Evolving System for Anomaly Detection

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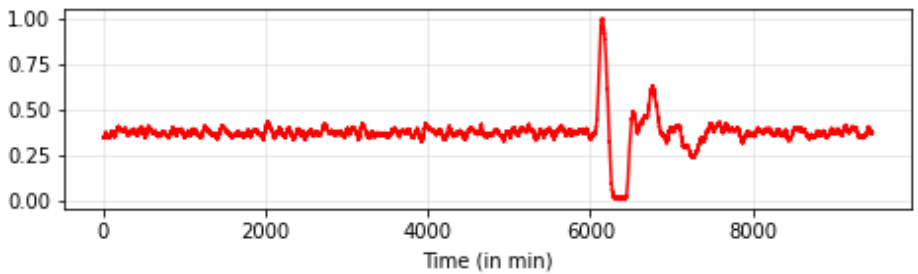
Polytechnique Montréal
DORSAL Laboratory

Outline

Introduction

- Real problems:
  - Detecting fraudulent use of credit cards
  - Data interoperability in IoT environments
  - Detecting and diagnosing faults in industrial processes, like a delayed response from a service

- Data stream
- Anomaly



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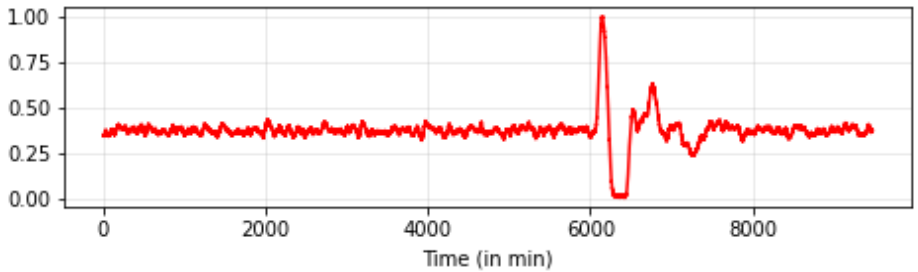

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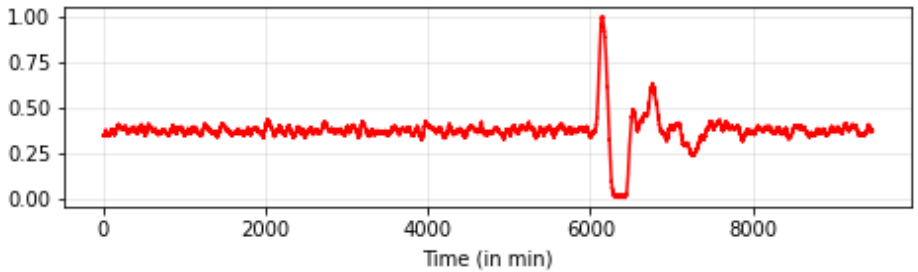

Objective

- Introduce the Macro SOStream algorithm
- Propose framework employing the Macro SOStream

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- Concept evolution
- Shift and concept drift
- Single data pass
- The Macro SOStream algorithm
  - Clustering
  - Online and density
  - Microclusters and Macroclusters

Figure: Four types of patterns of changes over time.

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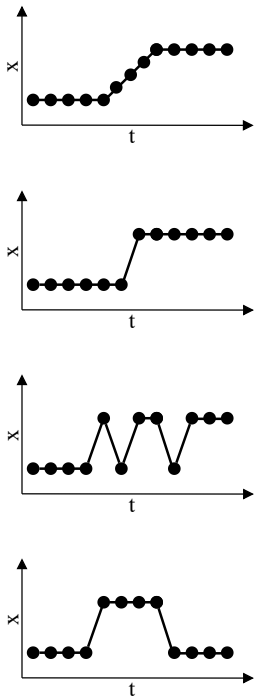

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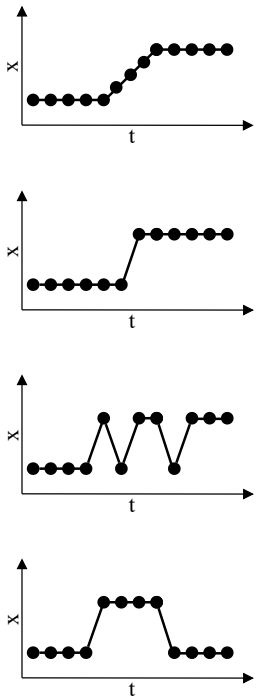

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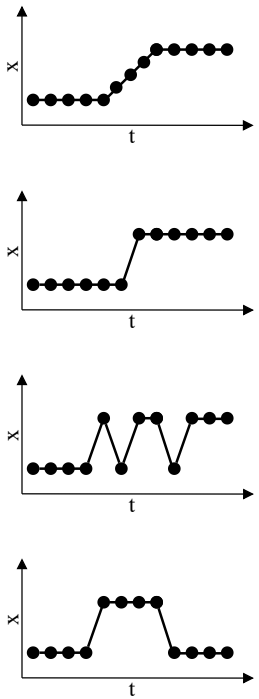

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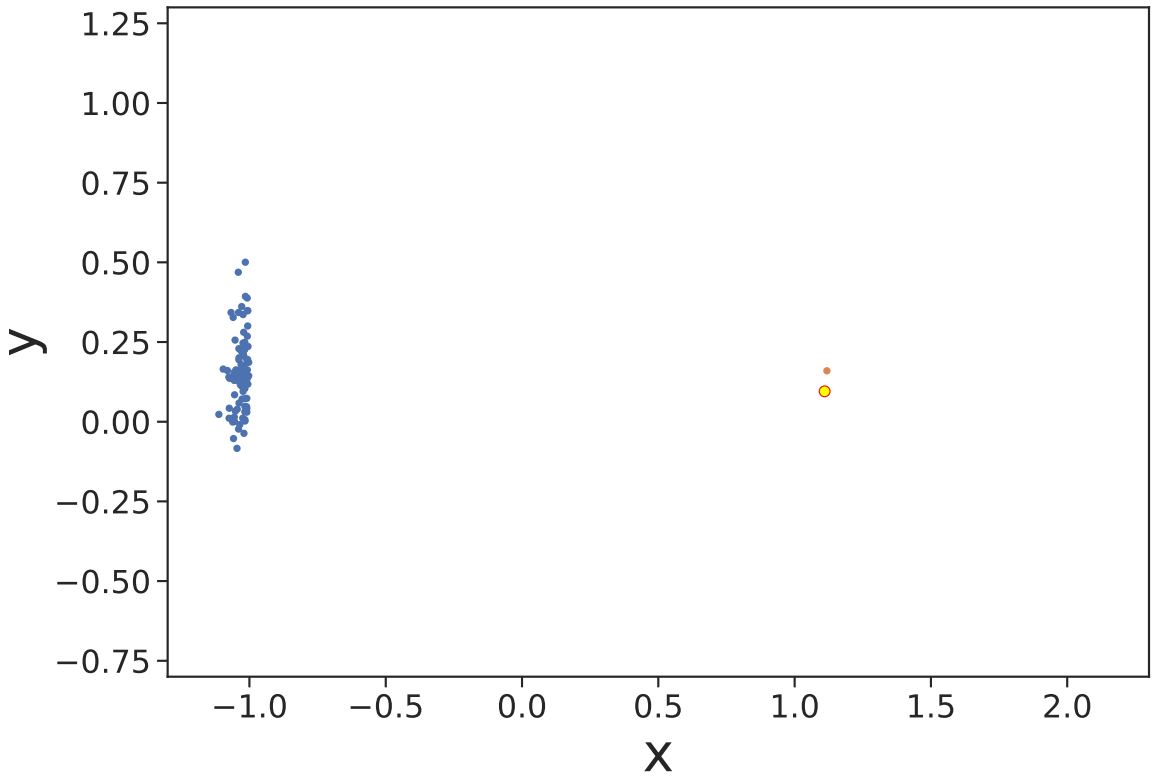

