TECHX

Asia's Largest

AI & Cloud

Conference 2024

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Chennai Trade Center, Chennai

It’s me

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About Me

With over 15 years in software engineering, my expertise spans computer graphics, AR/VR, and machine learning, specializing in advanced rendering techniques and optimization. I am the author of The Modern Vulkan Cookbook, an industry resource on Vulkan programming. My career includes key contributions to companies like Adobe, Microsoft, and MathWorks, where I led projects in real-time rendering, virtual/augmented reality, and high-performance simulations. Passionate about developing innovative solutions in 3D graphics, I bring a deep technical foundation in Vulkan, Metal, and OpenGL, with a focus on efficient, visually stunning applications.

Agenda

- Need for High -Performance Rendering in AR/VR/XR
- Rendering engine core components
- Cross-Platform Development for AR/VR/XR
- System Architecture Overview
- AI in Rendering
- NeRF and Gaussian Splatting
- Diffusion Models
- Future Trends in AR/VR/XR Rendering

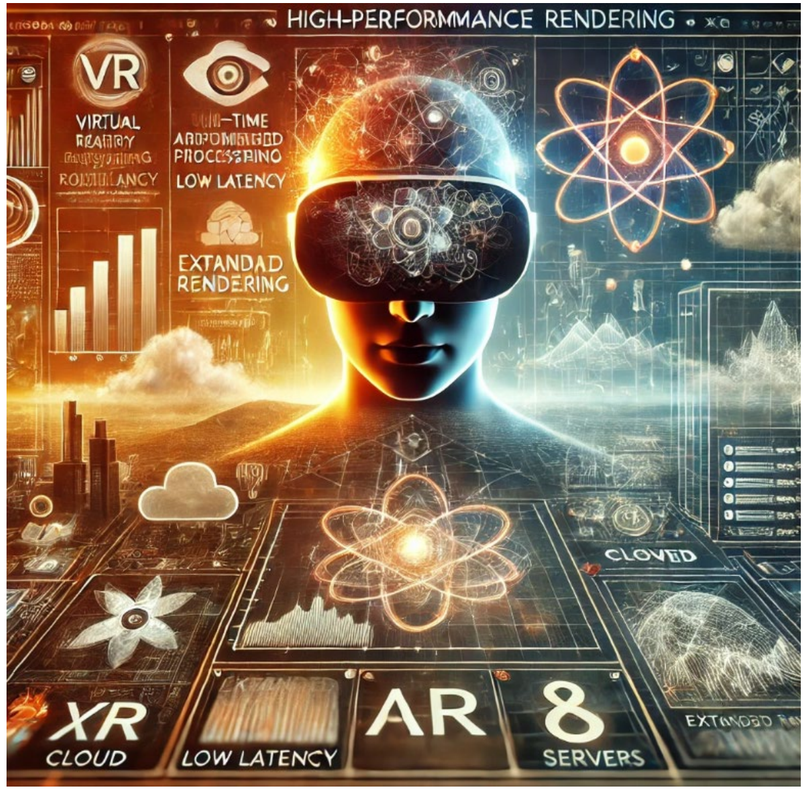
Rendering in AR/VR/XR

Immersive User Experience

Low Latency Requirements / High Frame Rates

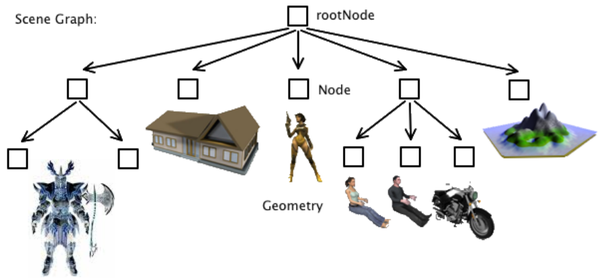
Complex 3D Environments

Device Constraints



Rendering engine core components

Scene Graph



Rendering Techniques

Rasterization

Ray tracing

Shaders

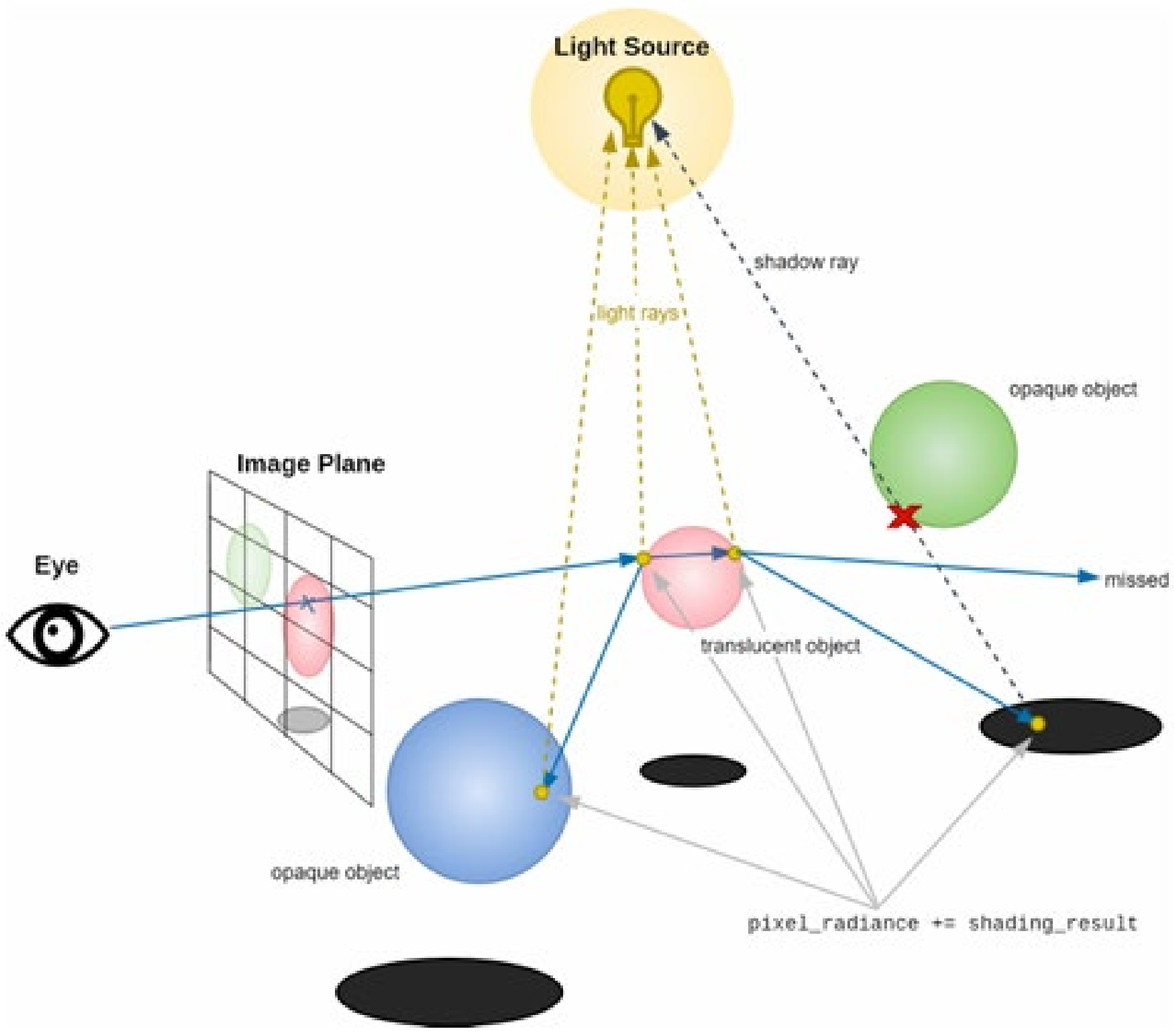
Vertex Shader

Fragment Shader

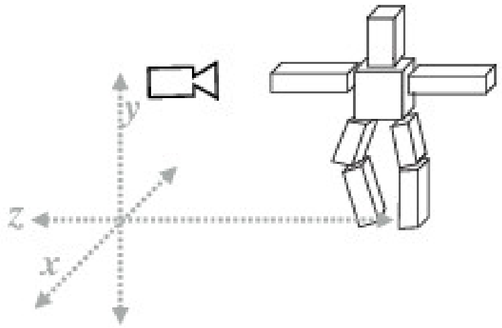
Compute Shader

Resource Manager

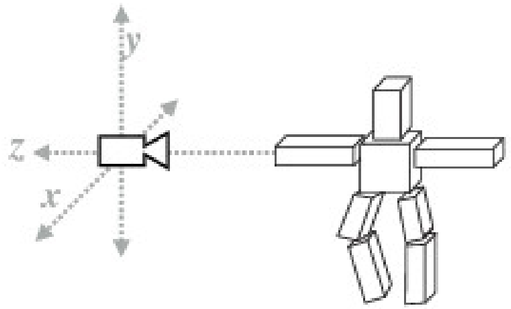
Ray tracing overview



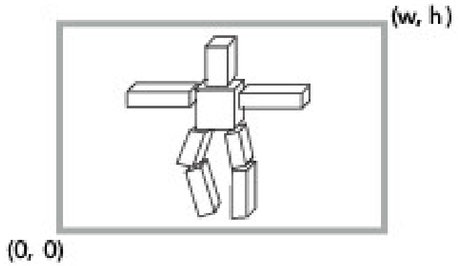
Rasterization overview



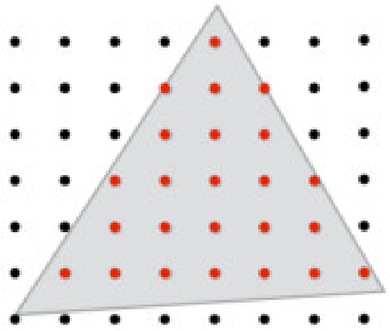
Position objects and the camera in the world



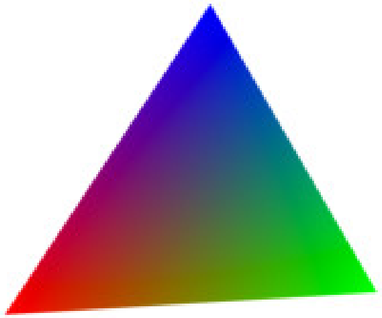
Compute position of objects relative to the camera



