Comparison of Neural Networks for Segmentation of Vocalizations

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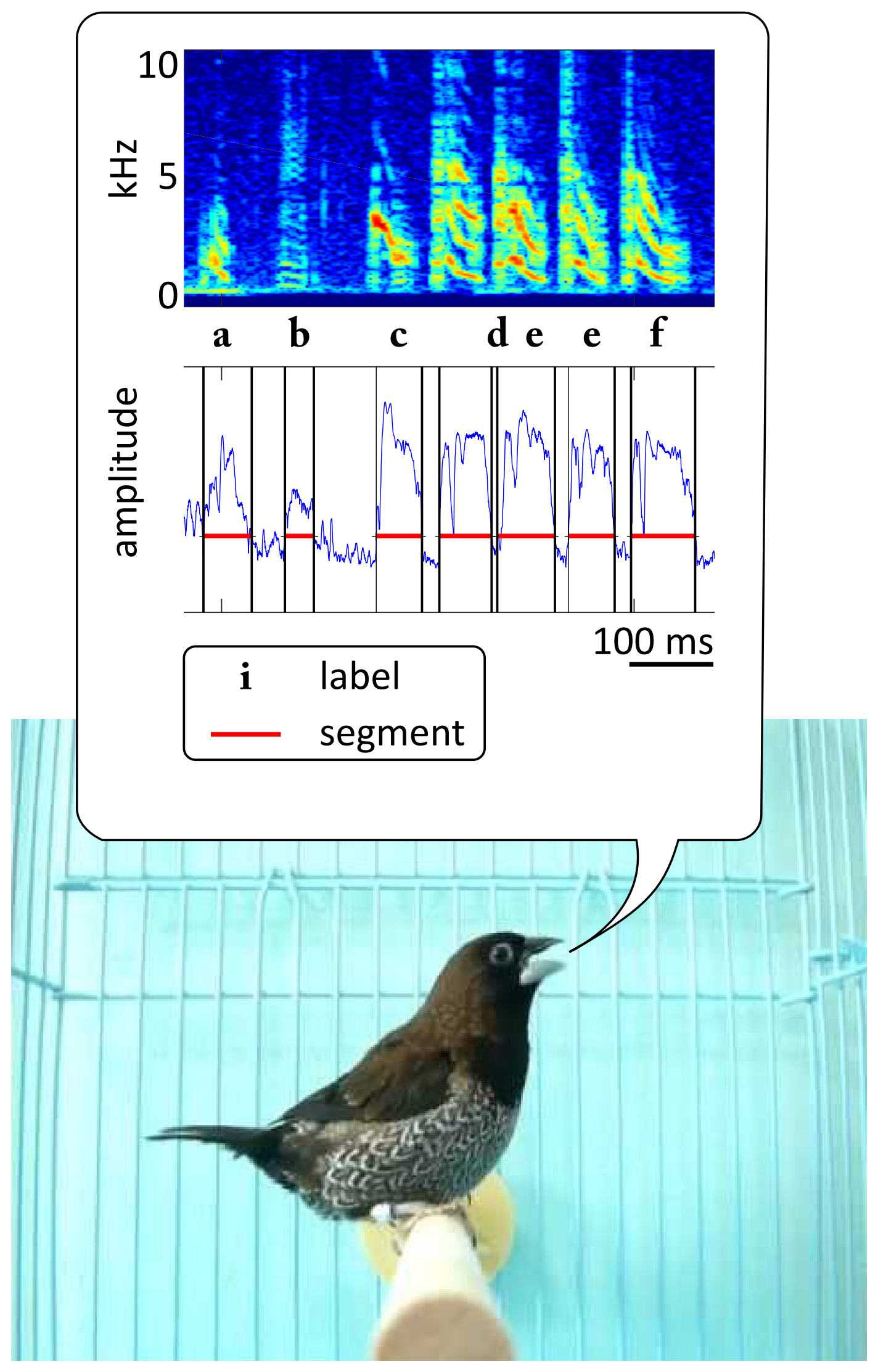
Introduction

