Research of Initiative Learning Model Based on Multi-Agent

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Abstract

This paper analyzes the characteristic of initiative learning in network environment by using constructive pedagogic theory. In this work, we construct the domain knowledge base using ontology, and discuss the issues of choice in learning route and strategy by multi-agent. It brings a multi-agent initiative learning model based on constructive pedagogic theory.

Keywords

Constructivism, Ontology, Multi–Agent, Initiative Learning.

1. Introduction

According to the modern research of the cognition science, the teaching theory model experienced 3 development stages. They are Behaviourism established on" stimulate- respond coupling", Cognitivism according to the information handling model and Constructivism according to the epistemology.

The traditional teaching mode and current network teaching mode are mainly according to Behaviourism and Cognitivism. When students face inflexible writing on the blackboard, lesson piece, video frequency...etc., they just study passively. Since the students do not study actively, they cannot really attain independent study.

The Constructivism studies the whole learning process and considers how learner to construct knowledge and knowledge framework based on original experience, learning structure and mental structure [2]. It thinks that, knowledge is not simply got through induction, but the learner studies knowledge under certain social cultural background, with the help of the others (the teacher, the parents and the partner), by necessary technique and information, in the way of the meaning construction. Study is a process that learner actively constructs the knowledge. This means that the learner is not stimulated by the external world negatively and passively, or moves the knowledge from the external world mechanically to the memory, but selects the external information actively and progressively with original experience, and constructs new knowledge by contrast with old experience again and again.

Therefore, it is necessary to explore new study mode, especially the study mode under network environment based on the Constructivism. This will make students really realize the independence study. There are two problems here need to be resolved. One is the design of domain knowledge base. The other is how to choose different study routes and study strategies according to the student's different knowledge background, by exchanging with system.

The structure of the paper is described next. First, the domain knowledge base is presented in Section2. The process of ontology building is described in Sections 3. In Section 4, the multi-agent initiative learning model in e-learning environments is described. Finally, some conclusions are put forward in Section 5.

2. Basedomain Knowledge Basw

The Semantic Web aims at adding semantic information to web contents in order to create an environment in which software agents will be capable of doing tasks efficiently. The basic properties of the Semantic Web allow for meeting initiative learning requirements: quickness, just-in-time and pertinent learning.

Based on the characteristics of teaching domain, we build the semantic web as W=(Point, Point-Attribute, Relation, Relation-Property, Rules), Where Point is a set of knowledge points. Point-Attribute is a set of knowledge point properties. It can be expressed as Point-Properties ={mid, name, type, keyword, type, objective, requirement, content, correlation, homework and exercise, quiz}.

mid: code or index of knowledge

name: name or title of knowledge

keyword: keyword of knowledge

type: type of knowledge, like concept, principle, calculation, skill

objective: like know, understand, master

requirement: importance level of knowledge

content: detail description of knowledge

correlation: related knowledge

homework and exercise: use to consolidate learning effect

quiz: use to check learning effect

Relation is a set of relation between knowledge points. Relation = {(point1, point2)| point1, point2 ∈ Point} .And Relation-Type stands for the relation type between knowledge points. Normally, the relation between the knowledge points of a course or area are not the simple sequence relations, they can be many other relations. Here we will discuss those relations of Parent-Children, Rely-on, parallel, implication, equal, reference and dissociation.

(1) Father-child relation

The two knowledge points which are in knowledge tree and have father-child relation, are father-child relation knowledge points.

Typically the father knowledge point is composite or structure knowledge point, the child knowledge point can be either composite or unit knowledge point. Normally the father knowledge point and child knowledge point also have sequence relation, which mean we need learn father knowledge firstly and then child knowledge. Some time father knowledge is the summary of child knowledge, in this case we need learn child knowledge firstly prior to father knowledge.

(2) Related-with relation.

Related-with relation is identical to sequence relation. If it's necessary to learn knowledge A before learn knowledge point B, then B rely on A.

In implementation we only need describe direct Related-with relation, the indirect rely-on relation can be concluded via computing. By computing Related-with relation we can get a Related-with relation link which can determine the learning sequence of knowledge points.

(3)Parallel relation

In knowledge tree, those points which have same father are parallel relation or brother relation. Normally the parallel relation knowledge points describe father point from different point of view and scope. The content of these points are related.

