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An XCS-Based Intelligent Searching Model for Cross-Organization Identity Management in Web Service

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ABSTRACT

Internet services in distributive organization are normally built on an open network environment. In the environment internet service provisioning cannot be expected executing in a single close organization [1]. Identity management in cross-organization becomes an issue for handling Internet service and distributive business process.

The "identity" in cross-organization web service is defined as global identity rather than private identity from client. Global identity searching table that registers all related service organization is the normal way we used to [2]. Through global identity searching table the target service organization can be looked up directly. For some business program, however, global identity is not necessary registered in specific service organization, e.g. IMSI (International Mobile Subscriber Identification) registration in NP (Number Portability) Service [3], for instance. In NP Service each IMSI can be re-assigned to different mobile service provider if the IMSI apply the re-assignment.

In the example about IMSI in NP service mentioned above, if there is an internet service will be executed according to identity management with IMSI, then it will be a challenge to find the organization for available IMSI in very short response time. To dynamically re-assign a IMSI in different mobile service provider, the traditional global identity searching table will not be practical due to frequently changing the registration of IMSI in different service provider.

To give an intelligent searching model for cross-organization global identity management is a better way than a static global identity searching table management in Web service. In this article the XCS (eXtended Classifier System) classifier system [4] will be proposed as the kernel system. With the characteristics in machine learning and rules management, the XCS-based intelligent searching model can help to predict where the web service can find the global identity in the open and cross-organization environment.

Keywords: Identity Management, Cross-Organization Searching Model, Web Service, XCS Classifier System

1. INTRODUCTION

The cross-organization web service allows a user to seamlessly traverse different sites on different organizations [1]. For any cross-organization service in Internet, global identity is not necessary found from first organization which detects service request from client. It implies that service organization should be "searched" if it will offers required global identity.

In this field a lot of searching scheme under the assumption of fixed network topology, such as Microsoft TrustBridge [6], IBM Tivoli Federated Identity Authentication System and Secure Web Service [7], etc.. Most of major applications for m-commerce or e-commerce, identity management is developed as same way in opening internet environment [1][9].

For any changing in an opening cross-organization web environment, re-configuring of network topology, routing table will be overhead of adjusting global identity distribution. Therefore, the design of an intelligent searching model for getting right service organization is the major topic in the article.

For achieving the objective, an XCS-Based intelligent searching model for accessing cross-organization global identity is proposed. Not only give the capability to find required global identity in dynamic service organization, but also give capability in searching rules management, learning and GA based evolutionary operations.

2. IDENTITY MANAGEMENT IN CROSS-ORGANIZATION WEB SERVICE

Identity management in cross-organization web service is more complicated than in single organization environment. The major problems are:

1. The table schema for depicting global identity in cross-organization is complicated.

2. The prediction for global identity in unknown organization is not easy to perform.

Before answering the issues mentioned above, some fundamental research should be performed in advanced.

2.1 Cross-Organization Web Service

Web service is the major communication mechanism in e-commerce. Through web service, flexibility to business partners, suppliers and customers is the major inspiration for business operation. Some standards in web service were taken. These standards normally solve the problems of finding, binding and accessing service. The major standards in web service include UDDI (Universal Description, Discovery and Integration), WSDL (Web Service Definition Language) [8], SOAP (Simple Object Access Protocol) [10], SAML [11], etc.

For providing efficient cross-organization web service under the standards above, identity management is necessarily implemented with intelligent way, not only for its feasibility, but also for its flexibility.

2.2 Cross-Organization Identity Management

The challenges to handle identity management in cross-organization web service are:

1.   How to get global identity for required application in acceptable response time?

2.   How to define the relationship among service organizations?

3.   How to predict the address of service organization that the required global identity belong to, especially the required global identity can be "moved" to any service organization?

In web service, normally the scenario of service requested is defined as the following way:

1.   A service requester is detected via client ID. Identity management process is started. In the identity management process, related identity document will be analyzed in terms of user's profile, service portfolio, privacy, authorization and transaction. The cache for recent contacting would be adopted for raising access performance.

2.   If the global identity is analyzed through identity management and first service organization is hit, a service ticket will be generated and reply to the service requester. Go to 6.

3.   Else if the global identity is confirmed that NOT belong to the first service organization, then the searching of right service organization will be run.

4.   If right service organization for required global identity is found, then return the global identity back to first service organization, go to 6.

5.   If right service organization cannot be found in time, then exceptional handling will be enabled.

6.   No further cross-organization searching action will be required. Execute the application service with the delivered global identity.

