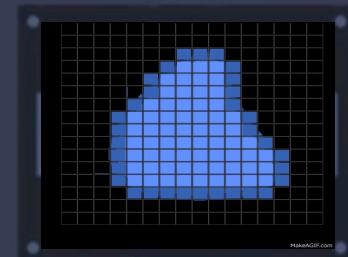
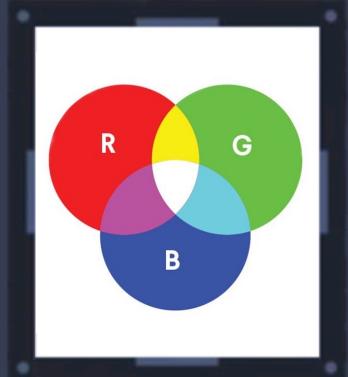


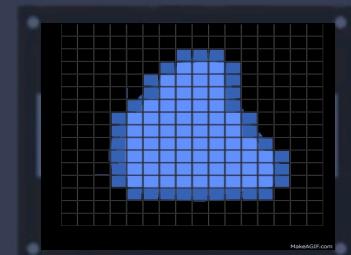
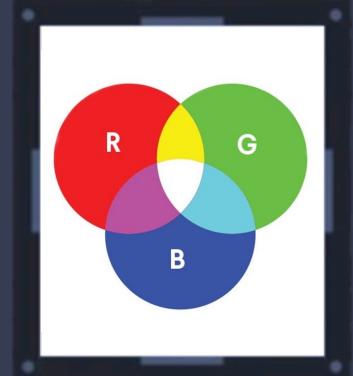
Rendering

Computação Gráfica



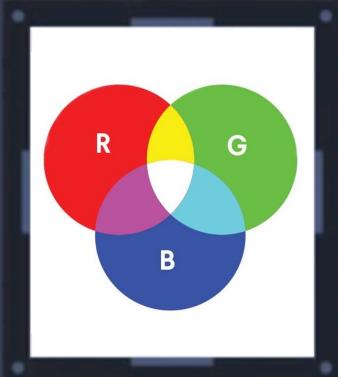
Rendering

- Síntese de imagens através do computador
 - Geometria da cena, informações como cores e texturas, iluminação ambiente, etc.
- Conversão de dados em uma imagem realística
- Sintetizar um objeto ou cena de forma que sua aparência seja real



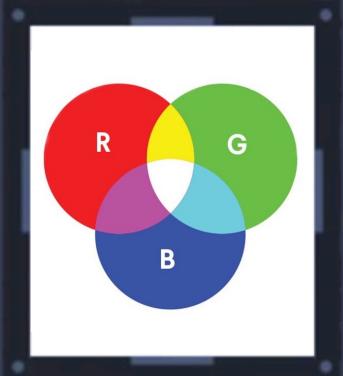
Realismo Visual e Iluminação

- Criação de imagens sintéticas realistas
- Realismo visual
 - Técnicas de tratamento computacional aplicadas a objetos sintéticos para gerar imagens realistas
 - Usado em simulações, entretenimento, educação, ...
- Duas etapas
 - Estática
 - Dinâmica (movimento da cena e seus personagens)

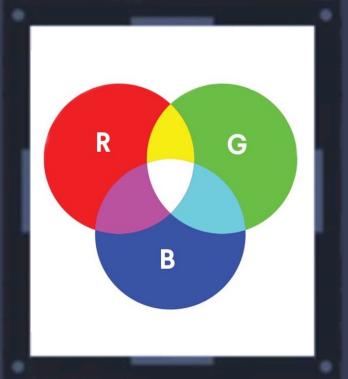


Realismo Visual

- Nível de realismo adequado a cada projeto
- Quanto maior o realismo de uma cena, maior será seu tempo de processamento e custo
- Fases ou passadas
 - Utilizada pela grande maioria dos sistemas para geração de cenas realísticas
- Permite renderizar atributos de cenas separadamente da sua geração ou modelagem
- Técnicas e softwares participam do processo de inclusão do grau de realismo desejado à cena

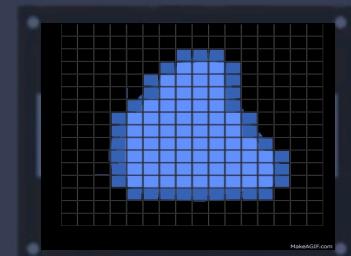
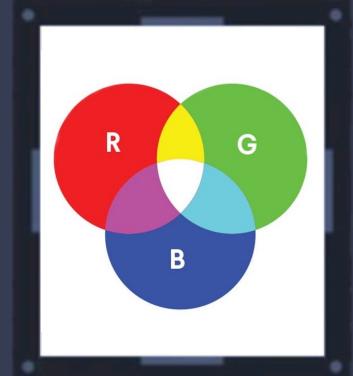


Realismo Visual

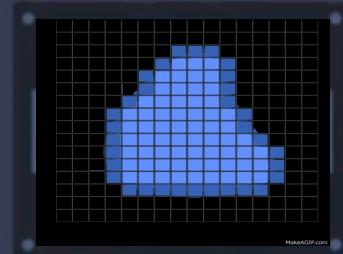
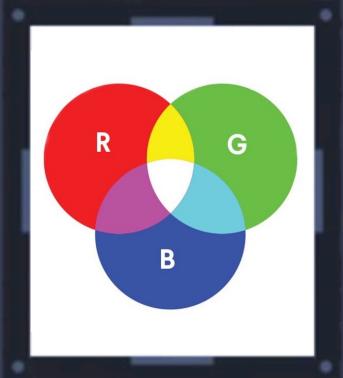
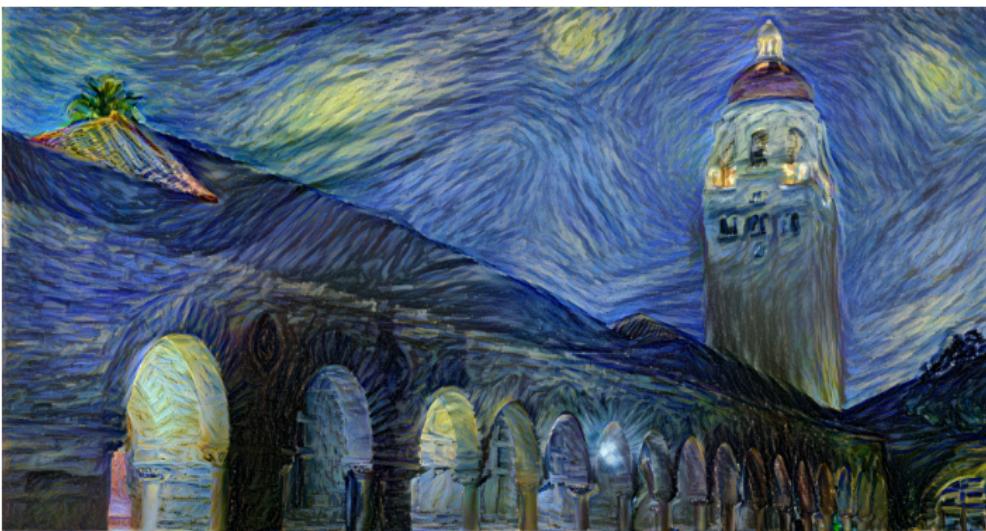


Imagens não Fotorealistas

- Rendering realístico tenta gerar imagens sintéticas indistinguíveis de fotografias
- Non-photorealistic (NPR) ou *stylistic rendering*
 - Simulação de pinturas reais
 - Efeitos criativos imitando serigrafias
 - Estilo de expressão de um artista, etc.