(4) Implication relation

If knowledge point A is part of knowledge point B, A and B are implication relation. Usually implication relation points also have rely-on relation and father-child relation

(5) Reference relation

In a course system or knowledge area, normally, there is related knowledge among which has no certain rely-on relation or implication relation. For example, when learning knowledge point A, we may also learn knowledge point B for below reason, then A and B have reference relation:

(6) Dissociation relation

We can build knowledge tree via father-child relation and knowledge link via knowledge link. Based on knowledge tree and knowledge link, together with parallel relation, implication relation, reference relation and dissociation relation, we can provide characterized learning support based on students' requirement, and generate several teaching plan based on teachers' experience and style.

3. Constrction of the Ontology

Ontology has become the de-facto standard knowledge representation technology after the emergence of the Semantic Web along with Semantic Web Services and the Semantic Grid. In a web context, ontology provides a shared understanding of a domain. Hence before we build the initiative learning model, we need to construct the ontology.

1) Definition of the main domain classes of knowledge points and description of their meaning. This task comprises the following subtasks:

(a) Definition of the set of classes, called P, each being identified by a point.

(b) Definition of the set of relations, called R, each being identified by a point.

(c) For every class $p \in P$, define the set of attribute names A_p.

(d) For every attribute $a \in A_p$, $p \in P$ define its type (INT, STRING, NUMBER, etc. or other class).

2) Construction of the taxonomy of domain. This task involves define all class pairs.

$< p_1, p_2 >, p_1 \in P \ p_2 \in P, \ r(p_1, p_2) \rightarrow p_1 "IS\_A\_Children\_Of" p_2, r \in R$

$< p_1, p_2 >, p_1 \in P \ p_2 \in P, \ r(p_1, p_2) \rightarrow p_1 "IS\_RELATED\_With" t_2, r \in R$

$< p_1, p_2 >, p_1 \in P \ p_2 \in P, r(p_1, p_2) \rightarrow p_1 "IS\_PARALLEL\_Of" p_2, r \in R$

$< p_1, p_2 >, p_1 \in P \ p_2 \in P, \ r(p_1, p_2) \rightarrow p_1 "IS\_IMPLICATION\_Of" p_2, r \in R < p_1, p_2 >, p_1 \in P$ $p_2 \in P, r(p_1, p_2) \rightarrow p_1 "IS\_REDFERENCED\_with" p_2, r \in R$

$< p_1, p_2 >, p_1 \in P \ p_2 \in P, \ r(p_1, p_2) \rightarrow p_1 "IS\_DISSOCIATION\_Of" p_2, r \in R$

Definition of the rules. Here we need to define the rule about the knowledge points.

For example, for p_1 and p_2, r is not exist. It can be defined as:

$p_1, p_2 \Rightarrow < p_1, p_2 > \neq r, \ p_1 \in P \ p_2 \in P, r \in R$

4. Multi-Agent Initiative Learning Model

The objective of Constructivism emphasizes developing the independence of students. From Constructivism perspective, students are the substance of information processing and the builder of meaning, but not passive receiver stimulated by outside. Student should be initiative to build knowledge meaning with finding method and discovery method, to collect and analyze regarding information and materials and bring out and verify various suppositions. So, student should emphasize to build up learning method and strategy, strengthen the initiative of knowledge study.

Because student's learning activities are to build up knowledge structure based on its characteristic knowledge background. Initiative learning processing should firstly analyze

students' characteristic knowledge structure, build up related learning background, and promote the interaction between new learning activity and existing knowledge background.

With this initiative learning strategy, we adopt multi-agent technology to build initiative learning model. Multi-agent system is one branch of distributed artificial intelligent research. Agent perceives environment via sensor, and effects environment via translator. Agent is initiative and adaptive, has social ability and mobility. By applying agent's these properties to initiative learning system, we can adopt different learning route to different learners.

Below is the figure of multi-agent initiative learning model based on the Constructivism.

Interface agent provides the interface between learning client and system.

Knowledge point management agent uses to managing the domain knowledge base of the course.

Learning strategy agent group analyze student's learning background and interactive with knowledge point management agent to setup learning strategy. In the learning strategy agent group, information filter agent analyzes student basic information and learning history in customer information database, and setup students learning background; And learning structure analysis agent provides test to students, based on the test result, it can analyzes how deep students understand a certain knowledge point. With the input of information filter agent and learning structure analysis agent, learning strategy constituting agent can setup student's learning strategy.

With the learning strategy from the learning strategy agent group, initiative learning agent group use the data from course database, audio/video database, exercise database and homework database, to design the specific learning content and route, instruct students to learn knowledge initiatively. In the initiative learning agent group, teaching structure agent provide the content of knowledge point and perform the teaching; Teaching content management agent handle the related course and audio/video content; Quiz/evaluation agent design the quiz for specific knowledge point; Automatic question response agent is to answer student's question.