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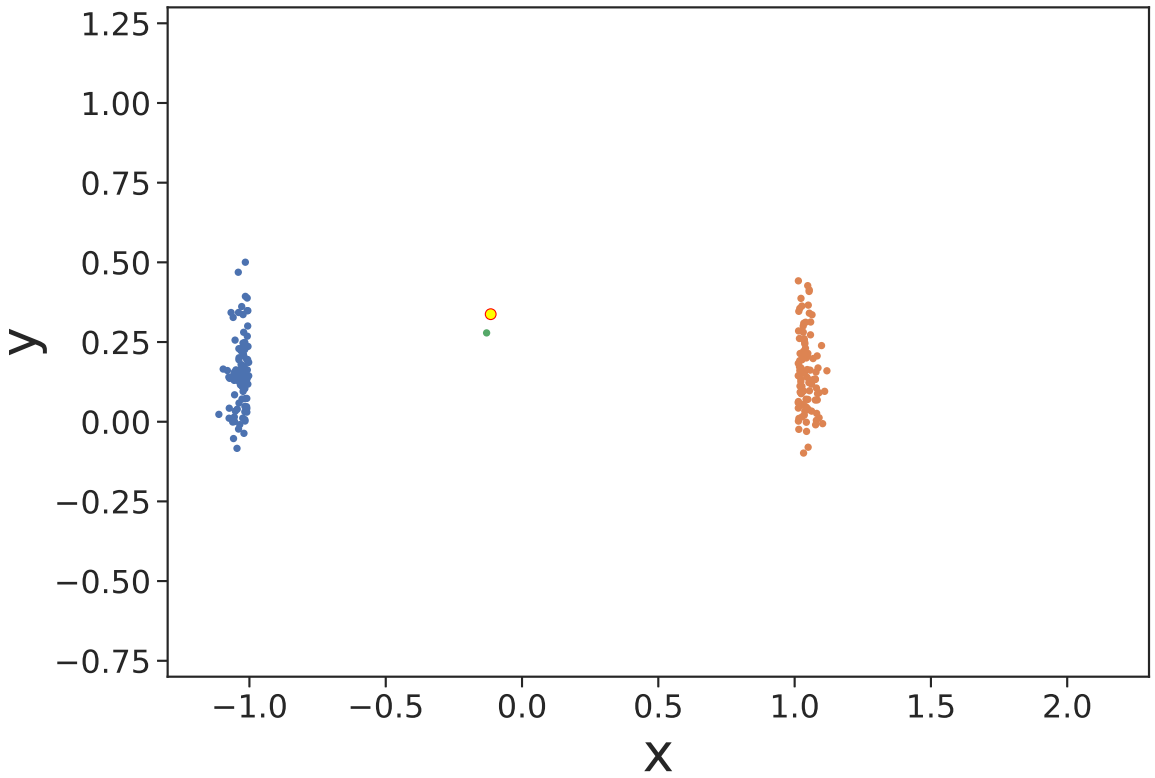

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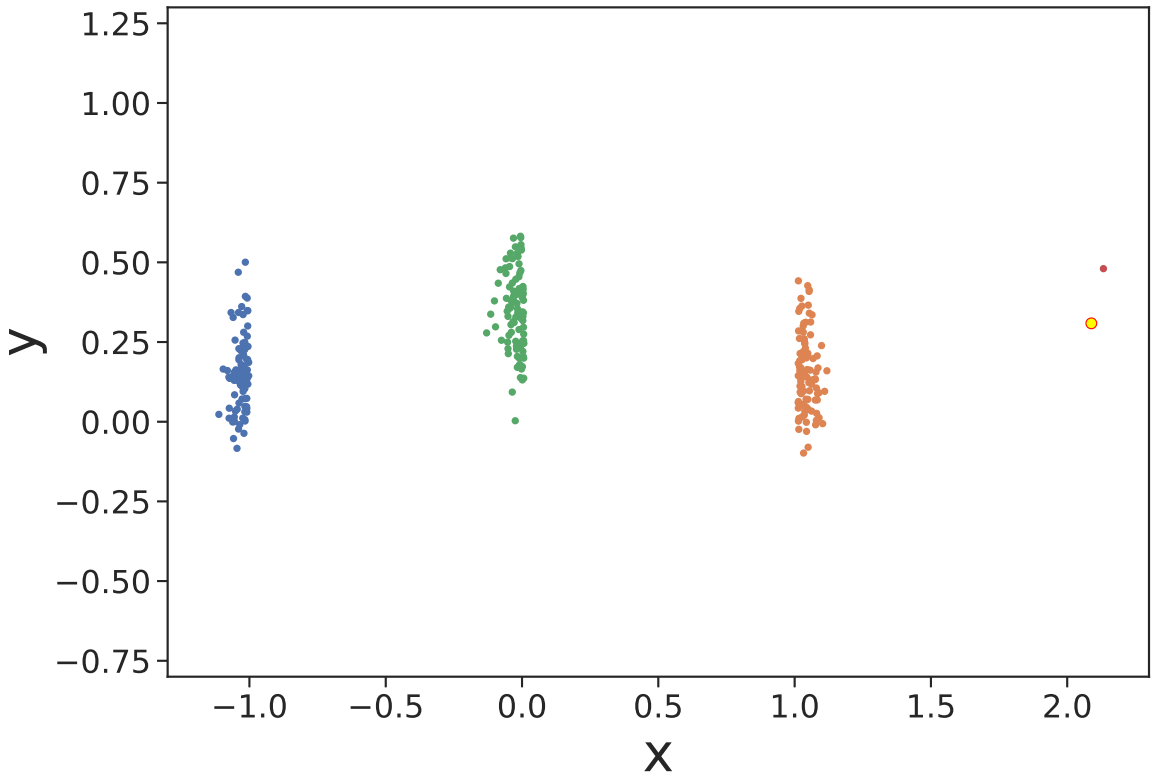