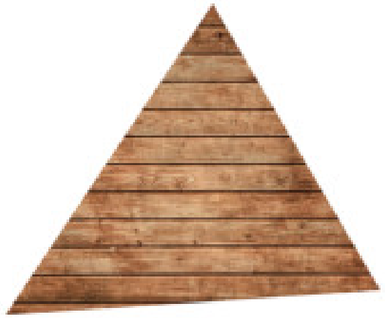
Project objects onto the screen



Sample triangle coverage

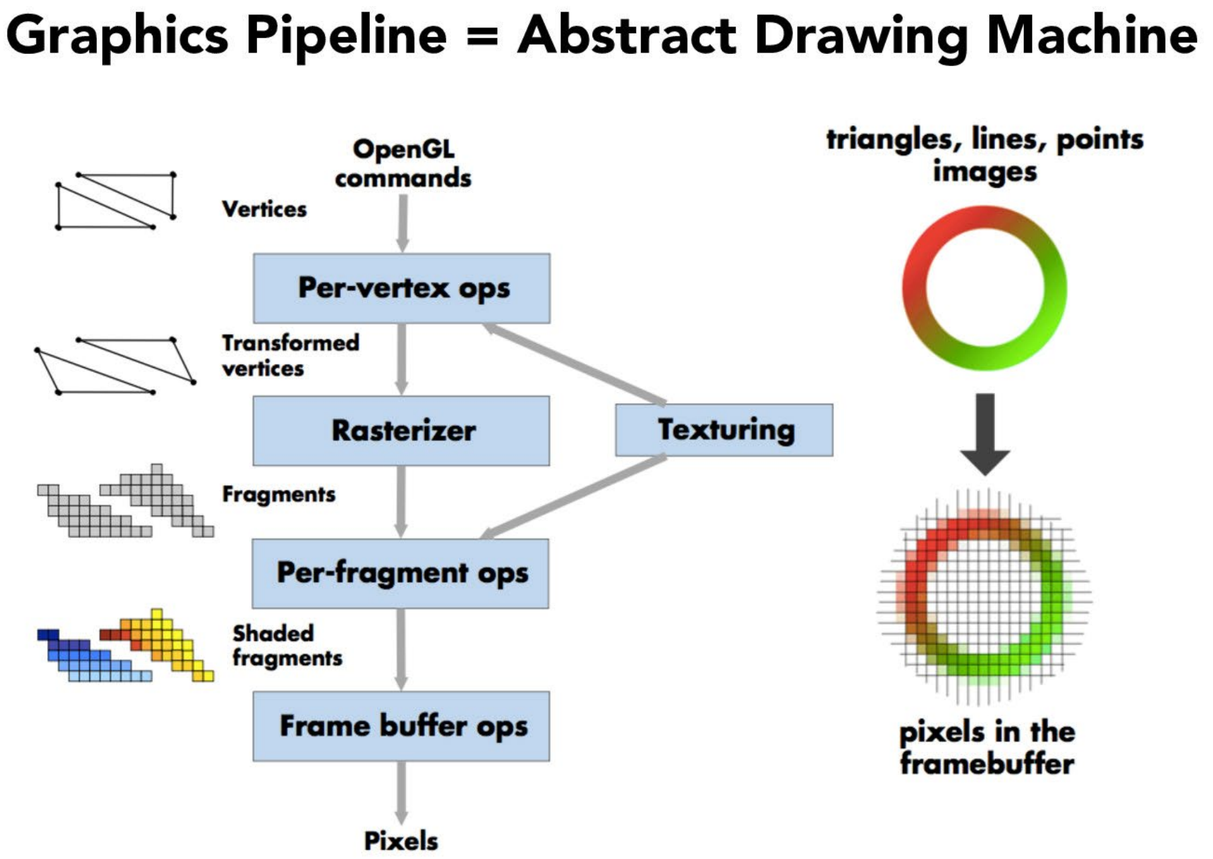


Interpolate triangle attributes

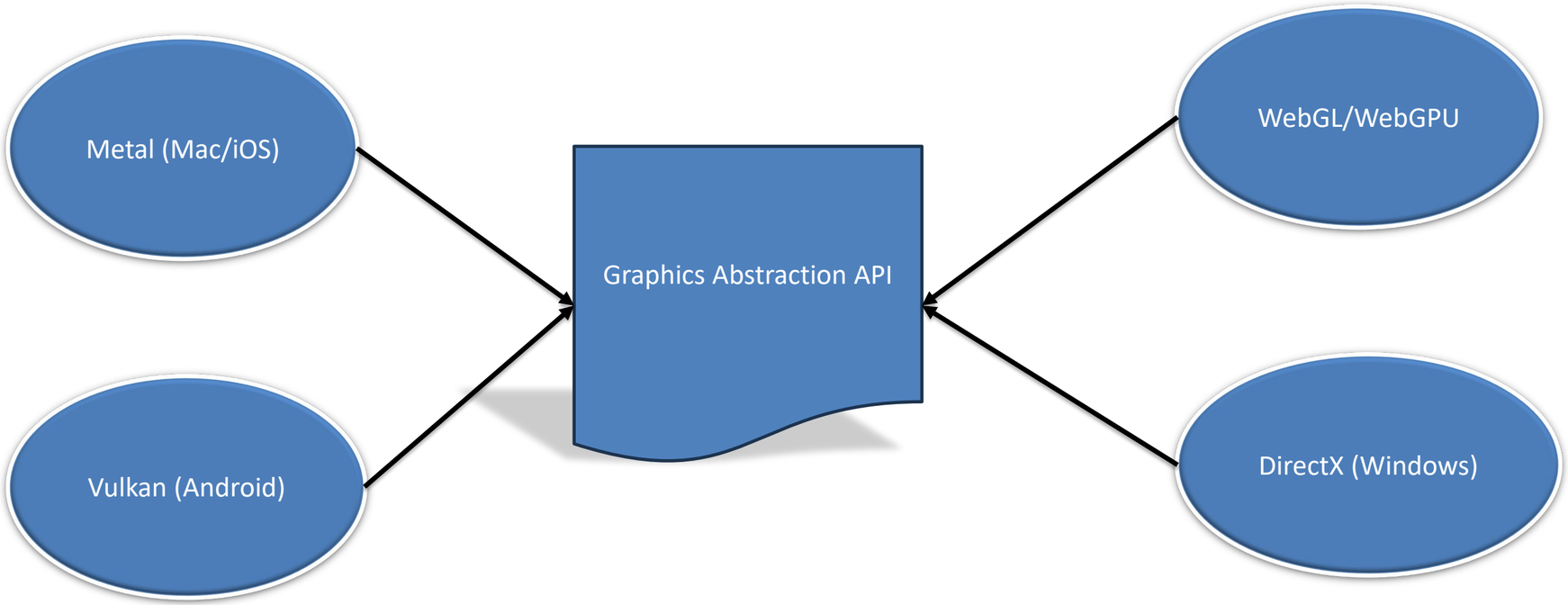


Sample texture maps

Rendering pipeline



Cross-Platform



Cross-Platform : Introducing bgfx

