

Mechanical Part Classification Using Sequence Models



Lucas Crupi, Dr. Alison Olechowski

Background

- Sequence models for CAD focus on sketches or simple 3D geometry. [1][2]
- Classification models started many machine learning fields. [3][4]

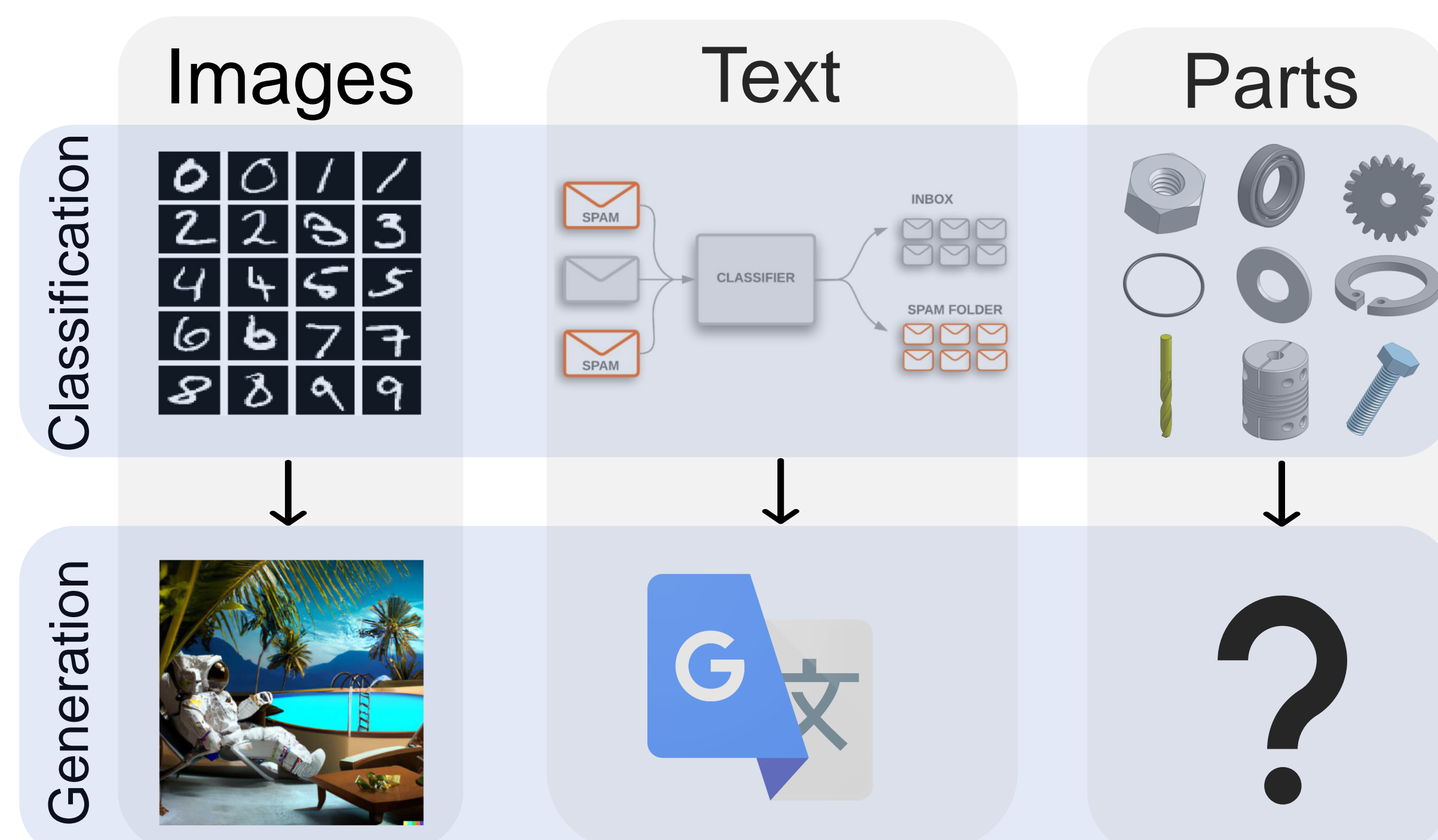


Figure 1: Classification and generative models. [3][4][5]

Data Collection

- 38 different part classes were identified including screws, nuts, washers, bearings, shafts, gears and more.