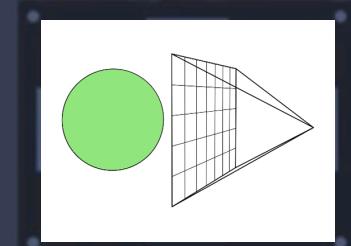
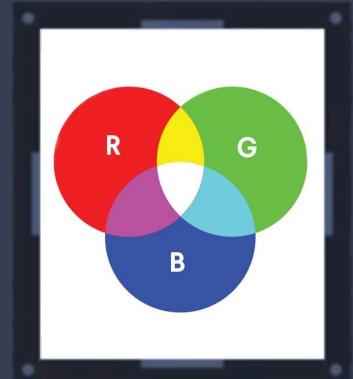
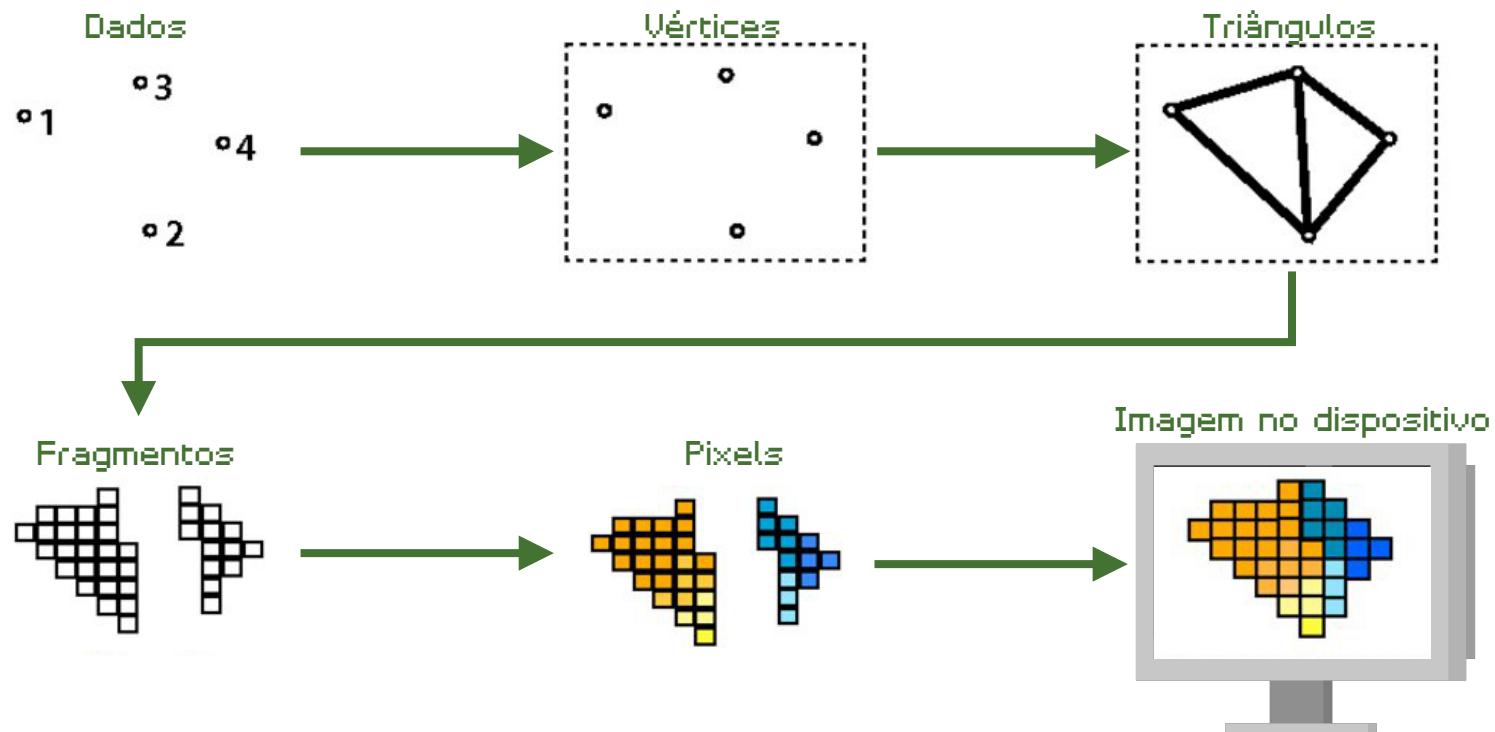


Imagens não Fotorealistas



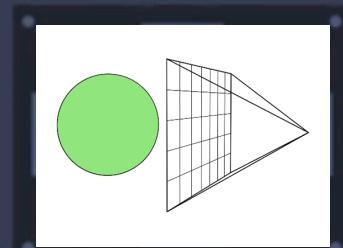
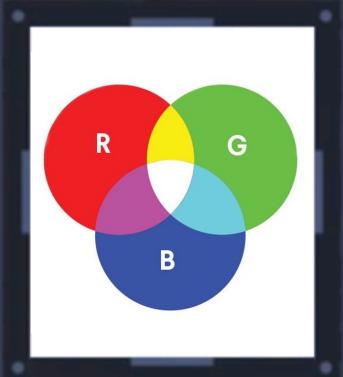
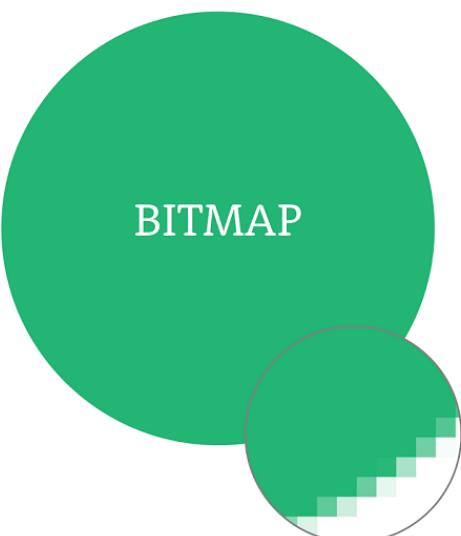
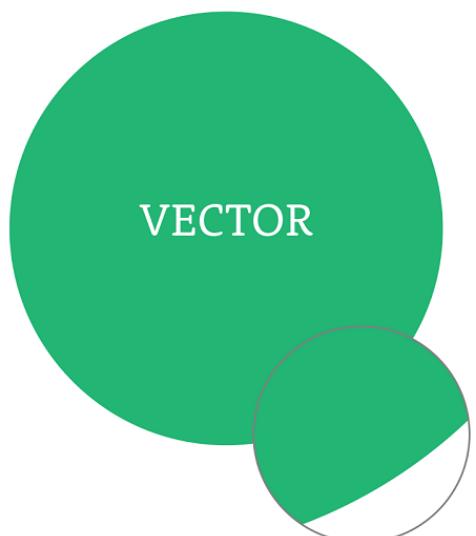
Geração de Imagens

- Conjunto de métodos e técnicas para transformar dados em imagem através de um dispositivo gráfico



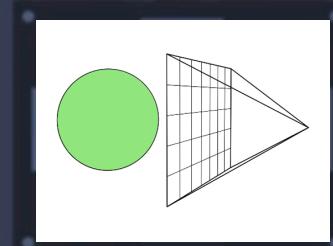
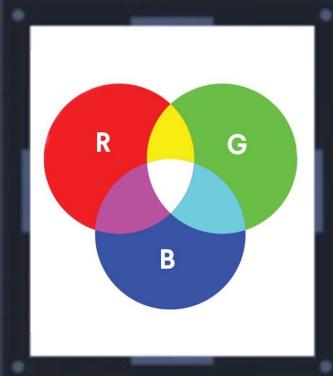
Rasterização

- Processo de conversão da representação vetorial para a matricial
- Transforma um desenho qualquer em representação capaz de ser armazenada na memória

