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A Multi-Agent Diagnostic System using nonmonotonic reasoning

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Recentry, for diagnostic systems, we need to study how to cope with the enlarging objects that their system diagnose to. There are some frameworks of this study, and one of them is in the distributed artificial intelligence. The advantages of the distributed artificial intelligence is mainly considered as follows.

- We can cope with by using the system more complicated and large tasks. Because the system's load desparses equally all over the system.
- The system has redundancy. The destributed systems has robustness because the same task can be precessed in plural areas.
- In distributed systems, efficient processing can be expected because a task can be processed in parallel.
- The system has permeability and fine scalability because its every distributed elements is independent.

Recently, there is a extended framework based on distributed artificial inteligent.This is the multi agent system. The multi-agent system has following additional property.

- Every element in the system is selfish. The pursuit of self profits could lead to it's robustness.
- All agent's ability in the system is equality. This says that even if some agents in the system would be out of order, the system could be keeped almost ordinary ability of diagnosis.

These twe properties lead to the system's robustness. Thus, we tried to the diagnostic system applying to the multi agent system.

There is the earlier work based on multi agent framework . According to tha flamework,a multi agent system has several advantages as follows:

- The reduction of the amount of its communication according to sharing information and resources,
- improved parformance according to dispersing its load,
- improved robustness according to redundancy, and
- improved scalability according to locality of the distributed elements.

Our interest is the system's robustness. But, in the work, its robustness is only for a lack of infomation, and there is the other fault variation in distributed systems. This is the byzantine fault, and these two fault types are mainly. In this framework, for coping with the byzantine fault, we define it as the failing informations an agent reported. Thus, if the infomation that used in a diagnostic processing would be fault, then the result of reasoning is changed correctly. Generally, this refer to nonmonotonic reasoning. Thus, we adopt the nonmonotonic reasoning for dealing with a fault information.

The nonmonotonic reasoning deal with incomplete information and thus if the information deriveing current theories would be exploded, some theories deleted. The default logic is one of the most famous framework of nonmonotonic logic. And it is the logic for dealing with consistent reasoning in "generally speaking" or "in common-sense tarm". Forexamole a default rule "**:M(¬ can-fly(x))/¬can-fly(x)**"means informaly that for any objects, if it is consistent to the assummption "it cannot fly " ,assume so.

To applying the default logic to distributed diagnostic system, the diagnostic system has rubustness for the fault information reported by diagnostic agent. Here we define a default rule as follow.**diagnostic-agent(x):M(reliable(x))/obsavation(x)** Its informaly meanings that for any diagnostic agents, if it is reliable, assume the information observed by the agent.

To improving the reliance of system, we need to the system's diagnosis system. But the diagnosis system's reliance are not improved. Thus we need the diagnosis system for improving the reliance of the diagnosis system. This process is infinite. This paradox is caused by sorting out the diagnosis systems from their object systems. Thus the mutual recognition netwark ,that make no deference between the diagnosis system and its object system, is proposed. In this frame, one agent of its system test two agents and tested by other two agent. And the relaice of every agent is derived. In our system, we use this infomation for applying the default rule.

In this paper, we proposed the framework of applying nonmonotonic reasoning and multi agent systems for improving its robustness. And for using default logic, we also acept the mutual recognition that diagnostic agents test one and tested by the other. And we make the experimental system by the parallel object oriented language ABCL/f. The results are as follows.

- We confirmed the robustness for incomplete infomation. We proved that if some agent stopped or fault, the system continue the diagnosis and few infomation delete.
- We showed nonmonotonicity in the agents inference process, and the process correspond with extention of default logic.
- We make the experimental system on AP1000 providing real parallel experimental environment.

In this framework, our interest is only improving system's robustness. But there are many point of issue in diagnostic systems. We have the following remaining problem.

- The amount of comunication is improved.
- We experiment on the real problem. In this pepar, the diagnosis object is the logical circuit. But this framework is modeled on the assumption that their diagnosed object is large and distributed systems.