Managed Doom Blazor


Managed
Doom
Blazor
ASP.NET
MVC
.NET
C#

Speaker

DevRel @ Worldline

Teacher

yostane

YCoding

Yassine BENABBAS

Agenda

- Introduction
- Managed DOOM
- Running .net on the browser
- Making the port using Blazor
- Tips and Tricks

Introduction

- Released in 1993 for DOS
- One the most successful First Person Phooters
- Basically, it's an engine + a WAD file

Ported to a LOT of platforms

http://mrglitchsreviews.blogspot.com/2012/09/doom-console-ports.html

https://www.link-cable.com/top-10-weird-doom-ports/

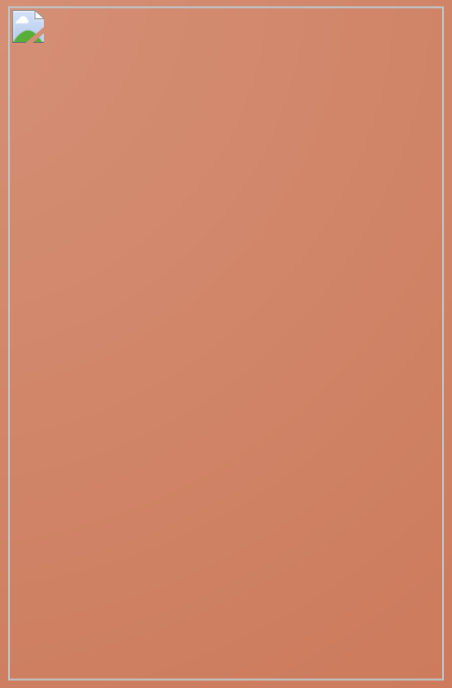
Microsoft and Doom

- The game was used to demosntrate Windows 95
- Microsoft acquisition of Zenimax in 2020

Source: https://www.yahoo.com/news/1995-bill-gates-gave-crazy-180900044.html

ManagedDoom

- C# Port of LinuxDoom
- Just clone the repo, run the solution and enjoy the game
- V1 Uses SFML for graphics + audio + input
  - V2 (in beta as of Jan 3) uses silk.net
- My work is based on a fork of **ManagedDoom V1**



Running .net on the web

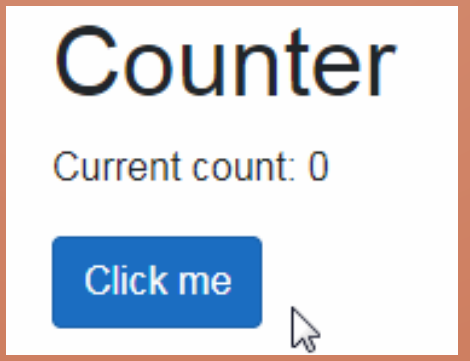
- Blazor WASM
- JS interop (since .net 7)
- Both rely on compiling .net code to WASM
- **My current port uses Blazor WASM**

Blazor

- Framework for building web apps
- Component based (like Angular and VueJS)
- Uses .net and C# instead of JS
- .Net code can run in either on:
  - the server
  - or the browser: Blazor WASM

A Razor component

```
 1 @page "/counter"
 2
 3 <h1>Counter</h1>
 4 <p>Current count: @currentCount</p>
 5 <button @onclick="IncrementCount">Click me</button>
 6
 7 @code {
 8     private int currentCount = 0;
 9     private void IncrementCount() { currentCount++; }
10 }
```



Summary

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- Doom has a LOT of ports
- A .net port already available (ManagedDoom)
- Blazor run .net in the Browser

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Let's make Balzor Doom

MangedDoom V1 architecture

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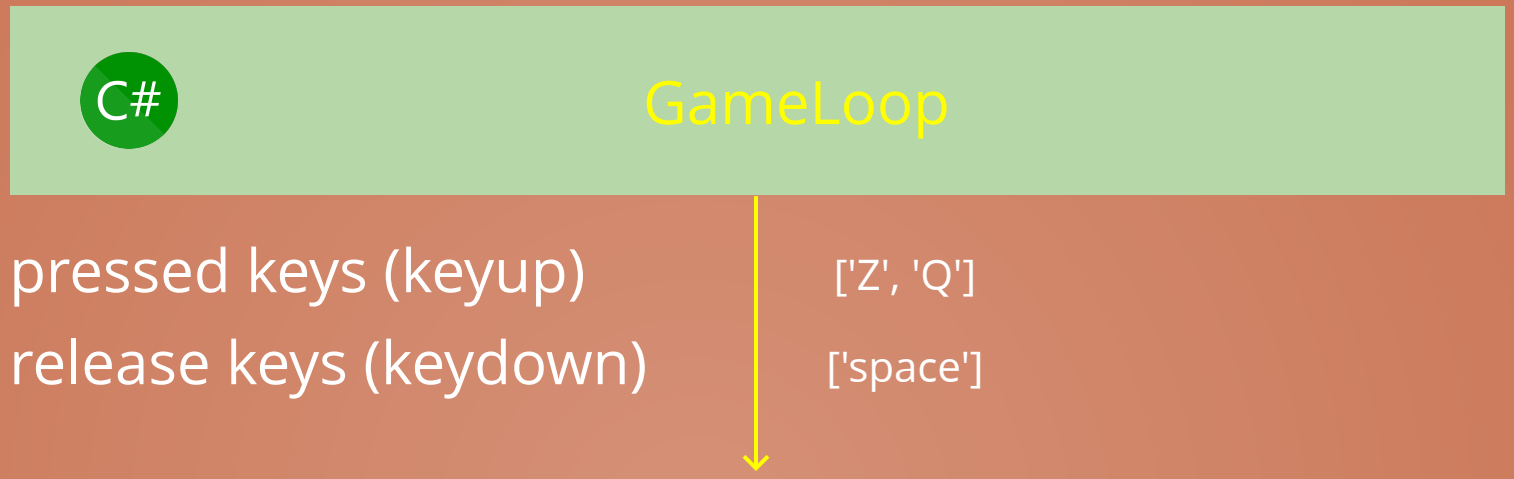

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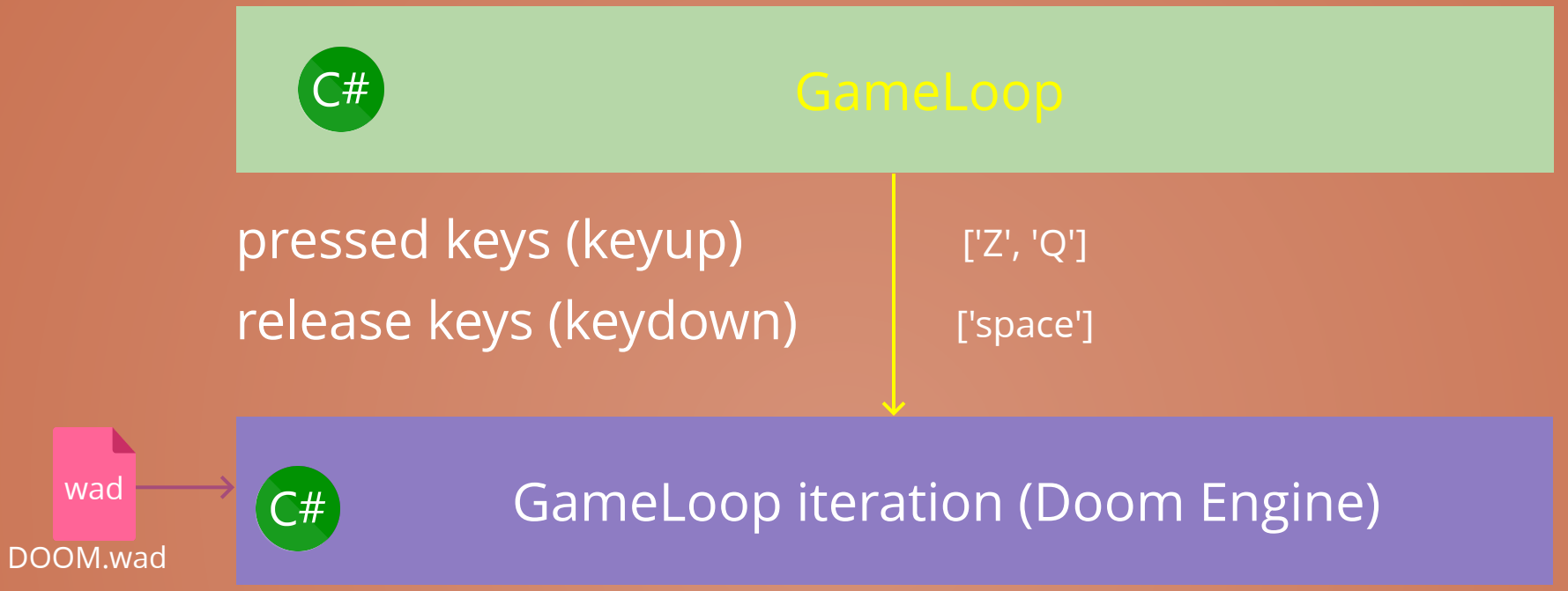

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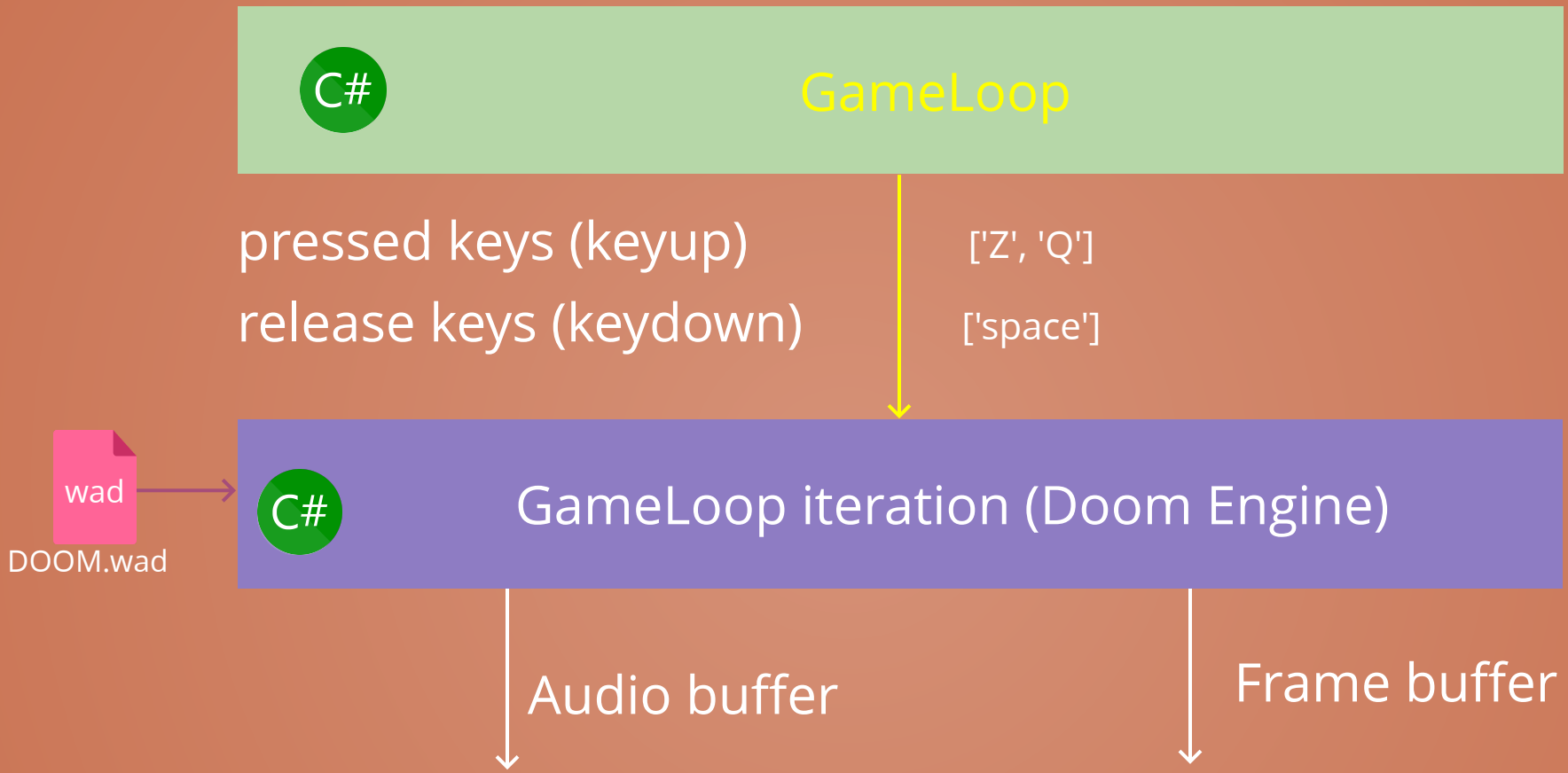


MangedDoom V1 architecture

C# GameLoop

pressed keys (keyup) ['Z', 'Q']

release keys (keydown) ['space']

wad

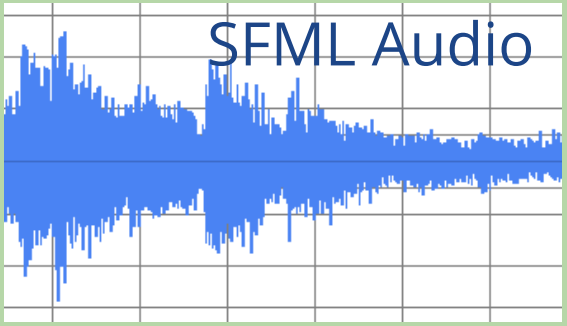
DOOM.wad

C# GameLoop iteration (Doom Engine)