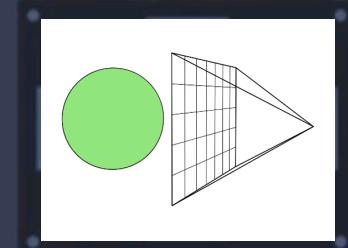
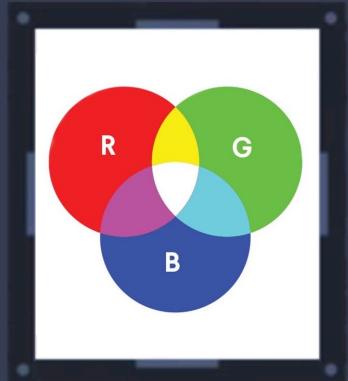
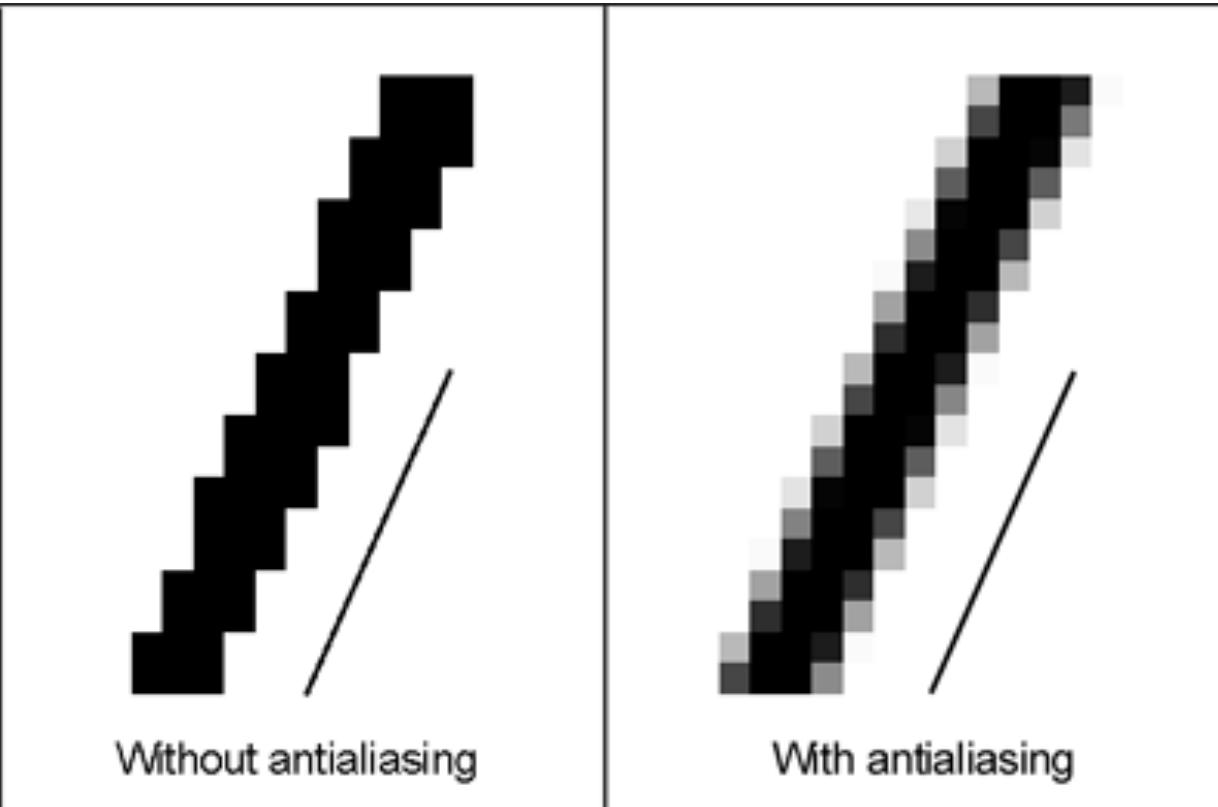


Rasterização de Retas

- Nem sempre é possível obter uma forma perfeita
 - Representação por pixels (aproximação)
- Pode ter aparência serrilhada (aliasing)
 - Quebras de continuidade (malha de pontos)
 - Menor resolução implica em maiores quebras
- Algoritmos de anti-aliasing
 - Visam “enganar” o olho humano
 - “Boram” as bordas de um desenho
 - Usam uma cor intermediária
 - Suavizam o contraste

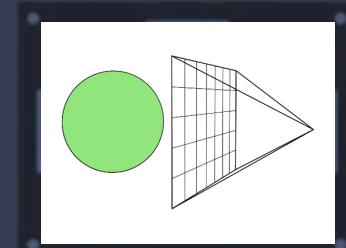
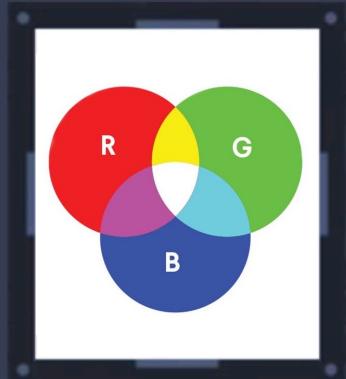
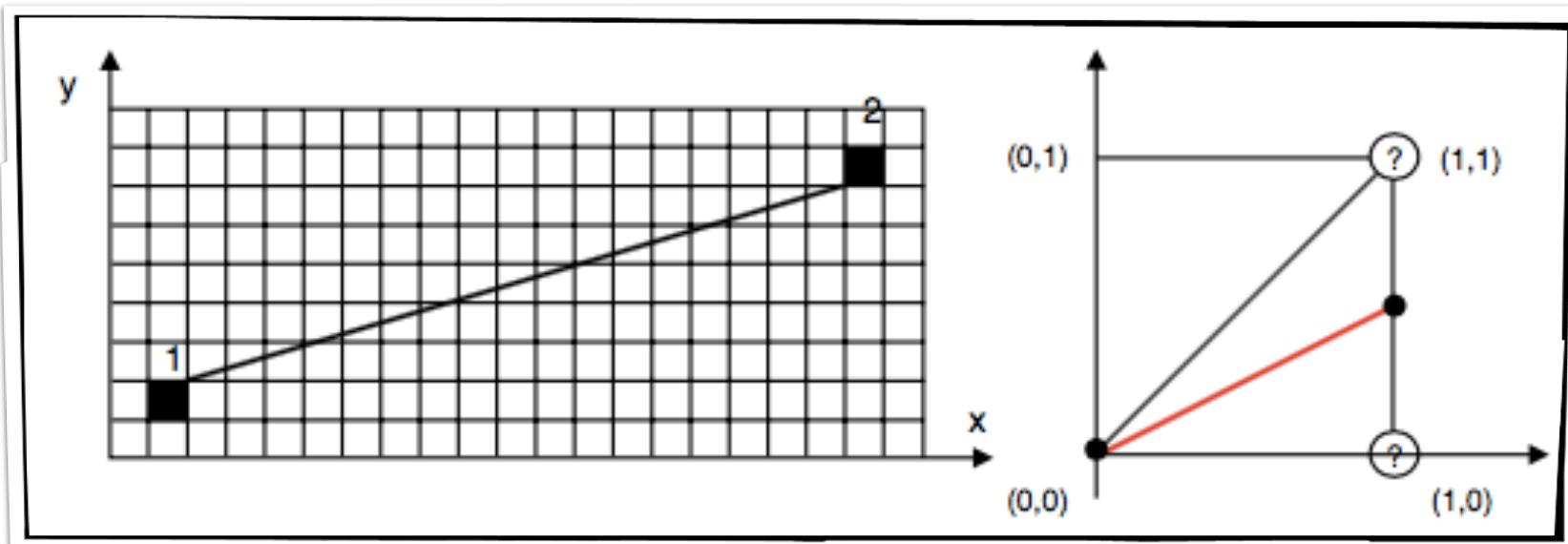