Cross-Platform Capability

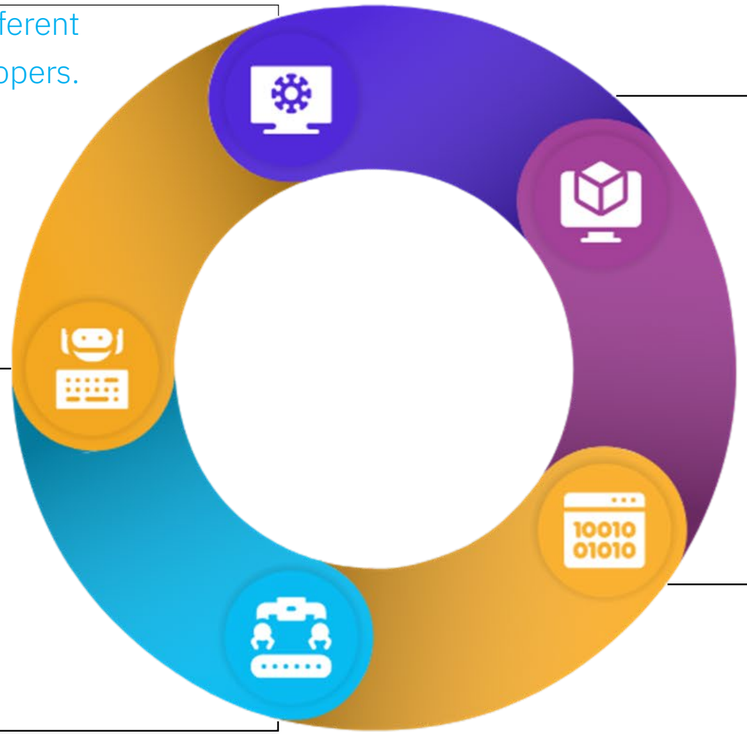
Bgfx operates seamlessly across different platforms, making it versatile for developers.

Core Principles and Benefits

Understanding the core principles of Bgfx aids developers in leveraging its full potential in graphics programming.