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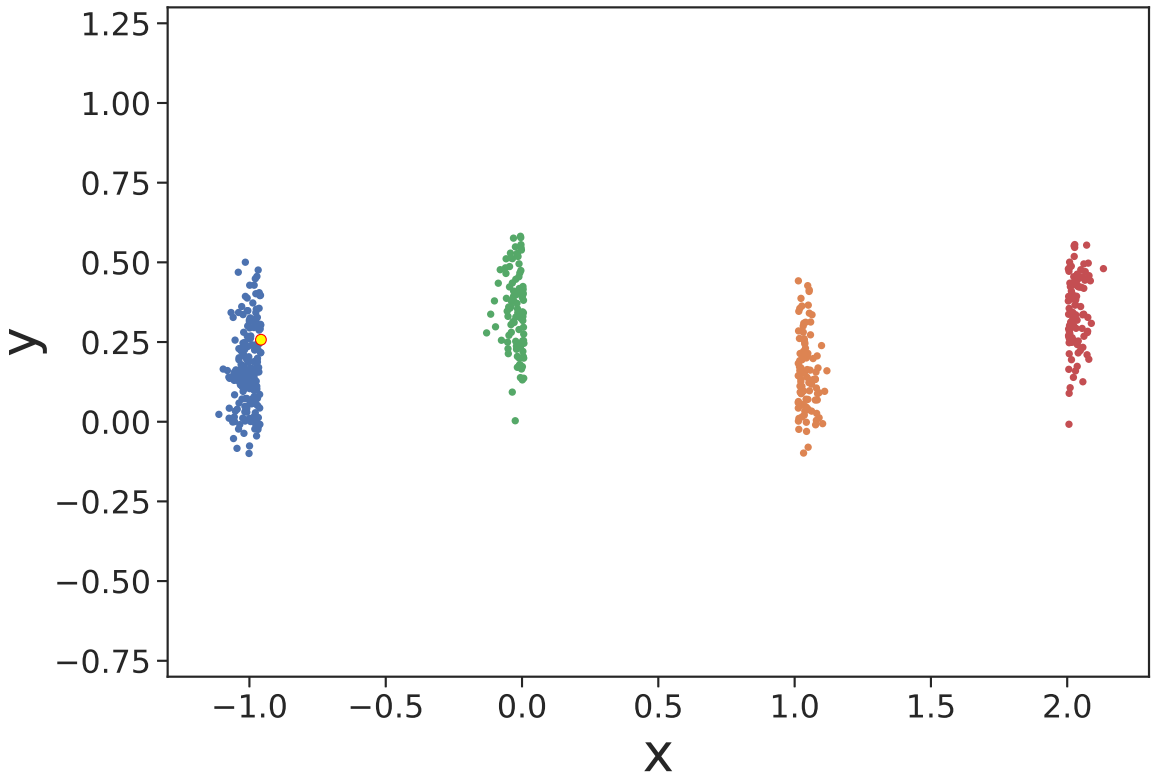

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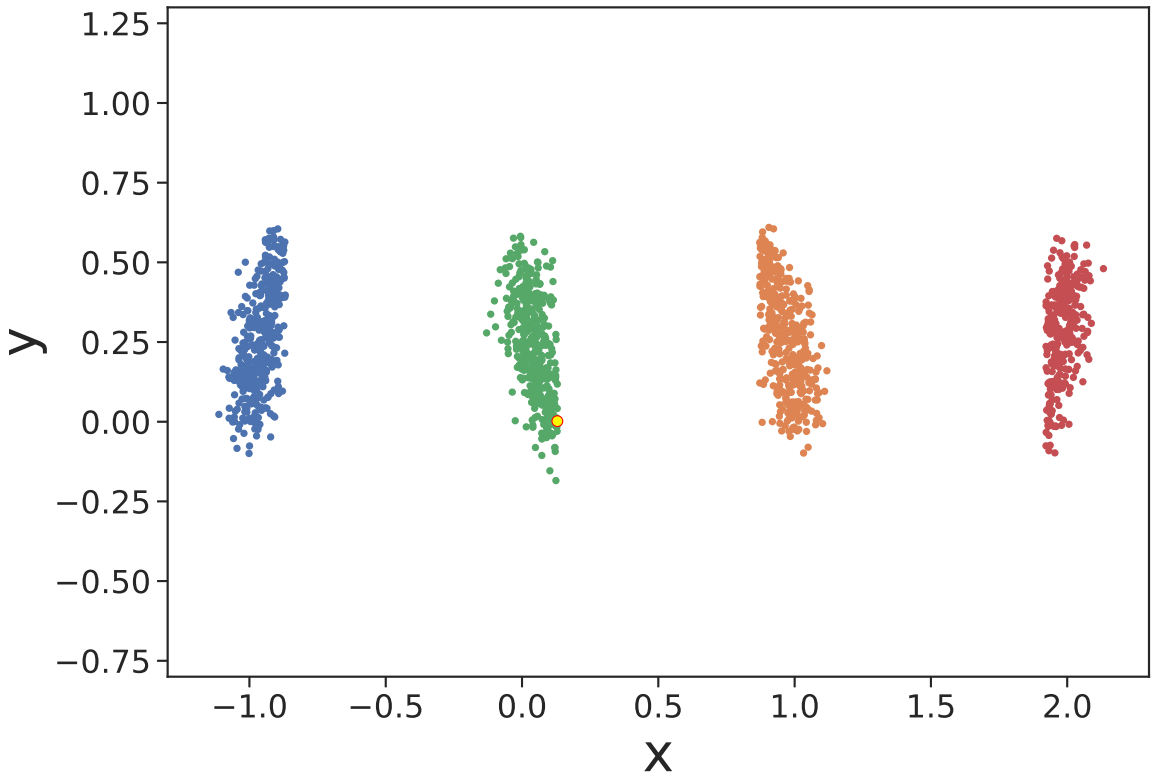

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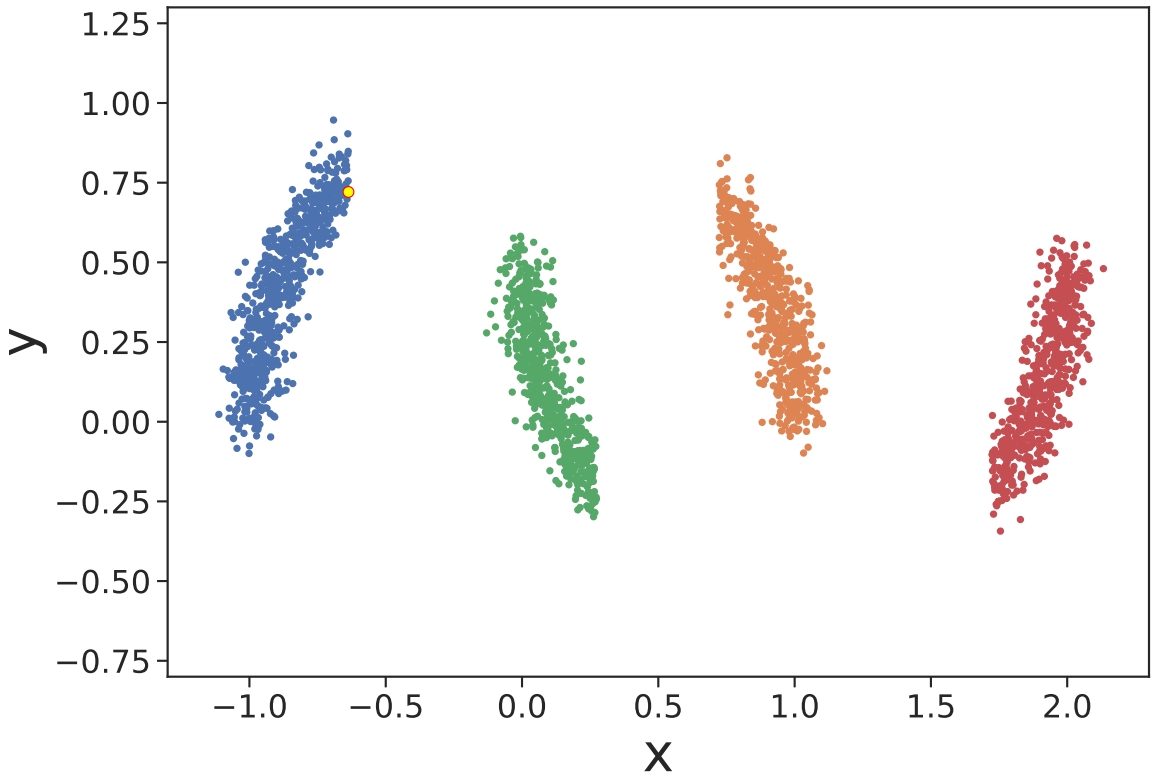