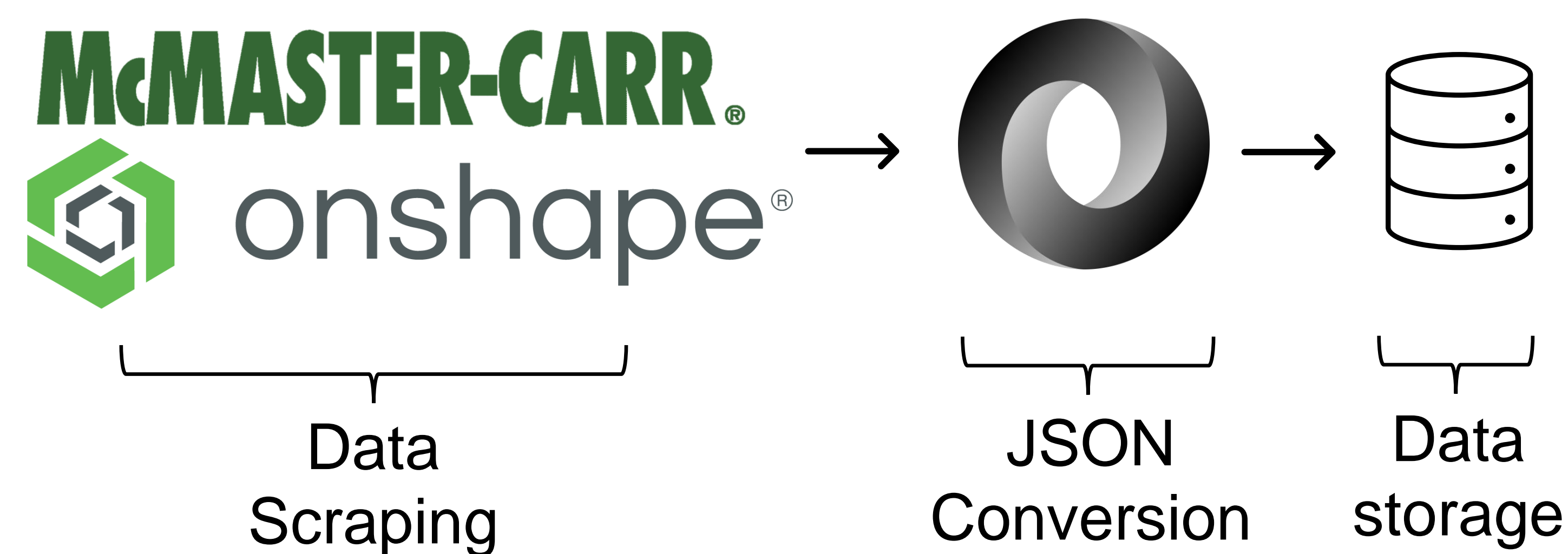
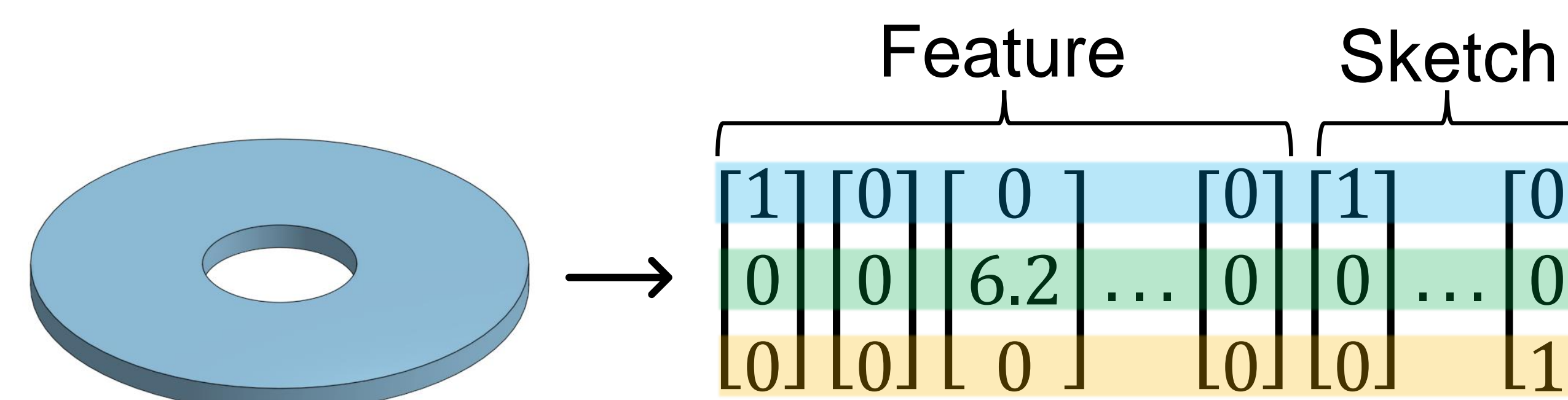