Unified Rendering Interface

It provides a consistent interface for rendering, facilitating cross-platform compatibility.



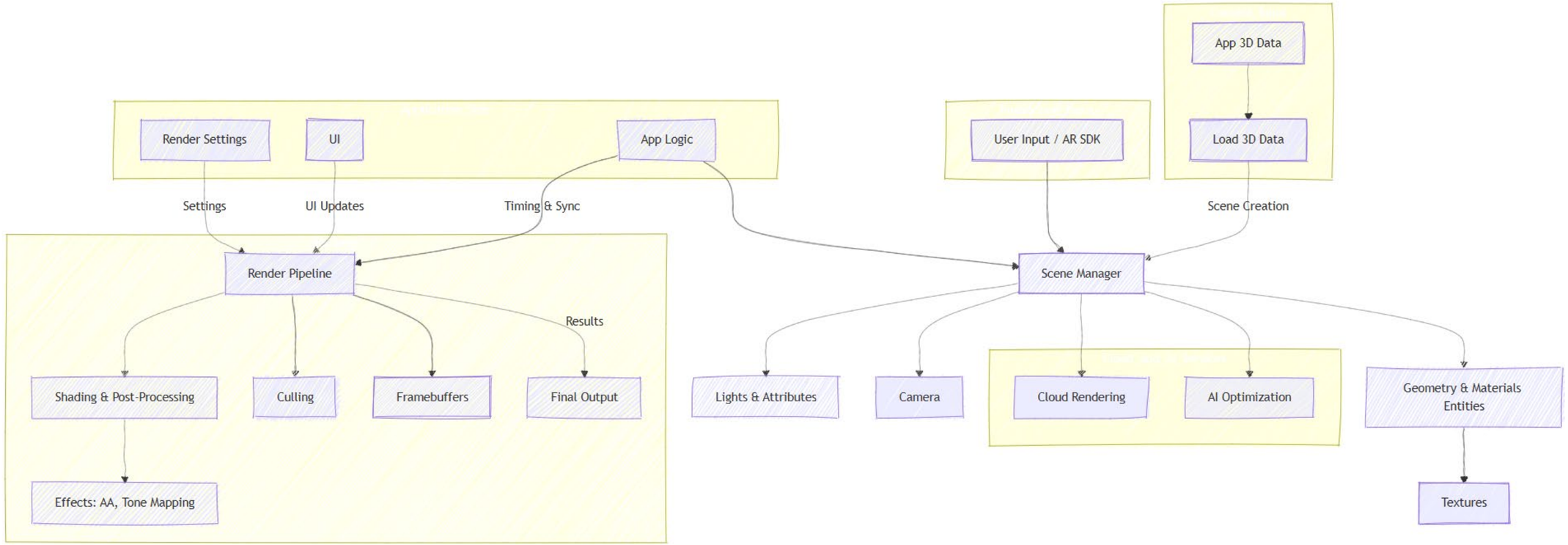
Focus on 3D Graphics

It is specifically designed to cater to the needs of 3D graphics applications, enhancing visual experiences.