Audio buffer

Frame buffer

C#



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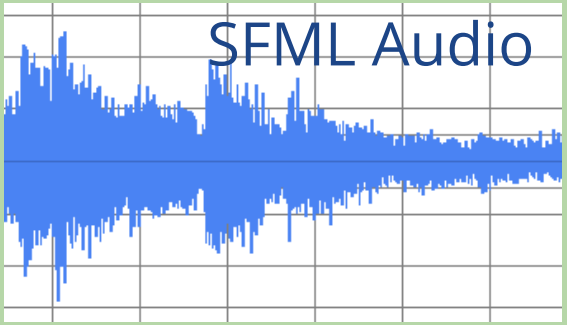

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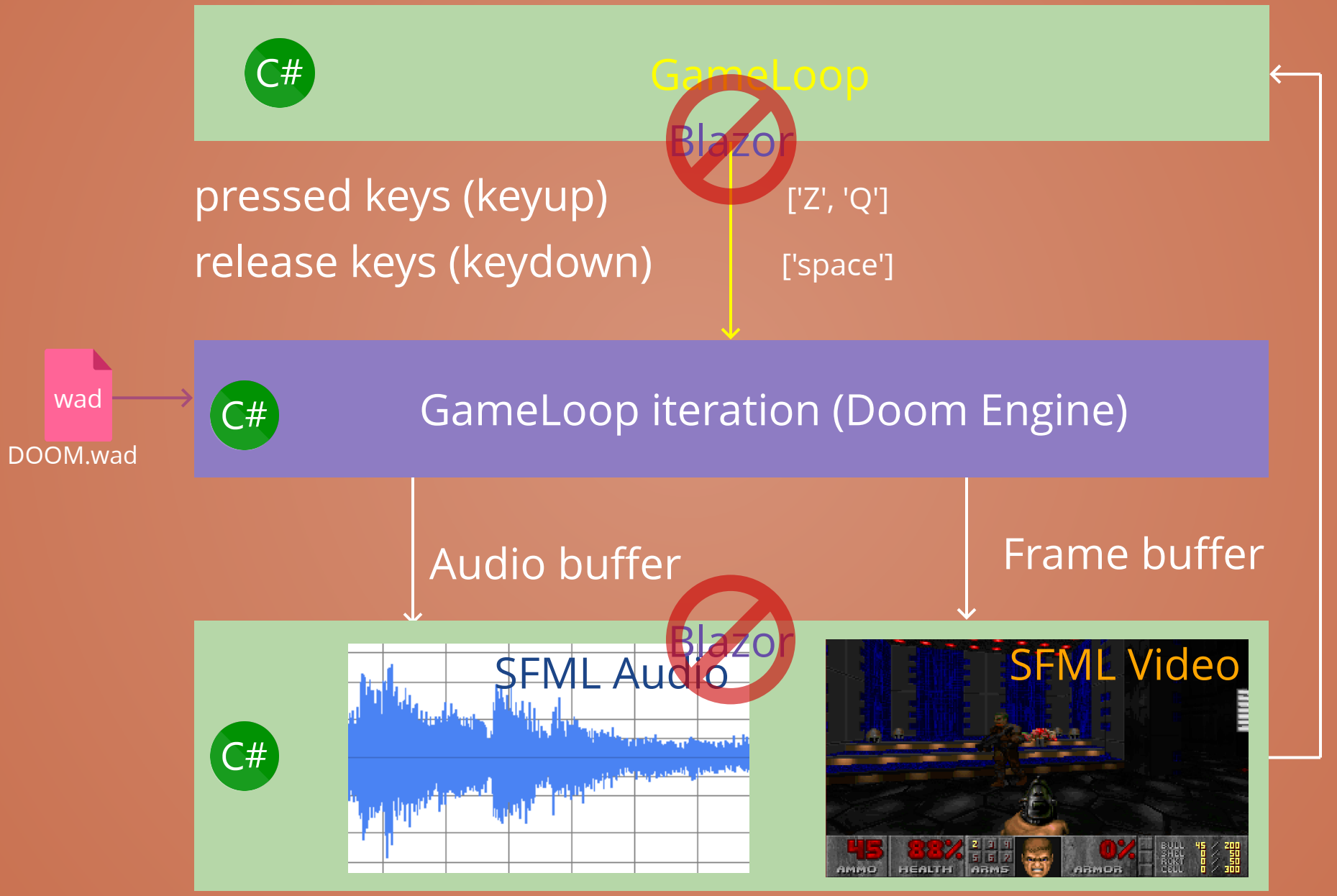

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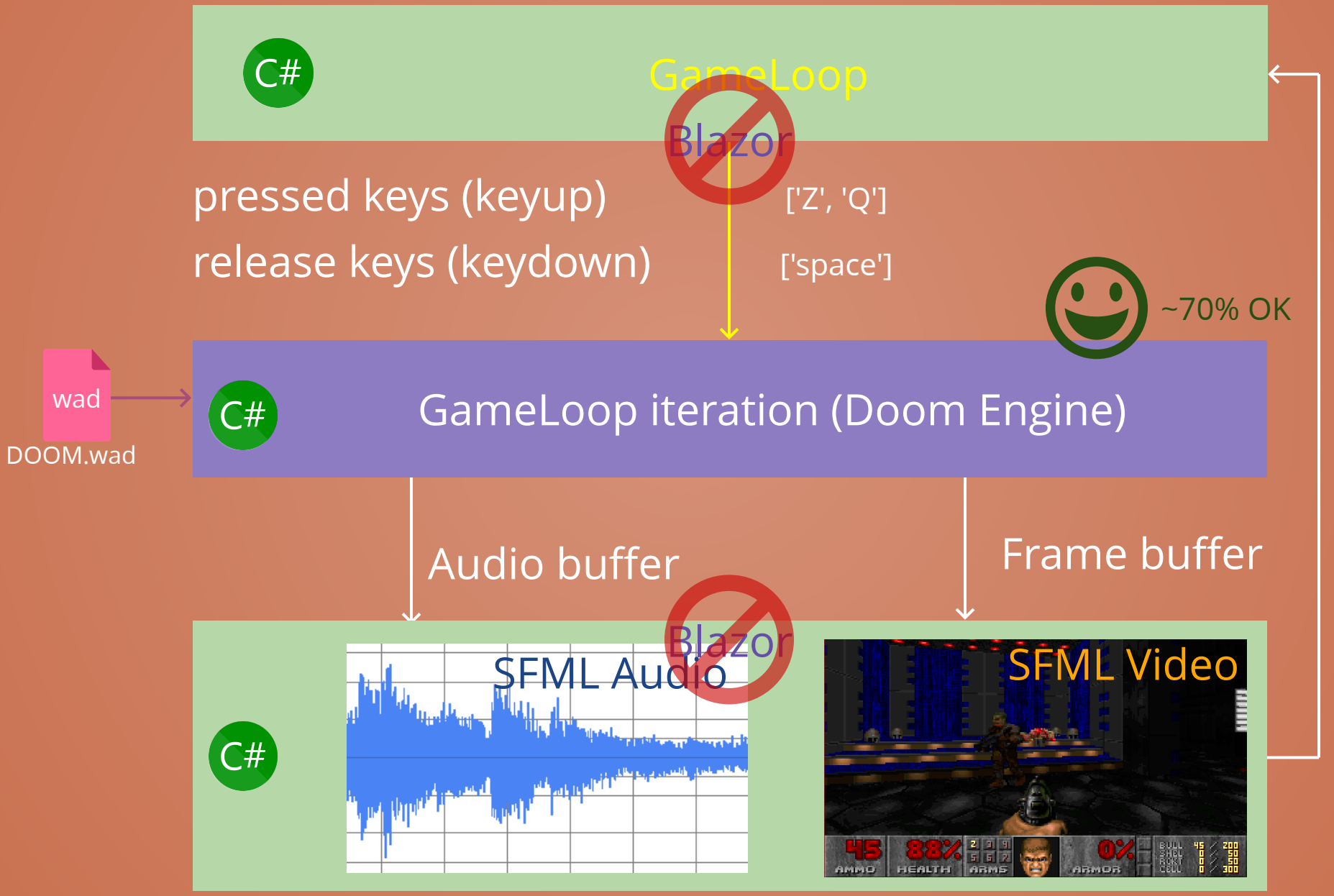

Game architecture

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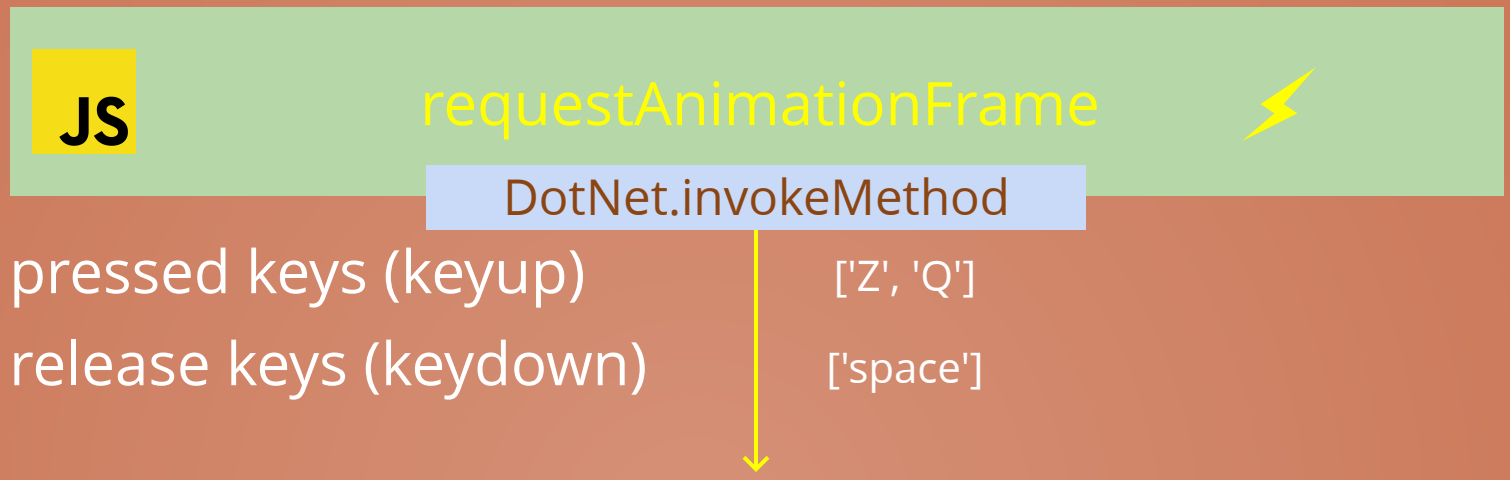

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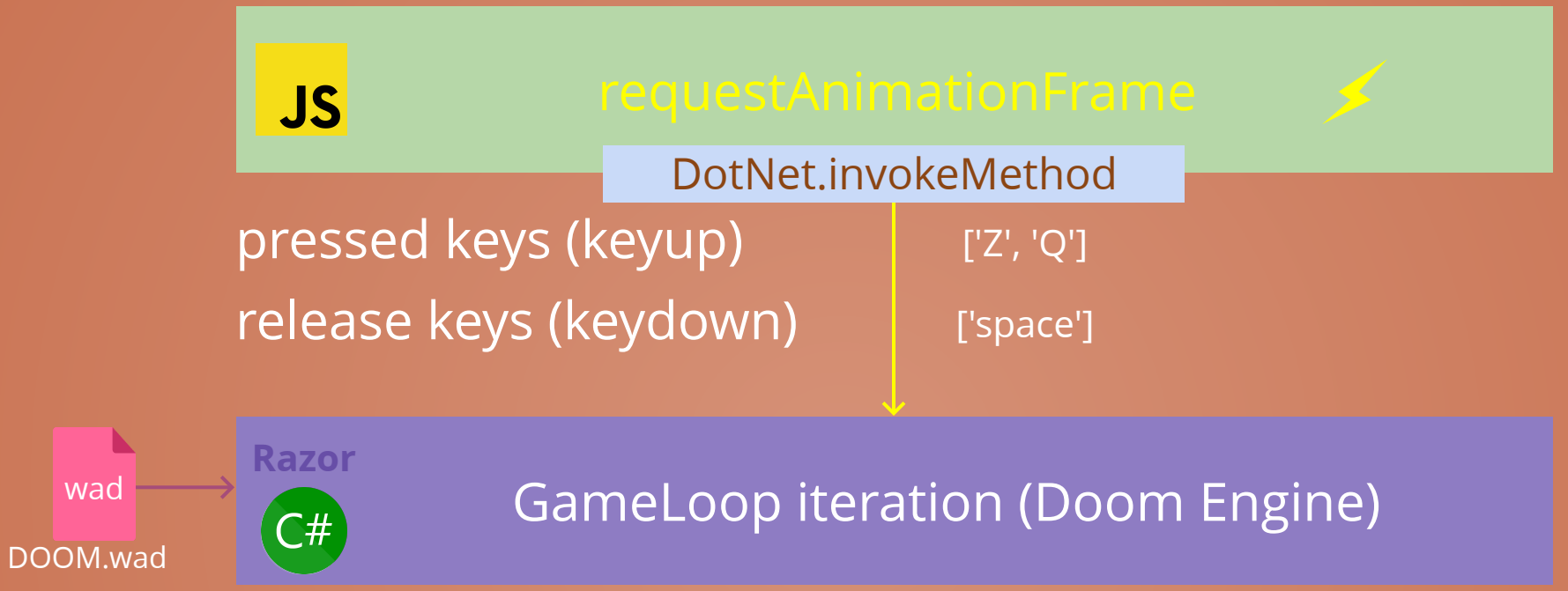

