Task 3: RNN for many to many prediction

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1 approach

Parameters: n_1 the length of learning curves for training, n_2 the length of learning curves for predictions

- Train an RNN on learning curves of length n_1, at each step using the next step as target.
- Provide the configuration at the first step only (alternative: at each step).
- Prediction: feed the first n_2 steps of the learning curve into the RNN to predict step $n_2 + 1$.
- Then append the predicted step to the learning curve and feed it into the RNN to predict step $n_2 + 2$.
- Repeat until step 40.

2 expectations

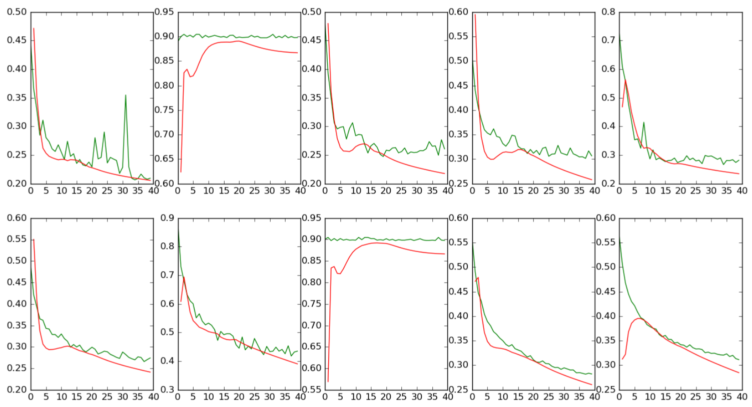
- increasing n_1 should generalise much better
- risk of propagating errors (erronous prediction at step k is fed into the network to predict step $k + 1$)
- increasing n_2 should reduce this risk
- not sure if predictions for steps $k > n_1$ make sense, when all training sequences only had length n_1

3 first insights

- small n_1 or small n_2 are both problematic
- if the RNN predicts that the test error increases at step k, it increases all the following steps (sometimes even leading to final predictions greater than 1)
- overall it seems a promising method, since training and validation losses get below 0.001 (but that's for the prediction of the first n_1 steps of a sequence, not for the final test error!)

- when training on all steps ($n_1 = 40$) and $n_2 = 20$, the test loss for the prediction of the final training error is 0.001403 (after training only 10 epochs), but we should choose $n_1 \in \{5, 10, 20\}$

The following plot shows 10 predicted curves (using the test set of the first CV fold), resulting from training on whole sequences (all 40 steps), and prediction using the first 20 steps from the sequence (steps 21 to 40 are predicted by the RNN and then fed back into it to predict the following step):
green = true curve, red = prediction



So far, the RNN seems to underestimate the error in each step.

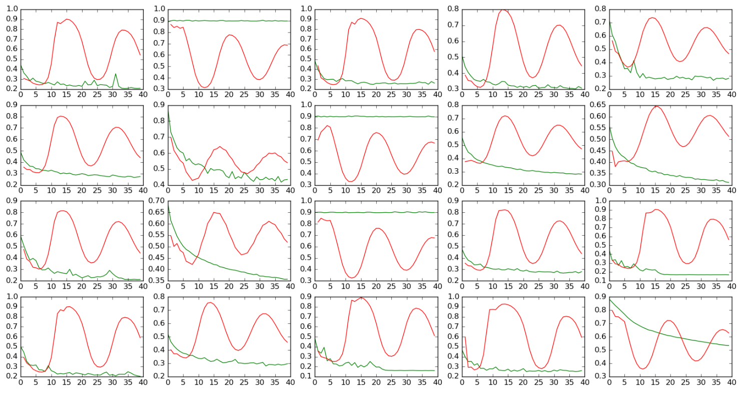
4 first results

The evaluation is made on 1 fold only, training for 200 epochs.