Figure 2: Outline of data collection process.

Data Representation

- Conversion from JSON to sequence data.
- Extend triplet model to represent parts. [1]



■ Categorical Data ■ Continuous Data ■ End Key

Figure 3: Part to triplet sequence example.

- Sequences are padded to length 1024 and uniformly scaled.
- Features are permuted, and parts are oriented in 6 primary directions.

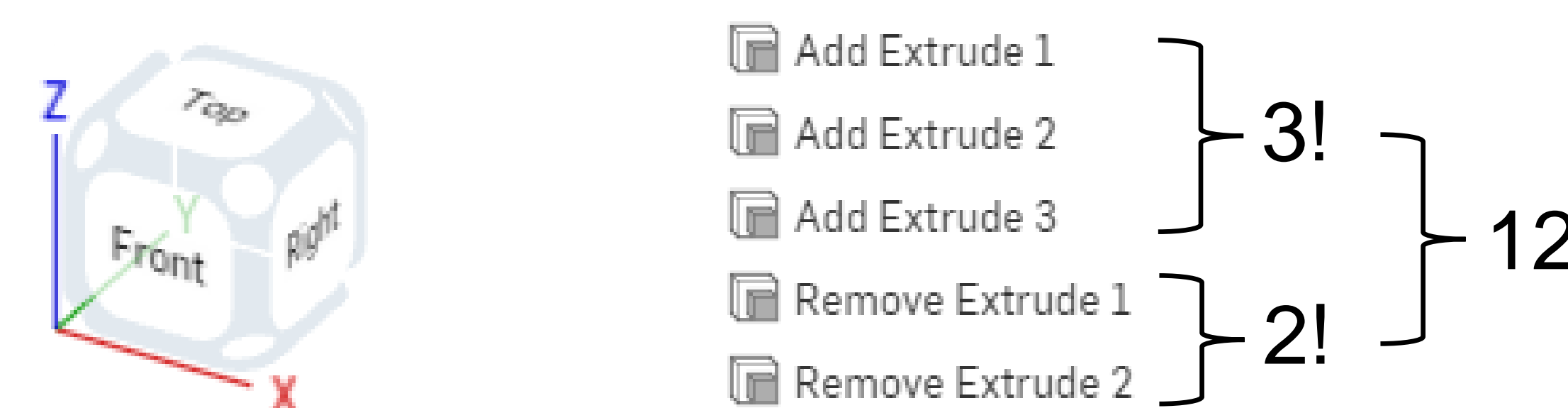


Figure 4: Data Augmentation examples.

Future Work

- Assembly organization and search tools.
- Feature generation for 3D parts.

