Graph Similarity based Cloud Migration Service Composition Pattern Discovery

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ABSTRACT

The demands of migrating on-premises complex enterprise applications to cloud dramatically increase with the wide adoption of cloud computing. A recent research validates the possibility of combining multiple proprietary migration services offered by different vendors together to complete cloud migration. Pattern based service composition has been proven as an appealing approach to accelerate the service composition and ensure the qualities in the Service Oriented Architecture (SOA) domain and can be applied to the cloud migration service composition theoretically. However, current pattern discovery approaches are not applicable for the cloud migration due to lack of either existing cloud migration business process knowledge or execution logs. This paper proposes a novel approach to discover cloud migration patterns from a set of service composition solutions. The authors formalize the pattern discovery as a special graph similarity matching problem and present an algorithm to calculate the similarities of these service composition solutions. Patterns are chosen out of the solutions by similarity under designed criteria. The benchmark results and quantitative analysis show that our proposed approach is effective and efficient in pattern discovery for cloud migration service composition.

Keywords: Cloud Migration, Graph Similarity, Knowledge Retrieval, Pattern Discovery, Service Composition, Web-based Services

INTRODUCTION

The booming cloud computing inspires the business application migration to the Cloud. The public cloud workloads are expected to increase at CAGR (Compound Annual Growth Rate) of 50% in the next three years, according to Morgan Stanley in (Holt et al., 2011). The regional distribution of cloud workloads are expected to grow at 24% ~ 45% CAGR from
2012 to 2017, according to Cisco (Cisco, 2013). By 2016, global cloud traffic will account for nearly two-thirds of total data center traffic, according to IDC (Mahowald and Sullivan, 2012). In response to the huge migration demands, many migration service vendors have emerged in recent years, offering services based on a diverse set of migration techniques. In general, these techniques can be categorized into three major types: image-based migration, application-centric migration, and migration to virtualized containers (Wang et al., 2013). Most of vendors expose their migration ability as web services.

However, migrating existing on-premises enterprise applications to cloud is a costly, labor-intensive, and error-prone activity due to the complexity of the applications, the constraints of the clouds, and the limitations of existing migration techniques provided by migration service vendors (Frey and Hasselbring, 2010). To address these challenges, a recent paper presented an approach to find out the most cost effective solution by composing multiple migration services from different vendors together to complete one migration task (Wang et al., 2013). We call it the sandbox approach because it only provides a one-off solution by calculating without verified precedent. It adopts an exhaustive searching based algorithm with pruning to improve the efficiency. In the sandbox approach, the metric for migration service selection and composition is the total cost. In fact, the cost is not the only metric for solution selection. The reliability, privacy and other non-functional constraints should be considered as well. Besides, there are other nontechnical factors that will impact the selection. For example, a customer may prefer services from specific vendors. More critically, a case by case solution discovery approach has not explicitly process logic for tracing, benchmarking, debugging and optimization.

Fortunately, pattern has been proven as an appealing approach to accelerate the service composition and ensure the quality. It can also be applied to the cloud migration service composition to solve the above mentioned challenges. Pattern is based on the fact that an idea has been proven useful in one practical context and will probably be useful in others (Gamma et al., 1995). Even though, every system has its own set of prerequisites, hidden costs, one-off requirements and special case exceptions, the best practices could tell us how to cope with these issues. More specifically, service patterns are defined over services and present the typical ways of composing services to achieve certain goals (Fu et al., 2009). The pattern in this paper refers service composition pattern dedicates to the service composition for the cloud migration. Service composition patterns facilitate the web service composition and accelerate the response to the market. This is exactly why the patterns are appealing as a medium to convey solutions (Rotem-Gal-Oz, 2012).

A complete on-premises application/system migration to cloud generally involves two major decisions: the destination cloud selection and the migration process. In this paper, we focus on the migration process. In order to apply patterns to the cloud migration service composition, discovering or generating patterns is the prerequisite. Existing service composition pattern discovery approaches can be classified as two families: deduction and induction. The former is usually based on business process knowledge. An inductive method discovers patterns by abstracting execution instances. The top-down approach can be classified as deductive approach. In the top-down approach domain specialists review the business processes to discover patterns. The bottom-up approaches in (Tang and Zou, 2010) are to mine the business processes from the execution logs of applications and then abstract the processes to service composition patterns. Those approaches can be classified as induction. The demand of the migration to cloud drives the emerging of related web services for migration. The migration to cloud has its own characteristics: the application to migrate and the target platform are known, the services for migration is also enumerable. But how to process the complex application migration is not clear. Consequently, there is no clear business processes available and the de-
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