# Design Audio Experiences on the Web - I

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# Introduction / Context

# Web Technologies - *an history*

## *Internet*

Set of protocols dedicated to transfert data (TCP, IP, …)
and interconnect computers and networks

**1972** - First demonstration of *ARPANET*
*sent a message between UCLA and Stanford*

**1983** - *ARPANET* is officially renamed *Internet*

## *World Wide Web*

System dedicated to the sharing of hypertext informations
built on top of Internet

**1989-1992** - Development at the CERN by T. Berners Lee
et *Robert Caillau (software and protocoles)*

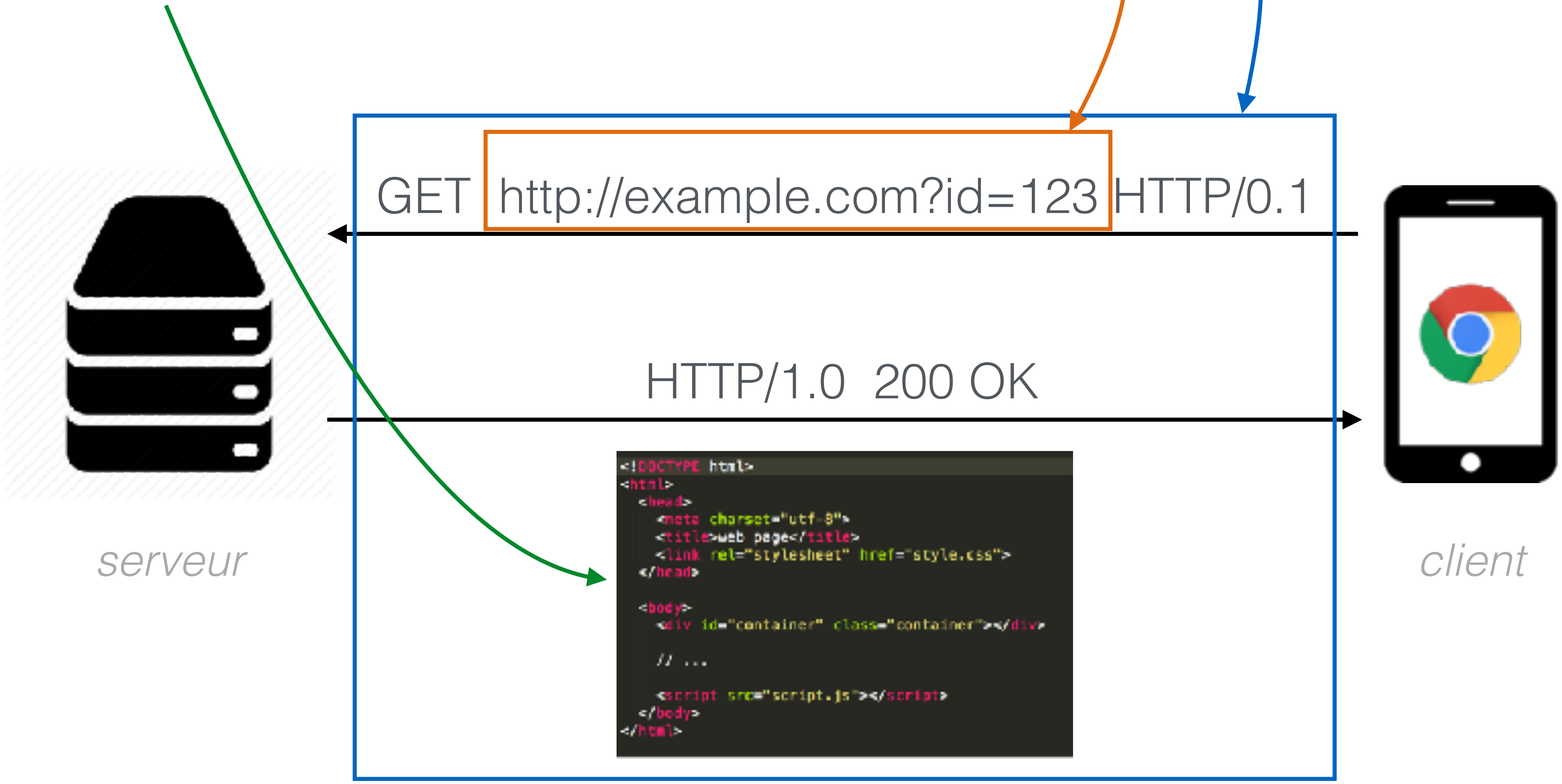
**1993** - the CERN opens the technologies to the public

# Web Technologies - *protocols*

**HTTP** *HyperText Transfert Protocol*

**URL** *Uniform Resource Locator*

**HTML** *HyperText Markup Language*



GET http://example.com?id=123 HTTP/0.1

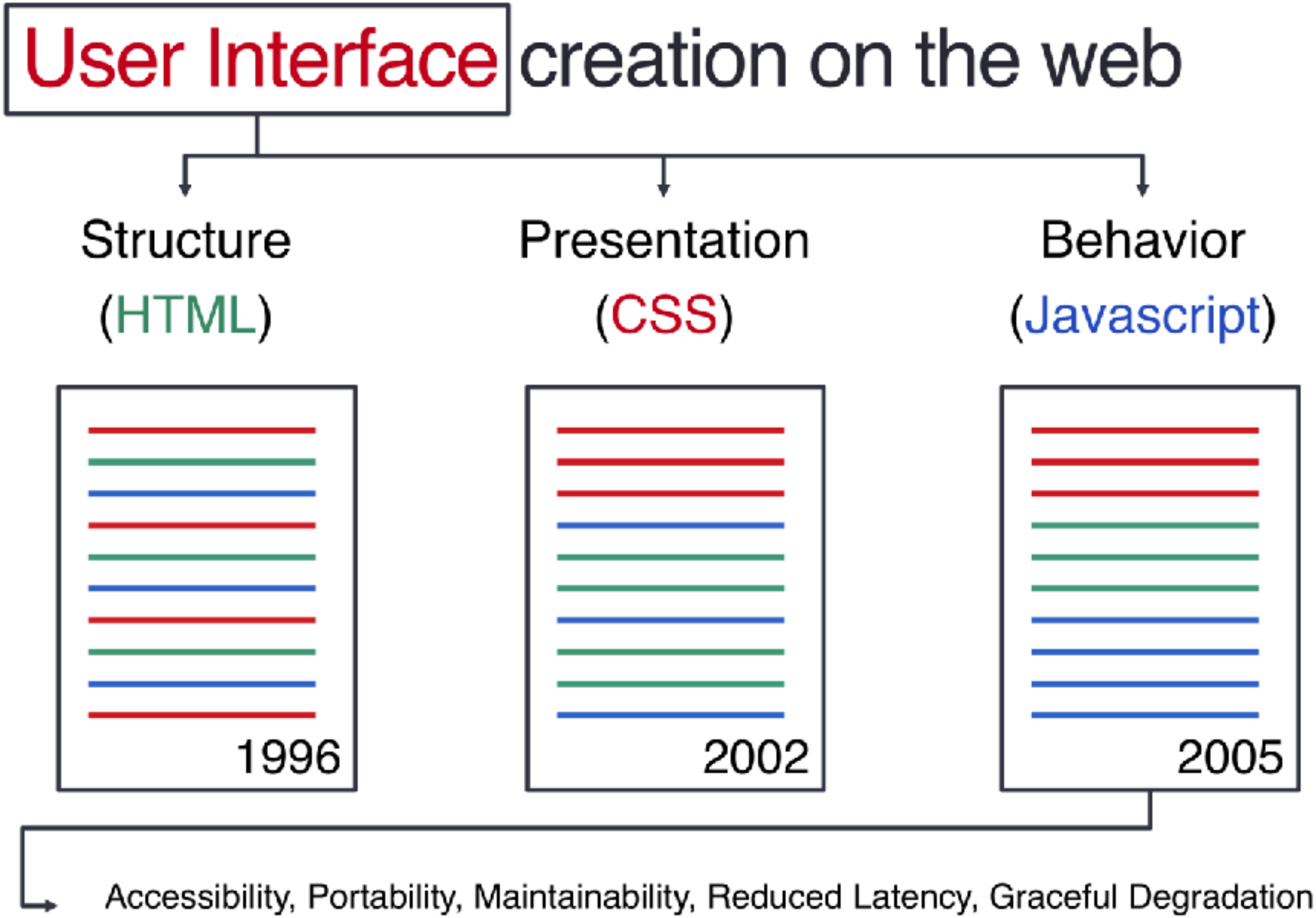
HTTP/1.0 200 OK

```
<!DOCTYPE html>
<html>
  <head>
    <meta charset="utf-8">
    <title>web page</title>
    <link rel="stylesheet" href="style.css">
  </head>

  <body>
    <div id="container" class="container"></div>

    // ...

    <script src="script.js"></script>
  </body>
</html>
```

*serveur*

*client*

# Web Technologies - *languages*



User Interface creation on the web

Structure (HTML)

Presentation (CSS)

Behavior (Javascript)

1996

2002

2005

Accessibility, Portability, Maintainability, Reduced Latency, Graceful Degradation

