

# ANTS: Agent-Based Navigational Training System

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**Abstract.** There is an explosive growth of e-learning trend during the last few years. More and more learning resources are generated by different purposes in the world. How to make the learning resources to be sharable and reusable is a key factor in e-learning environment. This paper presents a system framework of Agent-based Navigational Training System (ANTS) to facilitate lecturers and learners achieving their works. Besides, we apply the model of Dynamic Fuzzy Petri Net (DFPN) and the intelligent agent into the system to assist learners. The intelligent agent can dynamically generate the learning path for each learner. Moreover, the system is compatible to Sharable Content Object Reference Model (SCORM) which is the most acceptable e-Learning system developing standard. Accordingly, the learning resources could be sharable and reusable in any platforms which are compatible to SCORM standard.

## 1 Introduction

Due to the appearance of Internet, many people use computer networks to accomplish a plenty kinds of tasks. In last few years, lots of lecturers put the teaching materials to the Web and define a term – e-Learning. It provides a convenient channel to gain information without going to school.

Web services are web applications consisting of eXtensible Markup Language (XML), Universal Description Discovery & Integration (UDDI), Simple Object Access Protocol (SOAP) and Web Services Description Language (WSDL). Based on Web services, the learning resources can be integrated and share with other e-Learning systems. UDDI provides two basic functions: registration and searching. All the requests and responses are contained in the UDDI registry and all partners are transmitted by SOAP messages. SOAP contains message layout specifications, which defines a uniform way of passing XML-encoded data [1]. WSDL applies multiple XML schemas defining the specific web services structure. The advantage of using web services architecture could make useful learning resources sharable and reusable.

Intelligent agents as a concept have been around for more than a decade, and it has gained popularity as a marketable product in the recent times. The proposed agent has

aply described intelligent agent as “e-assistant” that is basically responsible for carrying out various requests for each learner [2]. In [3] [4], they described the concept of agent applying in e-learning, and the agent suggests possible actions or web resources based on its understanding of the learner’s behavior. In [9], the authors proposed the concept of Dynamic Fuzzy Petri Net (DFPN) applying to e-learning. In this paper, we apply DFPN model to be expert agent’s knowledge guiding learner achieving his learning target. Expert agent is a connector between the system and learner, and it can judge what the next course should provide to the learner based on DFPN model [15].

The rest of this article is organized as follows. Section 2 describes the features of ANTS with web services. Section 3 shows the component WSMS of ANTS. Section 4 outlines expert agent features and its related methodology. Then, there is a system presentation introduction in the Section 5. Finally, section 6 draws conclusions.

## 2 Agent-Based Navigational Training System (ANTS)

### 2.1 System Architecture

The main system framework of ANTS is shown in Fig 1. Authoring tool provides lecturers a convenient tool and edits several learning assets into a course [10] [11]. It produces standard Sharable Content Object (SCO) for database and Web Service Management System (WSMS). With the help of authoring tool, lecturers can use their learning resources like video or MS-PowerPoint slides to organize a SCO. Consequently, the easiness and convenience is the goal of this authoring tool.

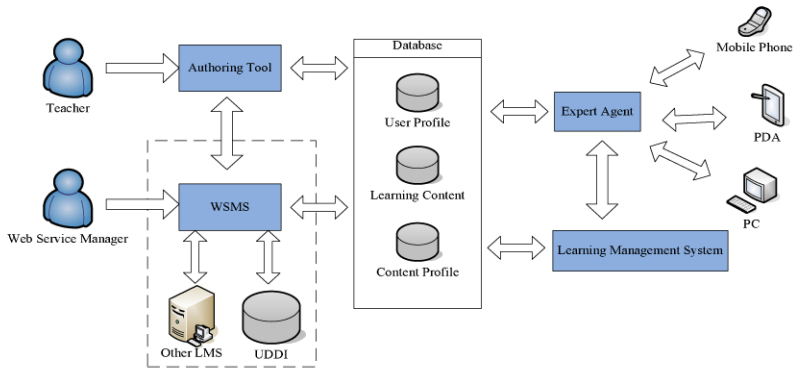


Fig. 1. Agent-based Navigational Training System Framework

The ANTS system databases are built in relational database schema, which include learner profile, learning content and content profile. Learner profile keeps learner’s personal data and learning status. By keeping those data, system can analyze learner’s behavior to find out learner’s learning pattern and provide learner with some useful suggestions. Learning content keeps data about learning resources which include

documents, pictures, video, and some other multimedia data. Content profile database is responsible to record information of learning content.

LMS extracts data from database and provides information for learners. It is a learning platform which gives the channel for lecturers and learners to communicate with each other. It also provides three roles which is administrator, lecturer and learner. Administrator manages the registration and certification of the learners. Lecturer could place a course in LMS and register it, and then learners can read the course online. Learner has several useful functions in LMS; they can read courses, write down their notes of certain courses, assign their personal calendars, and so on.

Eventually, the rule of expert agent in this system is to provide learning suggestion based on learner's behavior by using DFPN model [9]. This agent operates its job according to learner's learning process, and this operation does not visible for the learner. The system just suggests the learner what is the next course to learn by agent's arrangement. The full description is written in the third section of this paper.

## 2.2 Web Services Management System (WSMS)

The concept of WSMS combines traditional authoring tool with web services technique. Using web services technique integrates the digital learning resource into service oriented architecture. If the learning resource content provider wants to provide their content on web services architecture, they can simply register their content by the UDDI server which is built by the system. Therefore, lecturers can find the course by UDDI searching and directly use the resources provided by the UDDI server.

With the usage of web services, WSMS can integrate the other LMS resources registered on the UDDI server. By this framework, lecturers or learners can obtain online courses not only from the local LMS but also the other LMS. WSMS would classify the different resources from different LMS by a classification method. Thus, lecturers and learners could find the resources easily.

