# MNIST Training for BNN

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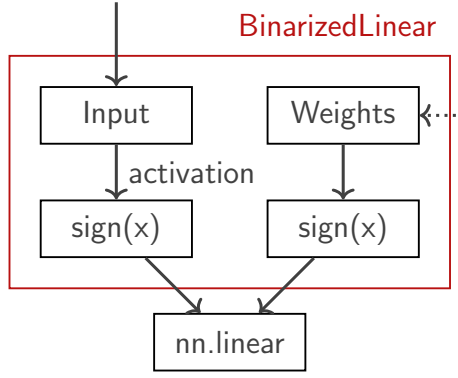
Design Your Own CPU - Design of Embedded Systems

# Content

## Binarisation of Linear Layer

- binarisation of weights
- binarisation of input data for hidden layers
- calculation through *nn.linear*



## Activation

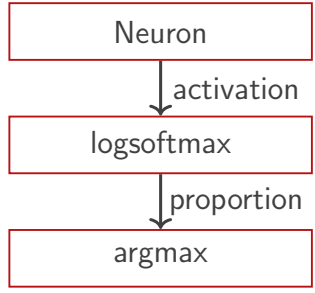
Inhalt...

## Batch Norm (BN)

- In NN
  - normalize batches
  - mean 0
  - standard derivation 1
- In BNN
  - prevent *expolding gradient*

## Evaluation of last layer

- normalisation of activation
- decision of the network



1. Neural Networks

2. BNN Design

3. **BNN Training Analysis**
   - Layer Analysis
   - Parameter Analysis

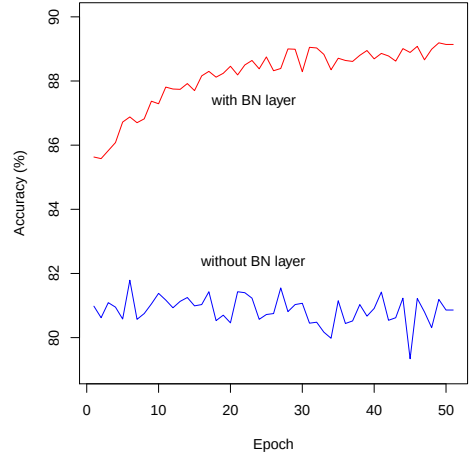
## Consequences of linear layer binarisation

| Run | binary | normal |
|---|---|---|
| 1 | **88.29**% | **97.43**% |
| 2 | 87.32% | 96.98% |
| 3 | 87.19% | 97.2% |

- training for 50 epochs
- mean loss of 9,6%
- loss in granularity

## Effect of Batch Norm

- 7.4% improved peak performance
- Less jitter with BN
- Reduced expolding gradient



## learning rate

- higher value $\rightarrow$ more weights are updated
- balance between over- and underfitting

## evaluation learning rate