Anti-Aliasing

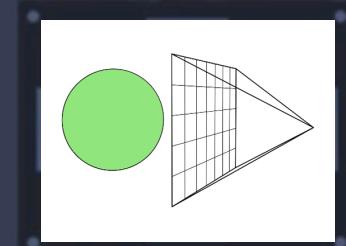
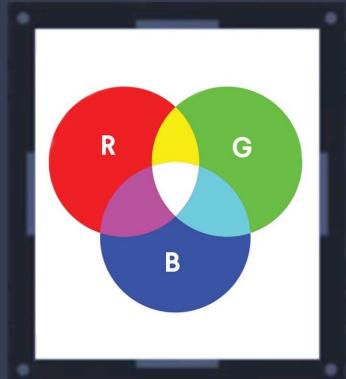
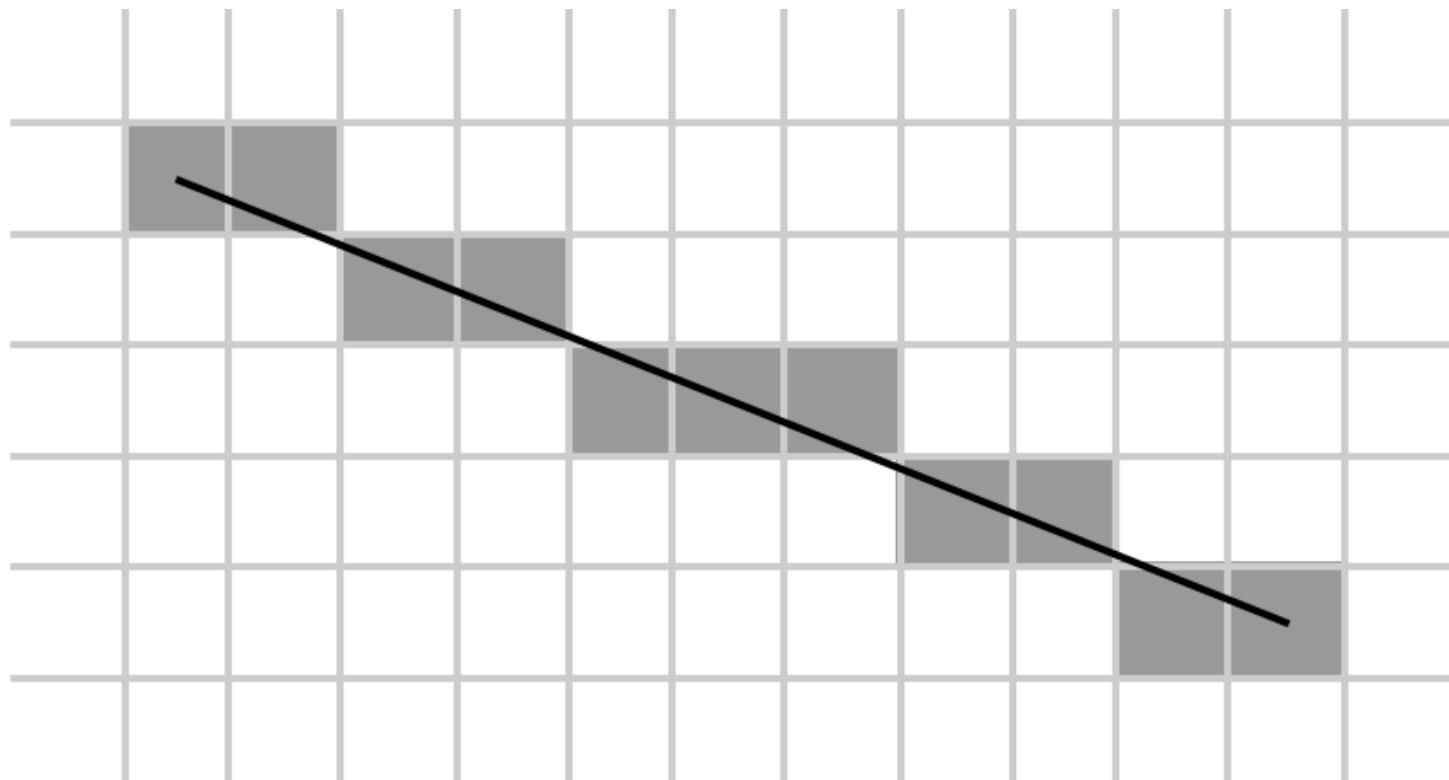


Algoritmo de Bresenham e DDA

- DDA - Digital Differential Analyser
- Traçado de linhas
 - Localização de dois pixels (x_1, y_1) e (x_2, y_2)

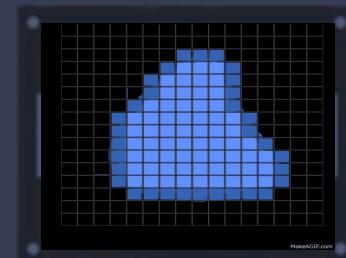
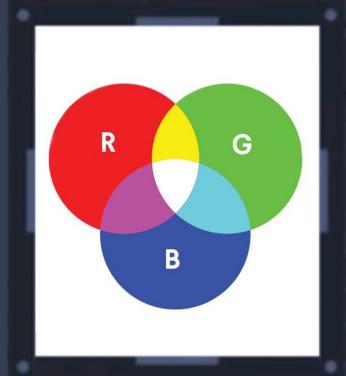


Algoritmo de Bresenham e DDA



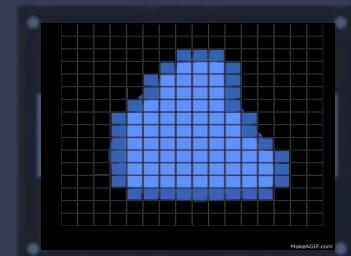
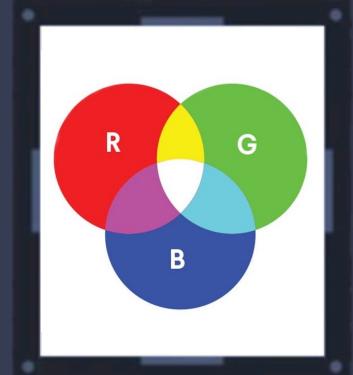
Rasterização de Polígonos

- Polígonos são geralmente representados pela lista de seus vértices (pontos 3D)
- São projetados na tela dos dispositivos (pontos 20) pela projeção de cada um desses vértices
- Resultam da conexão dos vértices por linhas
- Calcula-se a interseção das linhas horizontais do vídeo (scan lines) com as linhas dos lados



