Note: Graphs, parameters, and numerical results in this presentation may not all be up to date with the final report results.

Weld Defect Classification Using Deep Neural Network

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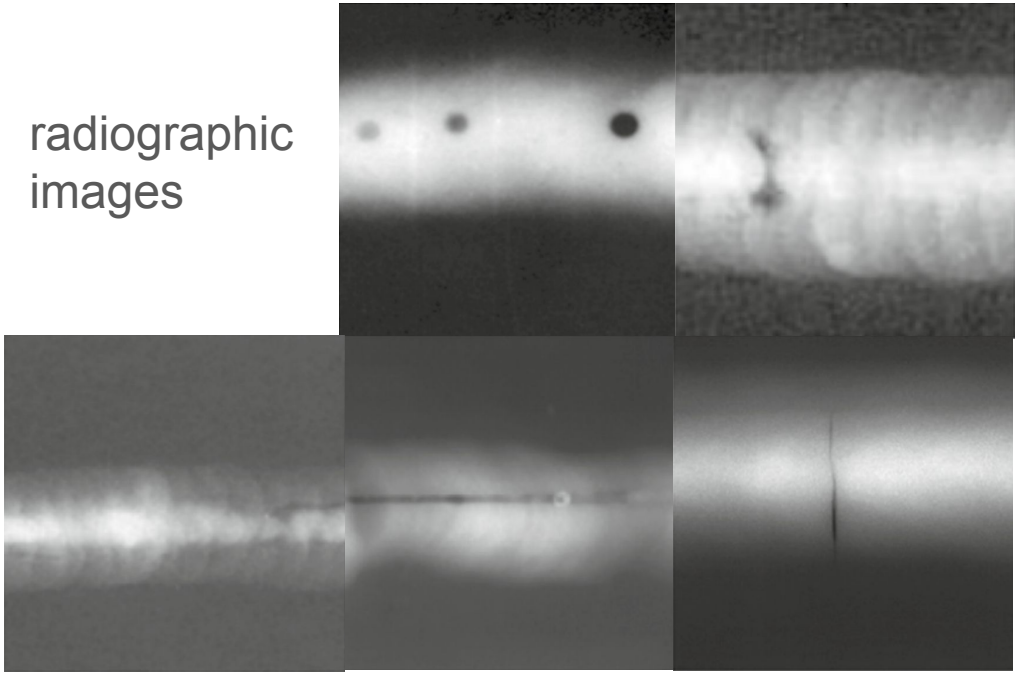
MEM T380 - Applied ML in ME

Drexel UNIVERSITY

Problem & Approach

radiographic images



[1]

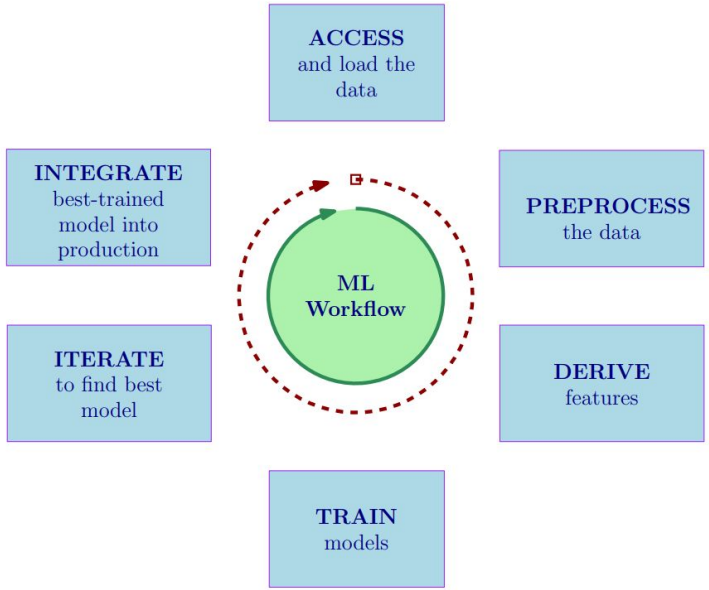


Figure 1: Workflow of `ML` modeling. [2]