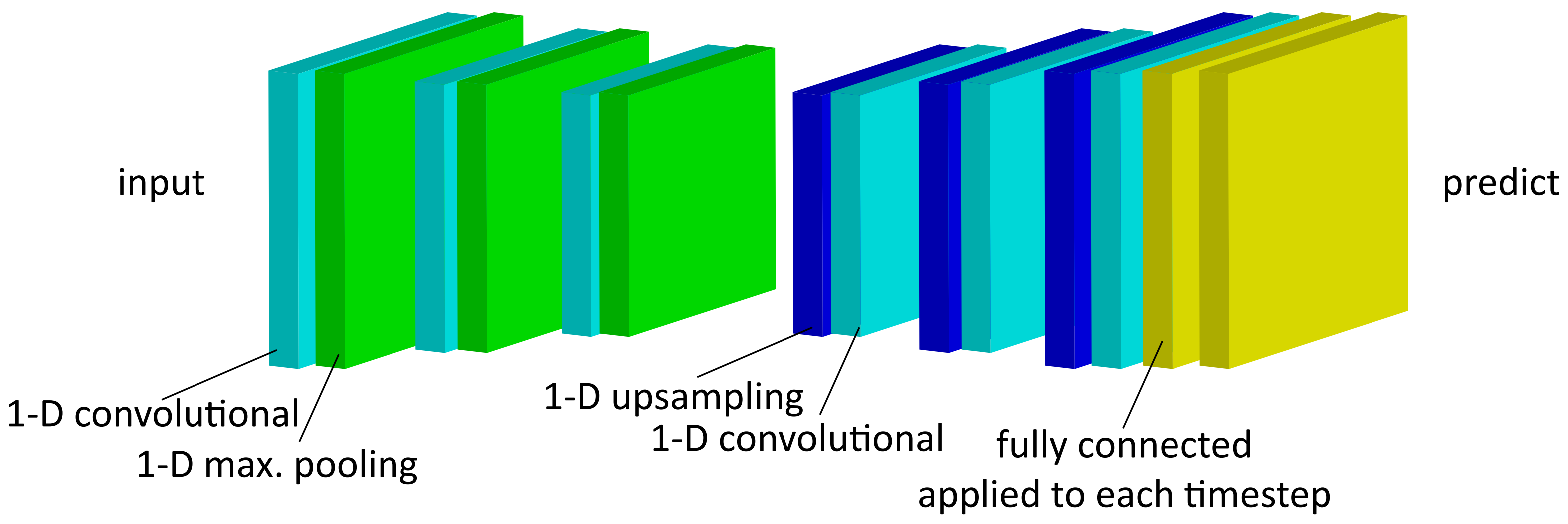


- Scientists study how songbirds learn and produce their song to understand how our brains learn and control behaviors like speech
- To get results from experiments with songbirds, scientists **segment** song into elements called *syllables*, and then **label** these syllables to extract acoustic parameters such as pitch
- Supervised machine learning can automate labeling *but fails when noise or experimental conditions impair segmentation*
- Here I compare neural networks that both segment song and classify syllables