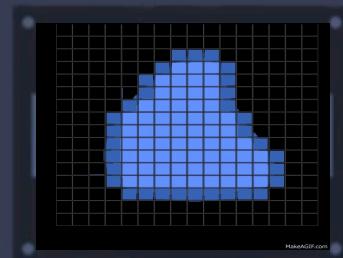
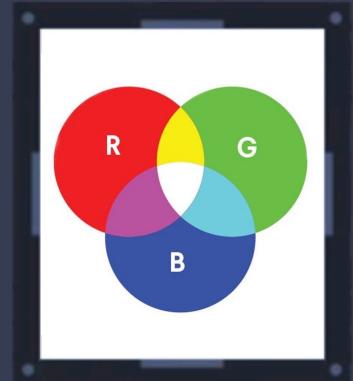
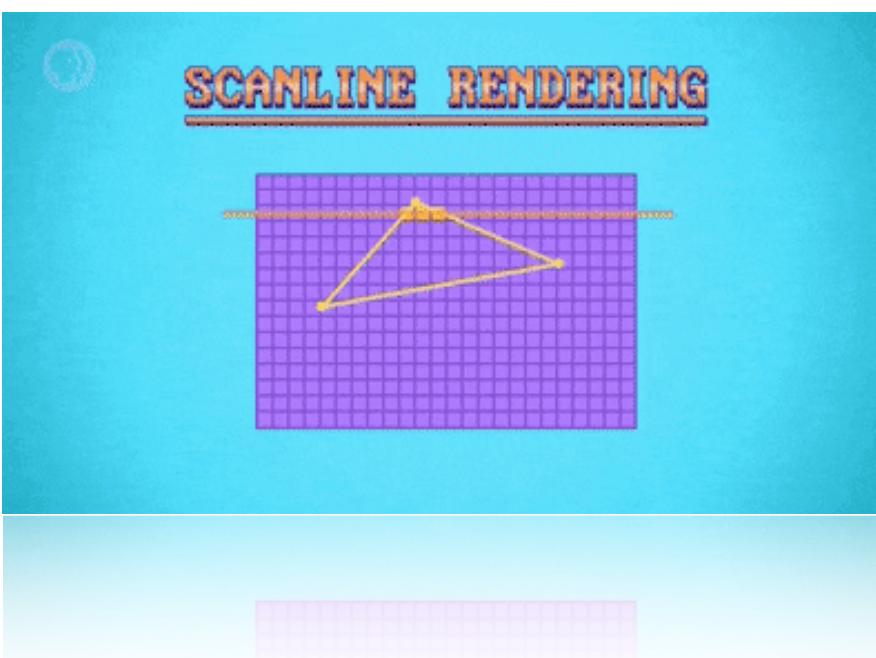
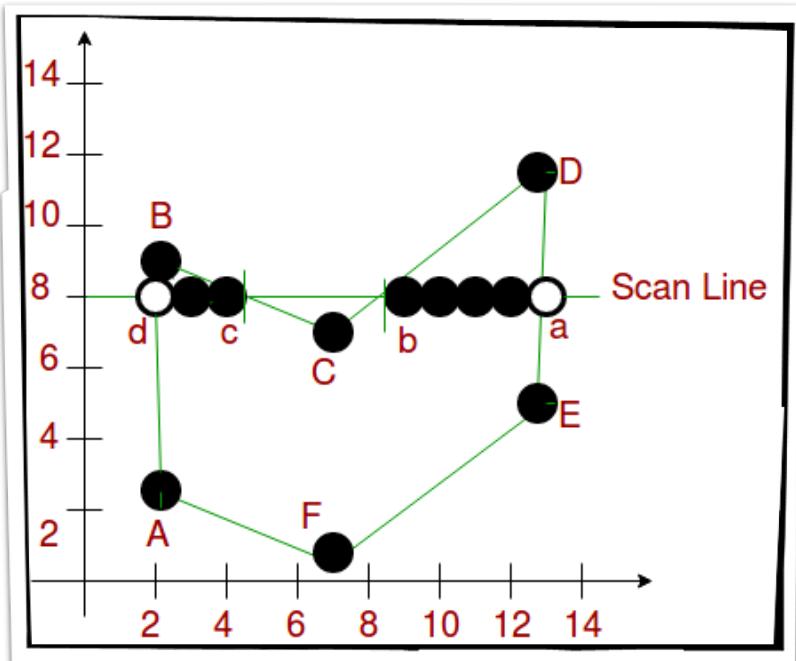
Preenchimento de Polígonos

- Pixels adjacentes em um polígono possuem as mesmas características
 - Variam apenas nas bordas do polígono
- Algoritmo Scan line
- Conversão de varredura (scan conversion)
 - Determinar os pixels desenhados no preenchimento



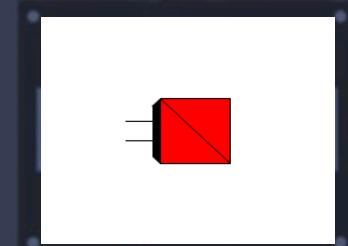
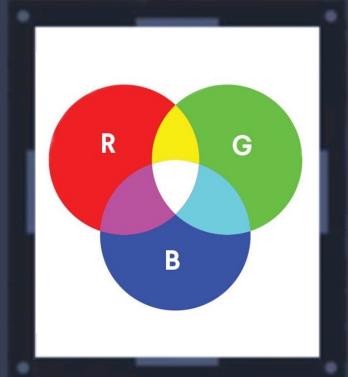
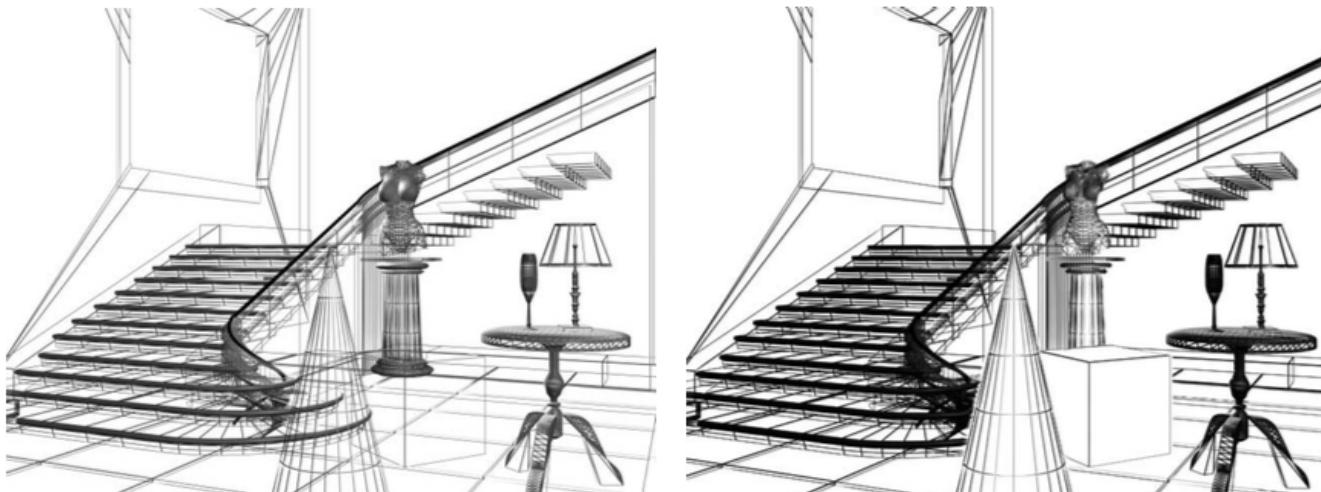
Preenchimento de Polígonos

- Fora do polígono
- Dentro do polígono



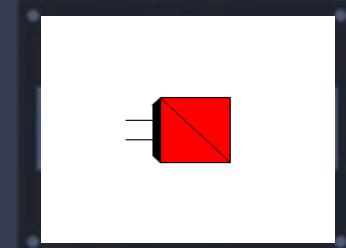
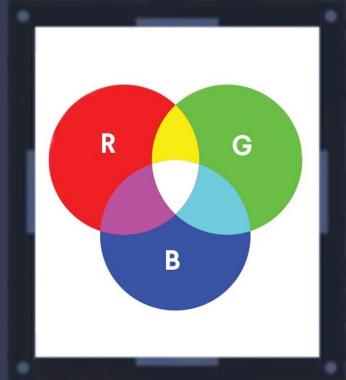
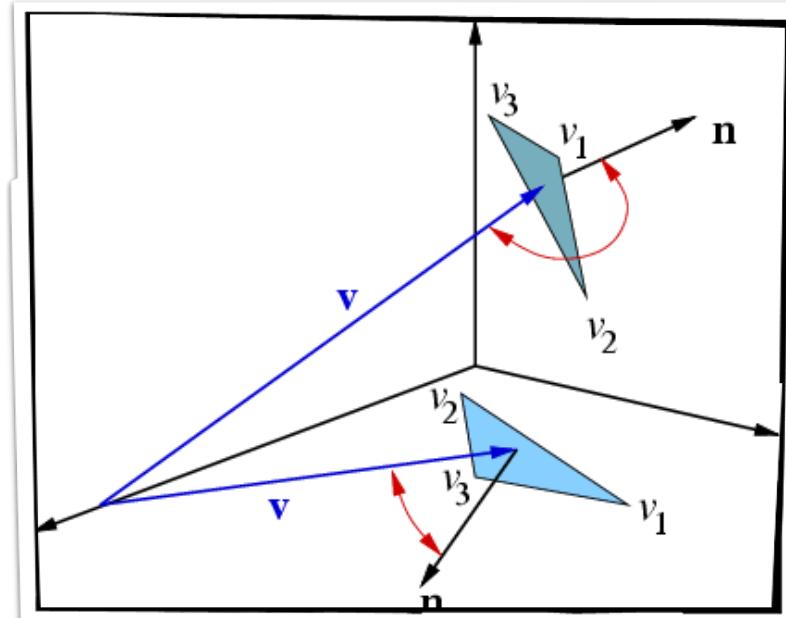
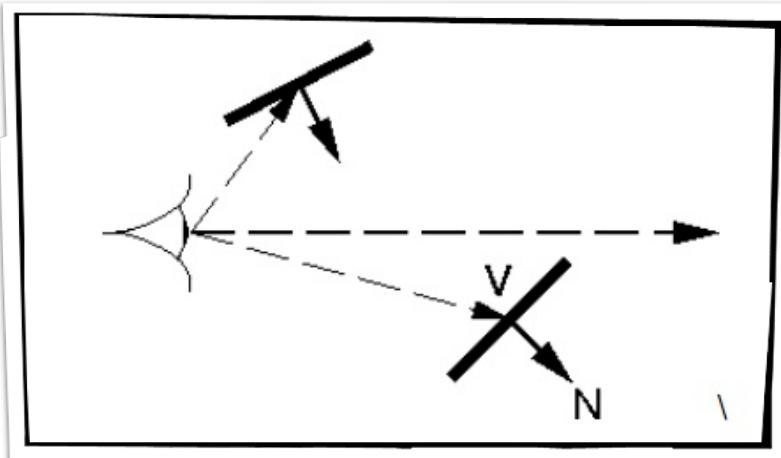
Visibilidade de Polígonos

