

Task B04

Group 3

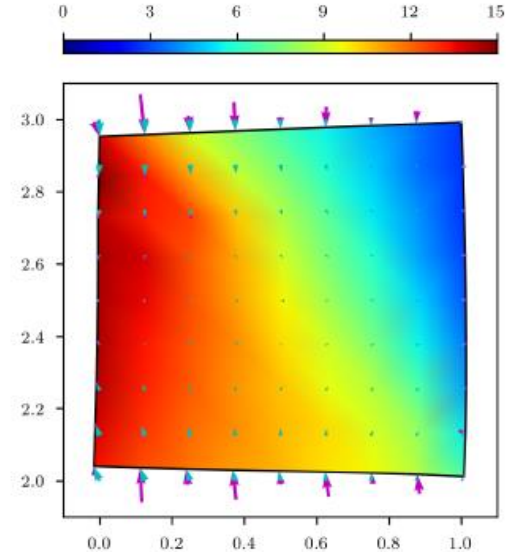
Task B04 | Group no. 3
Ali, Mishra, Karwacki | 15 Jan 2020

Motivation and Aim

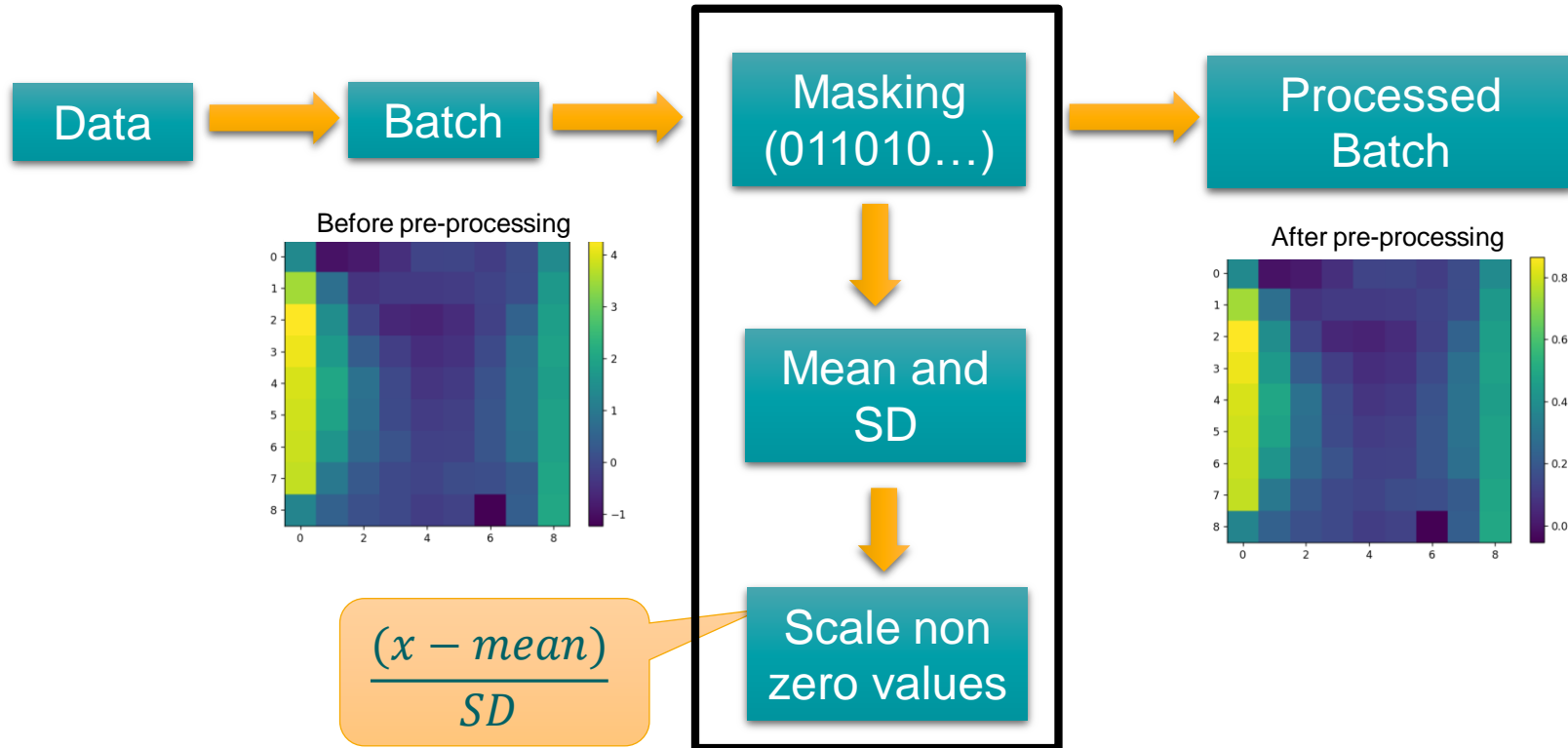
- To build neural network that predicts the values of the target features from the input features for a nonlinear boundary value problem in solid mechanics (Square continuum with elastoplastic material behaviour subjected to deformation)
- Compare performance of reference Architecture with our own architecture