Database includes customer information database, teaching procedures database, audio/video database, and exercise database. These database interactive with according agent and provide data.

5. Conclusion

Here, we present construct the domain knowledge base using ontology. We then present a multi-agent artificial intelligence model that helps learner to study independent. In fact, an initiative learning system is being explored at present. We use the course database principle. In the future, we will attempt to use the system in distance learning.

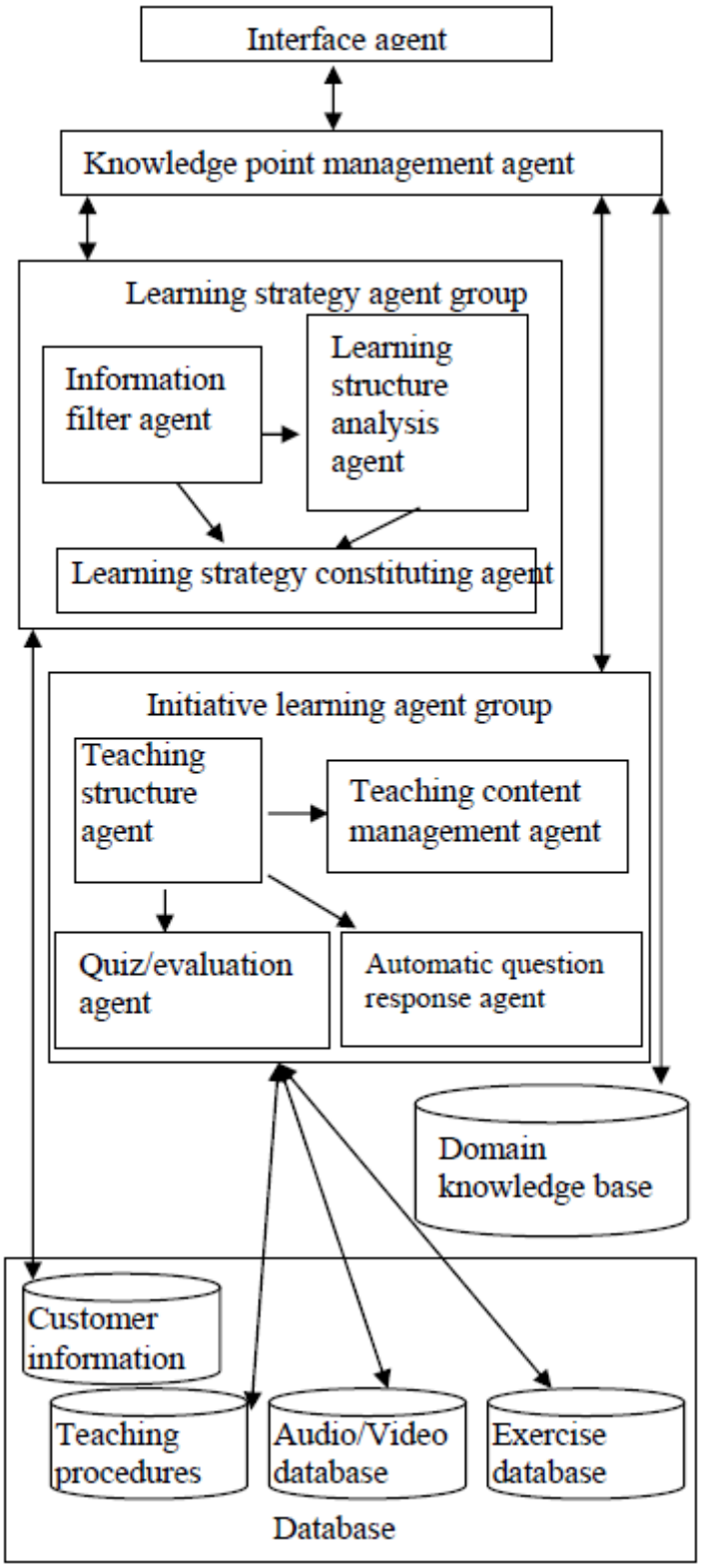

Figure 1. Multi-agent initiative learning model based on Constructivism

Acknowledgments

This paper was supported by Foundation of Teacher Team Building in 2017 - Teacher Teaching Promotion - Virtual Teaching Team Building in Double Training Program (Municipal) - E-Commerce in Beijing Municipal Commission of Education (No. PXM2017_014224_000026).

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