Low-Level API Abstraction

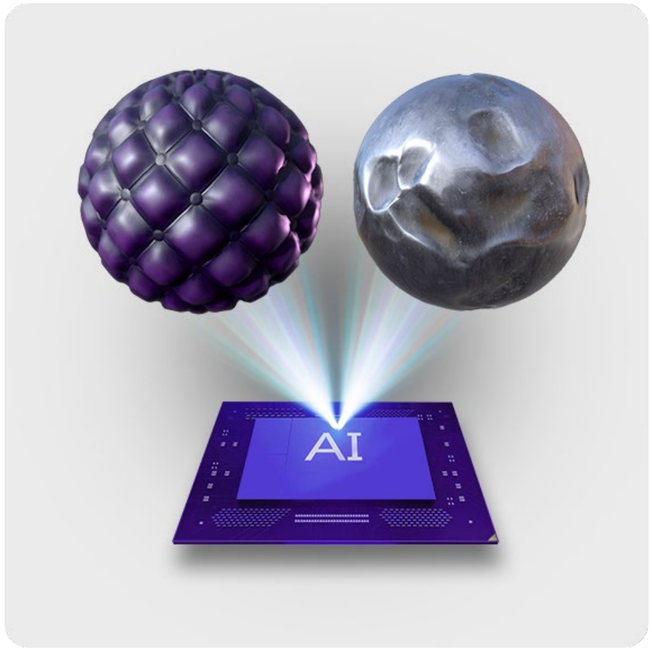
Bgfx abstracts the complexities of low-level graphics APIs, allowing for easier programming.