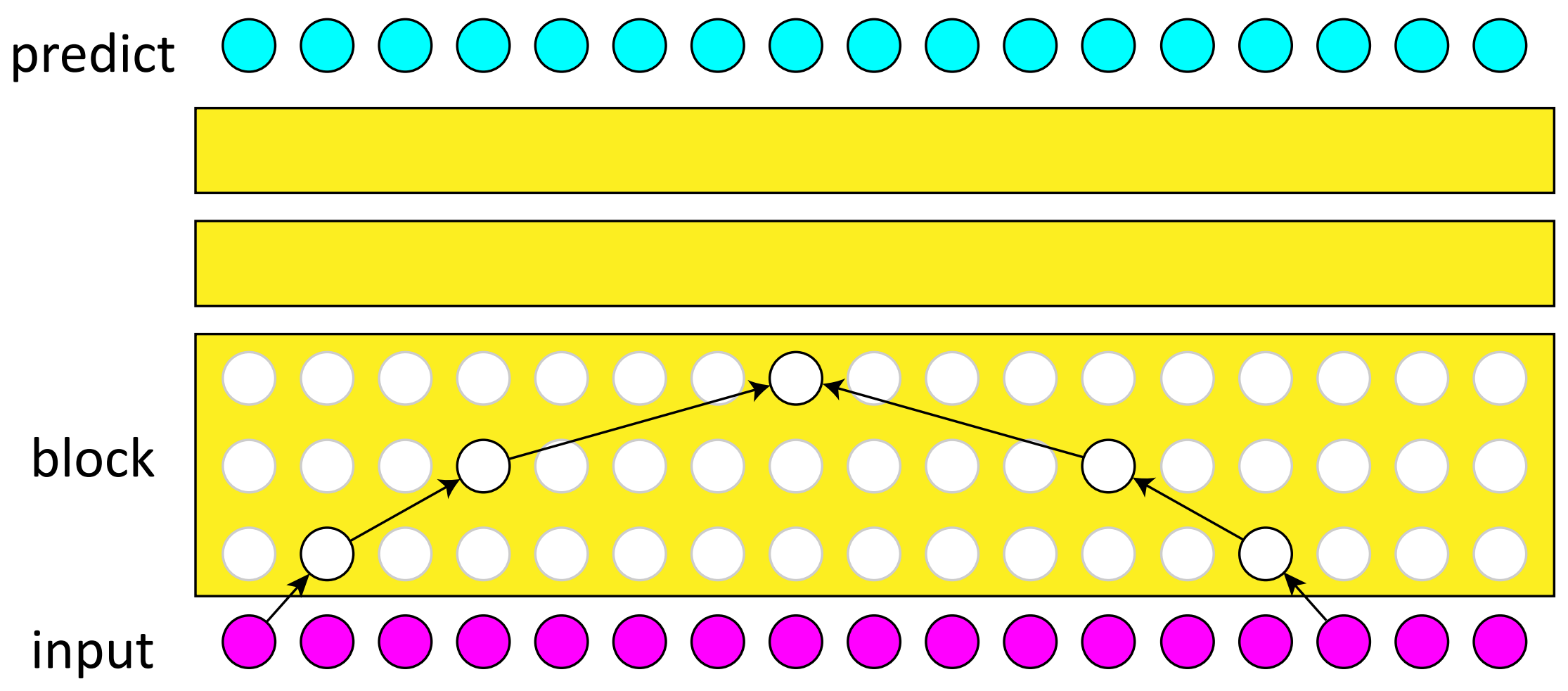
Methods

- Compare three different neural network architectures:

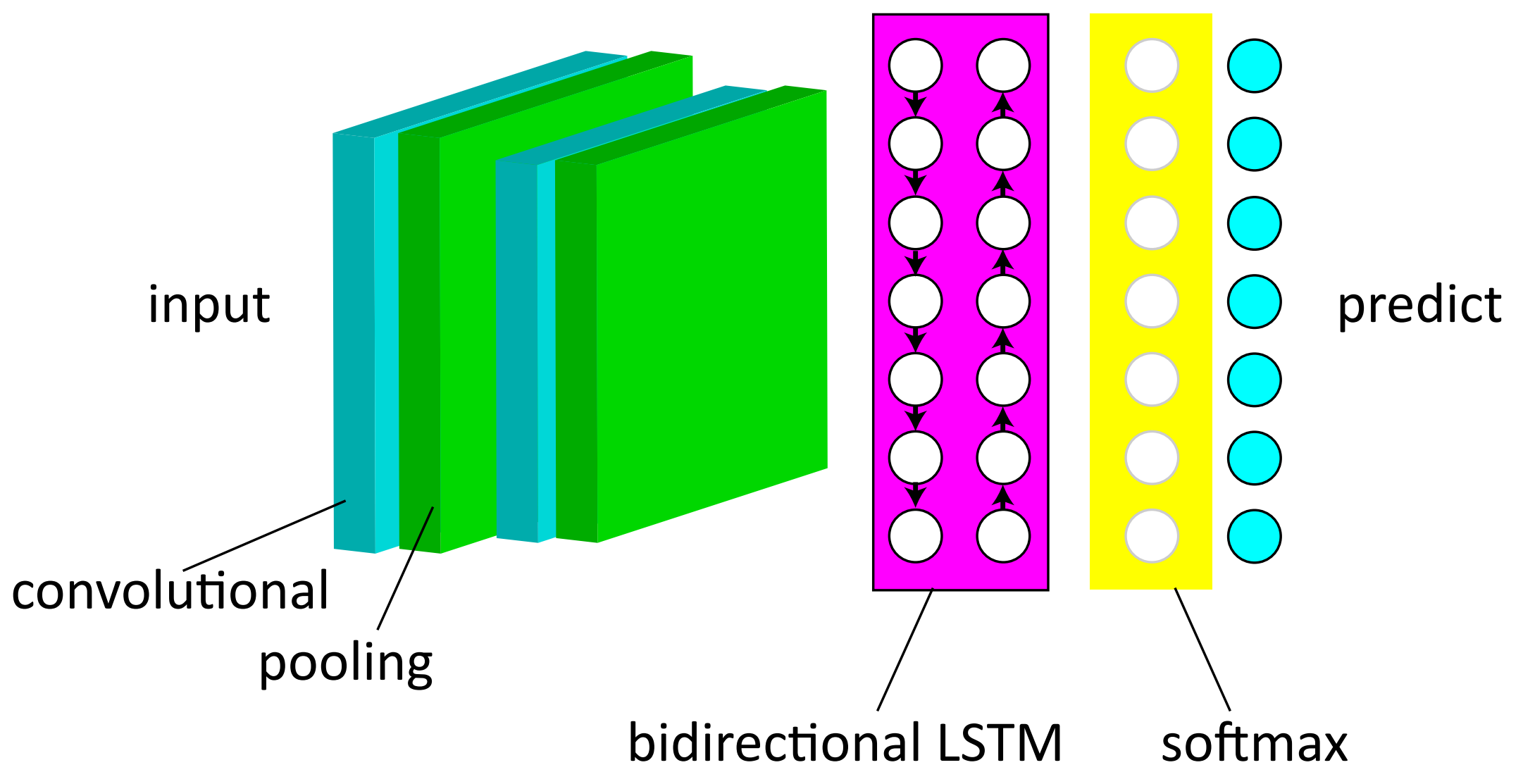
Convolutional encoder-decoder



Dilated convolutional

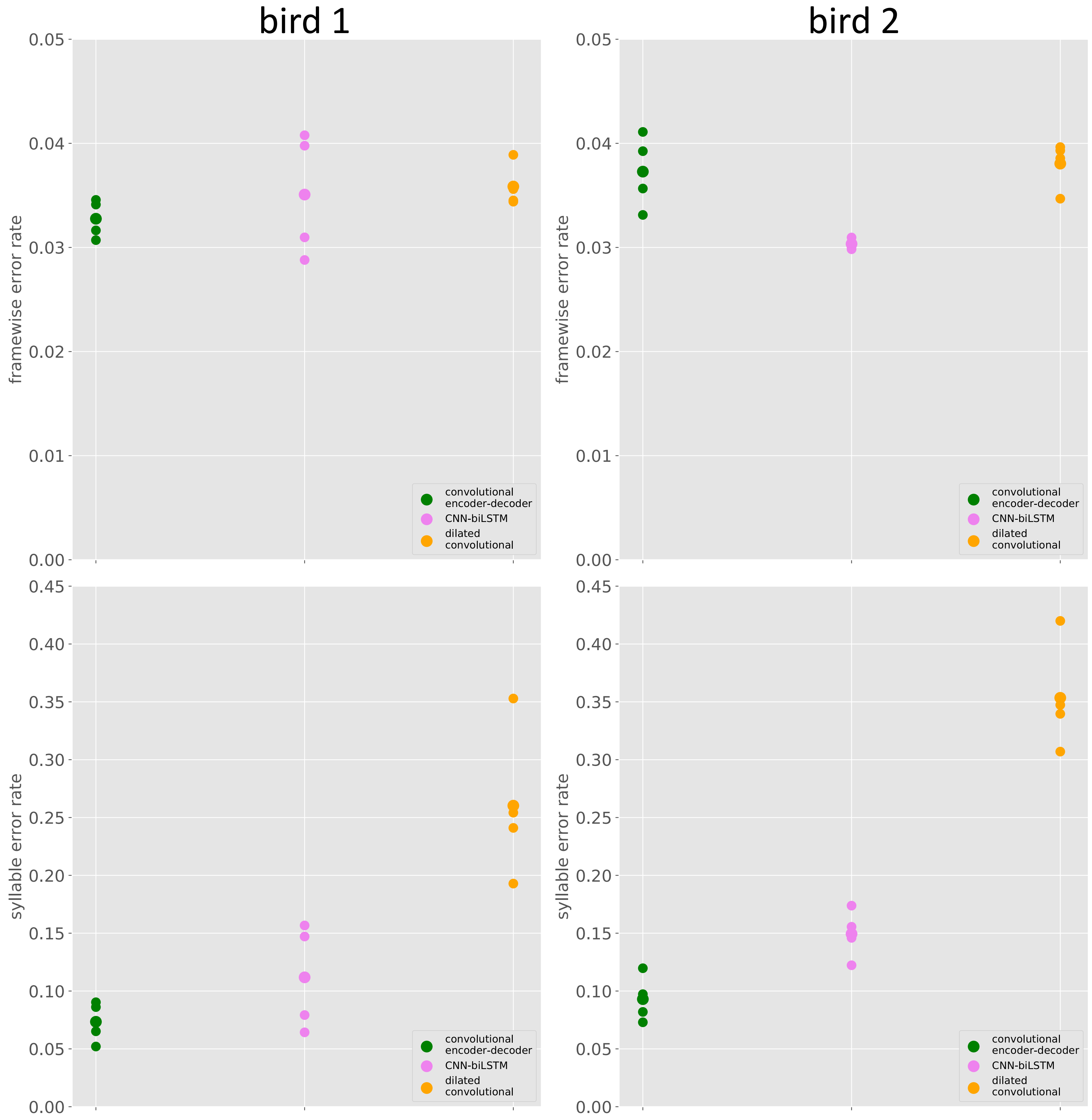


Convolutional + bidirectional LSTM



- Benchmark on song from public repositories:
https://figshare.com/articles/Bengalese_Finch_song_repository/4805749
https://figshare.com/articles/BirdsongRecognition/3470165

Results



- Framewise error not significantly different between the three network types
- Syllable error:
encoder-decoder < CNN-bidirectional LSTM < dilated convolutional

Conclusion

- Fully convolutional networks are competitive with recurrent networks, giving roughly the same framewise error rate, and in the case of the encoder-decoder network, lower syllable error rate than the CNN-bidrectional LSTM
- *and* fully convolutional networks require much less time to train (1 hour for encoder-decoder and dilated convolutional versus 3-4 hours for CNN-bidirectional LSTM)

References

René, Colin Lea Michael D. Flynn, and Vidal Austin Reiter Gregory D. Hager. "Temporal convolutional networks for action segmentation and detection." (2017).

https://github.com/colincsl/TemporalConvolutionalNetworks

https://github.com/yardencsGitHub/tf_syllable_segmentation_annotation

https://github.com/NickleDave/tf_syllable_segmentation_annotation/network