First Symposium on the Personal Web

Web Personalizer as User Consultant

Kamran Sartipi and Mehran Najafi
McMaster University

{sartipi, najafm}@mcmaster.ca
http://www.cas.mcmaster.ca/~sartipi

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Outline

- Shift from "user-assistant" to "user-consultant"
- Web Personalizer
- Steps for utilizing Web Personalizer
- Different components:
  - Service Agent
  - Broker Agent
  - Analyzer Agent
- Infrastructure requirements:
  - Semantic interoperability
  - Cross-domain interoperability

Motivation: Need for User Consultant

- Enterprise web applications require extra knowledge and expertise from users to take advantage of the available features and operations of the services:
  - Time constraints causes users to limit themselves to a minimum set of available features. They don't use manuals.
  - Similar situations exist in using different applications in other domains: automobile gadgets, home appliances, entertainment centers.
- The user interactions of the applications are already sophisticated and hence, they act as "**user-assistants**" by providing different types of information. However, domain knowledge is still needed.
- Next generation of computerize systems (embedded or software) should incorporate the required expertise as part of the system's functionality:
  - This means a shift of mission from "**user-assistant**" to "**user-consultant**".
  - Therefore, instead of expecting the user to be an expert, the web service itself acts as an expert.

Web Personalizer

- A Web Personalizer allows the user to manage her web assets and perform the desired tasks with minimum effort and time. Such a Web Personalizer provides smart interactions and consultation for the user.
- It is a collection of three generic agents "service agent", "broker agent" and "analyzer agent" that are deployed at "client platform", "broker platform" and "provider platform".
- These generic agents will be specialized using roles and training skills to act as delegate:
  - from service provider to the client (i.e., service agent), or
  - from client to service provider (i.e., broker agent and analyzer agent).
- The agents are customizable by receiving a set of well-defined task information.
- The proposed Web Personalizer will be an addition to the traditional services which receive a client request for a service, perform the service at the provider's platform and return the results to the client.

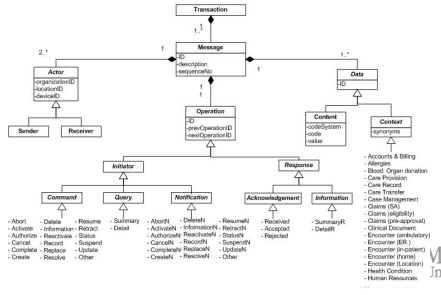
Steps for Utilizing Web Personalizer

Step 1: Identifying the User's Context

- Context refers to any information that can be used to characterize the situation of a service requester or provider.
- A sample context:
  <Name, Role, Team, Location, Time, Requested resources, Service type, Data type>
- Context information is monitored dynamically to feed a database of context-logs that will be used during the service selection.
- Context can also be defined as a "Context Description Text" that describes the type of data and services that are requested.

Context Description Analyzer using Context Schema

Similar Technique can be used for Mapping Context Description (scenario) to Standard Expert Services using Semantic Analysis



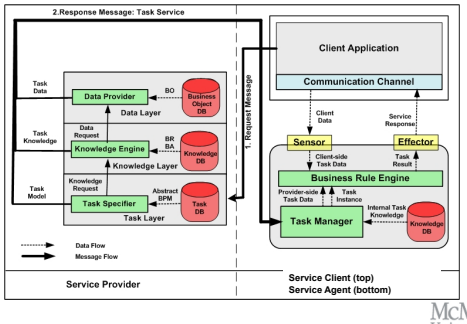
Step 2: Selecting the Required Task

- User asks (or explains via a context description) for a specific task and the required expertise to assist him.
- A client proxy mines the context-logs (or analyzes the description) and then consults with the web registry to generate a ranked list of relevant services that provide different levels of expertise in that task (and their charges).
- User selects an appropriate service which best fits with his situation.
  - Web registry should have a list of application domains (e.g., banking, insurance, healthcare, airline, government) and the lists of different expertise in each domain.
- Example of domains and expertise:
  - **Banking**: mortgage consultant, financial advisor, credit checker, home/car insurer, ..
  - **Healthcare**: virtual nurse, PHR viewer, medication administrator, ...