3. INTELLIGENT XCS MODEL

XCS (eXtended Classifier System) was developed from LCS (Learning Classifier System) [4] and issued by Stewart W. Wilson in 1995. Classifier System [12] is the major research model for evolutionary computation in artificial intelligence. It is an intelligent learning mechanism with rules of expertise, messaging between rules and parallel process. Except the capability derived from LCS, XCS was also derived from related ZCS (Zeroth Level Classifier System) Research since 1994 [13][14] regarding to classifier system simplification.

By the characteristics of rules management, learning capability and evolutionary GA capability, XCS model is very suitable for representing prediction function in changeable environment as what we study in identity management.

3.1 The XCS Interactive Environment

As a classifier system, the interaction between XCS and environment was built on the information which can be depicted as the binary set way as below:

$$\sigma(t) \in \{0,1\}^L \quad \text{.....................} (3.1)$$

In equation (3.1), $\sigma(t)$ indicates the detected binary information in timing t, L indicates the length of detected binary information. The action set for handling the detected information $\sigma(t)$ can be expressed as the equation as below:

$$\alpha(t) \in \{a_1, \ldots\ldots, a_n\} \quad \text{..........}(3.2)$$

In equation (3.2), $\alpha(t)$ indicates the system action for handling $\sigma(t)$ in timing t. Furthermore, for each $\alpha(t)$, the corresponded payoff $\rho(t)$ will be generated. For different condition, the detected $\sigma(t)$ is handled by one-step or multi-steps action. The flag *eop* will be set if $\sigma(t)$ is processed completely in multi-steps action.

The *rp* (Reinforcement Program) [18], which was developed by Dorigo and Colombetti in 1998, will be enabled by payoff and *eop* which is set by XCS for handling $\sigma(t)$ and $\alpha(t)$. Figure 3-1 indicates the interaction among XCS rule set, *rp* and Environment with related $\rho(t), \sigma(t)$ and $\alpha(t)$ [4]:
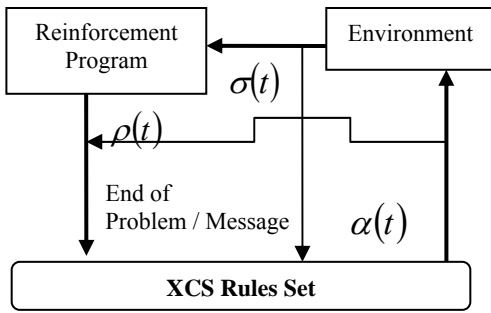
Figure 3-1: The Interaction among XCS Rule Set, *rp* and Environment with related $\rho(t), \sigma(t)$ and $\alpha(t)$

3.2 XCS Definition and Information Structure

The basic information structure in XCS is derived from normal classifier system which includes Condition, Action and Prediction (State), as table depicted in Figure 3-2:

Classifier									
Condition			Action			Prediction(State)			
1	0	#	1	0	1	0	1	0	1

Figure 3-2: The Basic Information Structure in XCS

However, XCS is more powerful than the traditional classifier system. More system parameters for XCS mechanism including Prediction error ε, fitness function *f*, the counting variable *exp* of using corresponded XCS classifier in each action, the time stamp *ts* for last GA operation in action set, the size *as* of action set and the Numerosity *num* which is used for counts the numbers of micro classifiers under the appointed macro-classifier.

For any XCS Classifier cl，the attributes can be represented as：

$$x_{cl} \in \{C, A, p, \varepsilon, f, \exp, ts, as, num\} \ldots\ldots\ldots(3.3)$$

In addition, XCS is also derived from LCS. According to LCS, the GA operation and learning mechanism in XCS classifier [19] follow MDSE (Markov Decision Support Environment) [20][21][22]. For NMDSE (Non-Markov Decision Support Environment) [23], some extended Internal-State registers were taken for handling learning operation and system evolution.

The XCS system parameters regarding to learning capability includes N (Size of XCS Population), β (Learning Rate), α (Learning Coefficient), ε_0 (Precision of ε), v (Power Parameter) , γ (Factor of Discount), θ_{GA} (GA Threshold), χ (Probability of Cross Over), μ (Probability of Mutation), θ_{del} (Deletion Threshold), δ (Expected Difference between Fitness and Prediction), θ_{sub} (Threshold of Subsumption), $P_{\#}$ (Probability of Adopting #:Don't Care in condition), p_I, ε_I, and f_I for initialize new XCS classifier, $p_{\exp lr}$ (Exploration Probability), θ_{mna} (Threshold to Cover all Conditions [M]), *doGASubsumption* (Boolean Parameter If Offspring classifier will be tested when subsumption) , *doActionSetSubsumption* (Boolean Parameter If Action Set will be tested when subsumption) that were defined in [4].