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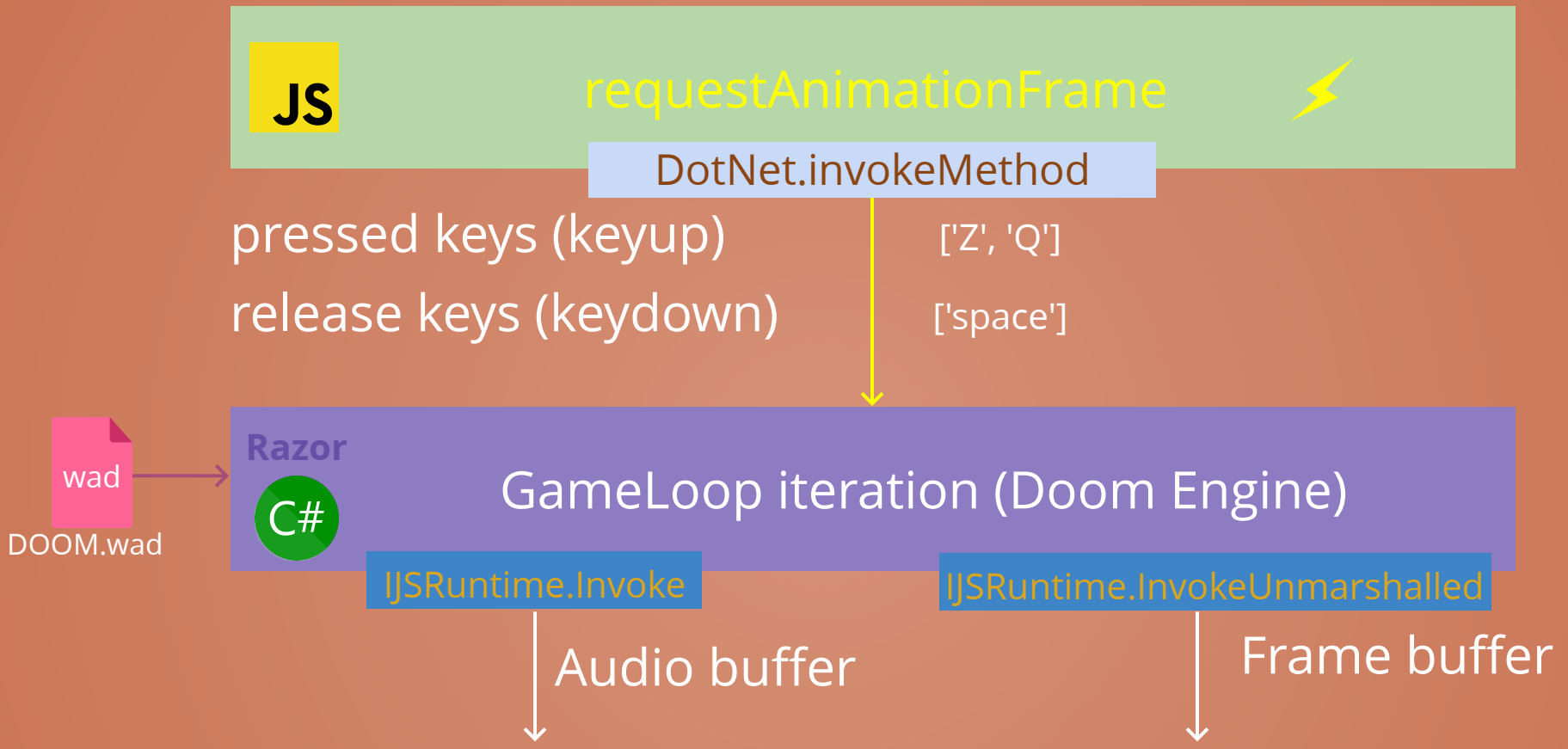

Game architecture

JS

requestAnimationFrame

DotNet.invokeMethod

pressed keys (keyup) ['Z', 'Q']

release keys (keydown) ['space']

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Razor

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GameLoop iteration (Doom Engine)

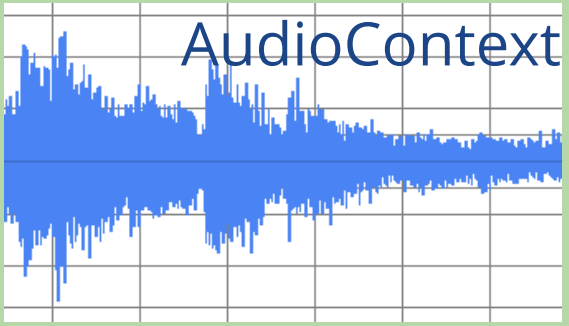
IJSRuntime.Invoke

IJSRuntime.InvokeUnmarshalled

Audio buffer

Frame buffer

JS



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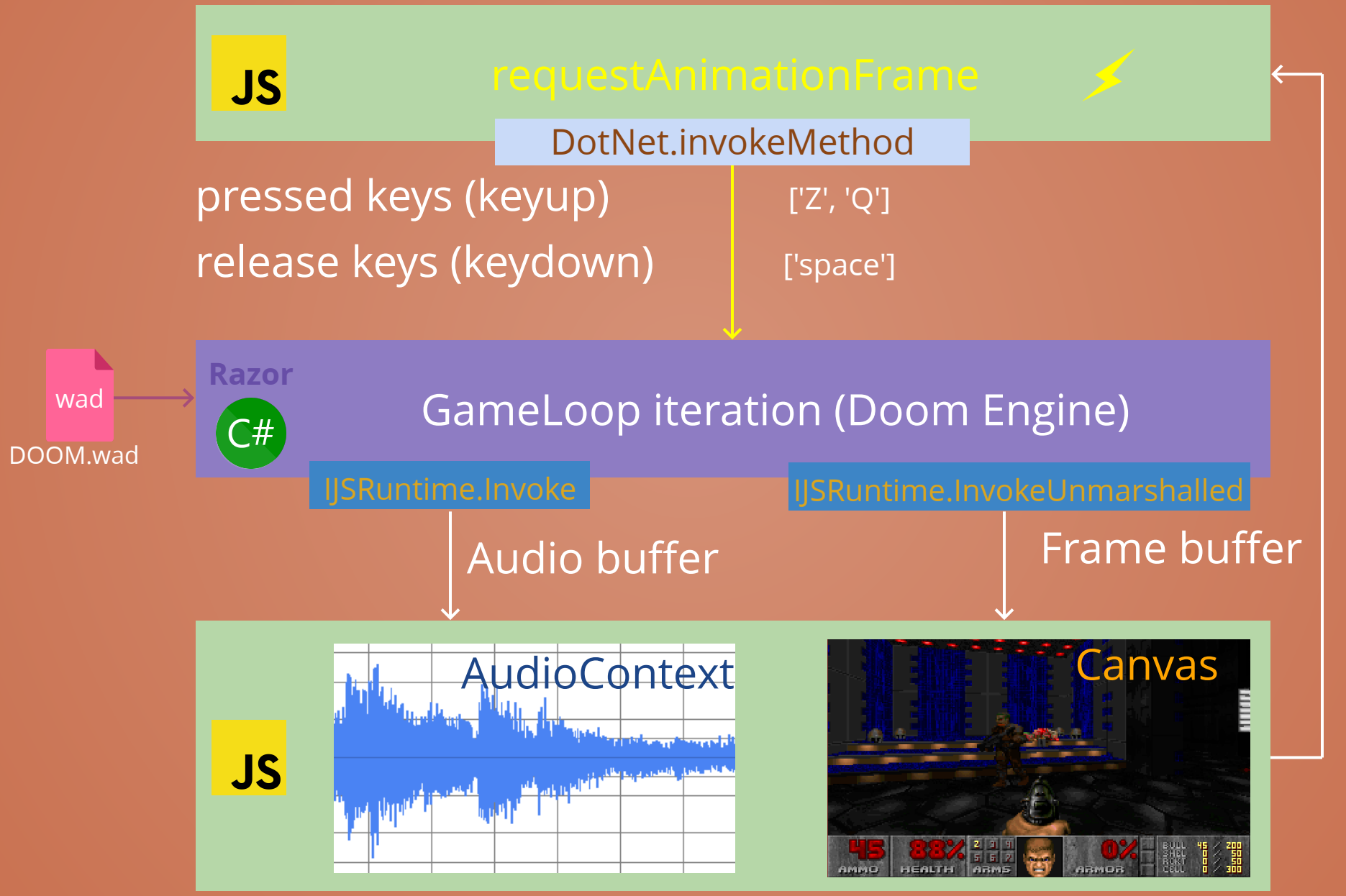


Technical details

show me some code !

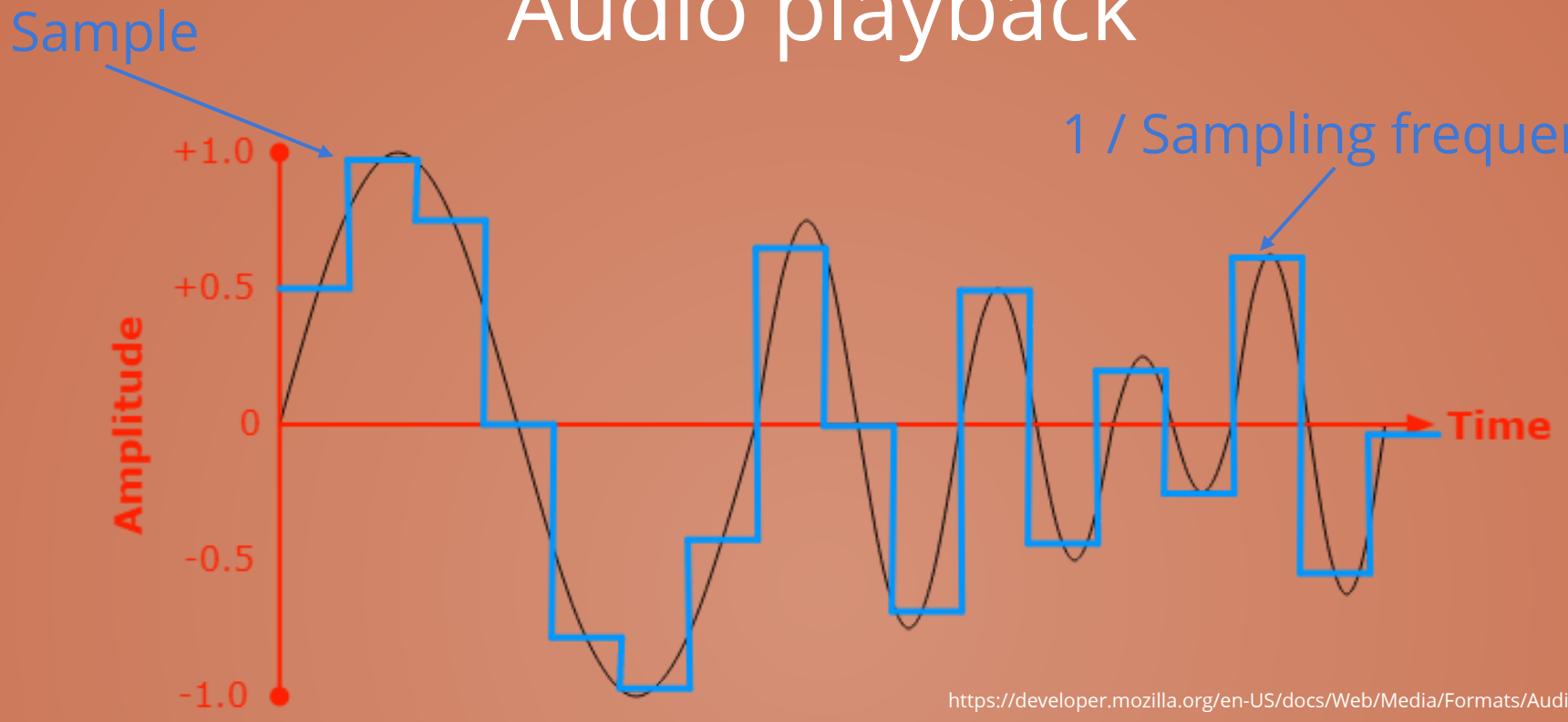
The DOOM component

```
<label>WAD url (shareware wad used by default)</label>
<input type="text" value="@wadUrl" />

<button class="btn btn-secondary" @onclick="@StartGame">Start game</button>

<canvas id="canvas"  Width="320" Height="320"
        style="width:100%; height:auto; image-rendering: pixelated;">
</canvas>


@code {
    protected override async Task OnAfterRenderAsync(bool firstRender)
    {
        await StartGame();
    }

    private async Task StartGame()
    {
        var stream = await Http.GetStreamAsync(wadUrl);
        var commandLineArgs = new ManagedDoom.CommandLineArgs(args);
        app = new ManagedDoom.DoomApplication(commandLineArgs, configLines, Http,
         stream, jsRuntime, jsProcessRuntime, webAssemblyJSRuntime, wadUrl);
        jsProcessRuntime.InvokeVoid("gameLoop");
    }

    [JSInvokable("GameLoop")]
    public static void GameLoop(uint[] downKeys, uint[] upKeys)
    {
        app.Run(downKeys, upKeys);
    }
}
```

