Multicriteria Evaluation Based Framework for Composite Web Service Selection

Samir Youcef and Salem Chakhar

Laboratoire d'Analyse et de Modélisation
des Systèmes pour l'Aide à la Décision
Université de Paris-Dauphine

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{youcef, chakhar}@lamsade.dauphine.fr

Elementary Web Service

Web service definition (W3C)

▷ Web service is a software system designed to support interoperable machine to machine interaction over a network

▷ Interoperability among services is insured by the open protocols:

- Description: XML (eXtensible Markup language)
- Transport: SOAP (Simple Object Access Protocol)
- Interface: WSDL (Web Service Description Language)

WSDL is limited to simple operations:

- How compose the different operations (Need a standard description of the process)

Composite Web service

Composition languages

- WSFL (Web Services Flow Language): IBM
- XLANG (XML Business Process Language): Microsoft
- PBML (Business Process Modeling Language): BPML.org

BPEL4WS

- BPEL4WS is the merger of WSFL, XLANG et PBML

BPEL4WS constructors

- Basic: invoke, receive, reply, wait, assign,...
- Structured: sequence, switch, while, flow, pick,...

Conventional Web service architecture

- ▷ A Web service can be discovered in UDDI registry.

Web services selection

▷ Composite Web service= $A+B+C$ (What is the best composition?)

Web services selection

Quality of service (QoS)

QoS is a combinaison of several properties:

- Qualitative: security, reputation,...
- Quantitative: response time, availability,...

Previous studies

- Single evaluation criterion
- Successive evaluation ("general level" of different composition)
- Local strategy selection

Web services selection

Limitations

- A single criterion does not permit to encompass all the facets of the problem
- Weighted sum-like aggregation rules may lead to the compensation problem
- Several QoS evaluation criteria are naturally qualitative

Proposed solution

- Using multicriteria evaluation of the different composition
- Extend the conventional Web service architecture, using QoS

Extended conventional Web service architecture

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Extended conventional Web service architecture

Dynamics of the system

Definitions

Elementary Web service definition

Web service $s_i, i \in \{1, \dots, n\}$ is characterized by the tuple:

- F_i : description functionality
- Q_i : specification of its QoS
- C_i : cost specification

P_i : set of providers of functionality $F_i, i \in \{1, \dots, n\}$

Composite Web service definition

$G = (X, V)$ composite graphe associated with $s_1, \dots, s_n$

- A composite Web service is an instance $\{s_1, \dots, s_n\}$ of G , such: $s_1 \in P_1, \dots, s_n \in P_n$
- s_i^j : i th elementary Web service offered by the j th provider

Potential composite Web services

Algorithm CompositionsConstruction

INPUT: $G = (X, V)$: composition graph

$P = \{P_1, P_2, \dots, P_n\}$: providers

OUTPUT: C : potential compositions

$T \leftarrow \text{Construct_Tree}(X, P)$

$t \leftarrow 1$

WHILE $t \leq \prod_{i=1}^n |P_i|$

$X_t \leftarrow \text{ElementaryPath}(T)$

// $X_t = \{s_1, s_2, \dots, s_n\}$

FOR each $(S_h, S_k) \in V$

$V_t \leftarrow (s_h, s_k)$

END_FOR

$C_t \leftarrow G_t = (X_t, V_t)$

$C \leftarrow C \cup C_t$

$t \leftarrow t + 1$

END_WHILE

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Evaluation of compositions

General formula:

$$v_j(x) = \Phi_j[g_j(x), \Omega(\Gamma^+(x))] \quad (1)$$

- Response time:

$$v_1(x) = g_j(x) + \max\{v_1(y) : y \in \Gamma^+(x)\} \quad (2)$$

or

$$v_1(x) = g_j(x) + \sum_{y \in \Gamma^+(x)} \pi(x, y) \cdot v_1(y) \quad (3)$$

- Security

$$v_4(x) = \min\{g_j(x), \min_{y \in \Gamma^+(x)} \{v_4(y)\}\} \quad (4)$$

Evaluation of compositions

Composition graph

C_1

Evaluation of compositions

Response time of composite Web service:

$$V(s_6^3)=2$$

Evaluation of compositions

Response time of composite Web service:

$$V(s_6^3)=2$$

$$V(s_5^2)=6$$

Evaluation of compositions

Response time of composite Web service:

$$V(s_6^3)=2$$

$$V(s_5^2)=6$$

$$V(s_4^4)=4$$

Evaluation of compositions

Response time of composite Web service:

$$V(s_6^3)=2$$

$$V(s_5^2)=6$$

$$V(s_4^4)=4$$

$$V(s_3^1)=5$$

Evaluation of compositions

Response time of composite Web service:

$$V(s_6^3)=2$$

$$V(s_5^2)=6$$

$$V(s_4^4)=4$$

$$V(s_3^1)=5$$

$$V(s_2^2)=3$$

Evaluation of compositions

Response time of composite Web service:

$$V(s_6^3)=2$$

$$V(s_5^2)=6$$

$$V(s_4^4)=4$$

$$V(s_3^1)=5$$

$$V(s_2^2)=3$$

$$V(s_1^2)=7$$

Conclusion

Proposed model

- General framework to composite Web services using QoS
- Multicriteria evaluation based approach
- QoS criterion evaluation
- Generate the different potentials compositions

Futur research

- Finalization of the being developed prototype
- Extension for the framework to support dynamic composition (composition graph)
- Quantitatives criteria: random variables (response time, availability,...)

Second Workshop Decision Deck

Area: Web services

Topic: Performance evaluation of Web services

Laboratory: Lamsade (Paris-Dauphine)

Home page: <http://www.lamsade.dauphine.fr/~youcef>

Thank you for your attention !