3.3 Generalization Hypothesis and System Behavior

Generalization Hypothesis, which was developed by Wilson, is one of the important system features in XCS [4]. The objective of generalization hypothesis is offering of "precise classifier sets" which got complete but non-repeated functional classifiers. The "precise classifier sets" must be as small as possible so that it improves the access performance in traditional classifier system. The Generalization was defined as below[20]：

§ Generalization：is viewed as the problem of finding the smallest set of rules (the classifiers) which completely and accurately represents the task that the agent has solved.

However, generalization is not easy to implement. Because generalization can be viewed as a minimization-covering problem so that normally it was treated as an NP problem [24]. Actually generalization was not a novel model. There were some literatures regarding to artificial intelligence was published for researching how to approach a definite generalization model [23][16]. Of course, XCS is one of the major models in generalization application [5].

With generalization, initialization process and XCS algorithm *RUN EXPERIMENT* was defined in message handling main loop [4].

According to the algorithm *RUN EXPERIMENT*, XCS behavior can be depicted as the figure 3-3 shown as below Figure 3-3.

However, for meeting the requirement of generalization, it would make an issue: How can XCS handle new input message $\sigma(t)$ but no right classifier can offer right action?

For the issue mentioned above, 2 operations that can offer "covering" capability and handle the input new message are [4]:

1. Exploration：Actions are selected randomly.

2. Exploitation：always the most predictive action is selected.

For any new classifiers generated via exploration process, it will drive deletion actions for the weakest classifiers in XCS population [P].
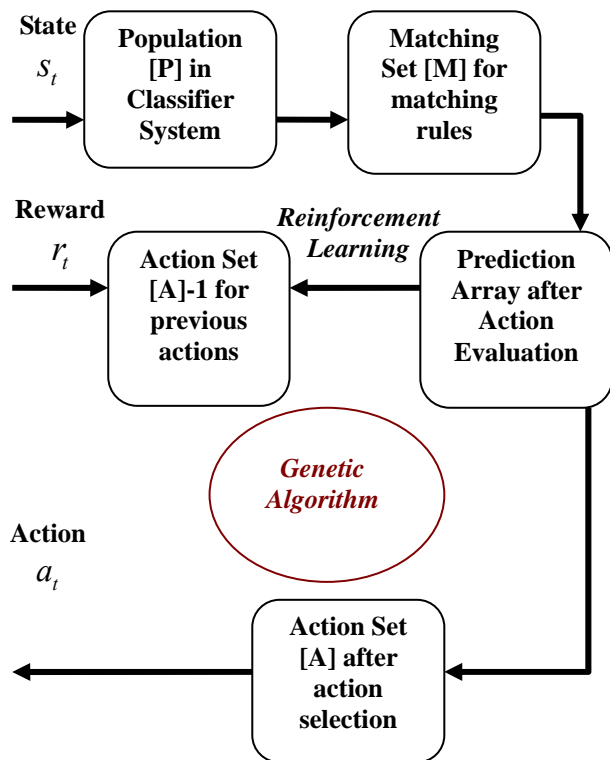

Figure 3-3: The XCS System Behavior

4. XCS-BASED INTELLIGENT SEARCHING MODEL

In cross-organization internet environment, the first service organization which detects the requirement from client is not necessary the one which can offers right global identity for further application process. For the issue from global identity searching in cross-organization web service, XCS got the advantages from its flexible searching rules management, searching rules learning capability and self-evolutionary mechanism via GA operations.

Therefore, both attributes C and A are the key factors to express how to find right global identity for clients service request within input message σ. The information structure of σ is proposed as the data structure shown as figure 4-1:

Input Message σ			
Requested Event ID	Time Stamp	Client ID	Organization A

Figure 4-1: The Info. Structure of Input Message σ

Regarding to input message σ in figure 4-1, the sub-field "Client ID" is the index to find the global identity in cross-organization web service, sub-field "Organization A" is the target organization for finding global identity (Of course, if the value of "Organization A" is *null*, then more classifiers in XCS will be invoked to handle the input message σ), the sub-field "Time Stamp" records the execution time which can be taken for verifying if the service scenario is right or not, and the sub-field "Requested Event ID" can be enumerated rely on the requirement of application. For example, in NP telecommunication service, the requested Event ID could be "Login", "Access Voice Mail", "Deliver Short Message", "Turn on service of don't disturb", etc., that may be required to execute cross-organization web service in m - commerce environment.

Following the principle of XCS operation, the input message σ will be handled by XCS main loop *RUN EXPERIMENT* ()[4].

