Trazendo Metal para sua Vida (View)

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- Metal?
- Onde usar?
- Animando com Metal

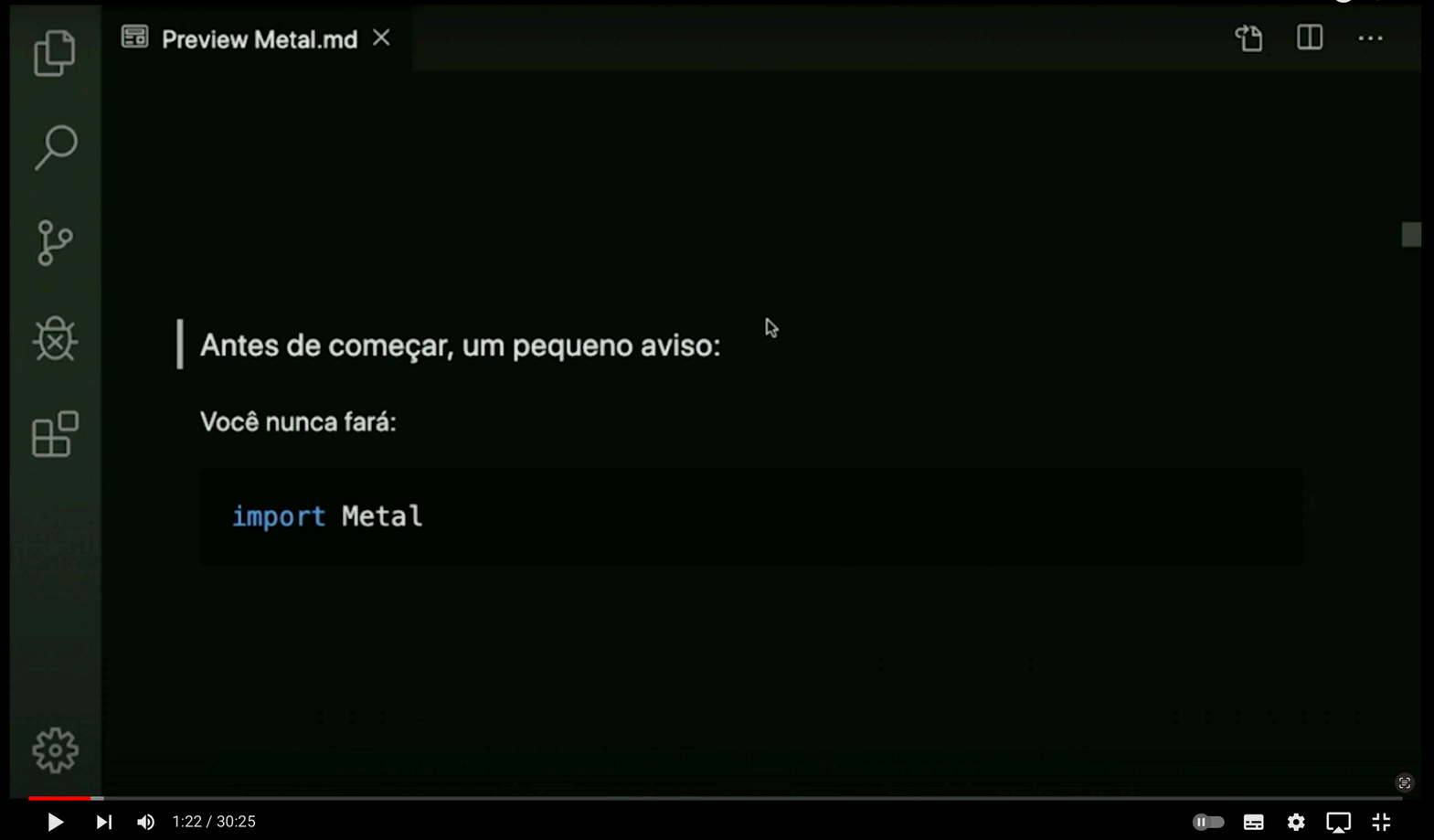
The Roots Of Metal

NSBrazil 2019

https://www.youtube.com/watch?v=QIf_j_Zcpd4

busted

NSBrazil19 - The Roots of Metal



Metal

Metal

- API gráfica de baixo nível.
- Utiliza GPU e não a CPU.
- É extremamente rápida para paralelismo.
- É o “DirectX da Apple”.
- Metal significa "hardware" e não Heavy Metal.
- UIKit, SwiftUI e SceneKit usam Metal.
- Usável com Swift, Objective-C e "C++".