Step 3: Delegate Expertise to the Client

- After interactively selecting the required task, the client proxy retrieves the service descriptions and invokes the service from the provider's platform at run time (i.e., dynamic invocation).
- Instead of performing the requested task, the provider sends a tuple <model, knowledge, data> to the client.
- The generic service-agent receives the tuple and customizes itself to become an expert consultant for the user.

Architecture of Service Agent for Web Personalizer



Expert Service Agent

- A generic agent that is deployed at the client's platform and provides an expert service for the user.
- It ensures the user will take advantage of available service functionality by adjusting the service locally and according to the user's context information.
- Advantages of processing the service locally:
  - Client data confidentiality is preserved
  - Reduces network traffic
  - A new set of enterprise level operations can be generated.
- Examples: financial advisor, decision support system, etc.

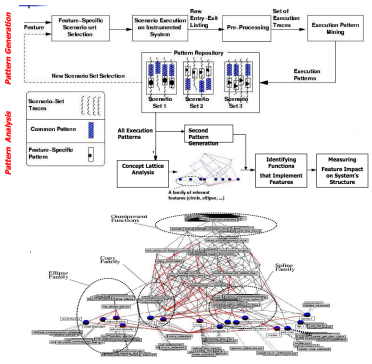
Customizable Broker Agent

- Evaluates a set of candidate traditional web services in order to allow a better selection.
- The client-proxy contacts the web registry and provides a list of high-level quality features, such as: performance, security, availability, maintainability, for the user. After user selects, the proxy accesses the web registry to receive: i) service description; and ii) the selected expertise as the tuple <model, knowledge, data> from the registry.
- The proxy sends the selected expertise to the generic broker-agent to customize it for the intended service evaluation operation.
- The broker agent then customizes the Analyzer Agent and sends a number of service invocations to the candidate service. This candidate service is selected by the user to be evaluated.
- The analyzer agent returns the results to the broker where the broker will use an objective function (cost function) with parameters that are defined by the user's context information.
- The broker will send back the list of ranked services with short report of merits or drawbacks for each service.

Customizable Analyzer Agent

- Intended to provide in-depth analysis information for a customized broker-agent to perform sophisticated service quality analysis than those currently used for service selection and service aggregation.
- Broker agent customizes the analyzer-agent which is located in the provider's platform to:
  - Instrument the service application by embedding binary code into the service so that the analyzer can collect execution traces or profiling statistics that are run by the broker or by the client application.
  - Broker will perform dynamic analysis on the execution traces, such as: security flaw identification; or feature localization and scattering.
- Examples of analysis: policy monitoring, auditing, message content monitoring through SOAP analysis.
- What is the major requirement of this approach?

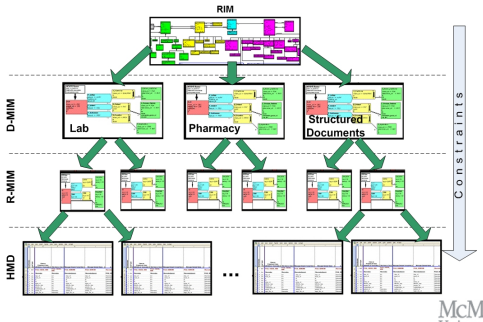
Feature Scattering Analysis using Execution Pattern Mining



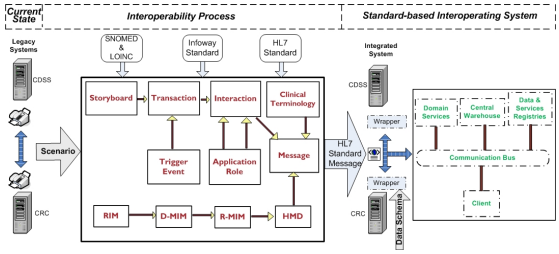
Infrastructure Requirements: Semantic Interoperability

- Communicating with sophisticated enterprise services requires interoperability of terms and concepts between the clients and servers.
- Interoperability of heterogeneous distributed system have been resolved through available technologies (SOA, XML, CORBA, ..)
- A more challenging issue is interoperability of terms and concepts between different organizations (i.e., semantic interoperability).
- In some domains, terminology systems are used for semantic interoperability (e.g., SNOMED for healthcare domain)
- HL7 organization provides a well defined reference information model (RIM) for health and medical domain which allow data and semantic interoperability.