- Remoção de Polígonos Escondidos (Back-face Culling)
- Algoritmos de Visibilidade
 - Determinam quais elementos serão exibidos na tela
 - Base a posição dos objetos em relação à câmera
 - Algoritmo do Pintor e Z-Buffer



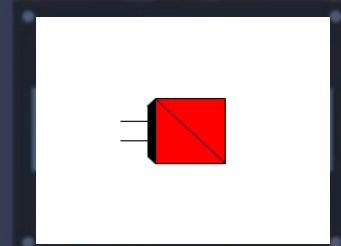
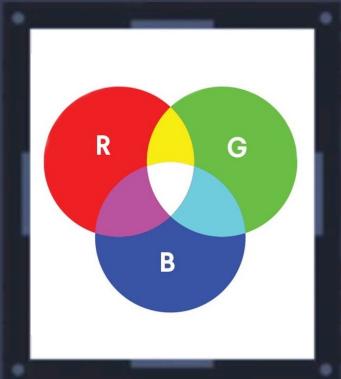
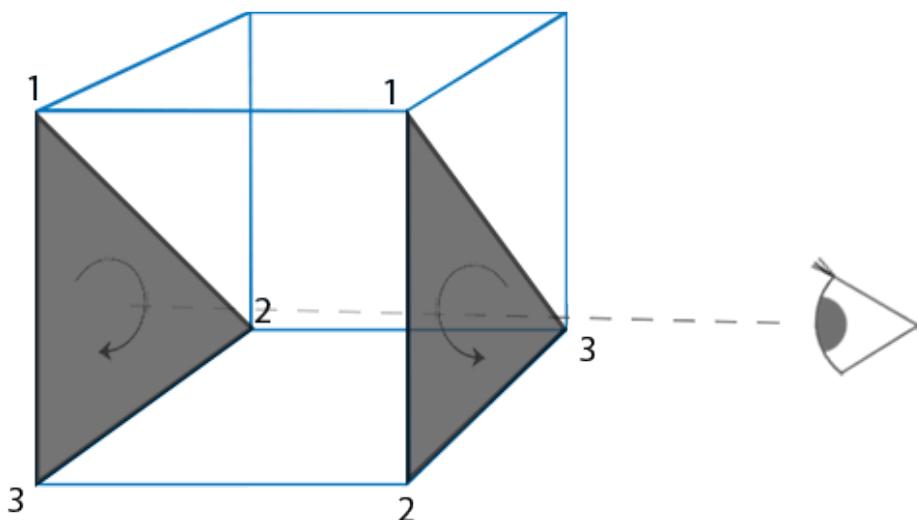
Back-Face Culling

- Eliminação de Faces Ocultas pelo Cálculo da Normal
- Ângulo entre a normal e a direção de observação
 - Visível se sua normal estiver entre -90° e $+90^\circ$



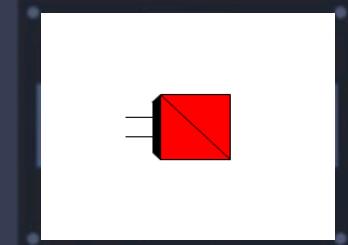
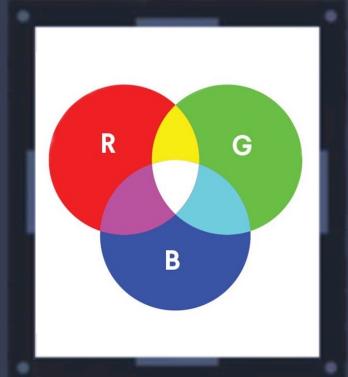
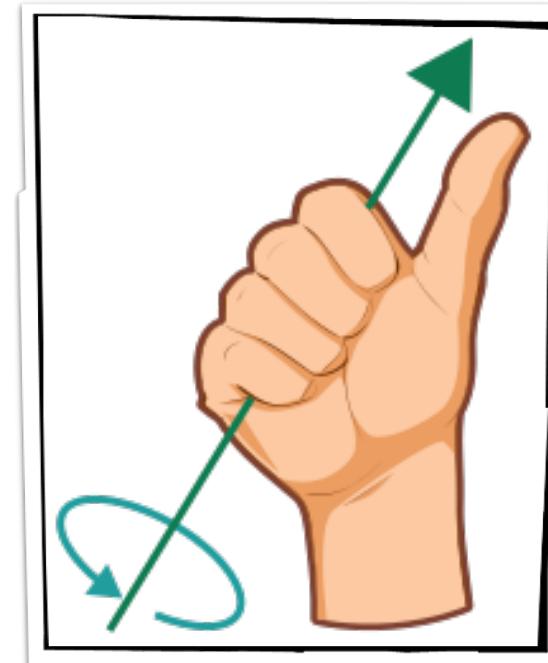
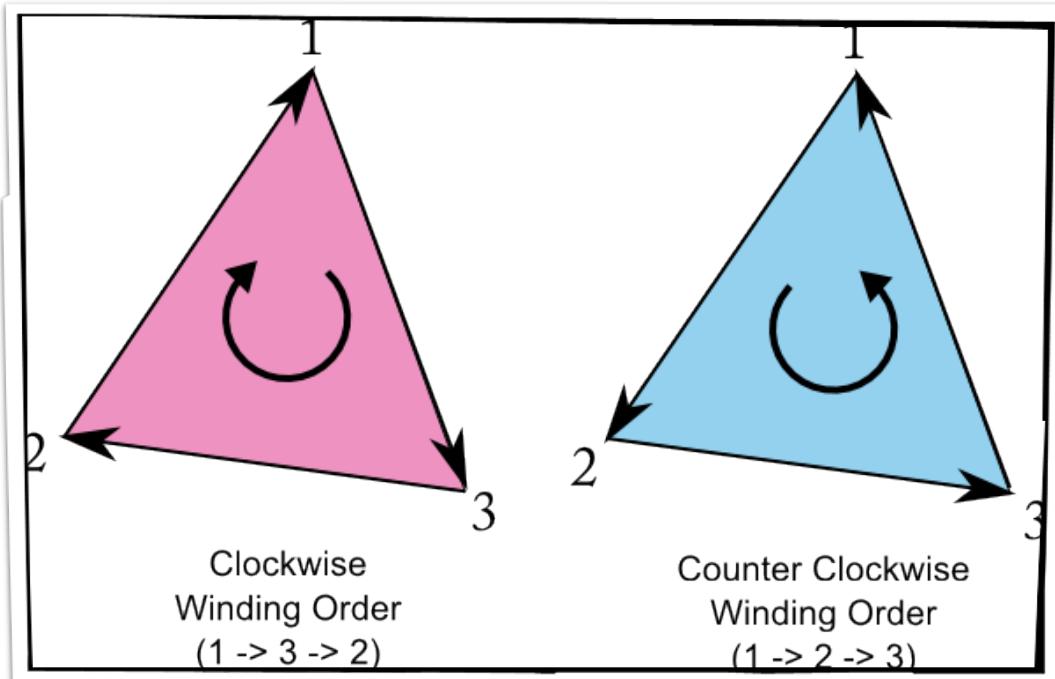
Eliminação de Faces Ocultas pela Normal