# The Web as a Creative Platform

## ubiquity

almost every device implements web standards

## interactive multimedia

HTML5/CSS, Web GL, Canvas, Web Audio API, DeviceMotion/Orientation, Geolocation

## networking

HTTP, WebSockets, WebRTC

## rapid prototyping & interoperability

very rapid development / deployment cycles

Wyse L. and Subramanian S., *The Viability of the Web Browser as a Computer Music Platform,* Computer Music Journal, 2014 pp. 10–23

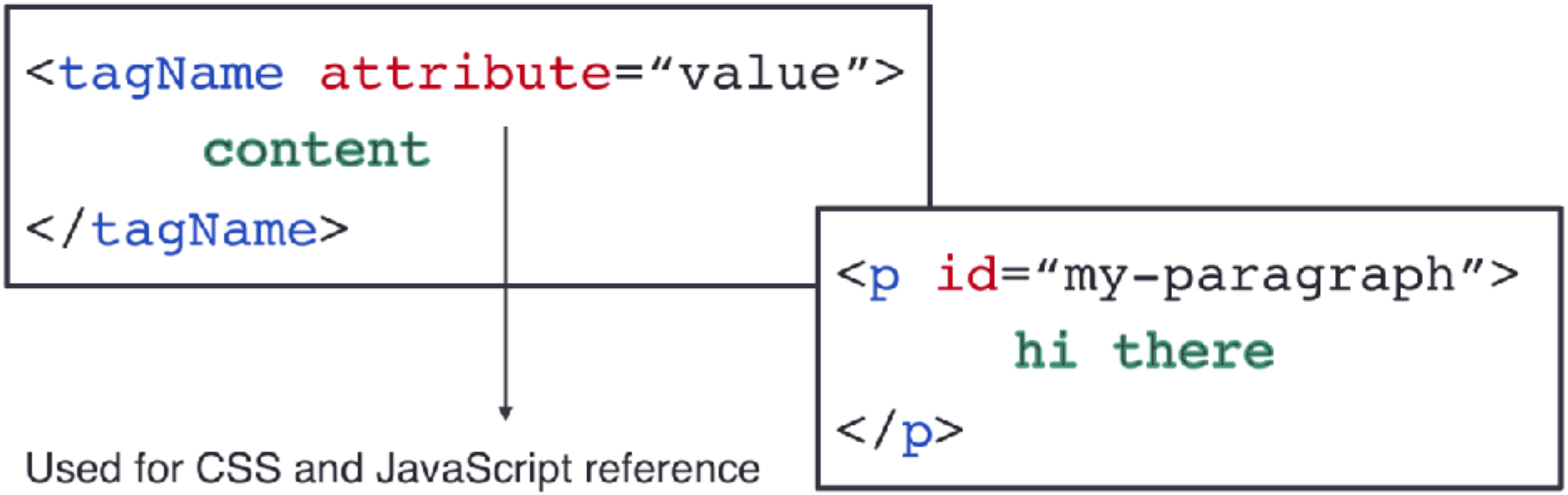
# The HTML / CSS / javascript Trinity

Slides by David Poirier-Quinot

# HTML (Hypertext Markup Language)

Define content and structure. Not a programming language but a formatting language.

## Anatomy of an HTML tag



```
<tagName attribute=“value”>
      content
</tagName>
```

```
<p id=“my-paragraph”>
      hi there
</p>
```

Used for CSS and JavaScript reference

# HTML tags examples

- <h1> headline </h1>

- <p> paragraph </p>

- <!-- unordered list -->

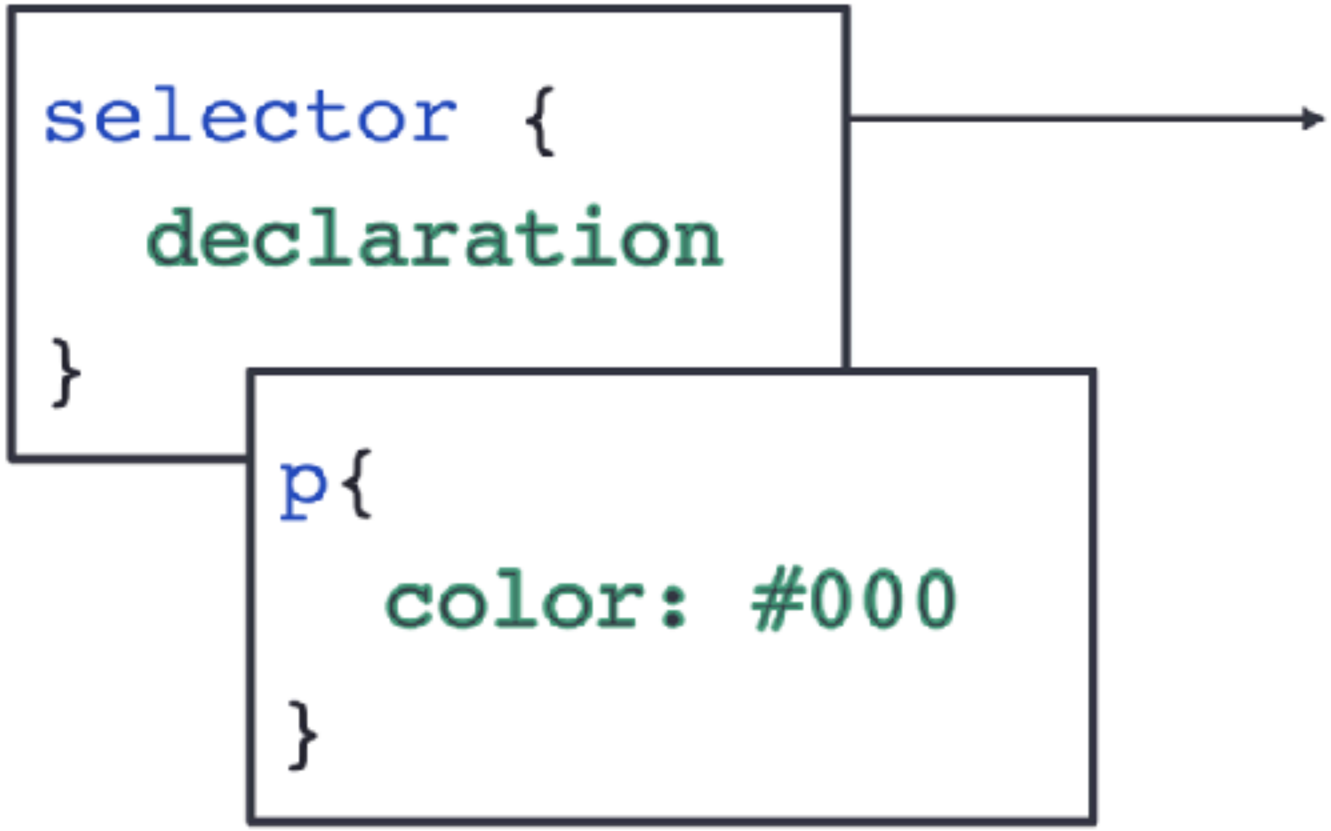
  ```
  <ul>
        <li> list item </li>
  </ul>
  ```

- <a href=“url”> link </a>

# CSS (Cascading Style Sheet)

Define presentation and formatting rules of an HTML or XML document.

## Anatomy of a CSS chunk



```
selector {
  declaration
}
```

```
p{
  color: #000
}
```

- A selector can be:
  - An element (p, h)
  - A class (.class)
  - An id (#)

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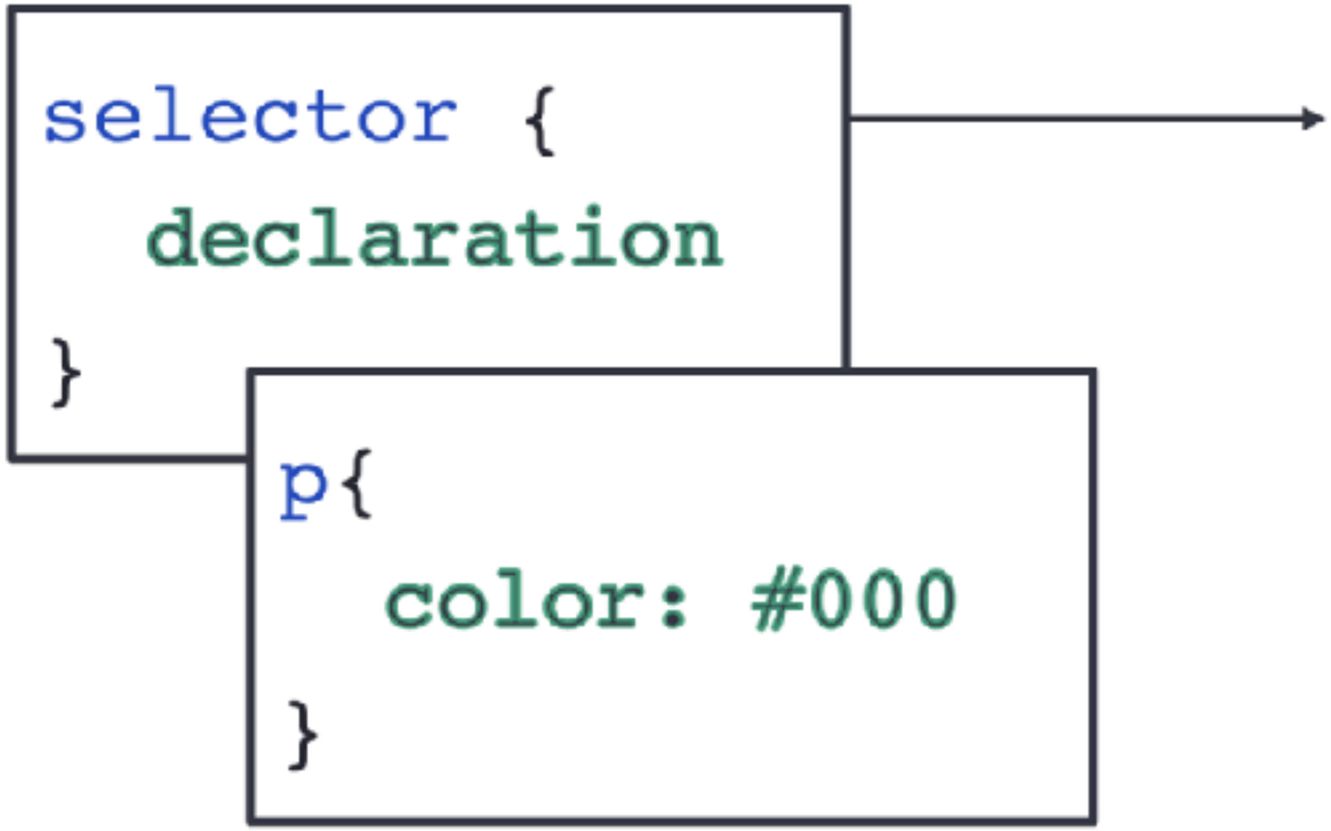