Data Preparation

- Combine subsets `pd.concat`

Features

- Normalize `MinMaxScaler()`

Target

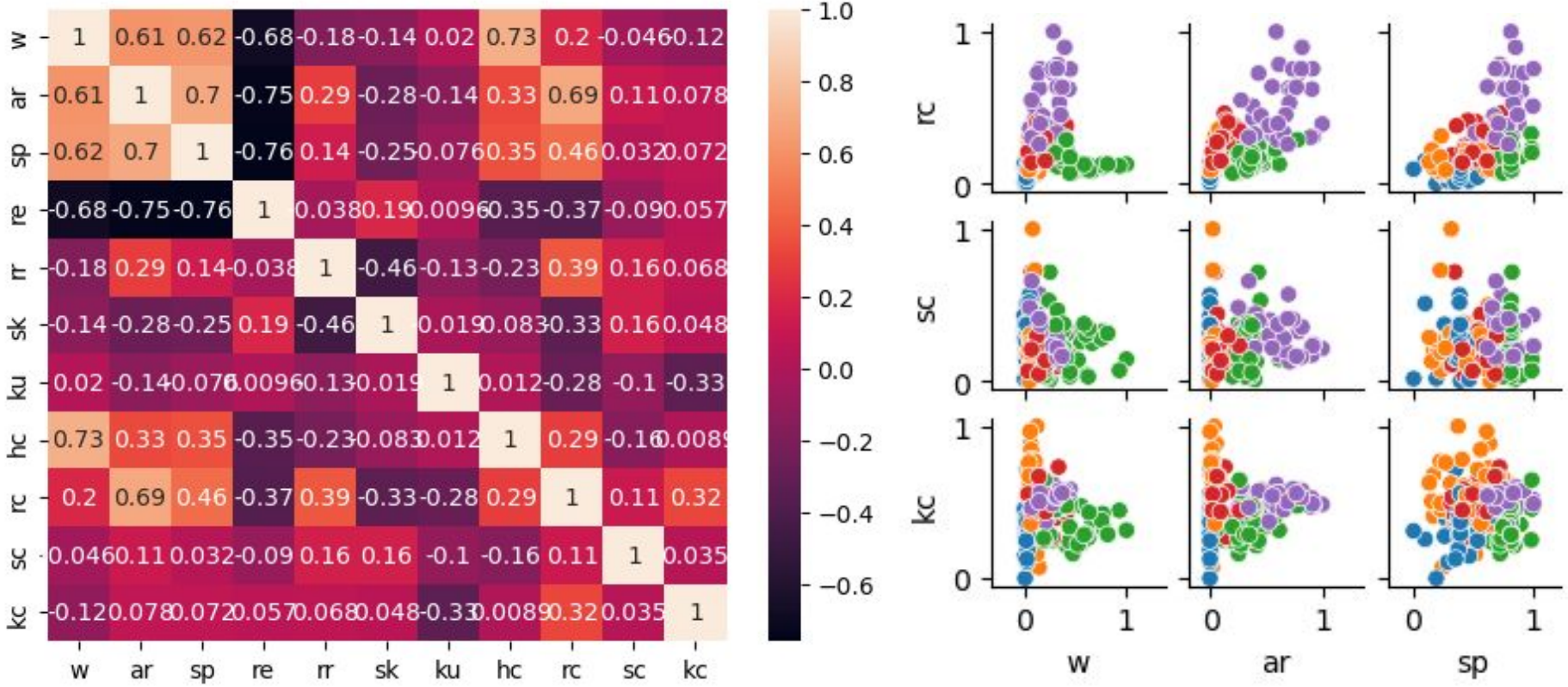
- One-hot encode `pd.get_dummies`

ACCESS and load the data

