

# Combining TOSCA and Docker



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- 5 Conclusions and Future work

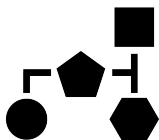
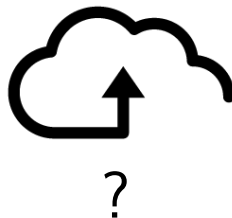
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# Software deployment and Orchestration



# Software deployment and Orchestration

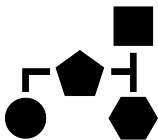


Application  
specification

# Software deployment and Orchestration



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Application  
specification

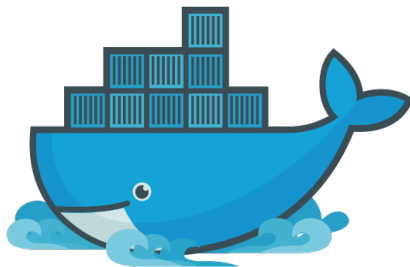


Application  
orchestration

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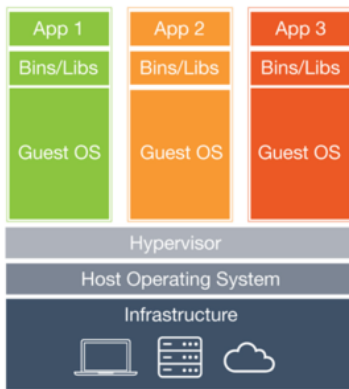
# Docker



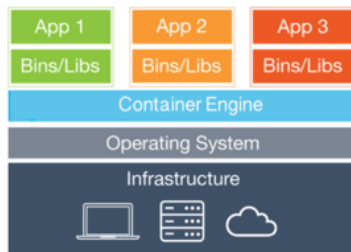
Docker is a tool that can package an application and its dependencies in a virtual container that can run on any Linux server.



# VM vs Docker



Hypervisor-based Virtualization



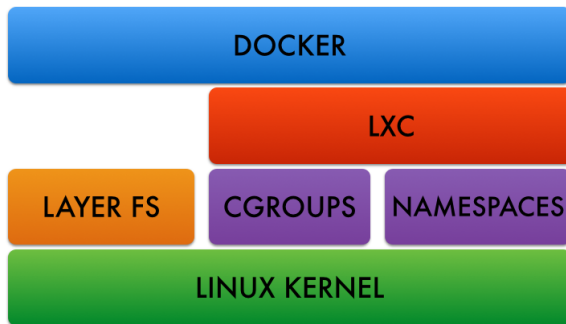
Container virtualization

# Main concepts

## Main concepts of the Docker platform

- **Dockerfile**, a script to generate a Docker Image
- **Docker Image**, a separated file-system with all the binaries and library
- **Docker Container**, running instance of a Docker Image
- **Docker Volume**, a persistent data storage system
- **Docker Hub**, a public database of Docker Images

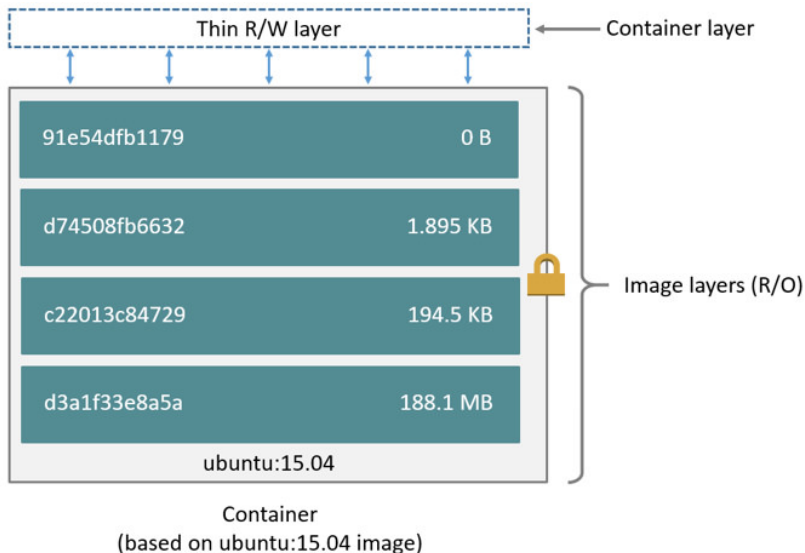
# Architecture of Docker



- **LXC**, an operating-system-level virtualization method
- **Layer file-system**, a Union file system

