DEVELOPING ADVANCED TECHNIQUES FOR INTERACTIVE MACHINE LEARNING

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3. PROGRAM AREA

Adaptive Human Interfaces

4. KEYWORDS

Interactive Machine Learning, Intelligent Tutoring, Learning through Multimodal Interactions, User-Modeling

5. PROJECT SUMMARY

This is a planning grant in the Research Opportunity for Woman (ROW) program. The main purpose of this project is to perform preliminary investigations and planning works that will lead to a full-fledged project on advanced techniques for *interactive* machine learning and intelligent tutoring. The idea of the project is to integrate the modern interactive system technologies with machine learning/tutoring in order to build more powerful and flexible learning/tutoring systems, which combine learning/tutoring, inferencing, interactions with human via multimodal interface (natural language and others) in an integrated way.

The planning activities suggested in the project proposal have been successfully carried out. A comprehensive literature survey has been done, which further confirms the validity of the basic idea of interactive learning/tutoring. An architecture for the integrated interactive learning/tutoring systems has been developed, together with preliminary investigations about the learnability models. Several critical issues about interactive learning/tutoring research have been identified, including system integration, knowledge representation, user-modeling and reasoning for multimodal interaction and learning, and the effects of multimodal interactions on learning/tutoring performance. New learning method using fuzzy clustering has been experimented and a new logical system more suitable for user modeling has been developed. We have also designed and implemented a prototype intelligent tutoring system which can learn the student model from multimedia interactions with students, and adapt tutoring according to such models. On-going works include the development of an interactive learning system that learns robot navigation rules using genetic algorithms and multimodal communications (direct manipulation, natural language) with the teacher.

6. PROJECT REFERENCES

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7. AREA BACKGROUND

Research in *Interactive Systems* and *Machine Learning* have been developed so far for the most part in isolation with a few exceptions such as works in *Intelligent Agents*; yet a good integration of the two will definitely bring fruitful results to both areas. Motivated by the need of such an integration, we have started to investigate combining techniques for machine learning, intelligent tutoring, and multimedia intelligent interfaces to produce more powerful learning/tutoring systems.

Machine learning studies the computational models of learning and aims at building intelligent computer learning systems. Various learning techniques have been developed, among which the decision tree inductive learning method, genetics-based learning method, the neural network learning method and fuzzy clustering approach are the most notable ones. The general idea of learning is to extract general (patterns or regularities) from specific data, by inductive inference (clustering, parameter adjustment, manipulation of rules, etc). Obviously the learning system needs to communicate with the external source of information (data, teacher, environment) in order to learn. This is where the intelligent interactive systems techniques can come to facilitate the learner/teacher interaction. A related issue is intelligent tutoring where the computer program is a teacher (rather than a learner) which teaches human learners on some subjects.

Research on intelligent interactive systems have produced many powerful techniques that allow flexible, multimodal human-computer interaction. Studies on adaptive interface and in particular, on intelligent agents, focus on building interface programs that can adapt its behavior through interaction with users. The issue of user modeling can be viewed as a machine learning problem, and several works (e.g., by Patti Maes, et. al.) have used genetics based machine learning approach to tackle the problem. Obviously there are many potential future works possible in applying other machine learning techniques to build adaptive interfaces.

8. AREA REFERENCES

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9. RELATED PROGRAM AREAS

Speech and Natural Language Understanding