Input features	U_i _boundary, Ξ_i
Targets	U_i , S_i
Reference Architecture	Time-distributed Dense
Our Architecture	ConvNet and RecNet

- Why?
 - Helps save simulation time
 - Quick results
 - Can be used for sensitivity analysis



Data pre-processing



Neural Network Model

Reference NN

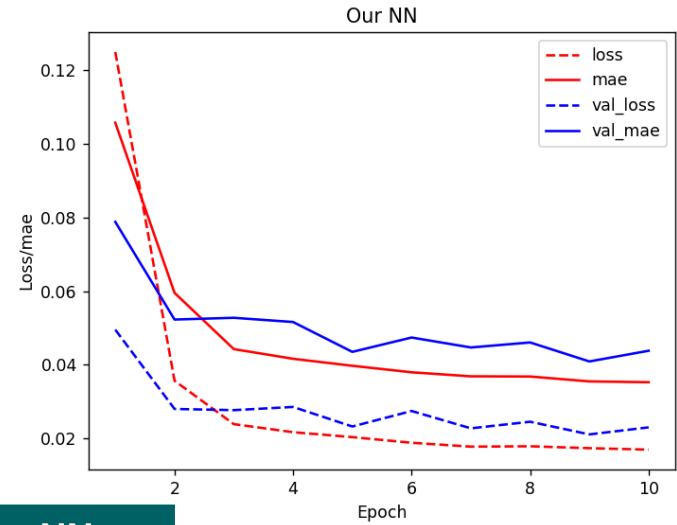
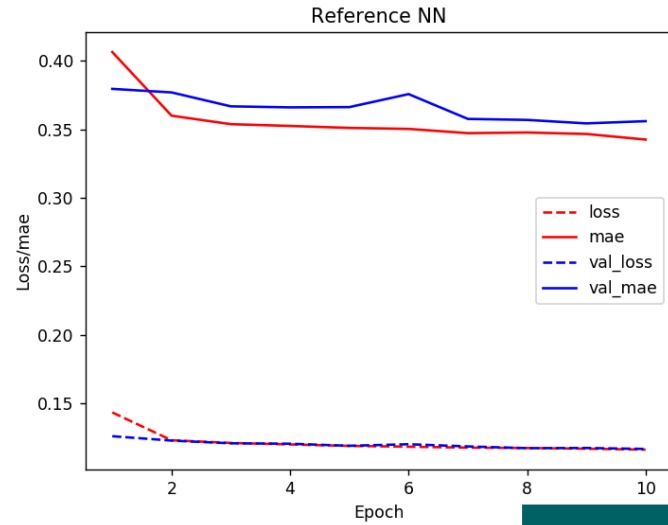
Layer type	Activation function	Output Shape
Input layer		(32,100,9,9,4)
Masking sequence		(32,100,9,9,4)
Masked Time distributed Dense	Linear	(32,100,9,9,20)
Masked Time distributed Dense	Relu	(32,100,9,9,80)
Masked Time distributed Dense	Relu	(32,100,9,9,160)
Masked Time distributed Dense	Relu	(32,100,9,9,80)
Masked Time distributed Dense	Relu	(32,100,9,9,20)
Masked Time distributed Dense	Linear	(32,100,9,9,8)