Gameloop orchestration

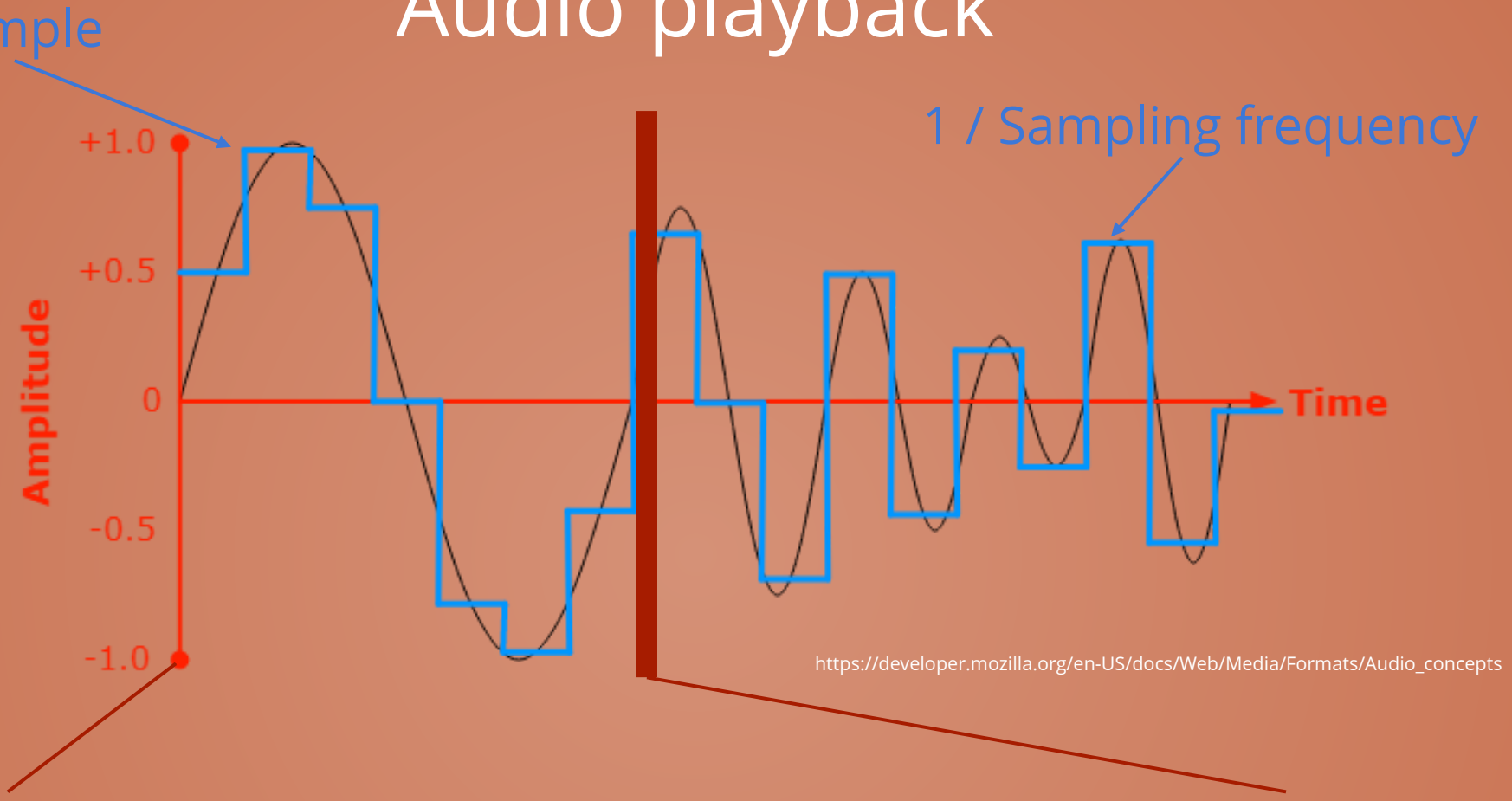

```
window.gameLoop = function (timestamp) {
  if (timestamp - lastFrameTimestamp >= frameTime) {
    lastFrameTimestamp = timestamp;
    DotNet.invokeMethod('BlazorDoom', 'GameLoop', downKeys, upKeys);
    upKeys.splice(0, upKeys.length);
  }

  window.requestAnimationFrame(window.gameLoop);
}
```

Audio playback



https://developer.mozilla.org/en-US/docs/Web/Media/Formats/Audio_concepts

Audio playback



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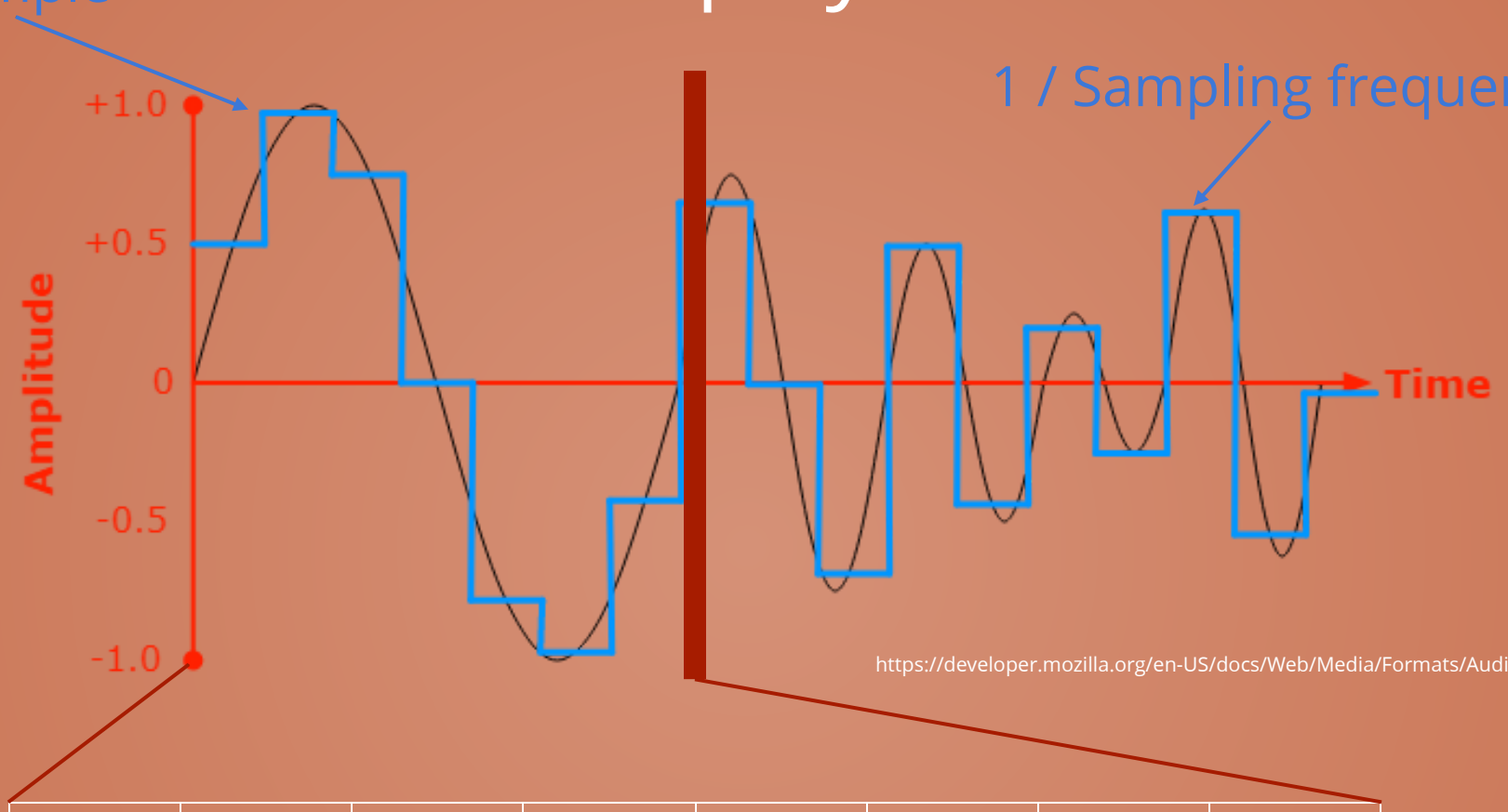
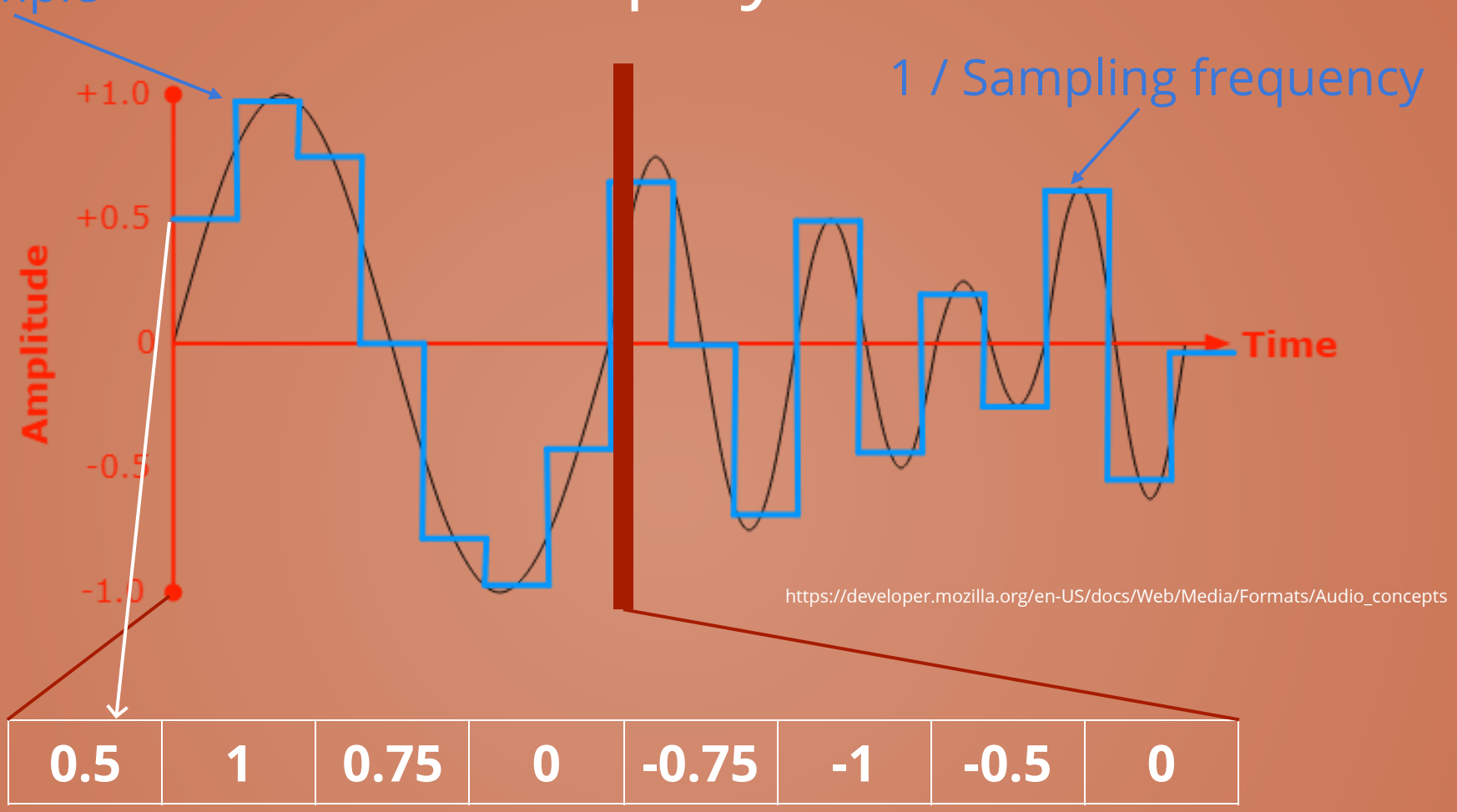


0.5	1	0.75	0	-0.75	-1	-0.5	0

Audio playback



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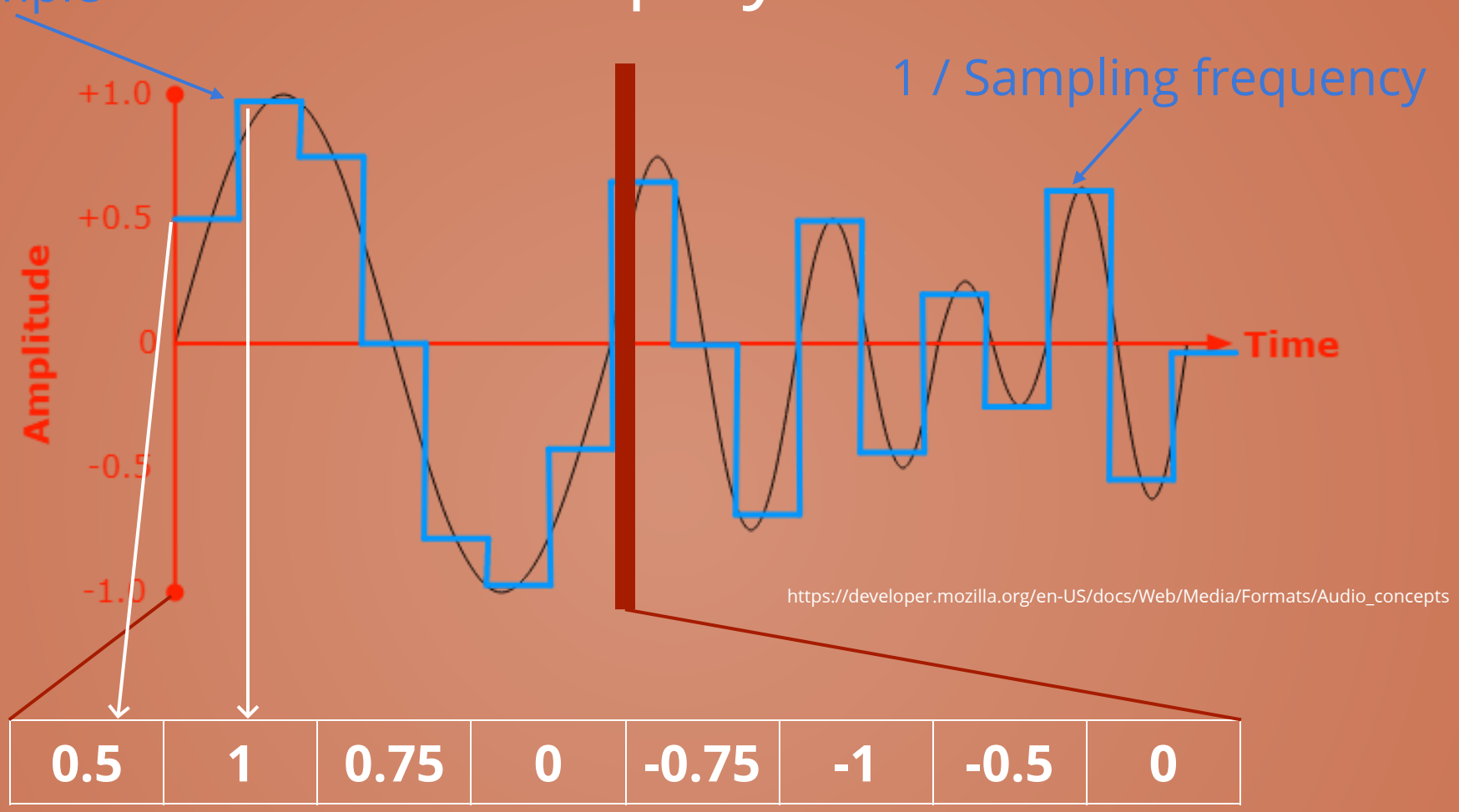