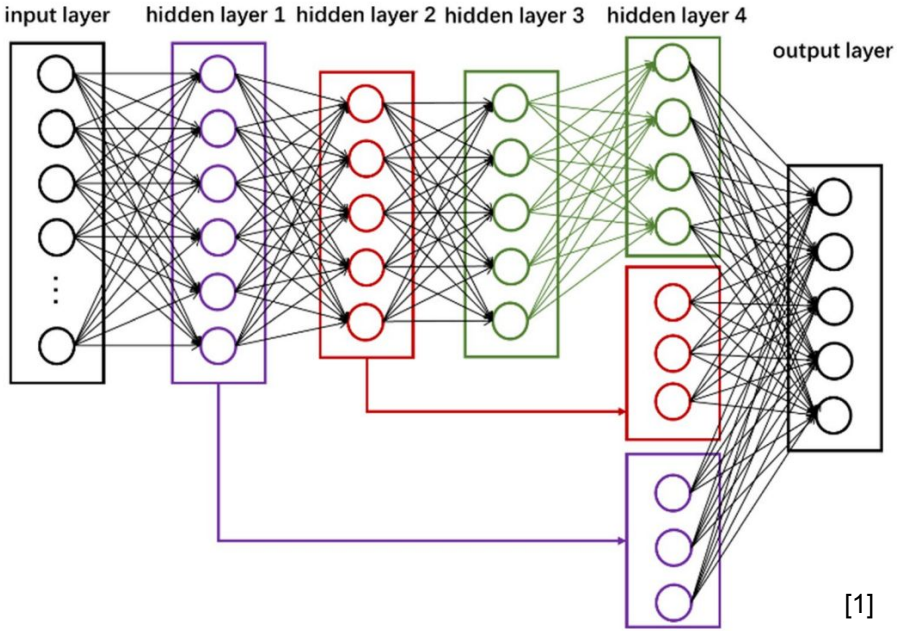
PREPROCESS the data

DERIVE features

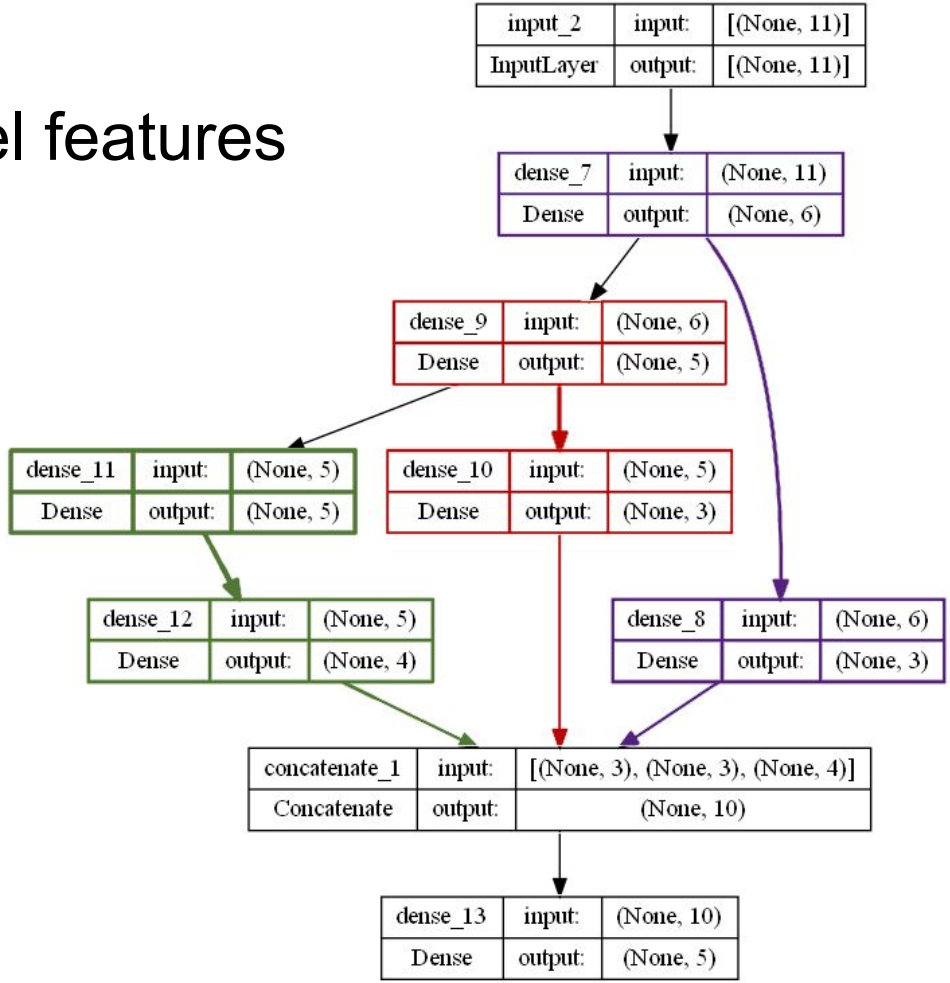
Data Exploration



Architecture: unified DNN with multi-level features



[1]