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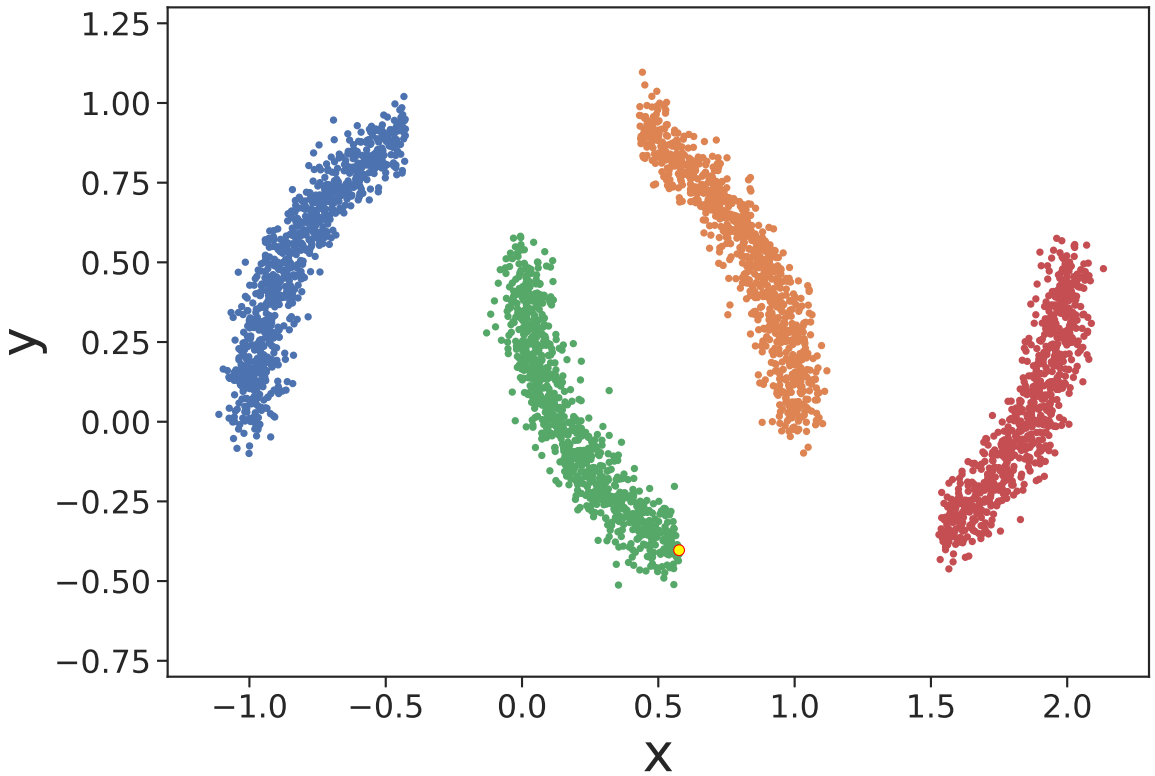

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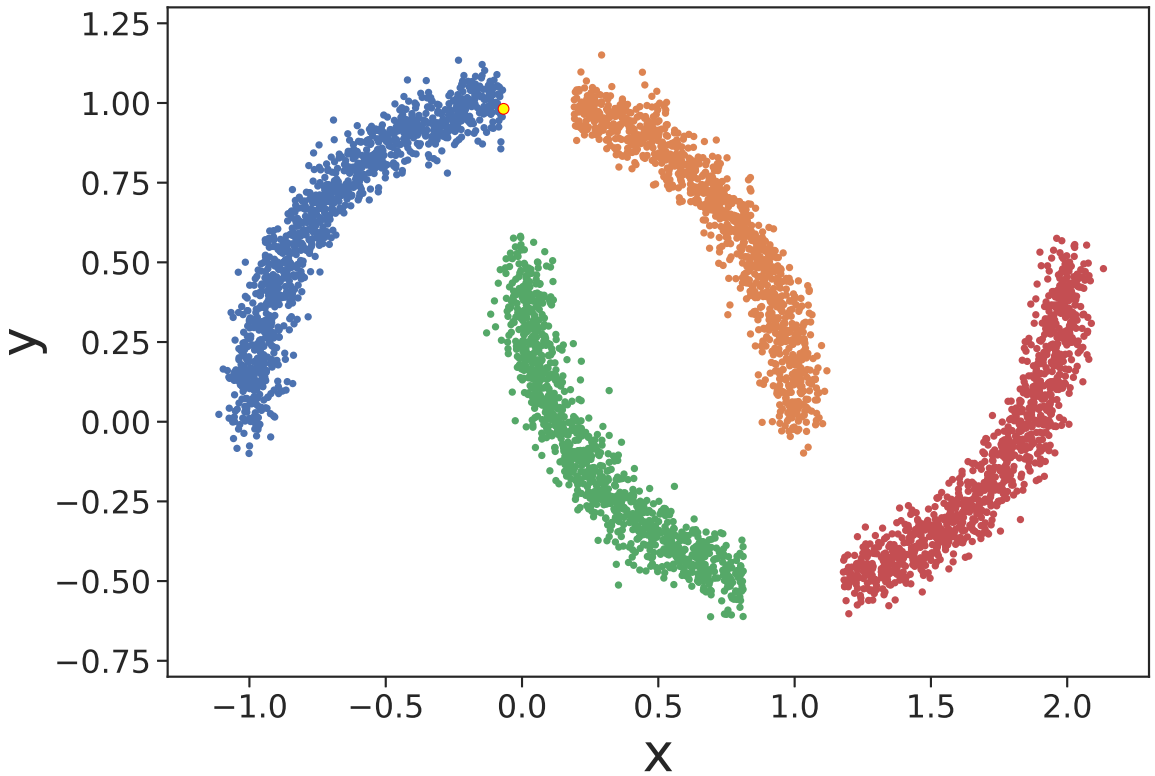