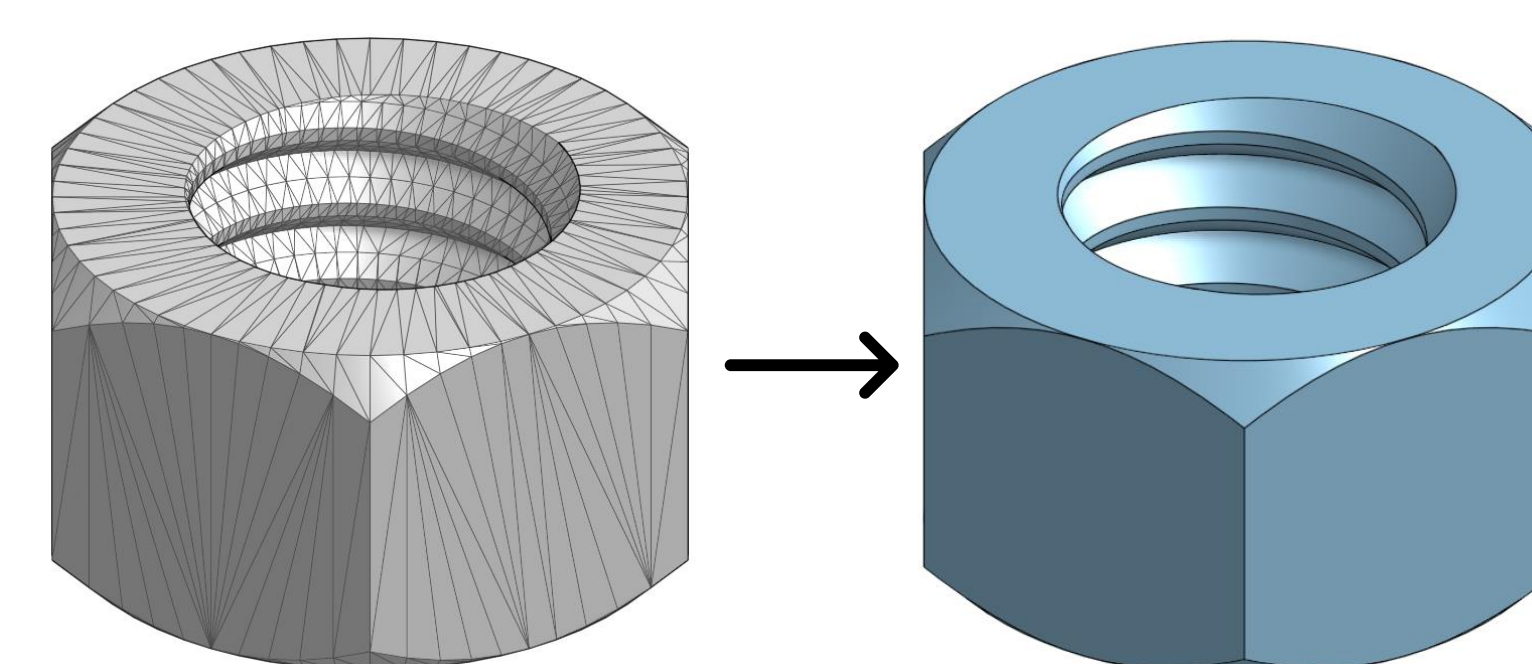


Figure 5: STL to parametric part example.

Classification Model

- Data is available for screws and nuts. The model is trained on 11,000 parts
- Model shows classification accuracy over 99% on train and test set.