- Ler as coordenadas do objeto no espaço 3d
- Localizar a posição do observador
- Calcular o vetor normal de cada face do objeto
- Realizar o teste de visibilidade



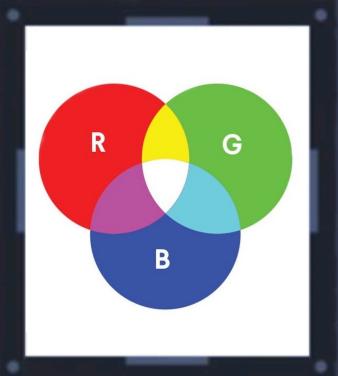
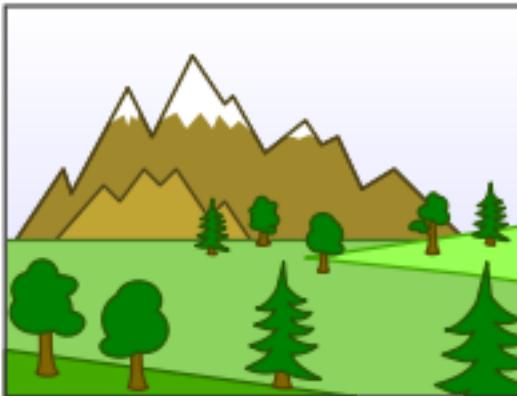
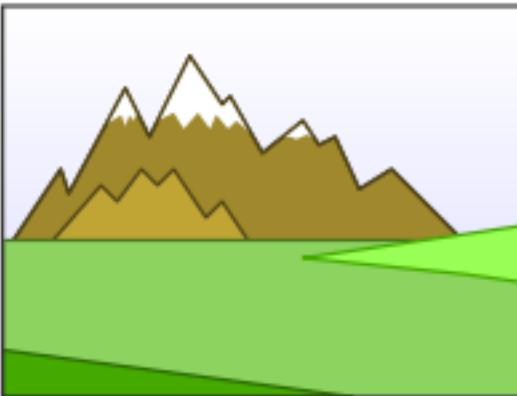
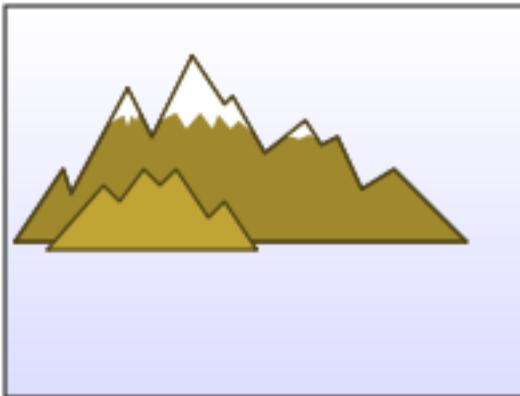
Cálculo da Normal

- Regra da mão direita
- Pode seguir o sentido horário ou anti-horário

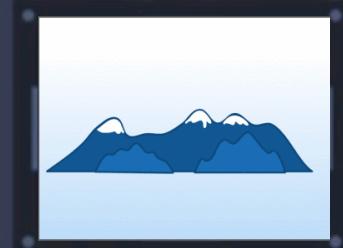
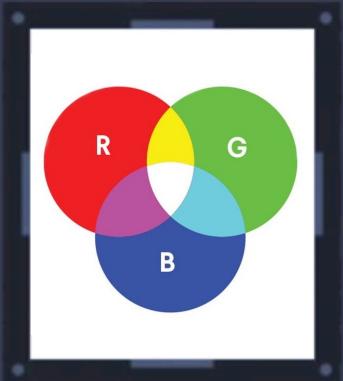
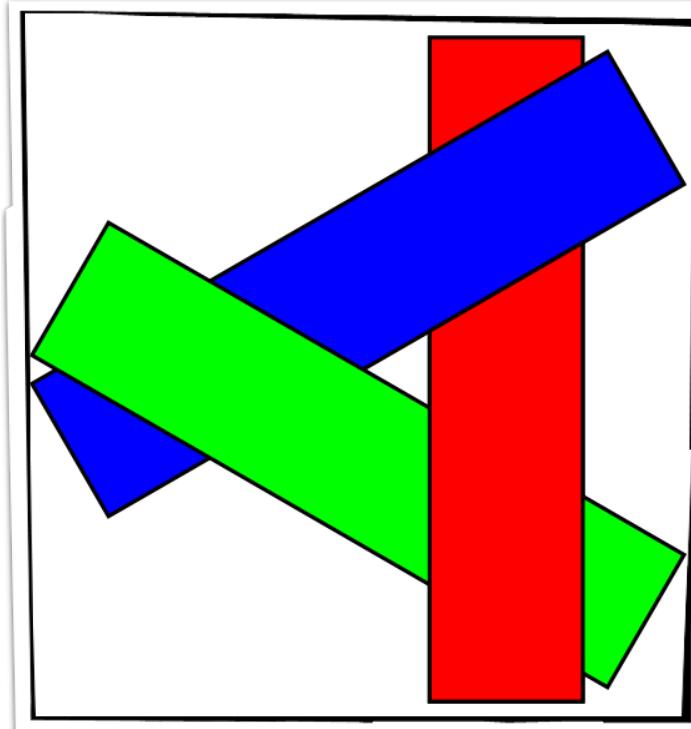
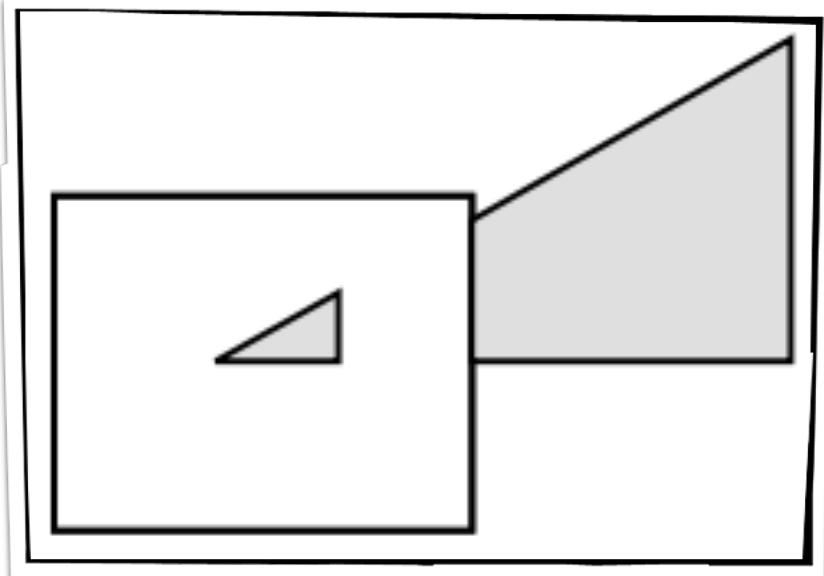