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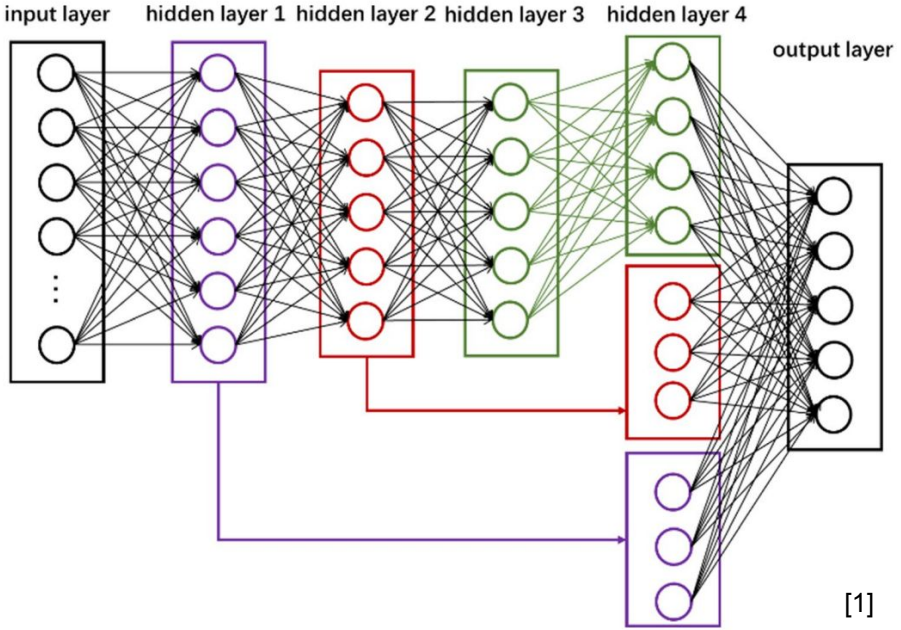
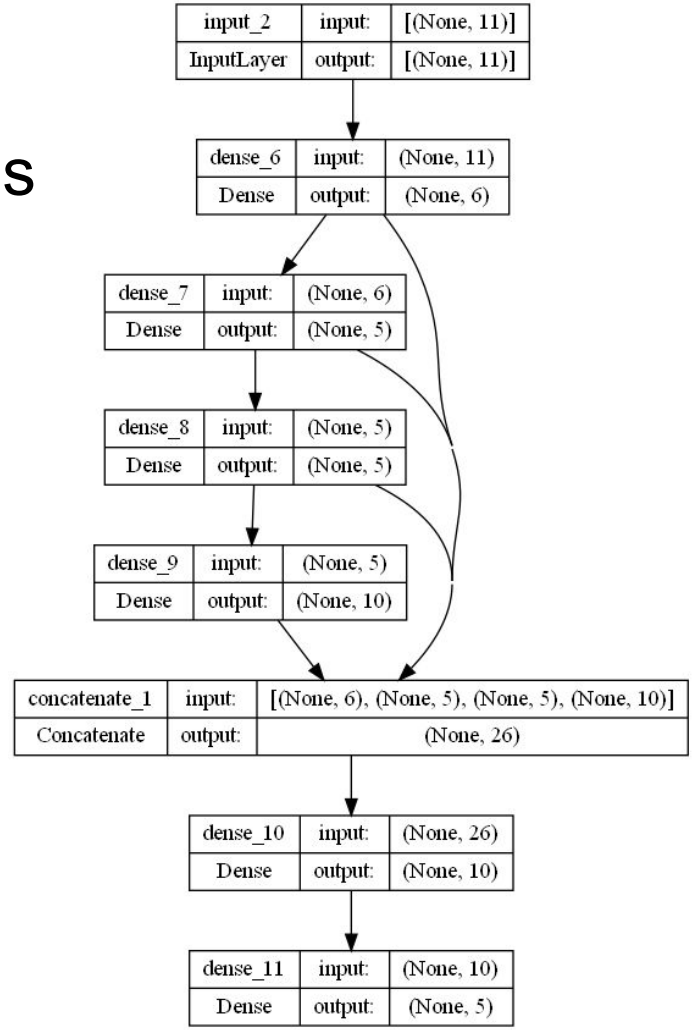
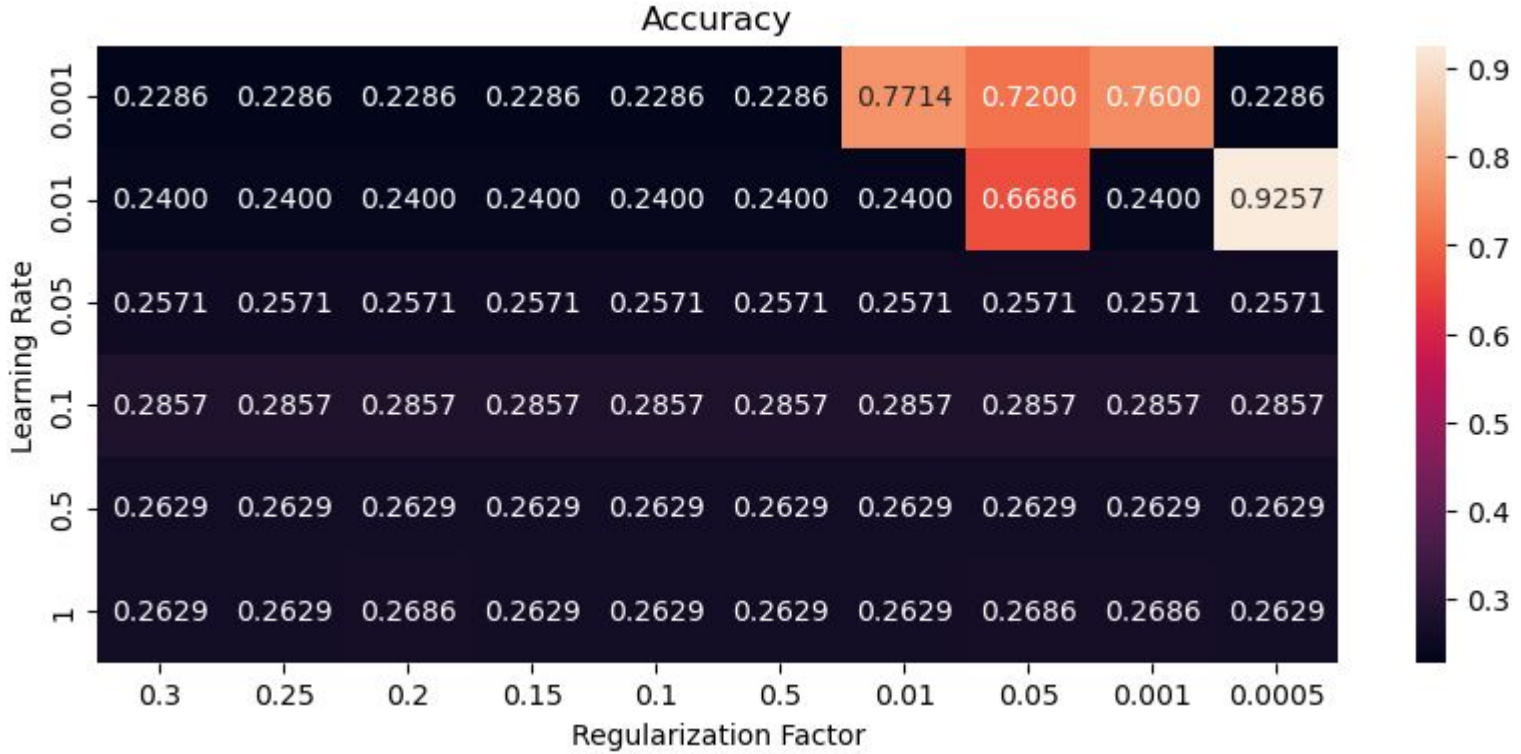