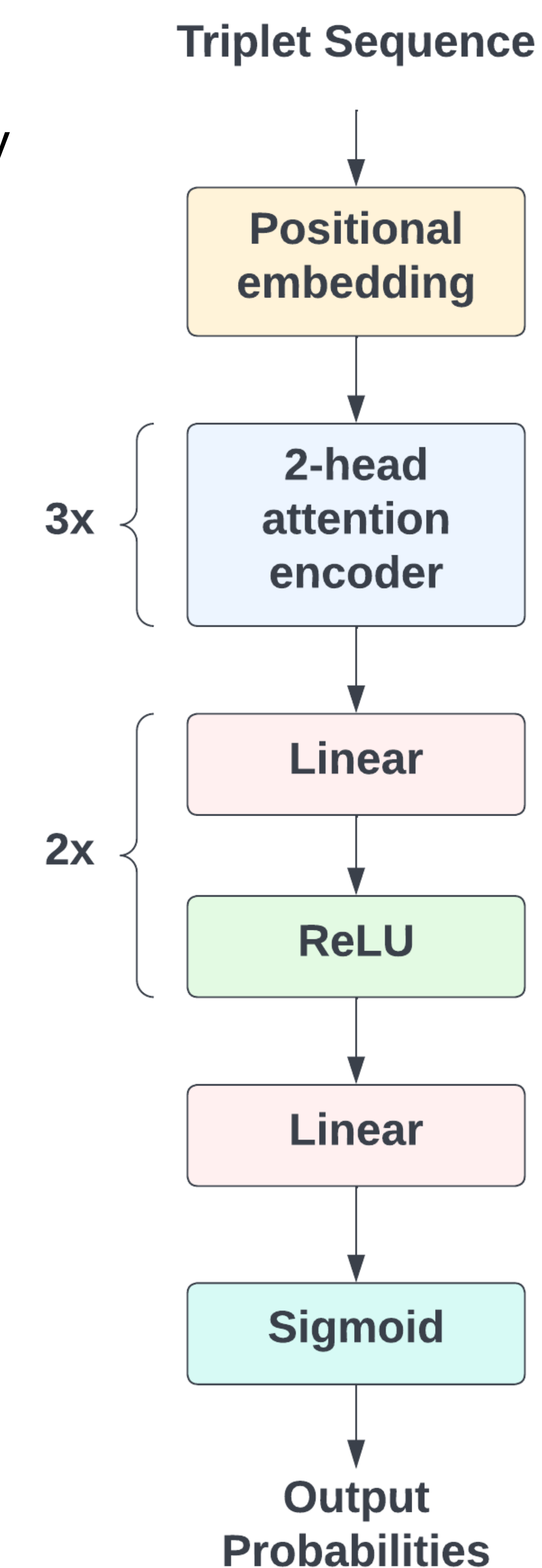


Figure 6: Classification model flowchart. [6]