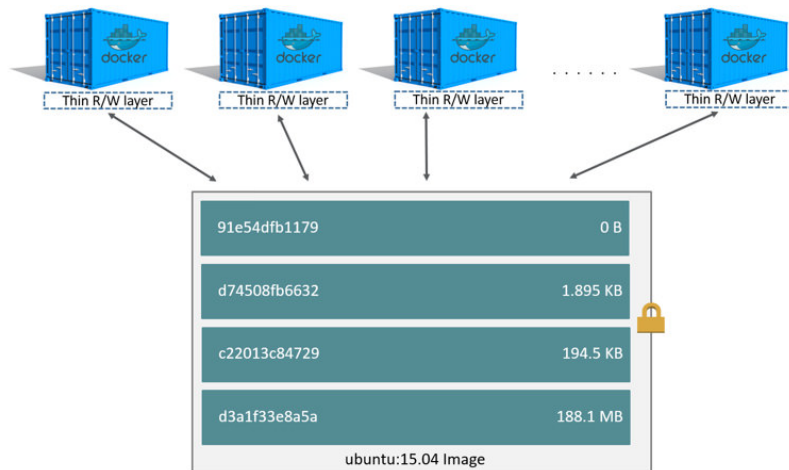
# Layer file-system

Each layer is only a set of differences from the layer before it.

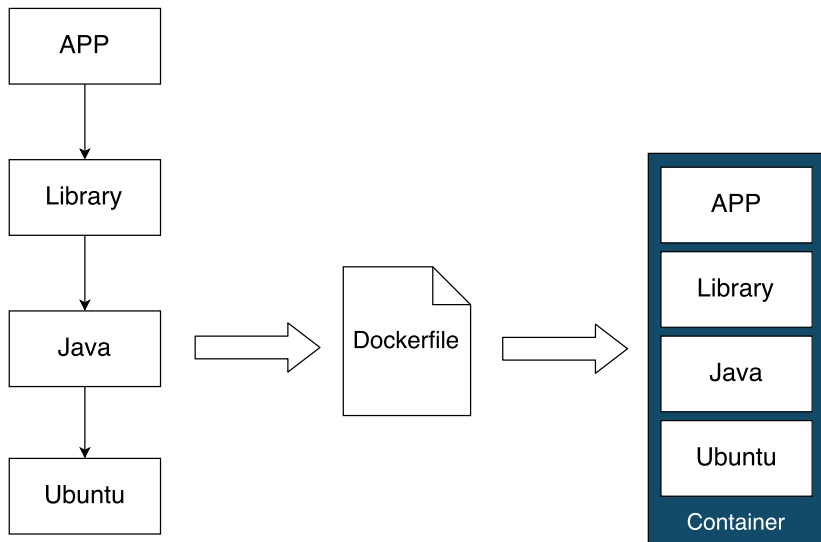


# Layer file-system

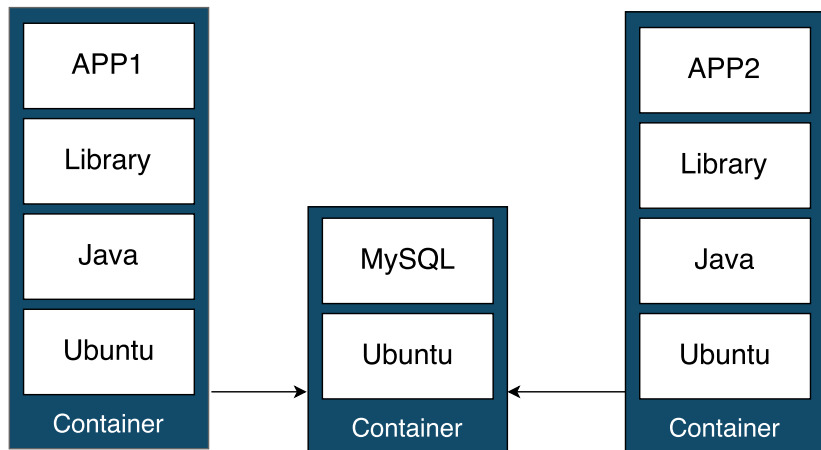
Copy-on-write permits to share the same layer between more containers.