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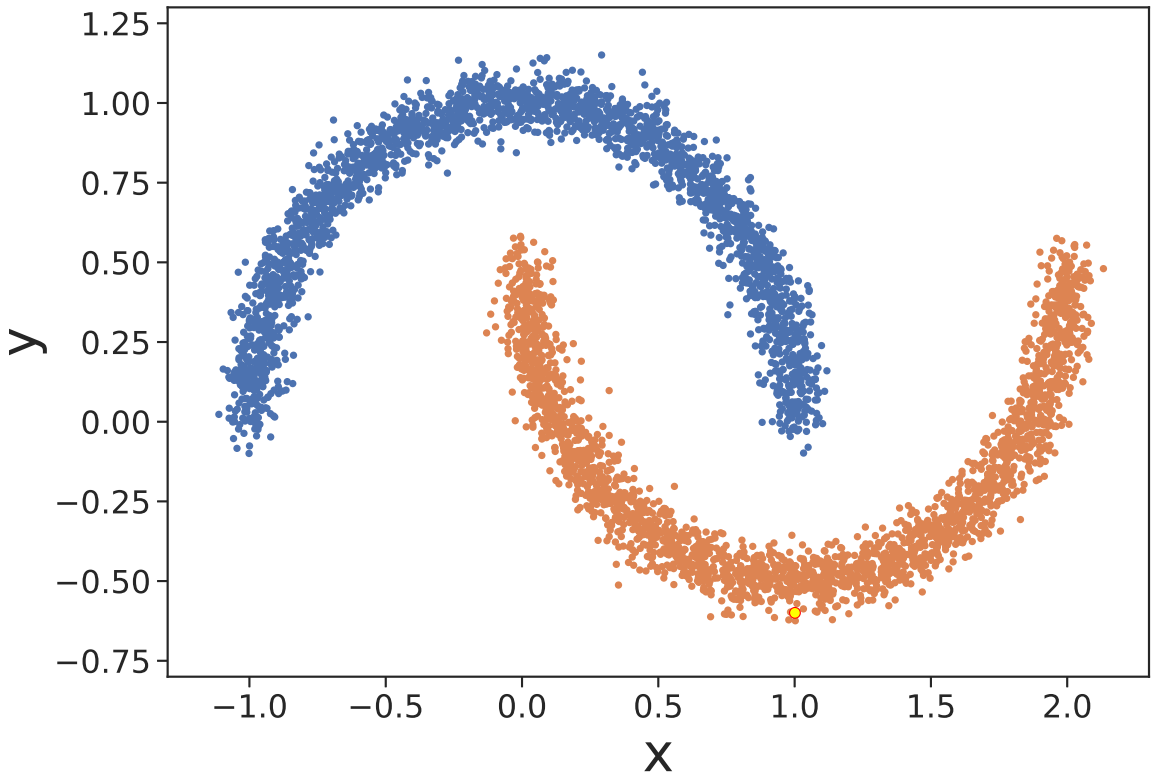

Pipeline

- Leverage Macro SOStream's strengths:
  - Unsupervised learning
  - Single pass online method
  - Robust to distribution shifts
- Design an anomaly detection framework
- Provide intelligible insights to users

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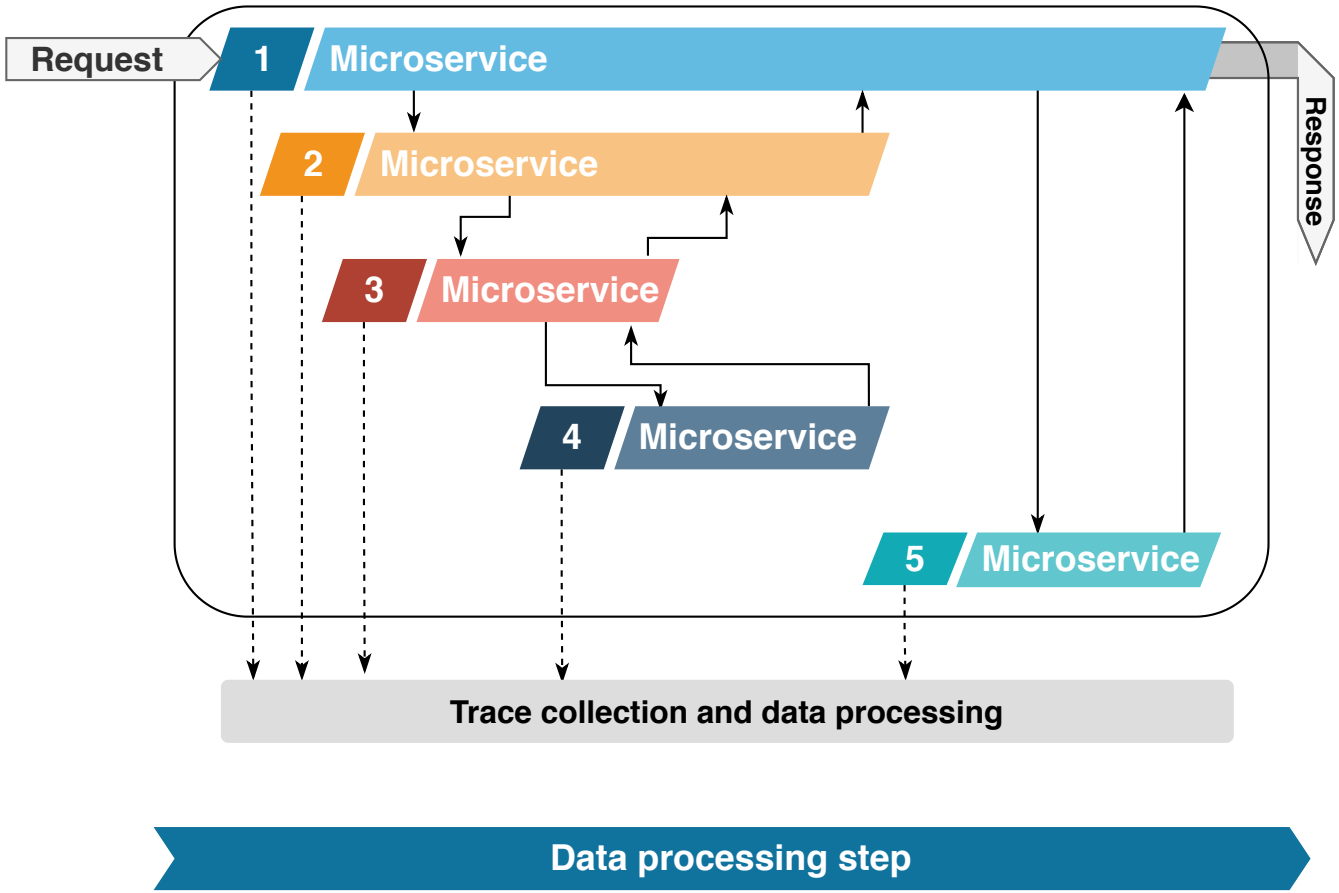
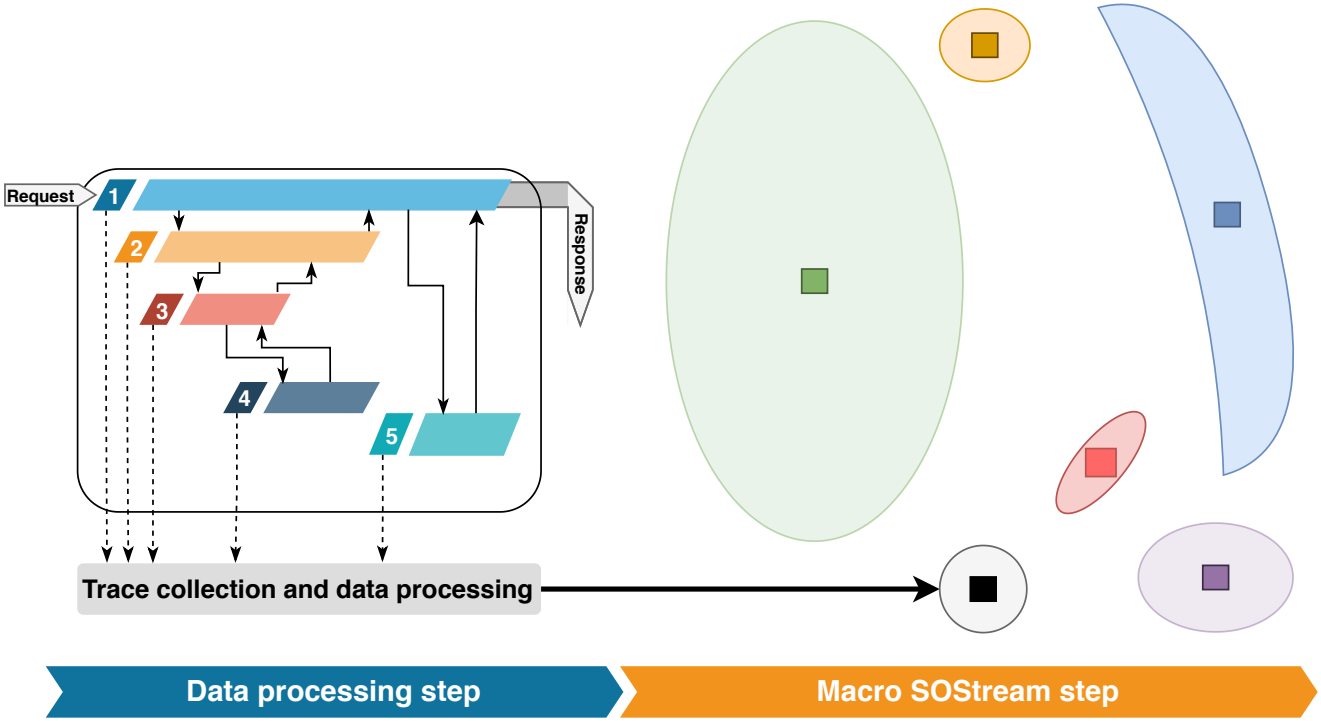

