

## Research Proposal for Perpetual Learning in Knowledge Base System

### Problem Statement:

A) Developing stimulus-specific inconsistency learning algorithms and heuristics for the framework of perpetual learning agents for;

- (1) Asymmetric inconsistencies &
- (2) Mismatching inconsistencies

B) Inconsistencies in an agent's decision-making indicates that the knowledge base of agent can't properly and adequately handle encountered inconsistent circumstances.

C) Thus when the agent encounters a conflicting circumstance for which it does not know how to handle, it needs to initiate the learning episode that relies on the inconsistency-specific heuristics to revise, refine, or augment existing knowledge to adapt to the emergent patterns and behaviors.

### Scope:

A) Developing the inconsistency-specific learning algorithms and heuristics for the inconsistency-induced learning framework which has been proposed in the previous related work in the i2Learning. [3,7,8,9]

B) Developing and defining these stimulus-specific learning strategies and algorithms for the pertinent domain specific real world application.

### Approach:

A) The agent detects the conflicting situation that arises during problem-solving episode and suspends the current problem-solving session to initiate the learning algorithm.

B) Then the learning algorithms and heuristics will carry out the learning process by recognizing the category of inconsistency in the conflicting circumstance by;

- (1) Detecting the stimuli-specific inconsistency
- (2) Resolving the induced-inconsistency using defined logic to restore consistency and then

C) The algorithm then will overcome the inconsistency that in turn results in updating the agent's knowledge base.

D) Afterward, agent will restarts the previous suspended problem-solving session. The agent will remain in problem-solving episodes until the next learning stimulus arises.

### Related work:

A) The framework for perpetual learning agents has been proposed.

The framework that has been proposed for i2learning (1) allows an agent to be engaged in an alternating sequence of problem-solving episodes and learning episodes. (2) Recognizes set of learning stimuli to initiate learning episode (3) and then lodges the stimulus-specific learning algorithms and strategies. (4) It then defines the feedback loop to refine or augment the agent's existing knowledge at the end of a learning episode. [3,7,8,9]

C) Various studies have been conducted on defining, classifying, analyzing the causes of, measuring, and handling inconsistencies in different problem domains. [1,2,4,5,6,9,11]

D) Several inconsistency-specific learning algorithms have been proposed for i2Learning [3,7,8,9]. Such as;

- (1) Complementary Inconsistency
- (2) Mutually Exclusive Inconsistencies
- (3) Inheritance Inconsistencies
- (4) Incompatible Inconsistencies
- (5) Anti-Subsumption Inconsistencies

### Preliminary Survey:

A) Various studies that have been conducted on defining, classifying, analyzing the causes of, measuring, and handling inconsistencies in different problem domains [1,2,4,5,6,9,11].

B) Perpetual learning framework based on spiral model of episodic and perpetual learning. [12]

D) Inconsistency-specific learning algorithms have been proposed for i2Learning [3,7,8,9].

### Schedule of Activities:

A) Survey and analysis of the inconsistency-specific learning algorithms and framework that have been proposed for i2Learning.

B) Analyzing existing heuristics to handle induced inconsistencies and perpetual learning machines.

C) Determining the additional inconsistencies and developing inconsistency-specific learning algorithms and heuristics for i2Learning framework.

D) Modifying and implementing the developed inconsistency-specific learning algorithm for some domain specific real world application to restore the knowledge base of the working agent.

## References:

- [1] D. Zhang and D. Nguyen, PREPARE: a tool for knowledge base verification, *IEEE Transactions on Knowledge and Data, Engineering*, Vol.6, No.6, 1994, pp.983-989.
- [2] D. Zhang, Inconsistency: the good, the bad, and the ugly, *International Transactions on Systems Science and Applications*, Vol.6, No.2/3, August 2010, pp.131-145.
- [3] Du Zhang and M. Lu, Inconsistency-induced learning for perpetual learners, *International Journal of Software Science and Computational Intelligence*, Vol.3, No.4, 2011, pp.33-51.
- [4] D. Zhang, On localities of knowledge inconsistency, *International Journal of Software Science and Computational Intelligence*, Vol.3, No.1, 2011, pp.61-77.
- [5] D. Zhang and E. Gregoire, The landscape of inconsistency: a perspective, *International Journal of Semantic Computing*, Vol.5, No.3, 2011, pp.235-256.
- [6] D. Zhang, Inconsistency in multi-agent systems, *Foundations of Intelligent Systems, Advances in Intelligent and Soft Computing* Vol. 122 (AISC 122), Y. Wang and T. Li (eds.) Springer-Verlag (*Proc. of the Sixth International Conference on Intelligent, Systems and Knowledge Engineering*), Shanghai, China, December 15-17, 2011, pp.401-412.
- [7] D. Zhang, i2Learning: perpetual learning through bias shifting, *Proc. of 24th International Conference on Software Engineering and Knowledge Engineering*, San Francisco, CA, July 2012, pp. 249-255.
- [8] D. Zhang and M. Lu, Learning through overcoming inheritance inconsistencies, *Proc. of 13th IEEE International Conference on Information Reuse and Integration*, Las Vegas, NV, August 2012, pp.201-206.
- [9] D. Zhang and M. A. Orgun, BRINK: initial theory on bounded rationality and inconsistent knowledge, *Proc. of the Eleventh IEEE International Conference on Cognitive Informatics*, Kyoto, Japan, August 2012, pp.18-26.
- [10] D. Zhang, Learning through overcoming incompatible and antisubsumption inconsistencies, *Proc. of the 12th IEEE, International Conference on Cognitive Informatics*, New York City, NY, July 2013, pp.137-142.
- [11] D. Zhang, Inconsistencies in big data, *Proc. of the 12th IEEE, International Conference on Cognitive Informatics*, New York, City, NY, July 2013, pp.61-67
- [12] D. Zhang, Perpetual learning through Overcoming Inconsistencies, ICTAI 2013

## Project URL:

<http://athena.ecs.csus.edu/~isawey/>