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# Javascript

Programming language. Controls page behavior. Makes the web interactive.

- check text value in form
- drag and drop
- dropdown menu
- etc.

*not related to Java*

# javascript

variables

```
const a = true;
let b = 0;
```

operators

```
let b = 2 * (3 + 1);
```

strings

```
const title = `hello world`;
```

functions

```
function double(x) { return x * 2; }
const double = (x) => x * 2;
```

arrays

```
const list = [1, 2, 3, 4];
```

objects

```
const dog = {
  name: `doog`,
  age: 4,
  bark: () => console.log(`wouaf`),
};
```

# javascript

conditionals

```
if (myVar === true) {
   doThis();
} else {
   doThat();
}
```

loops

```
for (let i = 0; i < 10; i++) {
   doSomethingWith(i);
}
```

# javascript

```
&& logical AND

  1 && 1 = 1
  1 && 0 = 0
  0 && 1 = 0
  0 && 0 = 0

 || logical OR

  1 || 1 = 1
  1 || 0 = 1
  0 || 1 = 1
  0 || 0 = 0
```

# …some useful resources

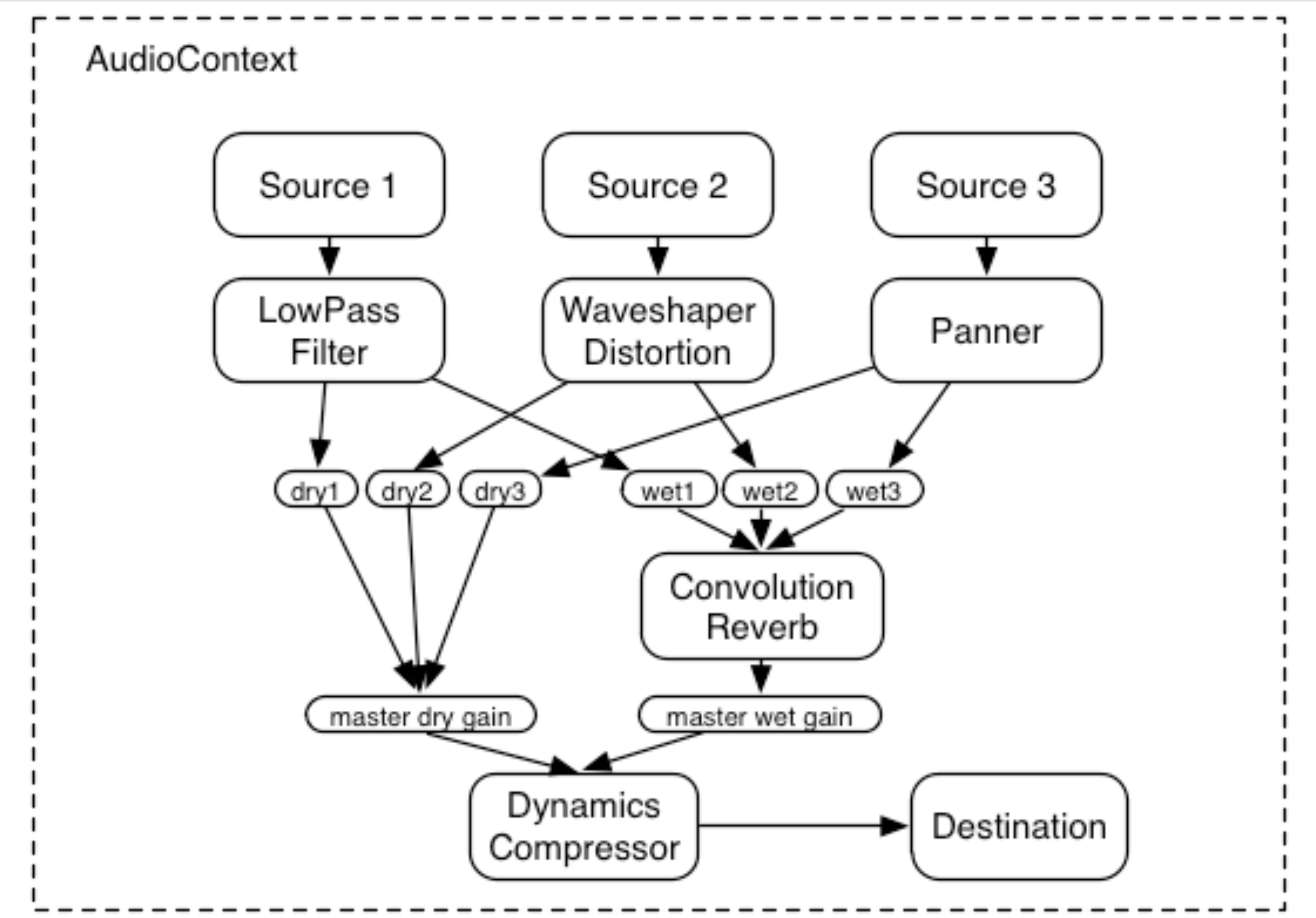
https://developer.mozilla.org/fr/

http://javascript.info/

https://babeljs.io/learn-es2015/

# Audio on the Web

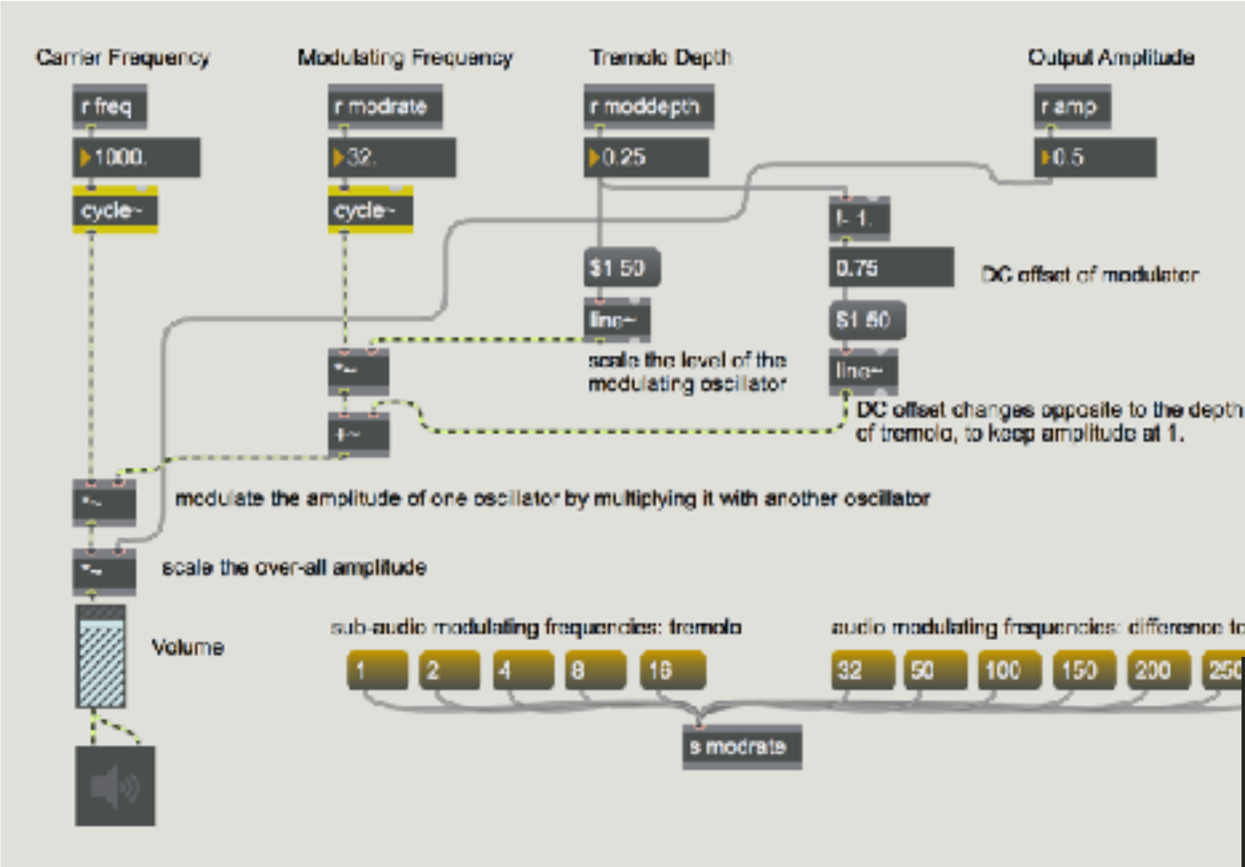
# WebAudio API



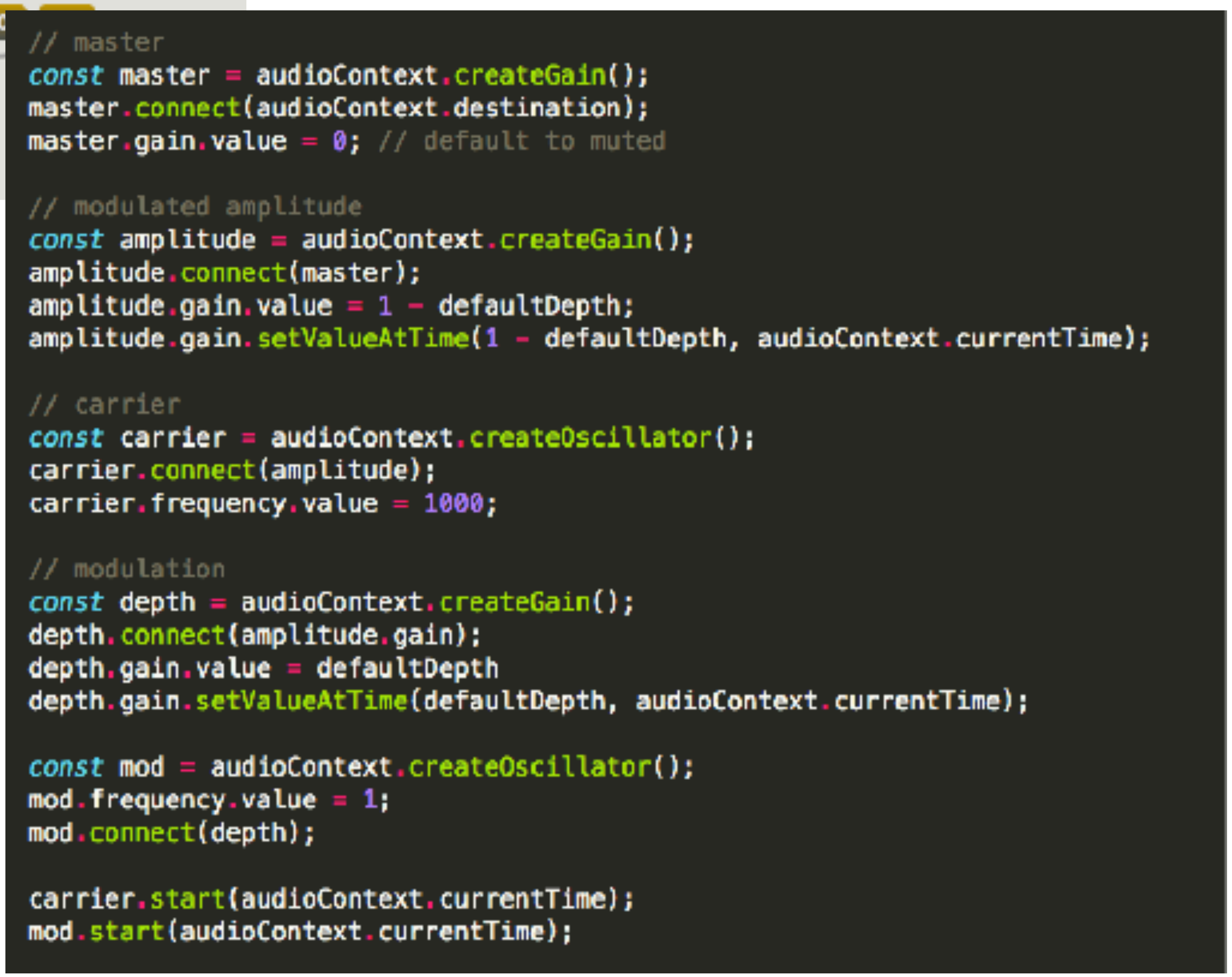
**specification**

https://webaudio.github.io/web-audio-api/

# WebAudio API



Carrier Frequency
Modulating Frequency
Tremolo Depth
Output Amplitude
r freq
r modrate
r moddepth
r amp
1000.
32.
0.25
0.5
loadbang
; amp 0.5; moddepth 0.25; modrate 1.; freq 1000.
initialize values
cycle~
cycle~
!- 1.
$1 50
0.75
DC offset of modulator
line~
$1 50
scale the level of the modulating oscillator
*~
line~
+~
DC offset changes opposite to the depth of tremolo, to keep amplitude at 1.
*~
modulate the amplitude of one oscillator by multiplying it with another oscillator