Request
1
Microservice
2
Microservice
3
Microservice
4
Microservice
5
Microservice
Response
Trace collection and data processing
Data processing step

Pipeline


Request
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2
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Response
Trace collection and data processing
Data processing step
Macro SOStream step

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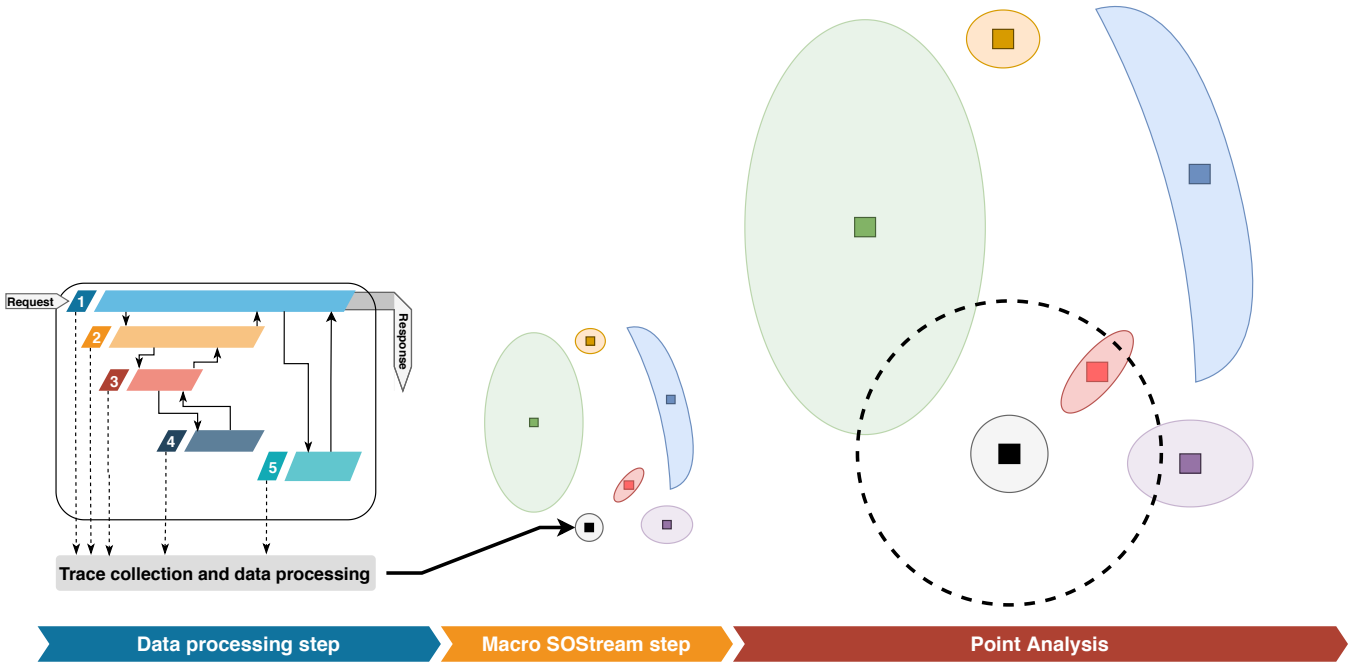
Request
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2
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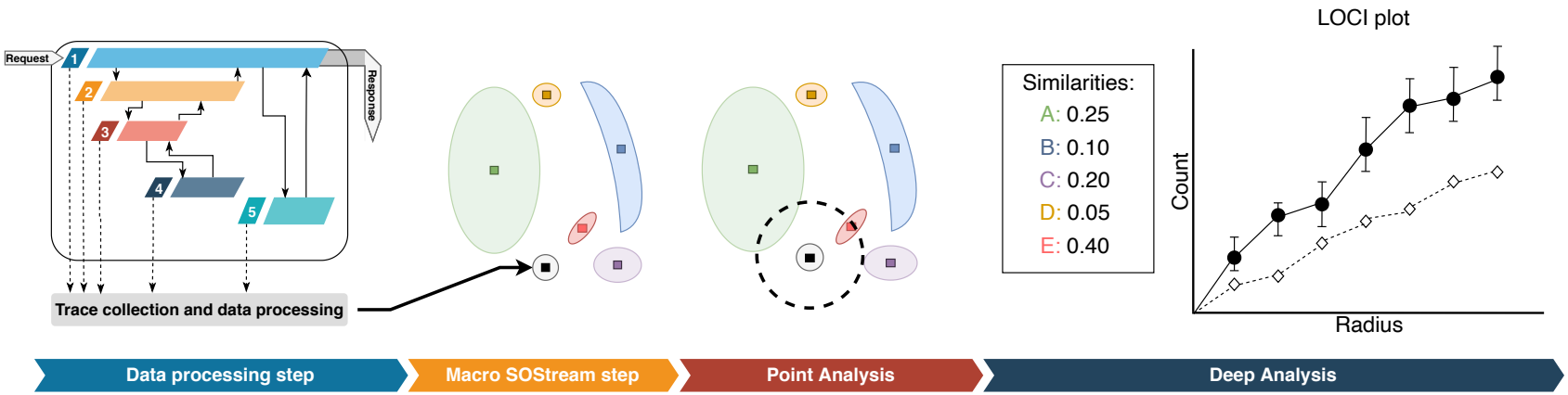
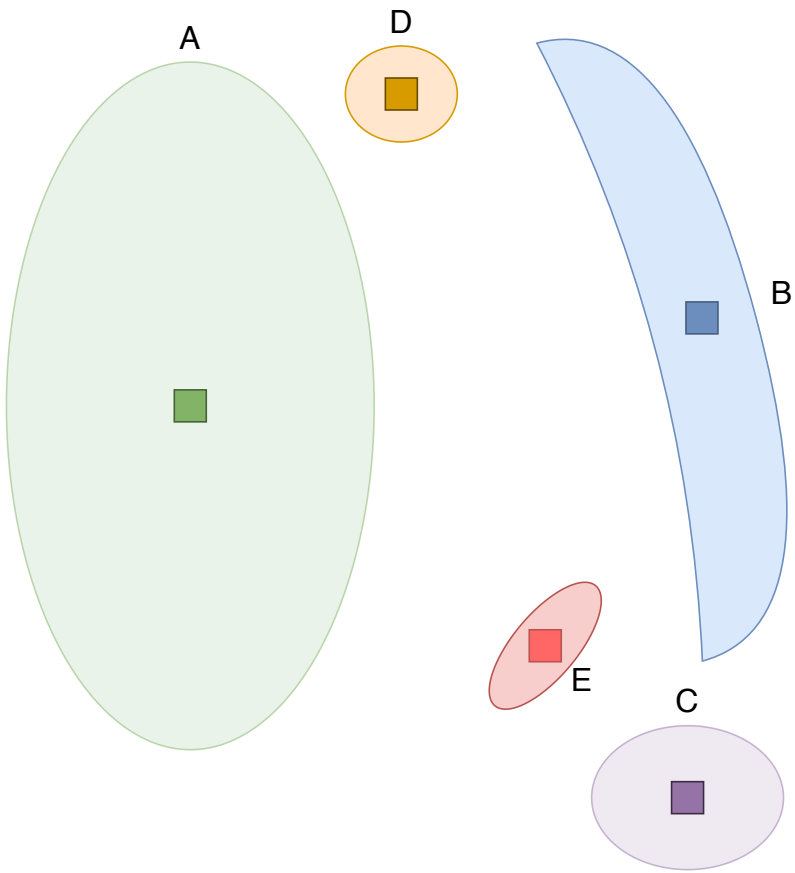
4
5
Response
Trace collection and data processing
Data processing step
Macro SOStream step
Point Analysis