HL7 Message Refinement Process



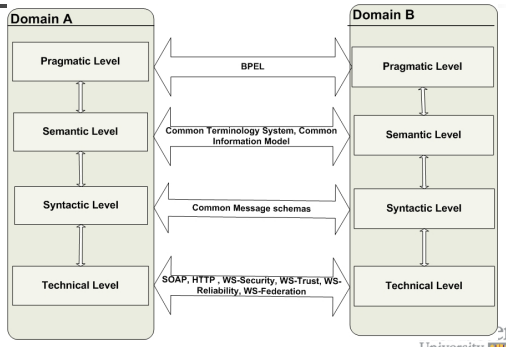
Legacy Healthcare System Integration Framework



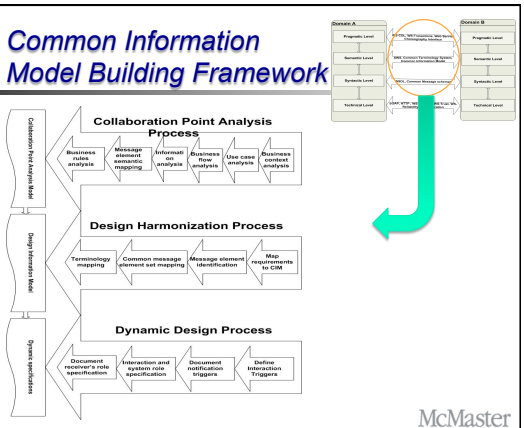
Infrastructure Requirements: Cross-Domain Interoperability

- A more challenging issue is interoperability of web services among applications in different domains.
- For achieving this the domains need to have standard information model and a shared terminology systems.
- Interoperability is achieved through exercising the process of standard message development framework where two domain are considered together.
- HL7 development framework (HDF) provides guidelines on how to develop common messages.
- However, a shared terminology is required.

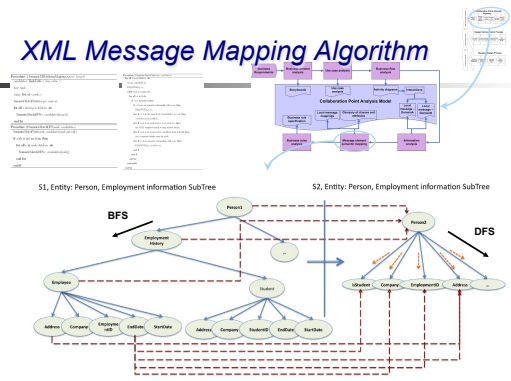
Interoperability Framework



Common Information Model Building Framework



XML Message Mapping Algorithm



Conclusion

- Utilization of the rich variety of internet resources requires more sophisticated and customizable web clients.
- In enterprise web applications SOA technology provides abstractions and less dependencies, however, SOA can not meet the requirement for flexible and customizable services based on the needs of Personal Web paradigm.
- New web applications, such as social networks, user centric concept, and web application integration (Mashups), are driving forces for ICT professionals to provide more variety of complex internet resources.
- Web Personalizer provides customizable services as user consultant and as sophisticated web service analyzer.

Conclusion

- New demands for

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Kamran Sartipi
Information Systems Group
DeGroote School of Business
Master University

sartipi@mcmaster.ca
http://www.cas.mcmaster.ca/~sartipi

Mehran Najafi
Department of Computing and Software
|McMaster University

najafm@mcmaster.ca

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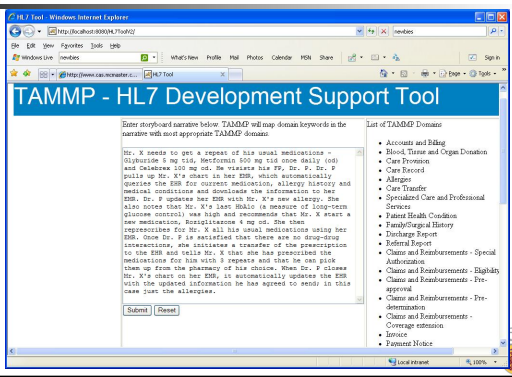
Prototype Tool - Screenshots