*~
scale the over-all amplitude
Volume
sub-audio modulating frequencies: tremolo
1
2
4
8
16
audio modulating frequencies: difference tones
32
50
100
150
200
250
s modrate



```
// master
const master = audioContext.createGain();
master.connect(audioContext.destination);
master.gain.value = 0; // default to muted

// modulated amplitude
const amplitude = audioContext.createGain();
amplitude.connect(master);
amplitude.gain.value = 1 - defaultDepth;
amplitude.gain.setValueAtTime(1 - defaultDepth, audioContext.currentTime);

// carrier
const carrier = audioContext.createOscillator();
carrier.connect(amplitude);
carrier.frequency.value = 1000;

// modulation
const depth = audioContext.createGain();
depth.connect(amplitude.gain);
depth.gain.value = defaultDepth
depth.gain.setValueAtTime(defaultDepth, audioContext.currentTime);

const mod = audioContext.createOscillator();
mod.frequency.value = 1;
mod.connect(depth);

carrier.start(audioContext.currentTime);
mod.start(audioContext.currentTime);
```

# Setting Up a Development Environment

# Development Environment

## Browsers

*prefer* Chrome or Firefox

## Text Editor

Sublime, VS Studio, …

## Tools

NodeJS (https://nodejs.org/en/ prefer LTS), npm

# Les Classes

Une classe décrit les composantes communes d'un ensemble d'objets, à travers :

- Des **propriétés** → l'état d'un objet
- Des **méthodes** → le comportement d'un objet

Exemple de classe qui décrit un point dans un espace en 2D:

```
class Point(object):
    def __init__(self, x, y):
        self.x = x
        self.y = y

    def translate(self, tx, ty):
        self.x += tx
        self.y += ty

    def is_origin(self):
        return (self.x == 0) and (self.y == 0)
```