Pipeline


Request
1
2
3
4
5
Response
Trace collection and data processing
Similarities:
A: 0.25
B: 0.10
C: 0.20
D: 0.05
E: 0.40
LOCI plot
Count
Radius
Data processing step
Macro SOStream step
Point Analysis
Deep Analysis

Pipeline



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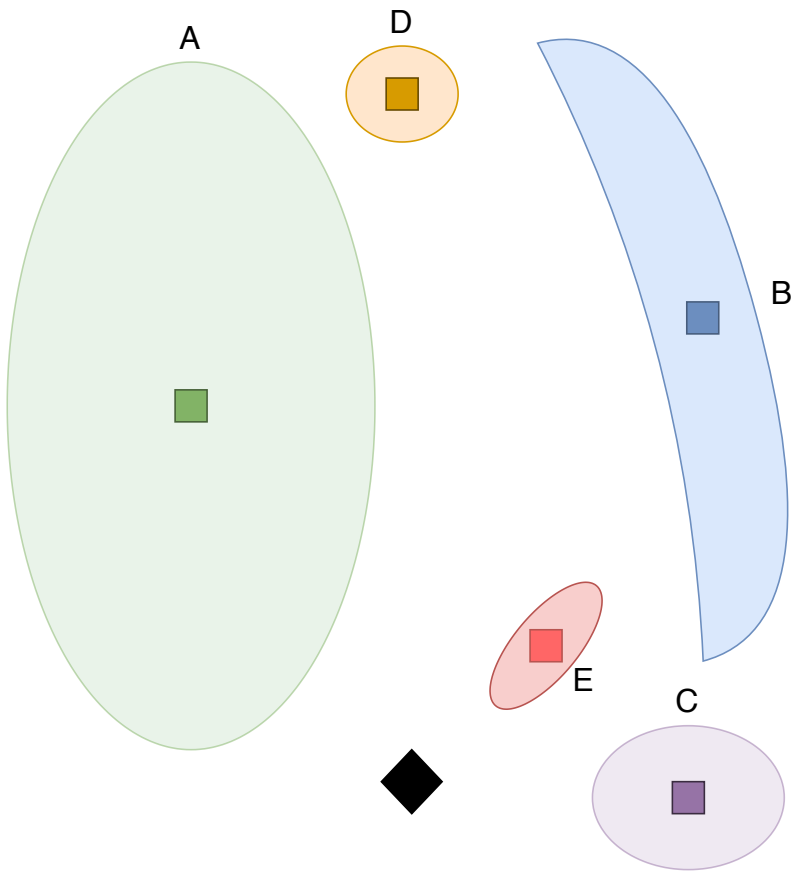

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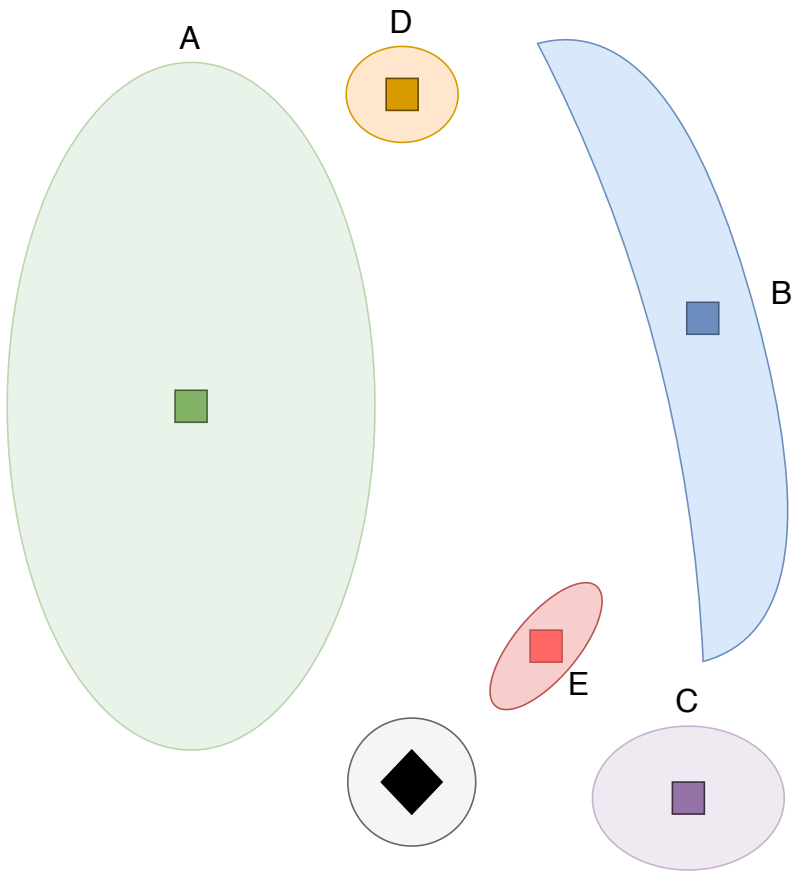