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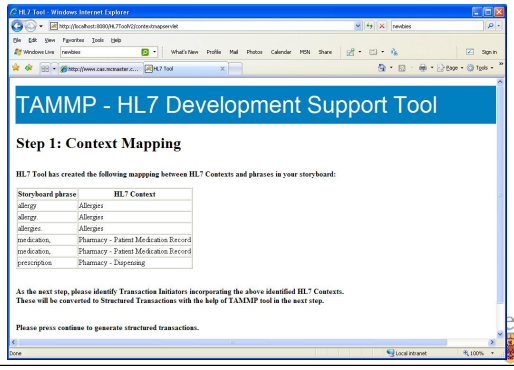
Prototype Tool - Screenshots



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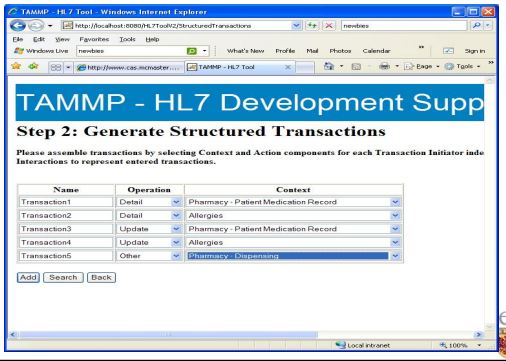
Prototype Tool - Screenshots



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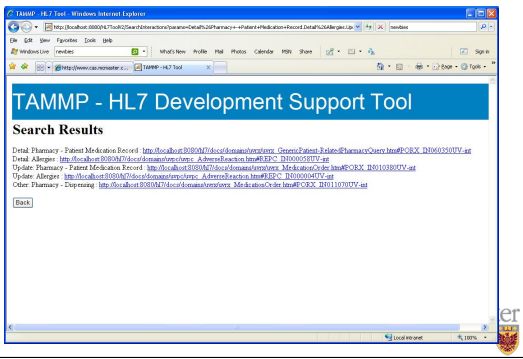

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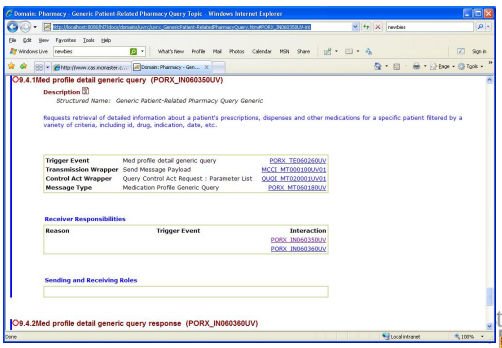

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Research Project

Data Mining to Assist Patient Diagnosis

• Applies concept lattice analysis on the existing relations between different diseases and their corresponding symptoms and sings, which allows to extracts highly related groups of diseases and their symptoms.

• Identified groups are refined using the patient's specific symptoms and EMR records which allow the physician to focus on the most relevant diagnosis for the patient's disease

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Motivation

- Problem:
  - Retrieval of scenario specific information from an extensive electronic health record (EHR) is a tedious, time consuming and error prone task.
- Solution:
  - We propose a model and a technique for mining relevant clinical information with respect to the most probable diagnostic hypotheses in a clinical scenario.
  - This involves investigation of patient's EHR for evidences that *strengthen* or *weaken* the diagnostic hypotheses.

