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A General Model for Acquiring Knowledge

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***Abstract*—**In this paper, based on the work in [1], we further give a general model for acquiring knowledge, which first focuses on the research of how and when things involved in problems are made then describes the goals, the energy and the time to give an optimum model to decide how many related things are supposed to be involved in. Finally, we acquire knowledge from this model in which there are the attributes, actions and connections of the things involved at the time when they are born and the time in their life. This model not only improves AI theories, but also surely brings the effectiveness and accuracy for AI system because systems are given more knowledge when reasoning or computing is used to bring about results.

***Keywords*—**Time, knowledge, model.

I. Introduction

SO far, AI research mainly focuses on knowledge of things about their attributes, their behaviors and some interactions. In fact, the common nature of objects, time, space and even some related natural laws are also very important, useful and can give important knowledge for AI systems [1]. And we should also research the knowledge that may be quite useful or helpful in every process of AI System Problem Solving because it's the common knowledge of all objects in the world. Without thinking of these relationships, sometimes we may make mistakes or can not give the results more exactly.

All objects exist in the world or space, at different times, they may have different states, different locations or attributes, as well as different behaviors (or actions) and interactions to get connected with each other. Time seems to be able to decide every thing about objects we want to know, particularly at the time when an object is made or born, the very basic knowledge of the object is decided , which is very important in AI problem solving and should be put into AI system to be the key part of it.

In another words, when something is made or born, the very basic knowledge, or nature including the attributes, behaviors and connections, which may probably be very important or have a key role in its action for problem solving during its life, has been decided. Like a product, before it has been put into use, the design has been decided, which is the key for us to solve problems.

Also, think about the whole world, whoever made or designed it may not be important. The important thing for us is to research the commonality of the whole thing and then we can figure out how it works, which is unrelated to time and is the other very basic knowledge we should put into AI system to be the key part of it in problem solving.

In fact, we do have some knowledge of this kind that has been put into use like Chinese traditional medicine, or Darwin's Species. The problem is that this basic knowledge seems related to every thing and is very important part of every AI system. So we need to know how it gets integrated with AI system, which will definitely be useful in problem solving.

From the statement above, we can conclude that anything in the world can be regarded as time-related and time-unrelated and we mainly discuss time-related knowledge in this paper.

The paper [1] gives a framework to integrate this knowledge with AI systems, the key part of which should be important in AI problem solving and in this paper, based on these work, we further give a general model for establishing knowledge based systems, which first focuses on the research of how and when things involved in problems are made then describes the goals, the energy and the time to give an optimum model to decide how many related things are involved in. Finally, we acquire knowledge from this model in which there are the attributes, actions and connections of the things involved at the time when they are born and the time in their life. This model not only improves AI theories, but also surely brings the effectiveness and accuracy for AI system because systems are given more knowledge when reasoning or computing is used to bring about results.

II. A General Model

A. COUPLE-UNIT and SUBCOUPLE-UNIT

The whole world can be made of two kinds of things or objects. They may coexist, depend on each other and conflict with each other like male and female, good and bad as well as left and right. So any problem can be divided into this kind of things to solve. Therefore, if we can figure out how this kind of things work, from which we can acquire knowledge we need to solve problems, we will find the commonality of the whole things to solve all the problems.

Definition 1 we call two things COUPLE-UNITs, if there are the following conditions:

1. They coexist, depend on each other and may conflict with each other; one is called Male COUPLE-UNIT and the other is called female COUPLE-UNIT;
2. If they are put together, they can make new things, each of which is called SUBCOUPLE-UNIT, under some conditions which may not be related to time.

These SUBCOUPLE-UNITs inherit attributes, actions and connections from them and finally will have those of their own because they may constantly interact with some other related things at some time t_i.

Suppose M represents anything and COUPLE-UNIT(M) is the set including all the COUPLE-UNITs of M which can be divided into the following parts:

1. M itself has COUPLE-UNITs with some others;
2. The attributes, actions and connections of M can also make COUPLE-UNITs with some other things;
3. There are some rules for M to make the COUPLE-UNITs.

M does follow the rules:

The first is that it acts stochastically, the results of which can only be given by probabilities.

The second is that it partially follows the rules, the results of which can be given by conditional probabilities.

The third is that it completely follows the rules, the results of which can be given by the rules probably related to mathematics methods or models.

When it follows the rules, the actions, including interactions with some others, tend to keep the stability or balance for a piece of time until the time becomes used up. And COUPLE-UNITs may be the best way among them for keeping the balances or the stability.

In reality, not all the COUPLE-UNITs in COUPLE-UNIT(M) involve the problem, which depends on the goal and energy, which is what the COUPLE-UNITs need and coact for what happen to COUPLE-UNITs to make SUBCOUPLE-UNITs. COUPLE-UNITs have goals because they have time, energy and also interact with others to get what they need for their goals and do what they can do for others in return.