Constructeur : méthode appelée à la creation de l'objet

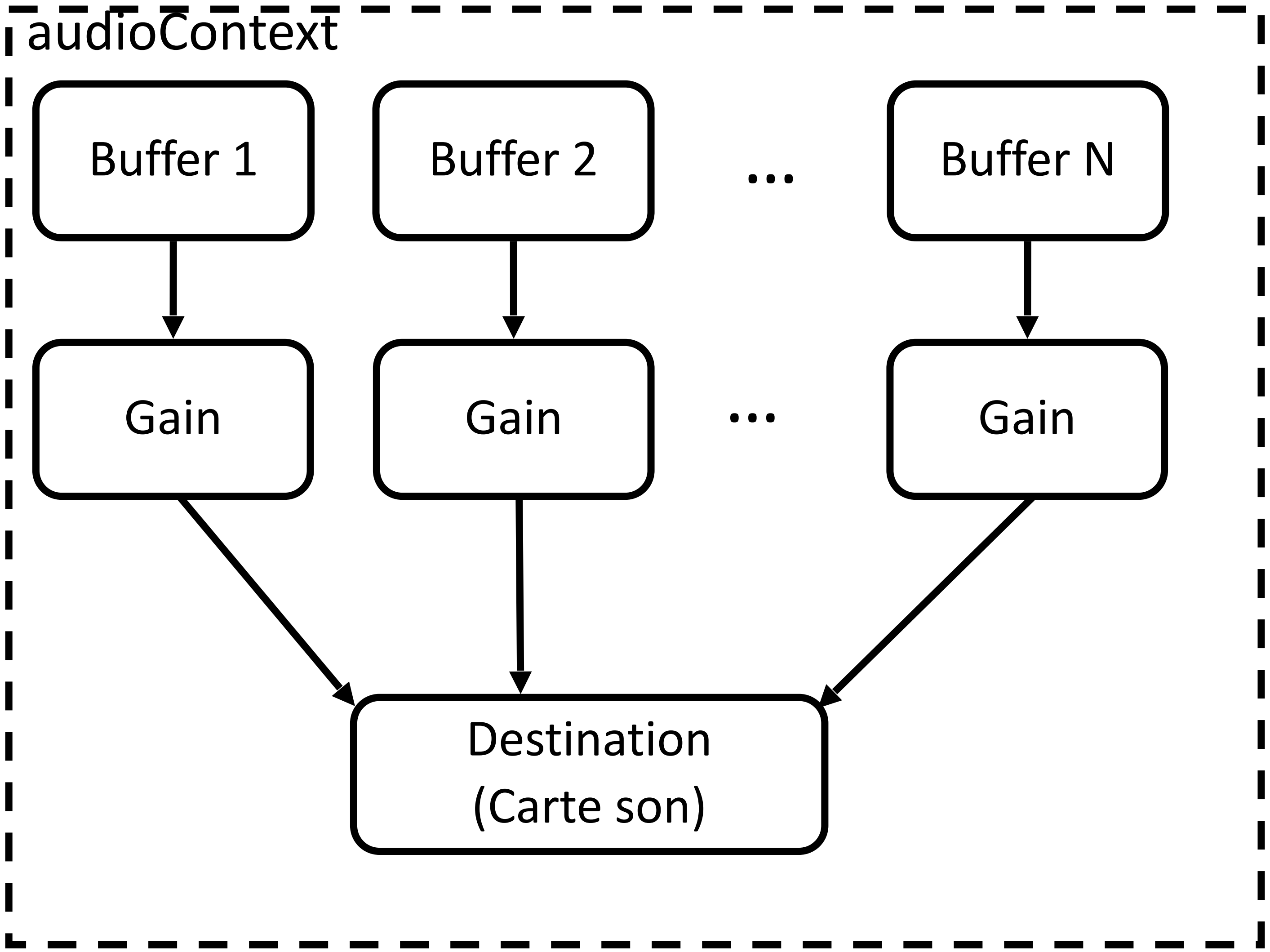
2 propriétés : coordonnées en x et y

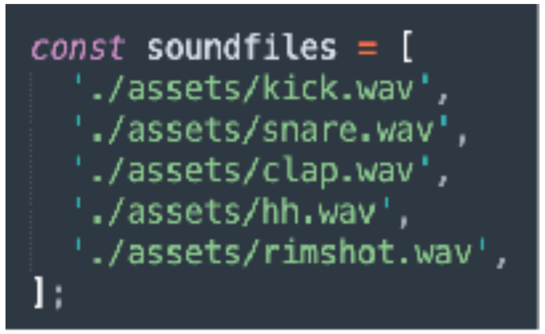
Méthode qui translate le point

Méthode qui vérifie si le point est l'origine du repère

Autres exemples : https://web.mit.edu/music21/doc/moduleReference/moduleNote.html
https://developer.mozilla.org/en-US/docs/Web/API/AudioBuffer

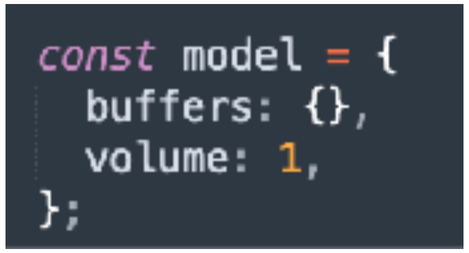
# Playing audio buffers





```
const soundfiles = [
  './assets/kick.wav',
  './assets/snare.wav',
  './assets/clap.wav',
  './assets/hh.wav',
  './assets/rimshot.wav',
];
```

Liste des chemins vers les fichiers sons



```
const model = {
  buffers: {},
  volume: 1,
};
```

Objet 'model' avec 2 propriétés :

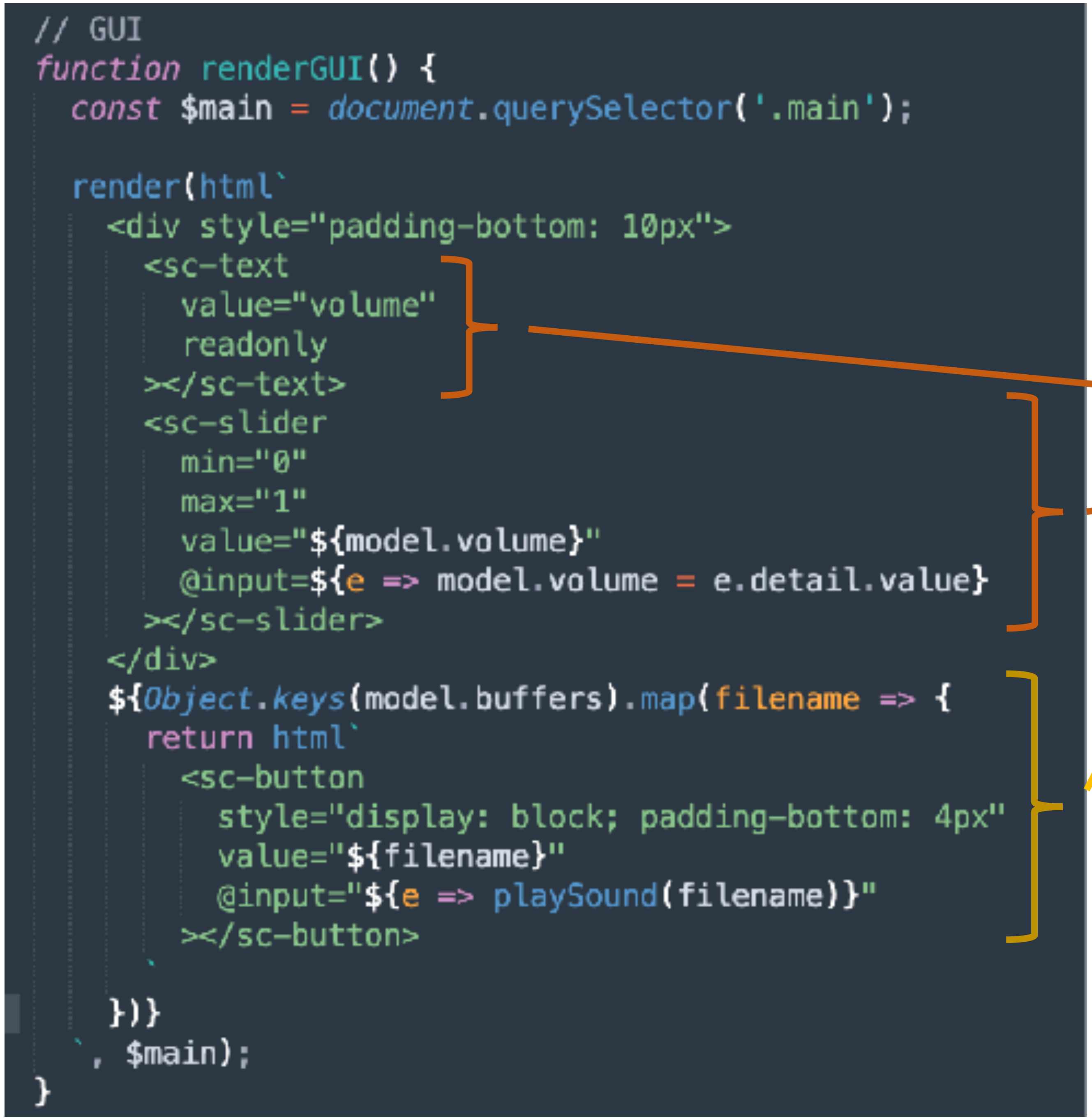
- buffers : objet qui va contenir les buffers
- volume : float du volume général

Ces variables sont déclarées **globalement**.

