

# Synopsis for 02456 Project ”Various Deep Learning Architectures for Urban Sound Classification”

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## Background and Motivation:

Sound classification is a task commonly solved by RNNs rather than CNNs, which in turn are rather suitable for image data. However, since a spectrogram of an audio sequence can be interpreted as an image, CNNs too can be used for sound data, as was done e.g. in [1]. Therefore, sound data is a good opportunity to work with two of the architectures we learned in 02456, namely CNNs and RNNs. The dataset chosen for the project was the *UrbanSound8K* [2], which is a collection of over 8000, 2 to 7 seconds long, audio clips from urban environments with labels such as dog barking or jackhammer.

## Milestones:

1. (also safe plan B) Reproduce the CNN architecture proposed in [1], with each audioclip processed into several  $60 \times 41$  pixel spectrograms.
2. Same architecture and same data as in Milestone 1, but now train the less noisy observations first and the noisier observations afterwards (see *curriculum learning* [3]). See if the performance improves.
3. Implement an architecture combined of CNN and RNN (maybe realizing some of the ideas in [4]).
4. Experiment with mixed data: (i) Artificially overlap two audios of classes  $a$  and  $b$  and make it one observation. The network should give a softmax output where the highest values are in  $a$  and  $b$ . (ii) Concatenate audios, e.g. dog – jackhammer – silence – jackhammer. Use CTC [5, 6] to automatically segment the new audio and give a label for each segment.

## References

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- [3] Y. Bengio, J. Louradour, R. Collobert, J. Weston: ”Curriculum Learning”

- [4] Baidu Research – Silicon Valley AI Lab: "Deep Speech 2: End-to-End Speech Recognition in English and Mandarin"
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- [6] TensorFlow implementation of [5]: [https://www.tensorflow.org/versions/r0.12/api\\_docs/python/nntk/connectionist\\_temporal\\_classification\\_\\_ctc\\_](https://www.tensorflow.org/versions/r0.12/api_docs/python/nntk/connectionist_temporal_classification__ctc_)