Diploma / Master Thesis
Persistence, Discovery, and Generation of Viable Cloud Application Topologies
Beginning: immediately

Description
Due to the benefits introduced by the Cloud computing paradigm and the increase of available Cloud services (VM- and non VM-oriented), in the last years the number of application developers strongly supporting a partial or complete migration of application component to Cloud environments has significantly increased. For example, it is possible to host the application’s database off-premise (e.g. in a DBaaS solution) while keeping the remaining components (presentation or business logic components) on-premise. However, the previous application deployment is only one possible distribution alternative of its components, and the existence of further alternatives allows the generation of a wide variety of distribution combinations [1]. Standards like TOSCA, or approaches like GENTL [2] and MOCCA [4] allow for the modeling and management of application topologies, further supporting the application distribution capabilities. Cloud application topologies can be defined as typed labeled graphs constituted by a set of nodes, edges, and labels [1]. Nodes represent the application components, while the edges depict the relationship among them. Multiple nodes can be grouped in order to potentially build reusable sub-topologies. There exist two main modeling approaches which can be used for specifying the topological representation of Cloud applications: (i) exclusively defining the application specific sub-topology, or (ii) defining the complete application stack, i.e. including middleware components, operative system, and hardware resources. A cloud application viable topology is a feasible distribution of the application components according to the depicted or discovered application independent sub-topologies. Due to the previously presented modeling approaches, exclusively defining the application specific components in the topology model requires the discovery and matching of potential viable distributions which can be further analyzed, e.g. evaluating their performance characteristics [3] or monetary cost [2].

This thesis focuses on providing a topology modeling framework capable of supporting the following three fundamental aspects: (i) analyzing and leveraging existing technologies to efficiently and effectively persist and retrieve Cloud application topologies, (ii) design and develop the concepts and mechanisms towards dynamically discovering and constructing cloud application viable distributions (viable topologies) specifications (typically XML representations), and (iii) developing the visualization means within an existing topology modeling environment.

Tasks
1) Investigation and evaluation on existing approaches and technologies for:
   a) Persisting, retrieving and searching Cloud application topologies in an efficient manner, e.g. using semantic queries, etc.
   b) Discovering, matching and building Cloud application viable topologies (viable distributions), e.g. based on application hard constraints, filter functions, etc.
2) Based on the previous analysis, derive the concepts and specification for persisting, discovering, and building Cloud application viable topologies in an efficient manner.
3) Architecture, specification, and design of loosely coupled and RESTful-based [6] framework supporting (i), (ii), and (iii), reusing existing technologies, such as:
   a) Nefolog Cloud offerings and configurations knowledge system [5]
   b) OpenTOSCA Winery1 or GENTL Environment [2] only for visualization aspects
   c) ...
4) Prototypical implementation of the approach under the Apache License 2.0.
5) Validation and Evaluation

**Required previous knowledge and experiences**

- Java/Python programming skills and expertise
- Cloud Computing
- Topology specification and modeling, e.g. TOSCA, GENTL [2].
- ...or the declared intention to deeply dive into these topics in advance

The lectures of Service Management and Cloud Computing, and the literature attached, such as [1], [2], [3], and [4] are recommended for preparation. The student has to manage his schedule including this work packages and milestones for himself. A helpful guide for planning and writing a thesis can be found in [6] and [7]. **The preferred language of the work is English.**

**Literature**


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1 Open TOSCA: [http://www.iaas.uni-stuttgart.de/OpenTOSCA/](http://www.iaas.uni-stuttgart.de/OpenTOSCA/)