Metal

- Buffers
- Shaders
  - Vertex (Posicionamento)
  - Fragment (Cor de pixels)
  - Kernel (Cálculos)
- Comandos
- Renderizar

Onde usar?

Onde usar?

- Criar jogos
- Machine Learning
- Cálculos físicos e matemáticos
- Qualquer tela de devices da Apple
- Efeitos visuais complexos
- Entre outros

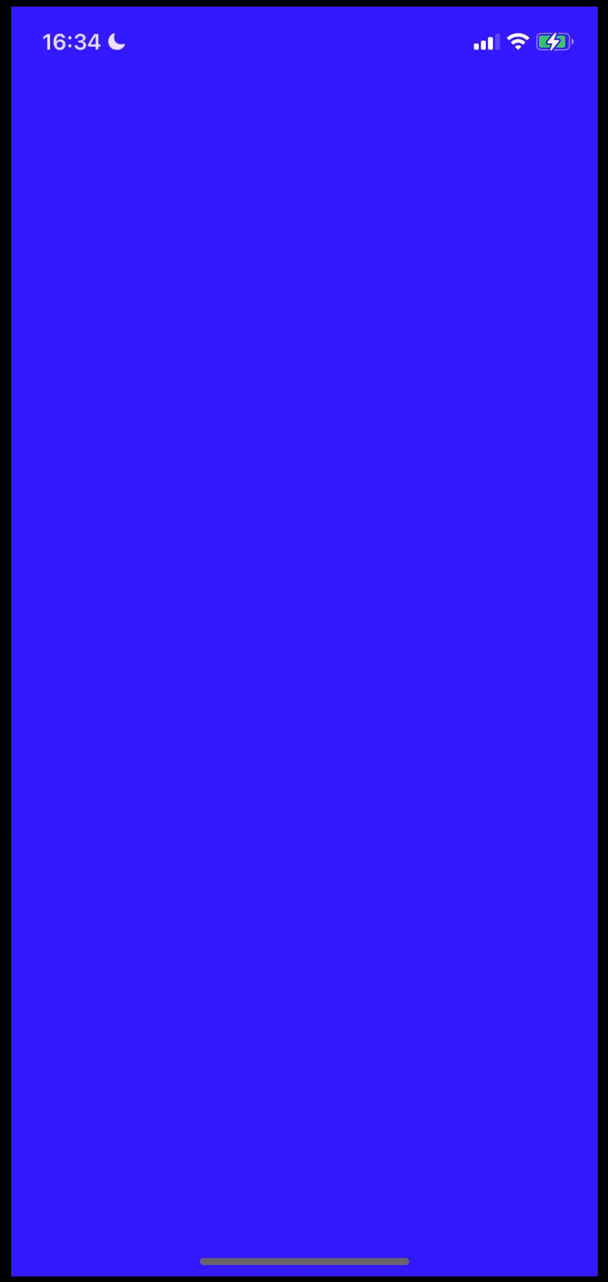
Onde usar?

- Com:
  - SpriteKit
  - SceneKit
  - UIKit
  - SwiftUI
- Ou usar apenas o Metal para processamento

Animando com Metal

Animando com Metal

- Vamos criar uma transição customizada.
- O push da Navigation Controller é muito sem graça.
- Mas sem UIKit ou CoreAnimation.
- Para deixar mais interessante, vamos usar Metal.


16:34


peacock


DOOM™
id
SOFTWARE
id SOFTWARE, ©1993

Doom Screen Melt

https://doom.fandom.com/wiki/Screen_melt

Animando com Metal

- Vamos fazer a transição do Doom.
- Ao fazer o push, a tela “derreterá”.
- O código servirá para qualquer app, não só telas coloridas.
- E agora você poderá fazer o “import Metal” no seu projeto.