Our NN

Layer type	Activation function	Output Shape
Input layer		(32,100,9,9,4)
Masking sequence		(32,100,9,9,4)
Conv2D	Relu	(32,100,9,9,20)
Reshape		(32,100,1620)
LSTM	Relu	(32,100,20)
Masked Time distributed Dense	Linear	(32,100,648)
Output layer reshape		(32,100,9,9,8)

- Optimizer: Adam
- Loss: mse
- Metric: mae

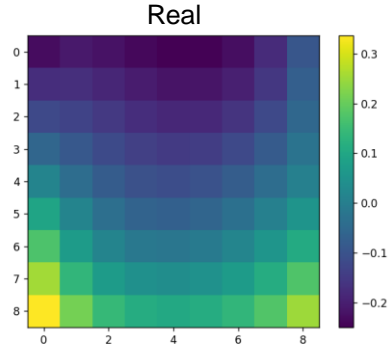
Results



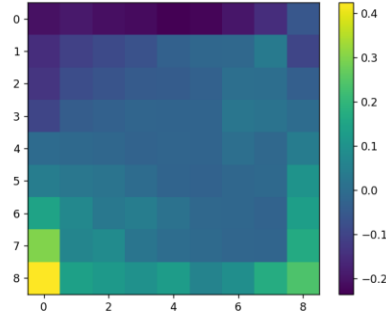
	Ref NN	Our NN
Loss	0.116	0.029
Mae	0.344	0.041
Smape	0.518	0.218

Results

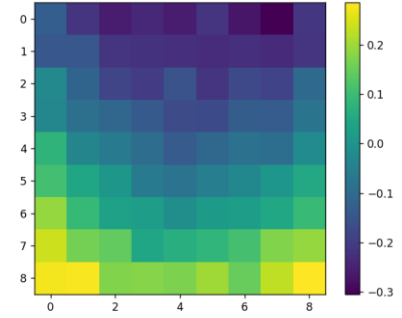
U_i



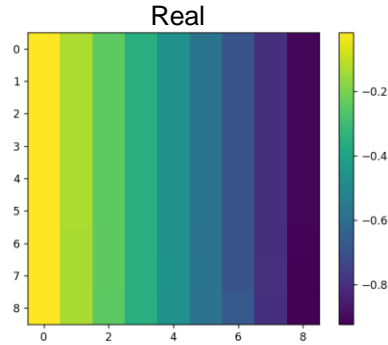
Reference NN predicted



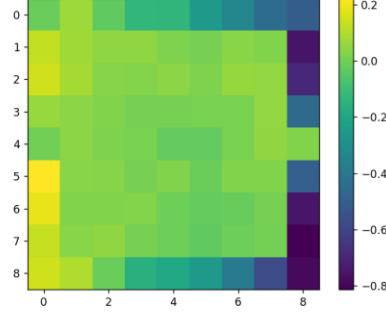
Our NN predicted



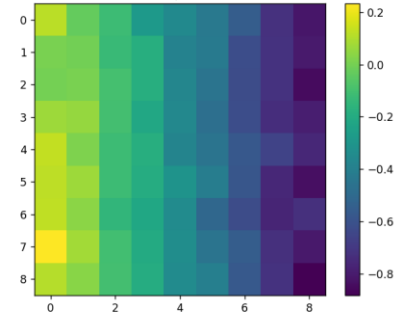
S_i



Reference NN predicted



Our NN predicted



Discussion and conclusion

- Our NN architecture with ConvNet and RecNet layers performed better than the reference architecture with TimeDist Dense layers
- Reference NN predicted the U_i at boundaries better than our NN architecture, but our architecture predicted better elsewhere
- Stress predictions were far better in our NN architecture



Our NN!!!

Thank you