1. Charger les fichiers sons dans des buffers
2. Ajouter ces buffers au modèle

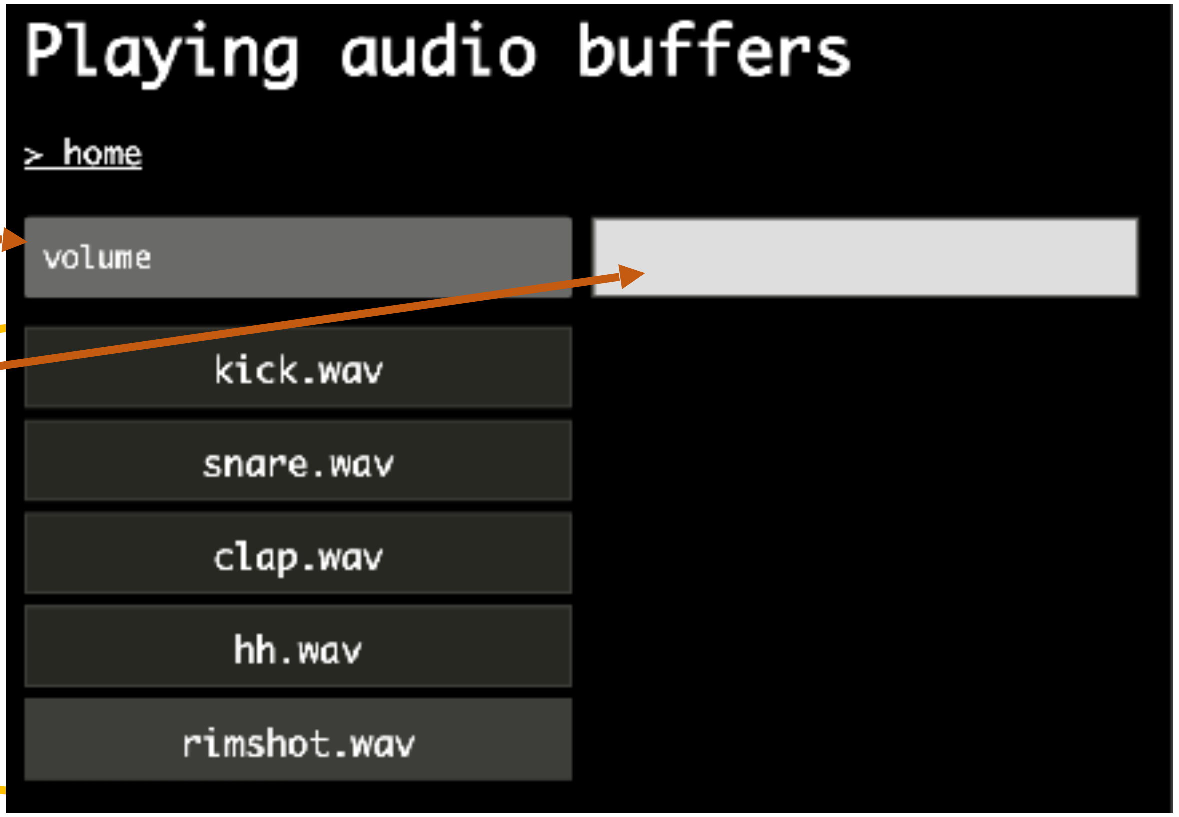
# Playing audio buffers

Fonction qui touche directement au html :



```
// GUI
function renderGUI() {
  const $main = document.querySelector('.main');

  render(html`
    <div style="padding-bottom: 10px">
      <sc-text
        value="volume"
        readonly
      ></sc-text>
      <sc-slider
        min="0"
        max="1"
        value="${model.volume}"
        @input=${e => model.volume = e.detail.value}
      ></sc-slider>
    </div>
    ${Object.keys(model.buffers).map(filename => {
      return html`
        <sc-button
          style="display: block; padding-bottom: 4px"
          value="${filename}"
          @input="${e => playSound(filename)}"
        ></sc-button>
      `
    })}
  `, $main);
}
```



Playing audio buffers

> home

volume

kick.wav

snare.wav

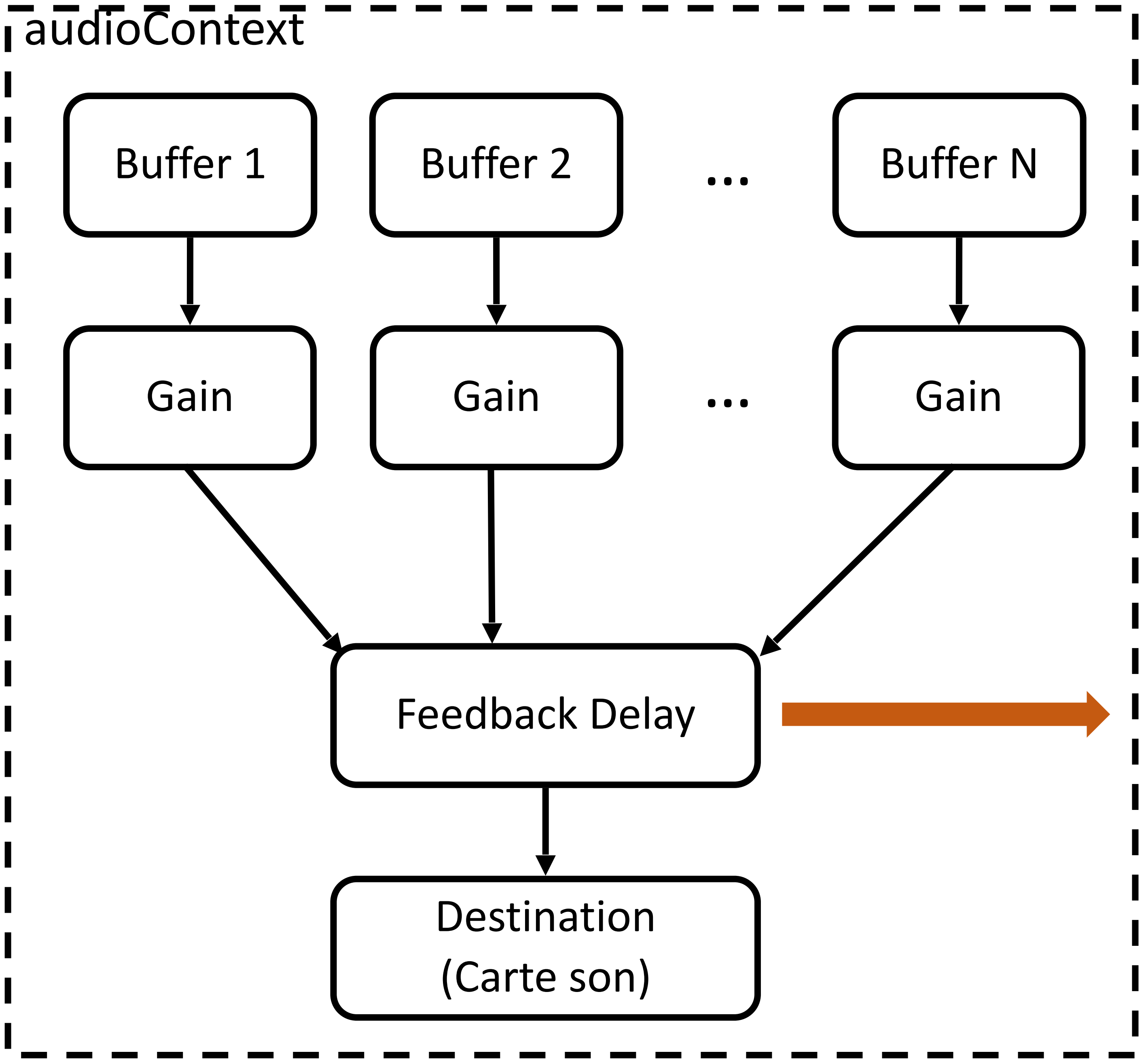
clap.wav

hh.wav

rimshot.wav

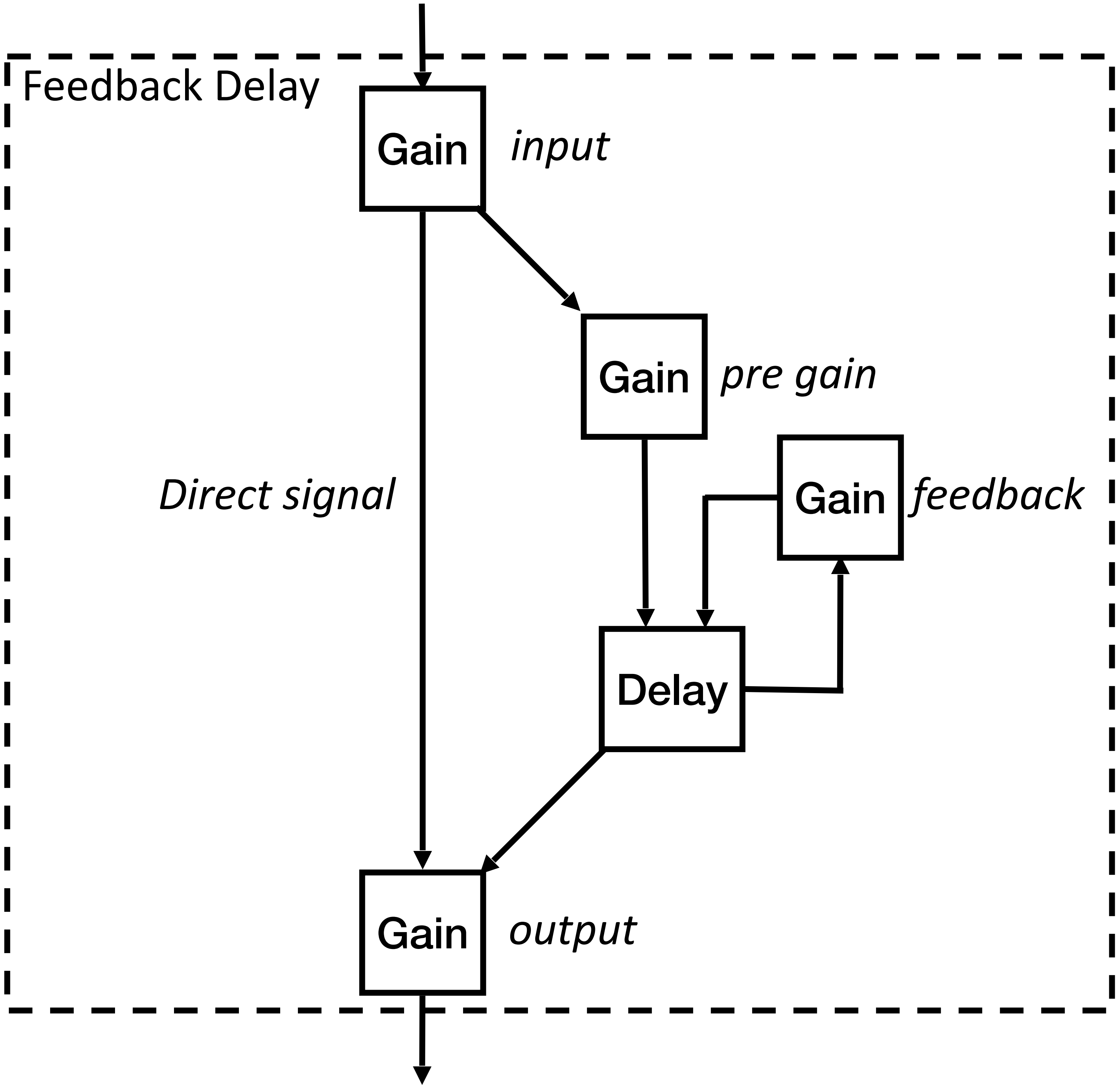
Reste à écrire la fonction ‘playSound’ dans laquelle on va définir le graph precedent.

