A Deep Neural Network for Unsupervised Anomaly Detection and Diagnosis in Multivariate Time Series Data

(Zhang et al., AAAI 2019)

Cited in “Deep Learning for Anomaly Detection: A Review”

Presenter: Kaiyan Liu

GEORGE MASON UNIVERSITY

Motivation

- **Task**:
  - Detecting and diagnosing anomalies in multivariate time series data without relying on labeled examples.

- **Challenges**:
  - Lack of temporal modeling;
  - Sensitivity to noise;
  - Lack of severity-aware (duration) diagnosis.

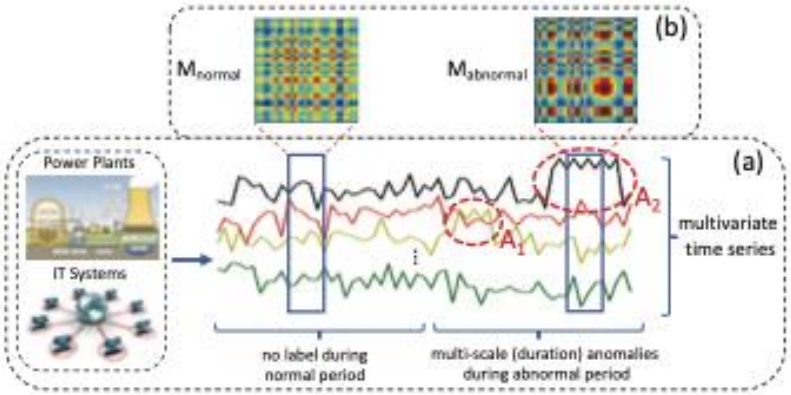

Figure 1: (a) Unsupervised anomaly detection and diagnosis in multivariate time series data. (b) Different system signature matrices between normal and abnormal periods.

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Model Framework

MSCRED (Multi-Scale Convolutional Recurrent Encoder-Decoder) :

(a) Encode the inter-sensor correlations via a convolutional encoder;

(b) Incorporate temporal patterns with attention based ConvLSTM networks;

(c) Reconstruct signature matrix via a convolutional decoder.

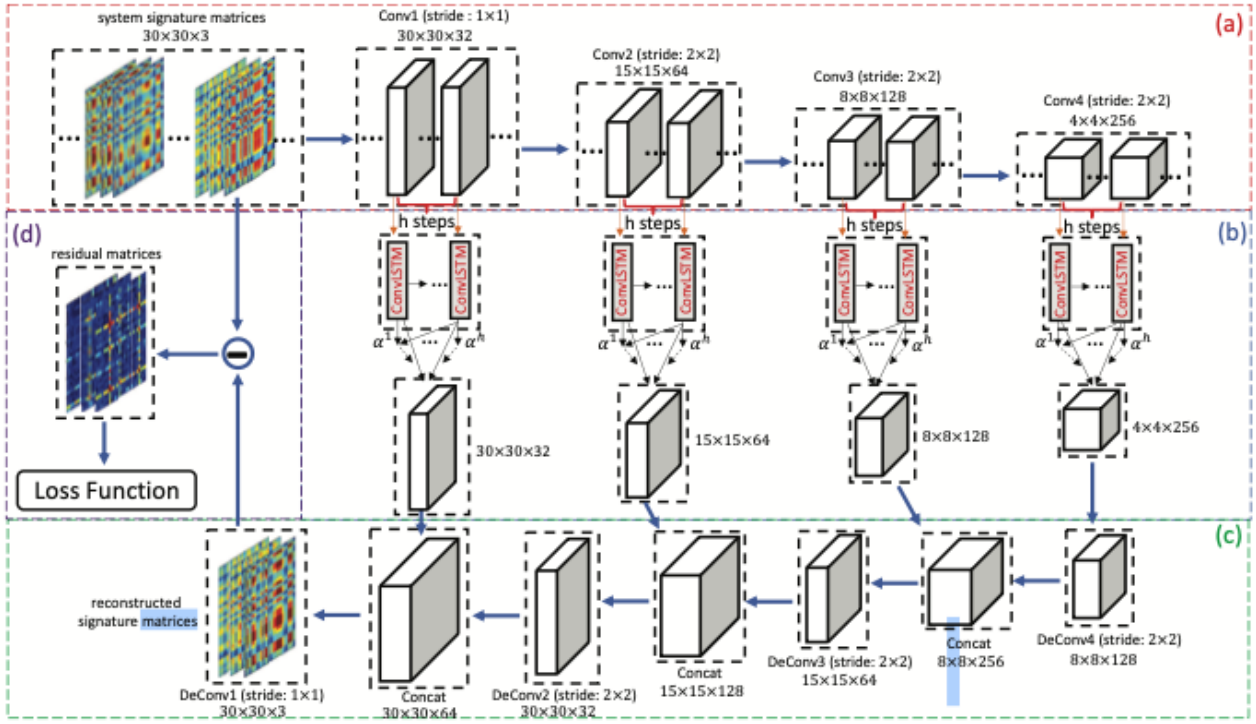

Figure 2: Framework of the proposed model: (a) Signature matrices encoding via fully convolutional neural networks. (b) Temporal patterns modeling by attention based convolutional LSTM networks. (c) Signature matrices decoding via deconvolutional neural networks. (d) Loss function.

Project Plan

1. Reproduce the Original Work

Reimplement the MSCRED model using the PyTorch framework and reproduce the experimental results.

2. Model Improvement — Temporal Dependency Enhancement

Replace the ConvLSTM module with a Transformer-based temporal encoder to capture long-range temporal dependencies.

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Thank you !