B. *The Goal and Energy for COUPLE-UNITs to Make SUBCOUPLE-UNITs*

Before COUPLE-UNITs make SUBCOUPLE-UNIT, they need the goal and the energy like conditions, supports and power or strength that can really push things happening and this goal and energy may also transfer to SUBCOUPLE-UNIT if the goal is not reached completely and the energy is still enough like the following:

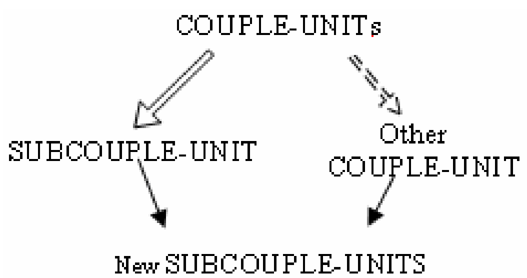

Fig. 1 The tree structure for COUPLE-UNITs

In Fig. 1, the right-top arrow points the so called Other COUPLE-UNIT, called interacted COUPLE-UNIT here, may come from the COUPLE-UNITs or some other COUPLE-UNITs and there are probably more interacted COUPLE-UNIT. The New SUBCOUPLE-UNIT may do the same things as the SUBCOUPLE-UNIT does, but it has to stop according to the goal and the energy, which make each node in Fig. 1 have an extent to be present.

C. *Choices of Interacted COUPLE-UNIT*

Before interacted COUPLE-UNIT is chosen, there may be a problem that which one is the best or the optimum. One of the solutions to the problem is the causal model in [2] shown as the following:

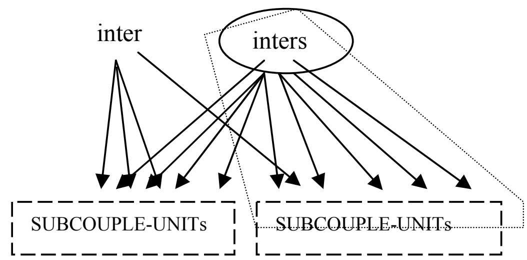

Fig. 2 The optima interacted COUPLE-UNITs

In Fig. 2, "inter" represents interacted COUPLE-UNIT.

The problem is that if SUBCOUPLE-UNITs are given, what kind of interacted COUPLE-UNITs we have for making the new SUBCOUPLE-UNITs. So the chosen interacted COUPLE-UNITs can be causes and the new COUPLE-UNITs can be the results as those in [2], which give the solution.

D. *The Evolutionary Process for SUBCOUPLE-UNIT*

The following are evolutionary process for SUBCOUPLE-UNIT.

COUPLE-UNITs have eight different states, shown in Table I, one of which SUBCOUPLE-UNIT may inherit from the COUPLE-UNITs when born.

TABLE I
COUPLE-UNIT 'S STATES

1	Male attribute	Male behavior	Male interaction
2	Male attribute	Female behavior	Female interaction
3	Male attribute	Female behavior	Male interaction
4	Male attribute	Male behavior	Female interaction
5	Female attribute	Female behavior	Female interaction
6	Female attribute	Male behavior	Female interaction
7	Female attribute	Female behavior	Male interaction
8	Female attribute	Male behavior	Male interaction

One of the eight states which COUPLE-UNIT can inherit from the parents when born

TABLE II
COUPLE-UNIT'S STATES

1	Male' attribute'	Male' behavior'	Male interaction'
2	Male' attribute'	Female' behavior'	Female interaction'
3	Male' attribute'	Female' behavior'	Male interaction'
4	Male' attribute'	Male' behavior'	Female interaction'
5	Female' attribute'	Female' behavior'	Female interaction'
6	Female' attribute'	Male' behavior'	Female interaction'
7	Female' attribute'	Female' behavior'	Male interaction'
8	Female' attribute'	Male' behavior'	Male interaction'

The other eight states the object may receive from another two kinds of objects

When the SUBCOUPLE-UNIT begins its life, at any time ti, it may interact with the other same kinds of COUPLE-UNITs (denoted as male'or female') from which it may receive one of the other eight different states like those in Table II. Such SUBCOUPLE-UNIT may have one of 64 different states. And the two kinds of states compete with each other (the rules are based on the goal and the energy) to gradually reach a stable state at some time of SUBCOUPLE-UNIT's life or to be changeable for its whole life, which has stochastic distributions for its lifetime. SUBCOUPLE-UNIT will have its own attributes, behaviors to get interacted with others like the case in [2] that the objective function E(t) can be gradually reduced to its minimum when the activation values of the nodes in M^+ or D are changed constantly according to the activation rules and the network is in the equilibrium..