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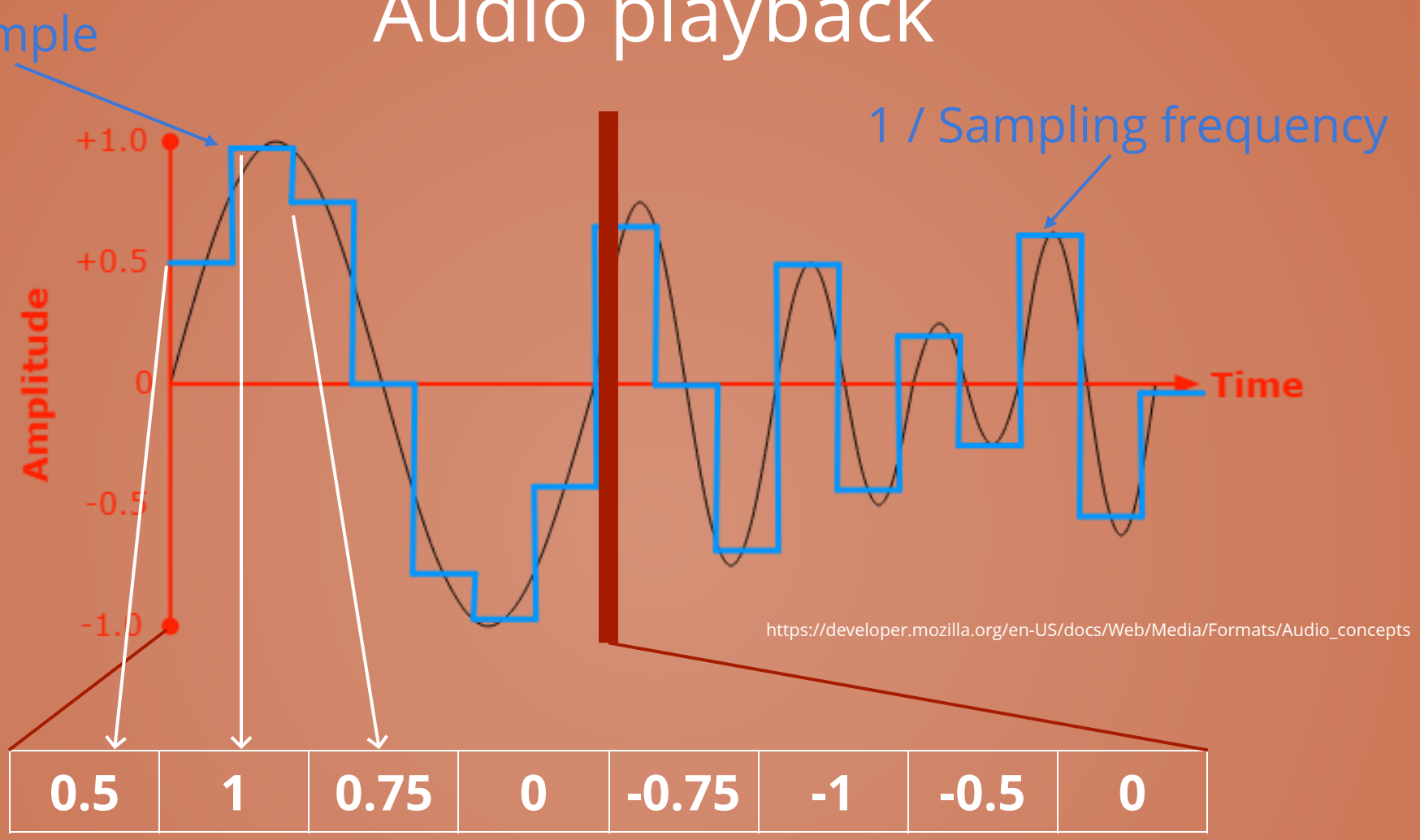

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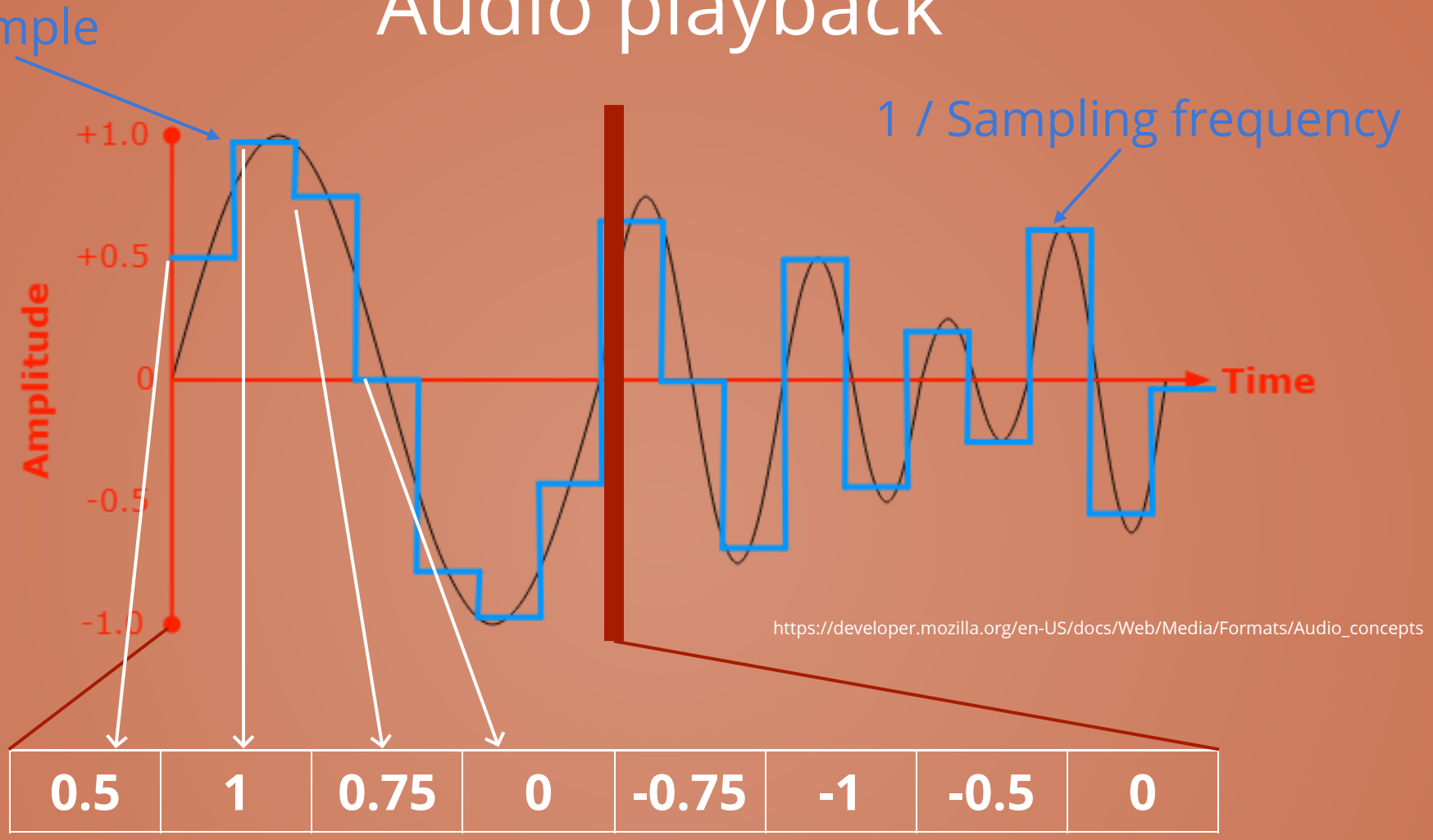

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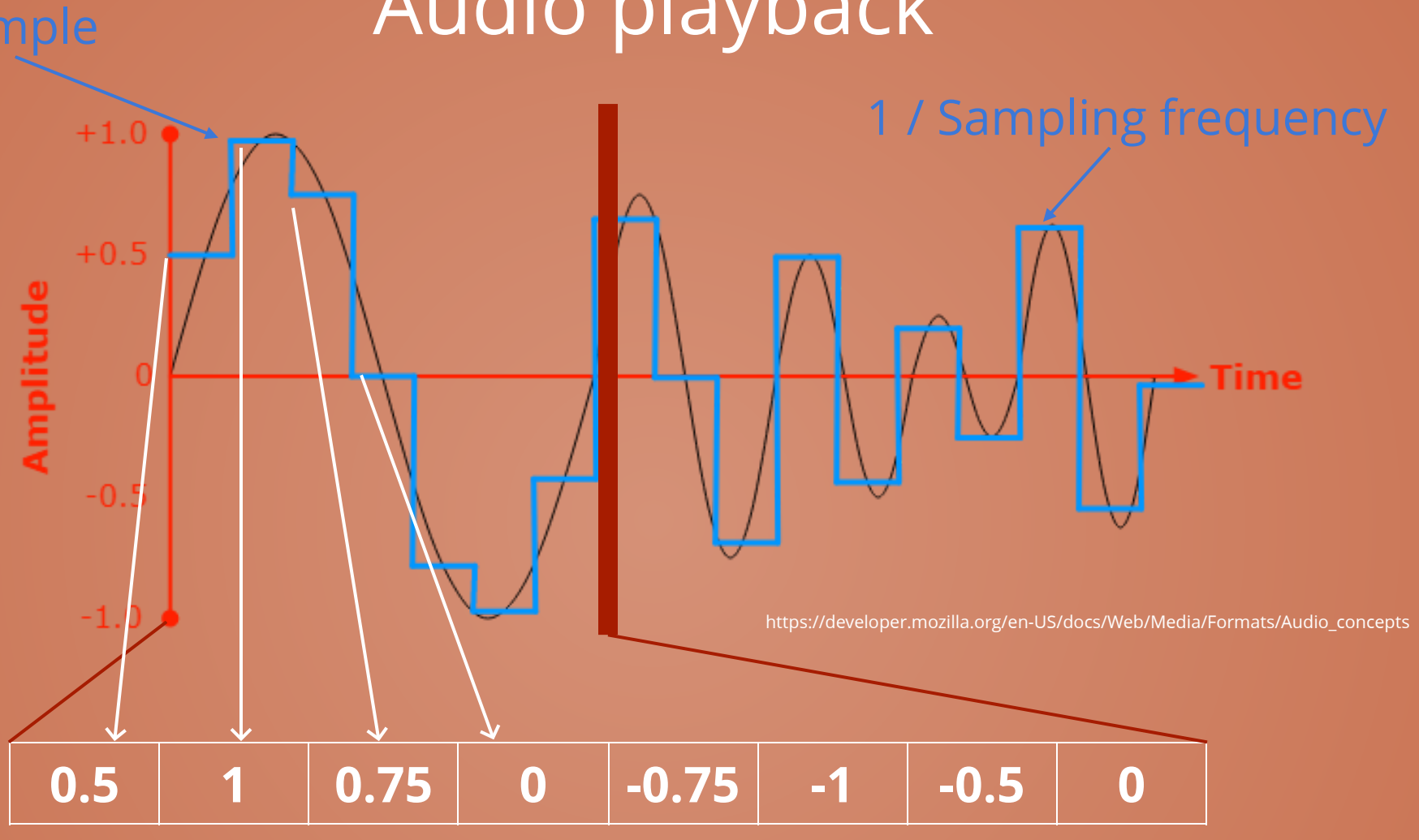
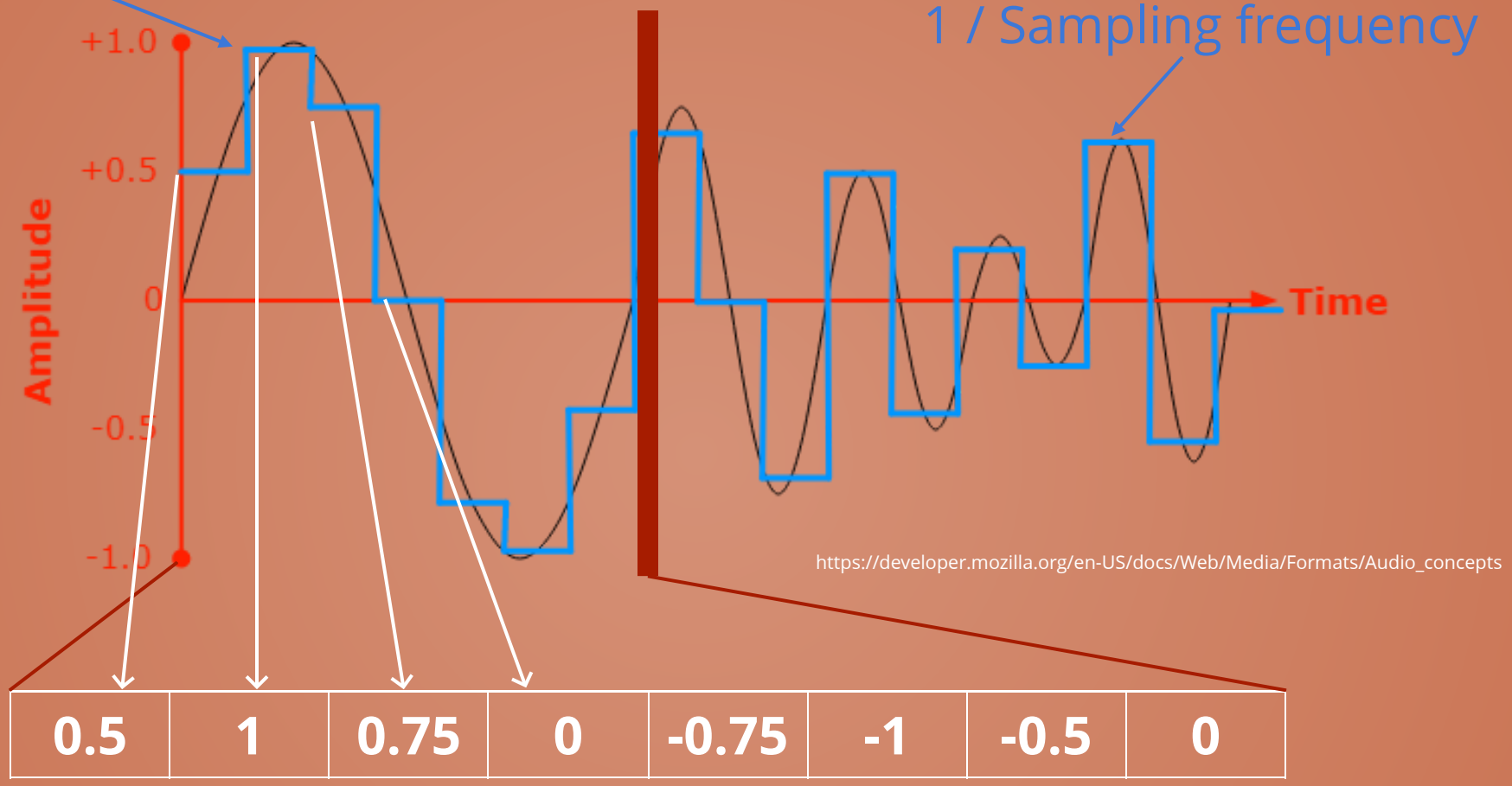