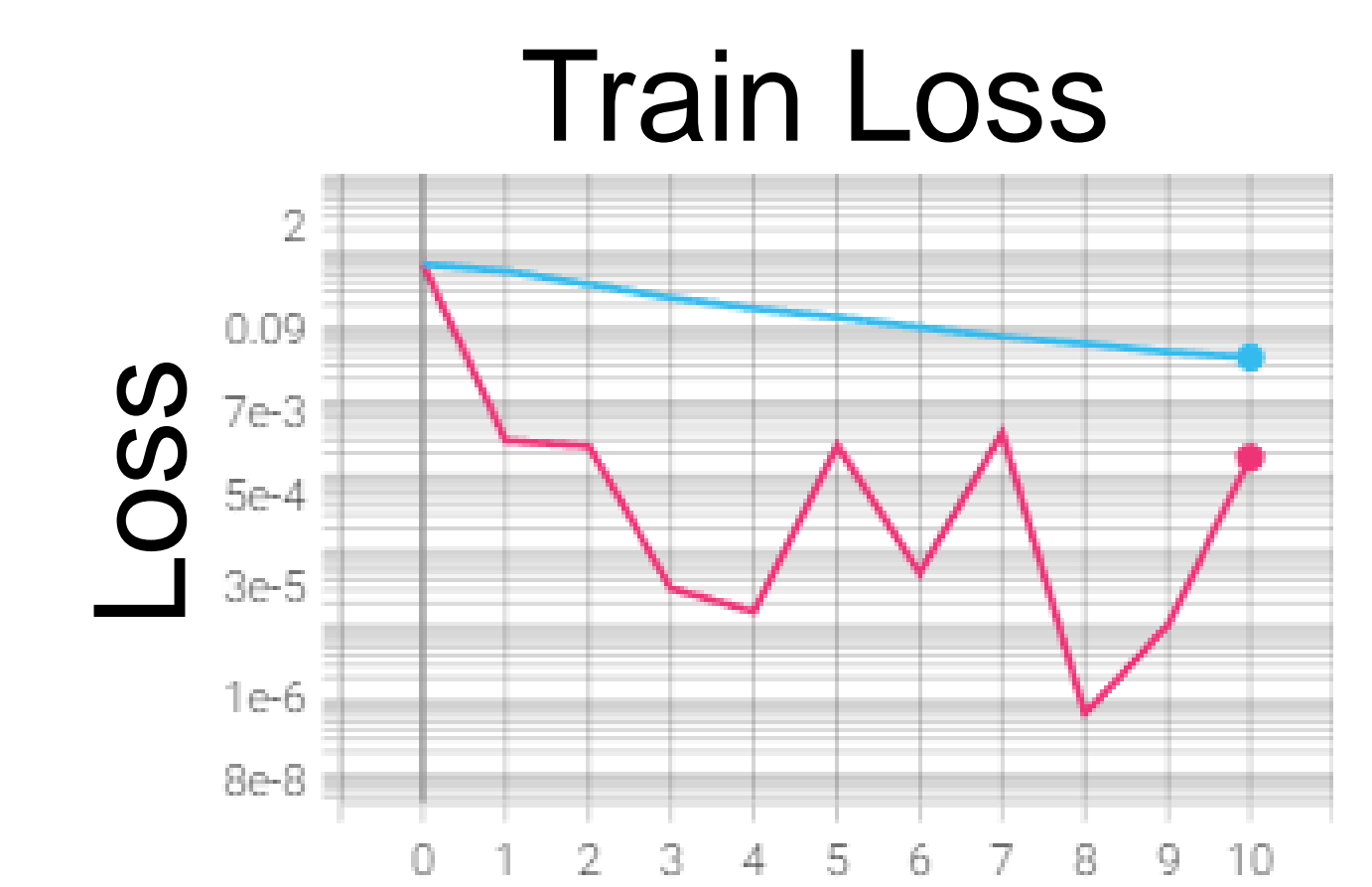
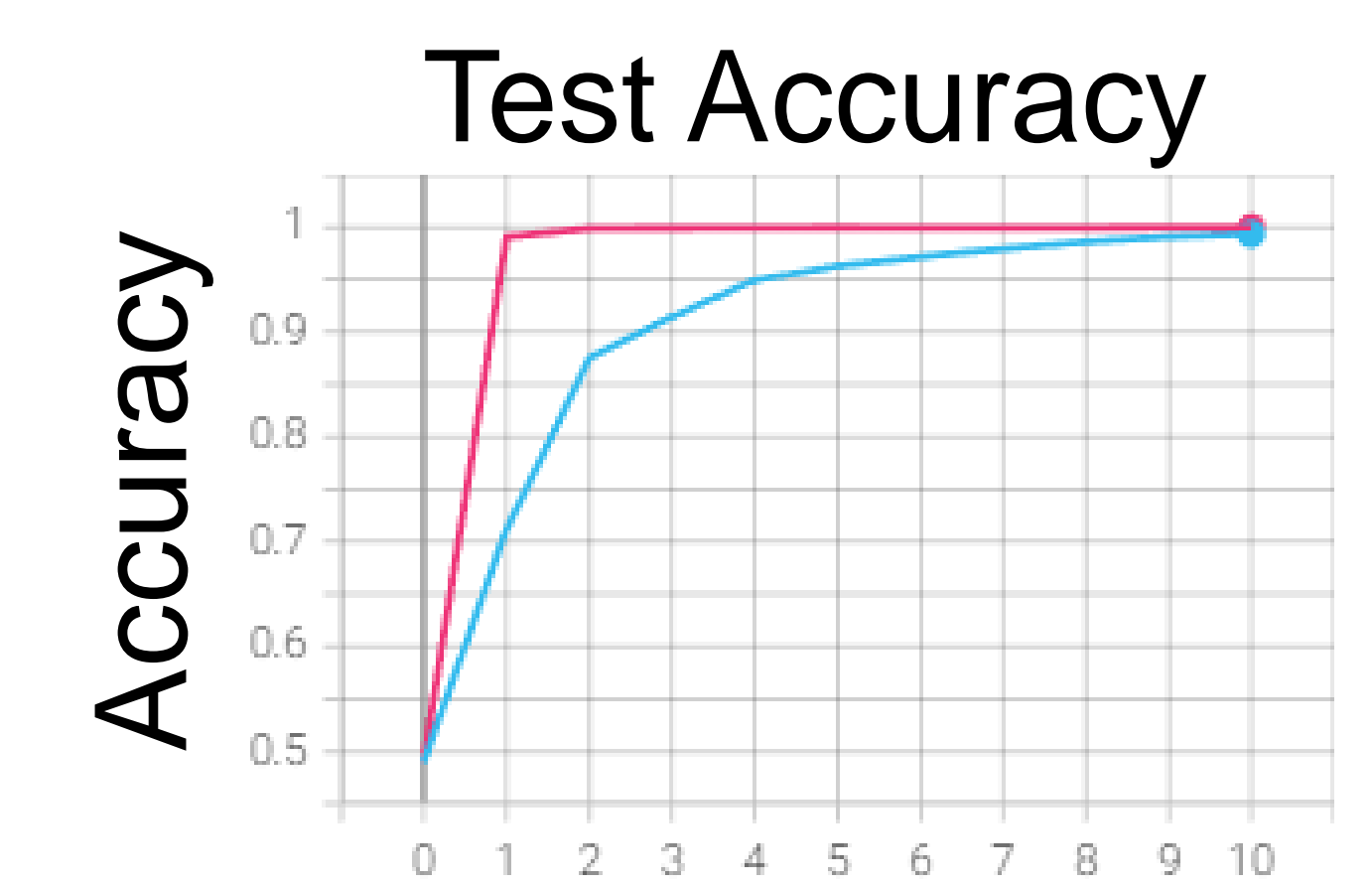