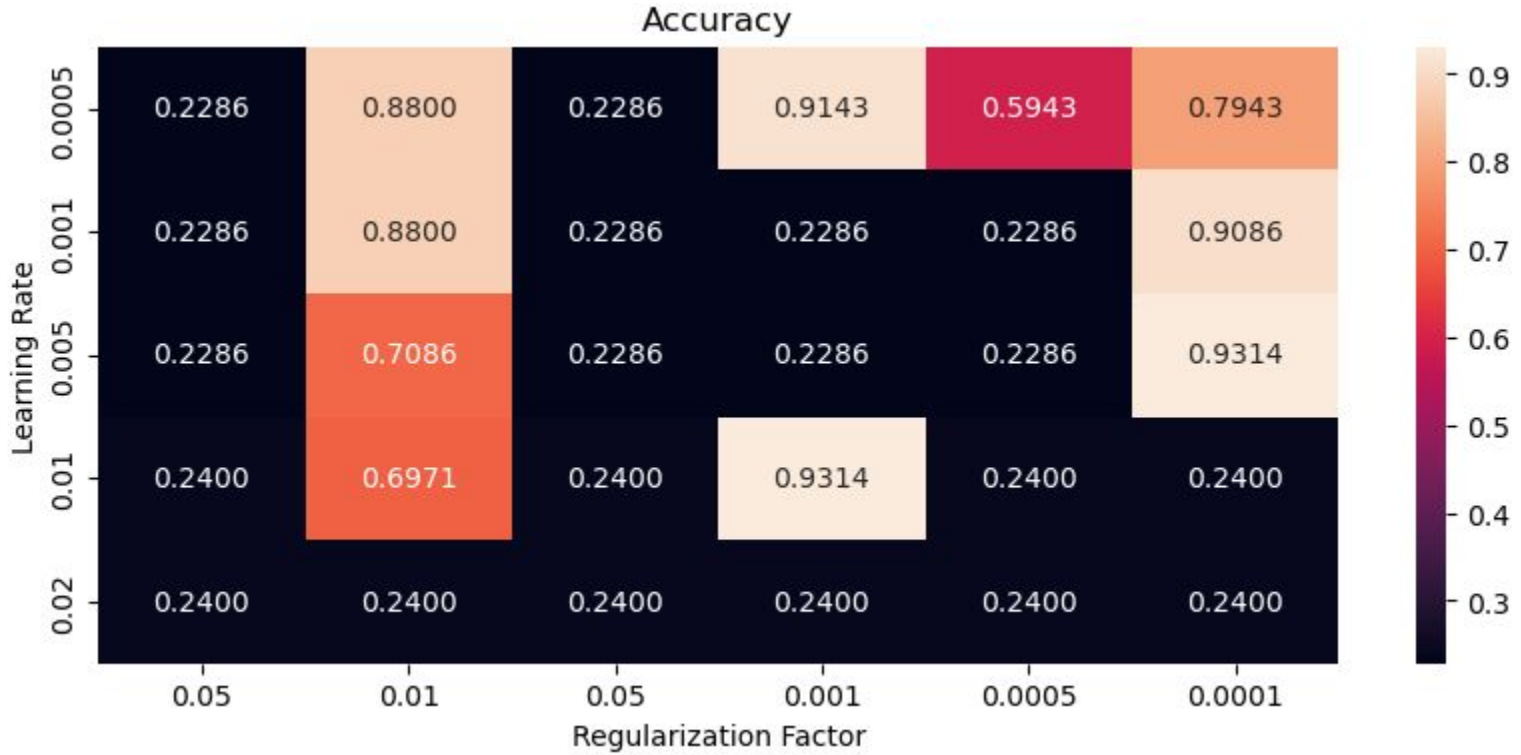
[1]



