A replication study of transformer-based TabPFN for assessing the applicability of neural-network based solutions in tabular classification.

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Abstract

Abstracts must be able to stand alone and so cannot contain citations to the paper's references, equations, etc. An abstract must consist of a single paragraph and be concise. Because of online formatting, abstracts must appear as plain as possible. Three to six keywords must be included. Each keyword should not exceed three words.

Keywords: keyword1, keyword2, keyword3, keyword4, keyword5, keyword6.

1. Introduction

Deep Learning has revolutionized the field of AI and led to remarkable achievements in applications involving image and text data. In particular, large transformer-based models trained on massive corpora, are disrupting machine learning in many areas. However, when it comes to tabular (a.k.a. structured) data, traditional machine learning methods, such as gradient-boosted decision trees have shown superior performance over deep learning.

Recently, TabPFN [1] proposes a radical change to how tabular classification is done, introducing a pre-trained Transformer that is able to perform classification without training. This project aims to replicate and do an empirical review of TabPFN's claims, while potentially exploring avenues for further scaling and modifications based on latest advancements in the Transformer space.

2. Background on TabPFN

2.1 TabPFN Architecture

TabPFN proposed a two-stage approach for tabular data classification: (i) First, meta-learn to approximate Bayesian inference using synthetic datasets. (ii) Second, use the labeled samples *in context* to classify unlabelled samples.

```
TransformerModel(
  (transformer_encoder): TransformerEncoderDiffInit(
    (layers): ModuleList(
      (0-11): 12 x TransformerEncoderLayer(
        (self_attn): MultiheadAttention(
          (out_proj): NonDynamicallyQuantizableLinear(in_features=512, out_features=512, bias=True
        )
```

[1] https://github.com/automl/TabPFN

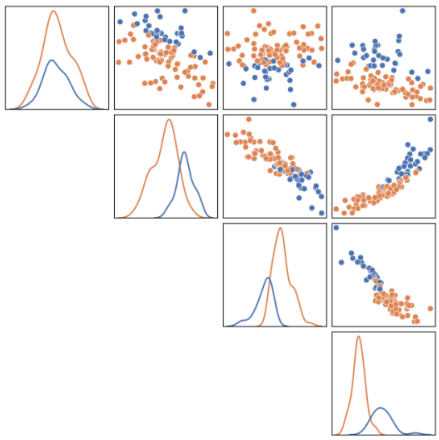

Figure 1: Visualization of Prior samples.

```
        (linear1): Linear(in_features=512, out_features=1024, bias=True)
        (dropout): Dropout(p=0.0, inplace=False)
        (linear2): Linear(in_features=1024, out_features=512, bias=True)
        (norm1): LayerNorm((512,), eps=1e-05, elementwise_affine=True)
        (norm2): LayerNorm((512,), eps=1e-05, elementwise_affine=True)(dropout1): Dropout(p=0.0, i
        (dropout2): Dropout(p=0.0, inplace=False)
      )
    )
  )
  (encoder): Linear(in_features=100, out_features=512, bias=True)
  (y_encoder): Linear(in_features=1, out_features=512, bias=True)
  (decoder): Sequential(
    (0): Linear(in_features=512, out_features=1024, bias=True)
    (1): GELU(approximate='none')
    (2): Linear(in_features=1024, out_features=10, bias=True)
  )
  (criterion): CrossEntropyLoss()
)
```

2.2 How to create sections and subsections

Simply use the section and subsection commands, as in this example document! With Overleaf, all the formatting and numbering is handled automatically according to the template you've chosen. If you're using the Visual Editor, you can also create new sections and subsections via the buttons in the editor toolbar.

2.3 This is an example for second level head - subsection head

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Figure 2: TabPFN Architecture.

lacus. Duis cursus enim ut augue. Cras ac magna. Cras nulla. Nulla egestas. Curabitur a leo. Quisque egestas wisi eget nunc. Nam feugiat lacus vel est. Curabitur consectetuer.

2.3.1 This is an example for third level head - subsubsection head

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This is an example for fourth level head - paragraph head
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3. Replication and Evaluation

3.1 Baselines

We start with evaluation of the existing model provided the authors of TabPFN. We compare against five standard ML methods and two state-of-the-art AutoML systems for tabular data.

3.1.1 Datasets

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4. Conclusions

Some conclusions here.

A. Some Notation

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A.1 Appendix subsection title here

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