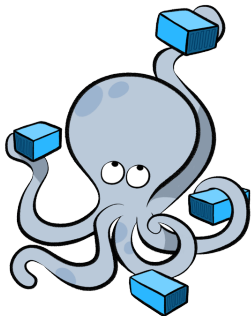
# How use Docker



# Multi-container application



# Docker Compose



```
version: "2"
services:
  web:
    build: .
    ports:
      - "5000:5000"
    volumes:
      - .:/code
  redis:
    image: "redis:alpine"
```



# Problems

- The container hide the components that it contains

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- Poor application orchestration

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- The container hide the components that it contains
- Poor application orchestration
- Docker containers as "minimal orchestration entities"

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# TOSCA

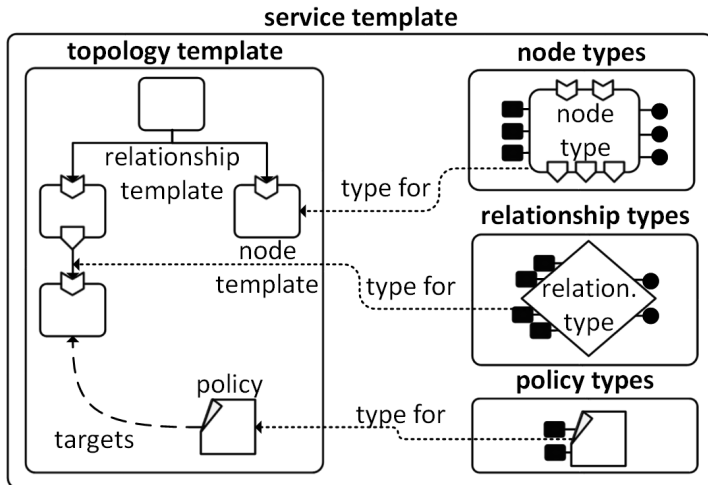


OASIS standard meta-language to describe the topology of an application, with its components and relationships.

# Main concepts

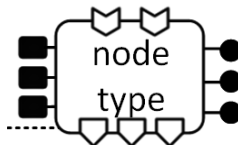
- YAML-based description
- CSAR archive containing TOSCA specs and executable artifacts
- Declarative processing

# TOSCA description



Legenda ■ Property ● Interface ⌋ Capability ⌋ Requirement

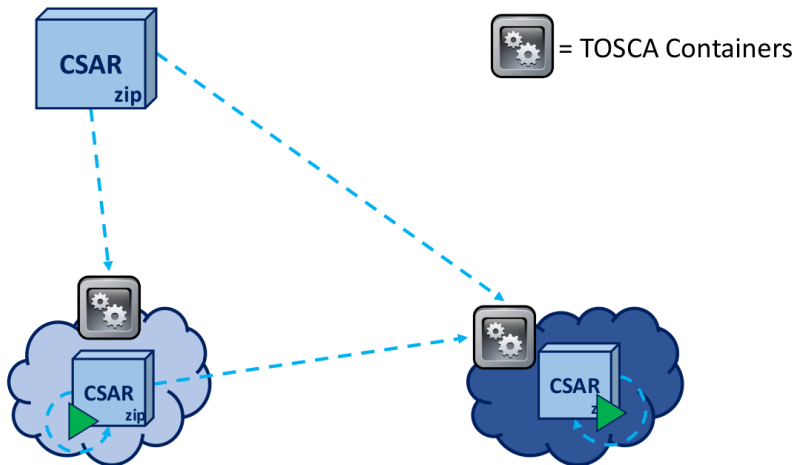
# Node type



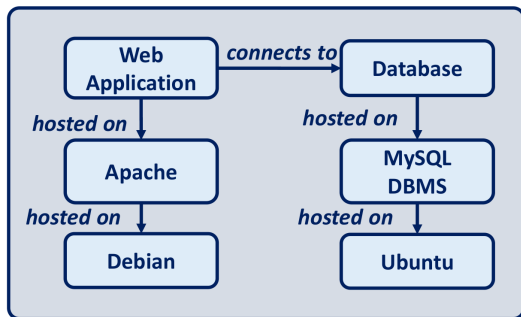
- **requirements**, what a component requires
- **capabilities**, what a component offers
- **properties**, descriptive information about a component
- **interfaces**, operations to deploy and manage a component
- **artifacts**, installables/executables/data implementing interface operations