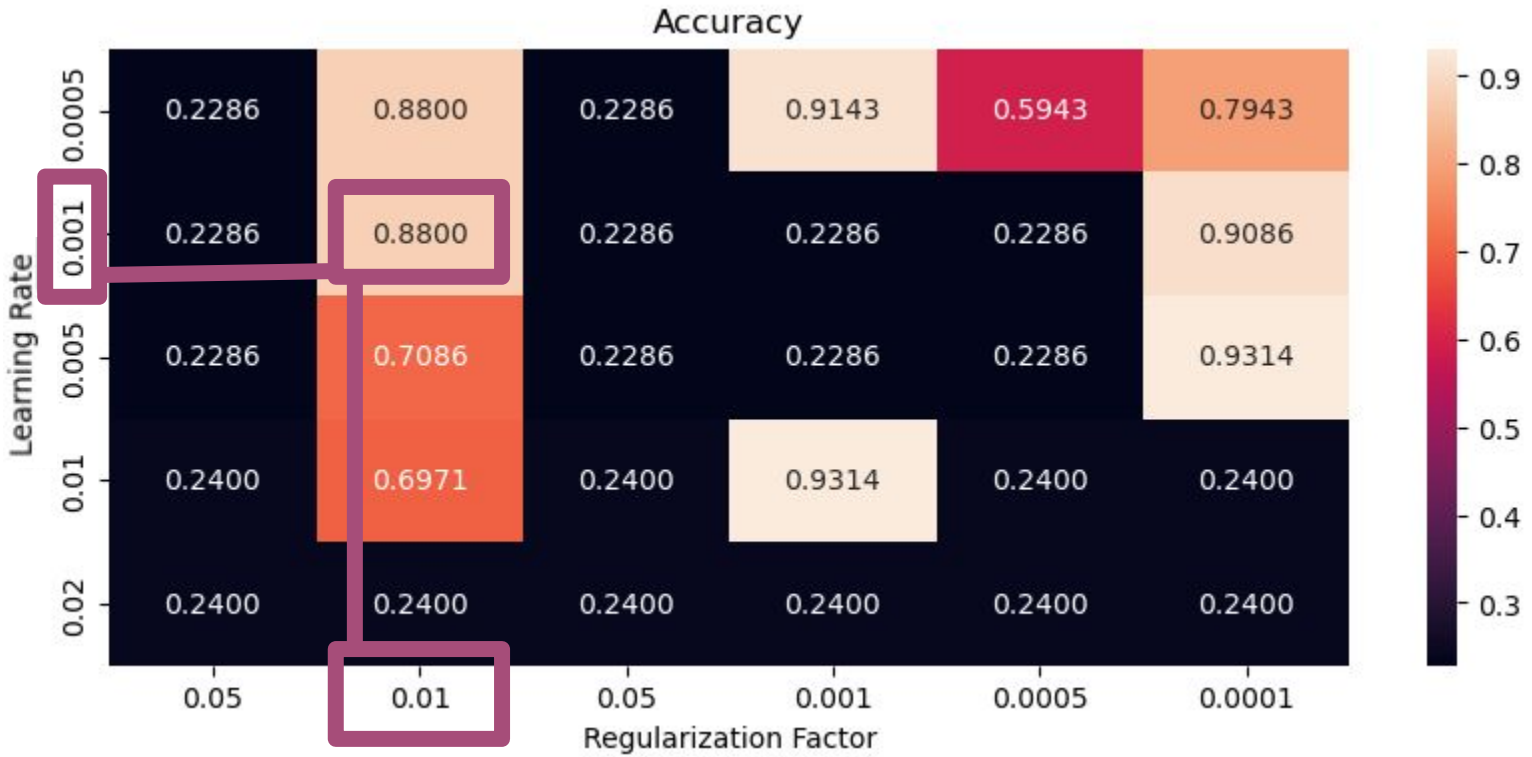
Parameter Tuning



Parameter Tuning

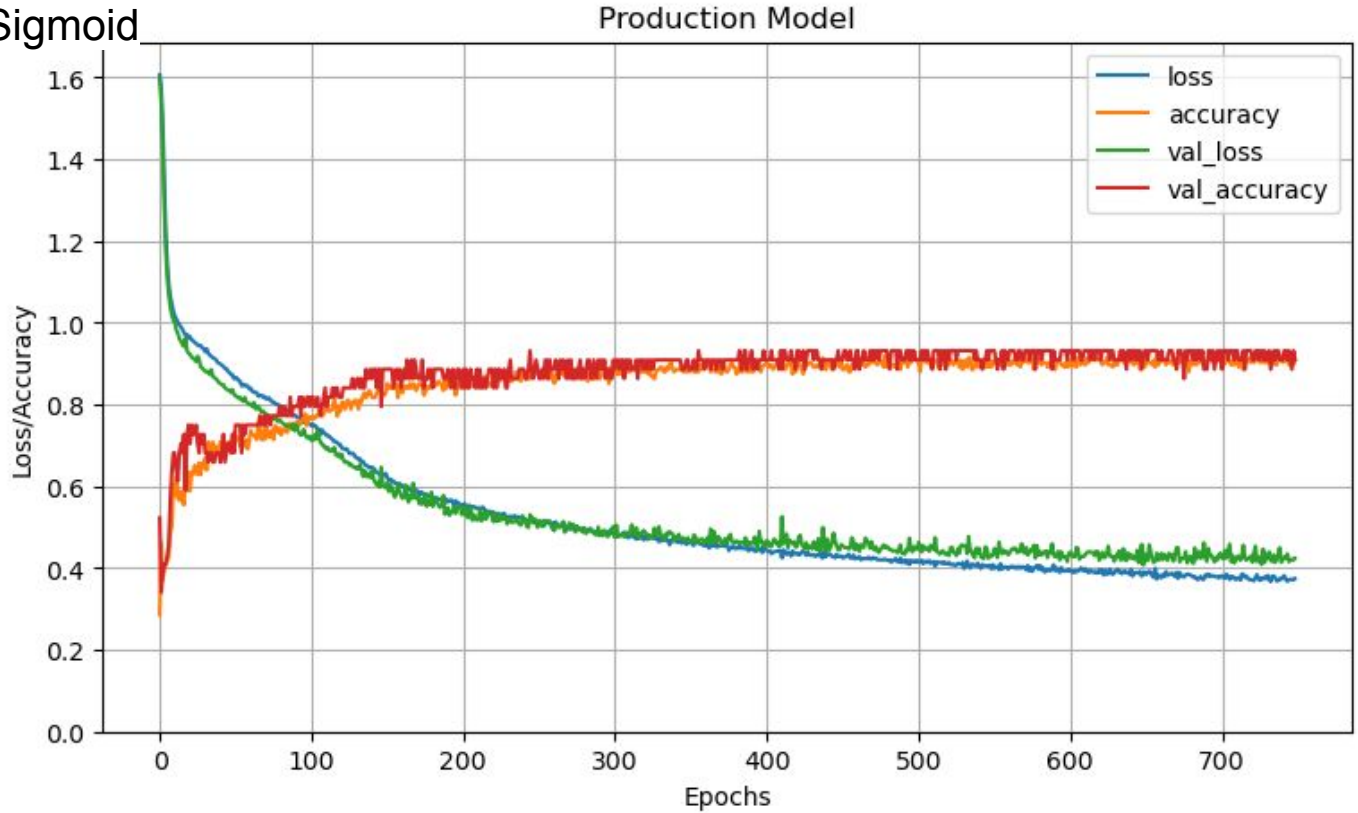


Parameter Tuning



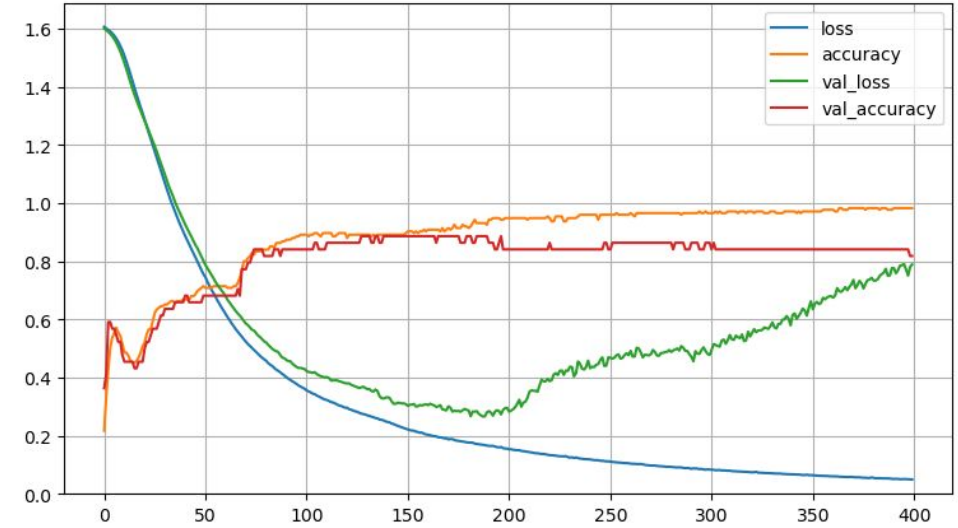
Kernel Initializer = Random Normal
Tensorflow Random Seed = 0
Train Test Split Random State = 42
Hidden Layer Activation = Rectified Linear Unit
Output Layer Activation = Sigmoid

Learning Rate = 0.001
Regularization = 0.01
Optimizer = Adam
Batch Size = 1
Epochs = 1000
Early Stop Patience = 100