Vai ser muito código

Mas não se assuste!

```
extension FirstViewController: UINavigationControllerDelegate {




}
```

```
extension FirstViewController: UINavigationControllerDelegate {
    func navigationController(



    ) -> UIViewControllerAnimatedTransitioning? {
    }
}
```

```swift
extension FirstViewController: UINavigationControllerDelegate {

    func navigationController(
        _ navigationController: UINavigationController,
        animationControllerFor operation: UINavigationController.Operation,
        from fromVC: UIViewController,
        to toVC: UIViewController
    ) -> UIViewControllerAnimatedTransitioning? {

    }

}
```

```
extension FirstViewController: UINavigationControllerDelegate {

    func navigationController(
        _ navigationController: UINavigationController,
        animationControllerFor operation: UINavigationController.Operation,
        from fromVC: UIViewController,
        to toVC: UIViewController
    ) -> UIViewControllerAnimatedTransitioning? {
        return DoomTransition()
    }

}
```

```
class DoomTransition: NSObject, UIViewControllerAnimatedTransitioning {









}
```

```
class DoomTransition: NSObject, UIViewControllerAnimatedTransitioning {

    let duration: TimeInterval = 2
    let view = MetalView(device: device)
    let queue = DispatchQueue.main









}
```

```
class DoomTransition: NSObject, UIViewControllerAnimatedTransitioning {

    let duration: TimeInterval = 2
    let view = MetalView(device: device)
    let queue = DispatchQueue.main

    func transitionDuration(
        using transitionContext: UIViewControllerContextTransitioning?
    ) -> TimeInterval {
        duration
    }









}
```

```
class DoomTransition: NSObject, UIViewControllerAnimatedTransitioning {

    let duration: TimeInterval = 2
    let view = MetalView(device: device)
    let queue = DispatchQueue.main

    func transitionDuration(
        using transitionContext: UIViewControllerContextTransitioning?
    ) -> TimeInterval {
        duration
    }

    func animateTransition(
        using transitionContext: UIViewControllerContextTransitioning
    ) {
        /// Aqui inicia a animação
    }

}
```

animateTransition

animateTransition

```
guard
    let from = transitionContext.viewController(forKey: .from),
    let to = transitionContext.viewController(forKey: .to)
else { return }

let container = transitionContext.containerView
let frame = container.frame
```

animateTransition

```
guard
    let from = transitionContext.viewController(forKey: .from),
    let to = transitionContext.viewController(forKey: .to)
else { return }

let container = transitionContext.containerView
let frame = container.frame

view.frame = CGRect(x: 0, y: 0, width: frame.width, height: frame.height)
container.addSubview(to.view)
container.addSubview(view)
```

animateTransition

```
guard
    let from = transitionContext.viewController(forKey: .from),
    let to = transitionContext.viewController(forKey: .to)
else { return }

let container = transitionContext.containerView
let frame = container.frame

view.frame = CGRect(x: 0, y: 0, width: frame.width, height: frame.height)
container.addSubview(to.view)
container.addSubview(view)

view.fromTexture = from.view.snapshot()
view.toTexture = to.view.snapshot()
```

animateTransition

```
guard
    let from = transitionContext.viewController(forKey: .from),
    let to = transitionContext.viewController(forKey: .to)
else { return }

let container = transitionContext.containerView
let frame = container.frame

view.frame = CGRect(x: 0, y: 0, width: frame.width, height: frame.height)
container.addSubview(to.view)
container.addSubview(view)

view.fromTexture = from.view.snapshot()
view.toTexture = to.view.snapshot()

queue.asyncAfter(deadline: .now() + duration) {
    self.view.removeFromSuperview()
    transitionContext.completeTransition(
        !transitionContext.transitionWasCancelled
    )
}
```