SUBCOUPLE-UNITs, on the other hand, may gradually have the energy and something of their own goals, which compete and conflict with that of COUPLE-UNITs, and get partially independent of COUPLE-UNITs during the evolutionary processes and finally have their own goals and energy that gives the possibility for them to do the same things independently as COUPLE-UNITs do.

SUBCOUPLE-UNIT or COUPLE-UNIT has to choose the interacted COUPLE-UNIT according to the goals and energy, which forms the requirements for them to act, which may have the following levels:

1. living
2. respect
3. acceptance
4. self-realization
5. Others

Which level is chosen? In most cases, it has the natural order from level 1 to 5. But it really depends on the attributes, the connection or the goals and energy as we talk above like that different people have different personalities which make us have different actions or behaviors, some of which are reasonable and some of which may not be reasonable. But even though you make a mistake, you cannot get the chance at the same time because time never goes back for them.

SUBCOUPLE-UNIT is made by COUPLE-UNITs and may die for the following reasons:

1. the goal is reached or gets lost;
2. the energy or the time becomes used up or is spoiled by interacting with others;
3. Other reasons.

E. Acquiring Knowledge

In [1], we give a definition as the following:
Definition 2 for any object and its lifetime, there are the following definitions:

1. The attributes, the behaviors or the actions and the interactions of an object are denoted as the object's CONCEPT(T), T is denoted as its lifetime, and CONCEPT(ti) is that of the object at any time ti in its lifetime;
2. The changeable CONCEPT(T) of the object for its whole lifetime is denoted as CONCEPT(C) and CONCEPT(ci) is that of the object at any time ti in its lifetime;
3. The unchangeable CONCEPT(T) of the object for its whole lifetime has two parts. One is denoted as CONCEPT(Ub) inherited from its parents; The other is denoted as CONCEPT(U), and CONCEPT(ui) comes mainly from 64 different states at stable state at any time ti in its lifetime.

From above, we have the following knowledge[1]:

1. Each SUBCOUPLE-UNIT also has the attributes, behaviors and interactions with the others, denoted as SUBCOUPLE-UNIT's CONCEPT(T), T is denoted as its lifetime, and CONCEPT(ti) is that of SUBCOUPLE-UNIT at any time t_i in its lifetime;
2. The changeable CONCEPT(T) of SUBCOUPLE-UNIT for its whole lifetime is denoted as CONCEPT(C) , and CONCEPT(c_i) is that of SUBCOUPLE-UNIT at any time t_i in its lifetime;
3. The unchangeable CONCEPT(T) of SUBCOUPLE-UNIT for its whole lifetime has two parts. One is denoted as CONCEPT(U_b) inherited from its COUPLE-UNIT; The other is denoted as CONCEPT(U) , and CONCEPT(u_i) comes from the 64 different states at the stable state at any time t_i in its lifetime.

After acquiring these knowledge, then we can set up our systems for problem solving according to the framework for AI system[1].

F. The Model and the Solution

Actions or processes may have the iterated processes that can be found from what we talk about above. These iterations keep on going constantly, making the attributes, actions and connections for the whole world and we are getting the knowledge from the easy way we are talking about. The next is the model and the solutions for problem solving.

Suppose O is the goal of the COUPLE-UNITs with time and energy. I_i is that of the SUBCOUPLE-UNIT that gradually has for its own when interacting with some other things.

Q_i represents the SUBCOUPLE-UNIT's goal imposed on by the COUPLE-UNITs and decided by the CONCEPT(Ub) of the SUBCOUPLE-UNIT. If $||Q||$ and $||Q_i||$ are respectively represented as a kind of quantizing variables and there is the following in some cases:

$$||Q|| = \sum||Q_i|| \quad (1)$$

Where I =1, 2, 3,…, n and n is the number of all the SUBCOUPLE-UNITs.

Then $||Q||$, $||Q_i||$ and $||Ii||$ can be respectively used as object function values to figure out how Q, Q_i and Ii can be reached. Actually, for each SUBCOUPLE-UNIT, its object function values can be $||Q_i||-||I_i||$ in which the sign - has special meaning that shows the competition between CONCEPT(C) and CONCEPT(U_b) as that in D. So (1) can be changed as below:

$$||Q|| = \sum(||Q_i||-||I_i||) \quad (2)$$

We have the three cases as the following:

1. $||I_i||$ becomes 0, which means the SUBCOUPLE-UNIT completely depends on the COUPLE-UNITs ;
2. $||Q_i||$ becomes a relatively stable value(not 0);
3. $||Q_i||$ becomes 0, which means that the SUBCOUPLE-UNIT gets independent of the COUPLE-UNITs and (2) becomes (3) as below when all the $||Q_i||$ become 0.