# How it works

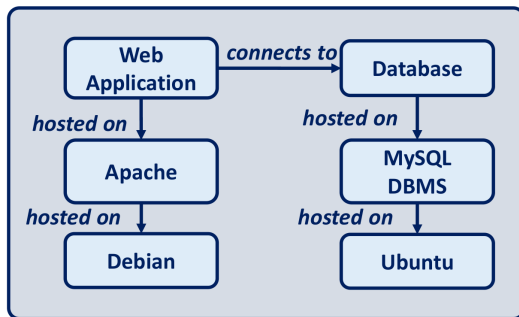


# Declarative processing - A possible execution



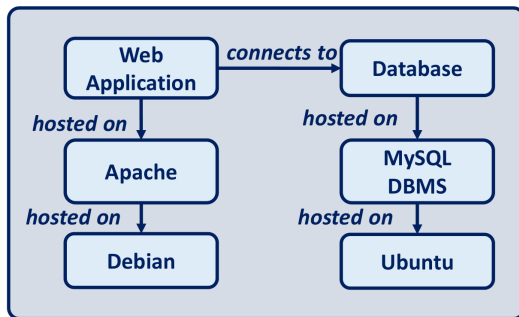
① Debian, Ubuntu

# Declarative processing - A possible execution



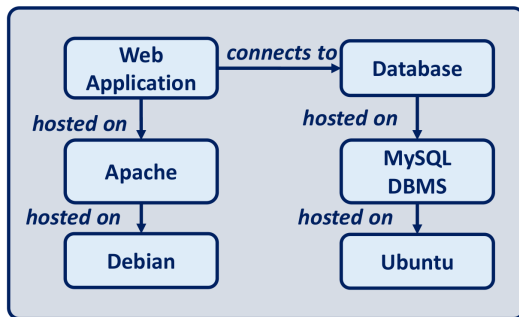
- 1 Debian, Ubuntu
- 2 Apache, MySQL

# Declarative processing - A possible execution



- 1 Debian, Ubuntu
- 2 Apache, MySQL
- 3 Database

# Declarative processing - A possible execution



- ① Debian, Ubuntu
- ② Apache, MySQL
- ③ Database
- ④ Web Application

# Problems

- Specs may be too verbose
- Lack of tools for supporting development of TOSCA apps
- Lack of engines for running TOSCA apps

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# TosKer

An orchestration engine capable of deploying, on top of Docker, applications described in TOSCA YAML.

- TosKer inputs a TOSCA description of a multi-component application, and
- it automatically deploys and orchestrates such application on top of the Docker engine



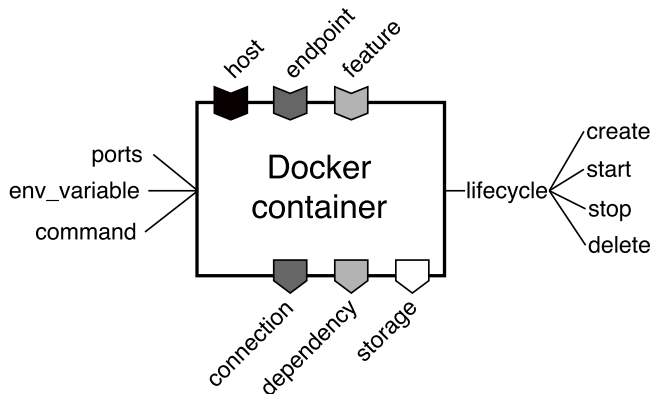
# Describing applications with TosKer

- Applications are specified as a composition of the following components:
  - *Docker containers* `tosker.nodes.Container`
  - *Docker volumes* `tosker.nodes.Volume`
  - *Software* `tosker.nodes.Software`