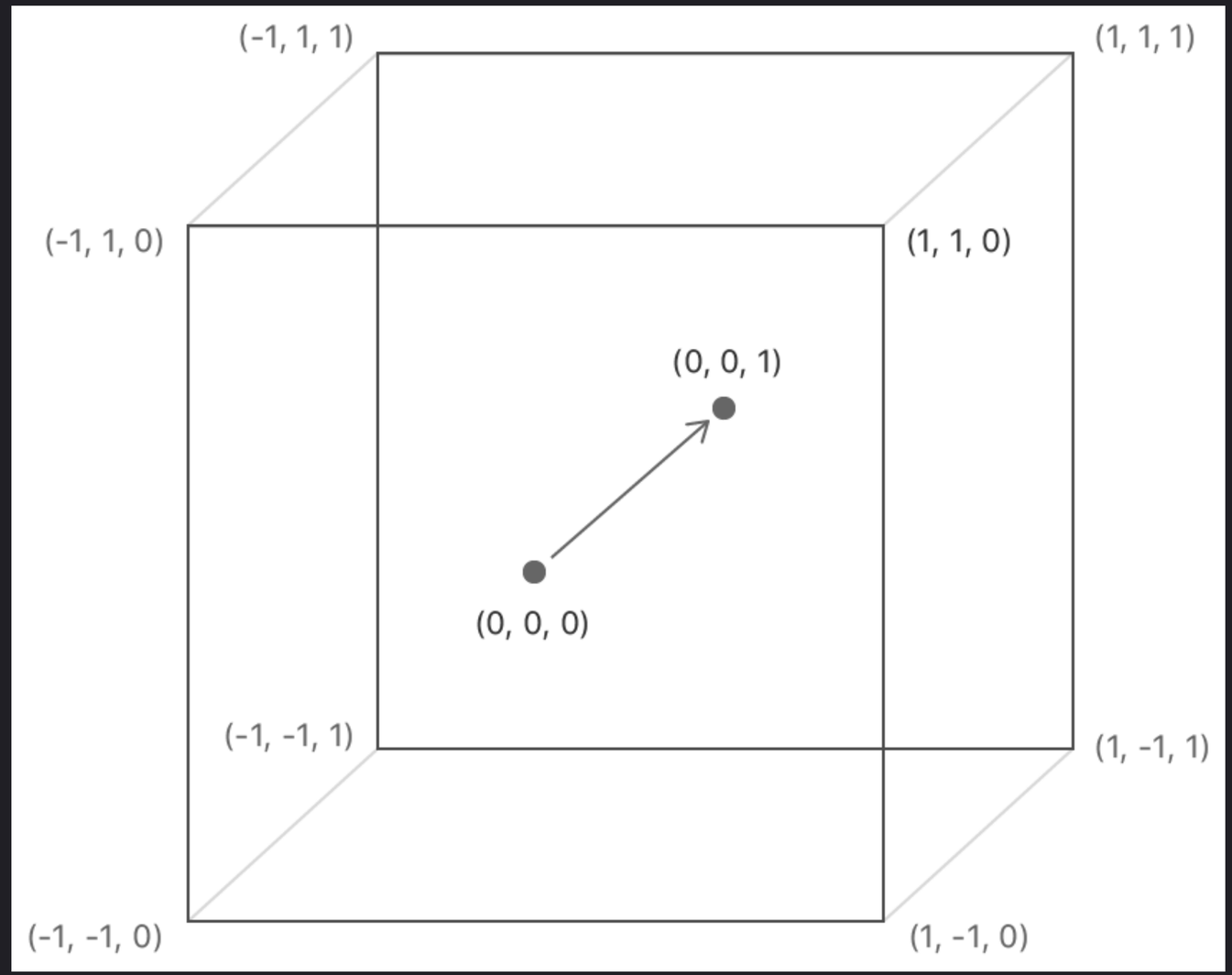
```
final class MetalView: MTKView {




}
```

```
final class MetalView: MTKView {

    let positions = [
        // ...
    ]

    let textureCoordinate = [
        // ...
    ]









}
```