+ Sampling frequency

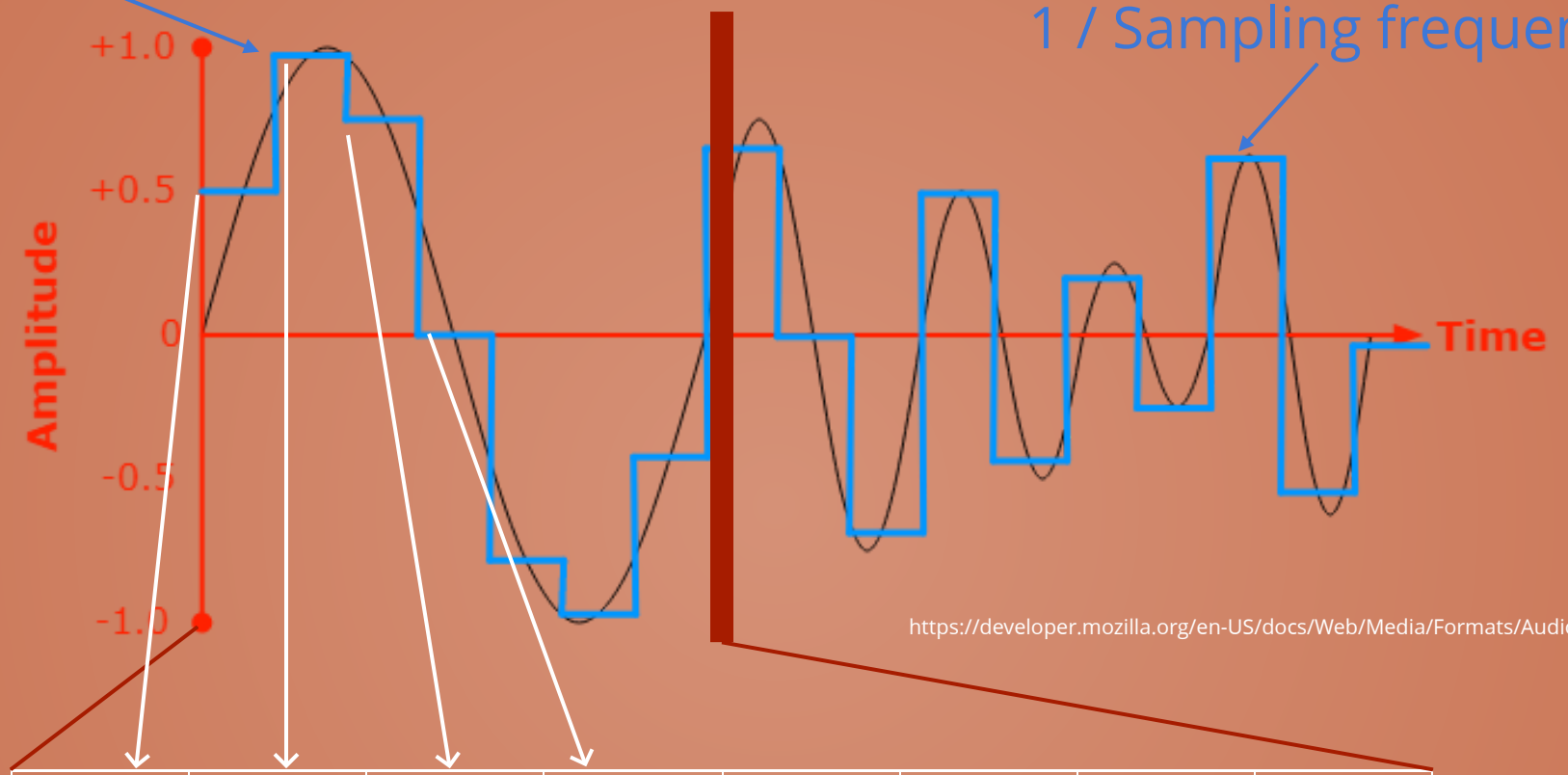
Audio playback



+ Sampling frequency

JS AudioContext

Audio playback



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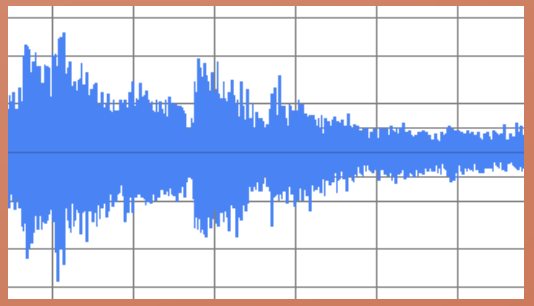
+ Sampling frequency

JS AudioContext



Audio playback

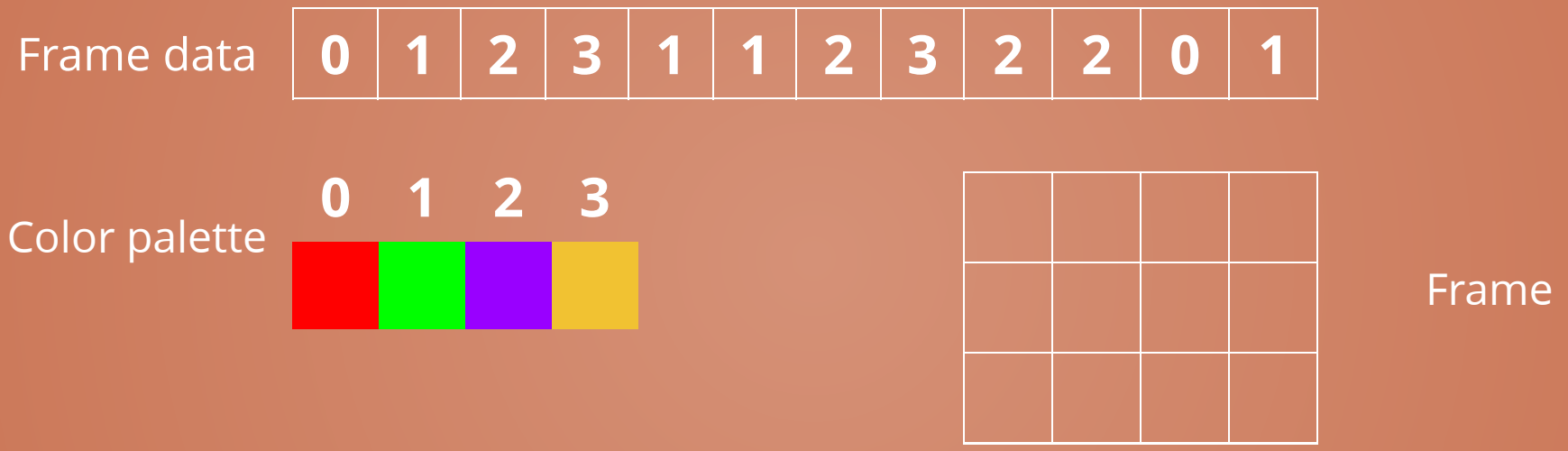

```csharp
var audioData = new object[] {
        SoundBuffer.samples,
        SoundBuffer.sampleRate,
        0,
        Position
};

DoomApplication.WebAssemblyJSRuntime.Invoke<object>(
        "playSound",
        audioData);
```


```javascript
playByteArray(samples, sampleRate) {
    const audioBuffer = this.context.createBuffer(
      1,
      length,
      this.context.sampleRate
    );
    var channelData = audioBuffer.getChannelData(0);
    for (let i = 0; i < length; i += 2) {
      channelData[i] = samples[i] / 0xffff;
    }

    var source = this.context.createBufferSource();
    source.buffer = audioBuffer;
    source.connect(this.context.destination);
    source.start();
  }
```

How a frame is built



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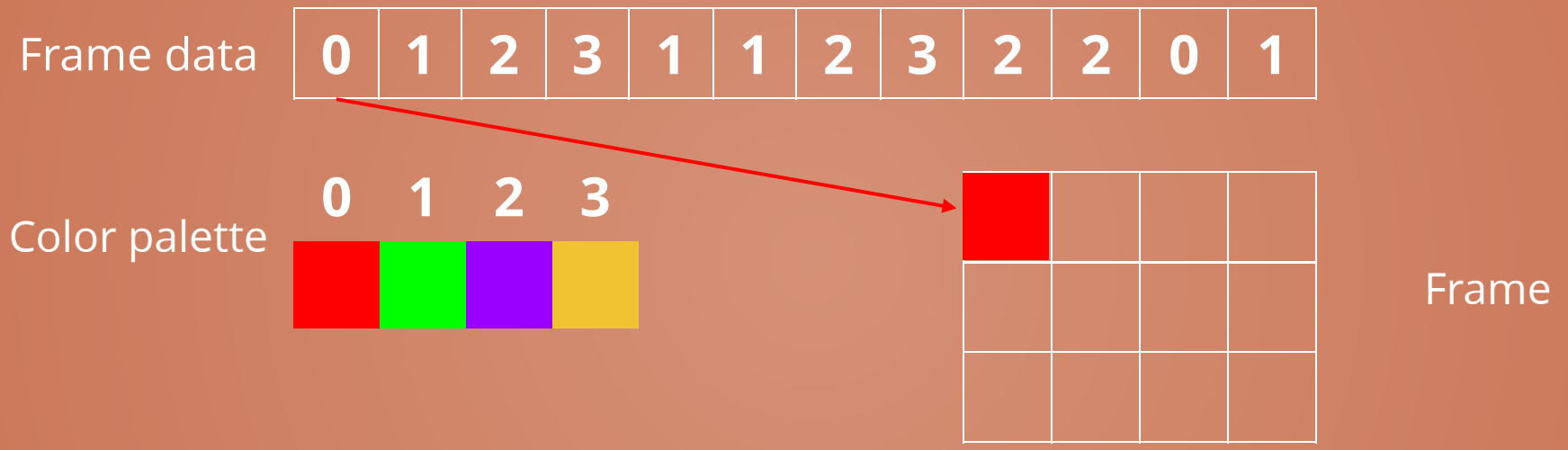

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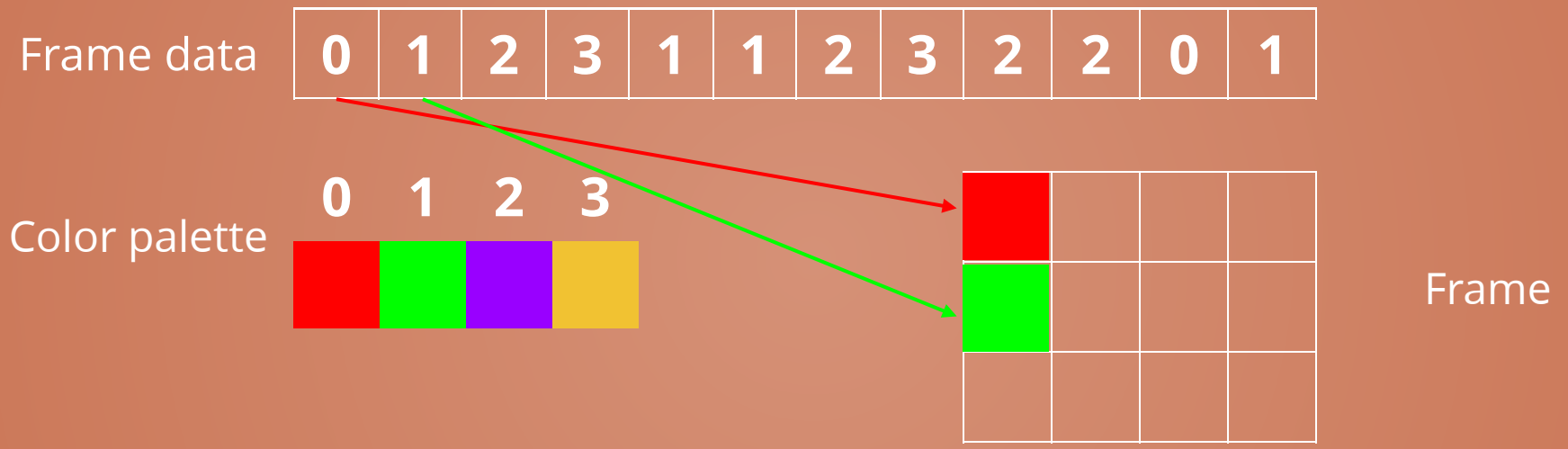