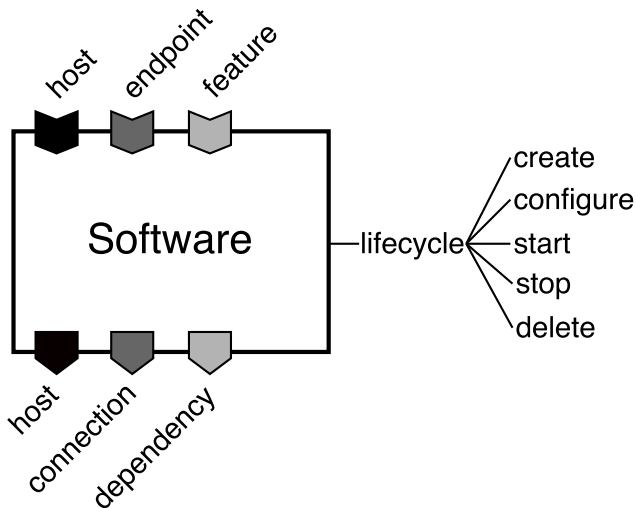
# Describing applications with TosKer

- Applications are specified as a composition of the following components:
  - *Docker containers* `tosker.nodes.Container`
  - *Docker volumes* `tosker.nodes.Volume`
  - *Software* `tosker.nodes.Software`
- Components can be interconnected with the following relationships:
  - *hosted on* (`tosca.relationships.HostedOn`)
  - *connected to* (`tosca.relationships.ConnectsTo`)
  - *attached to* (`tosca.relationships.AttachesTo`)
  - *depending on* (`tosca.relationships.DependsOn`)