# Feedback Delay

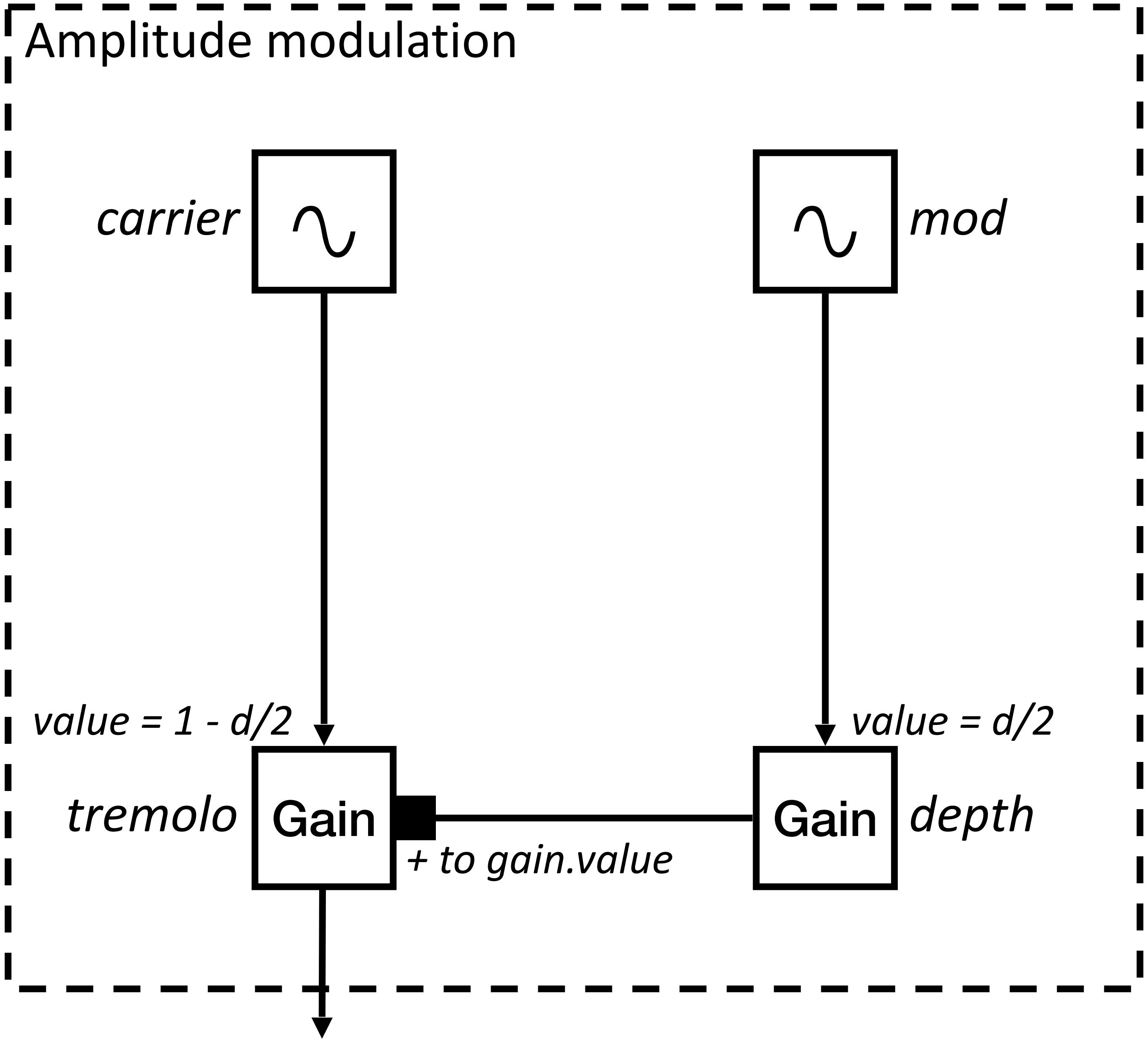


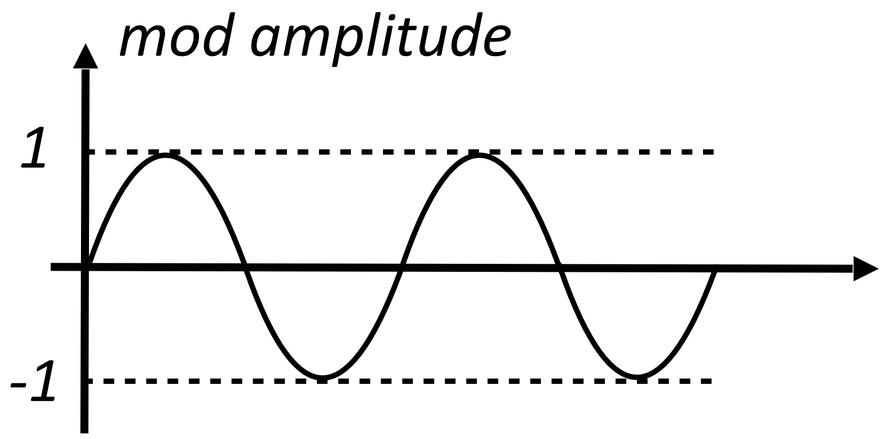
On doit créer une nouvelle classe qui s'intègre correctement dans l'API WebAudio