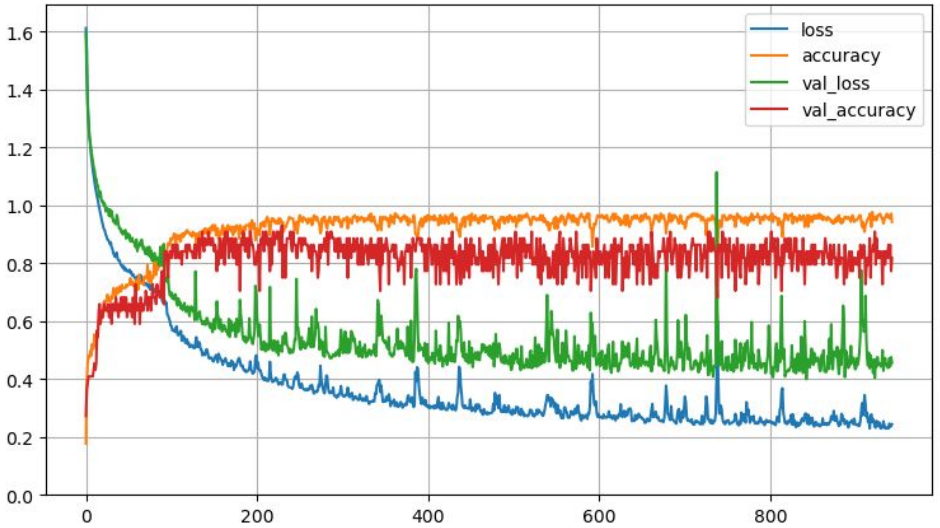


Suboptimal Models

No Early Stop

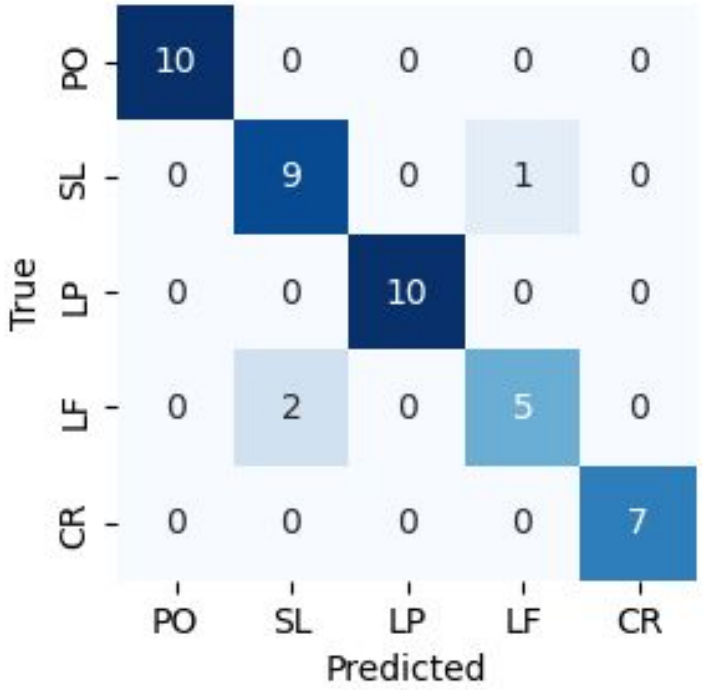


Learning Rate Too High

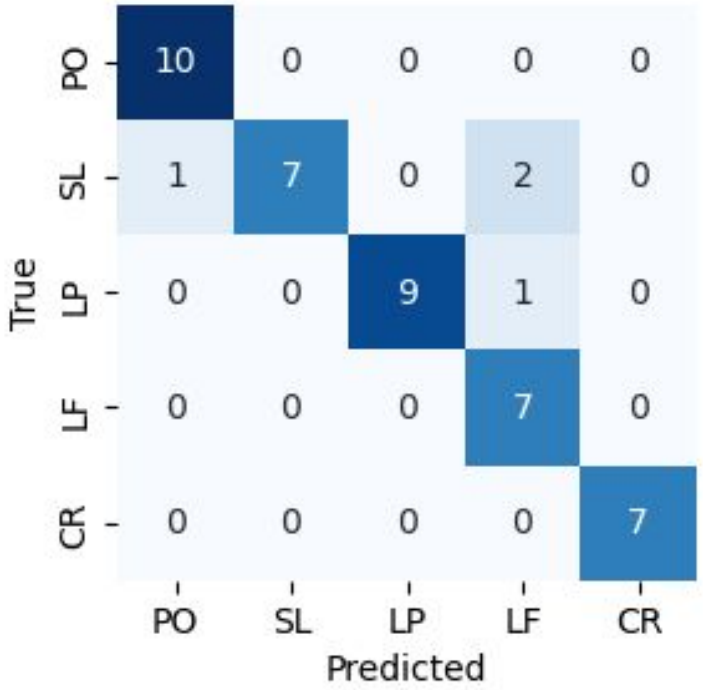


Confusion Matrix Comparison

Research Paper



Ours



Average Accuracy Under 5 Fold Cross Validation (%)						
	Research Paper Normalized Stratified K Fold	Ours - Normalized Data		Ours - Standardized Data		
		K Fold	Stratified K Fold	K Fold	Stratified K Fold	Exact Subsets
Training	97.95	91.03	92.01	99.77	99.57	99.68
Testing	91.36	89.97	91.41	92.39	95.71	95.27

Average Accuracy Under 5 Fold Cross Validation (%)						
	Research Paper Normalized Stratified K Fold	Ours - Normalized Data		Ours - Standardized Data		
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Conclusion / Paper Review

Any Unbalanced Validation?

Learning Rate
Regularization
Loss

Epochs?
Early Stop Patience?

References

[1] L. Yang and H. Jiang, “Weld defect classification in radiographic images using unified deep neural network with multi-level features,” *Journal of Intelligent Manufacturing*, vol. 32, no. 2, pp. 459–469, 2020. doi:10.1007/s10845-020-01581-2

[2] D. Fafalis, “Project Spring 2023,” *MEM T380 – Applied Machine Learning in Mechanical Engineering*

Thank You!

Questions?