INFORMATION ON DOCTORAL THESIS

1. Full name : Nguyen Van Tham   2. Sex: Male

3. Date of birth: 27th June 1982   4. Place of birth: Nam Dinh

5. Admission decision number: : 778/QĐ-ĐT dated 21th August 2017 by Headmaster of the University of Engineering and Technology, Vietnam National University, Hanoi

6. Changes in academic process: None

7. Official thesis title: Restoring the consistency and merging knowledge bases using the probability model

8. Major: Information system   9. Code: 9480104.01

10. Supervisors: Prof. D.Sc. Nguyen Ngoc Thanh

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11. Summary of the **new findings** of the thesis:

The thesis has achieved some main results as follows:

Firstly, the thesis proposes an architecture of a probabilistic knowledge-based system.

Secondly, the thesis puts forward two new models for restoring the consistency of a probabilistic knowledge base by focusing on changing the probabilities, namely, the model for restoring the norm-based consistency and the model for restoring the unnormalized consistency. In particular, the thesis proposes the consistency restoring operators and a set of intuitive and rational axioms for restoring result, examines and proves several logical properties of these axioms. The problem with restoring consistency is stated and proved. The consistency recovery algorithm is also proposed and implemented. Moreover, the thesis evaluates the complexity of this algorithm and the reliability of the obtained results from theoretical, practical, and experimental aspects.

Thirdly, the thesis proposes two methods to merge probabilistic knowledge bases, namely, a distance-based approach and the probability value-based approach:

- With the distance-based approach, the general probabilistic knowledge base merging process is proposed. In theoretical model, some theorems are pointed out and proved to provide mathematical background to construct the merging model. The merging problem will be considered over a finite set of events in a probabilistic knowledge base profile and accept the input knowledge bases that are inconsistent and structurally diverse. A deep survey on how to employ 21 divergence distance functions

between probability distributions to carry out the merging process are performed. In experimental aspect, several merging algorithms based on 21 divergence distance functions are proposed. Through the results of conducted experiments, the assessments and comparisons of computational performance and achieved merging results among algorithms with respect to norms are performed when the number of events and the input parameters are changed.

- With the probability values-based approach, two merging operators are proposed to compute new probability of common constraint. They ensure that the resulting probability is within the interval between the smallest and the largest value of probabilities. The probabilistic constraint deduction algorithm and the probability values-based merging algorithm are also proposed. The complexity of algorithms also are evaluating by mathematical proof.

12. Practical applicability:

The research results of the thesis can be widely applied in decision support systems, semantic web systems, multimedia information retrieval systems, medical imaging systems, cooperative information systems, multi-databases, multiagents, reasoning systems, and distributed expert systems as well as expert systems in order to enhance the accuracy of disease diagnostic systems, economic forecasting systems, weather forecasting systems; systems on responses to climate change, preventing natural disasters and epidemics; and other fields. These systems serve many aspects of social life as well as national security.

13. Further research directions:

- Continue to study and do in-depth research on the converting techniques and the representing with the probabilistic knowledge base from the knowledge base in reality, tools to reduce redundant probabilistic constraints. From there, propose solutions to construct two tools: "Probabilistic Knowledge Base Building Engine" and "Probabilistic Constraint Deducting Engine" in the probabilistic knowledge-based system.

- Improve the consistency recovery algorithm and the merging algorithms to be less dependent on the number of events in the model as well as building a standard data set for studies and experiments in future.

14. Thesis-related publications:

1. Van Tham Nguyen, Trong Hieu Tran (2017), "Inconsistency Measures for Probabilistic Knowledge Bases", *In: Proceedings KSE 2017, IEEE Xplore*, pp 156-161.

2. Van Tham Nguyen, Ngoc Thanh Nguyen, Trong Hieu Tran, Do Kieu Loan Nguyen (2018), "Method for restoring consistency in probabilistic knowledge bases", *Journal of Cybernetics and Systems, Taylor & Francis*, Volume 49, pp 317-338. (SCIE Journal, IF=1.433).

3. Van Tham Nguyen, Trong Hieu Tran (2018), "Solving inconsistencies in probabilistic knowledge bases via inconsistency measures", *In: Prof. of ACIIDS 2018, Lecture Notes in Artificial Intelligence, Springer*, pp 3-14.

4. Van Tham Nguyen, Ngoc Thanh Nguyen, Trong Hieu Tran (2018), "Framework for Merging Probabilistic Knowledge Bases", *In: Prof. of ICCCI 2018, Lecture Notes in Artificial Intelligence, Springer*, pp 31-42.

5. Van Tham Nguyen, Ngoc Thanh Nguyen, Trong Hieu Tran (2019), "Algorithms for Merging Probabilistic Knowledge Bases", *In: Prof. of ACIIDS 2019, Lecture Notes in Artificial Intelligence, Springer*, pp 3-15.

6. Van Tham Nguyen, Ngoc Thanh Nguyen, Trong Hieu Tran (2019), "A distance-based approach for merging probabilistic knowledge bases", *Journal of Intelligent & Fuzzy Systems IOS Press*, Volume 37, pp 7265-7278. (SCIE Journal, IF=1.851)

7. Van Tham Nguyen, Ngoc Thanh Nguyen, Trong Hieu Tran (2021), "A model for building probabilistic knowledge-based systems using divergence distances", Journal of Expert Systems with Applications, Elsevier, Volume 174, pp 114494. (SCIE Journal, IF=5.452).

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