A Framework for Service Discovery Based on Structural Similarity and Quality Satisfaction

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Abstract. The increasing number of published web services rendered the searching for a service within repositories a critical issue in many application domains. Recent approaches resorted to service structure and to preferences over quality attributes to reduce selectivity rate. In this paper, we present *S-MatchMaker*, a tool for service discovery based on both service structure and quality preferences. The tool implements several algorithms that can be coupled in different ways to provide a personalized solution for service discovery.

Keywords: Web service discovery, QoS, process model matching.

1 Introduction

The increasing number of published web services rendered searching for a specific service within repositories a critical issue for the success of service computing in general. On the functional aspect, recent approaches [1,2] invited users to detail their requirements by specifying a process model (PM) describing the structure of the requested service, and thus PM matchmaking techniques were necessary to find the services best matching the query. On the non-functional aspect, one way to discriminate between structurally similar services is to consider non-functional requirements such as quality preferences (e.g., response time) [3,4].

In previous works, we provided to the service discovery problem a number of contributions based on the PM specification of the service and on quality preferences [2,5,6,7]. These contributions are composed of (i) two heuristics to reduce the execution time of PM matchmaking, which is NP-complete, and (ii) a set of metrics from classic and fuzzy logics to evaluate structural similarity and quality preference satisfaction. In our approaches, services have their behavior represented by a PM graph adorned with QoS annotations, which can be also defined at the activity level. The user query is also a PM graph complemented with a set of selection clauses, which are defined either as required (hard preferences) or preferred criteria (soft preferences). The service discovery is seen as a matching process between the user query PM and a target PM. These contributions have been implemented to forge a flexible tool, called *S-MatchMaker*, capable of coupling different approaches for personalizing service discovery based on structural and quality aspects, as it will be described in the following sections.

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2 Architecture

The modules of S-MatchMaker, depicted in Figure 1, are executed as follows:

First, input query and target PMs, described in OWL-S or BPEL (the two most used languages for describing service composition), are parsed into our abstract graph model [2,5] by the *Parser* module. Next, *Service PM Matchmaking* module finds a mapping between query and target graphs based on the name and input/output similarities between activities. An optional heuristic based on graph summarization can be used to reduce the matchmaking time [8].

At the same time, the *Hard Preference Evaluation* module evaluates the satisfaction degrees of hard preferences when each pair of activity is matched (activity preferences) and when a mapping of two graphs is discovered (process preferences). A mapping is discarded whenever it disrespect a hard preference [5,7]. After that, the *Soft Preference Evaluation* module evaluates the satisfaction degrees of soft preferences.

The *Structural Similarity Metric* calculates the structural similarity degree from the mapping between query and target graphs. Four metrics were implemented: one is the sum of the mapping dissimilarities [2], another is based on linguistic quantifiers [6] and two others are based on bipolar conditions [7].

The *Preference Satisfaction Metric* aggregates the satisfaction degrees of hard and soft preferences. Three methods were implemented: one is the weighted average of satisfaction degrees [5], another is based on linguistic quantifiers [6] and the last one is based on a bipolar condition [7].

Then, the *Degree Aggregation* module provides four methods to aggregate structural similarity and preference satisfaction degrees: weighted average of structural similarity and preference satisfaction [5], min-combination of structural and preference degrees [6] and two other based on bipolar conditions [7].

Finally, the mapping and the similarity degree based on structural similarity and preference satisfaction for each query and its potential targets are returned.

The S-MatchMaker tools is very extensible: developers can use its API to create new parsers, matchmaking algorithms, similarity metrics, etc., and attach them to the tool. A Web interface offering less functionalities can be found at http://infosystems.prism.uvsq.fr:8080/WebMatchMaker.

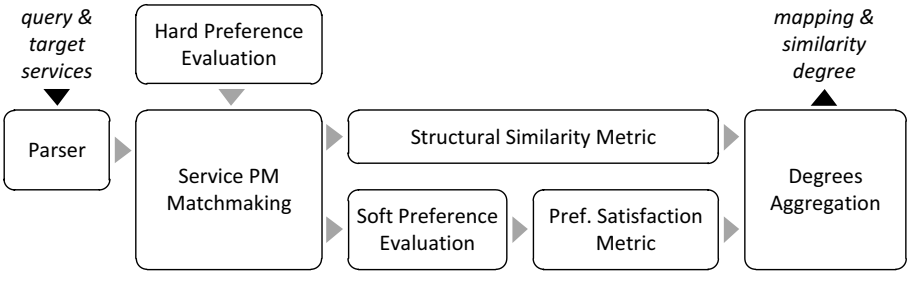

Fig. 1. S-MatchMaker architecture

3 Using S-MatchMaker

A typical session with S-MatchMaker is depicted in Figure 2. It starts with the user loading the service repository over which one or more queries will be posed