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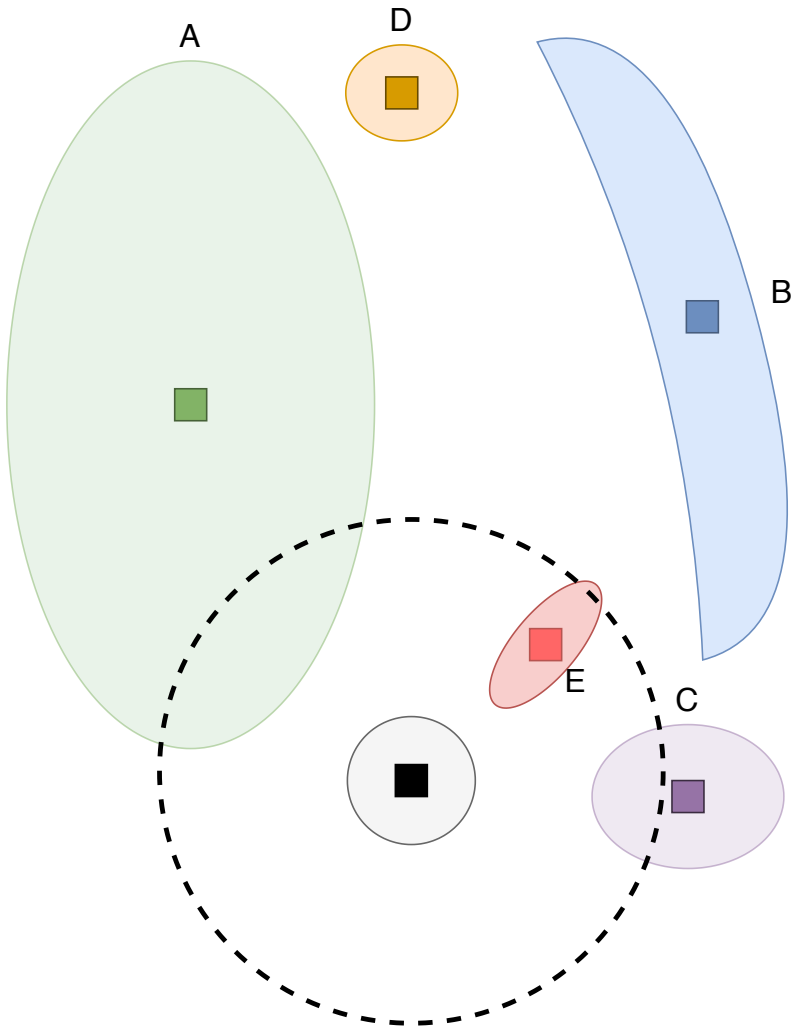

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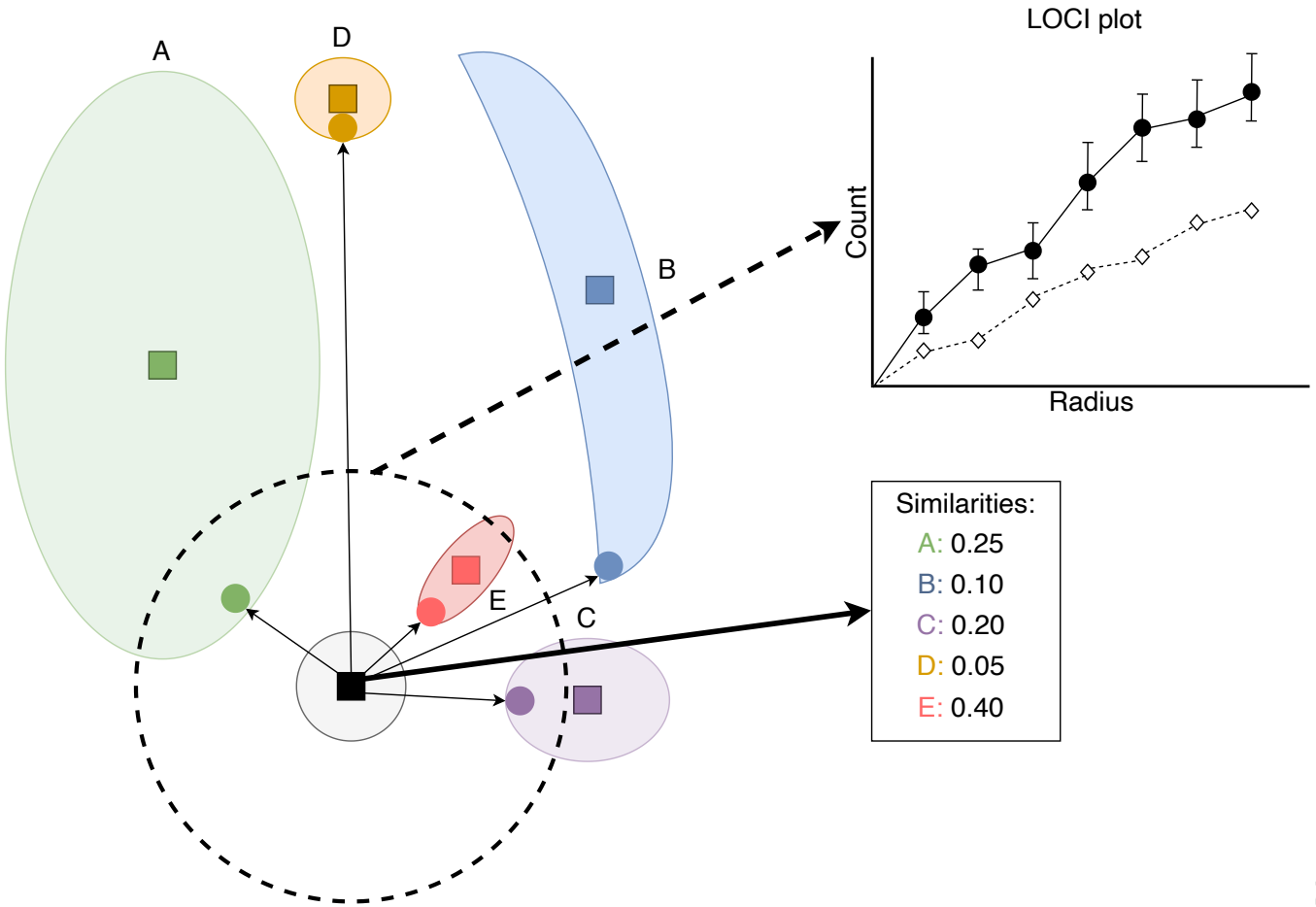
A
D
B
E
C
LOCI plot
Count
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Similarities:
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C: 0.20
D: 0.05
E: 0.40

Applications

- Experiment with a broad range of applications
- Microservices architecture
  - Performance issues
  - Networking problems
  - Intrusion attacks
  - Benchmark with four use cases
- Real-world use case with kernel traces

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Final Remarks

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- Intelligible anomaly detection framework
- Current state: Optimizing Macro SOStream
- Future work:
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Thank You!

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