System Architecture

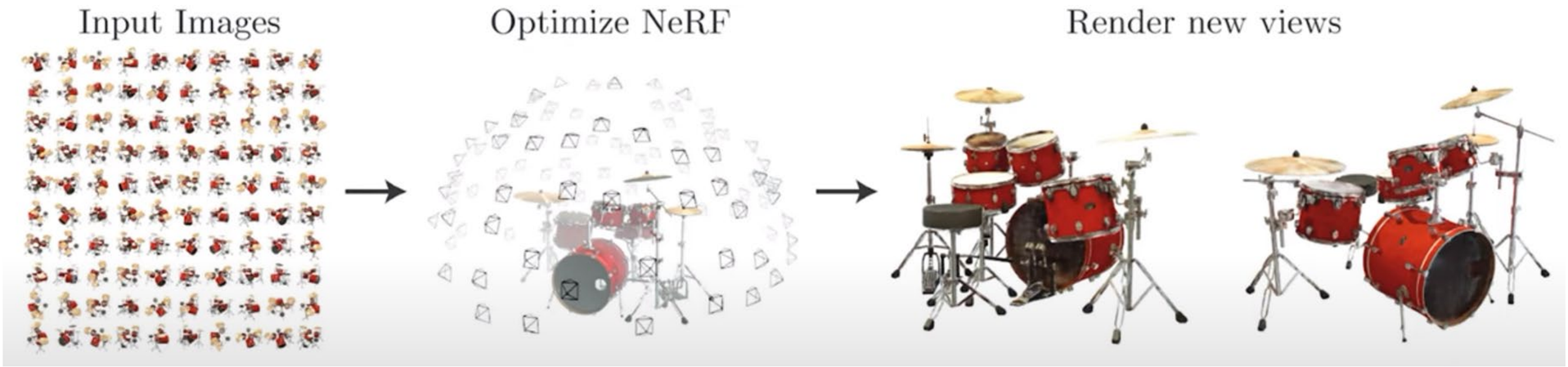


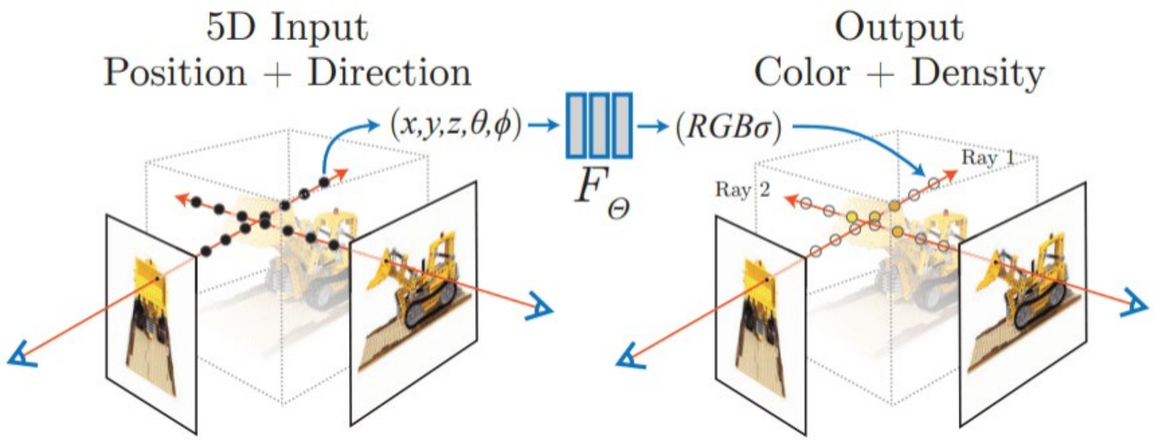
AI in Rendering

AI Generated Textures and Materials



NeRF

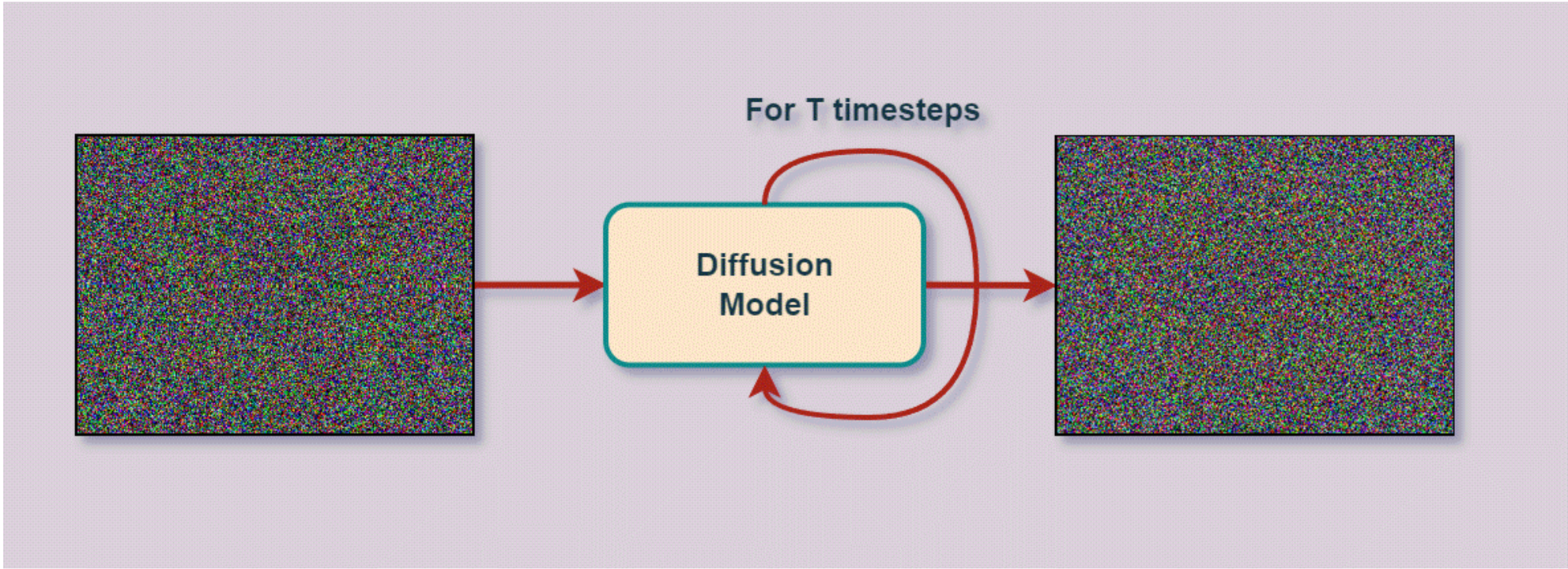

Input Images
Optimize NeRF
Render new views


5D Input
Position + Direction
Output
Color + Density
(x,y,z,θ,ϕ)
$(RGB\sigma)$
F_Θ
Ray 1
Ray 2