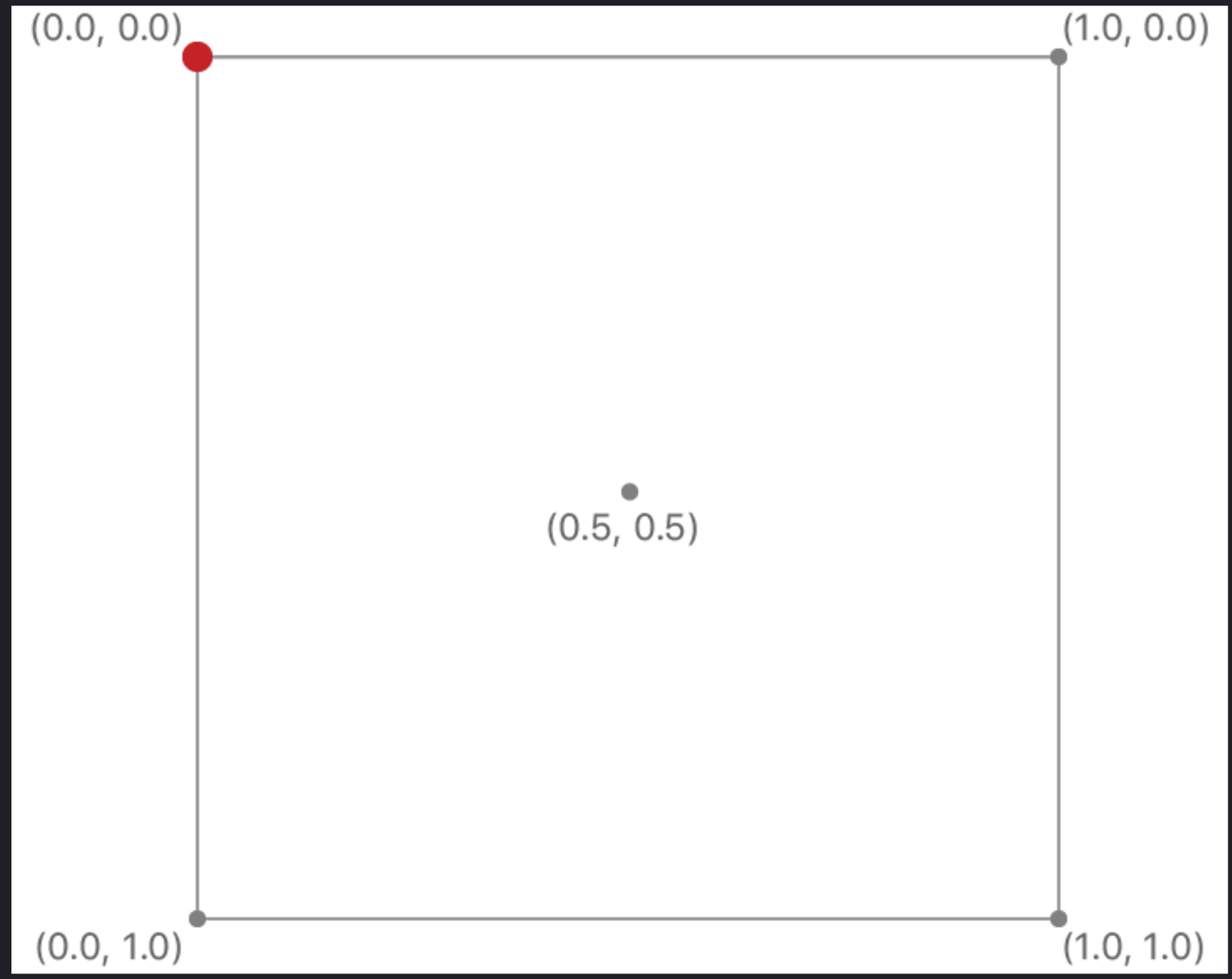
```
final class MetalView: MTKView {

    let positions = [
        // ...
    ]

    let textureCoordinate = [
        // ...
    ]

    var vertexBuffer: MTLBuffer!
    var renderPipelineState: MTLRenderPipelineState!
    var commandQueue: MTLCommandQueue!
    var sampler: MTLSamplerState!



}
```

```
final class MetalView: MTKView {

    let positions = [
        // ...
    ]

    let textureCoordinate = [
        // ...
    ]

    var vertexBuffer: MTLBuffer!
    var renderPipelineState: MTLRenderPipelineState!
    var commandQueue: MTLCommandQueue!
    var sampler: MTLSamplerState!

    var fromTexture: MTLTexture?
    var toTexture: MTLTexture?
    var deltaTime: Float = 0
}
```

```
let positions = [
    // Top Left
    SIMD3<Float>(-1,  1, 0),
    // Bottom Left
    SIMD3<Float>(-1, -1, 0),
    // Bottom Right
    SIMD3<Float>( 1, -1, 0),

    // Top Right
    SIMD3<Float>( 1,  1, 0),
    // Top Left
    SIMD3<Float>(-1,  1, 0),
    // Bottom Right
    SIMD3<Float>( 1, -1, 0),
]
```



```
let textureCoordinate = [
    // Top Left
    SIMD2<Float>(0, 0),
    // Bottom Left
    SIMD2<Float>(0, 1),
    // Bottom Right
    SIMD2<Float>(1, 1),

    // Top Right
    SIMD2<Float>(1, 0),
    // Top Left
    SIMD2<Float>(0, 0),
    // Bottom Right
    SIMD2<Float>(1, 1),
]
```



MetalView

```
func createRenderPipelineState() {




}
```

MetalView

```
func createRenderPipelineState() {
    let vertexDescriptor = MTLVertexDescriptor()
    vertexDescriptor.attributes[0].format = .float3
    vertexDescriptor.attributes[0].bufferIndex = 0
    vertexDescriptor.attributes[0].offset = 0









}
```

MetalView

```
func createRenderPipelineState() {
    let vertexDescriptor = MTLVertexDescriptor()
    vertexDescriptor.attributes[0].format = .float3
    vertexDescriptor.attributes[0].bufferIndex = 0
    vertexDescriptor.attributes[0].offset = 0
    vertexDescriptor.attributes[1].format = .float2
    vertexDescriptor.attributes[1].bufferIndex = 0
    vertexDescriptor.attributes[1].offset = MemoryLayout<SIMD3<Float>>.size









}
```