On the other hand, regarding to the condition C in proposed XCS classifier, it can be represented as information in figure 4-2:

Condition C in XCS Classifier x_{cl}			
Condition Operator	Client ID	Organization X	P_Next Condition

Figure 4-2: The Information Structure of Condition C in XCS Classifier

In condition C of XCS classifier x_{cl}, the sub-field "Condition Operator" can be enumerated as the logical operators "NOT", "OR", "AND", "XOR", etc., that can integrated with more conditions in sub-field "P_Next Condition". The sub-field "Client ID" is the private identity detected from client. The sub-field "Organization X" is the predicted target organization. The sub-field "P_Next Condition" is the pointer which links to the possible next conditions in the other XCS classifier.

Also, the action A can be represented as information in figure 4-3:

Action A in XCS Classifier x_{cl}			
Action State	Action Type	Organization X	P_Next Action

Figure 4-3: The Information Structure of Condition C in XCS Classifier

In action A of XCS classifier x_{cl}, the sub-field "Action State" can be enumerated as "Action On", "Action Off", "Invalid", "In Action", etc., the sub-field "Action Type" can be enumerated as "Send", "Receive", "Initialize", etc., that will rely on the given application service requirement. The sub-field "Organization X" is the predicted target organization. The sub-field "P_Next Action" is the pointer which links to more actions if necessary.

After defining the input message σ, information structure for condition C and action A in XCS classifier x_{cl}, the relationship of input message σ and macro view of XCS performance system is looked as the figure 4-4:
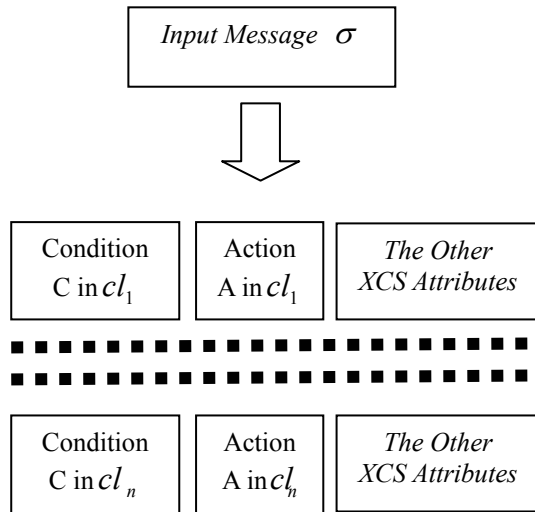

Figure 4-4: The Input Message σ Handling by XCS-Based Intelligent Searching Model

Of course, there are more attributes that can be taken for define global identity such as the personal information as name, sex, birthday, phone number, address, birth place, blood type, etc.. However, the additional personal attributes can be fed back with the returned global identity from the service organization.

5. CONCLUSION

The characteristics of intelligent XCS which offers multi-rules management and GA operation are the foundation of opening environment application. It is why the XCS is proposed for improving identity management in cross-organization web service. Also, the dynamic operation requirement, which cannot be carried out with static global identity searching table, is fulfilled in cross-organization web service.

More cross-organization web services, such as knowledge management, case study in e-business, CRM (Customer Relationship Management), e-learning…., etc., can be implemented with XCS-based intelligent model. However, there are still some issues happen in developing XCS-based intelligent technology in cross-organization web service:

1. For efficiently developing XCS-based intelligent technology, the information defined in input message σ, condition C, action A and the other attributes in XCS classfier, should be represented in semantic way rather than the fixed length format which was used in

traditional classifier system. Such kind of information representation, which is taken for all XCS system parameters, can follow the syntax analysis and semantic analysis executed in compiler or interpreter for program language. To "raise" the information level in XCS-based intelligent model will be beneficial to decode the high layer information representation in cross-organization web service.

2. Through the generalization hypothesis, the classifiers allocated in XCS can be "normally distributed". No repeated classifiers will be allocated in the same XCS. Covering procedure and related GA operation will be executed more efficiently. For improving performance and capability developed in LCS (Learning Classifier System), ZCS (Zeroth level Classifier System) and traditional CS (Classifier System), more than 25 parameters will be handled in the system. Without experiment, potential risk and system shortage cannot be found easily. Therefore, more experiments on dynamic classifier research and simulation should be run as more as possible.

3. For handling higher layer of input message, the neural network can be taken for defining higher level weighted function and neural activation function. With the capability of rules management, learning and GA operation, the XCS can be evolved more efficiently. More application can be developed via this business cooperation.

In the article, XCS was taken for intensifying the identity management in cross-organization web service. The research of innovative artificial intelligent model, such as XCS, is expanded very fast. New theories and methodologies are continually developed. The strength to integrate research with web service and artificial intelligent mechanism, via innovation and considerate analysis, will be the point.

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