CLAIM: a Lightweight Approach to Identify Microservices in Dockerized Environments

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Introduction

➔ **Context**:

Mining studies in the field of Empirical Software Engineering

➔ **Motivation**:

Identifying microservices in a Microservices Architecture

➔ **Needs**:

Lightweightness in execution time and resources consumption
Language independence

Background

State of Art:

- Baresi *et al.*[1]: **static approach** *via* parsing Docker *compose* files

Related Work: e.g. μMINER, MicroArt, etc.

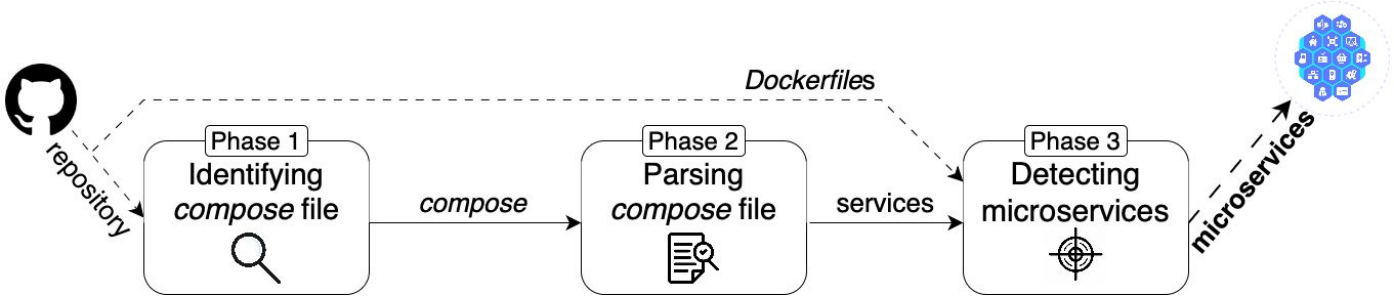
- recovery of the **entire architecture** (also architectural components)
- **dynamic** or **hybrid static-dynamic** approach → excessive effort
- **semi-automatic** approach (human intervention required)

CLAIM:

- **Convention-based empirical rules**
- **Refinement** and **extension** of Baresi *et al.*[1]
  - Identification and parsing of Docker *compose* files
  - Additional use of *Dockerfile* to improve effectiveness

[1] *"Microservice Architecture Practices and Experience: a Focused Look on Docker Configuration Files"* - L. Baresi, G. Quattrocchi, D. A. Tamburri (2022)

Approach



Phase 1

1. *compose* files collection
2. path-based filtering
3. path-based order
4. filename-based order
5. selection

Phase 2

1. variable interpolation
2. recursive inclusion resolution
3. inheritance reconstruction
4. services data extraction

Phase 3

1. *Dockerfiles* collection
2. extension-based filtering
3. path-based filtering
4. service-*Dockerfile* match
5. *Dockerfiles* checks

Research Questions

RQ_1 *What is the **effectiveness** of CLAIM in terms of microservice identification?*

Metrics:
- precision
- accuracy
- recall

RQ_2 *What is the **efficiency** of CLAIM in terms of execution time and memory consumption?*

Metrics:
- execution time per commit
- execution time per repository
- memory consumption per repository

Experiment

Experimental objects:

20 open source MSA repositories (13k commits, 1.7M SLOC, 160 microservices)

Ground truth:

6 *a priori* defined microservice Ground Truth
14 manually defined microservice Ground Truth

Experiment execution:

RQ_1	***compose* file selection**	(commit-wise)
RQ_1	**microservices identification**	(commit-wise)
RQ_2	**execution time and resource profiling**	(repository-wise)

Comparison:

Baresi *et al.*[1] tool

[1] *"Microservice Architecture Practices and Experience: a Focused Look on Docker Configuration Files"* - L. Baresi, G. Quattrocchi, D. A. Tamburri (2022)

