



Data Analytics  
Stiftung Universität Hildesheim  
Marienburger Platz 22  
31141 Hildesheim  
Prof. Dr. Dr. Lars Schmidt-Thieme

# Thesis

## Unsupervised Real-Time Time-Series Anomaly Detection

Abdul Rehman Liaqat  
271336, Liaqat@uni-hildesheim.de

## **Abstract**

Anomaly detection is a crucial task for machine learning due to wide-spread usage and type. In particular, it is worth noting that most data arising in industrial setups are of a streaming nature, thus restricting the range of standard anomaly detection tools. This thesis will identify the potential approaches to learn the identification of abnormal behavior from large-scale streaming data. An empirical comparison of state-of-the-art methods will to be extended by a novel technical contribution. In this thesis, the focus is particularly on streaming time-series Anomaly Detection which changes in nature with time and novel contribution will especially try to target this dynamic nature of time-series.

# Contents

<b>1</b>	<b>Introduction</b>	<b>4</b>
<b>2</b>	<b>Multi-Model Architecture</b>	<b>5</b>
2.1	Components . . . . .	5
2.2	Component Models Architecture . . . . .	6
2.3	Base Component Architecture . . . . .	7
2.4	Modality Nets . . . . .	10
2.4.1	Language Modality Net . . . . .	11
2.4.2	Image Modality Net . . . . .	11
2.4.3	Categorical Modality Net . . . . .	12
2.4.4	Audio Modality Net . . . . .	12
<b>3</b>	<b>Experiments</b>	<b>13</b>
3.1	Datasets . . . . .	13
3.2	Basic Questions . . . . .	13
3.3	Results . . . . .	14
<b>4</b>	<b>Conclusion</b>	<b>15</b>
<b>5</b>	<b>Discussions and Remarks</b>	<b>16</b>
5.1	General Review . . . . .	16
5.2	Technical Review . . . . .	16
<b>6</b>	<b>References</b>	<b>17</b>

# 1 Introduction

## 2 References

- [1] F. Chollet, “Xception: Deep learning with depthwise separable convolutions,” *CoRR*, vol. abs/1610.02357, 2016. [Online]. Available: <http://arxiv.org/abs/1610.02357>
- [2] L. et. al. (2017) Author discussion. [Online]. Available: <https://github.com/tensorflow/tensor2tensor/issues/9>
- [3] ——. (2017) Github Code github code. [Online]. Available: <https://github.com/tensorflow/tensor2tensor/blob/f9c859a7639831c6da864e360793a285613dcc5c/tensor2tensor/models/multimodel.py>
- [4] L. Kaiser, A. N. Gomez, N. Shazeer, A. Vaswani, N. Parmar, L. Jones, and J. Uszkoreit, “One model to learn them all,” *CoRR*, vol. abs/1706.05137, 2017. [Online]. Available: <http://arxiv.org/abs/1706.05137>
- [5] N. Shazeer, A. Mirhoseini, K. Maziarz, A. Davis, Q. V. Le, G. E. Hinton, and J. Dean, “Outrageously large neural networks: The sparsely-gated mixture-of-experts layer,” *CoRR*, vol. abs/1701.06538, 2017. [Online]. Available: <http://arxiv.org/abs/1701.06538>