MetalView

```
func createRenderPipelineState() {
    let vertexDescriptor = MTLVertexDescriptor()
    vertexDescriptor.attributes[0].format = .float3
    vertexDescriptor.attributes[0].bufferIndex = 0
    vertexDescriptor.attributes[0].offset = 0
    vertexDescriptor.attributes[1].format = .float2
    vertexDescriptor.attributes[1].bufferIndex = 0
    vertexDescriptor.attributes[1].offset = MemoryLayout<SIMD3<Float>>.size
    vertexDescriptor.layouts[0].stride = MemoryLayout<SIMD3<Float>>.stride
    + MemoryLayout<SIMD2<Float>>.stride









}
```

MetalView

```
func createRenderPipelineState() {
    let vertexDescriptor = MTLVertexDescriptor()
    vertexDescriptor.attributes[0].format = .float3
    vertexDescriptor.attributes[0].bufferIndex = 0
    vertexDescriptor.attributes[0].offset = 0
    vertexDescriptor.attributes[1].format = .float2
    vertexDescriptor.attributes[1].bufferIndex = 0
    vertexDescriptor.attributes[1].offset = MemoryLayout<SIMD3<Float>>.size
    vertexDescriptor.layouts[0].stride = MemoryLayout<SIMD3<Float>>.stride
    + MemoryLayout<SIMD2<Float>>.stride

    let renderPipelineDescriptor = MTLRenderPipelineDescriptor()
    renderPipelineDescriptor.colorAttachments[0].pixelFormat = .bgra8Unorm
    renderPipelineDescriptor.vertexFunction = vertexFunction
    renderPipelineDescriptor.fragmentFunction = fragmentFunction
    renderPipelineDescriptor.vertexDescriptor = vertexDescriptor



}
```

MetalView

```
func createRenderPipelineState() {
    let vertexDescriptor = MTLVertexDescriptor()
    vertexDescriptor.attributes[0].format = .float3
    vertexDescriptor.attributes[0].bufferIndex = 0
    vertexDescriptor.attributes[0].offset = 0
    vertexDescriptor.attributes[1].format = .float2
    vertexDescriptor.attributes[1].bufferIndex = 0
    vertexDescriptor.attributes[1].offset = MemoryLayout<SIMD3<Float>>.size
    vertexDescriptor.layouts[0].stride = MemoryLayout<SIMD3<Float>>.stride
    + MemoryLayout<SIMD2<Float>>.stride

    let renderPipelineDescriptor = MTLRenderPipelineDescriptor()
    renderPipelineDescriptor.colorAttachments[0].pixelFormat = .bgra8Unorm
    renderPipelineDescriptor.vertexFunction = vertexFunction
    renderPipelineDescriptor.fragmentFunction = fragmentFunction
    renderPipelineDescriptor.vertexDescriptor = vertexDescriptor

    renderPipelineState = try! device!.makeRenderPipelineState(
        descriptor: renderPipelineDescriptor
    )
}
```

MetalView

```
override func draw(_ rect: CGRect) {
    // Antes de chamar drawPrimitives
```

MetalView

```
override func draw(_ rect: CGRect) {
    // Antes de chamar drawPrimitives

    deltaTime += 1 / Float(preferredFramesPerSecond)
```

MetalView

```
override func draw(_ rect: CGRect) {
    // Antes de chamar drawPrimitives

    deltaTime += 1 / Float(preferredFramesPerSecond)

    commandEncoder?.setVertexBytes(
        textureCoordinates,
        length: MemoryLayout<SIMD2<Float>>.stride * textureCoordinates.count,
        index: 1
    )
```

MetalView

```
override func draw(_ rect: CGRect) {
    // Antes de chamar drawPrimitives

    deltaTime += 1 / Float(preferredFramesPerSecond)

    commandEncoder?.setVertexBytes(
        textureCoordinates,
        length: MemoryLayout<SIMD2<Float>>.stride * textureCoordinates.count,
        index: 1
    )

    if let fromTexture, let toTexture {
        commandEncoder?.setFragmentTexture(fromTexture, index: 0)
        commandEncoder?.setFragmentTexture(toTexture, index: 1)
        commandEncoder?.setFragmentSamplerState(sampler, index: 0)
        commandEncoder?.setFragmentBytes(
            &deltaTime,
            length: MemoryLayout<Float>.stride,
            index: 0
        )
    }
```

