Sound Detection and Classification
using Spiking Neural Networks

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Outline

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   - Data collection
   - Data augmentation
7. Spectrograms, MEL and MFCC
   - Spectrograms
   - MEL
   - MFCC

Introduction

- Presentation of the Project: Explaining the motivation and goals of the project.
- Sound Detection and Classification: Overview of the importance of sound detection and classification, especially in the context of Spiking Neural Networks (SNNs).
- Spiking Neural Networks: Brief introduction to SNNs and their relevance in handling temporal dynamics in sound data.

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Choosing the Type of Training Data

- Understanding the challenges of training SNNs compared to ANNs.
- Criteria for selecting data: Less computationally intensive, adaptable to pre-recorded and real-time processing.

Feasibility

- Selection of Google AudioSet database.
- Addressing copyright concerns (Creative Commons license).
- Data collection/extraction: Utilizing GitHub repositories for efficient downloading, formatting, and cropping of sound files.
- Assessing resource usage and parallelization impact.
- Uncertainties about data quality: Contextual issues, multi-labeling, Weak and Strong Label annotations.

Open to Other Databases

- Considering alternative databases (Freesound, Kaggle) if the selected dataset is insufficient.
- Flexibility in exploring and incorporating additional open-source label databases.

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ANNs Used for Audio Classification

- Overview of existing ANNs for audio classification.
- Mentioning pre-trained models on Google AudioSet, rearranged Resnet, inception, densenet, and LSTM-based models.
- Providing references to relevant GitHub repositories and research papers.

SNNs Used for Audio Classification

- Overview of existing SNNs for audio classification.
- Highlighting spiking convolutional neural networks (SCNN), multi-layer SNN using SpiNNaker, shadow training, and SNN simulators (BindsNET, NEST).
- Referencing GitHub repositories and documentation for each model.

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Technical Objectives Achievable with Pre-existing ANNs

- Identifying pre-trained ANNs suitable for achieving good accuracy with Google AudioSet.

Technical Objectives with Data

- Discussing the conversion of analog sound signals to digital representation.
- Extracting useful features from audio, including time domain features, frequency-domain features, and spectrograms.

Technical Objectives with SNNs

- Finding or creating a pre-trained SNN model for robust sound classification.
- Referencing a framework for creating SNNs for sound classification.

Feasibility

- Addressing uncertainties related to dynamic audio signals, varying acoustic environments, and challenges in modeling temporal aspects.
- Discussing potential challenges in training SNNs, considering non-linearity and sparsity of spikes.
- Highlighting potential data uncertainties, such as varied audio formats and unavailability of certain samples.
- Estimating computation time for data import and training.

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Theoretical Study of SNN

- Exploring different archetypes of spiking neural networks, focusing on the Leaky Integrate and Fire (LIF) model.
- Discussing neural coding schemes for converting input pixels into spikes.
- Overview of different ways to train SNNs: shadow training, backpropagation using spikes, and local learning rules.

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Pre-processing

- Collecting the data
- Adaptation of the data
- Checking that there are no errors / repetitions

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Spectrograms

- Spectrograms

MEL

- MEL

MFCC

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Spiking Neural Networks - First results

- First results

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Conclusion

- Summary
- Future Work