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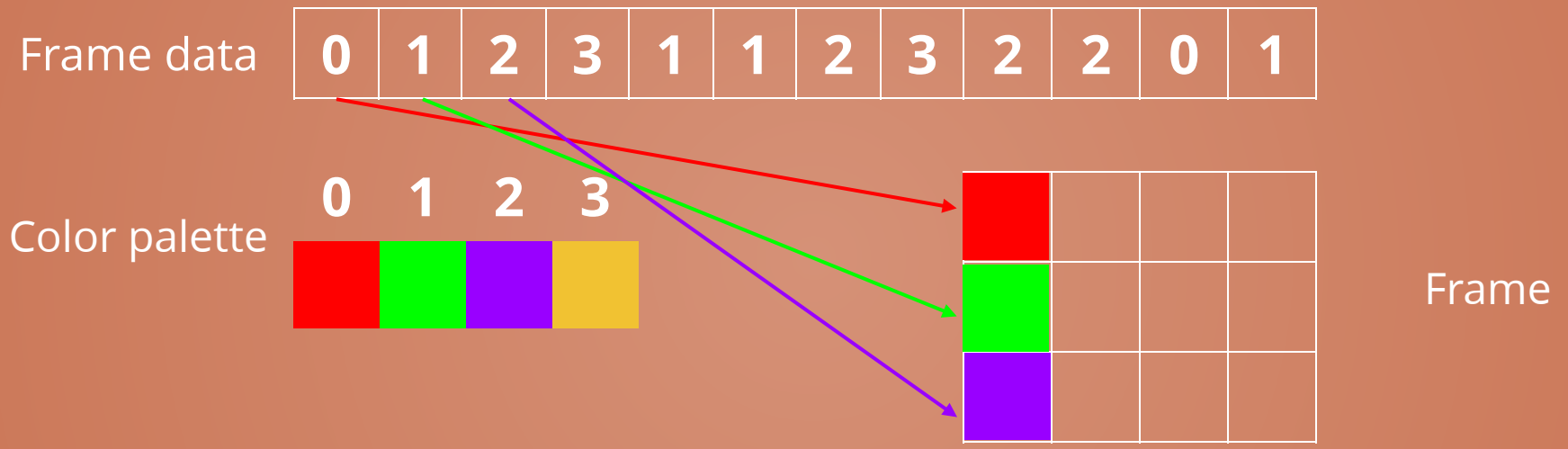

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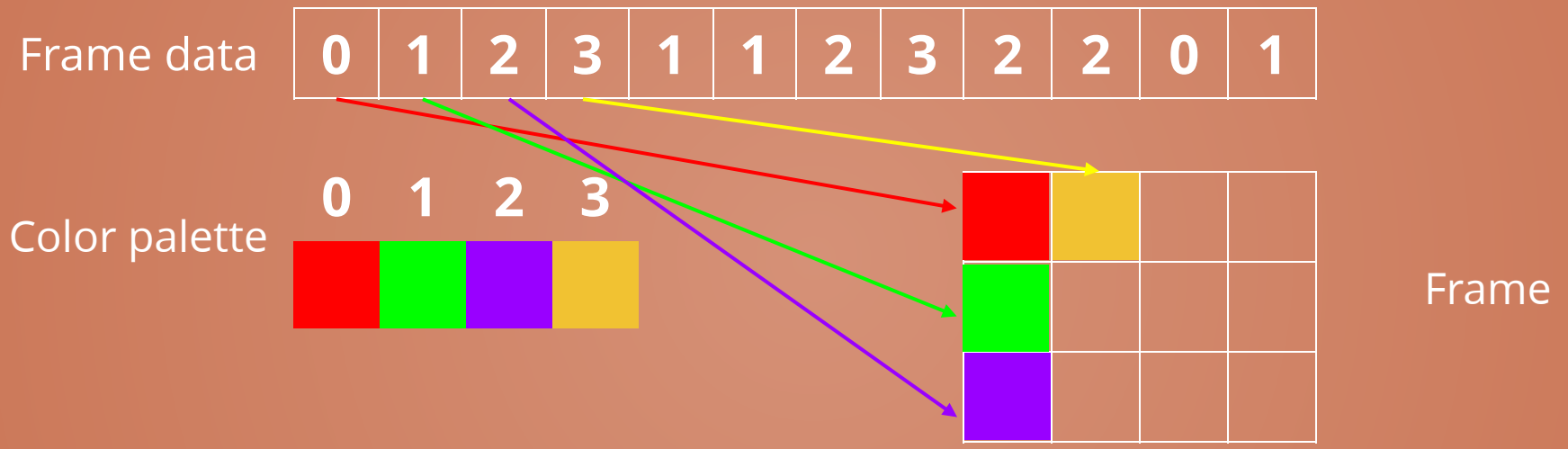

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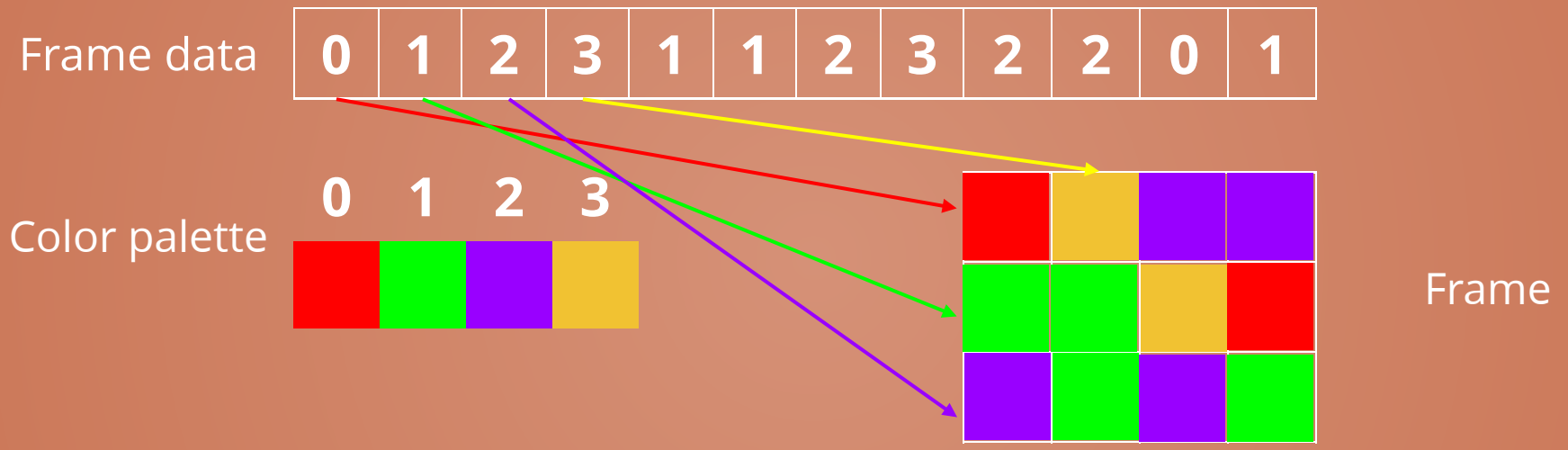

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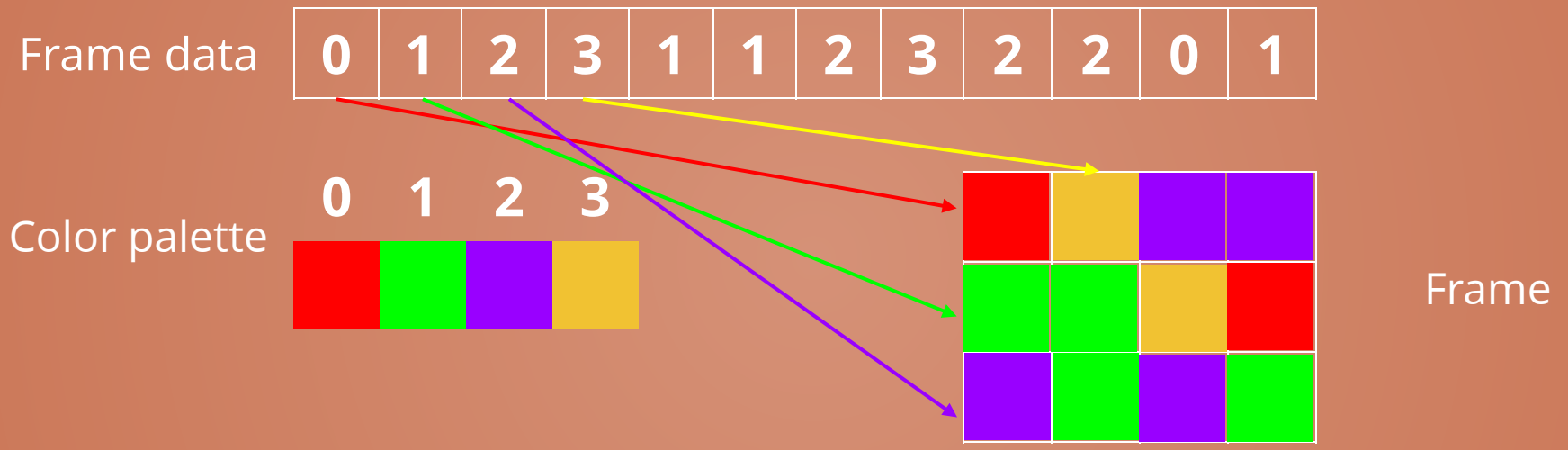
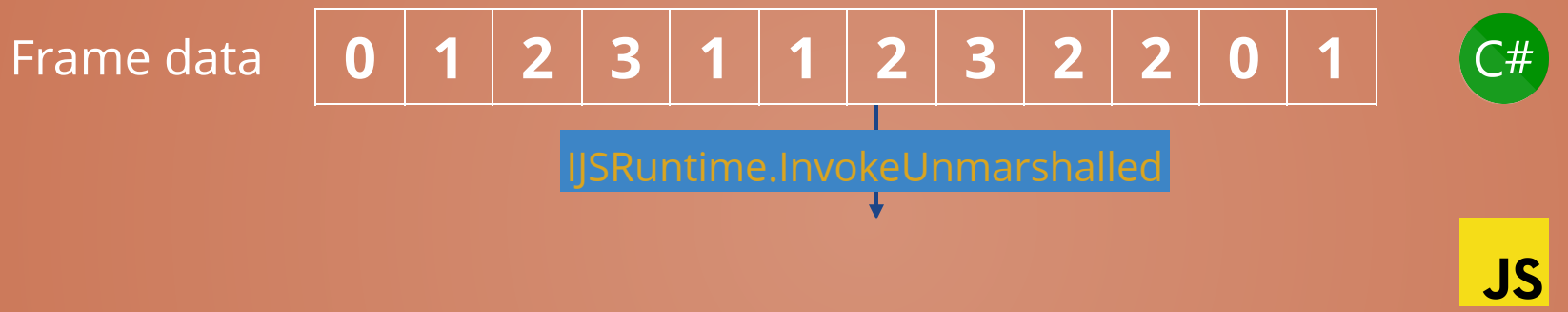
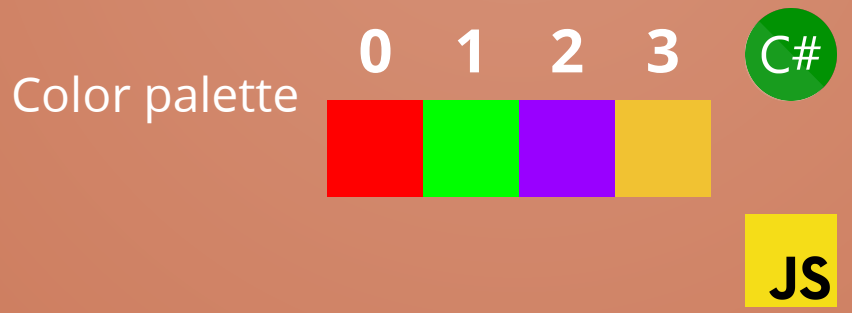


Image built from top to bottom and from left to right

Sending the frame to JS

```
1 var args = new object[] { screen.Data, colors, 320, 200 };
2 DoomApplication.WebAssemblyJSRuntime.InvokeUnmarshalled<byte[], uint[], int>
3         ("renderWithColorsAndScreenDataUnmarshalled", screen.Data, colors);
```





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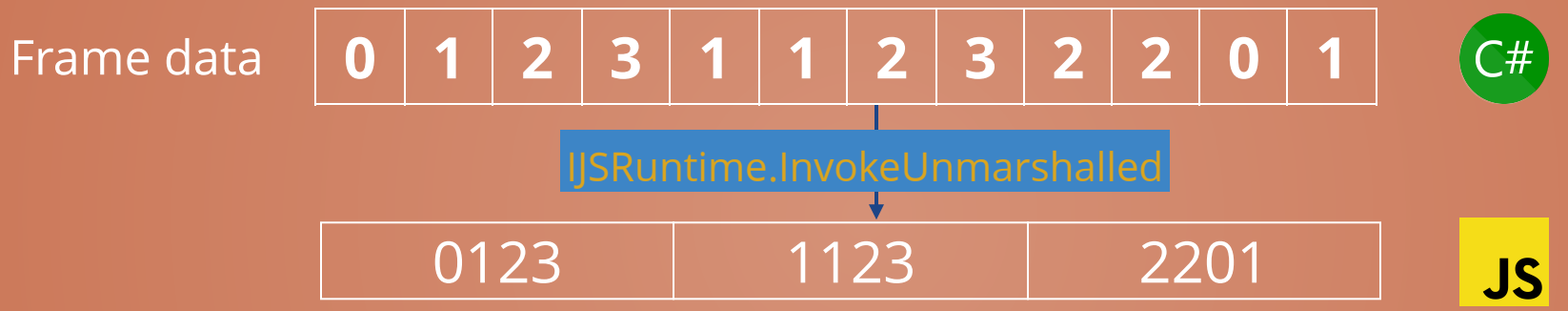