MetalView

```
override func draw(_ rect: CGRect) {
    // Antes de chamar drawPrimitives

    deltaTime += 1 / Float(preferredFramesPerSecond)

    commandEncoder?.setVertexBytes(
        textureCoordinates,
        length: MemoryLayout<SIMD2<Float>>.stride * textureCoordinates.count,
        index: 1
    )

    if let fromTexture, let toTexture {
        commandEncoder?.setFragmentTexture(fromTexture, index: 0)
        commandEncoder?.setFragmentTexture(toTexture, index: 1)
        commandEncoder?.setFragmentSamplerState(sampler, index: 0)
        commandEncoder?.setFragmentBytes(
            &deltaTime,
            length: MemoryLayout<Float>.stride,
            index: 0
        )
    }

   // Renderiza
}
```

Vertex Shader

```
vertex            main_vertex(

                                                    ) {



}
```

Vertex Shader

```
struct VertexOut {
    float4 position [[ position ]];
    float2 textureCoordinate;
};

vertex           main_vertex(

                                                    ) {




}
```

Vertex Shader

```
struct VertexOut {
    float4 position [[ position ]];
    float2 textureCoordinate;
};

vertex VertexOut main_vertex(

                                                        ) {




}
```

Vertex Shader

```
struct VertexOut {
    float4 position [[ position ]];
    float2 textureCoordinate;
};

vertex VertexOut main_vertex(constant float3 *positions [[ buffer(0) ]],
                             constant float2 *textureCoordinates [[ buffer(1) ]],
                             uint vertexID [[ vertex_id ]]) {




}
```

Vertex Shader

```
struct VertexOut {
    float4 position [[ position ]];
    float2 textureCoordinate;
};

vertex VertexOut main_vertex(constant float3 *positions [[ buffer(0) ]],
                             constant float2 *textureCoordinates [[ buffer(1) ]],
                             uint vertexID [[ vertex_id ]]) {
    VertexOut out {
        .position = float4(positions[vertexID], 1),
        .textureCoordinate = textureCoordinates[vertexID],
    };
    return out;
}
```

Fragment Shader

```
constant float START_SPEED = 2.7;
constant float MELT_SPEED = 1;

/// Adaptation of the Doom Effect shader from: https://www.shadertoy.com/view/XtlyDn
fragment float4 doom_melt(

                                                                    ) {




}
```

Fragment Shader

```
constant float START_SPEED = 2.7;
constant float MELT_SPEED = 1;

/// Adaptation of the Doom Effect shader from: https://www.shadertoy.com/view/XtlyDn
fragment float4 doom_melt(texture2d<float> from [[ texture(0) ]],
                          texture2d<float> to [[ texture(1) ]],

                                                                  ) {









}
```

Fragment Shader

```
constant float START_SPEED = 2.7;
constant float MELT_SPEED = 1;

/// Adaptation of the Doom Effect shader from: https://www.shadertoy.com/view/XtlyDn
fragment float4 doom_melt(texture2d<float> from [[ texture(0) ]],
                          texture2d<float> to [[ texture(1) ]],
                          sampler sampler [[ sampler(0) ]],
                          VertexOut vertexIn [[ stage_in ]],
                                                            ) {









}
```

Fragment Shader

```
constant float START_SPEED = 2.7;
constant float MELT_SPEED = 1;

/// Adaptation of the Doom Effect shader from: https://www.shadertoy.com/view/XtlyDn
fragment float4 doom_melt(texture2d<float> from [[ texture(0) ]],
                          texture2d<float> to [[ texture(1) ]],
                          sampler sampler [[ sampler(0) ]],
                          VertexOut vertexIn [[ stage_in ]],
                          constant float &deltaTime [[ buffer(0) ]]) {









}
```