Algoritmo do Pintor

- Visibilidade por prioridade
- Em uma pintura os detalhes próximos do observador são acrescentados encobrindo os posteriores
 - Calcula a distância entre observador e objetos
 - Ordena todos os polígonos pela distância
 - Desenha os polígonos seguindo a ordem

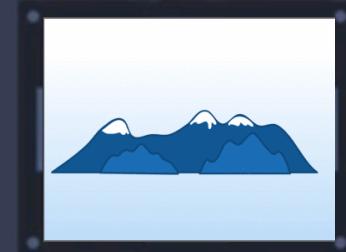
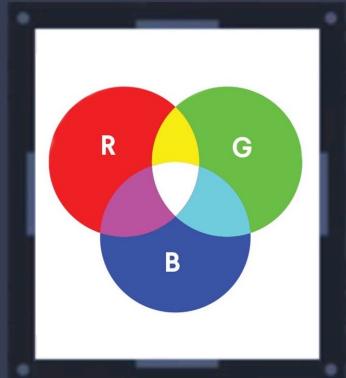
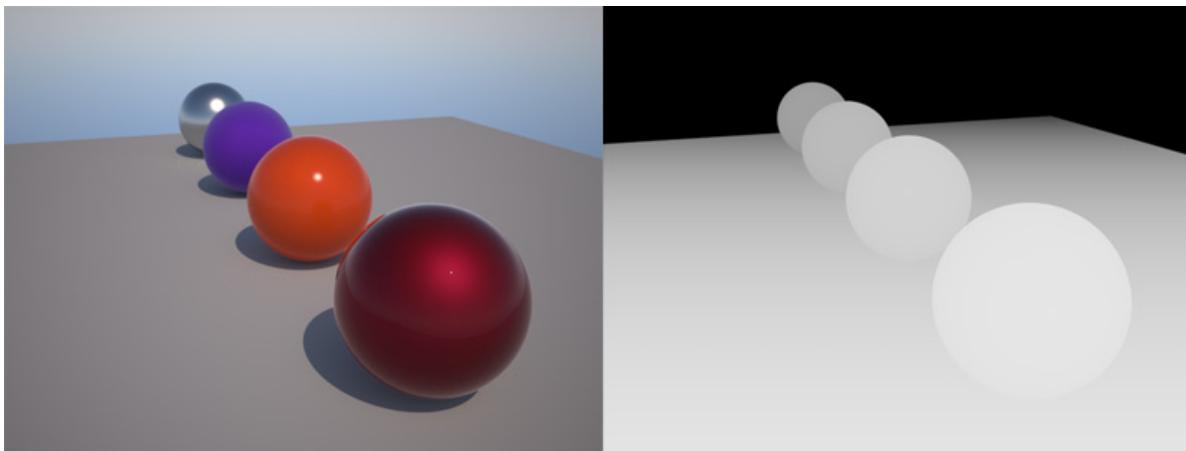


Algoritmo do Pintor

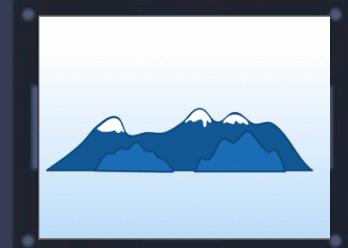
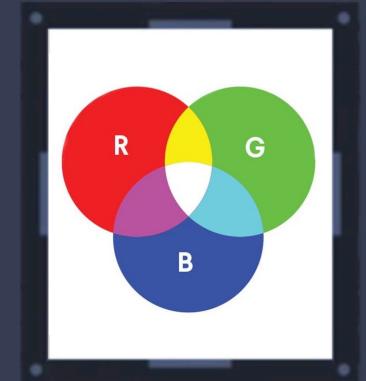
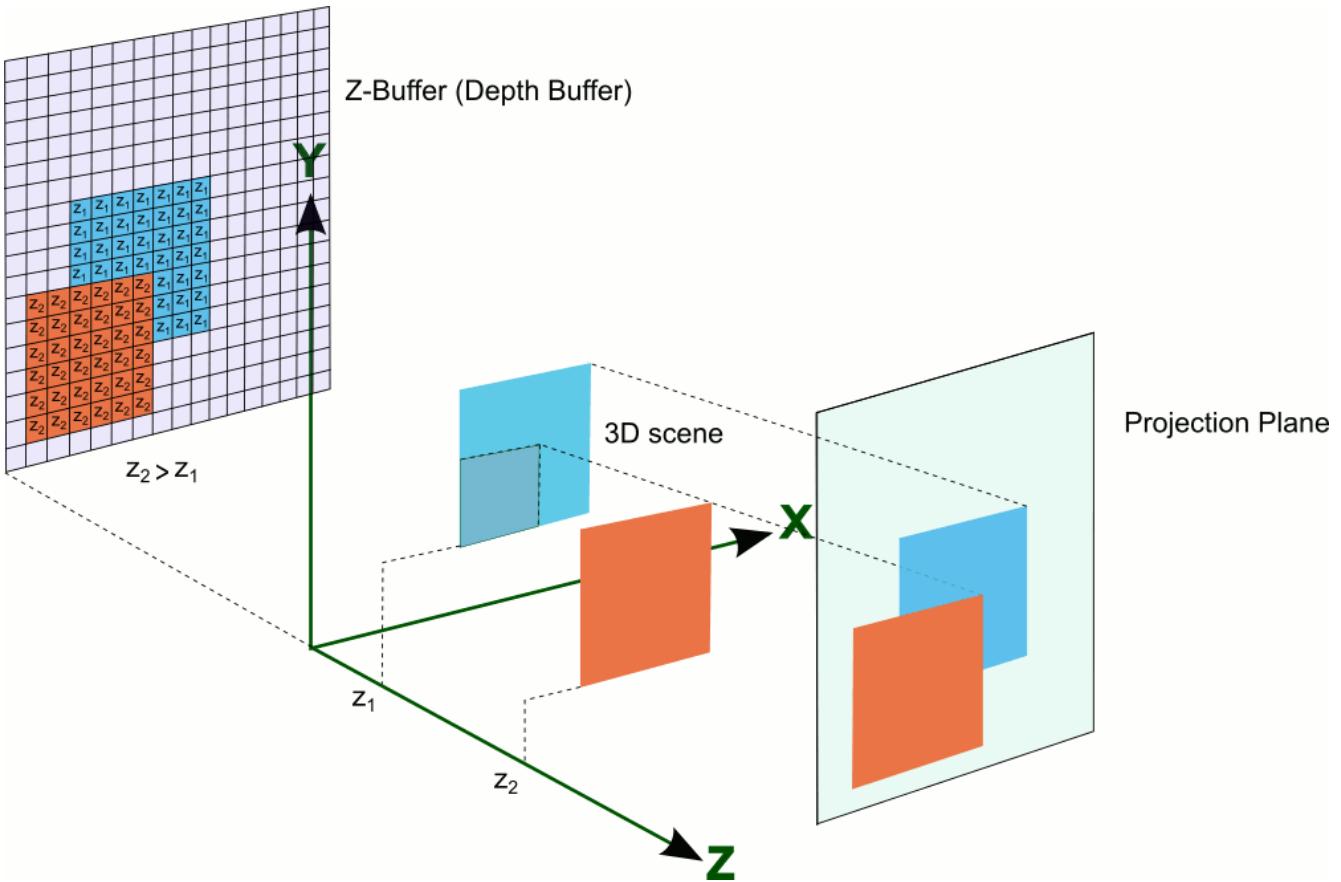


Algoritmo Z-Buffer

- Desenvolvido inicialmente por Catmull
- Simples de se implementar
 - Alto custo de memória e processamento
- Requer até duas matrizes na memória
 - Buffers de Imagem e de Profundidade
 - Distância de cada pixel ao plano de projeção



Algoritmo Z-Buffer



Exemplo