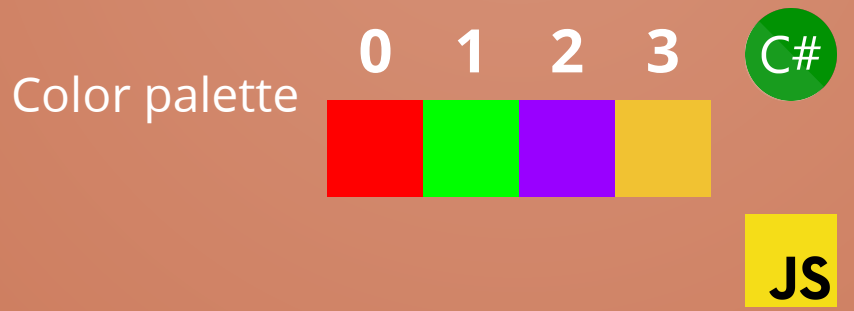

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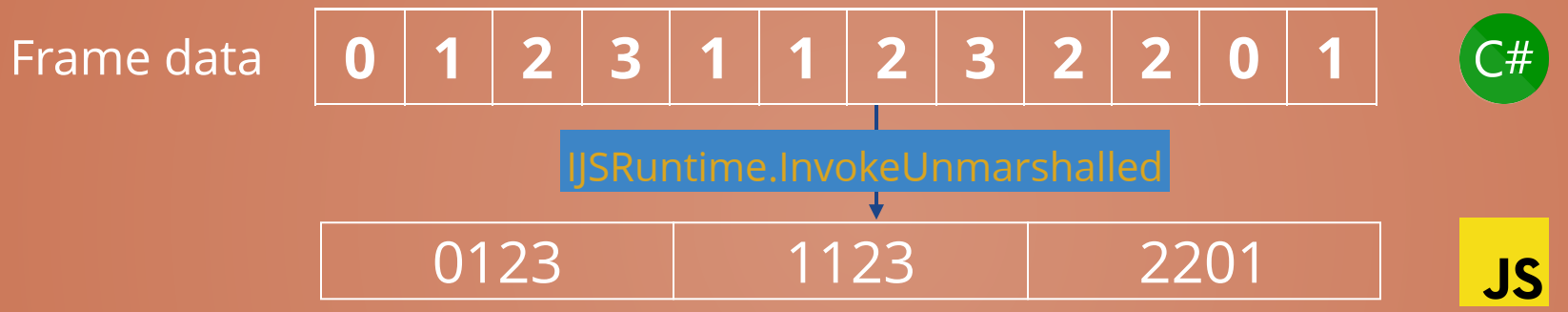

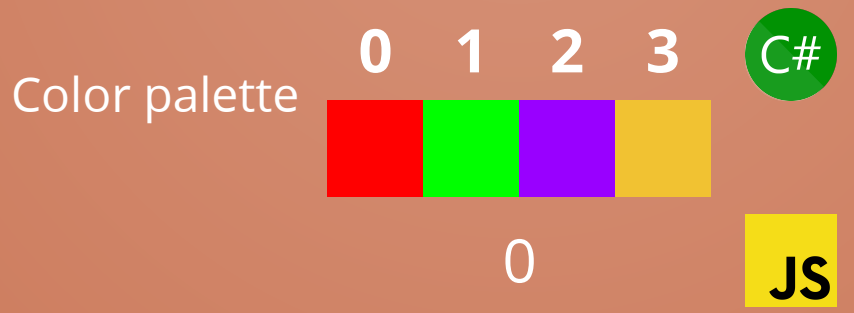

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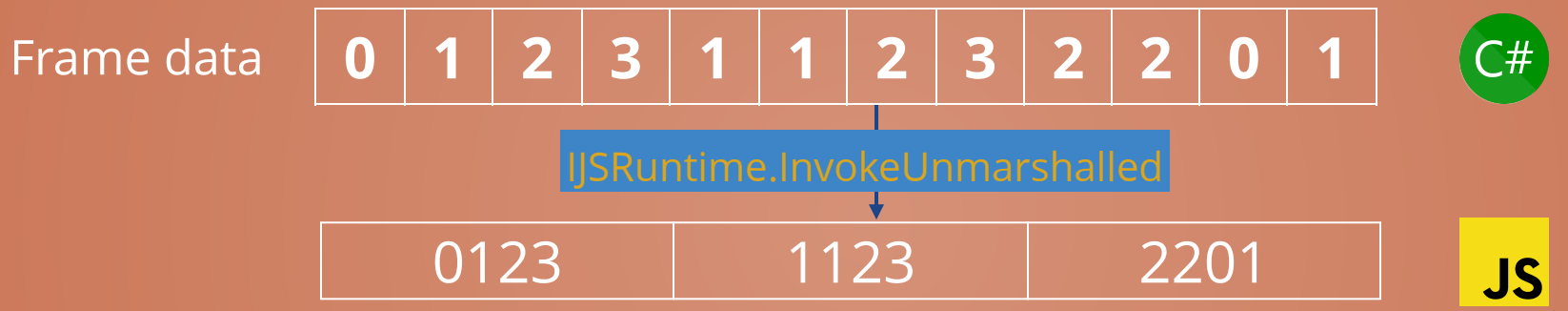

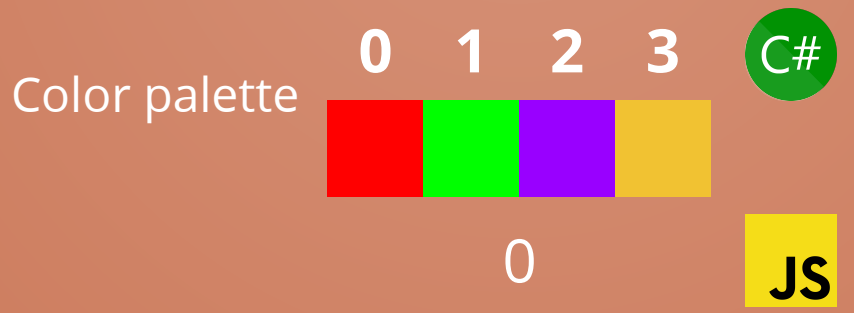

Bit shifting required in JS side !

Frame display

```
window.renderWithColorsAndScreenDataUnmarshalled = (screenData, colors) => {
  const canvas = document.getElementById("canvas");
  var context = canvas.getContext("2d");
  context.imageSmoothingEnabled = false;
  const imageData = context.createImageData(width, height);
  let x = 0;
  let y = 0;
  for (var i = 0; i < (width * height) / 4; i += 1) {
    const screenDataItem = BINDING.mono_array_get(screenData, i);
    let dataIndex;
    for (var mask = 0; mask <= 24; mask += 8) {
      dataIndex = y * (width * 4) + x;
      setSinglePixel(imageData, dataIndex, colors, (screenDataItem >> mask) & 0xff);
      if (y >= height - 1) { y = 0; x += 4; } else { y += 1; }
      dataIndex = y * (width * 4) + x;
    }
  }
  context.putImageData(imageData, 0, 0);
};
```

```
function setSinglePixel(imageData, dataIndex, colors, colorIndex) {
  const color = BINDING.mono_array_get(colors, colorIndex);
  imageData.data[dataIndex] = color & 0xff;
  imageData.data[dataIndex + 1] = (color >> 8) & 0xff;
  imageData.data[dataIndex + 2] = (color >> 16) & 0xff;
  imageData.data[dataIndex + 3] = 255;
}
```

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- Implement necessary methods little by little
  - Priority to image rendering
- Begin with quick and non-optimized code (static, raw values)
- Read Doom-Wiki and SFML documentation *only when necessary*
  - Used to understand image buffer structure

Fast Porting methodology

- Remove SFML and make the app compile
  - Replace with empty methods and put "TODO: implement"
- Implement necessary methods little by little
  - Priority to image rendering
- Begin with quick and non-optimized code (static, raw values)
- Read Doom-Wiki and SFML documentation *only when necessary*
  - Used to understand image buffer structure
- Side project duration: 2 weeks

Porting steps

Porting steps

- Remove SFML and unavailable methods
- Get at least image display
- Optimize image
- Keyboard input
- Sound effects
- Mouse input
- Game music
- More optimizations
- Try other WADs
- ...

Porting steps

Done

- Remove SFML and unavailable methods
- Get at least image display
- Optimize image
- Keyboard input
- Sound effects
- Mouse input
- Game music
- More optimizations
- Try other WADs
- ...

Tips and lessons learned

- Blazor
  - Avoid Array.Copy on Big arrays (in .Net 5)
  - InvokeUnmarshalled is very fast
    - But has problems with certain data types
    - Rely on undocumented APIs (`MONO` and `BINDING`) that have been removed in .Net 7 in favor of JS Interop
  - Extensive logging from Blazor slooooows the app
- JS
  - window.requestAnimationFrame allows to pace the frames
  - Browsers require interaction with the page to play audio

DEMO

JS Interop in .net > 7

- Less intricate way to run .Net from JS (no components)
- More adapted to this case than Blazor

Call JS from .Net

```js
// JS code
export function setLocalStorage(todosJson) {
  window.localStorage.setItem('dotnet-wasm-todomvc', todosJson);
}
```

```cs
// C# code
static partial class Interop
{
    [JSImport("setLocalStorage", "todoMVC/store.js")]
    internal static partial void _setLocalStorage(string json);
}
```

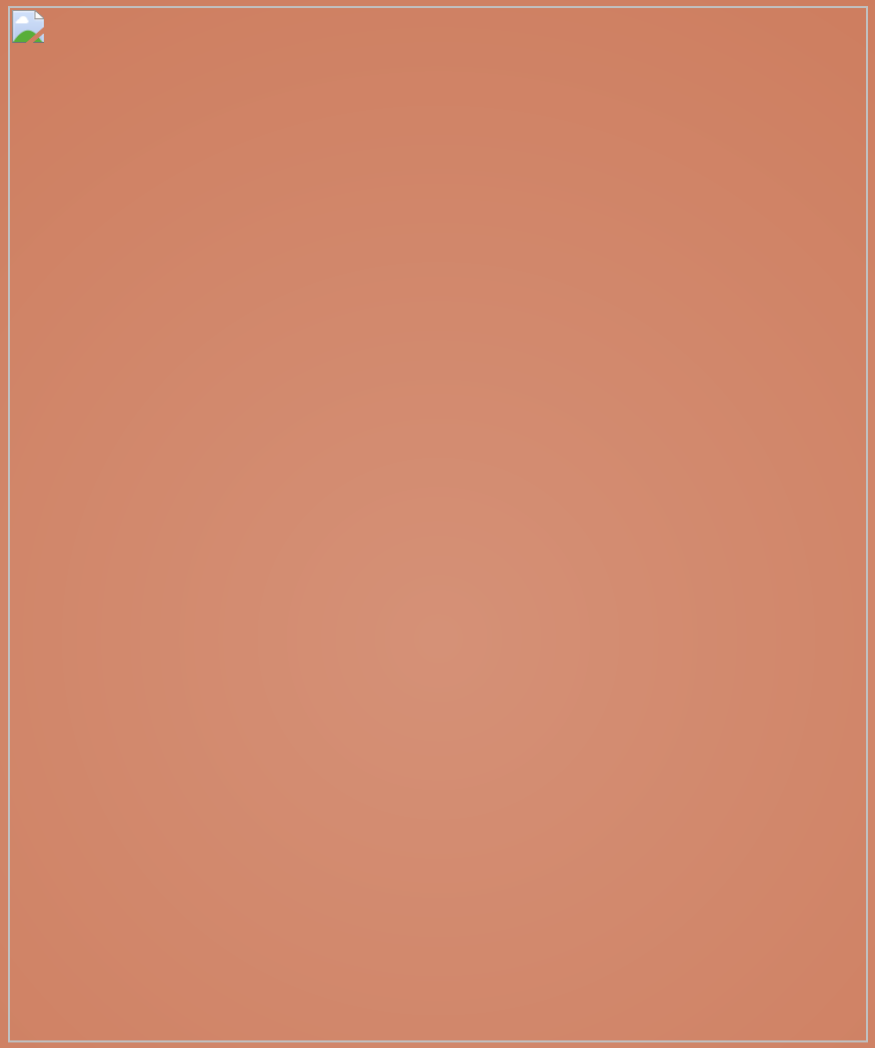
Call .Net from JS

```cs
// C# code
public partial class MainJS
{
    [JSExport]
    public static void OnHashchange(string url)
    {
        controller?.SetView(url);
    }
}
```

```js
// JS code
const exports = await getAssemblyExports(getConfig().mainAssemblyName);
exports.TodoMVC.MainJS.OnHashchange(document.location.hash);
```

Next steps

- Short term:
  - Migrate to JS Interop
  - Update to ManagedDoom V2
- Middle term:
  - Mouse input
  - Game music
  - Test WADs othen than DOOM1
- Long term / wish:
  - Make this port an official part of ManagedDoom



Thanks !

Links

- https://mspoweruser.com/this-doom-digital-camera-source-port-is-amazing-and-bizarre/
- https://www.link-cable.com/top-10-weird-doom-ports/
- pixabay.com