Fragment Shader

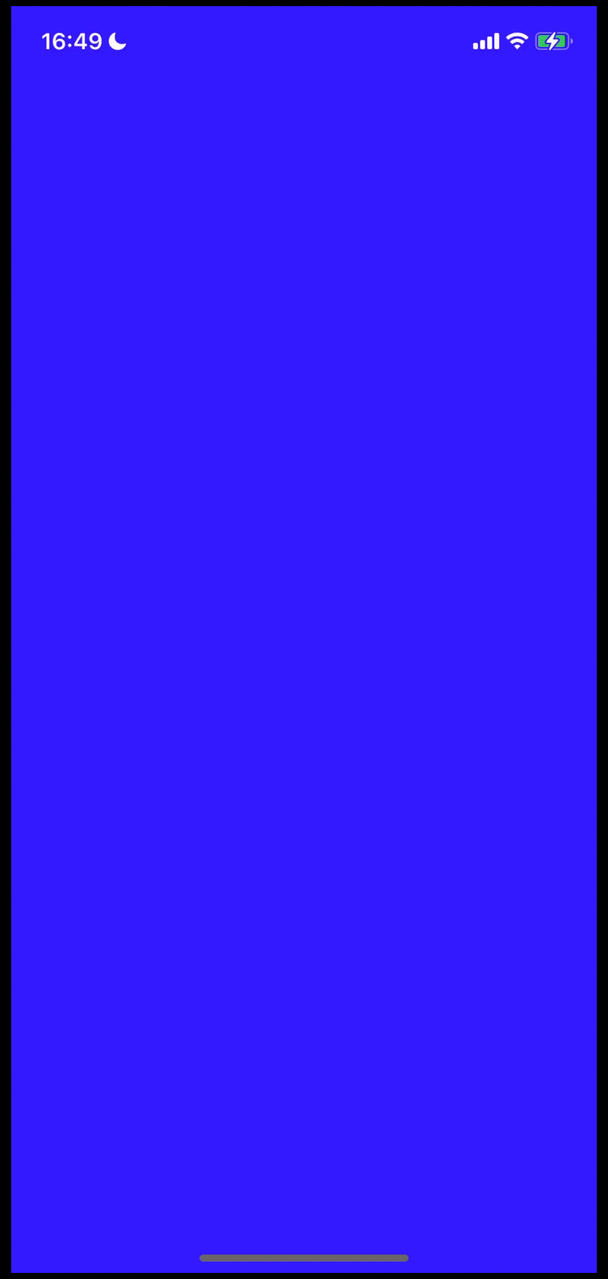
```
constant float START_SPEED = 2.7;
constant float MELT_SPEED = 1;

/// Adaptation of the Doom Effect shader from: https://www.shadertoy.com/view/XtlyDn
fragment float4 doom_melt(texture2d<float> from [[ texture(0) ]],
                          texture2d<float> to [[ texture(1) ]],
                          sampler sampler [[ sampler(0) ]],
                          VertexOut vertexIn [[ stage_in ]],
                          constant float &deltaTime [[ buffer(0) ]]) {
    float2 uv = vertexIn.textureCoordinate;
    float velocity = START_SPEED * deltaTime;
    if (velocity > 1) velocity = 1;

    uv.y -= velocity * 0.35 * fract(sin(dot(float2(uv.x, 0), float2(12.9898, 78.233))) * 43758.545);




}
```

Fragment Shader

```
constant float START_SPEED = 2.7;
constant float MELT_SPEED = 1;

/// Adaptation of the Doom Effect shader from: https://www.shadertoy.com/view/XtlyDn
fragment float4 doom_melt(texture2d<float> from [[ texture(0) ]],
                          texture2d<float> to [[ texture(1) ]],
                          sampler sampler [[ sampler(0) ]],
                          VertexOut vertexIn [[ stage_in ]],
                          constant float &deltaTime [[ buffer(0) ]]) {
    float2 uv = vertexIn.textureCoordinate;
    float velocity = START_SPEED * deltaTime;
    if (velocity > 1) velocity = 1;

    uv.y -= velocity * 0.35 * fract(sin(dot(float2(uv.x, 0), float2(12.9898, 78.233))) * 43758.545);

    if (velocity == 1) uv.y -= MELT_SPEED * (deltaTime - velocity / START_SPEED);




}
```

Fragment Shader

```
constant float START_SPEED = 2.7;
constant float MELT_SPEED = 1;

/// Adaptation of the Doom Effect shader from: https://www.shadertoy.com/view/XtlyDn
fragment float4 doom_melt(texture2d<float> from [[ texture(0) ]],
                          texture2d<float> to [[ texture(1) ]],
                          sampler sampler [[ sampler(0) ]],
                          VertexOut vertexIn [[ stage_in ]],
                          constant float &deltaTime [[ buffer(0) ]]) {
    float2 uv = vertexIn.textureCoordinate;
    float velocity = START_SPEED * deltaTime;
    if (velocity > 1) velocity = 1;

    uv.y -= velocity * 0.35 * fract(sin(dot(float2(uv.x, 0), float2(12.9898, 78.233))) * 43758.545);

    if (velocity == 1) uv.y -= MELT_SPEED * (deltaTime - velocity / START_SPEED);

    if (uv.y < 0) {
        return to.sample(sampler, vertexIn.textureCoordinate);
    }

    return from.sample(sampler, uv);
}
```


16:49

Agora vocês podem:

Graphics Engineer

Apple
(Watch Faces)

https://jobs.apple.com/en-us/details/200440795/graphics-engineer

Repositório

https://github.com/ricardorachaus/metaltransition

Perguntas?