Peak Detection in Time Series : TranAD Architecture

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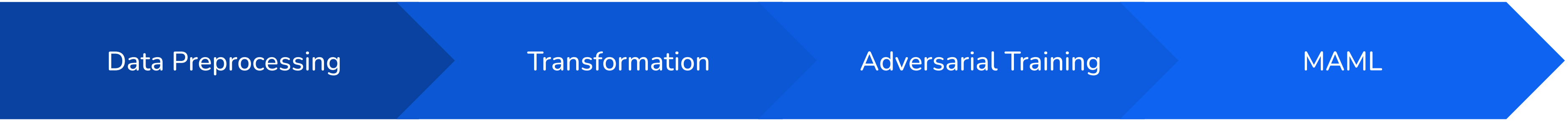
TranAD - Architecture



Normalize data - [0, 1]

Sliding windows - W

Encoder - self-attention and multi-head attention

Phase 1: Reconstruction using D1 and D2

Phase 2 : D2 calculates focus score using D1 reconstruction error.

Loss Function evolves using weighted combination of reconstruction loss and adversarial loss

Weights are updated using meta-optimization at the end of each epoch

Server Machine Dataset

❑ Released by **Facebook AI**

❑ Shape of Training data: **(708405, 38)**

❑ Features are anonymized (Ex : CPU usage %, Memory usage, Disk I/O, Network bandwidth, System load, Cache usage, Swap usage)

❑ Interpretation Labels - **(15849-16368:1,9,10,12,13,14,15)** - **(Time Steps : Column Indices)**

0.032258	0.039195	0..027871	0.024390	0.000000	….
0.043011	0.048729	0.033445	0.025552	0.000000	…
0.043011	0.034958	0.032330	0.025552	0.000000	….

Step 1 : Data Preprocessing

❑ W - Input Window by sliding windows function.

❑ Window size = 10

❑ Example :

```
[
          [t=0 row ],
          [t=1 row],
          ........

          [t=9 row]

]
```

Step 2 : Encoder to Decoder 1 (Phase 1)

- ❑ **Encoder**:
  - ❑ Positional Embedding and and Transformer Encoder self-attention layers for **[10, 28]**

- ❑ C = **$(W - O1\_repeated)^2$** of shape **[10, 38]**

- ❑ **Input2** = concat(W, C) = shape **[10, 76]**

- ❑ **Decoder 1 :**
  - ❑ Takes **W** as input window and reconstructs **t10** as **O1** output = shape **[10, 76]**

- ❑ Compute **Reconstruction Error** : also called as **Anomaly Error** = ($W[-1]$ - $O1)^2$

Step 3 : Encoder to Decoder 2 (Self-Conditioning)

- ❑ **Condition** the model using Anomaly Scores from Phase 1
  - ❑ C = **(W - O1_repeated)²** of shape **[10, 38]**
  - ❑ **Input2** = concat(W, C) = shape **[10, 76]**

- ❑ **Encoder** processes the **Input2** again.

- ❑ **Decoder 2** : Reconstructs final output **O2**= shape **[10, 38]**

- ❑ **Final Anomaly Score** : **(W[-1] - O1)²**
  - ❑ uses Mean Squared Error **(MSE)**

Performance Highlights

Outperforms baselines like LSTM-NDT, DAGMM, OmniAnomaly, GDN

F1 score increased by up to 17%

Training time reduced by up to 99%

References

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Thank You For Your Attention!

Autonomous Multisensor Systems