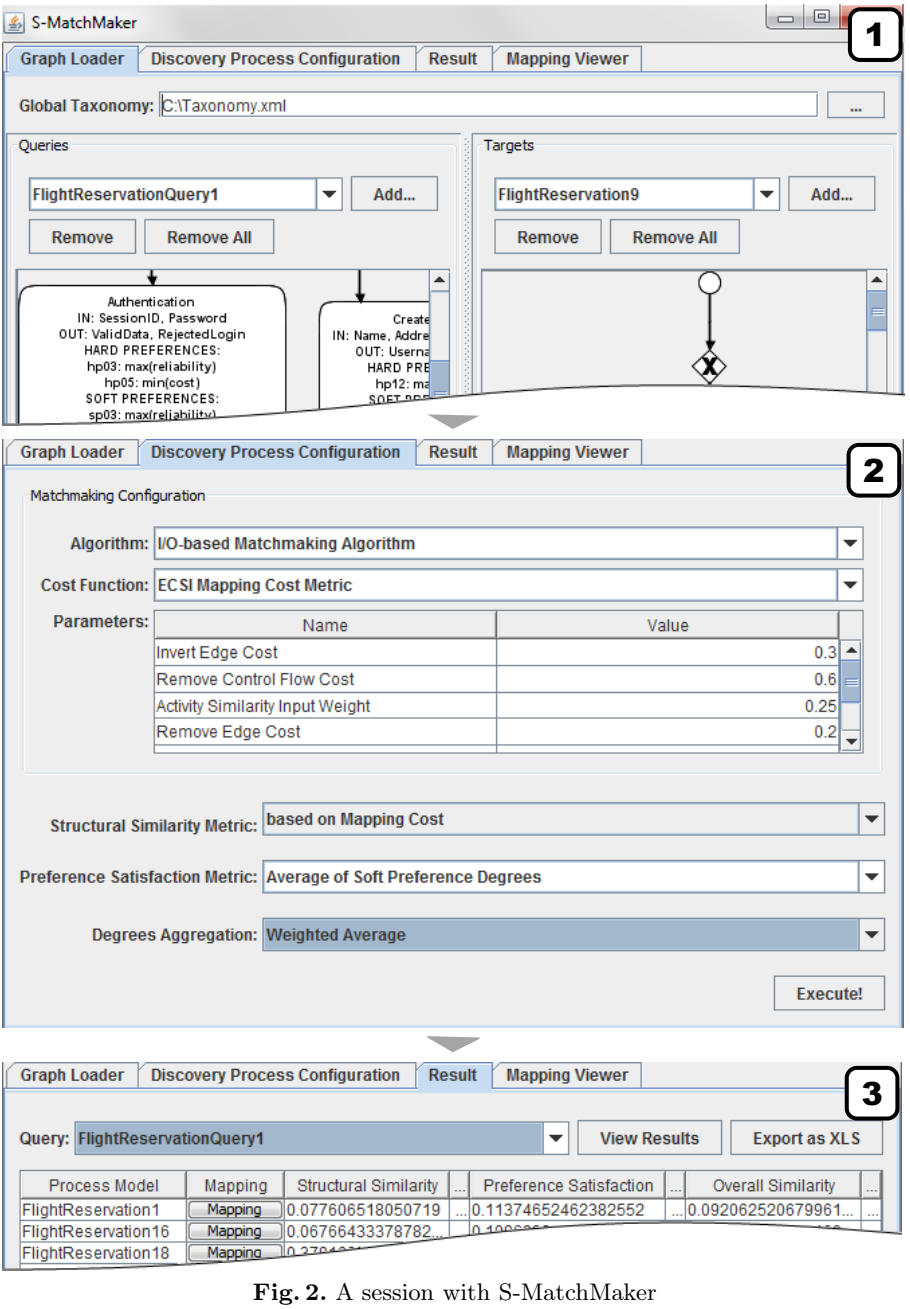

Fig. 2. A session with S-MatchMaker

(step 1). Through a BPMN[1] representation of the service PM, user can analyze the query/target structure and its preference/quality annotations.

In step 2, the user configures the discovery process by selecting: (i) the matchmaking algorithm to be executed (either the default I/O-based algorithm or the algorithm with the summarization heuristic) and defining its specific parameters (edit operation costs, thresholds, etc.); (ii) the metric to calculate the structural similarity degree; (iii) the metric to calculate the preference satisfaction degree; and (iv) the method to aggregate structural and preference degrees.

The results by query are presented in a dedicated interface (step 3). By clicking the *Mapping* button, user can visualize the mapping between the selected query and the corresponding potential target in the *Mapping Viewer* tab.

4 Conclusions

Here, we presented S-MatchMaker, a tool for service discovery process based on structural similarity and preference satisfaction. The tool features a graphical interface to load service PMs, configure the discovery process and visualize the results. Its modular architecture can be adapted to other service discovery approaches based on structural similarity and/or preference satisfaction.

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