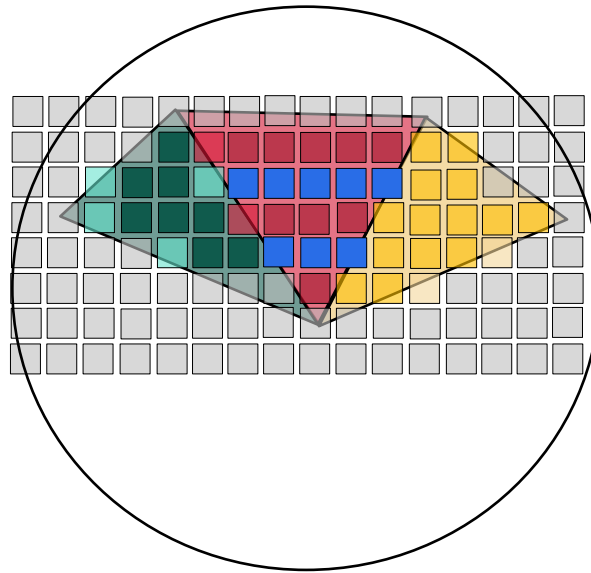
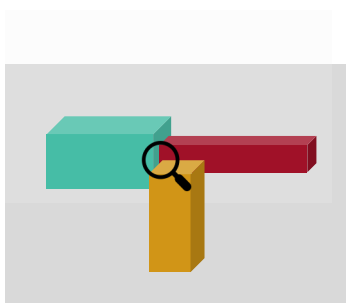
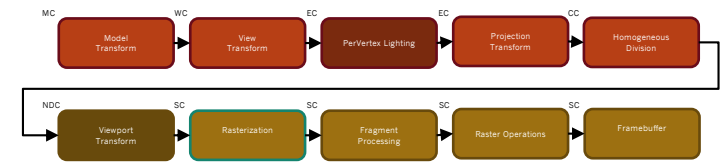
Graphics Pipeline

Fragment Processing



Graphics Pipeline

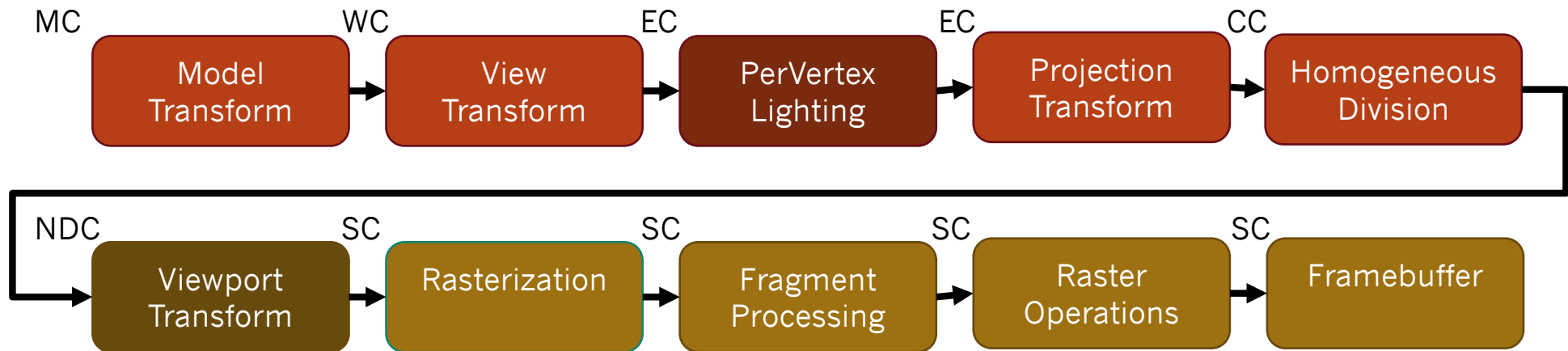
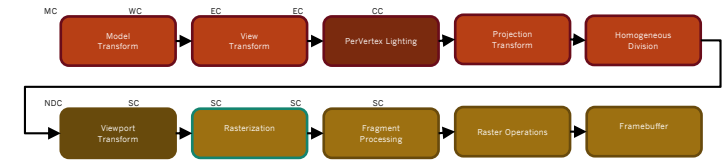
Pixel Operation (texture)



textura



Graphics Pipeline (Obj => Pic)



COORDINATES

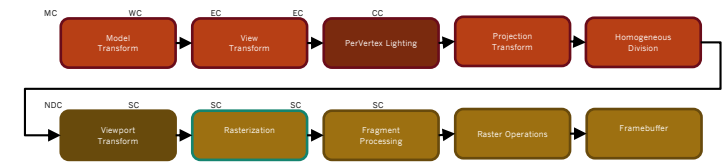
MC
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Model
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Screen

Graphics Pipeline (Obj => Pic)



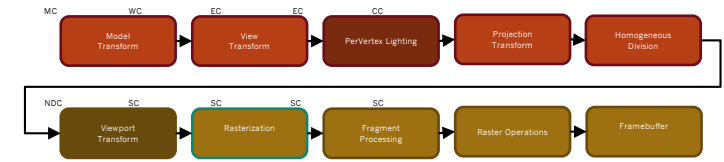
Método de alto desempenho

- particularmente quando se dispõe de boas GPUs

Cenas típicas:

- Modelos: dezenas de milhares a milhões de objetos (ou faces poligonais)
- Imagens: alta resolução (1M pixel, 1000 x 1000)
- A uma taxa de 100 vezes por segundo (interatividade)

Discussão



Pipeline: método tradicional

Método projetivo

- Os objetos são “jogados” para a tela

Interatividade (alto desempenho)

Base para implantação em GPUs

Outros métodos serão apresentados ao longo do curso

- Para melhores efeitos visuais (qualidade)
- Por amostragem da cena
 - *Ray Tracing*
 - *Particle Tracing*
- Para melhores efeitos visuais (qualidade)
- Por tratamento da cena
 - *Radiosity*
 - método parcial – apenas no espaço de cena
 - requer outro método para produzir a imagem
- Para visualização volumétrica
 - *Ray Casting*

Modelagem / Animação / ... próxima aula



Conclusão

DISCUSSÃO