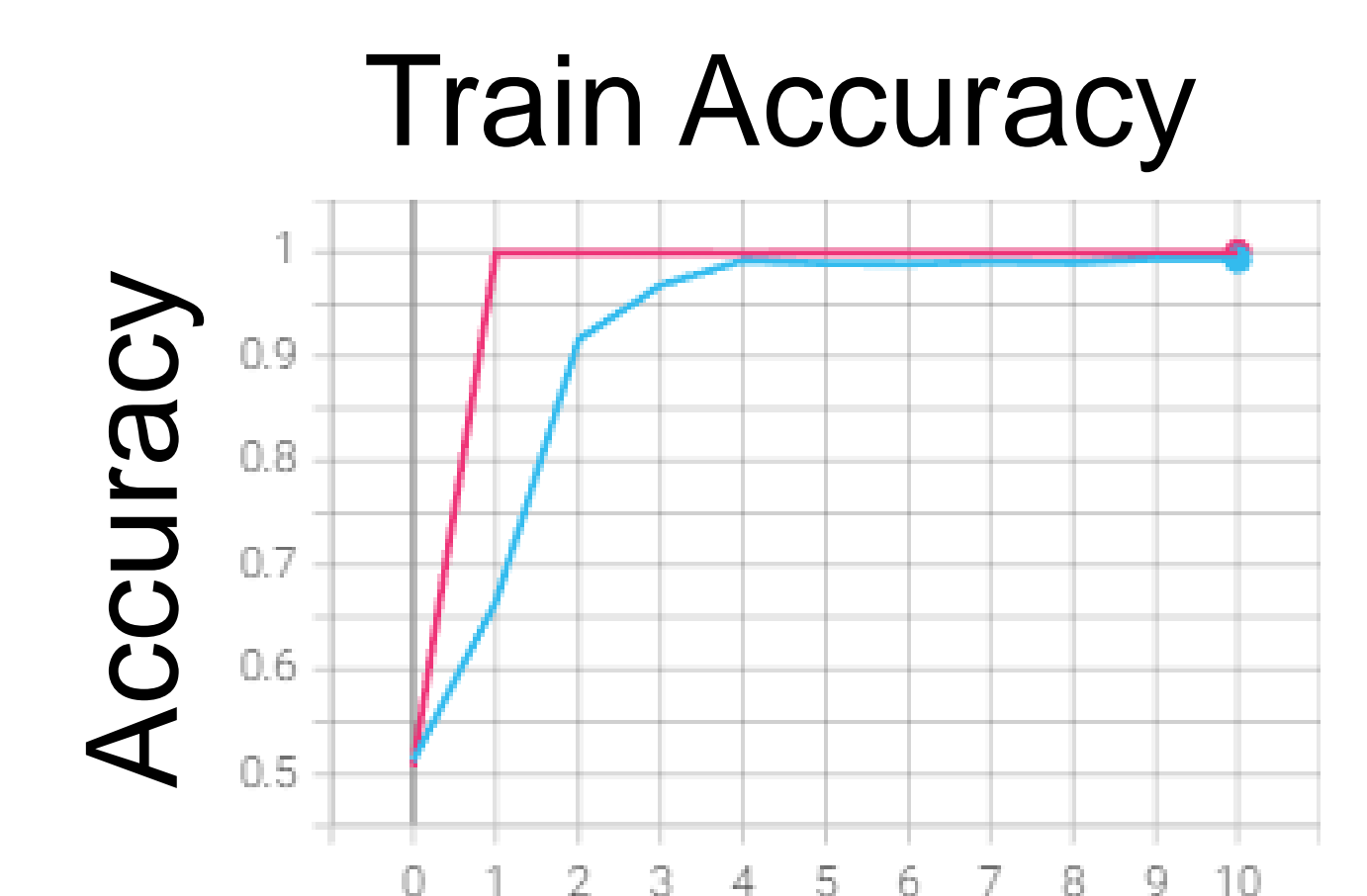


Figure 7: Model results and metrics. Blue – SGD Red – ADAM. [7]