According to SCORM, the web services architecture applies to the SCORM fully. That is, SCORM wants digital resources to be sharable and reusable, and WSMS does the same work. When lecturers search courses by UDDI server, they can download the course and re-organized the course which is claimed as free.

## 3 Expert Agent

Regarding the expert agent, the system use the method Dynamic Fuzzy Petri Net (DFPN) proposed by [9]. The architecture of the expert agent applies the DFPN to the learning path by generating the learning path dynamically for the learner. The method of DFPN model applying in e-learning is proposed in [9].

In our framework, the DFPN model is setting in the course by authoring tool. The information about the learning history would be delivered to DFPN model which can generate dynamic learning path according to the learning history. During the learning processing, the expert agent shows the best learning path for the learner by the learner's learning behavior. There is a diagram for DFPN in Fig 2. The real line represents the static learning path, and the dotted line represents the dynamic learning path. Circle A, B, and C represent different course respectively. There is a threshold

value set by the content provider or the lecturer between course A and course C. When a learner finishes course A, there is an exam. If the learner cannot get the score value over the threshold value, the dotted line would transform into real line. Then, the learner is guided to the course B which probably is an assisted course or a low level course. Once the learner finish the course B and pass the threshold value, he can go on to learn course C. This mechanism makes sure that every learner would understand what he learns online.

There is an example for DFPN process shown in Fig 3. Assume that the threshold value is set to be 0.6. And after a learner finishes a course, his exam score is 50. Using intensity function [8] to transform this score would get a value between 0 and 1. Accordingly, the score 50 is transformed to 0.5, the value is little than 0.6 (threshold value). Therefore, the dotted line becomes real line. That means the learner could not learn the course C until he pass the course B. On the contrary, if the learner gets score 0.7 which is bigger than the threshold value, the dotted line disappear. And the learner can directly learn the course C. The description is shown in Fig 3.

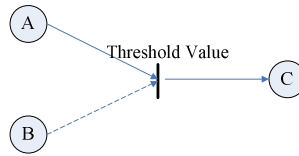


Fig. 2. Dynamic Fuzzy Petri Net

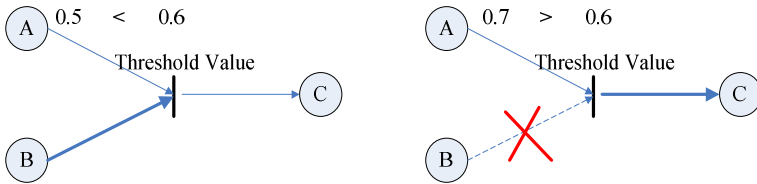


Fig. 3. The Sample of Dynamic Fuzzy Petri Net

### 4 System Presentation

This part of the paper introduces the presentation of the course and what guideline would the expert agent suggests. A learner may click the course of data structure Stack to learn as shown Fig 4. After the learner clicks the hyperlink, the course presentation provides the learner with the course video streaming, the course indexing terms and the course slides. If a learner finishes a course, he may have an exam or a simple test. Then, the score of the exam gives the expert agent for reference of the learner’s ability. According to the DFPN, if a learner fails a course, he would be guided to low level

course or assisted course. Otherwise, the learner would be guided to higher level course.

After the exam of the course, the learner could get a score. If the score is lower than 60 (threshold value), he fails the course. Then he is guided to low level course like Link List for advice (Fig 5(a), 5(b)). The reason of the learner cannot understand the course Stack may be that he didn't learn Link List well. Consequently, after the learner learns the course Link List well, he may pass the course Stack. Thus, the data structure course of Link List is called assisted course here.

In addition, when a learner finishes an assisted course Link List, he is expected to pass the course Stack. The expert agent then guides him to learn higher level course Tree (Fig 5(c), 5(d)). This process is operating by expert agent automatically.

Different course may be different degree for every learner. Some learners with powerful ability may learn chapter 3 without learn chapter 1 before. But the other learners may learn courses step by step otherwise they might get confused. Accordingly, DFPN which dynamically generate the learning path for every learner is a good solution applies to e-learning environment.

Course Name	Teacher	Score
Data Structure - Stack	Yueh-Min Huang	*

Fig. 4. View the Course – Stack

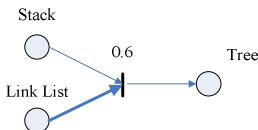


Fig 5(a). DFPN of three courses

Course Name	Teacher	Score
Data Structure - Stack	Yueh-Min Huang	59
Data Structure - Link List	Yueh-Min Huang	*

Fig 5(b). Fail the course, Go to low level Course

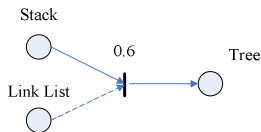


Fig 5(c). DFPN of three courses

Course Name	Teacher	Score
Data Structure - Stack	Yueh-Min Huang	80
Data Structure - Tree	Yueh-Min Huang	*

Fig 5(d). Pass the Course, Go to higher level Course

Fig. 5. DFPN Example

## 5 Conclusions and Future Works

This investigation proposes a framework – ANTS, which includes web services and DFPN technique. Therefore, ANTS can provide the learning suggestions to an individual learner. Moreover, ANTS is compatible to SCORM which is most accepted

e-learning standard in the world. This study also illustrates the system architecture and some detail system functions. Finally, a system presentation introduction is given to demonstrate the expert agent with different score value. The authors believe that this work provides lecturers and learners with a convenient way to learn online.

The further work would be the problem of the testing system which includes setting the questions online and publish them. A good testing system can evaluate the ability of learners even if their ability is unknown. This is important for us to understand learners' learning performance. Accordingly, by the testing score, we can improve the recommendation mechanism with more precision degree.

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