# Feedback Delay



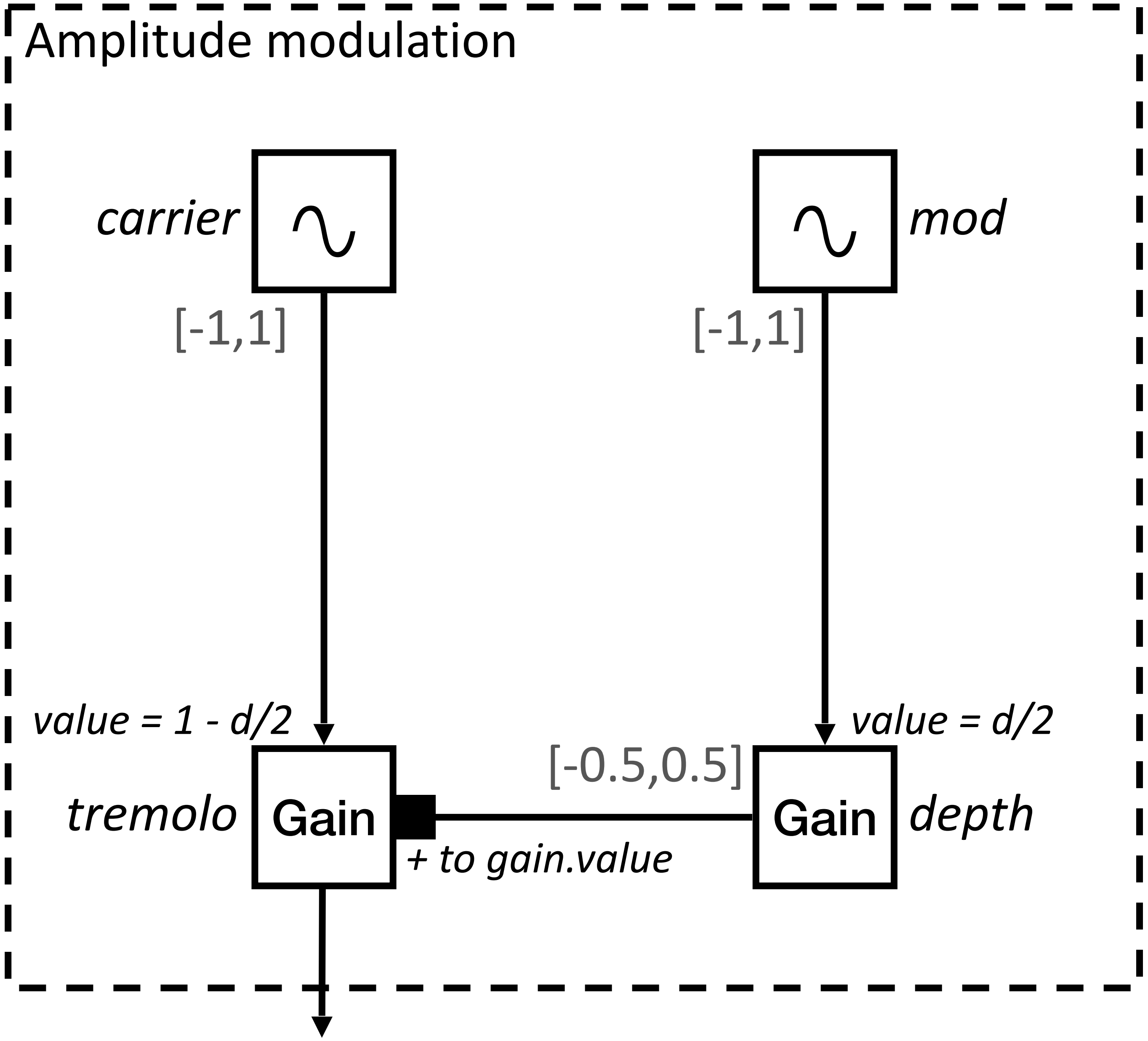
# Amplitude Modulation

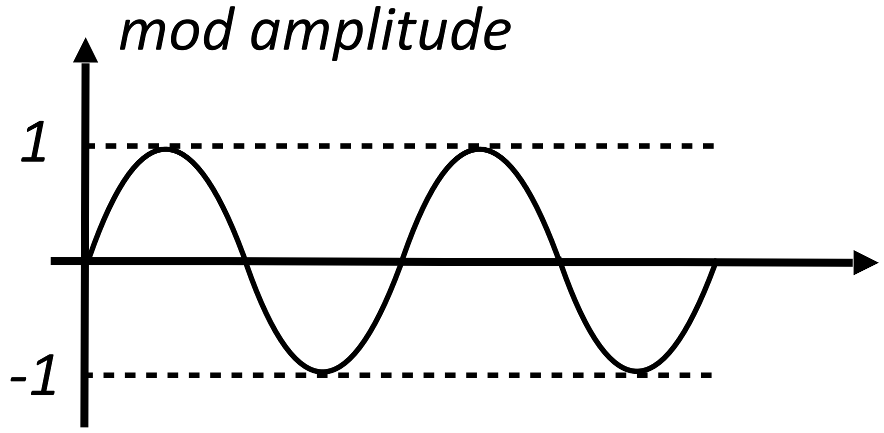




Paramètre de quantité de modulation :
d = 0 —> aucune modulation
d = 1 —> modulation max

# Amplitude Modulation





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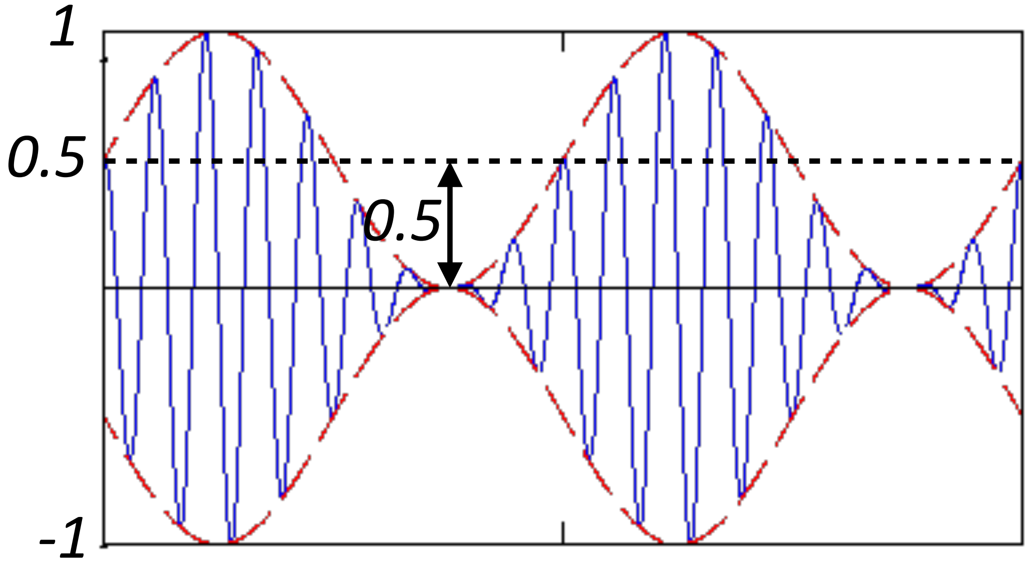
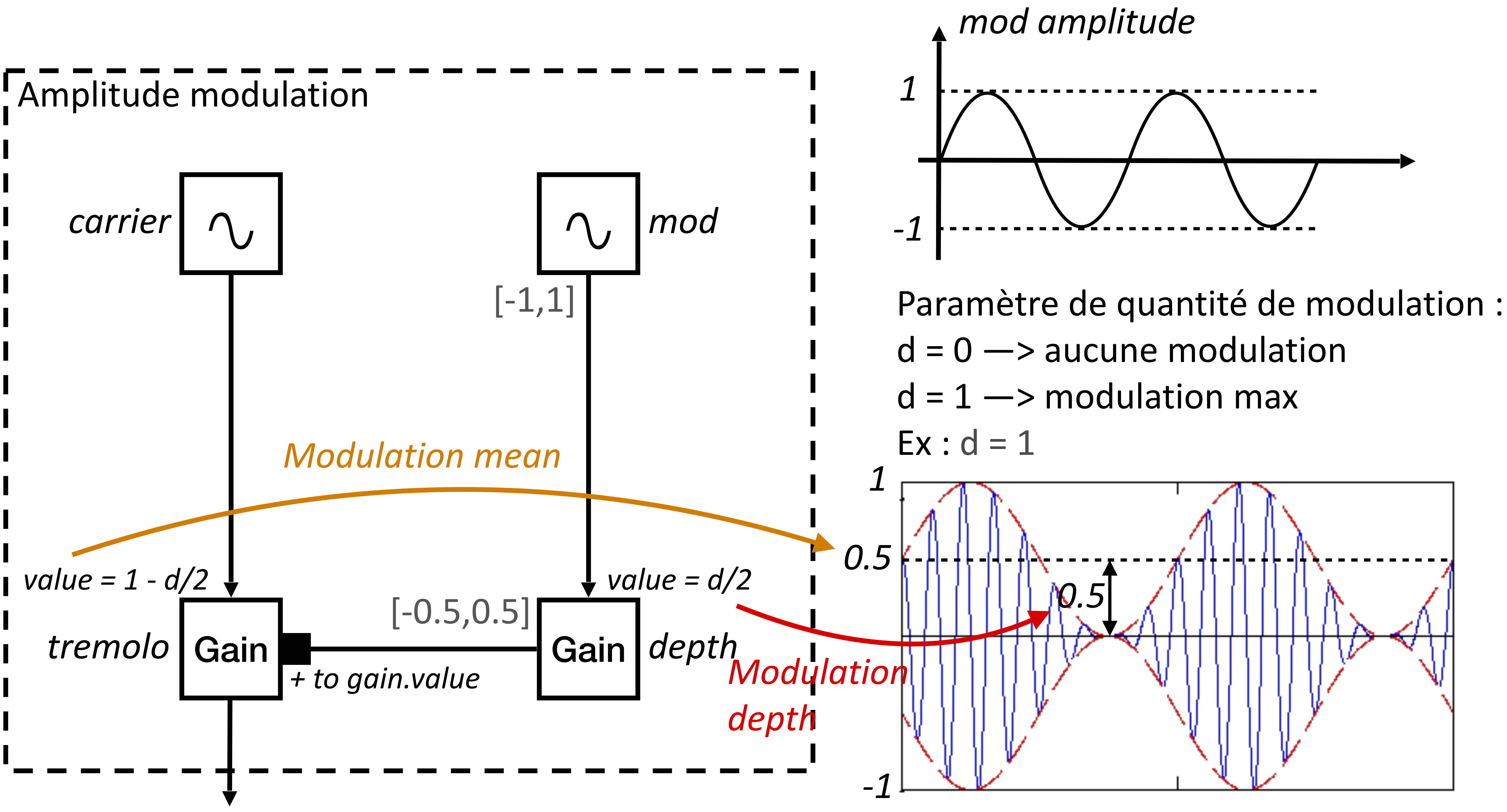
d = 1 —> modulation max

Ex : d = 1



# Amplitude Modulation



Paramètre de quantité de modulation :

d = 0 —> aucune modulation

d = 1 —> modulation max

Ex : d = 1

# Libraries used during the class

Resume audio context helper (one-liner to automatically create a button to resume the AudioContext) :

https://github.com/ircam-ismm/resume-audio-context

Waves-masters (library that contains the scheduler) :

https://github.com/wavesjs/waves-masters

Waves-loaders (to load and decode audio files) :

https://github.com/wavesjs/waves-loaders

Simple-components (set of components to create GUIs) :

https://github.com/ircam-ismm/simple-components

https://ircam-ismm.github.io/simple-components/ (examples)

# Some papers

Steven Yi Victor Lazzarini et Joseph Timoney. _Web Audio: Some Critical Considerations_. In : VI Ubimus. 2015.

Benjamin Tayler. _A History of the Audience as a Speaker Array_. In Proceedings of the NIME'17 Conference, 2017.

Chris Wilson. _A Tale of Two Clocks - Scheduling Web Audio with Precision_. 2013, http://www.html5rocks.com/en/tutorials/audio/scheduling/.

Lonce Wyse and Srikumar Subramanian. 2013. _The Viability of the Web Browser as a Computer Music Platform_. Computer Music Journal 37, 4, 2013, pp. 10–23.

Lonce Wyse. _Spatially Distributed Sound Computing and Rendering Using the Web Audio Platform_. In 1st Web Audio Conference, 2015, Paris.

Norbert Schnell, Victor Saiz, Karim Barkati, Samuel Goldszmidt. Of Time Engines and Masters An API for Scheduling and Synchronizing the Generation and Playback of Event Sequences and Media Streams for the Web Audio API. WAC, Jan 2015, Paris, France. ⟨hal-01256952⟩