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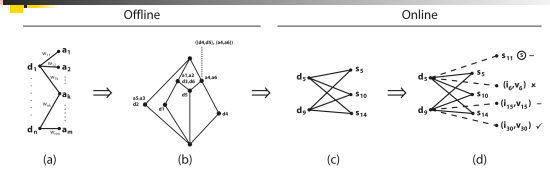
Overview of the proposed approach



(a) Generic graph representation of diseases and their attributes (e.g., symptoms, signs, EHR elements, etc.)
- W_{ij} is a quantity that we assign to an edge to indicate the support of attribute$_j$ in the diagnosis of disease$_i$

(b) Concept lattice representation of a specific disease-attribute graph
(c) A *maximal association* among diseases and symptoms&signs
(d) Extending maximal associations in (c) with relevant attributes from EHR

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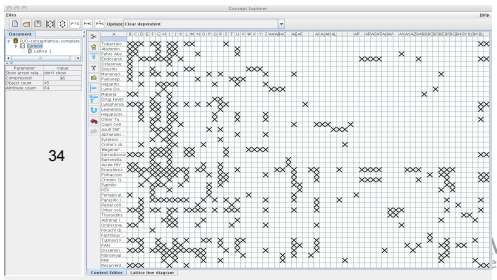
Context table

- Captures the relationship between diseases and their symptoms & signs
- We have employed *Concept Explorer* tool to generate and illustrate the concept lattice



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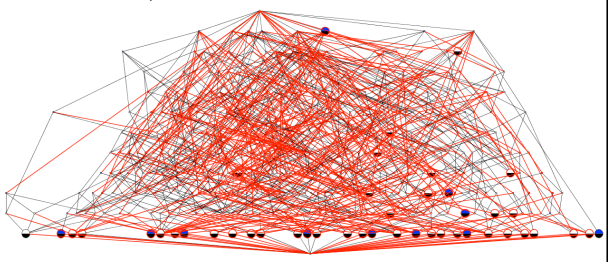
Concept lattice

- **45** diseases and **64** common symptoms and signs for Fever of Unknown Origin (FUO) syndrome
- **499** concepts



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Example Scenario

A 68-year-old Spanish female presented with anorexia, malaise, non productive cough, night sweats, chill and daily fever (temperature, 38.3 C -39.5 C) from 4 days ago. She recently moved to Canada and spoke English with difficulty and was not cooperative in giving a precise history. She was brought to clinic by her neighbor who was not aware of her past medical history, her medications and exposure or contact with animals or ill people. In her first physical examination, she was diagnosed *community acquired pneumonia* by family physician who prescribed antibiotic medication for her. Over the following weeks her fever persisted. Her medication was then switched to Clarithromycin for treating atypical pneumonia. There was no improvement in her condition. She was referred to specialist for further investigation of Fever of Unknown Origin (FUO).

The high-lighted terms represent symptoms and signs used to extract a specific concept from the generated concept lattice

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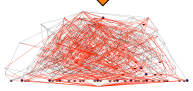
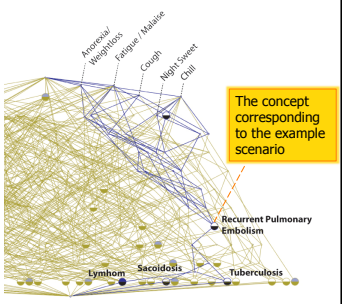
Discovering probable hypotheses

Observations (symptoms and signs): anorexia, malaise, cough, night sweats, fever, chill



Hypotheses (diseases): Tuberculosis, Sarcoidosis, Recurrent Pulmonary Emboli, Lymphoma



The concept corresponding to the example scenario

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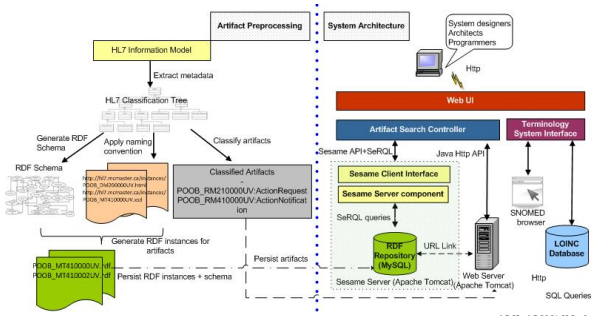
Mapping Context Description (text) to Standard Expert Services using Semantic Analysis



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