Deep Network Defined Error Correcting Code

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Abstract

Modern error correcting codes are used in wireless radio communications in order to detect and recover corrupted bits sent over noisy channels. Viterbi algorithm has been the popular decoding algorithm used for such purposes for its optimality. However, many of the algorithms used for radio nowadays depend on predefined scheme such as Trellis and generator matrices. In the research this semester, I explored the possibility of a deep neural network based approach to error correction, as an initial effort towards the goal of a end-to-end radio communication scheme in future. Specifically, I will briefly recap what I did this semester, what I learned, and what I found interesting in this report. I will also demonstrate some initial results obtained for Convolutional Encoding error correction by Feed Forward Neural Networks, Convolutional Neural Networks, Long Short Term Memory Networks (LSTM), and Bidirectional-LSTMs, compared against baseline optimal Viterbi decoding algorithm.

1. Model Architecture

Please follow the steps outlined below when submitting your manuscript to the IEEE Computer Society Press. This style guide now has several important modifications (for example, you are no longer warned against the use of sticky tape to attach your artwork to the paper), so all authors should read this new version.

1.1. Feed Forward Neural Networks

All manuscripts must be in English.

1.2. Convolutional Neural Networks

Please refer to the author guidelines on the CVPR 2018 web page for a discussion of the policy on dual submissions.

1.3. Long Short Term Memory Networks (LSTM)

Papers, excluding the references section, must be no longer than eight pages in length. The references section will not be included in the page count, and there is no limit on the length of the references section. For example, a paper of eight pages with two pages of references would have a total length of 10 pages. **There will be no extra page charges for CVPR 2018.**

1.4. Bidirectional LSTM

Overlength papers will simply not be reviewed. This includes papers where the margins and formatting are deemed to have been significantly altered from those laid down by this style guide. Note that this LaTeX guide already sets figure captions and references in a smaller font. The reason such papers will not be reviewed is that there is no provision for supervised revisions of manuscripts. The reviewing process cannot determine the suitability of the paper for presentation in eight pages if it is reviewed in eleven.

2. Experiments

List and number all bibliographical references in 9-point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example. Where appropriate, include the name(s) of editors of referenced books.

2.1. Training Data

List and number all bibliographical references in 9-point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example. Where appropriate, include the name(s) of editors of referenced books.

2.2. Results

List and number all bibliographical references in 9-point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example. Where appropriate, include the name(s) of editors of referenced books.

2.3. Discussions

List and number all bibliographical references in 9-point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square

Architecture	Short Msg, Low Corruption	Short Msg, High Corruption	Long Msg, Low Corruption
Viterbi Algorithm (Baseline)	99.43	93.72	99.18
Feed Forward Networks (FNN)	98.17	90.14	92.06
1D-CNN	**98.55**	**91.60**	94.62
RNN-LSTM	98.39	91.39	87.24
Bidirectional LSTM	98.45	91.34	**96.46**

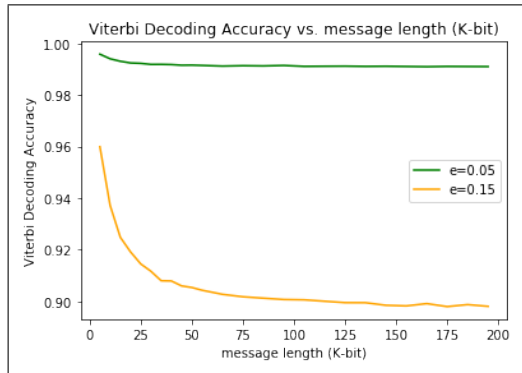Table 1. Comparison of Test Accuracy over Top Performing Models (30 Epochs)

Figure 1. Viterbi Accuracy over K-bit Message Length
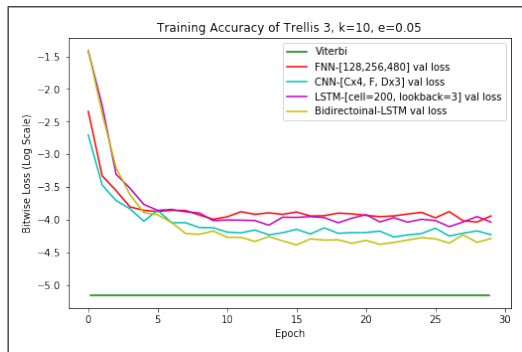

Figure 2. Short Message Length and Low Channel Corruption
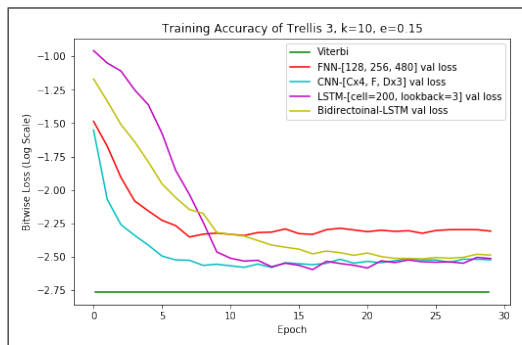

Figure 3. Short Message Length and High Channel Corruption

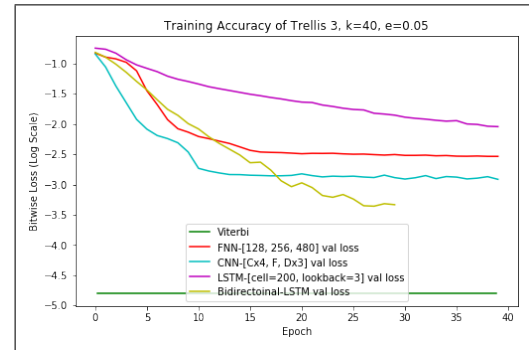brackets, for example. Where appropriate, include the

Figure 4. Long Message Length and Low Channel Corruption

name(s) of editors of referenced books.

2.4. Next Step: New Architectures

List and number all bibliographical references in 9-point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example. Where appropriate, include the name(s) of editors of referenced books.

3. Semester Reflection

List and number all bibliographical references in 9-point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example. Where appropriate, include the name(s) of editors of referenced books.

3.1. How I did

List and number all bibliographical references in 9-point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example. Where appropriate, include the name(s) of editors of referenced books.

3.2. What I have learned

List and number all bibliographical references in 9-point Times, single-spaced, at the end of your paper. When referenced in the text, enclose the citation number in square brackets, for example. Where appropriate, include the name(s) of editors of referenced books.

FAQ

Q: Are acknowledgements OK?
A: No. Leave them for the final copy.

Q: How do I cite my results reported in open challenges?
A: To conform with the double blind review policy, you can report results of other challenge participants together with your results in your paper. For your results, however, you should not identify yourself and should not mention your participation in the challenge. Instead present your results referring to the method proposed in your paper and draw conclusions based on the experimental comparison to other results.