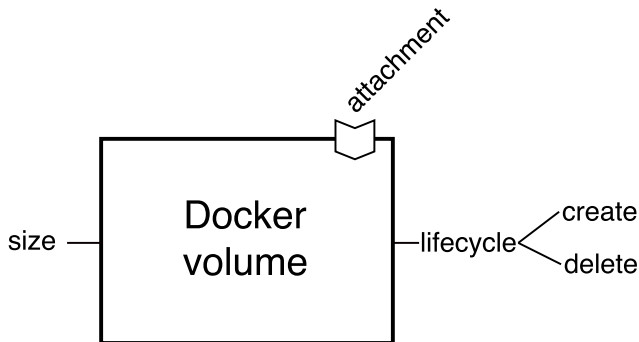
# tosker.nodes.Container



# tosker.nodes.Software



# tosker.nodes.Volume

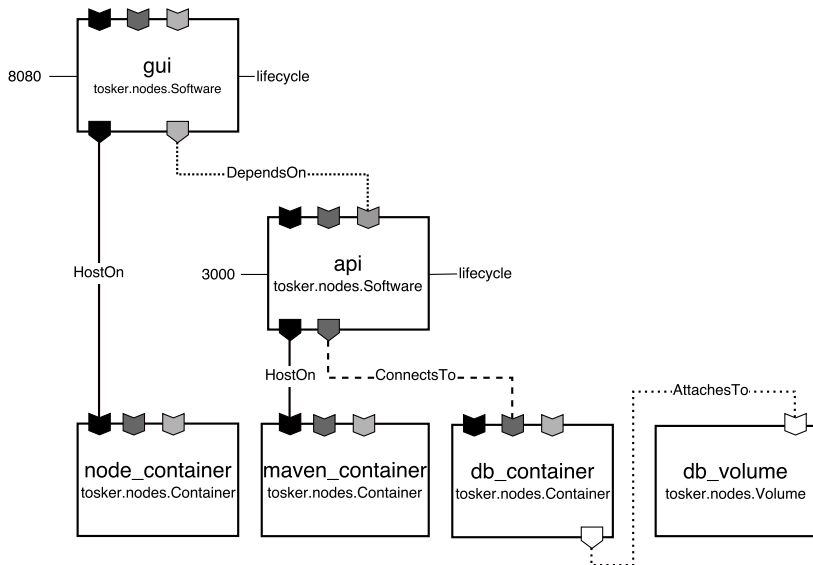


# Topology constraints

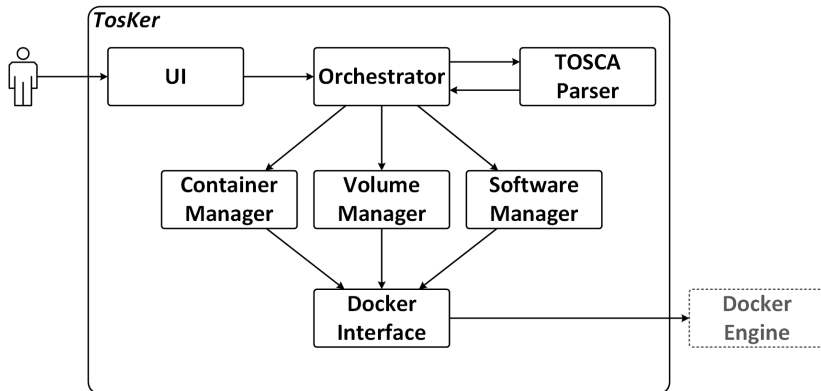
Each application topology must satisfy a set of constraints on how to compose nodes and relationships, e.g.,

- A *software* must be “*hosted on*” another *software* or a *Docker container*
- A *Docker container* and *Docker volume* cannot be “*hosted on*” other components
- Only *Docker containers* can be “*attached to*” *Docker volumes*

# Case study: Thoughts

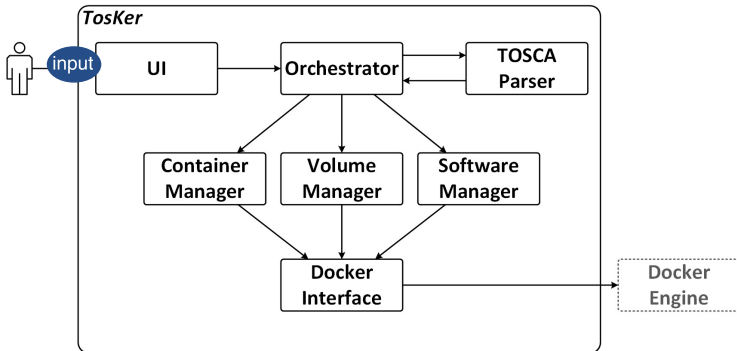


# Architecture





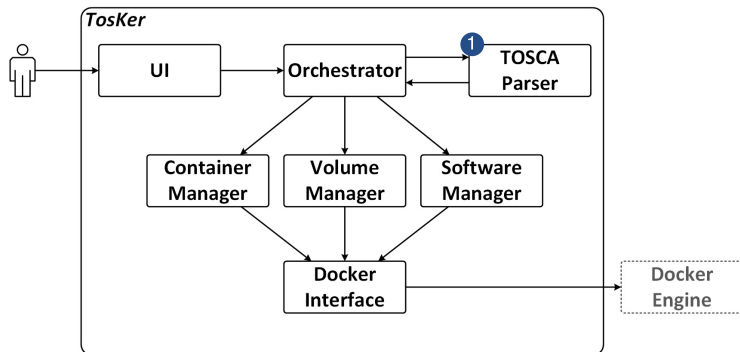
# How TosKer orchestrates applications



The input of TosKer is

- a TOSCA application specified using TosKer types, and
- management operation(s) to perform.

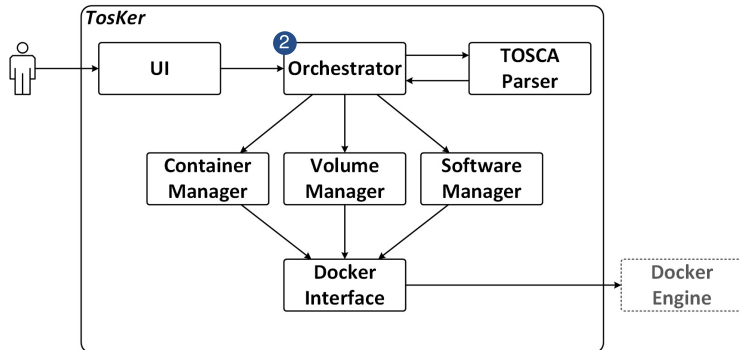
# How TosKer orchestrates applications



## TosKer

- parses and validates the TOSCA application, and
- executes a topological sorting algorithm.

