

# Exploring Audio Effects with SoundScape: A WebAudio Project

Ciaran McKay - Computational Sound (COMS 3430)

## Introduction:

In the field of computational sound, the WebAudio API has opened up a world of possibilities for creating interactive and immersive audio experiences directly in the web browser. SoundScape is a project that leverages the power of the WebAudio API to provide users with a comprehensive audio effects application, allowing them to apply a wide range of effects to various sound sources in real-time. This project aims to showcase the potential of web-based audio processing and demonstrates the creative possibilities that can be unlocked through the use of modern web technologies.

## Project Overview:

SoundScape is a web application that offers a user-friendly interface for exploring and applying audio effects to different sound sources. Users can select from a variety of pre-loaded audio samples or upload their own audio files. The application provides a set of intuitive controls for adjusting effect parameters, enabling users to shape and manipulate the sound in real-time. The available effects include reverb, delay, distortion, filtering, pitch shifting, and equalization.

## Implementation Details:

### **1. Audio Graph Setup:**

At the core of SoundScape lies the WebAudio API, which provides a powerful toolset for creating and manipulating audio in the browser. The application sets up an audio graph using the AudioContext, which serves as the central hub for routing and processing audio signals. The audio source, selected by the user, is connected to a GainNode for volume control. The GainNode is then connected to a series of effect nodes, each representing a specific audio effect. The output of the effect chain is finally connected to the AudioContext's destination, allowing the processed audio to be played back through the user's speakers or headphones.

### **2. Effect Nodes:**

SoundScape implements a modular approach to audio effects, with each effect encapsulated in its own module. This modular design promotes code reusability and maintainability. The effect nodes are created using the WebAudio API's built-in nodes, such as ConvolverNode for reverb, DelayNode for delay, WaveShaperNode for distortion, BiquadFilterNode for filtering, and ScriptProcessorNode for pitch shifting. Each effect module exposes a consistent interface for setting and retrieving effect parameters, making it easy to integrate them into the audio graph.

### **3. User Interface:**

The user interface of SoundScape is designed to be intuitive and visually appealing, providing a seamless experience for users to interact with the audio effects. The interface is built using HTML, CSS, and the Bootstrap framework, ensuring a responsive and modern layout. The main components of the interface include a dropdown menu for selecting the audio source, sliders for adjusting effect parameters, a play/pause button for controlling audio playback, and a visualizer that displays the waveform of the processed audio in real-time.

### **4. Real-time Parameter Control:**

One of the key features of SoundScape is the ability to adjust effect parameters in real-time, allowing users to dynamically shape the sound as it plays. This is achieved by attaching event listeners to the parameter sliders, which update the corresponding effect parameters in the audio graph whenever the slider values change. The WebAudio API's `AudioParam` interface enables smooth parameter automation, ensuring that parameter changes are applied seamlessly without any audible glitches.

### **5. Preset Management:**

SoundScape includes a preset management system, enabling users to save and recall their favorite effect configurations. The presets are stored in the browser's local storage, providing a convenient way to persist and retrieve custom effect settings. Users can enter a name for their preset and click the "Save Preset" button to store the current effect parameters. The saved presets are then available for selection from a dropdown menu, allowing users to quickly switch between different effect combinations.

### **6. Audio Visualization:**

To enhance the visual experience and provide real-time feedback, SoundScape incorporates an audio visualizer that displays the waveform of the processed audio. The visualizer is implemented using the `AnalyserNode` from the WebAudio API, which provides access to the frequency and time-domain data of the audio signal. The waveform is rendered on a canvas element, creating an engaging visual representation of the audio as it plays. The visualizer adds an interactive element to the application, allowing users to see the impact of the applied effects on the audio waveform.

### **7. File Upload:**

SoundScape provides a file upload feature, enabling users to load their own audio files into the application. When the user selects the "Upload Audio File" option from the audio source dropdown, a file input element is displayed, allowing the user to choose an audio file from their local machine. Once a file is selected, the application uses the `FileReader`

API to read the file contents as an ArrayBuffer. The ArrayBuffer is then decoded into an AudioBuffer using the AudioContext's decodeAudioData method. The decoded audio buffer is assigned to the source node, making it available for applying effects and playback.

### **Conclusion:**

SoundScape is a comprehensive audio effects application that showcases the power and flexibility of the WebAudio API in creating interactive and immersive audio experiences. By leveraging the concepts and techniques covered in the course, such as audio graph routing, effect processing, and real-time parameter control, SoundScape provides users with a versatile tool for exploring and manipulating sound in the web browser.

The project extends beyond the course material by incorporating advanced features like pitch shifting, equalization, audio visualization, and preset management. These additional features demonstrate the potential for creative sound manipulation and highlight the possibilities for creating sophisticated audio applications using web technologies.

Through its modular architecture, intuitive user interface, and real-time interactivity, SoundScape exemplifies the fusion of technical proficiency and creative expression in the realm of computational sound. It serves as a testament to the power of the WebAudio API and the endless possibilities it offers for shaping and transforming audio in the digital domain.

The development of SoundScape has been an enriching journey, allowing for a deeper understanding of audio processing techniques, web audio concepts, and the creative potential of computational sound. The project lays the foundation for further exploration and innovation in the field of web-based audio applications, inspiring future endeavors at the intersection of technology and artistic expression.