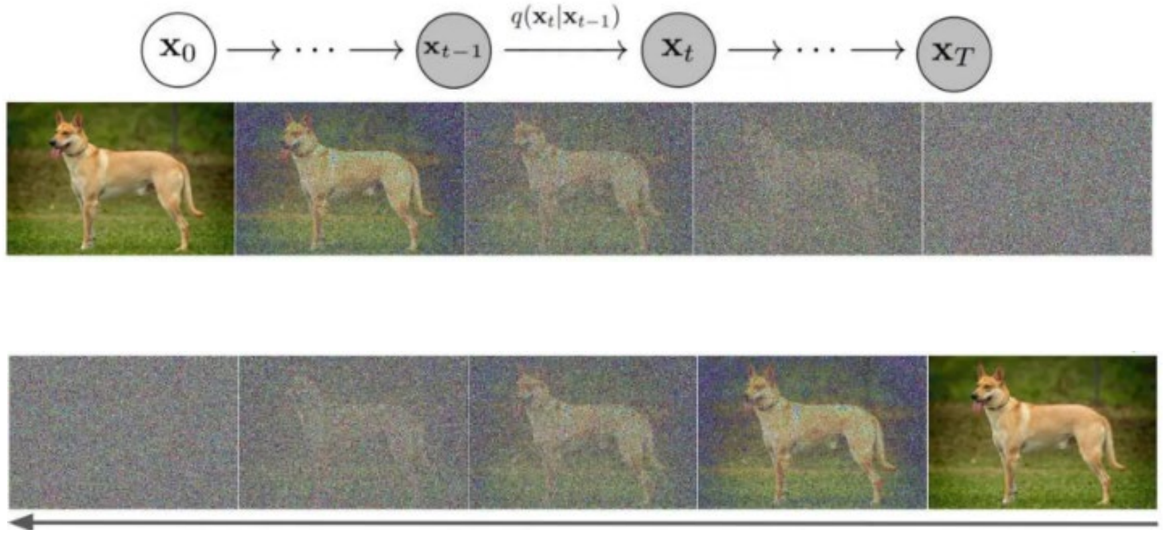
Diffusion models

- A generative model that learns to create data by iteratively refining noise into meaningful images or 3d content
- Starts with pure noise and progressively removes noise over multiple steps.
- Examples are Text-to-image generation (e.g., DALL-E, Stable Diffusion, Midjourney).
- Can be used for Image synthesis, inpainting, and enhancement

Diffusion model process



Diffusion Model Process



- Key concept in Diffusion Modelling is that if we could build a learning model which can learn the systematic decay of information due to noise, then it should be possible to reverse the process and therefore, recover the information back from the noise

- The diffusion process has a forward process which adds noise to the image and a reverse process which takes away noise from the image.

- In the forward diffusion process, gaussian noise is introduced successively until the data becomes all noise.

- The reverse/ reconstruction process undoes the noise by learning the conditional probability densities using a neural network model

Diffusion model applications

An astronaut riding a horse in a photorealistic style

Text to Image

Text to Video

“A photo of a sitting dog”

Image Editing using Text prompt

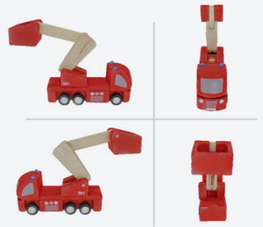
Diffusion model applications

Text-to-3D generation

text prompt

> a train engine made out of clay

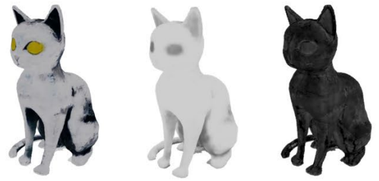
Image-to-3D generation



source views

Material decomposition

> a cat made of silver



albedo metalness roughness

> a cat made of rock

Relighting in different environments

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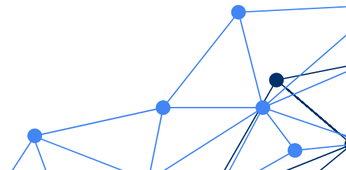
THANK YOU!

Preetish Kakkar



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Questions?