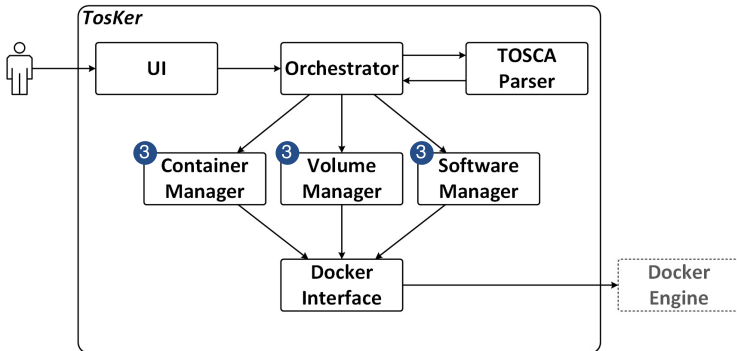
# How TosKer orchestrates applications



## TosKer

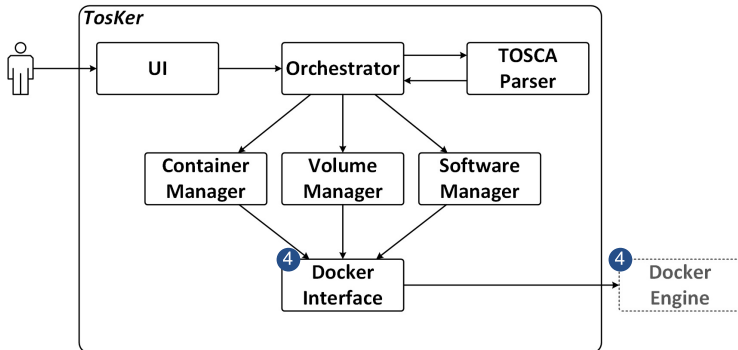
- scans the sorted application topology, and
- for each component, it calls a specific operation (e.g., create)

# How TosKer orchestrates applications



Each manager is in charge of implementing/executing the invoked operation on a component...

# How TosKer orchestrates applications

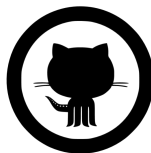


...by properly invoking the Docker engine (through the Docker interface)

# Implementation



Python



GitHub



MIT Licence

- **PyPI:** <https://pypi.python.org/pypi/tosKer>  
`pip install tosker`
- **GitHub:** <https://github.com/di-unipi-socc/TosKer>

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# Conclusions

We focussed on the problem of orchestrating the deployment and management of composite cloud applications.

- Docker
- TOSCA YAML



# Conclusions

We focussed on the problem of orchestrating the deployment and management of composite cloud applications.

- Docker
- TOSCA YAML

We presented the TosKer orchestration engine, which

- extends TOSCA by providing a Docker-based orchestration engine for TOSCA applications, and
- extends Docker by adding the capability of orchestrating software components together with Docker containers/volumes

# Future work

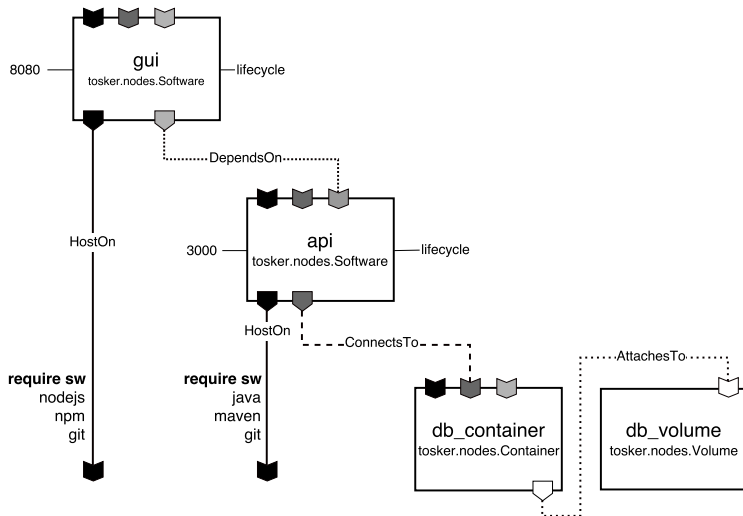
- Automatically determine the Docker containers needed to effectively run an application (**Dockerizer**)
- Support cluster of workstations and external cloud services
- Integrate TosKer with fault-aware management protocols

# Focus on Dockerizer

**Dockerizer**, a completer of TosKer specifications.

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**Dockerizer**, a completer of TosKer specifications.



Thank You

Q&A