$$||Q|| = \sum(||I_i||) \quad (3)$$

These three cases also give rules and definitions about the tree in Fig.1. All these things we are talking about can not exist without time. So we also have (4) below to measure the whole goals of the tree in Fig.1 at time t.

$$||Q(t)|| = \sum(||Q_i(t)||-||I_i(t)||)^2 \quad (4)$$

COUPLE-UNITs can be the root nodes and the end nodes are those whose goals are 0 like the case above when $||Qi||$ becomes 0. Each node has its attributes, actions and connections that can be the knowledge at time t which can be acquired from the related nodes that have been given the knowledge. So for anything, if we want to know the knowledge of it, first try to find the tree of it like that in Fig. 1. Then use the model and solution in [1] to give the related nodes that can best support it in knowledge. Then the knowledge of it can be described as the following:

$$\sum \text{CONCEPT}(T) * (||Q_i||-||I_i||)^2 \quad (5)$$

Where * is a kind of quantizing operator and i is limited to the range required by the model solution.

III. The Differences from Other Methods to Acquire Knowledge

So far, many methods to acquire knowledge to set up the intelligent systems are like the following:

Get some datum or information which we may try to find some knowledge from. Or get some datum kept training and gradually have something useful as knowledge. Also describe some given experience or knowledge in the way computer may accept like semantic analysis and so on. We may also use neural networks and genetic algorithm. But these methods are all trying to get something process and analysis to get the statistics, rules or some results from deductions even without having a clear goal and also may not be sure what they can get and for what we want to get, needless to say the extremely difficult ways to get the knowledge.

There are the following differences from other methods to acquire knowledge in problem solving like decision making, reasoning and learning:

Logically, it uses the general knowledge of the COUPLE-UNITs indirectly involved in the problems, which shows the natures of the things that may generally become the key to problem solving. For instance, this method can give some knowledge in decision-making or predicting for management, engineering or any other things happening at time t_i without collecting datum from wherever problems involve.

Actually, it also consider the knowledge of SUBCOUPLE-UNIT directly involved in the problem, which shows how well it gets used to the current situation at some time t_i and can give the accuracy and effectiveness in problem solving.

For many current methods to acquire knowledge as we talk about above, they often get knowledge from a lot of datum at time t_i, which not only shows difficulties, but also bring about the inaccuracy because the datum are changeable as time goes by and we can not, in most cases, get enough datum or information for us in this way to get the knowledge we need. Despite of this, we must also use these methods in problem solving as shown in [1].

IV. Examples

A. Management Science

Management may focus on that to cost the least and to get the most, which is really a big issue. According to our solution, we first go to research how management comes from. I mean how the management is set up like a company, a business and a team, for which two things like the plan and the people, the money or property are important to be set up. And these two things really have their own personal characteristics for the attributes, actions and connections that decide the management or the company. If we follow the solutions above, we can get very important knowledge for the management.

For the management issue here, there are more than one

COUPLE-UNITs involved and the most important one can be as the following:

1. a reasonable manage plan;
2. Whatever is required by the plan, including the money, the people and so on

The first COUPLE-UNIT is decided by some people and have some characteristics these people have and the second COUPLE-UNIT deals with partners or the people who are employed, and the money or property and so on. The management starts to go because of these COUPLE-UNITs that have the goals and the energy to support. If at first COUPLE-UNITs make a new company and then they gradually have sub-companies or departments or more people as well as some other parts they may need according to the goals and the energy, including the characteristics. And there will be a network in which there are nodes like in Fig.1. Finally, the solution will give the best results for the company to reach the goals like costing the least and getting the most that can be the knowledge for decision-making or the knowledge of some nodes at time ti.

B. Living Things

A typical example is none other than that of living things being male or female for the gender. The way of acquiring knowledge is exactly the same as what is talked about above.

V. Conclusion

Every AI system should have the very basic knowledge we discuss in this paper to be the key part in solving problems. We give a general model that can integrate this knowledge with the current AI system, which not only improves AI theories, but establishes a kind of channel from AI research field to the nature, including the time, object and some other things useful and helpful for us, which might be a new research direction for AI.

Of course, this paper is only the beginning of what is done. We still have a lot of things to do. We hope to have chances to make cooperation with those who are interested in it. We will surely make a great contribution to AI research field.

References

[1] Peng GuoQiang, "A framework for AI system", accepted by 2006 International Conference on AI.

[2] Peng GuoQiang and Cheng Hu, "A causal model for diagnostic reasoning", Journal of Computer Science and technology, Vol.15, No.3, May 2000.

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