Multi-View and Context-based Analysis for Service Integration

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Summary
Service-oriented architecture (SOA) enables reuse and sharing of system resources across organizations via the use of interoperable services to build complex service-based processes. However, SOA lacks the required infrastructure to thoroughly analyze services and uses producer-provided service description for service management purposes such as service selection and integration.

This research aims at devising an analysis-based framework for service integration which integrates static and dynamic service analysis techniques to make sophisticated decisions. The proposed framework benefits from techniques in decision support systems, reverse engineering and data mining to enhance the state of service integration.

We propose a decision flow based service selection mechanism that considers requester’s situation and its domain properties when answering a query. The proposed mechanism improves the effectiveness of service integration through dynamic selection of the appropriate analysis methods based on the context of the requester.

Introduction
Service Oriented Architecture (SOA) is regarded as key paradigm for implementing enterprise applications by integrating reusable packages of functionality, called services.

- Publish-Discover-Interaction paradigm
- Service description (e.g. WSDL)
- Service selection and integration are based on description matching

Service Integration: Problems and Applicable Techniques

Problems in Service Integration
- Limited knowledge about services
- Lack of thorough service analysis infrastructure
- Fixed selection mechanism

Applicable Techniques
- Static analysis
- Dynamic analysis
- Extracting service properties by analyzing source code and documents.
Specifying the Integrated Service

### The Functionalities

1. **Functionality 1 - EMR Query Medications**
   - **Functionality**: EMRQuery
   - **Input**: type = patient identifier
   - **Output**: type = medication history

2. **Functionality 2 - EMR Update Medications**
   - **Functionality**: EMRUpdate
   - **Input**: type = patient identifier
   - **Input**: type = new medication
   - **Output**: type = medication history

3. **Functionality 3 - Pharmacy Prescription Order**
   - **Functionality**: PharmacyPrescriptionOrder
   - **Input**: type = patient identifier
   - **Input**: type = new medication
   - **Output**: type = acknowledgement

### Service Selection Flow

#### Phases of Dynamic Analysis

1. **Phase 1 – Scenario Generation**
   - Generating a set of functionality-oriented scenarios for the requested functionality
   - Scenario is a sequence of service operations with specific values associated with a functionality
   - Example: for functionality 'EMRQueryMedications', a scenario set for a candidate EMR service includes a call to operation 'query' on the candidate service with different sets of medications as input

2. **Phase 2 – Extracting Execution Traces**
   - Executing the scenario set on an instrumented candidate service to extract the trace (sequence) of function calls related to the requested functionality
   - Include function inputs and outputs

3. **Phase 3 – Execution Pattern Mining**
   - Extracting pattern of function calls using sequential pattern mining
   - The extracted pattern represents core functions that realize the required functionality
   - Example: pattern associated with functionality 'EMRQueryMedications'

4. **Phase 4 – Feature Verification**
   - Verifying features on the extracted pattern
   - Example: behavioral feature "Service must require user to login before sending cut medication history" is validated on the extracted pattern

#### Contributions

- Enhancing the state of SOA by providing analysis infrastructure and analysis-based service integration framework
  - A mechanism for extracting service properties through dynamic analysis and execution pattern mining
  - An open SOA-based analysis framework for service management purposes
  - A service selection mechanism based on decision support systems strategy with the following characteristics:
    - Flexible
    - Context-based
    - Domain-aware
    - Analyze-based
  - A mechanism for semi-automatic scenario to query translation