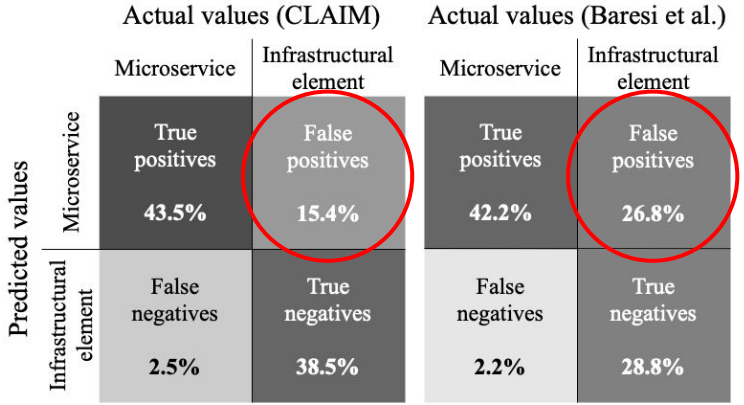
Results (RQ_1 - effectiveness)

compose file selection

	CLAIM	Baresi *et al.*[1]
Success rate	**99.2%**	94.8%

Microservices identification

		CLAIM	Baresi *et al.*[1]
Accuracy	(TP+TN)/(TP+TN+FP+FN)	**82%**	71%
Precision	TP/(TP+FP)	**73.8%**	61.2%
Recall	TP/(TP+FN)	94.5%	**95.0%**

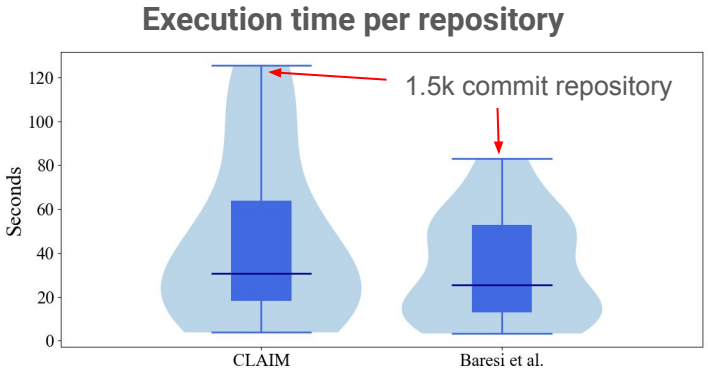


[1] *"Microservice Architecture Practices and Experience: a Focused Look on Docker Configuration Files"* - L. Baresi, G. Quattrocchi, D. A. Tamburri (2022)

Results (RQ_2 - efficiency)

Execution time

Execution time per commit	CLAIM	Baresi *et al.*[1]
Best case scenario	23 *ms*	**18 *ms***
Worst case scenario	266 *ms*	**216 *ms***
Median	61 *ms*	**38 *ms***



Memory consumption

	CLAIM	Baresi *et al.*[1]
Median	**20 MB**	30 MB

[1] *"Microservice Architecture Practices and Experience: a Focused Look on Docker Configuration Files"* - L. Baresi, G. Quattrocchi, D. A. Tamburri (2022)

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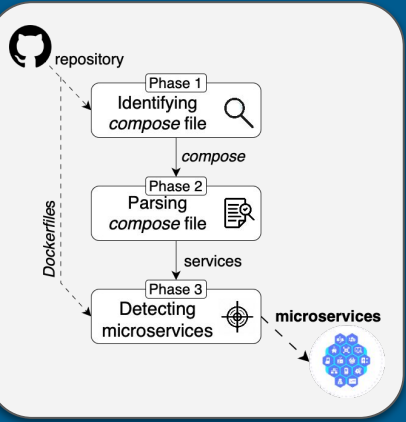
Summary



RQ_1: *What is the **effectiveness** of CLAIM in terms of microservice identification?*

RQ_2: *What is the **efficiency** of CLAIM in terms of execution time and memory consumption?*

Metric	Value
Precision	82%
Accuracy	73.8%
Recall	84.5%

Metric	Median value
Execution time (per commit)	61 *ms*
Memory consumption (per repository)	20 MB

- Valid and scalable option for microservices identification
- Stepping stone towards developing better techniques
- Conducting comparison also against dynamic approaches

Thank you, and… it's Q&A time!

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https://github.com/STLab-UniFI/CLAIM_rep-pkg