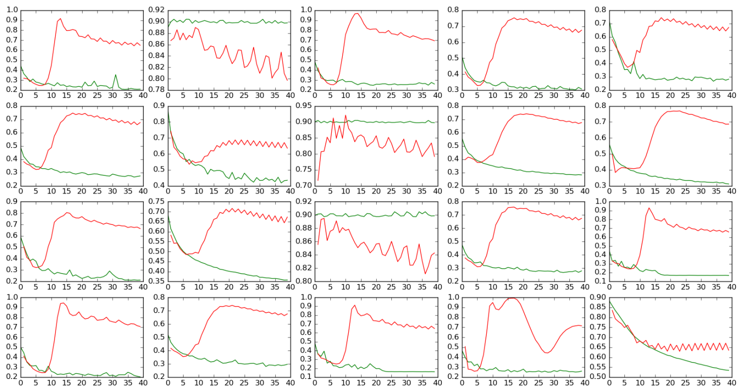
n_{train}	n_{test}	training loss	validation loss	final test E40 loss	best test E40 loss (@epoch)
5	5	0.000929	0.001588	0.145444	0.077837 (@149)
10	10	0.000646	0.001357	0.044646	0.005268 (@109)
20	20	0.000535	0.000684	0.009755	0.003154 (@99)

5 example curves

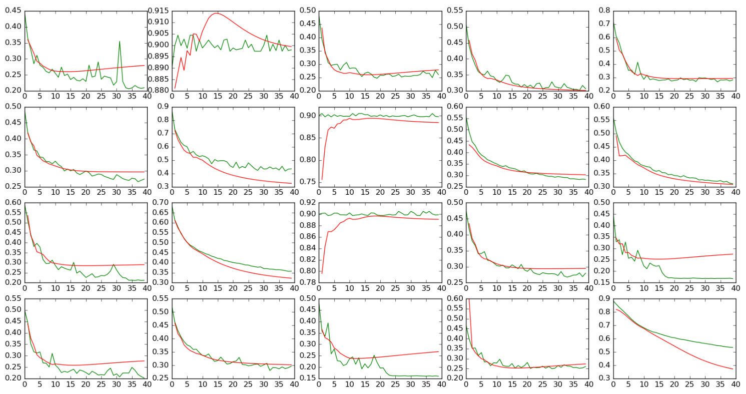
Training and prediction on 5 steps, after training for 150 epochs:



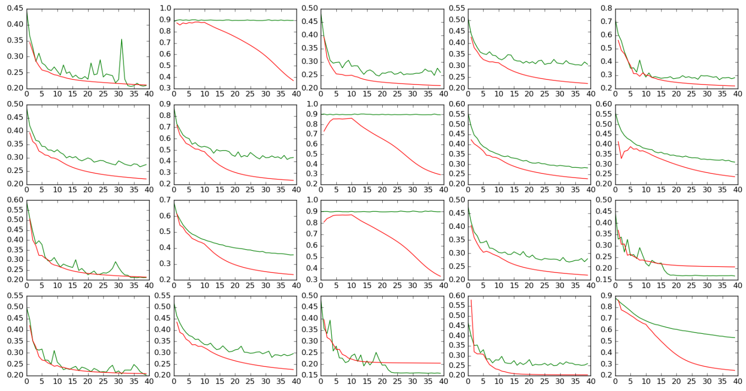
Training and prediction on 5 steps, after training for 200 epochs:



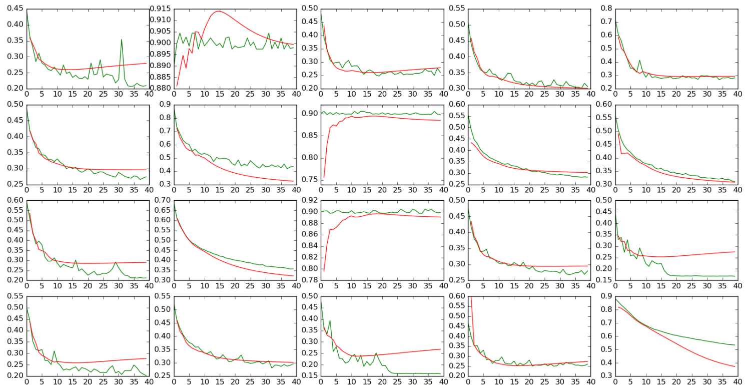
Training and prediction on 10 steps, after training for 110 epochs:



Training and prediction on 10 steps, after training for 200 epochs:



Training and prediction on 20 steps, after training for 110 epochs:



Training and prediction on 20 steps, after training for 200 epochs: